Insider ownership, institutional ownership, and the timing of open market stock repurchases

Amedeo De Cesari,[a, *] Susanne Espenlaub,[b] Arif Khurshed [b] and Michael Simkovic [c]

[a] Aston Business School, Birmingham, U.K.

[b] Manchester Business School, Manchester, U.K.

[c] Michael Simkovic is an attorney in New York and a former Olin Fellow in Law & Economics at Harvard Law School, U.S.A.

Abstract

Using a unique dataset of monthly repurchase data, we investigate the timing of US open market stock repurchases. We find strong evidence that repurchase transactions follow abnormal price declines and precede abnormal price increases. Moreover, average repurchase prices are lower than comparable average market prices, and the cost of a firm's repurchases is below benchmark costs of the same repurchases. We show that a firm's ownership structure is a crucial determinant of its tendency to repurchase stock at comparatively low prices (i.e. to time repurchases). As insider ownership increases, a firm's ability to time repurchases decreases. Also, at low levels of institutional ownership, there is a positive relation between this variable and a firm's tendency to time repurchases; this relation becomes negative when institutional ownership is high.

JEL Classifications: G14, G35.

[*] *Corresponding author:* Amedeo De Cesari, Assistant Professor in Finance, Finance, Accounting, and Law Group, Aston Business School, Aston University, Aston Triangle, Birmingham B4 7ET, the United Kingdom; Tel.: +44 (0) 121 2043028; email: a.decesari@aston.ac.uk.

1. Introduction

There are two main objectives in this paper. The first objective is to analyze whether repurchasing firms time the market by executing open market repurchases (OMRs) at relatively low prices. The second objective is to investigate whether a firm's ability and propensity to time repurchases is a function of its ownership structure and, in particular, of two ownership variables: insider ownership and institutional ownership.

We argue that these ownership variables are crucial determinants of a firm's tendency to time the market when repurchasing stock. By repurchases own stock at "cheap" prices, a firm increases its value. As insider ownership rises, the objectives of a firm's insiders become more and more aligned with the objectives of the firm's shareholders who want to maximize firm value (Jensen and Meckling, 1976). Hence, the "incentive alignment effect" of insider ownership may boost a firm's propensity to time repurchases. Moreover, institutional investors are often regarded as active monitors that strive to maximize the value of the firms they invest in. The "monitoring effect" of institutional ownership may, therefore, provide an incentive to executives to repurchase own stock at comparatively low prices. From a different point of view, firms should find it hard to time repurchases when the counterparties in the repurchase transactions are informed investors. Both insiders and institutions are normally considered well-informed investors. Hence, there may be an "information effect" of insider and institutional ownership that limits a firm's ability to time the market when making OMRs.

In the U.S.A., there is limited empirical research on the topics of this paper, probably owing to the historical lack of in depth data on repurchase transactions. Until very recently, there were no regulations forcing firms to disclose detailed data on repurchases. Following the introduction of a new SEC disclosure requirement on 17 December 2003,[1] it is now compulsory for US listed firms to report monthly volume and price data on their repurchase activity in their quarterly filings (10-Ks and 10-Qs). We take advantage of this recent regulatory change and create two unique datasets of observations on the monthly OMR activity of a sample of US firms. More specifically, we hand-collect one dataset of monthly OMR volume data (265 US firms and 5,035 firm-months) and one dataset of monthly OMR

[1] Purchases of Certain Equity Securities by Issuers and Others, Exchange Act Release No. 33-8335, available at http://www.sec.gov/rules/final/33-8335.htm.

price data (214 firms and 4,066 firm-months) from quarterly filings (10-Ks and 10-Qs). Both datasets are for the period between February 2004 and July 2006. The firms in the sample are listed in NYSE, NASDAQ, and AMEX.

We use these two datasets to test whether firms time the market by repurchasing stock at comparatively low prices. We find that the repurchase volume in the current month is negatively related to the market-adjusted returns in the previous months and positively related to the market-adjusted returns in the following months. Similarly, periods preceding months with repurchase activity are characterized by negative abnormal returns calculated using standard risk factors. Periods following months with repurchase activity are characterized by positive abnormal returns. Moreover, the average price paid by firms to repurchase is significantly lower than benchmark prices based on average market prices. Finally, the average total cost of a firm's repurchases is significantly below benchmark total costs of the firm's repurchases. On the whole, we find very strong evidence that firms time the market when repurchasing stock on the open market.

We also conduct a regression analysis to investigate the relation between ownership structure, i.e. insider and institutional ownership, and the timing of OMRs. As dependent variables, we use several novel "timing measures" that are functions of the differences, in relative terms, between the actual cost of repurchases and several benchmark costs of repurchases based on market price and volume data. To interpret our findings, it is very important to bear in mind that an increase (a decrease) in a firm's tendency to time repurchases results in a *decrease* (an *increase*) in the firm's timing measures. In the first stage of the analysis, we study insider ownership and institutional ownership separately and never include the two variables together in the same regressions. We find quadratic u-shaped relations between both insider and institutional ownership (x-axis variables) and the timing measures (y-axis variable). This finding implies that (1) a firm's tendency to time repurchases is positively related to insider ownership (institutional ownership) at low levels of insider ownership (institutional ownership), (2) a firm's tendency to time repurchases is negatively related to insider ownership (institutional ownership) at high levels of insider ownership (institutional ownership). The above findings for institutional ownership are not affected if in the regressions we include both insider and institutional ownership. In contrast, those for insider ownership vary substantially in that the u-shaped relation

between this variable and the timing measures disappears. This relation becomes monotonic, and insider ownership appears negatively related to a firm's tendency to time repurchases.

We interpret these findings as evidence that the monitoring effect of institutional ownership on the timing of OMRs is stronger than its information effect at low levels of institutional ownership. When institutional ownership is high, its information effect prevails over its monitoring effect. The sign of the slope of the relation between institutional ownership and the timing measures changes from negative to positive at values of the ownership variable ranging from 38.7% to 56.2%. As for insider ownership, the positive relation of this variable with the timing measures supports the presence of an information effect of insider ownership on a firm's ability to time repurchases.

This study contributes to the existing literature from several points of view. First, to the best of our knowledge, this is the first empirical study in finance research using detailed monthly data on US repurchases taken from 10-Ks and 10-Qs.[2] We expect an increasing number of researchers to publish finance papers based on repurchase data similar to ours in the future. We are confident that this paper, in particular the parts on the technical aspects of the data collection process, will represent a point of reference for these researchers. Second, the existing literature on the timing of repurchases is limited. The literature is particularly scarce in the USA, probably because of the historical lack of detailed data on repurchase transactions. Our study, which uses a novel dataset of monthly repurchase data, represents a significant contribution to an area that is under-researched. Finally, in this study we analyze the influence of a firm's ownership structure on the firms' ability and propensity to time the market when repurchasing stock. To the best of our knowledge, there are no published papers that pursue a similar line of investigation.

In Section 2, we revise the existing literature and outline the testable hypotheses. In Section 3, we describe the data used in this study, with a particular focus on repurchase data. The methodology followed and the empirical findings are presented in Section 4. Finally, Section 5 presents some concluding remarks.

[2] A repurchase dataset similar to ours is used by Simkovic (2009). This law and economics paper analyzes the impact of the new repurchase disclosure regime introduced at the end of 2003 on the completion rates of repurchase programs.

2. Literature review and hypotheses

2.1. The timing of open market repurchases

We expect firms to time the market when making OMRs because firms claim that they repurchase shares when they are undervalued. Brav, Graham, Harvey, and Michaely (2005) find that 86.4% of U.S. firms surveyed state that the current market price of their stock is an important or a very important factor to their repurchase decisions. In other words, 86.4% of firms tend to base their repurchase decision on whether their "stock is a good investment, relative to its true value." Brav, Graham, Harvey, and Michaely (2005) also conduct some follow-up interviews with executives. Around one half of the interviewed executives state that "their firm tracks repurchase timing and that their firm can beat the market". Moreover, in the same interviews executives often say that repurchases are accelerated or initiated when the market price of their stock is low in comparison with recent historical prices.

The quantitative empirical evidence on repurchase timing in the US stock market is limited. Some previous literature focuses on repurchase announcements and presents indirect evidence on firms' tendency to time repurchases. It shows that OMR announcements are greeted by abnormal increases in stock prices (e.g. Vermaelen, 1981; Comment and Jarrel, 1991), and that firms announcing OMR programs experience long-term abnormal increases in stock prices in the post-announcement period (Ikenberry, Lakonishok, and Vermaelen, 1995; Chan, Ikenberry, and Lee, 2007). These findings may indicate that firms tend to start repurchase programs when their stock is undervalued in the market; investors see repurchase announcements as signals of undervaluation, and push stock prices up through their trading on the announcement day and in the following months. This evidence is rather indirect given that actual purchases of own stock do not necessarily follow repurchase announcements. In other words, this evidence does not directly prove that firms effectively repurchase stock when it is undervalued.

There is also some limited US research on actual purchases of own stock on the market offering more direct evidence on repurchase timing. Stephens and Weisbach (1998) find an inverse relation between the number of repurchased shares in a quarter and the abnormal return in the previous quarter. Chan, Ikenberry, and Lee (2007) show that firms experiencing large positive abnormal returns in the

one-year period following a repurchase announcement repurchase less in the same period than firms with small or zero post-announcement abnormal returns; this finding is consistent with the notion that a firm repurchases less when investors, as a result of a repurchase announcement signalling undervaluation, react more quickly and reduce or eliminate the undervaluation of the firm's stock. Cook, Krigman, and Leach (2003) analyze a set of voluntarily disclosed daily repurchase transactions for a sample of 54 firms (NYSE and NASDAQ firms). They find that firms repurchase more after price declines. Cook, Krigman, and Leach (2004) use a similar dataset of voluntarily disclosed daily repurchases for 64 firms (NYSE and NASDAQ firms) and compare the effective cost of a repurchase program with benchmark costs based on naïve repurchase strategies. They show that the repurchase cost is lower than the benchmark costs for NYSE firms.

Outside the USA, Ikenberry, Lakonishok, and Vermaelen (2000) find that in Canada firms are particularly active in repurchasing stock in months following abnormal price declines. For the same country, McNally, Smith, and Barnes (2006) present evidence that daily purchases of own stock are preceded by abnormal price falls and followed by abnormal price increases. Brockman and Chung (2001) analyze a sample of daily repurchase transactions from Hong Kong and show that the actual total cost of a repurchase program is on average lower than the bootstrapped benchmark cost of the same program; in other words, the effective cost of repurchases is lower than a benchmark cost based on a random repurchase strategy. Zhang (2005) also uses a sample of daily repurchases executed in Hong Kong and finds that repurchase transactions follow abnormal declines in prices. Ginglinger and Hamon (2007) present very similar findings for the French stock market.

Overall, the existing empirical evidence supports the notion that firms tend to repurchase stock in the open market at comparatively low prices. On average, firms make OMRs after abnormal price declines and before abnormal price increases. Hence, we can formulate the following hypothesis:

H1: Firms time the market when repurchasing stock in the open market; as a result, they buy own stock at comparatively low prices.

2.2. Insider ownership

Firms can repurchase stock for many different reasons. For instance, companies can repurchase to distribute excess cash (e.g. Dittmar, 2000). Whatever is the reason why OMRs are made, we expect managers that want to maximize the value of their firms to strive to minimize the price at which stock is repurchased. In a seminal paper, Jensen and Meckling (1976) argue that when a firm's managers do not wholly control the firm, i.e. there is a separation of ownership and control, the objectives of the managers diverge from the objectives of the shareholders. In other words, the managers may prefer to maximize their own utility rather than serving their shareholders and maximizing firm value. Jensen and Meckling (1976) also posit that the loss in firm value owing to the conflicts between a firm's managers and a firm's shareholders is particularly large when the managers hold a small shareholding in the firm (i.e. when insider ownership is small). In contrast, this loss is relatively small when the managers hold a large shareholding in the firm (i.e. when insider ownership is large). Based on these arguments, we posit that managers have a "strong" ("weak") incentive to time repurchases and increase firm value when they hold a large (small) fraction of their firms' stock. Our second hypothesis, which reflects the "incentive alignment effect" of insider ownership, can be found below:

H2: All else equal, there is a positive relation between the fraction of a firm's stock owned by its insiders and the firm's tendency to time the market when making OMRs.

Firms can carry out OMRs at comparatively low prices if (1) the market value of their stock is sometimes below its "fair" value, (2) they can identify when their stock is undervalued in the market, (3) they can repurchase own stock from shareholders that are less informed and, for this reason, do not share their ability to identify when their stock is undervalued. With reference to points (1) and (2), undisclosed inside information is not impounded in stock prices and can be used by firms to determine when their stock is undervalued. Hence, firms should be able to time their repurchases. Regarding point (3), it is likely that most or all of a firm's outside shareholders, who do not directly take part in the management of the firm, are less informed than the insiders that preside over the execution of

OMR programs.[3] Hence, firms can easily exploit their informational advantage over outside shareholders when buying back stock from them. In contrast, shareholders that are also insiders possess information that is very similar to the information on which the firm trade when buying back stock. For this reason, firms should find it very hard to repurchase stock at comparatively low prices when trading against insiders. Following the arguments above, we posit that a firm's ability to time the market when repurchasing stock should be dependent on the fraction of the firm's stock controlled by insiders. We put forward the following hypothesis that is linked to the "information effect" of insider ownership:

H3: All else equal, there is a negative relation between the fraction of a firm's stock owned by its insiders and the firm's tendency to time the market when making OMRs.

H2 and H3 predict relations of opposite signs between a firm's insider ownership and its tendency to time OMRs. In principle, we cannot rule out the possibility that both hypotheses are valid and that both incentive alignment and information effects characterize the relation between insider ownership and repurchase timing. In this scenario, the relation between insider ownership and the timing of OMRs may be non-monotonic and quadratic. For example, H2 could dominate H3 (i.e. there is a positive relation between insider ownership and timing) when insider ownership is low and H3 could dominate H2 (i.e. there is a negative relation between insider ownership and timing) when insider ownership is high. In this scenario, there would be an inverted U-shaped relation between insider ownership (x-axis variable) and a firm's tendency to time the market when repurchasing stock (y-axis variable). We formulate the following hypothesis:

[3] It is not necessarily true that insiders are always better informed than any outside investor. For instance, outside shareholders may accumulate private information by analyzing public information through sophisticated and uncommon methods of investment analysis. By doing so, they may become better informed than insiders. Nevertheless, the existing empirical evidence shows that insiders trade on information that is not already reflected in market prices (e.g., Seyhun, 1986; Lakonishok and Lee, 2001; Ke, Huddart, and Petroni, 2003; Piotroski and Roulstone, 2005). This evidence confirms the widely-accepted notion that insiders normally possess information that outside investors do not have.

H4: All else equal, there is a non-monotonic quadratic relation between the fraction of a firm's stock owned by its insiders and the firm's tendency to time the market when making OMRs.

2.3. Institutional ownership

Institutional investors are fiduciaries who are specialized in the investment of funds belonging to other investors. Hence, institutions are highly specialized investors. Based on this notion, it is often assumed that institutions are knowledgeable and sophisticated investors that are capable, more than individual investors, of monitoring the activities of the firms in which they invest in order to boost their value and performance. Monitoring is a costly activity. The monitoring of a firm's activities requires the collection of information on the firm and actions through which the decisions of the firm's management are influenced. Drawing upon previous literature, Chen, Harford and Li (2007) suggest that institutions face a cost-benefit analysis when deciding whether it is worth monitoring. After analysing both the costs and the benefits of monitoring, they posit that institutions that are likely to monitor are large, independent from the firm they monitor, and with a long-term investment in the firm. Chen, Harford, and Li (2007) point out that the alternative to monitoring is trading, i.e. purchasing and selling securities without attempting to influence a firm's management.

We argue that trading by institutions may also affect a firm's activities and increase their value and performance. Non-monitoring institutional investors, who are dissatisfied with the way in which a firm is managed, can "vote with their feet" and sell their holdings in the firm. Sales by institutional investors may be feared by the firm's management because they may signal the firm's weaknesses to the market and exercise downward pressure on the price of the firm's stock (Parrino, Sias, and Starks, 2003). In other words, executives may strive to manage their firms in a satisfactory manner in order to avoid the penalties of institutional investors' sales.

Previous US empirical evidence confirms the notion that there is a positive relation between institutional ownership and firm value or performance. McConnell and Servaes (1990), Clay (2002), and Gugler, Mueller, and Yurtoglu (2008) find that an increase in the aggregate holding of

institutional investors leads to an increase in firm value.[4] Cornet, Marcus, Saunders, and Tehranian (2007) and Cornet, Marcus, and Tehranian (2008) provide evidence that both the fraction of a firm's stock held by institutional investors and the number of institutional investors are positively related to the firm's operating performance.

As discussed in Section 2.2., repurchasing firms can increase firm value by repurchasing stock at relatively low prices. Hence, it is possible that the presence of institutional investors provides an incentive to firms to time the market when repurchasing stock. We put forward the following hypothesis which reflects the "monitoring effect" of institutional ownership:

H5: All else equal, there is a positive relation between the fraction of a firm's stock owned by institutional investors and the firm's tendency to time the market when making OMRs.

Since institutional investors are professional investors, it is commonly argued that they are better informed than outside individual investors. There is a substantial and growing body of empirical research supporting the notion that institutions are well-informed investors who convey private information to the market through their trading activities.[5] For instance, Chen, Jegadeesh, and Wermers (2000) show that stocks that have been recently bought by mutual funds outperform stocks that have been recently sold by mutual funds. Sias, Starks, and Titman (2006) document a permanent effect of institutional trading on stock prices owing to the information conveyed by institutional trading. Yan and Zhang (2007) find that trades by institutions with short term investment horizons predict future stock returns and earnings. Piotroski and Roulstone (2004) show that trades by institutions facilitate the incorporation of the firm-specific component of future earnings into stock prices. Similarly, Ali, Durtschi, Lev, and Trobmley (2004) find that changes in institutional ownership in one quarter are positively related to the abnormal returns recorded when quarterly earnings are announced in the following periods. This evidence supports the notion that institutions have private

[4] In contrast, Agrawal and Knoeber (1996) present a statistically insignificant relation between institutional ownership and firm value.
[5] The existing literature in the area is particularly large. In this section, we do not aim to thoroughly review this literature. We primarily focus on some recent research papers that we consider of particular interest.

information on future earnings surprises and that they trade on this information. Finally, Boehmer and Kelley (2007) analyze the relation between informational efficiency and institutional ownership. They document that prices of stocks with greater institutional ownership more closely follow a random walk process.

Given a certain level of insider ownership, firms should find it easier to repurchase stock at comparatively low prices when most of the outside shareholders are poorly informed individual investors rather than well-informed institutional investors. Based on this argument, we formulate the following hypothesis which is linked to the "information effect" of institutional ownership:

H6: All else equal, there is a negative relation between the fraction of a firm's stock owned by institutional investors and the firm's tendency to time the market when making OMRs.

It is also possible that both H5 and H6 are valid hypotheses and that the relation between institutional ownership and the timing of OMRs is non-monotonic and quadratic. For instance, H5 could dominate H6 (i.e. there is a positive relation between institutional ownership and timing) when institutional ownership is low and H6 could dominate H5 (i.e. there is a negative relation between institutional ownership and timing) when institutional ownership is high. We put forward the following hypothesis:

H7: All else equal, there is a non-monotonic quadratic relation between the fraction of a firm's stock owned by institutional investors and the firm's tendency to time the market when making OMRs.

3. Data

3.1. Disclosure of monthly repurchase volume and monthly repurchase price data

In this study, we analyze the monthly repurchase activity of US firms on the open market to investigate whether companies time OMRs. In our analyses, we use hand-collected monthly volume and price data on OMRs carried out by a sample of US listed companies in the period between

February 2004 and July 2006. Data are gathered from quarterly SEC filings (10-Ks and 10-Qs). Our sample period starts at the beginning of 2004 because until December 2003 there was no regulation requiring US companies to disclose detailed information on monthly repurchase activity.

On 17 December 2003, a new SEC disclosure requirement took effect.[6] Based on the new rule, companies must include a table in their quarterly filings (10-Ks and 10-Qs) providing, for the quarter, the following information on a monthly basis: total number of shares repurchased (monthly repurchase volume), the average price paid per share (monthly repurchase price), the total number of shares repurchased as part of publicly announced repurchase programs, and the maximum number (or approximate dollar value) of shares that may still be purchased under existing repurchase programs. Moreover, in the footnotes to the table companies must provide information on repurchase programs that expire or are suspended over the period the table refers to. Finally, if there are repurchases that are not carried out as part of publicly announced repurchase programs, additional footnotes should be included disclosing the amount of shares repurchased outside publicly announced programs and the nature of the repurchase transactions. For example, the footnotes should specify the number of shares that are repurchased on the open market, through privately negotiated transactions (PNTs), or through self-tender offers (fixed-price or Dutch-auction self-tender offers).

We hand-collect data on OMRs from 10-Ks and 10-Qs, which are freely available from Edgar. In particular, we gather two datasets: one with monthly repurchase volume data and a smaller one with monthly repurchase price data. The datasets are described in the two following sections.

3.2. Repurchase volume dataset

We first identify US listed companies that potentially executed OMRs on their common stock in the sample period ranging from January 2004 to December 2004. We use the SDC Platinum Database of Mergers and Acquisitions to search for announcements of OMR programs of US listed companies (listed on NYSE, NASDAQ or AMEX) in the period between 1 January 2004 and 31 December 2004. We find 442 companies with announced repurchase programs.

[6] Purchases of Certain Equity Securities by Issuers and Others, Exchange Act Release No. 33-8335, available at http://www.sec.gov/rules/final/33-8335.htm.

One of the main objectives of this study is to analyze firms' propensity and ability to time the market when executing OMRs. We believe that the best way to study the timing of repurchases is to investigate a company's repurchasing strategy over a period in which it always has the right to repurchase and actually repurchases some shares in at least one of the sub-periods. In particular, we analyze a firm's repurchase timing in the 19 months following the month of the announcement of the firm's repurchase program (post-announcement period).[7]

For each of the 442 companies that announced repurchase programs, we collect monthly volume (total number of shares repurchased) data for the overall OMR activity in the 19-month post-announcement period from 10-Ks and 10-Qs.[8] We purge the monthly repurchase volume data by eliminating repurchase transactions that are not carried out on the open market. In particular, we eliminate repurchases executed through self-tender offers, off-market privately negotiated transactions (PNTs), accelerated share repurchases (ASR), and structured share repurchases (SSR).[9, 10] Most of the PNTs are repurchases from directors and employees to cover tax withholding obligations on exercises of stock options and vesting of restricted shares.[11] We take particular care to identify the volume of non-OMRs searching through 10-Ks and 10-Qs. The new SEC rule on repurchase disclosure requires companies to specify in their filings the nature of repurchases that are not carried out under publicly

[7] In several cases, companies split their quarters into three reporting periods that are very similar to calendar months but that do not exactly correspond to them. In these circumstances, reporting periods start a few days after or before the start of a calendar month and end a few days after or before the end of a calendar month. In this paper, we use the terms "firm-month", "monthly period", "calendar month", and similar terms even when we refer to periods that do not exactly correspond to calendar months. For example, a company's reporting period stretching from March 28, 2004 to April 28, 2004 is referred to as the calendar month April 2004.

[8] By "overall OMR activity", we refer both to OMRs part of the announced repurchase programs that we find on SDC Platinum and to OMRs related to other programs and/or executed outside publicly announced programs.

[9] In an ASR contract, the repurchasing firm purchases own shares from an investment bank. The investment bank sells the shares short to the company and receives an up-front payment in cash. In subsequent periods and until the end of the ASR contract, the investment bank purchases the shares of the company in the market to close its short position. The up-front payment originally made by the company is adjusted either upward or downward in relation to the average price paid by the bank to purchase the shares. Cook and Kim (2006) provide more details on an ASR.

[10] At the start of a SSR contract, there is an up-front payment from the company to the investment bank that is based on a set initial price of the shares. In return, the investment bank promises to deliver a certain amount of shares to the company at the end of the contract. The delivery is contingent on the average price of the stock over the contract period. When the contract expires, the company receives the up-front payment plus a premium if the average price over the life of the contract is higher than the initial price. Otherwise, the company receives the physical delivery of the shares. Cook and Kim (2006) present more details on a SSR.

[11] Directors and employees may be liable to pay taxes when they exercise stock options on their firms' stock. Also, they may be required to pay taxes when their restricted shares vest. In both cases, taxes are paid on their behalf by their firms to the taxation authorities. In return for these payments, the firms may receive own stock from their directors and employees.

announced repurchase programs. Unfortunately, the rule does not explicitly state that companies should disclose the nature of the repurchase transactions that are part of publicly announced programs. Hence, we cannot rule out the possibility that some transactions that we classify as OMRs are, in reality, non-OMRs.

Nevertheless, we are confident that a very large majority of the transactions included in our dataset are OMRs for the following reasons. First, Regulation FD, introduced by the SEC on 23 October 2000,[12] requires companies to disclose material non-public information to investors when the information has already been disclosed to a selected group of investors. By not disclosing the terms of executed ASRs, SSRs, and PNTs, companies would violate this rule given that these terms are arguably material (e.g. the price at which the company is willing to repurchase own stock conveys information to the market) and are known to the counterparties in the repurchase transactions. Second, it is very unlikely that the exact nature of large repurchase transactions is not disclosed in quarterly filings that are designed to inform investors. Self-tender offers, ASRs, and SSRs are normally very large and, for this reason, we are quite confident that information on these repurchase programs is normally provided in 10-Ks and 10-Qs. Likewise, it is likely that large PNTs are disclosed.

In collecting repurchase volume data, we exclude observations from the initial dataset of 442 companies for the following reasons. We exclude 60 companies because their filings cannot be found and/or do not provide sufficiently detailed information on OMRs. We exclude 6 companies with 13 sub-periods in their fiscal years instead of the standard 12 monthly periods. We also exclude 25 observations without any OMRs in the post-announcement period, and 82 companies whose repurchase authorization expires or whose repurchase activity is completed, discontinued, or suspended during the post-announcement period. Finally, we exclude 3 companies because the information presented in their 10-Ks and 10-Qs does not allow us to purge data from non-OMRs transactions. The final dataset of "clean" monthly volume data includes 265 companies and 5,035 firm-months.

[12] Selective Disclosure and Insider Trading, Exchange Act Release No. 33-7881, available at http://www.sec.gov/rules/final/33-7881.htm.

3.3. Repurchase price dataset

For each of the 265 companies with "clean" repurchase volume data, we collect monthly price (average price paid to repurchase shares) data for the 19-month post-announcement period from 10-Ks and 10-Qs. We exclude all the companies for which we cannot purge price data and eliminate the contaminating effects of non-OMRs owing to the lack of information in quarterly filings.[13] As a result, we exclude a total of 51 companies. The final sample with "clean" monthly repurchase price data comprises 214 companies and 4,066 firm-months.

3.4. Other data

We hand-collect data on insider ownership from firms' proxy statements. These statements report a figure for the fraction of a firm's outstanding shares owned by all of its officers and directors that comprise "contingent shares". These are firm's shares that officers and directors can acquire within 60 days of the proxy statement date through the exercise of stock options, warrants, and other similar rights. We take great care in identifying the number of contingent shares searching through the footnotes to the tables in the proxy statements. We adjust the reported figures on the aggregate ownership stake of officers and directors to eliminate the impact of contingent shares. As a result, the insider ownership data used in this study is net of contingent shares. We collect institutional ownership data from Thomson Financial 13F institutional database. This database contains information from 13F filings and, therefore, does not report equity holdings of institutions that are not required to file 13F forms. We download daily data on stock return, stock price, trading volume, number of shares outstanding, return on the S&P's Composite Index, return on the value-weighted market index (comprising NYSE, NASDAQ, and AMEX firms), and return on the equally-weighted market index (comprising NYSE, NASDAQ, and AMEX firms) from the Center for Research in Security Prices

[13] Filings normally provide less information that can be used to purge price data than to purge volume data. Non-OMRs are very often executed outside publicly announced programs. Following the introduction of the new SEC disclosure rule in December 2003, firms are obliged to disclose the exact nature of repurchases that are not part of publicly announced programs in the footnotes to the "repurchase table" in 10-Ks and 10-Qs. For example, they need to specify whether repurchases are executed on the open market or through PNTs. In the same footnotes to the "repurchase table", firms must disclose repurchase volume data for repurchases made outside publicly announced programs. In contrast, firms are not required to provide price data for these repurchases. For this reason, it is generally harder to collect "clean" repurchase price data than to gather "clean" repurchase volume data.

(CRSP). We use CRSP also to collect information on the market where a firm is listed and on the firm's SIC code. From the same database, we collect daily data on Fama and French's (1993) three factors and Carhart's (1997) momentum factor. In some empirical analyses, we use repurchase price and volume data from 10-Ks and 10-Qs that are adjusted for stock splits, reverse splits, stock dividends, spin-offs, and similar events. To carry out the adjustments, we retrieve the information needed from 10-Ks, 10-Qs, and CRSP. Similarly, we sometimes use adjusted daily price and trading volume data from CRSP. Finally, we collect accounting data from Compustat.

3.5. Descriptive statistics for the repurchase volume dataset

In this section, we provide some descriptive statistics for the larger repurchase dataset with "clean" volume data. In this dataset, there are 265 companies and 5,035 monthly observations. 2,939 of these observations are repurchase firm-months, i.e. firm-months in which the volume of repurchase shares is larger than zero. The remaining 2,096 observations are non-repurchase firm-months.

Table 1 contains the distribution of the number of firm-months by calendar month for the overall sample of 5,035 observations and for both sub-samples of repurchase and non-repurchase firm-months. Frequencies are especially large in the central part of the sample, between January 2005 and August 2005. In the first few calendar months (between February 2004 and December 2004), the percent frequencies of the sub-sample of repurchase firm-months are in most cases larger than those of the sub-sample of non-repurchase firm-months.

The structure of Table 2 is similar to that of Table 1, but in Table 2 we report the distributions of firm-months by event month. Event month 0 is the month of the announcement of a repurchase program, and event month +1 is the subsequent month. Event month +19 is the 19^{th} month after the month of an announcement. On the whole, the percent frequency distributions for the two sub-samples of repurchase and non-repurchase firm-months are quite similar. The only noticeable difference is that in event month +1 the percent frequency of firm-months with repurchases is much larger than the percent frequency for non-repurchase firm-months.

Since our sample comprises only 265 companies, we want to verify how representative of the whole universe of US listed companies this sample is. We compare some characteristics of the

companies in our sample with the same characteristics of the overall set of US companies with listed common stock (listed on NYSE, NASDAQ, and AMEX) that can be found in CRSP. At the end of April 2005 (the mid-point of the sample period), we find 4,795 US companies in CRSP. The mean and the median market values (price times number of outstanding shares) for the universe of CRSP companies are $2,823,578,000 and $275,933,100 respectively at the end of April 2005. On the same date, the mean and the median market values of the companies in our sample are $10,736,415,100 and $1,296,104,800 respectively. This shows that the companies in our sample are relatively large. At the end of April 2005, 59% of the companies in CRSP are listed on NASDAQ, 31% on NYSE, and 10% on AMEX. In our sample, 49% of the companies are listed on NASDAQ, 48% on NYSE, and 3% on AMEX.[14] Hence, NYSE is over-represented and NASDAQ and AMEX are under-represented in our dataset. In terms of industries where CRSP companies operate, 39% of the companies are in the manufacturing industry (sic codes 2011-3999), 20% in the financial sector (sic codes 6011-6799), and 19% in the services sector (sic codes 7011-8999). The remaining industries account for 22%. In our sample, 37% of the companies operate in the manufacturing industry, 28% in the financial sector, and 18% in the services sector. Hence, financial companies are over-represented in our dataset.

4. Empirical methods and findings

4.1. The timing of open market repurchases

4.1.1. Repurchase volume and market-adjusted returns

We analyze the relation between the magnitude of repurchase activity in one month and abnormal (market-adjusted) returns in the current month, in the previous months, and in the following months. In this section, the abnormal return is defined as the difference between the return on the stock of a repurchasing firm minus the return on a market index. Repurchasing companies that time the market should tend to execute repurchases after abnormal price falls and before abnormal price increases. In particular, if firms timed repurchases, we would expect the following findings. First, all else equal, months with a large repurchase volume are, on average, preceded by months with more negative or

[14] In computing these percentages, we discard 3 companies from the sample of 265 companies because they change exchange over the sample period.

less positive market-adjusted returns. Second, all else equal, months with a large repurchase volume are, on average, followed by months with more positive or less negative market-adjusted returns.

We run a series of regressions using the dataset of "clean" repurchase volume data, comprising 265 firms and 5,035 firm-months. In the regressions, the dependent variable is REP. For each-firm month, this variable is the number of shares repurchased over the firm's number of shares outstanding at the beginning of the month. Since REP is censored at zero, we use a Tobit methodology to estimate our regressions. In the overall sample of 5,035 firm-months, the mean of REP is 0.37%, its median is 0.08%, its maximum value is 15.95% (3.4% is the value of the 99th percentile), and its minimum value is 0.

The explanatory variable MAR 0 is always included among the independent variables of our regressions. For each firm-month, MAR 0 is the market-adjusted return, which is the return on the firm's stock in the month minus the return on a market index for the same month. Some of the regressions include the explanatory variables MAR -1 and MAR +1. MAR -1 is the market-adjusted return for the month preceding the current month. MAR +1 is the market-adjusted return for the month following the current month. Some specifications, instead of MAR -1 and MAR +1, include the independent variables MAR -1 TO -2 and MAR +1 TO +2. MAR -1 TO -2 is the market-adjusted return for the two months preceding the current month. MAR +1 TO +2 is the market-adjusted return for the two months following the current month. To compute the variables MAR 0, MAR -1, MAR +1, MAR -1 TO -2, and MAR +1 TO +2 we use return data for three different market indices: the S&P's Composite Index, the CRSP's value-weighted market index (comprising NYSE, NASDAQ, and AMEX firms), and the CRSP's equally-weighted market index (comprising NYSE, NASDAQ, and AMEX firms). Because of the inclusion of lags and leads of market-adjusted returns among our explanatory variables, some observations drop out from the original sample of 5,035 firm-months and are not used in the Tobit regressions.

Table 3 reports the estimates of six Tobit regressions. In particular, there are two different specifications for each of the three market indices used. Results are not qualitatively different across the three market indices. The coefficients on both MAR -1 and MAR -1 TO -2 are negative and statistically significant at a 1% level. This indicates that there is a negative relation between the

market-adjusted returns in past months and the magnitude of repurchase activity in the current month. The coefficients on MAR +1 are negative but statistically insignificant. Hence, no conclusions can be drawn. By contrast, those on MAR +1 TO +2 are positive and significant at a 10% level. These findings show that there is a positive relation between the market-adjusted returns in future months and the magnitude of repurchase activity in current months. On the whole, the evidence on the variables MAR -1, MAR -1 TO -2, and MAR +1 TO +2 indicates that repurchasing companies time their stock repurchases. Companies are more likely to repurchase after abnormal price declines than after abnormal price increases. Also, a company's repurchase activity is likely to be followed by abnormal increases in stock price. Based on this evidence, we conclude that H1 cannot be rejected.

The coefficient on MAR 0 is negative and statistically significant at a 1% level. This finding indicates that there is a negative relation between the market-adjusted returns in the current month and the magnitude of repurchase activity in the same month. Firms seem to choose months with abnormal price declines to buy back stock. We speculate that firms time repurchases by buying back stock near to the end of months with abnormal price declines. Unfortunately, data on U.S. repurchases are not available to formally test our speculation.

4.1.2. Event study analysis

We run an event study to analyze the abnormal returns of a firm's stock in months in which the firm repurchases shares, in months that precede share repurchases by the firm, and in months that follow them. If firms timed their repurchases, we would expect repurchase transactions to take place in months that follow negative abnormal returns and precede positive abnormal returns. In other words, we would expect companies to repurchase their own stock from the market when it is under-priced.

We run a series of ordinary least squares (OLS) regressions on the repurchase volume dataset containing 5,035 firm-months. The dependent variable is a stock's risk premium, i.e. the return on a stock (R) in excess of the risk-free rate of return (Rf). For stock *i* and month *t*, the dependent variable is computed as the average daily return on stock *i* in month *t* minus the average daily risk-free return in the same month.

As explanatory variables in the regressions, we include Fama and French's (1993) three factors and Carhart's (1997) momentum factor. In particular, we use average daily values of the factors.[15] In the estimated models, the Fama and French's factors are represented by the variables Rm-Rf, SMB, and HML. Rm-Rf is the average daily return on the market portfolio (average daily value-weighted market return) minus the average daily risk-free return. SMB is the average daily difference between the return on a portfolio of small stocks and the return on a portfolio of large stocks. HML is the average daily difference between the return on a portfolio of stocks with high book-to-market ratios and the return on a portfolio of stocks with low book-to-market ratios. The Carhart's momentum factor is the variable UMD, which is the average daily difference between the return on a portfolio of stocks with high past returns and the return on a portfolio of stocks with low past returns.

Among the explanatory variables we also include a series of dummy variables whose values are dependent on the timing of repurchase transactions. MONTH 0 is a dummy that equals one for firm-months with a positive volume of share repurchases. MONTH -1 (MONTH +1) is a dummy that is set to one if in the next (previous) monthly period some repurchase transactions take place. MONTHS -1 TO -2 (MONTHS +1 TO +2) is a dummy that is equal to one if in at least one of the next (previous) two monthly periods some repurchases are carried out. As a result of the inclusion of the dummies above, some observations drop out from the original sample of 5,035 firm-months and are not used in the OLS regressions.

The firm-month observations in our dataset are highly clustered over time since the sample period (February 2004 – July 2006) is quite short. Time-clustering can potentially induce cross-correlation in the observations which, in turn, can result in biases in the standard errors and *t-statistics* on the OLS estimates. In our OLS regressions, we adjust the *t-statistics* on the OLS estimates by taking into account the cross-correlation across errors of observations from the same calendar month (*Stata* option *cluster*).

[15] In 10-Ks and 10-Qs, the starting and ending dates of the three reporting periods in a quarterly reporting period do not always correspond to the starting and ending dates of calendar months. Hence, we cannot use monthly data provided by CRSP for stock returns, risk-free return, Fama and French factors, and momentum factor. Instead of monthly data, we use averages of daily data for days between actual starting and ending dates of reporting periods.

Table 4 presents the estimates of four specifications of the OLS regression. Some of the specifications comprise both the Fama and French's (1993) factors and the Carhart's (1997) momentum factor among the explanatory variables, whereas some specifications do not consider the momentum factor. Also, the set of explanatory variables of a regression either comprise the dummies MONTH -1 and MONTH +1 or the dummies MONTHS -1 TO -2 and MONTHS +1 TO +2.

Across the four regressions, the coefficients on the variables MONTH -1 and MONTHS -1 TO -2 are negative and statistically significant at a 1% level. This finding indicates that periods with repurchases tend to be preceded by periods with negative abnormal returns. The coefficients on the variables MONTH +1 and MONTHS +1 TO +2 are positive and statistically significant at least at a 5% level. This result shows that repurchases take place in months that are followed by periods with positive abnormal returns. On the whole, companies appear to time their repurchases by purchasing their own stock after abnormal price declines and before abnormal price increases. The evidence presented in this section supports H1.

Since the coefficient on the dummy MONTH 0 is negative and statistically significant at a 1% level, we conclude that repurchases are carried out in periods characterised by negative abnormal returns. This finding could indicate that companies time their repurchases by carrying them out at the end of months with abnormal price declines. Unfortunately, the data available do not allow us to test this hypothesis.

The coefficients on Rm-Rf and SMB are positive and statistically significant at standard levels, whereas that on HML is not significant. The coefficient on UMD is negative and either marginally statistically significant or insignificant at a 10% level. An interesting finding is that the coefficient on the constant is positive and statistically significant at least at a 5% level. Hence, there is a residual positive abnormal return that cannot be explained by risk factors and repurchase activity. Since our sample comprises firm-months for periods following announcements of repurchase programs, the positive coefficient on the constant confirms previous evidence on the existence of long-term post announcement positive abnormal returns (e.g., Ikenberry, Lakonishock, and Vermaelen (1995); Ikenberry, Lakonishock, and Vermaelen (2000)).

4.1.3. Cost of actual repurchases vs. cost of benchmark repurchases

In this section, we compare the price at which a firm executes repurchases in the market in a particular month with a benchmark that is given by the average price of the firm's stock in the same month. If firms timed their repurchases, we would expect the repurchase price to be lower than the benchmark price. Additionally, we analyze whether the total cost of a firm's repurchases over a 19-month period is on average lower or higher than the benchmark cost of the same amount of repurchases based on the average price of the firm's stock in the same period. For a monthly period, the cost of repurchases is given by the repurchase volume times the average repurchase price. Firms that time their repurchases are expected to execute them at a cost that is lower than the corresponding benchmark cost.

The empirical analyses of this section are carried out on data that is adjusted to eliminate the contaminating effects of stock splits, reverse splits, stock dividends, spin-offs, and similar transactions that artificially modify price and trading volume. Both repurchase data (volume and price) from 10-Ks and 10-Qs and market data (stock price and volume) are adjusted.[16]

4.1.3.1. Monthly average repurchase price vs. monthly average daily market closing price

We consider the sample of 4,066 firm-month observations with "clean" repurchase price. On a monthly basis, we compare the average price at which a firm repurchases stock with a benchmark given by the average closing price of the stock in the market. We analyze whether in months with repurchases firms buy back stock at low prices. Hence, we investigate what we define as "within-month" timing, which is the ability to buy back at relatively low prices within a particular month. For each of the 2,316 firm-months with repurchase activity, we compute the average daily closing price of the stock of the firm. This average is computed both as simple un-weighted average and as volume-weighted average. In this second case, the price in each trading day is weighted by the corresponding daily trading volume over the total monthly trading volume. For each firm-month, we use the average repurchase price and the average daily closing price to calculate the variable %PRICE, which is the

[16] In order to adjust repurchase price and volume data, we use information on stock splits, reverse splits, stock dividends, spin-offs, and similar transactions from 10-Ks, 10-Qs, and CRSP. Market data are adjusted based on information from CRSP.

percent difference between these two prices. More specifically, %PRICE, which is expressed as a percentage, is the repurchase price over the average closing price, minus one. There are two versions of the variable: one based on the simple average closing price (%PRICES) and one on the volume-weighted average closing price (%PRICEW).

For the variables %PRICES and %PRICEW, Panel A of Table 5 presents descriptive statistics and univariate tests on mean and median values. The maximum value of %PRICES (%PRICEW) is 21.543% (18.875%) and the minimum value of the variable is -21.624% (-23.199%). Both the mean (-0.619%) and the median (-0.207%) of the variable %PRICES are negative and statistically significant at a 1% level. This result indicates that, on average, repurchasing firms carry out repurchases on the market at a price that is 0.619% lower that the average closing price. Findings for the variable %PRICEW are very similar. Both its mean (-0.513%) and its median (-0.147%) are negative and statistically significant at a 1% level. Based on this evidence, we can conclude that firms time their repurchases and buy back stock on the market at prices that are significantly below average market prices. Hence, we cannot reject H1.

4.1.3.2. Effective cost of repurchases in the post-announcement period vs. benchmark cost of repurchase in the post-announcement period

In the analysis of the previous sub-section, data on repurchase volume is not considered. Also, in creating the benchmark we do not use market price data from firm-months without repurchase activity. In the analysis of this sub-section, we use these two additional sets of data. For each of the 214 firms with "clean" repurchase price data we find the total cost of the repurchases executed over the post-announcement 19-month period. This total cost is the sum of the repurchase costs (repurchase price times repurchase volume) in months with repurchase activity. For example, if a firm repurchases 100,000 shares at an average price of $35 in one month and 150,000 shares at an average price of $37 in another month, the total cost of repurchases is $9,050,000. We compare the effective total cost of repurchases with a benchmark that is the total number of shares repurchased over the post-announcement period times the average daily closing price over the same period. In the previous example, the total number of repurchased shares is 250,000; if the average closing price is $38, the

benchmark total cost of repurchases is $9,500,000. Since our benchmark depends on average market prices both from months with repurchases and months without repurchases, in this sub-section we jointly investigate the presence of "within-month" timing and "between-month" timing, which we define as the ability to choose months with relatively low prices to execute repurchases. For each firm, we create the variable %COST1, which is the percent difference between the effective cost and the benchmark cost of repurchases over the 19-month post-announcement period. In particular, %COST1, which is expressed as a percentage, is the effective total cost of repurchases over the benchmark total cost of repurchases, minus one. In computing the benchmark cost, we either use the un-weighted simple average daily price (%COST1S) or the volume-weighted average daily price (%COST1W).

For the variables %COST1S and %COST1W, descriptive statistics and univariate tests on mean and median values can be found in Panel B of Table 5. The maximum value of %COST1S (%COST1W) is 47.77% (72.413%) and the minimum value of the variable is -47.91% (-50.428%). The mean of %COST1S (-2.77%) is negative and statistically significant at a 1% level. The median of the variable (-1.767%) is also negative and statistically different from zero at the same level of significance. These findings indicate that firms, when repurchasing stock in the post-announcement period, spend less than what they would spend if repurchases were executed at the average market price over the period. Results are not qualitatively different for the variable %COST1W. Both the mean (-2.837%) and the median (-1.235%) of this variable are negative and statistically different from zero at a 1% level. Overall, the evidence above indicates that firms time their repurchases given that the actual cost of repurchases in the post-announcement period is significantly lower than the benchmark cost based on average market prices. Based on the evidence of this section, we conclude that H1 is supported.

4.1.3.3. Estimated cost of repurchases in the post-announcement period vs. benchmark cost of repurchases in the post-announcement period

We use the sample of 265 firms with "clean" repurchase volume data. Given that for some companies we do not have "clean" repurchase price data, instead of relying on effective repurchase prices we rely on estimated repurchase prices to find the total cost of repurchases. For each firm, we

estimate the cost of repurchases in each of the 19 months following the firm's repurchase announcement assuming that repurchases are executed at the average daily closing price of the firm's stock. For example, if in a month a company repurchases 250,000 shares and the average closing price is $15, the estimated cost of repurchases is $3,750,000. We find the total estimated cost of repurchases in the 19-month post-announcement period by cumulating the monthly costs of repurchases. We compare this total estimated cost with a benchmark total cost of repurchases that is the number of shares repurchased in the post-announcement period times the average daily closing price over the period. Since the estimated cost is based on average market prices rather than effective repurchase prices, we do not test for the presence of "within-month" timing. We only investigate the presence of "between-month" timing. For each firm, we calculate the variable %COST2S, which is the percent difference between the estimated cost and the benchmark cost of repurchases over the 19-month post-announcement period. More specifically, %COST2S, which is expressed as a percentage, is the estimated total cost of repurchases over the benchmark total cost of repurchases, minus one. We also create the variable %COST2W that differs from %COST2W in two ways. First, in estimating the cost of repurchases, %COST2S uses un-weighted simple average closing prices whereas %COST2W uses volume-weighted average closing prices. Second, for %COST2S the benchmark cost of repurchases is based on the un-weighted simple average closing price whereas for %COST2W it is based on the volume-weighted average closing price.

For the variables %COST2S and %COST2W, Panel C of Table 5 presents descriptive statistics and univariate tests on mean and median values. The maximum value of %COST2S (%COST2W) is 47.5% (71.889%) and the minimum value of the variable is -47.722% (-50.636%). Both the mean (-2.183%) of and the median (-1.126%) of %COST2S are negative and statistically significant at a 1% level. These results indicate that repurchasing firms buy back stock in months with relatively low prices. Findings are very similar for the variable %COST2W. Its mean (-2.474%) and its median (-0.915%) are negative and statistically different from zero at a 1% level. We can conclude that repurchasing firms time the market given that they execute repurchases in months with average market prices that are significantly lower than those of months without repurchases. Therefore, we cannot reject H1.

4.2. Insider ownership, institutional ownership, and the timing of open market repurchases

In this section, we analyze the relation between three dependent variables that are measures of a firm's tendency to time the market when repurchasing stock and a set of explanatory variables. While we argue that all the explanatory variables that we consider may potentially affect a firm's tendency to time repurchases, we mainly focus on two variables to which, based on previous research, we attribute particular relevance. These variables are insider ownership and institutional ownership.

4.2.1. Dependent variables, independent variables, and methodology

We use three different measures of a firm's tendency to time OMRs (i.e. "timing measures"). The first of these measures is A%PRICEW, which derives from the variable %PRICEW of Section 4.1.3.1. For a particular firm, in order to compute A%PRICEW we need the values of %PRICEW for all the months in which the firm repurchases stock. A%PRICEW is the average value of %PRICEW over these months. The other two timing measures are %COST1W and %COST2W from Sections 4.1.3.2. and 4.1.3.3. An increase (a decrease) in any of the three timing measures reflects a decrease (an increase) in a firm's ability and propensity to time repurchases. We have values for the variables A%PRICEW and %COST1W for a sample of 214 firms and values for the variable %COST2W for a larger sample of 265 firms.

We have also replicated the regression analyses of this section using three alternative timing measures as dependent variables. These measures are %COST1S (from Section 4.1.3.2.), %COST2S (from Section 4.1.3.3.), and A%PRICES, which is the average value of %PRICES (from Section 4.1.3.1.) over months with repurchases. The findings for these alternative dependent variables are not reported for the sake of brevity. Overall, they are qualitatively similar to those for A%PRICEW, %COST1W, and %COST2W. In any case, we consider A%PRICEW, %COST1W, and %COST2W more appropriate timing measures than A%PRICES, %COST1S, and %COST2S because they are built upon benchmark costs of repurchases that also take trading volume information into account.

In the regressions of this section, the main explanatory variables are INSO and INSTO. For a particular firm, INSO is the percentage of the firm's outstanding shares held by all the firm's officers and directors on the last proxy statement date before the start of the 19-month period that follows the

firm's repurchase announcement (post-announcement period). The explanatory variable INSO is included to test the validity of hypotheses H2, H3, and H4. INSTO is the percentage of the firm's outstanding shares held by all institutional investors on the last end-of-quarter date before the initiation of the firm's post-announcement period. The inclusion of INSTO among the explanatory variables is designed to test hypotheses H5, H6, and H7.

The regressions comprise additional controls that may determine a firm's tendency to time the market when repurchasing stock. We describe these additional controls below. SD is a measure of return volatility. In particular, it is the standard deviation of a firm's stock daily return over the post-announcement period. Firms with highly volatile stocks (higher SD) may have more opportunities to repurchase stock at comparatively low prices than firms with more stable stock prices. MV is the natural logarithm of a firm's market capitalization (number of outstanding shares in thousands times stock price) on the last trading day before the start of the post-announcement period. The "fair value" of the stocks of small firms (i.e. firms with small values of MV) is likely to be less precisely known by investors than that of large and well-known firms. Hence, small firms should be more able than large firms to time the market when repurchasing stock.

The variables CASH, CF, and MB are built on market and accounting data belonging to the last fiscal year that does not comprise parts of the post-announcement period. CASH is the value, at year end, of cash and short-term investments (Compustat item 1) scaled by the value, at year end, of total assets (Compustat item 6). CF is the value of operating income before depreciation and amortization (Compustat item 13) scaled by the end-of-year value of total assets. CF is a measure of cash flow. MB is the market-to-book ratio. To be more specific, it is the sum of the end-of-year values of market capitalization (in millions) and total liabilities (Compustat item 181) scaled by the value, at year end, of total assets. Cash-rich firms (with high values of CASH and CF) are financially very flexible and can always find spare cash to repurchase stock whenever their own stock can be bought at a "cheap" price. In contrast, firms with low levels of liquidity (low values of CASH and CF) may sometimes be forced to pass up good trading opportunities in their own stock owing to the lack of cash. On the whole, we expect cash-rich firms to be able to time repurchases more than firms with low levels of liquid resources. MB is a measure of growth opportunities. Firms with a lot of growth opportunities

(high MB) may be more reluctant to use cash to repurchase stock. These firms may prefer to retain high levels of liquid resources to finance future investments. The opposite can be said for firms with few growth opportunities (low MB). Overall, firms with low MB can make repurchases in a more flexible way than firms with high MB. We expect to find an inverse relation between a firm's MB and the firm's tendency to time repurchases.

In every regression, we include a set of industry dummies that are based on the ten main groups of SIC codes. Estimates for the coefficients of these dummies are not reported.

Descriptive statistics for all the explanatory variables are reported in Table 6. Panel A reports descriptive statistics for the sample of 214 firms that is used in the regressions for the dependent variables A%PRICEW and %COST1W. Panel B presents descriptive statistics for the sample of 265 firms that is used when the dependent variable is %COST2W. In Panel A, the mean (median) value of the variable INSO is 9.06% (4.02%). The mean (median) value of the variable INSTO is 64.28% (72.12%). Mean and median values of the variables INSO and INSTO are very similar in Panel B. It is worth noticing that, in both panels, the maximum value of INSTO is larger than 100% and equal to 123.52%. At first sight, this appears very odd given that institutions cannot, all together, own more than 100% of a firm's outstanding shares. Asquith, Pathak, and Rittter (2005) provide a logical explanation to this apparent puzzle. When a stock is sold short, two different institutional investors may formally own the stock at the same time: the investor from which the short seller borrows the stock and the investor to whom the short seller subsequently sells the stock. Short sales can inflate INSTO and push its value above the 100% threshold. Hence, we do not discard observations with a value of INSTO exceeding 100%.[17]

For firm *i*, the baseline multivariate model that we estimate in this section is described by the equation below:

$$\text{Timing measure}_i = \beta_0 + \beta_1 INSO_i + \beta_2 INSO_i^2 + \beta_3 INSTO_i + \beta_4 INSTO_i^2 + \beta_5 SD_i + \beta_6 MV_i + \\ + \beta_7 CASH_i + \beta_8 CF_i + \beta_9 MB_i + \text{Industry dummies}_i + u_i \qquad (1)$$

[17] There are 11 observations in the sample with 214 firms and 12 observations in the sample with 265 firms with values of INSTO exceeding 100%.

"Timing measure" can either be A%PRICEW, %COST1W or %COST2W. *u* is the error term. Among the explanatory variables, we include the squared terms $INSO^2$ and $INSTO^2$ to allow for quadratic relations between the ownership variables and the timing measures and test hypotheses H4 and H7. We adopt Ordinary Least Squares to estimate several versions of baseline regression (1). For instance, in some regressions, we include either INSO (INSTO) or INSO and $INSO^2$ (INSTO and $INSTO^2$) and we exclude INSTO and $INSTO^2$ (INSO and $INSO^2$). In others, we include INSO and INSTO without their squared terms.

4.2.2. Empirical findings

Table 7 contains several estimates of regressions of the three timing measures on either INSO or INSO and $INSO^2$ and on the other explanatory variables except INSTO and $INSTO^2$. When $INSO^2$ is not included as in columns (i), (iii), and (v), the coefficient on INSO is positive but statistically insignificant at standard levels. In contrast, the value of INSO becomes negative and, in most cases statistically significant, if the squared term $INSO^2$ is also comprised among the explanatory variables (columns (ii), (iv), and (vi)). The coefficient on this squared term is always positive and statistically significant at standard levels. The adjusted R-squared of the regressions with both INSO and $INSO^2$ are significantly larger than those with only INSO. On the whole, the findings of Table 6 support H4: there is a quadratic relation between insider ownership and a firm's tendency to time the market when repurchasing stock. This conclusion implies that over a certain range of values, an increase in insider ownership provides an incentive to managers to time repurchases; this "incentive alignment effect" is stronger than the "information effect" that is caused by the presence of well-informed inside shareholders in the market. Over another range of values, the information effect of insider ownership prevails over its incentive alignment effect, and an increase in insider ownership results in a fall in a firm's tendency to time repurchases. To be more specific, when INSO is low, an increase in this variable leads to a reduction in the timing measures (i.e. to an increase in a firm's tendency to time repurchases). When INSO is high, an increase in this variable leads to an increase in our three timing measures (i.e. to a decrease in a firm's tendency to time repurchases). Based on the estimates of column (ii), the slope of the relation between INSO and the timing measure turns from negative to

positive when the value of INSO is approximately 23.5% (0.00047/(2x0.00001)). In columns (iv) and (vi) this slope changes sign when the values of INSO are approximately 21.8% and 23.4%.

In most cases, the coefficients on the other explanatory variables are not statistically significant. The coefficient on MV is, as expected, positive and statistically significant only in columns (i) and (iii). As predicted, the coefficient on CASH is negative but statistically significant only in columns (i) and (ii).

In Table 8, we report the outputs of several regressions of the three timing measures on either INSTO or INSTO and $INSTO^2$ and on the other explanatory variables with the exception of INSO and $INSO^2$. When the squared term $INSTO^2$ is not included (columns (i), (iii), and (v)), the coefficient on INSTO is positive but either statistically insignificant or significant at a 10% level. When $INSTO^2$ is included (columns (ii), (iv), and (vi)), the coefficient on INSTO turns negative and always statistically significant at a 5% level. The sign of the coefficient on $INSTO^2$ is positive and statistically significant at a 1% level. The inclusion of $INSTO^2$ also causes a sizable rise in the adjusted R-squared statistic. We conclude that we cannot reject H7. There is a quadratic relation between institutional ownership and a firm's tendency to time repurchases. When INSTO is low, the "monitoring effect" of institutional ownership is stronger than its "information effect". Hence, an increase in INSTO leads to a decrease in the timing measures (i.e. to an increase in a firm's tendency to time repurchases). When INSTO is high, the information effect of institutional ownership prevails over its monitoring effect. Hence, an increase in INSTO leads to an increase in the timing measures (i.e. to a decrease in a firm's tendency to time repurchases). If we consider the estimates of column (ii), the slope of the relation between INSTO and the timing measure turns from negative to positive when the value of INSTO is approximately 54%. In columns (iv) and (vi) the turning points are at 45.6% and 50.8% respectively.

The coefficients on the other explanatory variables are normally insignificant from the statistical point of view. The only exceptions are MV in columns (ii) and (iv) and CASH in columns (i) and (ii). The coefficients on these two variables have the expected signs.

In the final set of regressions we include both insider and institutional ownership variables at the same time.[18] Results for these set of regressions are reported in Table 9. In columns (i), (iv), and (vii), we include the explanatory variables INSO and INSTO without their squared terms. The coefficients on both INSO and INSTO are positive and in most cases statistically significant at standard levels. In columns (ii), (v), and (viii), we also include the squared terms of the ownership variables. The inclusion of $INSO^2$ and $INSTO^2$ causes a significant rise in the value of the adjusted R-squared statistic. The coefficient on INSTO is negative whereas that on $INSTO^2$ is positive. Both coefficients are statistically significant at standard levels. These results indicate that there is a quadratic relation between INSTO and a firm's tendency to time repurchases. As in Table 8, the evidence on institutional ownership supports H7. With reference to the estimates of column (ii), when INSTO is lower than 56.2%, there is a negative relation between INSTO and the timing measure. When INSTO is higher than 56.2%, there is a positive relation between INSTO and the timing measure. In columns (v) and (viii), the turning points are at 47.5% and 38.7% respectively. The coefficients on both INSO and $INSO^2$ are in most cases statistically insignificant. The quadratic relation between INSO and the timing measures that we find in Table 7 disappears if we also control for the institutional ownership variables. Nevertheless, we cannot rule out the possibility that this relation becomes linear. In columns (iii), (vi), and (ix), we only include the variables INSO, INSTO, and $INSTO^2$, without the term $INSO^2$. The estimates of the coefficients on INSTO and $INSTO^2$ confirm the quadratic relation between INSTO and the timing measures. In columns (iii), (vi), and (ix) the turning points are 50%, 41.2%, and 44.8% respectively. As for INSO, its coefficient is positive and in two cases out of three statistically significant at a 5% level. This finding is supportive of H2 and of the information effect of insider ownership. It shows that as insider ownership increases, firms find it harder to time the market when repurchasing stock because it becomes more likely that they repurchase stock from insiders.

[18] If we keep the ownership stake of outside non-institutional investors constant, an increase (a decrease) in the value of INSO mechanically corresponds to a decrease (an increase) in the value of INSTO. Hence, we expect the variables INSO and INSTO to be negatively correlated. When the correlation between two explanatory variables is large (more than 0.8 or less than -0.8), multicollinearity problems may arise, and the regression estimates of the coefficients on the two variables may become less statistically significant. In the sample with 214 firms, the Pearson correlation coefficient between INSO and INSTO is equal to -0.42. This coefficient is also equal to -0.42 in the larger sample with 265 firms. The correlation between INSO and INSTO seems too low to be a cause for concern.

Turning to other control variables, the only one that is statistically significant in the majority of the regressions is MV. As predicted, its coefficient is positive.

4. Conclusion

In this study, we investigate the timing of open market repurchase transactions. We use a unique dataset of hand-collected monthly data on the repurchase activity of a sample of US firms in the period between February 2004 and July 2006. These data are collected from SEC quarterly filings (10-Ks and 10-Qs) and are based on information that firms started disclosing in their filings at the beginning of 2004.

Overall, we present strong evidence that firms can time the market and repurchase stock at comparatively low prices. First, we show that there is a negative relation between the repurchase volume in the current month and the market-adjusted returns in the previous months. Also, we find a positive relation between the repurchase volume in the current month and the market-adjusted returns in the following months. Second, there are negative abnormal returns in periods preceding months with repurchase activity. There are positive abnormal returns in periods following months with repurchase activity. Finally, firms repurchase stock at average prices that are significantly lower than comparable average market prices. Also, the total cost of a firm's repurchases over the sample period is significantly lower than the firm's benchmark costs of repurchases.

We also present evidence that a firm's tendency to time repurchases is related to its ownership structure. More specifically, a firm's ability to repurchase stock at comparatively low prices is negatively associated with the level of the firm's insider ownership. Moreover, when institutional ownership is low, an increase in this variable is related to a rise in a firm's tendency to time the market when repurchasing stock. When institutional ownership is high, an increase in this variable reduces a firm's ability to time repurchases.

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Table 1
Distribution of the number of firm-months by calendar month
The table presents the distributions of the number of firm-months by calendar month over the period February 2004 – July 2006 for a sample of 5,035 firm-months, a sub-sample of 2,939 firm-months with open market share repurchases, and a sub-sample of 2,096 firm-months without open market share repurchases. The 5,035 observations in the larger sample are for 265 repurchasing firms (19 firm-months per firm) that announced open market repurchase programs in 2004. These firms are identified through a search on SDC Platinum Database of Mergers and Acquisitions. Data on the repurchase activity of these firms is collected from SEC 10-Ks and 10-Qs filings. For each sample of firm-months and each calendar month, the table reports the number of firm-months (*Frequency*) and the number of firm-months multiplied by 100 and divided by the total number of firm-months in the sample (*% Frequency*).

	All firm-months		Firm-months with repurchases		Firm-months without repurchases	
Calendar month	Frequency	% Frequency	Frequency	% Frequency	Frequency	% Frequency
February 2004	10	0.2	9	0.31	1	0.05
March 2004	37	0.73	26	0.88	11	0.52
April 2004	51	1.01	32	1.09	19	0.91
May 2004	66	1.31	55	1.87	11	0.52
June 2004	93	1.85	62	2.11	31	1.48
July 2004	114	2.26	70	2.38	44	2.1
August 2004	146	2.9	107	3.64	39	1.86
September 2004	182	3.61	101	3.44	81	3.86
October 2004	204	4.05	105	3.57	99	4.72
November 2004	220	4.37	119	4.05	101	4.82
December 2004	241	4.79	122	4.15	119	5.68
January 2005	265	5.26	132	4.49	133	6.35
February 2005	265	5.26	153	5.21	112	5.34
March 2005	265	5.26	170	5.78	95	4.53
April 2005	265	5.26	154	5.24	111	5.3
May 2005	265	5.26	180	6.12	85	4.06
June 2005	265	5.26	146	4.97	119	5.68
July 2005	265	5.26	126	4.29	139	6.63
August 2005	265	5.26	183	6.23	82	3.91
September 2005	255	5.06	153	5.21	102	4.87
October 2005	228	4.53	125	4.25	103	4.91
November 2005	214	4.25	129	4.39	85	4.06
December 2005	199	3.95	114	3.88	85	4.06
January 2006	172	3.42	69	2.35	103	4.91
February 2006	151	3	92	3.13	59	2.81
March 2006	119	2.36	69	2.35	50	2.39
April 2006	83	1.65	39	1.33	44	2.1
May 2006	61	1.21	45	1.53	16	0.76
June 2006	45	0.89	36	1.22	9	0.43
July 2006	24	0.48	16	0.54	8	0.38
Total	5,035	100	2,939	100	2,096	100

Table 2
Distribution of the number of firm-months by event month
The table presents the distributions of the number of firm-months by event month for a sample of 5,035 firm-months, a sub-sample of 2,939 firm-months with open market share repurchases, and a sub-sample of 2,096 firm-months without open market share repurchases. The 5,035 observations in the larger sample are for 265 repurchasing firms (19 firm-months per firm) that announced open market repurchase programs in 2004. These firms are identified through a search on SDC Platinum Database of Mergers and Acquisitions. Data on the repurchase activity of these firms is collected from SEC 10-Ks and 10-Qs filings. Event month +1 is the month that follows the month of the announcement of an open market repurchase program by a firm (event month 0). Event month +19 is the 19th month after event month 0. For each sample of firm-months and each event month, the table reports the number of firm-months (*Frequency*) and the number of firm-months multiplied by 100 and divided by the total number of firm-months in the sample (*% Frequency*).

	All firm-months		Firm-months with repurchases		Firm-months without repurchases	
Event month	Frequency	% Frequency	Frequency	% Frequency	Frequency	% Frequency
+1	265	5.26	179	6.09	86	4.1
+2	265	5.26	154	5.24	111	5.3
+3	265	5.26	161	5.48	104	4.96
+4	265	5.26	154	5.24	111	5.3
+5	265	5.26	143	4.87	122	5.82
+6	265	5.26	150	5.1	115	5.49
+7	265	5.26	158	5.38	107	5.1
+8	265	5.26	150	5.1	115	5.49
+9	265	5.26	153	5.21	112	5.34
+10	265	5.26	163	5.55	102	4.87
+11	265	5.26	156	5.31	109	5.2
+12	265	5.26	153	5.21	112	5.34
+13	265	5.26	156	5.31	109	5.2
+14	265	5.26	159	5.41	106	5.06
+15	265	5.26	158	5.38	107	5.1
+16	265	5.26	158	5.38	107	5.1
+17	265	5.26	136	4.63	129	6.15
+18	265	5.26	147	5	118	5.63
+19	265	5.26	151	5.14	114	5.44
Total	5,035	100	2,939	100	2,096	100

Table 3
Repurchase volume and market-adjusted returns
The table contains estimates of Tobit regressions of a firm's monthly number of repurchased shares on a set of market-adjusted returns on the firm's stock. Regressions are run on two samples with 4,505 and 3,975 observations for 265 firms that announced open market repurchase programs in 2004. These firms are identified through a search of announcements of repurchase programs on SDC Platinum Database of Mergers and Acquisitions. Data on the repurchase activity of these firms is collected from SEC 10-Ks and 10-Qs filings. Data on stock returns and returns on market indices are obtained from CRSP. For each firm-month, *REP* is equal to the number of shares repurchased by the firm in the month over the firm's number of outstanding shares at the start of the month. *MAR* is the return on the firm's stock in the current month minus the return on a market index in the current month. *MAR -1* (*MAR +1*) is the return on the firm's stock in the previous (following) month minus the return on a market index in the previous (following) month. *MAR -1 TO -2* (*MAR +1 TO +2*) is the return on the firm's stock in the previous (following) two months minus the return on a market index in the previous (following) two months. In regressions (i) and (iv), the market index used to compute market-adjusted returns is the S&P's Composite Index. In regressions (ii) and (v), it is a value-weighted market index (comprising NYSE, NASDAQ, and AMEX stocks), whereas in regressions (iii) and (vi) it is an equally-weighted market index (comprising NYSE, NASDAQ, and AMEX stocks). For each regression, the table reports estimates of the *constant*, the number of *observations*, and the value of the *log likelihood* function. *t-statistics* are reported in parenthesis.

	Dependent variable: REP					
	S&P Composite	VW index	EW index	S&P Composite	VW index	EW index
Independent variables:	(i)	(ii)	(iii)	(iv)	(v)	(vi)
MAR 0	-0.0101 ***	-0.01 ***	-0.0078 ***	-0.0106 ***	-0.0106 ***	-0.0086 ***
	(-4.65)	(-4.6)	(-3.62)	(-4.59)	(-4.57)	(-3.73)
MAR -1	-0.018 ***	-0.017 ***	-0.0142 ***			
	(-8.06)	(-7.7)	(-6.49)			
MAR +1	-0.003	-0.0032	-0.0032			
	(-1.4)	(-1.47)	(-1.5)			
MAR -1 to -2				-0.0152 ***	-0.015 ***	-0.0135 ***
				(-9.2)	(-9.03)	(-8.21)
MAR +1 to +2				0.0028 *	0.003 *	0.003 *
				(1.74)	(1.85)	(1.86)
Constant	0.0003 *	0.0002	0.0001	0.0003 *	0.0002	0.0001
	(1.7)	(1.04)	(0.38)	(1.81)	(1.11)	(0.45)
Observations	4,505	4,505	4,505	3,975	3,975	3,975
Log likelihood	6,867.1126	6,864.078	6,851.3542	6,097.2241	6,095.6167	6,084.9437

***: significant at 1%; **: significant at 5%; *: significant at 10%.

Table 4
Abnormal returns around firm-months with repurchase activity
The table contains estimates of ordinary least squares regressions of a firm's risk premium on a set of dummies based on the firm's repurchase activity and on standard risk factors. Regressions are run on two samples of firm-months, one with 4,505 observations and one with 3,975 observations. Observations in both samples are for 265 firms that announced open market repurchase programs in 2004. These firms are identified through a search of announcements of repurchase programs on SDC Platinum Database of Mergers and Acquisitions. Data on the repurchase activity of these firms is collected from SEC 10-Ks and 10-Qs filings. Data on stock returns, market returns, risk-free returns, and risk factors are obtained from CRSP. For each firm-month, the dummy *MONTH 0* is equal to one if some repurchases are executed. The dummy *MONTH -1* (*MONTH +1*) is set to one if repurchases are carried out in the following (previous) month. The dummy *MONTHS -1 TO -2* (*MONTHS +1 TO +2*) is equal to one if repurchases are executed in at least one of the two following (previous) months. *R* is the average daily return in the month and *Rf* is the average daily risk-free rate of return. *Rm* is the average daily market return. The market return is the return on a value-weighted portfolio of US stocks. *SMB* and *HML* are the average daily Fama and French's size factor and the average daily Fama and French's book-to-market factor respectively. *UMD* is the average daily Carhart's momentum factor. For each regression, the table reports estimates of the *constant*, the number of *observations*, and the *adjusted R-squared*. *t-statistics* adjusted for heteroscedasticity and clustering across observations from the same calendar month are reported in parenthesis.

	Dependent variable: R - Rf			
Independent variables:	(i)	(ii)	(iii)	(iv)
MONTH 0	-0.0003 ***	-0.0004 ***	-0.0006 ***	-0.0006 ***
	(-3.11)	(-3.13)	(-4.25)	(-4.2)
MONTH -1	-0.0006 ***	-0.0006 ***		
	(-4.95)	(-4.87)		
MONTH +1	0.0003 **	0.0003 **		
	(2.43)	(2.51)		
MONTHS -1 to -2			-0.0009 ***	-0.0009 ***
			(-5.35)	(-5.41)
MONTHS +1 to +2			0.001 ***	0.001 ***
			(6.81)	(7.1)
Rm - Rf	0.9692 ***	1 ***	0.9737 ***	1.01 ***
	(10.6)	(8.71)	(11.61)	(9.27)
SMB	0.3065 **	0.3617 ***	0.3137 **	0.3638 ***
	(2.45)	(2.96)	(2.45)	(2.95)
HML	-0.1323	0.0591	-0.0611	0.1617
	(-0.88)	(0.32)	(-0.4)	(0.86)
UMD		-0.2047		-0.2329 *
		(-1.67)		(-1.88)
Constant	0.0006 ***	0.0006 ***	0.0004 **	0.0004 **
	(2.95)	(3.05)	(2.14)	(2.27)
Observations	4,505	4,505	3,975	3,975
Adjusted R-squared	0.1463	0.1478	0.1548	0.1564

***: significant at 1%; **: significant at 5%; *: significant at 10%.

Table 5
Descriptive statistics and univariate tests for the variables *%PRICES*, *%PRICEW*, *%COST1S*, *%COST1W*, *%COST2S*, and *%COST2W*
The table reports descriptive statistics and univariate tests on the mean and median values of the variables *%PRICES*, *%PRICEW*, *%COST1S*, *%COST1W*, *%COST2S*, and *%COST2W*. In the first panel of the table (*panel A*), the dataset under analysis comprises 2,316 firm-months with repurchase activity. In the other two panels (*panel B* and *panel C*), the two datasets consist of 214 and 265 firms that announced repurchase programs in 2004. These firms are identified through a search of announcements of repurchase programs on SDC Platinum Database of Mergers and Acquisitions. Data on the repurchase activity of these firms is collected from SEC 10-Ks and 10-Qs filings. Data on market stock prices and market stock trading volumes are obtained from CRSP. For each firm-month with repurchase activity, *%PRICES* is the percent difference between the average repurchase price and the average daily closing price of the firm's stock. The percent difference is 100 times the difference between the average repurchase price and the average daily price over the average daily price. For each firm-month, *%PRICEW* is the percent difference between the average repurchase price and the volume-weighted average daily closing price of the firm's stock. Trading volume data for the firm's stock is used to compute this volume-weighted average. For each firm, *%COST1S* is the percent difference between the effective total cost of repurchases in the 19 months following the firm's repurchase announcement and a benchmark total cost of repurchases based on the assumption that stock is repurchased at the stock's average daily closing price over the 19 months. *%COST1W* differs from *%COST1S* in that the benchmark used is computed assuming that repurchases are executed at the volume-weighted average closing daily price. For each firm, *%COST2S* is the difference between the estimated total cost of repurchases in the 19 months following the firm's repurchase announcement and a benchmark total cost of repurchases based on the assumption that stock is repurchased at the stock's average daily closing price over the 19 months. The monthly estimated total cost of repurchases is the number of repurchased shares times the average daily closing price over the month; monthly estimated costs are cumulated to find the estimated total cost of repurchases over the 19-month period. *%COST2W* differs from *%COST2S* in two ways. First, in each month, the estimated cost of repurchases is computed using the volume-weighted average daily price. Second, the benchmark cost of repurchases is calculated assuming that stock is repurchased at the volume-weighted average daily price. For each variable, the table shows the number of *observations*, the *mean*, the *median*, the *standard deviation*, the *skewness*, the *kurtosis*, the *maximum* value, and the *minimum* value of the variable. It also reports the significance levels of Student's t tests on means and of Mann-Whitney tests on medians.

Panel A: % difference between monthly repurchase price and monthly average daily market price

Variable	Observations	Mean	Median	Standard deviation	Skewness	Kurtosis	Maximum	Minimum
%PRICES	2,316	-0.619 ***	-0.207 ***	2.926	-0.945	8.7481	21.543	-21.624
%PRICEW	2,316	-0.513 ***	-0.147 ***	2.875	-1.015	9.381	18.875	-23.199

Panel B: % difference between effective total cost of repurchases and benchmark total cost of repurchases in the post-announcement period

Variable	Observations	Mean	Median	Standard deviation	Skewness	Kurtosis	Maximum	Minimum
%COST1S	214	-2.77 ***	-1.767 ***	11.054	0.529	6.082	47.77	-47.91
%COST1W	214	-2.837 ***	-1.235 ***	12.157	0.788	10.04	72.413	-50.428

Panel C: % difference between estimated total cost of repurchases and benchmark total cost of repurchases in the post-announcement period

Variable	Observations	Mean	Median	Standard deviation	Skewness	Kurtosis	Maximum	Minimum
%COST2S	265	-2.183 ***	-1.126 ***	9.919	0.302	6.44	47.5	-47.722
%COST2W	265	-2.474 ***	-0.915 ***	10.979	0.603	11.468	71.889	-50.636

***: significant at 1%; **: significant at 5%; *: significant at 10%.

Table 6
Descriptive statistics for the variables *INSO*, *INSTO*, *SD*, *MV*, *CASH*, *CF*, and *MB*.
The table contains descriptive statistics for the variables *INSO*, *INSTO*, *SD*, *MV*, *CASH*, *CF*, and *MB* for two samples: one with 214 (*panel A*) and one with 265 (*panel B*) firms that announced repurchase programs in 2004. The firms in the two samples are identified through a search of announcements of repurchase programs on SDC Platinum Database of Mergers and Acquisitions. For each repurchasing firm, a 19-month sample period is identified. The first month in the sample period is that following the month in which the firm announces a repurchase program. Data on insider ownership and on ownership by institutional investors is obtained from proxy statements and from Thomson Financial respectively. Market data on stock prices, stock returns, and number of outstanding shares are downloaded from CRSP. Accounting data are obtained from Compustat. For each firm, *INSO* is the percentage of the firm's outstanding shares held by all the firm's officers and directors on the last proxy statement date before the start of the firm's 19-month sample period. *INSTO* is the percentage of the firm's outstanding shares held by all institutional investors (required to file Form 13F) on the last end-of-quarter date before the initiation of the firm's 19-month sample period. *SD* is the standard deviation of the firm's stock daily return over the firm's 19-month sample period. *MV* is the natural logarithm of the firm's market capitalization (stock price multiplied by the number of outstanding shares in thousands) on the last trading day before the start of the firm's 19-month sample period. The variables *CASH*, *CF*, and *MB* are computed using market and accounting data for the last fiscal year that does not include parts of the firm's 19-month sample period. *CASH* is the end-of-year value of cash and short-term investments (Compustat item 1) scaled by the end-of-year value of total assets (Compustat item 6). *CF* is the annual value of operating income before depreciation and amortization (Compustat item 13) scaled by the end-of-year value of total assets. *MB* is the sum of the values of market capitalization (in millions) and total liabilities (Compustat item 181), both at year end, scaled by the end-of-year value of total assets. For each variable, the table shows the number of *observations*, the *mean*, the *median*, the *standard deviation*, the *skewness*, the *kurtosis*, the *maximum* value, and the *minimum* value of the variable.

Panel A: repurchase price dataset

Variable	Observations	Mean	Median	Standard deviation	Skewness	Kurtosis	Maximum	Minimum
INSO	214	9.0592	4.02	12.9802	2.7515	9.3271	80.6	0.07
INSTO	214	64.2848	72.1232	29.0032	-0.5951	-0.6386	123.5218	2.111
SD	214	0.0192	0.0176	0.007	1.3502	3.4457	0.055	0.0082
MV	214	13.8202	13.6943	1.8471	0.3368	-0.0985	18.8419	9.2415
CASH	214	0.2031	0.123	0.2034	1.1763	0.6619	0.8972	0.0003
CF	214	0.1317	0.1233	0.1135	1.2173	2.5058	0.5786	-0.1463
MB	214	2.1795	1.6331	1.5802	2.2772	6.3002	10.332	0.6906

Panel B: repurchase volume dataset

Variable	Observations	Mean	Median	Standard deviation	Skewness	Kurtosis	Maximum	Minimum
INSO	265	8.5255	3.41	13.079	2.8201	9.2798	80.6	0.07
INSTO	265	64.852	70.6283	27.2263	-0.6422	-0.3999	123.5218	2.111
SD	265	0.01855	0.0172	0.0068	1.2984	3.2337	0.055	0.0082
MV	265	14.1562	14.1301	1.977	0.3244	-0.2018	19.7735	9.2415
CASH	265	0.1862	0.1025	0.1935	1.3174	1.1273	0.8972	0.0003
CF	265	0.1361	0.1273	0.1165	1.5226	4.2179	0.739	-0.1463
MB	265	2.2021	1.6602	1.5808	2.4212	7.5584	10.6048	0.6906

Table 7
Determinants of the timing of OMRs: insider ownership.
The table reports ordinary least squares regressions of three measures of a firm's ability and propensity to time OMRs on insider ownership and other explanatory variables. Two samples are used: one with 214 and one with 265 firms that announced repurchase programs in 2004. The firms in the two samples are identified through a search of announcements of repurchase programs on SDC Platinum Database of Mergers and Acquisitions. For each repurchasing firm, a 19-month sample period is identified. The first month in the sample period is that following the month in which the firm announces a repurchase program. Data on the repurchase activity of the firms in the samples is collected from SEC 10-Ks and 10-Qs filings. Market data on stock prices, stock returns, trading volumes, and number of outstanding shares are downloaded from CRSP. Data on insider ownership is obtained from proxy statements. Accounting data are obtained from Compustat. For each firm, *A%PRICEW* is calculated using months in which the firm repurchases stock. For each of these months, *%PRICEW* is the percent difference between the average repurchase price and the volume-weighted average daily closing price of the firm's stock. The percent difference is 100 times the difference between the average repurchase price and the volume-weighted average daily price over the volume-weighted average daily price. *A%PRICEW* is the average value of *%PRICEW* over the months in which repurchases are made. *%COST1W* is the percent difference between the effective total cost of repurchases in the 19 months following the firm's repurchase announcement and a benchmark total cost of repurchases based on the assumption that stock is repurchased at the stock's volume-weighted average daily closing price over the 19 months. *%COST2W* is the difference between the estimated total cost of repurchases in the 19 months following the firm's repurchase announcement and a benchmark total cost of repurchases based on the assumption that stock is repurchased at the stock's volume-weighted average daily closing price over the 19 months. The monthly estimated total cost of repurchases is the number of repurchased shares times the volume-weighted average daily closing price over the month; monthly estimated costs are cumulated to find the estimated total cost of repurchases over the 19-month period. *INSO* is the percentage of the firm's outstanding shares held by all the firm's officers and directors on the last proxy statement date before the start of the firm's 19-month sample period. *SD* is the standard deviation of the firm's stock daily return over the firm's 19-month sample period. *MV* is the natural logarithm of the firm's market capitalization (stock price multiplied by the number of outstanding shares in thousands) on the last trading day before the start of the firm's 19-month sample period. The variables *CASH*, *CF*, and *MB* are computed using market and accounting data for the last fiscal year that does not include parts of the firm's 19-month sample period. *CASH* is the end-of-year value of cash and short-term investments (Compustat item 1) scaled by the end-of-year value of total assets (Compustat item 6). *CF* is the annual value of operating income before depreciation and amortization (Compustat item 13) scaled by the end-of-year value of total assets. *MB* is the sum of the values of market capitalization (in millions) and total liabilities (Compustat item 181), both at year end, scaled by the end-of-year value of total assets. A set of industry dummies is included among the explanatory variables. Estimates for these dummies are not reported. For each regression, the table reports estimates of the *constant*, the number of *observations*, and the *adjusted R-squared*. *t-statistics* adjusted for heteroscedasticity are reported in parenthesis.

	Dependent variable:					
	A%PRICEW	A%PRICEW	%COST1W	%COST1W	%COST2W	%COST2W
Independent variables:	(i)	(ii)	(iii)	(iv)	(v)	(vi)
INSO	0.00017	-0.00047	0.00137	-0.00393 *	0.00082	-0.00374 **
	(1.01)	(-1.45)	(1.37)	(-1.87)	(1.1)	(-2.12)
$INSO^2$		0.00001 *		0.00009 **		0.00008 **
		(1.71)		(2.06)		(2.25)
SD	0.31662	0.2195	-1.44836	-2.25276	-3.16464	-3.72814
	(0.84)	(0.69)	(-0.46)	(-0.8)	(-1.19)	(-1.59)
MV	0.00212 **	0.0013	0.01645 **	0.00965	0.00586	0.00103
	(2.1)	(1.38)	(2.41)	(1.58)	(1.25)	(0.25)
CASH	-0.02342 **	-0.02369 **	-0.08869	-0.09091	-0.05829	-0.05985
	(-2.3)	(-2.24)	(-0.97)	(-0.97)	(-0.7)	(-0.72)
CF	-0.00226	0.00298	-0.01649	0.0269	-0.031	-0.01761
	(-0.11)	(0.17)	(-0.12)	(0.23)	(-0.29)	(-0.18)
MB	-0.00033	-0.00002	0.00003	0.00257	0.00607	0.00804
	(-0.29)	(-0.02)	(0)	(0.22)	(0.66)	(0.87)
Constant	-0.02095	-0.00623	-0.1333	-0.0114	-0.05606	0.03719
	(-0.86)	(-0.28)	(-0.84)	(-0.08)	(-0.44)	(0.31)
Observations	214	214	214	214	265	265
Adjusted R-squared	0.1349	0.1649	0.078	0.1301	0.0506	0.0955

***: significant at 1%; **: significant at 5%; *: significant at 10%.

Table 8
Determinants of the timing of OMRs: institutional ownership.
The table reports ordinary least squares regressions of three measures of a firm's ability and propensity to time OMRs on institutional ownership and other explanatory variables. Two samples are used: one with 214 and one with 265 firms that announced repurchase programs in 2004. The firms in the two samples are identified through a search of announcements of repurchase programs on SDC Platinum Database of Mergers and Acquisitions. For each repurchasing firm, a 19-month sample period is identified. The first month in the sample period is that following the month in which the firm announces a repurchase program. Data on the repurchase activity of the firms in the samples is collected from SEC 10-Ks and 10-Qs filings. Market data on stock prices, stock returns, trading volumes, and number of outstanding shares are downloaded from CRSP. Data on institutional ownership is obtained from Thomson Financial. Accounting data are obtained from Compustat. For each firm, *A%PRICEW* is calculated using months in which the firm repurchases stock. For each of these months, *%PRICEW* is the percent difference between the average repurchase price and the volume-weighted average daily closing price of the firm's stock. The percent difference is 100 times the difference between the average repurchase price and the volume-weighted average daily price over the volume-weighted average daily price. *A%PRICEW* is the average value of *%PRICEW* over the months in which repurchases are made. *%COST1W* is the percent difference between the effective total cost of repurchases in the 19 months following the firm's repurchase announcement and a benchmark total cost of repurchases based on the assumption that stock is repurchased at the stock's volume-weighted average daily closing price over the 19 months. *%COST2W* is the difference between the estimated total cost of repurchases in the 19 months following the firm's repurchase announcement and a benchmark total cost of repurchases based on the assumption that stock is repurchased at the stock's volume-weighted average daily closing price over the 19 months. The monthly estimated total cost of repurchases is the number of repurchased shares times the volume-weighted average daily closing price over the month; monthly estimated costs are cumulated to find the estimated total cost of repurchases over the 19-month period. *INSTO* is the percentage of the firm's outstanding shares held by all institutional investors (required to file Form 13F) on the last end-of-quarter date before the initiation of the firm's 19-month sample period. *SD* is the standard deviation of the firm's stock daily return over the firm's 19-month sample period. *MV* is the natural logarithm of the firm's market capitalization (stock price multiplied by the number of outstanding shares in thousands) on the last trading day before the start of the firm's 19-month sample period. The variables *CASH*, *CF*, and *MB* are computed using market and accounting data for the last fiscal year that does not include parts of the firm's 19-month sample period. *CASH* is the end-of-year value of cash and short-term investments (Compustat item 1) scaled by the end-of-year value of total assets (Compustat item 6). *CF* is the annual value of operating income before depreciation and amortization (Compustat item 13) scaled by the end-of-year value of total assets. *MB* is the sum of the values of market capitalization (in millions) and total liabilities (Compustat item 181), both at year end, scaled by the end-of-year value of total assets. A set of industry dummies is included among the explanatory variables. Estimates for these dummies are not reported. For each regression, the table reports estimates of the *constant*, the number of *observations*, and the *adjusted R-squared*. *t-statistics* adjusted for heteroscedasticity are reported in parenthesis.

	Dependent variable:					
	A%PRICEW	A%PRICEW	%COST1W	%COST1W	%COST2W	%COST2W
Independent variables:	(i)	(ii)	(iii)	(iv)	(v)	(vi)
INSTO	0.00003	-0.00054 **	0.00065	-0.00365 **	0.00061 *	-0.00305 **
	(0.6)	(-2.55)	(1.49)	(-2.42)	(1.7)	(-2.28)
INSTO²		0.000005 ***		0.00004 ***		0.00003 ***
		(2.87)		(2.85)		(2.64)
SD	0.4223	0.3268	-0.67767	-1.38589	-2.70345	-3.16307
	(0.92)	(0.8)	(-0.19)	(-0.42)	(-0.93)	(-1.2)
MV	0.00166	0.00231 **	0.01058	0.01539 **	0.00188	0.0062
	(1.62)	(2.16)	(1.59)	(2.11)	(0.41)	(1.19)
CASH	-0.02571 **	-0.0236 **	-0.115	-0.09931	-0.08173	-0.07127
	(-2.39)	(-2.29)	(-1.26)	(-1.14)	(-0.99)	(-0.9)
CF	-0.0045	-0.01097	-0.07121	-0.1192	-0.08755	-0.1204
	(-0.23)	(-0.56)	(-0.56)	(-0.94)	(-0.85)	(-1.19)
MB	0.00002	0.00027	0.00508	0.00691	0.01054	0.01183
	(0.02)	(0.23)	(0.48)	(0.66)	(1.2)	(1.38)
Constant	-0.01829	-0.01274	-0.10182	-0.0607	-0.04352	-0.01199
	(-0.73)	(-0.55)	(-0.63)	(-0.4)	(-0.34)	(-0.1)
Observations	214	214	214	214	265	265
Adjusted R-squared	0.1249	0.1637	0.072	0.1246	0.0551	0.0955

***: significant at 1%; **: significant at 5%; *: significant at 10%.

Table 9

Determinants of the timing of OMRs: insider and institutional ownership.

The table reports ordinary least squares regressions of three measures of a firm's ability and propensity to time OMRs on insider ownership, institutional ownership, and other explanatory variables. Two samples are used: one with 214 and one with 265 firms that announced repurchase programs in 2004. The firms in the two samples are identified through a search of announcements of repurchase programs on SDC Platinum Database of Mergers and Acquisitions. For each repurchasing firm, a 19-month sample period is identified. The first month in the sample period is that following the month in which the firm announces a repurchase program. Data on the repurchase activity of the firms in the samples is collected from SEC 10-Ks and 10-Qs filings. Market data on stock prices, stock returns, trading volumes, and number of outstanding shares are downloaded from CRSP. Data on insider ownership and on ownership by institutional investors is obtained from proxy statements and from Thomson Financial respectively. Accounting data are obtained from Compustat. For each firm, *A%PRICEW* is calculated using months in which the firm repurchases stock. For each of these months, *%PRICEW* is the percent difference between the average repurchase price and the volume-weighted average daily closing price of the firm's stock. The percent difference is 100 times the difference between the average repurchase price and the volume-weighted average daily price over the volume-weighted average daily price. *A%PRICEW* is the average value of *%PRICEW* over the months in which repurchases are made. *%COST1W* is the percent difference between the effective total cost of repurchases in the 19 months following the firm's repurchase announcement and a benchmark total cost of repurchases based on the assumption that stock is repurchased at the stock's volume-weighted average daily closing price over the 19 months. *%COST2W* is the difference between the estimated total cost of repurchases in the 19 months following the firm's repurchase announcement and a benchmark total cost of repurchases based on the assumption that stock is repurchased at the stock's volume-weighted average daily closing price over the 19 months. The monthly estimated total cost of repurchases is the number of repurchased shares times the volume-weighted average daily closing price over the month; monthly estimated costs are cumulated to find the estimated total cost of repurchases over the 19-month period. *INSO* is the percentage of the firm's outstanding shares held by all the firm's officers and directors on the last proxy statement date before the start of the firm's 19-month sample period. *INSTO* is the percentage of the firm's outstanding shares held by all institutional investors (required to file Form 13F) on the last end-of-quarter date before the initiation of the firm's 19-month sample period. *SD* is the standard deviation of the firm's stock daily return over the firm's 19-month sample period. *MV* is the natural logarithm of the firm's market capitalization (stock price multiplied by the number of outstanding shares in thousands) on the last trading day before the start of the firm's 19-month sample period. The variables *CASH*, *CF*, and *MB* are computed using market and accounting data for the last fiscal year that does not include parts of the firm's 19-month sample period. *CASH* is the end-of-year value of cash and short-term investments (Compustat item 1) scaled by the end-of-year value of total assets (Compustat item 6). *CF* is the annual value of operating income before depreciation and amortization (Compustat item 13) scaled by the end-of-year value of total assets. *MB* is the sum of the values of market capitalization (in millions) and total liabilities (Compustat item 181), both at year end, scaled by the end-of-year value of total assets. A set of industry dummies is included among the explanatory variables. Estimates for these dummies are not reported. For each regression, the table reports estimates of the *constant*, the number of *observations*, and the *adjusted R-squared*. *t-statistics* adjusted for heteroscedasticity are reported in parenthesis.

	Dependent variable:								
	A%PRICEW	A%PRICEW	A%PRICEW	%COST1W	%COST1W	%COST1W	%COST2W	%COST2W	%COST2W
Independent variables:	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
INSO	0.00023	-0.00023	0.00024	0.00209 *	-0.00157	0.00218 **	0.00145 *	-0.00207	0.00143 **
	(1.28)	(-0.7)	(1.48)	(1.98)	(-0.74)	(2.3)	(1.87)	(-1.2)	(2.04)
$INSO^2$		0.000008			0.00006			0.00006 *	
		(1.27)			(1.43)			(1.75)	
INSTO	0.00008	-0.00045 **	-0.0005 ***	0.0011 ***	-0.00285 **	-0.0033 **	0.00095 ***	-0.00232 **	-0.00269 **
	(1.49)	(-2.57)	(-2.68)	(2.69)	(-2.28)	(-2.48)	(2.76)	(-2.08)	(-2.23)
$INSTO^2$		0.000004 ***	0.000005 ***		0.00003 ***	0.00004 ***		0.00003 **	0.00003 ***
		(2.88)	(3.03)		(2.83)	(3.06)		(2.54)	(2.73)
SD	0.26189	0.11896	0.15532	-2.15701	-3.23955	-2.95139	-3.644	-4.35989 *	-4.0903 *
	(0.7)	(0.37)	(0.45)	(-0.7)	(-1.2)	(-1.05)	(-1.41)	(-1.94)	(-1.71)
MV	0.0017 *	0.00182 *	0.00235 **	0.01084 *	0.01153 *	0.01579 **	0.002	0.00276	0.0063
	(1.67)	(1.86)	(2.27)	(1.72)	(1.77)	(2.31)	(0.46)	(0.59)	(1.26)
CASH	-0.02481 **	-0.02266 **	-0.0226 **	-0.1067	-0.0907	-0.09019	-0.07681	-0.0659	-0.06646
	(-2.43)	(-2.23)	(-2.28)	(-1.19)	(-1.04)	(-1.06)	(-0.94)	(-0.84)	(-0.85)
CF	-0.01141	-0.01077	-0.01841	-0.13493	-0.12661	-0.18711	-0.12594	-0.12681	-0.15818
	(-0.54)	(-0.6)	(-0.9)	(-0.98)	(-1.17)	(-1.42)	(-1.16)	(-1.41)	(-1.51)
MB	0.00015	0.00044	0.00041	0.00623	0.00839	0.00817	0.01116	0.01282	0.01243
	(0.12)	(0.37)	(0.35)	(0.58)	(0.8)	(0.78)	(1.28)	(1.51)	(1.46)
Constant	-0.01907	-0.00438	-0.01343	-0.10895	0.00475	-0.06695	-0.05173	0.04372	-0.02028
	(-0.78)	(-0.21)	(-0.6)	(-0.72)	(0.03)	(-0.47)	(-0.42)	(0.38)	(-0.17)
Observations	214	214	214	214	214	214	265	265	265
Adjusted R-squared	0.1378	0.1905	0.1789	0.1028	0.1786	0.159	0.0731	0.1351	0.1132

***: significant at 1%; **: significant at 5%; *: significant at 10%.