The Timing of Share Repurchases*

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Abstract

This paper examines the managerial timing ability of share repurchases using a unique data set for the U.S. for the period 2004-2010. The results document that the buyback anomaly has disappeared. There is no evidence of abnormal long-run performance of actual share repurchases, but firms buy back at below average market prices. I model and test two hypotheses to explain these findings: The *market-timing hypothesis* predicts that firms make use of private information and buy back before stock price increases. The *contrarian-trading hypothesis* predicts that firms buy back after decreases in the stock price at prices below average market prices. The empirical evidence only supports the contrarian-trading hypothesis. I conclude that neither recent repurchase announcements nor actual repurchases convey information. The difference between market prices and repurchase prices does not constitute a transfer of wealth from selling to non-selling shareholders.

Keywords: Buyback anomaly, actual share repurchases, managerial timing, long-run performance, repurchase costs

JEL classifications: 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. While the timing and performance of repurchase announcements has been studied extensively (e.g., Vermaelen (1981); Dann (1981); Ikenberry et al. (1995, 2000); Peyer and Vermaelen (2009)), research on actual share repurchases has been hampered by the fact that until recently, U.S. firms have not been required to provide detailed reports of their repurchase activity.[1] Most studies on actual share repurchases compare repurchase prices to market prices and predominantly find evidence in favour of managerial timing ability.[2] The finding that firms buy back below average market prices is striking, but all studies fail to identify why firms are able to do so. To date, there is also no evidence on the long-run performance of actual share repurchases for the United States, although such an analysis might shed light on this issue: If firms buy back at below average market prices because managers are able to anticipate stock returns, we should observe abnormal returns subsequent to actual share repurchases.

In this paper, I construct a unique and comprehensive data set in order to examine the timing of repurchase programs and actual share repurchases for the period 2004-2010. In particular, I investigate the drivers of actual repurchases and the ability of managers to time actual repurchases to periods when the stock price is low. I model and test two hypotheses explaining the timing of actual repurchases, the difference between market prices and repurchase prices, and the subsequent return performance of share repurchases.

The *market-timing-hypothesis* assumes that managers have private information with respect to the value of the stock, which enables them to anticipate stock returns. According to this hypothesis, repurchases would be followed by positive abnormal returns and average market prices would thus be higher than average repurchase prices. The most important empirical predictions of this hypothesis would be that the long-run performance of share repurchases is abnormally high and that the difference between market prices and repurchase prices is positively correlated with contemporaneous abnormal returns. As a further consequence of return predictability, the difference between market prices and repurchase prices should be positively related to subsequent abnormal returns when the private information is

[1]In 2003, the Securities and Exchange Commission adopted amendments to Rule 10b-18 which mandate the publication of monthly share repurchases under the quarterly filings with the SEC. Studies before 2004 analyzing actual U.S. stock repurchases had to use proxies for the number of shares bought back derived from CRSP and Compustat, for example, Stephens and Weisbach (1998) and Dittmar (2000). See Banyi et al. (2008) for an exhaustive overview on studies using proxies from CRSP and Compustat and the reliability of these measures.

[2]In favor of timing ability: Cook et al. (2004); De Cesari et al. (2012); Ben-Rephael et al. (2013) for the U.S. and Brockman and Chung (2001) for Hong Kong. Not in favor: Ginglinger and Hamon (2007) for France.

not fully incorporated into the stock price immediately.

The *contrarian-trading hypothesis* postulates that firms buy back at below average market prices because they start buying after decreases in the stock price and stop buying after increases in the stock price. As a result of this trading pattern, the average repurchase price will be lower than the average market price if repurchase price and market price are not measured at the exact same points in time. This is the case for the U.S., where average repurchase prices are only available on a monthly basis and therefore have to be compared to monthly average market prices. Empirical predictions of the *contrarian-trading hypothesis* would be that the difference between market prices and repurchase prices is negatively related to abnormal returns, if firms buy back after decreases in the stock price, and that the difference between market prices and repurchase prices is positively related to abnormal returns, if firms stop buying back after increases in the stock price.

Consider the following example illustrating the *contrarian-trading hypothesis*. A firm announces a buyback program with the intention to complete the program within the next 12 months. The goal of the program is to buy back at the lowest possible cost. As large programs will have an impact on the stock price, firms will spread their repurchase activity over the following 12 months when the stock price stays constant. When the stock price decreases, the firm will try to finish its repurchase program faster. When the stock price increases, the firm will either try to finish its program later, hoping for more favorable prices, or buy back less shares at higher prices. In each of the depicted scenarios, firms buy back more when the stock price is low and buy back less when the stock price is high.

In a simple model, which I will discuss in detail in the hypothesis section, firms will be only allowed to buy at the beginning and at the end of the month. If the stock price decreases over the course of the month, contrarian-trading firms will buy back more stock at the end of the month. Consequently, the average repurchase price will be lower than the average market price. If over the course of the month the stock price increases, contrarian-trading firms will buy back less stock at the end of the month. Again, the average repurchase price will be lower than the average market price. Thus, under the *contrarian-trading* hypothesis firms will buy back at prices below average market prices irrespective of whether the monthly stock return is positive or negative.

In order to test the empirical predictions of both hypotheses, I obtain monthly repurchase activity from quarterly filings with the SEC and construct a unique data set covering monthly open market repurchase volumes and prices of all repurchasing firms publicly traded in the United States between January 2004 and December 2010.[3] The data set comprises 6,462

[3]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

repurchase announcements and 87,614 firm-months including 47,301 repurchase months of 2,934 repurchasing firms.

Among the most important drivers of monthly repurchases are lagged and contemporaneous returns, program size, and the distance to the start of the program. In line with the *contrarian-trading hypothesis*, negative past returns predict an increase in share repurchases. Most of the time series variation of actual share repurchases, however, cannot be explained.

I find that firms buy back at prices which are both statistically and economically significantly lower than average market prices. A multivariate regression analysis of the difference between market prices and repurchase prices documents that both contemporaneous positive abnormal returns and contemporaneous negative abnormal returns increase this difference. The difference between market prices and repurchase prices is furthermore negatively correlated with subsequent abnormal returns, which contradicts the predictions of the *market-timing hypothesis* of a positive correlation.

The analysis of the long-run performance of share repurchases does not support the *market-timing hypothesis.* Returns around buyback announcements are close to zero and subsequent returns are no longer abnormally high in the medium or long-run. The medium and long-run return performance of actual repurchases is neither economically nor statistically significantly different from zero. This result is not changed by looking only at first, last, small, or large open market repurchases.

In conclusion, the results of the empirical analysis provide strong support for the *contrarian-trading hypothesis*: Repurchases are driven by past negative returns, firms buy back at below average market prices, and both negative returns and positive returns increase the difference between market prices and repurchase prices. Thus, a simple trading strategy is capable of accounting for all the patterns observed in the data. The empirical evidence does not support crucial predictions of the *market-timing hypothesis.* Returns subsequent to both buyback announcements and actual repurchases are not abnormally high. The difference between market prices and repurchase prices is not positively correlated with subsequent abnormal returns. Therefore, the evidence is not in line with the notion that managers are able to anticipate stock returns.

Extant literature predominantly documents evidence for managerial timing ability of actual share repurchases. 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 while NYSE firms buy back at below the costs of naive accumulation strategies, NASDAQ firms do not. Using the uniquely transparent disclosure environment of the Hong Kong Stock Exchange,

repurchases. 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 filings with the SEC. See Appendix A.1 for details.

Brockman and Chung (2001) find that managers exhibit substantial timing ability. By simulating repurchases via bootstrapping, the authors demonstrate that managers buy back at prices below the ones obtained by simulating repurchases holding constant the authorized repurchasing period, the number of actual repurchase days, and the number of actual shares repurchased on each repurchase day. Both Cook et al. (2004) and Brockman and Chung (2001), however, do not include lagged returns as drivers of repurchases when constructing their benchmarks. Ginglinger and Hamon (2007) do not find evidence of timing ability for France. De Cesari et al. (2012) and Ben-Rephael et al. (2013) have made use of the newly available monthly repurchase data for the U.S. and report that firms buy back at prices that are both economically and statistically significantly lower than market prices. Both studies regard the difference between repurchase prices and average market prices as an expropriation of wealth from selling to non-selling shareholders. However, both studies do not link the difference between market prices and repurchase prices directly to managerial timing ability and the use of private information respectively.

I extend this line of research by integrating the drivers of actual repurchases, the execution of repurchase programs, and the subsequent stock price performance of actual repurchases into one coherent analysis. Moreover, the *contrarian-trading hypothesis* provides an alternative explanation of why firms buy back at below average market prices which is better capable of explaining the empirical evidence than the *market-timing hypothesis*. The results of this paper therefore challenge earlier conclusions of the literature such as in Brockman and Chung (2001); Cook et al. (2004); De Cesari et al. (2012); Ben-Rephael et al. (2013).

For the United States, it is also the first paper to conduct a profound analysis of the timing of monthly repurchase activity including program characteristics such as duration and program size. The established literature on the drivers of actual share repurchases in the United States, including Stephens and Weisbach (1998) and Dittmar (2000), either use changes in shares outstanding derived from CRSP or Compustat purchases of common stock. Banyi et al. (2008) document that even the most accurate measure, a quarterly Compustat-based measure, "deviates from the actual number of shares repurchased by more than 30% in about 16% of the cases".

Several studies have documented that stocks substantially outperform the market over the years following the announcement of a buyback program (e.g., Vermaelen (1981); Dann (1981); Ikenberry et al. (1995, 2000)). Peyer and Vermaelen (2009) have confirmed that the buyback anomaly has not disappeared for a data set from 1991 to 2001. Manconi et al. (2011) extend this analysis to an international context and report similar patterns for other countries. Meanwhile, Fu et al. (2012) document in a recent working paper that the buyback anomaly has disappeared since 2002. The authors explain this finding with substantial improvements in market efficiency over time. I provide further evidence on that the buyback anomaly has disappeared. As the SDC database only covers a fraction of share repurchase announcement, this paper also mitigates concerns of selection biases by using a comprehensive and therefore bias-free data set of repurchase announcements.

Finally, this paper is also the first to present evidence on the long-run performance of actual share repurchase for the U.S. In the only other study of this kind for Hong Kong, Zhang (2005) does not find abnormal returns on the long-run on average.

The rest of this paper is structured as follows. Section 2 introduces a model that describes the relationship between repurchase activity, monthly returns and the difference between market prices and repurchase prices. From this model, I subsequently derive the empirical predictions of the *market-timing hypothesis* and the *contrarian-trading hypothesis*. Section 3 describes the selection of the data set, the construction of the sample, and the definition of the variables. Section 4 contains the empirical analysis of buyback programs and actual share repurchases respectively. Section 5 concludes.

2 Hypotheses

In this section, I introduce a model that describes the relationship between repurchase activity, (subsequent) abnormal returns and the difference between market prices and repurchase prices. In the base model, I will generate empirical predictions assuming that repurchase activity and returns are independent. Subsequently, I will show that the predictions of this model will change under both the *market-timing hypothesis* and the *contrarian-trading hypothesis* where I will either allow the manager to predict returns or make repurchase activity a function of prior returns. Table 1 summarizes the predictions generated by the *market-timing-hypothesis* and the *contrarian-trading-hypothesis.*

2.1 Base model

The model comprises three periods: The repurchase month (t), the month before the repurchase month (t-1), and the month after the repurchase month (t+1). In a more general sense, t-1 may also denote any time before the repurchase month and t+1 may denote any time after the repurchase month. Prices, which are observed at the end of the month, are risk-adjusted and monthly returns, $R_t = (P_t - P_{t-1})/P_{t-1}$, consequently are abnormal returns. I assume that R_t is a random variable with mean zero and standard deviation σ_R.

In the repurchase month, an abnormal change in the stock price takes place. Thus, at some point in the month, the stock price changes from P_{t-1} (before the change) to P_t (after the change). As I am just interested in the price before the change (P_{t-1}) and in the price after the change (P_t) and the respective buyback quantities, it is not necessary to define the exact point at which the stock price changes. A discrete-time model where firms can only buy back either at the beginning of the month or at the end of the month therefore contains all the relevant information for analyzing the problem at hand. As the stock price is allowed to change only once within the month, the stock price at the beginning of the month will be equal to the stock price at the end of the previous month, P_{t-1}. Therefore, for the model it is sufficient to observe P_{t-1} (representing the stock price before the price change, at the beginning of the month), P_t and the respective buyback quantities which I will denote $q_{t,b}$ (quantity bought back at the beginning of t) and $q_{t,e}$ (quantity bought back at the end of t).

The average stock price in t, $\bar{P}_t$, will then be the average of P_{t-1} and P_t :

$$\bar{P}_t := \frac{P_{t-1} + P_t}{2}$$

The repurchase price, P_t^*, is the weighted average of repurchases at P_{t-1} and P_t:

$$P_t^* := \frac{P_{t-1} q_{t,b} + P_t q_{t,e}}{q_{t,b} + q_{t,e}}$$

Based on these definitions, the difference between average market price and average repurchase price is equal to

$$\bar{P}_t - P_t^* = \frac{P_{t-1} + P_t}{2} - \frac{P_{t-1} q_{t,b} + P_t q_{t,e}}{q_{t,b} + q_{t,e}}$$

In Appendix A.3, I show that by rearranging this formula, I obtain the following expression for a relative, volume-weighted difference between average repurchase and average market price:

$$\frac{(\bar{P}_t - P_t^*)(q_{t,b} + q_{t,e})}{P_{t-1}} = \frac{1}{2} R_t (q_{t,b} - q_{t,e})$$

Now, let the relative, volume-weighted difference between average repurchase and average market price be equal to *Bargain*, B_t.

$$\begin{aligned} B_t &:= \frac{(\bar{P}_t - P_t^*)(q_{t,b} + q_{t,e})}{P_{t-1}} \\ &= \frac{1}{2} R_t (q_{t,b} - q_{t,e}) \end{aligned}$$

As argued above, monthly abnormal return, R_t, and repurchase quantity, $q_{t,\cdot}$, are assumed to be independent random variables with the following statistical properties: $R_t \sim (0, \sigma_R)$ and $q_{t,\cdot} \sim (\mu_q, \sigma_q)$. If repurchase trades are entirely uninformed and rather follow a repurchase scheme which is independent of both realized and expected abnormal returns, the following assumptions are valid: $E(R_t) = 0$, $Cov(R_t, q_{t;\cdot}) = 0$, and $E(q_{t,1}) = E(q_{t,2}) = \mu_q$. Under these assumptions, the expected bargain is equal to zero:

$$\begin{aligned} E(B_t) &= E[\frac{1}{2}R_t(q_{t,b} - q_{t,e})] \\ &= \frac{1}{2}0(\mu_q - \mu_q) = 0 \end{aligned}$$

Furthermore, assuming that $E(R_t^2 q_t) = E(R_t^2)E(q_t)$ which is reasonable for uninformed repurchase trades, the covariance between return and bargain is zero as well (see Appendix A.3 for a detailed derivation):

$$\begin{aligned} Cov(R_t, B_t) &= E[(R_t - E(R_t))(B_t - E(B_t)] \\ &= \frac{1}{2}E[(R_t^2(q_{t,b} - q_{t,e})] = 0 \end{aligned}$$

From the independence assumption between returns and repurchase activity, it also follows that repurchase activity should not predict subsequent abnormal returns which is in line with assuming a semi-strong efficient market:

$$E(R_{t+1}|q_t > 0) = 0$$

The results are in line with what one would intuitively expect assuming an efficient capital market: If repurchase trades are entirely uninformed in the sense that they are independent of both expected and realized returns, the expected bargain, the covariance between bargain and return, and the abnormal (long-run) performance following repurchases will all be equal to zero.

2.2 Market-timing hypothesis

Market 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 fundamental value, the selling shareholders are paid less than their shares' worth. The non-selling shareholders proportionately gain at the selling shareholders' expense. A repurchase below fundamental 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 can be bought back given a specified repurchase program size, the larger the increase in power of large non-selling shareholders. Therefore, there are at least two reasons why managers might have an interest in buying back at low prices. (1) Managers' performance evaluation or compensation is related to stock price performance. (2) Large shareholders pressure managers to buy back at low prices, because they gain from doing so. It is thus reasonable to presume that managers will use private information for buying back shares when they have it.

Even if the timing of share repurchases is based on private information, the market will adjust its assessment of the stock price only to the extent that either the private information becomes public or firms put private information into prices by their trading activity. In semi-strong 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 in the long-run.

Under the *market-timing hypothesis*, I consequently assume that managers will be able to decompose return, R_t, into two parts, one that can be anticipated, ε_t, and one that cannot be anticipated, η_t:

$$R_t \quad = \quad \varepsilon_t + \eta_t$$

where $\varepsilon_t \sim (\mu_\varepsilon, \sigma_\varepsilon)$, $\eta_t \sim (0, \sigma_\eta)$, and $Cov(\varepsilon_t, \eta_t) = 0$. Thus, we have the following moments from the point of view of the manager: $E_M(R_t) = \mu_\varepsilon$ and $Var_M(R_t) = \sigma_\varepsilon^2 + \sigma_\eta^2$.

Managers anticipating ε_t will buy back shares at $P_{t,1}$ when $\mu_\varepsilon > 0$. For reasons of convenience only, I will model repurchase quantities as a binary choice, i.e. firms either buyback a fixed quantity or not. Under the *market-timing hypothesis*, the buyback quantity will thus be deterministic which is the only difference in the model compared to Section 2.1. When $E_M(R_t) = \mu_\varepsilon$, managers will buyback at the beginning of the month at P_{t-1}. Thus, the repurchase quantities are $q_{t,b} = 1$ and $q_{t,e} = 0$ respectively, The expected bargain when managers possess private information, which I denote E_M, will then be larger than zero:

$$\begin{aligned} E_M(B_t) &= \frac{1}{2}E[q_{t,b}R_t - q_{t,e}R_t] \\ &= \frac{1}{2}E[1 \cdot R_t - 0 \cdot R_t] = \frac{1}{2}\mu_\varepsilon \end{aligned}$$

Prediction MTH-1. $E_M(B_t) > 0$

With $E_M(B_t) = \frac{1}{2}\mu_\varepsilon$, the covariance between contemporaneous return and bargain will be larger than zero as well (see Appendix A.3 for a detailed derivation):

$$\begin{aligned} Cov_M(R_t, B_t) &= E[(R_t - E_M(R_t))(B_t - E_M(B_t)] \\ &= \frac{1}{2}E_M(R_t^2 - \mu_\varepsilon^2) = \frac{1}{2}Var_M(R_t) > 0 \end{aligned}$$

In other words, under the market timing hypothesis, the bargain will be larger the larger positive abnormal returns are.

Prediction MTH-2. $Cov(R_t, B_t) > 0$

It might be more realistic to assume that a fraction of the anticipated returns will materialize in t, while the remaining fraction will materialize only in t+1. If the expected anticipated return in t will be only $\mu_\varepsilon(1-\kappa)$, the remaining anticipated return $\mu_\varepsilon\kappa$ will materialize in t+1. In this case, the expected bargain conditional on the information set of the manager will still be larger than zero:

$$\begin{aligned} E_M(B_t|\kappa \neq 0) &= \frac{1}{2}E[q_{t,b}R_t - q_{t,e}R_t] \\ &= \frac{1}{2}\mu_\varepsilon(1-\kappa) > 0 \end{aligned}$$

Assuming that part of the anticipated return materializes after the repurchase months, the bargain and future abnormal returns will be related (see Appendix A.3 for a detailed derivation):

$$\begin{aligned} Cov_M(R_{t+1}, B_t|\kappa \neq 0) &= E_M[(R_{t+1} - E_M(R_{t+1}))(B_t - E_M(B_t)] \\ &= \frac{1}{2}Cov_M(R_t, R_{t+1}) \end{aligned}$$

Thus, the sign on $Cov_M(R_{t+1}, B_t|\kappa \neq 0)$ will depend on the sign of the autocorrelation of returns which is positive (see Appendix A.3 for a detailed derivation):

$$\begin{aligned} Cov_M(R_t, R_{t+1}|\kappa \neq 0) &= E_M[(R_t - E_M(R_t)(R_{t+1} - E_M(R_{t+1}))] \\ &= \kappa(1-\kappa)(\sigma_\varepsilon^2 + \sigma_\eta^2) > 0 \end{aligned}$$

Prediction MTH-3. $Cov_M(R_{t+1}, B_t|\kappa \neq 0) > 0$

Finally, if fraction κ will be put in the prices only after the repurchase month, repurchase activity should predict returns in the next period:

Prediction MTH-4. $E_M(R_{t+1}|q_t > 0) = \mu_\varepsilon \kappa > 0$

Table 1 summarizes all of the predictions generated by the *market-timing hypothesis*.

2.3 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. Informal accounts from CFOs suggest that firms apply a contrarian trading strategy when buying back their own stock: Firms in many cases have outsourced their repurchase programs to financial institutions that buy back shares within a pre-specified price bracket over a certain period of time. This scheme allows firms to buy additional shares if the price is low and to buy less shares if the price is high. In other cases, firms conduct repurchases on their own, but by basically applying the same algorithm. Hong et al. (2008) furthermore 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. The results of Hong et al. (2008) are also in line with a survey by Brav et al. (2005), where CFOs indicate price support as an important motivation for repurchase trading. As the bargain measure compares monthly averages of repurchase prices to market prices, contrarian traders will buy back at bargain prices, if they buy shortly after drops in the stock price.

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.

In order to model this kind of trading behavior I assume that the firm will buy back a "default" quantity of shares when there is no movement of the stock price. As firms usually buy back the intended amount of shares during a certain period of time (usually between 12 to 24 months), the default quantity should be approximately the total size of the program divided by the number of repurchase months. Firms will increase their repurchase volume when the stock price decreases and buy back more than the default quantity in order to minimize the repurchase costs. Therefore, I add k times the absolute return to k for this scenario. Finally, firms will not buy back shares after an abnormal increase in the stock price.

$$q_{t,\cdot}(R_t) = \begin{cases} k(1+|R_t|) & \text{if } R_t < 0 \\ k & \text{if } R_t = 0 \\ 0 & \text{if } R_t > 0 \end{cases}$$

Note that the subsequently generated predictions will also hold for any other functional form for the case of $R_t < 0$ as long as the outcome is larger than k. For example, setting $k(1 + |R_t|) = l$ where l is larger than k will produce qualitatively similar predictions.

The first prediction follows directly from the functional relationship between returns and repurchase quantity presented above:

Prediction CTH-1. There is a negative correlation between returns and repurchase activity: $corr(R_t, q_t) < 0$

I will subsequently demonstrate that both positive and negative returns increase the bargain. For this purpose I introduce two new variables, R_t^+ and R_t^-, which are defined as

$$R_t^+ = \begin{cases} R_t & \text{if } R_t > 0 \\ 0 & \text{else} \end{cases} \quad \text{and } R_t^- = \begin{cases} R_t & \text{if } R_t \leq 0 \\ 0 & \text{else} \end{cases}$$

Above, I have defined the relative bargain as

$$B_t(q_{t,b}(R_{t-1}), q_{t,e}(R_t), R_t) \quad = \quad \frac{1}{2}(R_t q_{t,b} - q_{t,e} R_t)$$

I assume that the prior month abnormal return is zero. When $R_{t-1} = 0$, the buyback quantity at P_{t-1} will be k: $q_{t1} = k$. There are three scenarios to analyze with respect to the contemporaneous return:

(1) If the realized return in month t is equal to zero as well, the bargain as denoted above will be zero.

(2) If the realized return in month t is positive, firms will buy quantity k at P_{t-1} and will stop buying back after they observe the increase in stock price: If $R_{t-1} = 0$ and $R_t > 0 \Rightarrow q_{t,b} = k,\ q_{t,e} = 0$, then

$$B_t(q_{t,b}(R_{t-1}), q_{t,e}(R_t), R_t) \;=\; \frac{1}{2}kR_t$$

Thus, we have: $R_t \to +\infty \Rightarrow B_t \to +\infty$

Prediction CTH-2. There is a positive correlation between positive returns and the bargain: $corr(R_t^+, B_t) > 0$

(3) If the realized return in month t is negative, firms will buyback default quantity k and P_{t-1} and quantity $k(1 + |R_t|)$ after they observe the decrease in stock price: If $R_{t-1} = 0$ and $R_t < 0 \Rightarrow q_{t,b} = k, q_{t,e} = k(1 + |R_t|)$

$$\begin{aligned} B_t(q_{t,b}(R_{t-1}), q_{t,e}(R_t), R_t) &= kR_t - k(1 + |R_t|)R_t \\ &= -kR_t|R_t| > 0 \end{aligned}$$

Thus, we have: $R_t \to -1 \Rightarrow B_t \to k > 0$

Prediction CTH-3. There is a negative correlation between negative returns and the bargain: $corr(R_t^-, B_t) < 0$

The average bargain in a given month will be the average over the three scenarios depicted above ($R_t < 0$, $R_t = 0$, $R_t > 0$). From above it follows that the bargain will be larger than zero if $R_t \neq 0$ and consequently, the average bargain will be larger than zero under the *contrarian-trading hypothesis.*

Prediction CTH-4. The bargain is larger than zero for contrarian-trading firms. $B_t > 0$

3 Data and methodology

New disclosure requirements in the U.S. mandate the publication of monthly share repurchases under the new Item 2(e) of Form 10–Q and under the new Item 5(c) of Form 10–K. The requirement applies to all periods ending on or after March 15, 2004. Under these rules firms have to report the total number of shares purchased, the average price paid per share, the number of shares purchased under specific repurchase programs, and either the maximum dollar amount or the maximum number of shares that may still be purchased under these programs. Appendix A.1 discusses the current state of the regulation of share repurchases in the United States in further detail. 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, I manually checked and corrected observations where necessary.

For the analyses of this paper, I am interested in the shares repurchased under a program, which often differs from the total number of shares repurchased. The difference arises for a number of reasons, for example when shares are delivered back to the issuer for the payment of taxes resulting from the vesting of restricted stock units or from the exercise of stock options by employees and directors. Appendix A.2 discusses the issues arising from this difference in further detail. 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).

3.1 Repurchase announcements

The repurchase announcements have been collected via two different sources. The Securities Data Company (SDC) Platinum M&A database is the commercial reference data base. Furthermore, repurchase announcements have been collected from SEC filings for the period 2004 to 2010. Table 2 describes the selection criteria used for both of the repurchase announcement data sets.

My proprietary and comprehensive sample of repurchase announcements is taken directly from SEC filings. Before a firm can repurchase any shares its board of directors has to approve the repurchase program which is stated in the quarterly filing. In total I identify 8,816 repurchase programs from the firms' form 10-Q and 10-K filings. Of these, 130 programs are deleted because the announcement date of the program is unknown. I also delete 1,516 programs, which have been started before 2004 and one program which was announced after 2010. Furthermore, 149 programs are excluded, because they are not executed in the open-market (e.g., as private transactions or tender offers).

As a starting point for the construction of the SDC samples, I use all observations available in the SDC mergers and acquisitions database during the period 1991 until 2001 and the period 2004 until 2010 that are tagged as repurchase observations. I eliminate all events that are not labeled as open market purchases and all events with status "intent withdrawn" or "withdrawn". In addition, I exclude events if the program announcement date coincides with the program completion date and all observations which are not classified as buyback announcements of common stock. The SDC database uses historical CUSIP numbers as primary security identifier. However, in my further analyses, I need data on holding period returns and number of shares outstanding from CRSP and data on book value of equity, total assets and EBITDA from Compustat for all event firms. Therefore, I require that I can assign the corresponding permno identifier to each event firm. In this step, I lose about 10% of the observations. Moreover, I remove firms if they are already included with an earlier program announcement within 30 days in the sample. To circumvent the problem of skewed long-term return calculations (Loughran and Ritter (1996)), I eliminate events when the respective stock price ten days prior to the announcement is smaller than $3. Finally, I drop observations if the market capitalization one month before the announcement, the BM ratio at the fiscal year-end prior to the announcement or the return in at least one (all) of the six months prior (subsequent) to the announcement is not available.

The final sample size spanning the period from 1991 to 2001 consists of 7,925 events. This number is in the same order of magnitude as figures obtained by Banyi et al. (2008) and Bonaimé (2012), but more than twice as high as that reported by Peyer and Vermaelen (2009) who exclude announcements which they could not verify via LexisNexis. Nonetheless, the peak years in my sample, 1998 with 1,374 observations, followed by 1999 with 1,082 and 1996 with 1,072 events, coincide with the peak years recorded by Peyer and Vermaelen (2009).

The final SDC sample spanning the period 2004-2010 consists of 3,740 events. Peak years are 2008 and 2007 with 790 and 774 events, respectively. Thus, interestingly, in all years of this sample, the number of announcements is lower compared to those for the late 1990s. With 6,462 observations, the final SEC sample includes more than one and a half times as many events as the SDC 2004-2010 sample.

3.2 Actual repurchase data

I use the CRSP monthly stock file as a starting point to construct the data set covering actual repurchases. 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 link the repurchase data from the 10-Q and 10-K filings.

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 87,614 firm-months including 47,301 repurchase months of 2,934 repurchasing firms.

3.3 Variable construction

Table 3 describes all variables used in this study. *Bargain* denotes the percentage difference between the average market price and the average repurchase price. I compute the market price as the monthly average of daily closing prices from CRSP.

For a measure of the relative spread, 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 are matched to all of these transactions. If there is more than one bid and ask quote in a given second, I assume that the last quote in the respective second is the prevailing quote.[4] I only consider the NBBO (National Best Bid and Offer) quotes.[5] I calculate the quote midpoint price as the average of the prevailing bid and ask quotes. *Relative spread* is defined as time-weighted average of the difference between the prevailing ask and the prevailing bid quote divided by the quote midpoint price.

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.

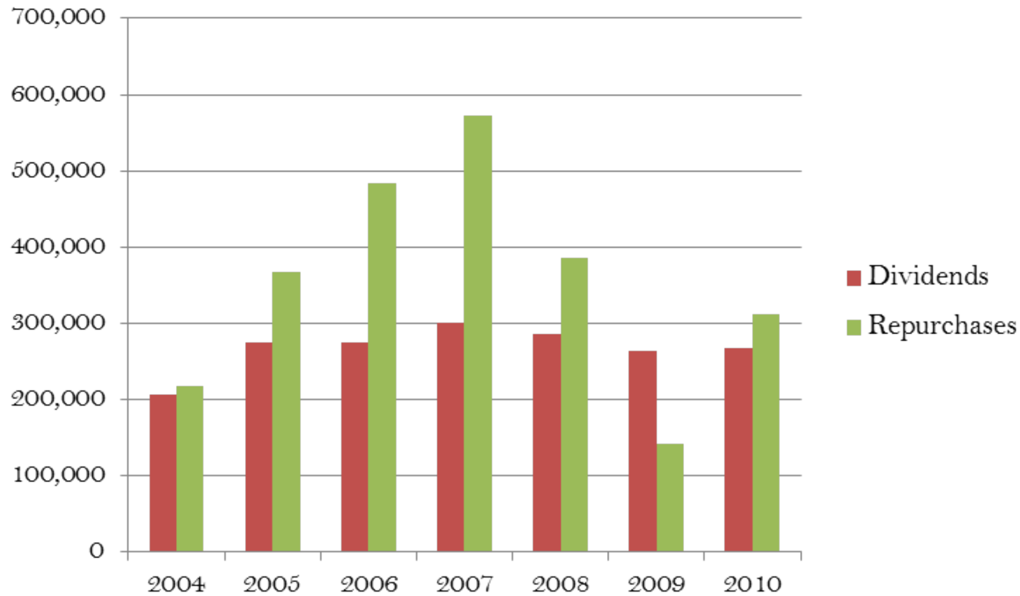
4 Empirical analysis

This chapter provides empirical tests of the predictions of the *market-timing hypothesis* and the *contrarian-trading hypothesis*. Table 1 summarizes all of the predictions generated in Section 2.

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

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

Figure 1: **Annual volumes of repurchases and dividends**. This figure depicts dividends derived from Compustat data item *dv* and actual open market repurchases collected from SEC filings. The numbers stated are in million dollars.



4.1 The determinants of actual share repurchases

In this section I test prediction CTH-1 of the *contrarian-trading hypothesis* which is that (lagged) returns and repurchase activity are negatively correlated, i.e., firms buy back after declines in the stock price.

In order to set the discussion of what drives share repurchases into a broader context, Figure 1 depicts annual volumes of dividends and open market repurchases. The chart illustrates the relationship between repurchases and dividends very well. While dividends stay relatively constant over time, repurchases relate very much to market conditions. As such, open market repurchases are highest in 2007 where they equal 573 billion dollars and lowest in the year following the bankruptcy of Lehman where they equal 140 billion dollars. Repurchase activity is cyclical and thus not constant over time.

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.

Dittmar (2000) analyzes quarterly repurchase activity and finds that firms buy back to take advantage of undervaluation (measured by the book-to-market ratio) and to distribute excess capital. Further motives the author empirically validates are to change leverage, fend off takeovers, and to serve exercised stock options.

It should be noted that the established literature on the drivers of actual share repurchases in the United States, including Stephens and Weisbach (1998) and Dittmar (2000), either use changes in shares outstanding derived from CRSP or Compustat purchases of common stock. Banyi et al. (2008) document that even the most accurate measure, the Compustat-based measure, "deviates from the actual number of shares repurchased by more than 30% in about 16% of the cases." Additionally, this measure is only available on a quarterly basis.

4.1.1 Regression model

In order to examine the drivers of actual share repurchases, I regress a measure of stock repurchases on returns and a range of controls identified in the literature.

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

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. $Return_t$ denotes the month return, $Control_l$ 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 open market repurchase programs. Including all firm months of firms currently or never having a repurchase program does, however, not change the results. In subsequent analyses, I will add a lagged dependent variable and program characteristics (program size and duration) to the set of explanatory variables.

4.1.2 Results

Table 4 provides descriptive statistics on the actual repurchase data set which is restricted to open repurchase programs. Overall, the data set comprises 87,978 firm months of which 32,331 contain actual repurchases. Repurchase intensity amounts to 0.68% of shares outstanding on average and represents about 10% of the average program size which is equal to 6.58%. The average program lasts 16.15 months which is higher than the median program which lasts exactly one year.

I present estimates of equation 1 in Table 5. In columns (1), (2), and (3) the dependent variable is repurchases scaled by shares outstanding and in columns (4), (5), and (6) the dependent variable is a dummy variable making the model a linear probability model. In general, the models have very low explanatory power. When I do not include lagged dependent variables, the model does explain only 3.0% to 6.3% of the time-series variation of the dependent variable. When including lagged dependent variables in model (2) and model (5) respectively, the model explains 6.1% of variation in repurchases to shares outstanding and 19.1% of variation in the linear probability model. Including program related variables such as program size and duration adds additional explanatory power. Overall, previous repurchase activity seems to be the by far strongest predictor of repurchase activity while most of the time-series variation of share repurchases remains unexplained.

The coefficients on $Return_t$ and $Return_{t-1}$ are in line with the predictions of the *contrarian-trading hypothesis*. Firms buy back more when the stock price has gone down and buy back less when the stock price goes up. Notice that lagged returns have a stronger impact on repurchase activity than contemporaneous returns. This observation might indicate that the contemporaneous return rather is an endogenous variable that is driven by repurchase activity than an exogenous variable driving repurchase activity.

Duration denotes the natural logarithm of the distance between the respective repurchase month and the start of the program. The coefficient on duration is negative for both repurchase intensity and repurchase dummy pointing out that repurchase activity is highest at the beginning of the month.

Program size denotes the number of shares to be repurchased under the respective program scaled by shares outstanding at the beginning of the program. Therefore, this variable does not have within-program variation. The positive coefficient on program size is in line with what one would expect. Repurchase intensity is higher when program size is higher. Repurchase activity, denoted by the dummy variable, does not depend on program size.

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 the expected signs (Dittmar (2000) and Stephens and Weisbach (1998)). *Relative Spread* is negatively related to repurchase intensity and repurchase activity.[6] *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*) or in the process of being acquired (*Target*) purchase significantly less. This result is not in line with Dittmar (2000), but still reasonable as today most firms repurchase stocks regularly. Therefore, a few instances where firms use repurchases as a takeover deterrent are opposed by many more instances where firms stop

[6] For a thorough discussion of the relationship between share repurchases and stock liquidity for a U.S. sample, see Hillert et al. (2012).

buying back shares during friendly takeover attempts. As only those firms using repurchases as a takeover deterrent will increase repurchase activity it is reasonable to presume that the effect of acquisitions on repurchase activity will be negative on average.

4.2 Repurchase cost perspective / analysis of the bargain

In this section, I analyze the relative difference between the monthly average repurchase price and average market price, which I refer to as the bargain throughout this paper. Under both the *market-timing hypothesis* and the *contrarian-trading hypothesis*, the bargain will be larger than zero (MTH-1 and CTH-4). The *market-timing hypothesis* predicts furthermore that positive abnormal returns and the bargain are positively correlated (MTH-2) and that the bargain and subsequent abnormal returns are positively correlated (MTH-3). The *contrarian-trading hypothesis*—in line with the *market-timing hypothesis*—postulates that positive abnormal returns and the bargain are positively correlated (CTH-2). Furthermore, it predicts that negative abnormal returns and the bargain are positively correlated (CTH-3). This section provides empirical tests on these predictions.

Two studies have so far made use of the newly available monthly repurchase data and report that firms buy back at an economically and statistically significant bargain. De Cesari et al. (2012) compare repurchase prices to average market price and relate the difference to measures of insider ownership and institutional ownership. The authors document that firms buy back at a bargain and conclude that "OMRs are timed to benefit non-selling shareholders". Meanwhile, institutional ownership is negatively related to the bargain as it "reduces companies' opportunities to repurchase stock at bargain prices".

Ben-Rephael et al. (2013) use a data set similar to the one of De Cesari et al. (2012) and document as well that firms buy back at prices which are below average market prices. In addition, the authors find that the market responds positively to share repurchases when they are disclosed in earnings announcements. The authors conclude that "the informational effects of actual repurchase that we find suggest that regulators should consider even tighter disclosure requirements" and expect "such requirements to result in more informative prices and to alleviate wealth expropriations from uninformed investors".

4.2.1 Regression model

In order to test the empirical predictions generated by the market-timing hypothesis and the *contrarian-trading hypothesi*s, I conduct a multivariate regression analysis of the bargain:

$$
\begin{aligned}
Bargain_{i,t} \;&=\; \alpha + \beta_1 AR^{+}_{i,t} + \beta_2 AR^{-}_{i,t} + \beta_3 CAR(1,6)_{i,t} + \beta_5 Repurchases\,to\,trading\,volume_{i,t} \\
&\quad + \beta_5 Repurchases\,to\,shr.\,out._{i,t} + \beta_6 Spread_{i,t-1} + \mu_i + u_{t,i} \qquad (2)
\end{aligned}
$$

Here, $Bargain_{i,t}$ refers to the relative difference between average monthly repurchase price and average monthly market price. AR^{+}_{t} either denotes the positive abnormal return or is zero, AR^{-}_{t} 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, *Spread* denotes the relative time-weighted bid-ask spread as defined in Section 4, 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.

The *market-timing hypothesis* predicts a positive coefficient on β_1 (MTH-2) and β_3 (MTH-3) while the *contrarian-trading hypothesis* predicts positive coefficients on β_1 (MTH-3) and β_2 (MTH-4).

4.2.2 Results

In line with earlier studies by Ben-Rephael et al. (2013) and De Cesari et al. (2012), Table 6 reports an economically and statistically significant bargain. The bargain over 43,526 repurchase months is is equal to 0.56% on average. The median bargain is about half of the mean bargain which indicates that some repurchase months exhibit extraordinary high bargains. Both mean and median are statistically significantly different from zero according to a standard t-test and a ranksum-test respectively.[7] In terms of U.S. Dollars (USD), the average bargain in a given month is equal to approximately 120,000 USD which amounts to 5.4 billion USD over the 43,526 repurchase months between January 2004 and December 2010. Total bargains account for 0.22% of total repurchase volume which is equal to 2.5 trillion dollars.

Table 7 presents the results of the regression analysis of the bargain. In column (1) and column (2) I make use of the whole sample from 2004 to 2010. In column (3) and column (4) I exclude the financial market crisis and in column (5) and column (6) I exclude all observations after the financial market crisis. The motivation behind excluding the financial market

[7] 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 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.

crisis lies in the observation that while many firms have stopped their repurchase activity, others have bought back immense volumes of shares suggesting that firms have changed their repurchase policies and motives during these extraordinary times. Furthermore, the data sets of both Ben-Rephael et al. (2013) and De Cesari et al. (2010) end before the financial market crisis. Thus, excluding the financial market crisis and the aftermath might make my sample more comparable to their samples. The coefficients on the variables of interest are robust to the inclusion of the financial market crisis, however. The second column of each sample includes time fixed effects. The models explain between 1.1% and 2.8% of within-firm variation. Ben-Rephael et al. (2013) report an R^2 in the range of between 1.5% and 1.8%.

The coefficient on AR_t^+ is positive which is in line with the predictions of both hypotheses (MTH-2 and CTH-2). By multiplying the coefficient on AR_t^+ with the average of AR_t^+ as presented in Table 6, I determine the extent to which the respective variable contributes to the bargain. The result is 0.11% for all specification. Thus, about one fifth of the bargain, which is equal to 0.56% on average, can be attributed to positive abnormal returns.

The coefficient on AR_t^- is negative which is in line with the *contrarian-trading hypothesi*s (CTH-3). Multiplying the coefficient on AR_t^- with the average of AR_t^- yields different results for different time periods. Multiplying the coefficient on AR_t^- with the average of AR_t^-yields 0.09% for the full sample specification in column (1) and goes up to 0.22% for specification (6) where firm-fixed effects are included and all months after the start of the financial crisis (07/2008) are excluded. Thus, negative abnormal returns contribute between approximately 20% and 40% to the average bargain.

In sum, a substantial fraction of the bargain can be attributed to either positive or negative abnormal returns. When using the whole sample and including month fixed-effects in column (2), the product is equal to 0.21% which is approximately 38% of the bargain reported for this time period. Excluding the financial market crisis increases the share of this product on the bargain to 53% for (column 4) and 68% (column 6) respectively. These numbers provide strong support for the notion that either market timing or contrarian-trading is driving the systematic component of the bargain. The very low explanatory power of the model does not hinder this conclusion. It rather suggests that most of the bargain is a realization of a random variable, i.e. noise.

The coefficient on CAR(1,6) is the opposite of what the market-timing hypothesis predicts. While the *market-timing hypothesis* predicts that the bargain and subsequent abnormal returns are positively correlated, the regression coefficient shows the opposite sign. The higher the bargain, the lower subsequent abnormal returns. This finding is puzzling at first sight. In fact, it could be further evidence in favor of the *contrarian-trading hypothesis:* Suppose that a firm provides price support by buying shares after a steep decline in the stock price. If the price decline is either informed or the result of systematic changes in the market, efficient market theory dictates that the price will converge to its fundamental value at least on the long-run (after share repurchases have stopped). Thus, price support might stabilize prices for the time being and will result in firms buying back at below average market prices. Subsequently, prices will adjust fully which will result in negative subsequent abnormal returns and most likely a negative correlation between bargain and subsequent abnormal returns.

The results on the controls are intuitive. *Repurchases to trading volume* indicates the relationship between price impact and the bargain. Obviously, large trades should have a positive impact on the stock price. Consequently, the bargain should be lower in these cases as the repurchase price will have increased relative to the average market price. The impact of repurchases to trading volume on the bargain is only in rare cases—where stocks are traded very thinly—economically significant. For example, a repurchase at the 75th percentile relative to trading volume will decrease the bargain by about 0.03%. *Repurchase intensity* is only significant when the financial crisis is included. The same is true for *Relative Spread*. The higher the lagged spread the lower the bargain. Again, this measure picks up price impact as ceteris paribus repurchases will be more expensive, the larger the relative bid-ask spread. Thus, the coefficient is in line with expectations and results reported by De Cesari et al. (2012).

In conclusion, while the R^2 is low in general which suggests that the bargain to the most degree is random, positive and negative abnormal returns nevertheless account for up to 68% of the bargain when we disregard the financial market crisis months and the aftermath. All of the results of this section are in line with the *contrarian-trading hypothesi*s while the results are only partially in line with the *market-timing hypothesis*. The empirical result that the bargain and subsequent abnormal returns are negatively correlated contradicts the prediction of the *market-timing hypothesis*.

4.2.3 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. Results also remain stable when using unadjusted returns instead of abnormal returns.

4.3 Long-run performance of share repurchases

An analysis of the long-run performance of share repurchases represents the classical test of the market-timing hypothesis (in this paper: MTH-4). Several studies have documented that stocks substantially outperform the market over the years following the announcement of a buyback program (e.g., Vermaelen (1981); Dann (1981); Ikenberry et al. (1995, 2000)). Peyer and Vermaelen (2009) have confirmed that the buyback anomaly has not disappeared for a data set from 1991 to 2001. Most prominent explanations of the buyback anomaly that have been discussed in the literature are the risk-change hypothesis proposed by Grullon and Michaely (2004), the liquidity hypothesis, and the overreaction hypothesis. Peyer and Vermaelen (2009) conclude from their analysis that the evidence is only in line with the overreaction hypothesis which posits that firms would initiate repurchase program as a response to the overreaction of the market to bad news. According to this hypothesis, abnormal returns prior to the announcement have led to an undervaluation of the firm which triggers managers to start a buyback program. Manconi et al. (2011) extend this analysis to an international context and report similar patterns for other countries. In a recent working paper, Fu et al. (2012) document that the buyback anomaly has disappeared since 2002. The authors explain this finding with the increasing efficiency of the capital market which they proxy by (reduced) trading costs and increased institutional ownership.

Zhang (2005) extends the analysis of Brockman and Chung (2001) for Hong Kong 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. The author does not find abnormal returns on the long-run on average. To my knowledge there is no study of long-run performance of actual share repurchases for the U.S.

This section will first look at the long-run performance of buyback programs by computing abnormal returns over 12, 24, and 36 months starting from the announcement of a buyback program. A similar analysis of the long-run performance of actual share repurchases follows subsequently.

4.3.1 Methodology

There is a long-standing discussion in the literature with respect to the question of how to measure long-run performance of corporate events. Buy and hold abnormal returns (BHAR) as first introduced by Ritter (1991) are associated with several statistical problems and selection biases which need to be adressed (e.g., Ikenberry et al. (1995); Barber and Lyon

(1997); Kothari and Warner (1997)). In particular, as Fama (1998) points out, the BHAR methodology does not account for cross-sectional dependence. He therefore advocates a calendar-time portfolio approach.

Loughran and Ritter (2000) object to Fama (1998)'s recommendation remarking that calendar-time does work against the notion of timing ability (even if there is one) as timing ability which should lead to a clustering of events over time is removed by forming calendar-time portfolios. Lyon et al. (1999) argue furthermore in favor of the BHAR methodology that it "accurately represents investor experience".

However, Mitchell and Stafford (2000) who revisit all the methodologies discussed in the literature do not find empirical evidence backing up the concerns of Loughran and Ritter (2000). To the contrary, they find that the calendar-time portfolio procedure has more power to identify reliable evidence of abnormal performance than the BHAR approach, even after accounting for dependence. Like Fama (1998), the authors therefore strongly advocate a calendar-time portfolio approach.

In addition, Schultz (2003) points out that event-time methods might be subject to pseudo market timing[8] 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 could observe positive abnormal returns after the repurchase in event-time and no abnormal returns in calendar-time.

In conclusion, calendar-time methods seem to provide more reliable t-statistics than event-time methods which is a problem that is aggravated when events cluster over time which in turn is likely to be the case in this study. The method of choice from an econometric point of view should thus be a calendar-time method.

Peyer and Vermaelen (2009) argue for complimenting the calendar-time results by Ibbotson's Returns Across Time and Securities (IRATS) event-time methodology as it allows changing factor loadings on the risk factors. By allowing for changing factor loadings, IRATS should control for changes in the riskiness of stocks due to the changes in capital structures brought about by share repurchases. I will use both the calendar-time method and IRATS in the empirical analyses as the methods are described subsequently.

I will use IRATS in combination with the Fama-French risk factors to estimate abnormal

[8]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.

returns. The following cross-sectional regression is run for each event month (an actual share repurchase):

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

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.

As Loughran and Ritter (2000) note, it should be the small firms that are misvalued and in particular those firms would be underrepresented when returns would be weighted by market cap and therefore I use equally weighted market returns.

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 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):

$$R_{p,t} - R_{f,t} \;=\; a_j + b_j(R_{m,t} - R_{f,t}) + c_j SMB_t + d_j HML_t + \epsilon_{i,t} \tag{4}$$

where $R_{p,t}$ is the monthly return of all stocks that had an event within the event window, $R_{f,t}$ 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 a time series regression.

4.3.2 Long-run performance of buyback programs

Table 8 provides statistics on the annual number of repurchase announcements and compares the SDC data to the manually collected SEC data.[9] A concern in the literature which is only partially mitigated by Banyi et al. (2008) is that the buyback anomaly is the result of a selection bias in SDC. Therefore, I will put a particular focus on the question whether there are any systematic differences between the data from SDC and my manually collected sample.

For the benchmark period from 1991 to 2001, I record 7,925 events from SDC. This

[9] For details regarding the collection process, see the Appendix.

number is in the same order of magnitude as figures obtained by Banyi et al. (2008) and Bonaimé (2012), but more than twice as high as the 3,481 events reported by Peyer and Vermaelen (2009) who exclude announcements which they could not verify via LexisNexis.

For the recent period from 2004 to 2010, the SDC data set lists 3,740 announcements whereas the SEC sample lists 6,462 announcements. Although Peyer and Vermaelen (2009) suggest that half of the SDC data seem to be misclassified, the SEC sample suggests that the SDC database only covers about 50% even if assuming that all SDC announcements are classified correctly. When assuming that all announcements in the SDC sample that are not covered by the SEC sample are misclassified, the coverage ratio drops to 43% (2,771 divided by 6,462)

Even when assuming that SDC has classified all repurchases correctly[10], the coverage ratio of the SEC sample relative to the combined SDC/SEC sample is still equal to 87%. Therefore, I would consider the SEC sample to be very close to a full representation of the population.

The number of annual events is not stable over the period from 2004 to 2010. The annual number peaks in 2007 with 1,349 repurchase announcements and hits its low in 2009 with 416 repurchase announcements. This observation is in line with the flexibility hypothesis which suggests that the permanent components of cash-flows are distributed via dividends, while the non-permanent components are distributed via repurchases. Notably, the SDC coverage ratio is higher when the overall number of announcements in a year is smaller. Furthermore, the more recent years seem to have a higher coverage ratio.

Despite all of the aforementioned data issues, the SDC coverage ratio is the same over all book-to-market- and size-quintiles. This observation mitigates concerns of selection biases. Announcement in SDC seem to be a random draw from the population plus noise.

Descriptives - Announcement Returns Table 9 reports univariate statistics for the open market repurchase sample. For the benchmark period, the average abnormal return in the three days around the announcement is equal to 2.10% which is close in economic terms to the 2.62% reported by Peyer and Vermaelen (2009). The average cumulative return over the six months prior to the repurchase announcement is equal to -1.59%. Peyer and Vermaelen (2009) report a slightly positive number (0.43%).

The results are very similar for the benchmark SDC sample and the recent SDC sample from 2004 to 2010. For the SEC sample I report a lower three day announcement return of 0.65% and slightly positive prior returns of 0.86%. As the numbers are in any way close to

[10]After verifying SDC announcement with data from LexisNexis, Peyer and Vermaelen (2009) exclude approximately half of the SDC sample. This assumption does therefore certainly not hold in reality.

zero, the differences do not merit deeper analysis. An adhoc explanation of the differences would be that the SEC sample covers many follow-up program announcements which do not convey much information. Given the very low announcement returns for the recent period, the results do not support the hypothesis that the buyback anomaly has disappeared because the market has incorporate the information conveyed by the announcement immediately into the stock price.

Long-run performance As outlined in section 5, I use both the IRATS and the calendar-time methodology to estimate abnormal long-run returns. Note that while IRATS reports cumulative abnormal returns, the calendar-time portfolio approach reports average abnormal returns. The results are presented in Table 10.

For the benchmark period, buy back announcements generate abnormal returns over time horizons of 12, 24, and 36 months according to both IRATS and the calendar-time portfolio method. Although the sample is about twice as large as the one used in Peyer and Vermaelen (2009), the results for the period between 1981 and 2001 are basically the same: The 16.34% reported by IRATS for a three year period are very close to the 18.60% reported by Peyer and Vermaelen (2009). The same insight holds for the calendar-time results (0.34% vs. 0.45% average monthly abnormal returns for the same time period). Noteworthy, the calendar time method produces much lower t-statistics than IRATS indicating that cross-sectional dependence is a major issue in the data set at hand.

For the recent period from 2004 to 2010, the buyback anomaly seems to have disappeared. There is no evidence of abnormal long-run performance after buyback announcements irrespective of which data set I use and which estimation method I apply. In a recent working paper, Fu et al. (2012) have shown a similar result already for the SDC data set. To this date, it remains unclear why the buyback anomaly has disappeared. As outlined above, abnormal returns around the announcement have not increased for the more recent time period. The evidence is therefore not in line with the hypothesis that the buyback anomaly has disappeared because of the market incorporating the information conveyed by the announcement immediately into the stock price. Improvements in market efficiency as suggested in a recent working paper by Fu et al. (2012) might be an explanation, but a convincing identification strategy to support this hypothesis is yet missing. As this paper makes use of the unique data being available since 2004 in order to bring together repurchase activity, repurchase costs, and the long-run performance of actual repurchases, a profound analysis of this question is beyond the scope of this paper.

The only return pattern that seems to hold also for the recent time period is that prior returns are abnormally low. The absolute level however has decreased as well to about 50%

of the -7.35% (IRATS) and -1.09% (calendar time) respectively for the benchmark period.

4.3.3 Long-run performance of actual repurchases

Table 11 reports abnormal returns over several time windows prior, post, and around actual repurchases. Notice that while IRATS produces cumulative abnormal returns over the time period considered, calendar-time abnormal returns represent average monthly abnormal returns over the period.

In Panel A, I include all repurchase months having taken place between 2004 and 2010. In the subsequent panels, I form subgroups in order to exclude repurchase months which are unlikely to be driven by managerial timing ability and thus potentially distort long-run abnormal performance. Regardless of the methodology employed and the portfolio formed, abnormal returns before actual repurchases are negative and statistically significant. Negative abnormal returns trigger repurchase activity which is further evidence in favor of the *contrarian-trading hypothesis* (CTH-1)

The abnormal long-run performance of all actual repurchases as depicted in Panel A is larger than zero but only statistically significant for IRATS. The results are furthermore not economically significant: While abnormal long-run performance of buyback announcements between 1981 and 2001 was about 16% over 36 months, it was between 1.44% (Calendar-time: 0.04%x36months) and 1.77% (IRATS) for the more recent period. Only IRATS produces t-statistics that exceed or at least come close to critical values needed to document statistical significance. As earlier analyses indicated cross-sectional dependence, it will, however, be the calender time method which will produce the more reliable test statistics. In conclusion, the results do not provide evidence of abnormal performance of actual share repurchases. The results are thus not in line with the notion of actual repurchases being based on private information or any other form of managerial timing ability.

In Panel B, I only look at the first buyback after the start of the repurchase program. Subsequent repurchases might no longer or only marginally exploit undervaluation as the stock price adjusts immediately after the first buyback month. Therefore, the evidence for timing ability should be stronger when including only the first repurchase month after the start of the program. Furthermore, cross-sectional dependence should be mitigated in this case as every program is allowed to enter the statistic only once. While coefficient estimates for IRATS are similar for most time windows, test statistics collapse. In this setup, none of the two methods provides statistically significant results.

In Panel C and Panel D, repurchases are selected when either the prior three months have not seen repurchase activity (Panel C) or when the subsequent three months will not see repurchase activity (Panel D). By these means, I identify irregular repurchasing firms, which may be more concerned with timing their repurchases, at the cost of increasing cross-sectional dependence. As the selection criteria will produce events which are even more cross-sectionally dependent than in Panel A, again only test statistics of the calendar-time method should be trusted. Again, the positive abnormal returns which are not economically significant, are not large enough to indicate statistical significance.

In Panel E and Panel F, I look at small (Panel E) and large (Panel F) repurchases separately. The idea here is that repurchase intensity might indicate the value of private information the manager has. The smallest repurchases do not exhibit negative abnormal returns in the months preceding the repurchase. Subsequent performance ist not abnormally high, if anything, the empirical evidence suggests that subsequent performance is abnormally low. The largest repurchases exhibit low abnormal returns on the long-run. T-statistics indicate statistical significance only for IRATS which produces too large statistics in case of cross-sectional dependence. Looking at the large negative abnormal returns prior to the repurchase, cross-sectional dependence seems likely. Again, calendar-time does not indicate statistical significance.

In conclusion, even if I disregard that test statistics are too low to indicate statistical significance, the long-run abnormal returns generated by actual repurchases are too low from an economic point of view to support the notion of managerial timing ability. If anything, there might be very few companies that are capable of timing the market because they have private information. The results of this analysis do not support the notion that market timing takes place on a large scale.

4.3.4 Conclusion

The empirical evidence is not in line with the prediction of the market-timing hypothesis that repurchases are followed by an abnormal stock price performance. This observation holds for both buyback announcements and actual repurchases and is not changed by restricting the sample to observations which are more likely to be subject to managerial timing ability.

5 Discussion and conclusion

This paper examines the timing of repurchase programs and actual share repurchases.

The results suggest that the buyback anomaly has disappeared. A comparison of announcements taken from SDC with manually collected data from SEC mitigates concerns that either prior research by Vermaelen (1981); Dann (1981); Ikenberry et al. (1995, 2000) documenting the buyback anomaly or recent results documenting that the buyback anomaly has disappeared are driven by sample errors or selection biases. The data collected by SDC appears to be a random draw from the population.

An analysis of the drivers of actual share repurchases reveals that most of the time series variation of actual share repurchases cannot be explained. Among the most important drivers of repurchases are lagged returns, program size, and the distance to the start of the program.

The medium and long-run return performance of actual repurchases is neither economically nor statistically significantly different from zero. This result is not changed by looking only at first, last, small, or large actual repurchases.

In line with papers by Ben-Rephael et al. (2013) and De Cesari et al. (2012), I however find that firms buy back at below average market prices. I model and test the *market-timing hypothesis* and the *contrarian-trading hypothesis* which are both able to explain this finding. As summarized in Table 1, the empirical evidence is only in line with the predictions generated by the *contrarian-trading hypothesis*.

The *contrarian-trading hypothesis* provides an explanation of why repurchase costs are lower than average market prices which is not related to managerial timing ability. This puts into question earlier conclusions of the literature such as in Brockman and Chung (2001); Cook et al. (2004); De Cesari et al. (2012); Ben-Rephael et al. (2013). The analysis conducted in this paper therefore implies that comparing repurchase prices to average market prices is not a useful approach to measure and examine managerial timing ability.

I conclude that for the recent time period both repurchase announcements and actual repurchases do not convey information and that there is thus no evidence consistent with the notion of managerial timing ability of share repurchases.

To this date, it remains unclear why the buyback anomaly has disappeared. Abnormal returns around the announcement are not higher than in earlier years and therefore cannot explain why returns are no longer abnormally high in the months following the repurchase. Improvements in market efficiency as suggested in a recent working paper by Fu et al. (2012) might be an explanation. Rock-solid empirical evidence in favor of this notion, however, has not yet been presented and will thus be an area of further research.

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A Appendix

A.1 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.[11] 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.[12]

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.[13]

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.

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

[12] 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 .

[13] The difference between the total number of shares purchased and the number of shares purchased under programs are often shares delivered back to the issuer for the payment of taxes resulting from the vesting of restricted stock units and the exercise of stock options by employees and directors. Besides the number of shares purchased and the purchase price, firms have to indicate the method of repurchase (e.g., open market repurchase, private transaction, tender offer).

A.2 Data collection issues

This appendix provides more detailed information on how we collected and edited the information on share repurchases and repurchase programs from the form 10-Q and 10-K filings. As mentioned in Section 3, the new regulatory requirements mandate the disclosure of (1) the total number of shares purchased, (2) the total number of shares purchased under a repurchase program, and (3) the purchase price per share on a monthly basis.

The difference between the total number of shares purchased and the number of shares purchased under a program is important. The total number of shares purchased includes, among other things:

- shares delivered back to the issuer for the payment of taxes resulting from the vesting of restricted stock units;
- shares delivered back to the issuer for the payment of taxes and the exercise price of stock options exercised by employees and directors;
- the repurchase of unvested restricted stock units from employees whose employment terminated before their shares vested.

In these cases the employee and not the company decides whether the company has to purchase shares while in a repurchase program the purchase decision is made by the company. Significantly, in transactions with employees the price can be different from the current stock market price, e.g., if companies use their own fundamental valuation instead of the market price when purchasing shares from their employees.[14]

Repurchases of unvested restricted stock units from employees whose employment terminated before their shares vested are typically executed at the nominal share value, which is often just one cent. Therefore, repurchases of unvested restricted stock introduce a significant downward bias of the average purchase price.[15]

In addition to the above mentioned more common repurchase activities outside of a program there are other, less common transactions, which also lead to repurchases outside of active repurchase programs. One example is the repurchase of shares that were issued as

[14] In October 2007 Morgan Stanley (CIK 895421) repurchased shares from employees at an average price of \$66.34 while it purchased shares under the repurchase program at an average price of \$63.32 (see form 10-K filed on January 29, 2008). In October 2008 the difference became even more pronounced, when shares from employees were purchased at \$36.13, while shares under the repurchase program were purchased in the open market at \$15.09.

[15] For example, in April 2006 Sun Microsystems Inc. (CIK 709519) purchased 188,675 shares at an average price of \$0.09 although its stock price during that month was around \$5.

acquisition currency when the target is later divested.[16] Finally, some data corrections are necessary if companies report transactions under a repurchase program that were repurchased outside the program, e.g., when shareholders held put options against the company.[17]. In some cases, companies even report buybacks as repurchases under a program even though no program existed at the time.[18] While misclassifications from put options, divestitures, and similar transactions are rare, the misclassification of repurchases from employees as repurchases under a program is more common.

It is generally not possible to determine the transaction price of the shares purchased under a program when the total number of shares purchased differs from the number of share purchased under a program. Companies then provide the average purchase price, which corresponds to the total number of shares purchased, and therefore includes purchases outside the program that were conducted at different prices. We therefore correct for these errors by manually checking the footnotes and remarks in the filings and setting the repurchases under a repurchase program to zero whenever such a misclassification took place.

Furthermore, we manually adjusted the number of shares and the purchase price for stock splits and stock dividends when necessary. Usually, companies report the repurchase data during the period covered by the filing on a post stock split basis even if the stock split took place not before the second or the third month of the quarter. For example, if a company repurchases 100 shares at $10.00 in January and conducts a 2:1 stock split in February, then the company will report this transaction in its filings for the period from January to March as 200 shares purchase at $5.00. This means that the repurchases in the first and in the second month of a quarter can be reported post-split although they can take place pre-split. We always adjusted the repurchase data to match the stock market data from CRSP.

A.3 Derivations and proofs of Section 2

Subsequently, the empirical predictions generated in Section 2 are derived.

[16]One example is The Interpublic Group of Companies Inc. (CIK 51644), which recorded a repurchase of 15,325 shares in February 2010. The company writes in its 10-K that these shares consist "(...) of our common stock that we received as consideration for the sale of our interest in a company that we previously had acquired (the "Acquisition Shares")."

[17]In the Form 10-Q filing for the period from April to June 2006 Refac Optical Group (CIK 82788) reports repurchases under a program when shareholders exercised their right to sell their shares to the company at a predetermined price pursuant to a merger agreement.

[18]Unit Corp (CIK 798949) records in its 10-Q filing for April to June 2008 all shares as purchased under a program although they were all related to the payment of taxes and to the payment of the exercise price of stock options and Unit Corp did not have any repurchase program at this time.

Versata Inc. (CIK 1034397) reports in its 10-Q filing for February to April 2005 purchases from shareholders, who received the right to sell their shares back to the company at a premium in a security class action, as repurchases under the program. At this time Versata Inc. did not have a repurchase program.

A.3.1 Base model

The difference between average market price and average repurchase price can be expressed as follows:

$$\begin{aligned}
\bar{P}_t - P_t^* &= \frac{P_{t-1} + P_t}{2} - \frac{P_{t-1}q_{t,b} + P_t q_{t,e}}{q_{t,b} + q_{t,e}} \\
(\bar{P}_t - P_t^*)(q_{t,b} + q_{t,e}) &= \frac{1}{2}(P_{t-1} + P_t)(q_{t,b} + q_{t,e}) - P_{t-1}q_{t,b} - P_t q_{t,e} \\
&= \frac{1}{2}(P_{t-1}q_{t,b} + P_{t-1}q_{t,e} + P_t q_{t,b} + P_t q_{t,e}) - P_{t-1}q_{t,b} - P_t q_{t,e} \\
&= \frac{1}{2}(P_{t-1}q_{t,b} + P_{t-1}q_{t,e} + P_t q_{t,b} + P_t q_{t,e} - 2P_{t-1}q_{t,b} - 2P_t q_{t,e}) \\
&= \frac{1}{2}(-P_{t-1}q_{t,b} + P_{t-1}q_{t,e} + P_t q_{t,b} - P_t q_{t,e}) \\
&= \frac{1}{2}[P_{t-1}q_{t,e} + P_{t-1}(1 + R_t)q_{t,b} - P_{t-1}q_{t,b} - P_{t-1}(1 + R_t)q_{t,e}] \\
&= \frac{1}{2}P_{t-1}[q_{t,e} + (1 + R_t)q_{t,b} - q_{t,b} - (1 + R_t)q_{t,e}] \\
\frac{(\bar{P}_t - P_t^*)(q_{t,b} + q_{t,e})}{P_{t-1}} &= \frac{1}{2}(q_{t,e} + q_{t,b} + R_t q_{t,b} - q_{t,b} - q_{t,e} - q_{t,2e}R_t) \\
&= \frac{1}{2}R_t(q_{t,b} - q_{t,e})
\end{aligned}$$

Monthly abnormal return, R_t, and repurchase quantity, $q_{t,\cdot}$, are assumed to be independent random variables with the following statistical properties: $R_t \sim (0, \sigma_R)$ and $q_{t,\cdot} \sim (\mu_q, \sigma_q)$. If repurchase trades are entirely uninformed and rather follow a repurchase scheme which is independent of both realized and expected abnormal returns, the following assumptions are valid: $E(R_t) = 0$, $Cov(R_t, q_{t;\cdot}) = 0$, and $E(q_{t,1}) = E(q_{t,2}) = \mu_q$. Under these assumptions, the expected bargain is equal to zero:

$$\begin{aligned}
E(B_t) &= E[\frac{1}{2}R_t(q_{t,b} - q_{t,e})] \\
&= \frac{1}{2}0(\mu_q - \mu_q) = 0
\end{aligned}$$

Furthermore, assuming that $E(R_t^2 q_t) = E(R_t^2)E(q_t)$ which is reasonable for uninformed repurchase trades, the covariance between return and bargain is zero as well:

$$\begin{aligned}
Cov(R_t, B_t) &= E[(R_t - E(R_t))(B_t - E(B_t)] \\
&= E[(R_t(\frac{1}{2}R_t(q_{t,b} - q_{t,e}))] \\
&= \frac{1}{2}E[R_t^2(q_{t,b} - q_{t,e})] \\
&= \frac{1}{2}E(R_t^2)E(q_{t,1} - q_{t,e}) \\
&= \frac{1}{2}\sigma_R^2 0 \\
&= 0
\end{aligned}$$

Note that: $Var(R_t) = E(R_t^2) - [E(R_t)]^2 = E(R_t^2) = \sigma_R^2$,

A.3.2 Market-timing hypothesis

With $E_M(\dot{B}_t) = \frac{1}{2}\mu_\varepsilon$, the covariance between contemporaneous return and bargain will be larger than zero as well:

$$\begin{aligned}
Cov_M(R_t, B_t) &= E[(R_t - E_M(R_t))(B_t - E_M(B_t)] \\
&= E_M[(R_t - \mu_\varepsilon))(\dot{B}_t - \frac{1}{2}\mu_\varepsilon)] \\
&= E_M[(R_t - \mu_\varepsilon)(\frac{1}{2}(R_t q_{t,b} - q_{t,e}R_t) - \frac{1}{2}\mu_\varepsilon)] \\
&= \frac{1}{2}E_M[(R_t - \mu_\varepsilon)(1 \cdot R_t - \mu_\varepsilon)] \\
&= \frac{1}{2}E_M(R_t^2 - R_t\mu_\varepsilon - R_t\mu_\varepsilon + \mu_\varepsilon^2) \\
&= \frac{1}{2}E_M(R_t^2 - \mu_\varepsilon^2) = \frac{1}{2}Var_M(R_t) > 0
\end{aligned}$$

It might be more realistic to assume that a fraction of the anticipated returns will materialize in t, while the remaining fraction will materialize only in t+1. If the expected anticipated return in t will be only $\mu_\varepsilon(1-\kappa)$, the remaining anticipated return $\mu_\varepsilon\kappa$ will materialize in t+1. In this case, the expected bargain conditional on the information set of the manager will still be larger than zero:

$$\begin{aligned}
E_M(B_t|\kappa \neq 0) &= \frac{1}{2}E[q_{t,b}R_t - q_{t,e}R_t] \\
&= \frac{1}{2}E[1 \cdot R_t - 0 \cdot R_t] = \frac{1}{2}\mu_\varepsilon(1-\kappa)
\end{aligned}$$

Assuming that part of the anticipated return materializes after the repurchase months, the bargain and future abnormal returns will be related:

$$
\begin{aligned}
Cov_M(R_{t+1}, B_t) &= E_M[(R_{t+1} - E_M(R_{t+1}))(B_t - E_M(B_t)] \\
&= E_M[(R_{t+1} - \kappa\mu_\varepsilon)(\frac{1}{2}(R_t q_{t,b} - q_{t,e}R_t) - \frac{1}{2}\mu_\varepsilon(1-\kappa)] \\
&= \frac{1}{2}E_M[(R_{t+1} - \kappa\mu_\varepsilon)((1 \cdot R_t) - \mu_\varepsilon(1-\kappa)] \\
&= \frac{1}{2}E_M[(R_{t+1} - \kappa\mu_\varepsilon)(R_t - \mu_\varepsilon + \mu_\varepsilon\kappa)] \\
&= \frac{1}{2}E_M[(R_{t+1}R_t - R_{t+1}\mu_\varepsilon + R_{t+1}\mu_\varepsilon\kappa - \kappa\mu_\varepsilon R_t + \kappa\mu_\varepsilon^2 - \kappa^2\mu_\varepsilon^2)] \\
&= \frac{1}{2}[E_M(R_{t+1}R_t) - \mu_\varepsilon\kappa\mu_\varepsilon + \mu_\varepsilon\kappa\mu_\varepsilon\kappa - \kappa\mu_\varepsilon\mu_\varepsilon(1-\kappa) + \kappa\mu_\varepsilon^2 - \kappa^2\mu_\varepsilon^2] \\
&= \frac{1}{2}[E_M(R_{t+1}R_t) - \kappa\mu_\varepsilon\mu_\varepsilon(1-\kappa)] \\
&= \frac{1}{2}[E_M(R_{t+1})E_M(R_t) + Cov_M(R_{t+1,}R_t) - \kappa\mu_\varepsilon\mu_\varepsilon(1-\kappa)] \\
&= \frac{1}{2}Cov_M(R_t, R_{t+1})
\end{aligned}
$$

Thus, the sign on $Cov_M(R_{t+1}, \dot{B}_t)$ will depend on the sign of the autocorrelation of returns which is positive:

$$
\begin{aligned}
Cov_M(R_t, R_{t+1}) &= E_M[(R_t - E_M(R_t)(R_{t+1} - E_M(R_{t+1}))] \\
&= E_M[((1-\kappa)(\varepsilon_t + \eta_t) - (1-\kappa)\mu_\varepsilon)((\varepsilon_t + \eta_t)\kappa - \kappa\mu_\varepsilon)] \\
&= \kappa(1-\kappa)E_M[((\varepsilon_t + \eta_t) - \mu_\varepsilon)((\varepsilon_t + \eta_t) - \mu_\varepsilon)] \\
&= \kappa(1-\kappa)[E_M(\varepsilon_t + \eta_t)^2 - E_M(\varepsilon_t + \eta_t)\mu_\varepsilon - \mu_\varepsilon E_M(\varepsilon_t + \eta_t) + \mu_\varepsilon^2] \\
&= \kappa(1-\kappa)[E_M(\varepsilon_t + \eta_t)^2 - \mu_\varepsilon^2 - \mu_\varepsilon^2 + \mu_\varepsilon^2] \\
&= \kappa(1-\kappa)[E_M(R_t)^2 - \mu_\varepsilon^2)] \\
&= \kappa(1-\kappa)Var_M(R_t) \\
&= \kappa(1-\kappa)(\sigma_\varepsilon^2 + \sigma_\eta^2) > 0
\end{aligned}
$$

Tables

Table 1: **Predictions and Evidence.** This table summarizes the predictions generated by the *market-timing hypothesis* and the *contrarian-trading hypothesis* and the corresponding results of the empirical analysis. B_t denotes monthly bargain, R_t denotes monthly stock return, and q_t denotes monthly repurchase volume.

Predictions		Empirical evidence	Details / source
Market-timing hypothesis			
MTH-1:	$\mathrm{E}(\mathrm{B}_t)>0$	Confirmed	Table 6
MTH-2:	$\mathrm{Cov}(\mathrm{R}_t^+,\mathrm{B}_t)>0$	Confirmed	Table 7
MTH-3:	$\mathrm{Cov}(\mathrm{R}_{t+1},\mathrm{B}_t)>0$	Rejected	Table 11
MTH-4:	$\mathrm{E}(\mathrm{R}_{t+1}\vert \mathrm{q}_t>0)>0$	Not confirmed	Table 7
Contrarian-trading hypothesis			
CTH-1:	$\mathrm{corr}(\mathrm{R}_{t-1},\mathrm{q}_t)<0$	Confirmed	Table 5
CTH-2:	$\mathrm{corr}(\mathrm{R}_t^+,\mathrm{B}_t)>0$	Confirmed	Table 7
CTH-3:	$\mathrm{corr}(\mathrm{R}_t^-,\mathrm{B}_t)<0$	Confirmed	Table 7
CTH-4:	$\mathrm{B}_t>0$	Confirmed	Table 6

Table 2: **Event Sample Construction.** This table summarizes how many events are excluded in each step of the data cleansing process. The information is provided separately for the SDC sample covering the period 1991 until 2001, the SDC sample covering the period 2004 until 2010, and for the SEC sample covering the period 2004 until 2010.

Downloaded from SDC:	1991-2001*	2004-2010
Initial sample size	11,441	5,042
Not labeled as open market repurchase	949	274
Program announcement date coincides with completion date	131	35
Status: intent withdrawn or withdrawn	294	33
Buybacks other than common stock	82	19
Acquirer and Target CUSIP do not match	2	2
Assignment of permno identifier unsuccessful	771	676
Intermediary sample size	9,212	4,003
Earlier announcement within one month existing	101	25
Stock price ten days prior to the announcement smaller than $3	473	165
Market capitalization not available	11	7
BM ratio not available	614	45
Return prior to the announcement not available	83	18
Return subsequent to the announcement not available	5	3
Final sample size	7,925	3,740
Downloaded from SEC:		2004-2010
Initial sample size		8,816
Tender offer or Dutch auction programs		128
Odd lot programs (programs for small investors)		8
Dubious programs		13
Announcements outside the period analyzed (2004-2010)		1,517
Observations for which announcement date is not available		130
Event firm not available in CRSP data set		110
Intermediary sample size		6,910
Earlier announcement within one month existing		96
Stock price ten days prior to the announcement smaller than $3		216
Market capitalization not available		10
BM ratio not available		98
Return prior to the announcement not available		1
Return subsequent to the announcement not available		27
Final sample size		6,462

* Same time period as used in Peyer and Vermaelen (2009) which serves as a benchmark for the analyses

Table 3: **Definition of variables.** This table defines all of the variables used in the subsequent tables.

Name	Definition (Source)	Unit
Acquiror	1 if firm is currently (time between announcement and end of the offer) bidding for another company	binary
AR / Abnormal Return	Abnormal return in the event month	
CAR(1,6)	Cumulative abnormal return in the six months post event	
Bargain	Relative difference between monthly average of CRSP closing price and repurchase price (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
Duration	Distance between current month and start of program	unit
EBITDA to assets	Sales (item: saleq) - COGS (item: cogsq) - Expenses (item: xsgaq) divided by total assets (item: atq) (COMPUSTAT)	ratio
Leverage	(Total asset - book value equity) / (total asset - book value equity + market cap) (CRSP/COMPUSTAT)	ratio
Market cap	Monthly average of daily market capitalization (CRSP)	million
Program Size	Program size scaled by shares outstanding at the beginn of program	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
Repurchase intensity	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 trading volume	Dollar volume of shares repurchased in respective month divided by total trading volume (CRSP/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
Assets	Total assets (Compustat item: atq) (ln)	million

Table 4: **Descriptives - Total Sample.** All variables are defined in Table 3.

	N	mean	p50	p25	p75	min	max
Repurchase intensity	32331	0.68%	0.38%	0.14%	0.85%	0.00%	18.73%
Repurchase dummy	87614	0.37	0	0	1	0	1
Return	87978	0.68%	0.41%	-5.57%	6.50%	-87.76%	333.33%
Relative spread	87978	0.74%	0.14%	0.07%	0.47%	0.00%	30.66%
Assets	87822	9811.22	1091.79	372.94	3616.50	0.78	2321963.00
Cash to assets	87978	15.73%	8.04%	3.03%	23.21%	0.11%	78.84%
EBITDA to assets	87978	2.78%	2.69%	0.63%	4.53%	-23.70%	12.02%
Dividends to assets	86921	1.03%	0.17%	0.00%	1.16%	0.00%	13.78%
Leverage	87813	43.28%	35.78%	18.44%	69.52%	0.50%	99.85%
Book to market	87813	65.62%	52.63%	32.21%	81.49%	-86.12%	382.76%
Acquiror	87978	9.71%	0.00%	0.00%	0.00%	0.00%	100.00%
Target	87978	0.50%	0.00%	0.00%	0.00%	0.00%	100.00%
Program information							
Program size	6468	6.58%	5.26%	3.38%	8.55%	0.01%	47.80%
Duration	6468	16.15	12	6	22	1	87

Table 5: **Analysis of Repurchases.** The dependent variable is either repurchases scaled by shares outstanding (*Repurchase intensity*) or a binary variable which is 1 if a repurchase takes place in the respective month *(Repurchase Dummy).* All independent variables are defined in Table 3. 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) Repurchase intensity	(2) Repurchase intensity	(3) Repurchase intensity	(4) Repurchase dummy	(5) Repurchase dummy	(6) Repurchase dummy
Return_t	–0.001***	–0.001***	–0.001***	–0.040***	–0.060***	–0.062***
	(–4.87)	(–5.61)	(–5.84)	(–3.97)	(–6.38)	(–6.68)
Return_{t-1}	–0.003***	–0.003***	–0.003***	–0.135***	–0.131***	–0.127***
	(–13.03)	(–12.98)	(–12.80)	(–11.23)	(–12.35)	(–12.31)
Relative spread_t (ln)	–0.001***	–0.001***	–0.001***	–0.035***	–0.032***	–0.026***
	(–9.79)	(–10.33)	(–8.75)	(–5.12)	(–6.68)	(–5.73)
Assets_{t-3} (ln)	0.001***	0.001***	0.001***	0.036**	0.024**	0.014
	(4.13)	(4.23)	(4.08)	(2.09)	(2.10)	(1.34)
Cash to assets_{t-3}	0.003***	0.003***	0.003***	0.101**	0.110***	0.100***
	(4.91)	(5.55)	(5.56)	(1.98)	(3.23)	(3.16)
EBITDA to assets_{t-3}	–0.000	–0.001	–0.002	0.254**	0.119	0.024
	(–0.10)	(–0.46)	(–1.40)	(2.00)	(1.33)	(0.27)
Dividends to assets_{t-3}	0.002	0.002	–0.000	0.227	0.079	0.011
	(0.82)	(0.60)	(–0.17)	(0.86)	(0.45)	(0.07)
Leverage_{t-3}	–0.006***	–0.005***	–0.004***	–0.519***	–0.320***	–0.261***
	(–9.65)	(–9.29)	(–8.14)	(–9.70)	(–9.03)	(–7.73)
Book to market_{t-3}	0.001***	0.001***	0.001***	0.011	0.013*	0.016**
	(4.75)	(5.16)	(5.68)	(1.03)	(1.83)	(2.29)
Acquiror $(\text{Dummy})_t$	–0.000***	–0.000***	–0.000***	–0.047***	–0.030***	–0.026***
	(–4.27)	(–3.82)	(–3.11)	(–6.86)	(–5.83)	(–5.08)
Target $(\text{Dummy})_t$	–0.001*	–0.000	–0.000	–0.103***	–0.062***	–0.051***
	(–1.90)	(–1.45)	(–0.80)	(–6.07)	(–4.27)	(–3.53)
Repurchase intensity_{t-1}		0.180***	0.161***			
		(17.29)	(15.80)			
Program size_t			0.008***			–0.018
			(5.38)			(–0.22)
Duration_t (ln)			–0.001***			–0.082***
			(–24.83)			(–28.03)
$\text{RepurchasedDummy}_{t-1}$					0.365***	0.348***
					(54.74)	(52.84)
Constant	–0.006***	–0.005***	–0.003***	0.214*	0.072	0.275***
	(–4.01)	(–4.55)	(–2.75)	(1.79)	(0.92)	(3.72)
R^2	0.030	0.061	0.079	0.063	0.191	0.205
Observations	87614	87411	87411	87614	87411	87411
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes

Table 6: **Descriptives - Bargain Analysis.** $AR_t^+ (AR_t^-)$ is equal to the abnormal return if it is positive (negative) or zero. All other variables are defined in Table 3. I test *Bargain* and AR against the null hypothesis that mean and median respectively are equal to zero. A paired t-test is used to examine whether the means are significantly different from zero. A Wilcoxon signed-rank test is used to examine whether medians are significantly different from zero. *, **, *** indicate significance at the 10%, 5% and 1% level respectively.

	N	mean	p50	p25	p75	min	max
Bargain (%)	43526	0.56%***	0.27%***	1.74%	-0.72%	-70.07%	48.96%
Bargain (mn Dollar)	43526	0.12	0.00	-0.02	0.12	-120.92	213.29
AR	43526	-0.54%***	-0.63%***	-5.23%	3.95%	-72.43%	200.02%
AR_t^+	43526	3.05%	0.00%	0.00%	3.95%	0.00%	200.02%
AR_t^-	43526	-3.59%	-0.63%	-5.23%	0.00%	-72.43%	0.00%
CAR(1,6)	43526	-2.00%	-1.89%	-14.75%	10.62%	-253.69%	424.28%
Return	43526	0.09%	0.22%	-4.77%	5.07%	-67.46%	233.33%
Rep. Intensity	43526	0.66%	0.36%	0.13%	0.81%	0.00%	21.52%
Rep. to trading volume	43526	6.34%	3.27%	1.20%	7.64%	0.00%	80.00%
Relative spread	43526	3.05%	0.00%	0.00%	3.95%	0.00%	200.02%

Table 7: **Analysis of Bargains.** The dependent variable is the relative difference between the monthly repurchase price and the monthly average CRSP closing price *(Bargain)*. *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. $AR_t^+(AR_t^-)$ is equal to the abnormal return if it is positive (negative) and zero otherwise. All other variables are defined in Table 3. Independent variables denoted with (ln) are expressed as natural logarithms. I denote the product of the coefficient on $AR_t^+(AR_t^-)$ and the average of $AR_t^+(AR_t^-)$ as presented in Table 6 by *coeff x* $AR_t^+(AR_t^-)$. Standard errors are clustered at the firm level. t-statistics are provided in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level respectively.

	2004-2010		excl. 07/2008-04/2009		excl. 07/2008-12/2010	
	(1)	(2)	(3)	(4)	(5)	(6)
Repurchases to trading volume$_t$	–0.040***	–0.040***	–0.033***	–0.033***	–0.029***	–0.030***
	(–9.29)	(–9.19)	(–9.71)	(–9.61)	(–8.69)	(–8.82)
Repurchase intensity$_t$	0.083**	0.101**	0.034	0.045	0.036	0.047
	(2.06)	(2.49)	(1.16)	(1.49)	(1.06)	(1.34)
Relative spread$_t$ (ln)	–0.002**	–0.002***	–0.001	–0.001	–0.000	–0.001
	(–2.56)	(–2.78)	(–1.41)	(–1.13)	(–0.85)	(–1.35)
AR_t^+	0.035***	0.037***	0.041***	0.040***	0.044***	0.043***
	(3.38)	(3.53)	(3.16)	(3.09)	(4.07)	(3.98)
AR_t^-	–0.025***	–0.028***	–0.051***	–0.052***	–0.066***	–0.066***
	(–2.83)	(–3.16)	(–5.47)	(–5.48)	(–6.20)	(–6.16)
CAR(1,6)$_t$	–0.006***	–0.006***	–0.006***	–0.005***	–0.006***	–0.006***
	(–4.76)	(–4.59)	(–4.31)	(–4.13)	(–4.74)	(–4.50)
R^2	0.011	0.022	0.015	0.024	0.019	0.028
Observations	43468	43468	38861	38861	31435	31435
Firm FE	Y	Y	Y	Y	Y	Y
Month FE	N	Y	N	Y	N	Y
coeff x AR_t^+	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%
coeff x AR_t^-	0.09%	0.10%	0.17%	0.18%	0.22%	0.22%
Sum	0.20%	0.21%	0.28%	0.28%	0.33%	0.33%
Bargain	0.56%	0.56%	0.53%	0.53%	0.48%	0.48%
% of Bargain	35.04%	38.05%	53.25%	53.38%	68.59%	68.06%

Table 8: **SDC-SEC Comparison.** This table contains a comparison of the SDC sample and the SEC sample over the period 2004-2010. Panel A provides information with regard to the number of events that are comprised in both samples or in one of the samples only. Panel B reports SDC coverage for book-to-market and size quintiles, respectively.

Panel A:	Annual number of events						
Year	SDC event	SEC event	SDC & SEC	Only SDC	Only SEC	SDC (% of total events	SEC (% of total events
1991-2001*	7,925						
2004	458	912	359	99	553	45%	90%
2005	527	1,076	397	130	679	44%	89%
2006	493	1,106	384	109	722	41%	91%
2007	774	1,349	606	168	743	51%	89%
2008	790	1,069	592	198	477	62%	84%
2009	280	416	203	77	213	57%	84%
2010	418	534	230	188	304	58%	74%
2004-2010	3,740	6,462	2,771	969	3,691	50%	87%

Panel B:	Number of events per book-to-market and size quintile, 2004-2010				
	Book-to-market				
Quintile	1	2	3	4	5
SDC event	772	894	801	782	491
SEC event	1360	1472	1420	1366	844
SDC / SEC	57%	61%	56%	57%	58%
	Size				
Quintile	1	2	3	4	5
SDC event	219	514	671	835	1501
SEC event	355	908	1119	1616	2464
SDC / SEC	62%	57%	60%	52%	61%

* Same time period as used in Peyer and Vermaelen (2009) which serves as a benchmark for the analyses

Table 9: **SDC-SEC Descriptives.** This table provides univariate statistics for the SDC sample covering the period 1991 until 2001, for the SDC sample covering the period 2004 until 2010 and for the SEC sample covering the period 2004 until 2010. CAR[-1, +1] refers to the cumulative abnormal return in the three-day window around the repurchase announcement, using the market model. The market return is proxied by the CRSP equally-weighted index. Prior return is the cumulative return on the firm's stock in the six months preceding the announcement.

		SDC			SEC	
Year	No. of events	CAR[-1,+1]	Prior return	No. of events	CAR[-1,+1]	Prior return
1991 - 2001*	7,925	2.10%	-1.59%			
2004	458	1.05%	4.62%	912	0.57%	6.59%
2005	527	1.46%	4.02%	1,076	0.55%	4.69%
2006	493	1.24%	2.97%	1,106	0.43%	4.03%
2007	774	1.76%	-2.02%	1,349	0.82%	0.17%
2008	790	2.10%	-14.05%	1,069	0.91%	-13.45%
2009	280	2.28%	-0.67%	416	0.62%	1.86%
2010	418	1.22%	5.58%	534	0.53%	6.79%
All	3,740	1.61%	-1.29%	6,462	0.65%	0.86%

* Same time period as used in Peyer and Vermaelen (2009) which serves as a benchmark for the analyses

Table 10: **Long-run performance after announcements.** I use Ibbotson's Returns Across Time and Securities (IRATS) event-time methodology 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. For both IRATS and Calendar-time estimation, I use the CRSP equally-weighted return an as the market return. 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,-1)	(0,0)	(+1,+6)	(+1,+12)	(+1,+24)	(+1,+36)
1991-2001 (sample period of Peyer and Vermaelen, 2009), N=7925						
IRATS (cumulative ARs)	-7.35%	0.13%	1.58%	4.10%	11.10%	16.34%
t-stat	-22.51***	0.82	4.19***	7.72***	13.78***	16.01***
Calendar time (average AR)	-1.09%	0.48%	0.38%	0.37%	0.44%	0.34%
t-stat	-5.59***	1.65*	2.32**	2.27**	3.11***	2.65***
2004-2010, SDC sample, N=3740						
IRATS (cumulative ARs)	-3.52%	0.38%	0.19%	-0.45%	-0.92%	-0.08%
t-stat	-9.11***	2.01**	0.45	-0.71	-0.95	-0.062
Calendar time (average AR)	-0.62%	0.29%	0.05%	0.10%	0.12%	0.11%
t-stat	-3.65***	1.22	0.34	0.74	0.91	0.84
2004-2010, SEC sample, N=6462						
IRATS (cumulative ARs)	-2.35%	0.36%	0.15%	-0.36%	-0.69%	-0.02%
t-stat	-8.23***	2.71***	0.5	-0.8	-0.98	-0.02
Calendar time (average AR)	-0.54%	0.33%	0.05%	0.13%	0.14%	0.09%
t-stat	-3.16***	1.67*	0.29	0.92	0.96	0.73

Table 11: **Long-run performance of actual repurchases.** I use Ibbotson's Returns Across Time and Securities (IRATS) event-time methodology 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. For both IRATS and Calendar-time estimation, I use the CRSP equally weighted return an as the market return. 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,-1)	(0,0)	(+1,+6)	(+1,+12)	(+1,+24)	(+1,+36)
Panel A. All repuchases N=47301						
IRATS (cumulative ARs)	-1.50%	-0.17%	0.42%	0.33%	0.49%	1.77%
t-stat	-14.63***	-3.91***	3.59***	1.91*	1.88*	5.221***
Calendar time (average AR)	-0.27%	-0.27%	0.08%	0.07%	0.06%	0.04%
t-stat	-2.06*	-1.90*	0.55	0.48	0.44	0.28
Panel B. First buys of program, N=5984						
IRATS (cumulative ARs)	-3.02%	0.12%	0.45%	0.20%	-0.01%	1.18%
t-stat	-8.231**	2.71***	0.5	-0.8	-0.98	-0.02
Calendar time (average AR)	-0.74%	0.03%	0.19%	0.15%	0.08%	0.08%
t-stat	-3.64***	0.13	1.27	1.13	0.59	0.59
Panel C. First repurchase after three months, N=7206						
IRATS (cumulative ARs)	-2.23%	-0.76%	0.81%	0.52%	1.34%	3.17%
t-stat	-7.29***	-5.44***	2.41**	1.07	1.84	3.37***
Calendar time (average AR)	-0.42%	-0.88%	0.12%	0.14%	0.14%	0.14%
t-stat	-3.00**	-4.07***	0.82	1.22	1.23	1.33
Panel D. No repurchase in following three months, N=6561						
IRATS (cumulative ARs)	-4.77%	0.26%	0.64%	0.04%	-0.04%	3.03%
t-stat	-14.27***	1.67*	1.59	0.08	-0.04	2.86**
Calendar time (average AR)	-0.80%	0.09%	0.22%	0.19%	0.09%	0.12%
t-stat	-5.42***	0.36	0.98	0.89	0.45	0.67
Panel E. Low repurchase intensity (lowest 20%), N=10120						
IRATS (cumulative ARs)	-0.18%	0.31%	-0.47%	-0.70%	-0.82%	-0.04%
t-stat	-0.74	2.84***	-1.76*	-1.8*	-1.42	-0.06
Calendar time (average AR)	0.00%	0.33%	-0.07%	0.04%	0.01%	-0.02%
t-stat	-0.02	1.93*	-0.43	0.25	0.06	-0.14
Panel F. High repurchase Intensity, (highest 20%), N=10120						
IRATS (cumulative ARs)	-4.28%	-0.34%	0.73%	1.12%	1.51%	2.80%
t-stat	-18.03***	-3.14***	2.76***	2.81***	2.44**	3.49***
Calendar time (average AR)	-0.76%	-0.59%	0.23%	0.18%	0.17%	0.14%
t-stat	-4.57***	-2.56**	1.36	1.08	1.12	0.96