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W.P. No. 2013-11-10
This version: November 20, 2013

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MARKET TIMING ABILITY OF INDIAN FIRMS IN OPEN MARKET REPURCHASES

Sobhesh Kumar Agarwalla, Joshy Jacob[†] and Ellapulli Vasudevan

Abstract

The paper examines the market timing ability of Indian firms engaged in open market repurchases. The study is primarily motivated by the unique disclosure feature of repurchases in India, where the disclosures are far more frequent than in any other market. We find that the repurchasing firms in India are able to accumulate shares at favorable prices similar to the US market. However, the cost savings do not translate into significant wealth creation for the insiders as indicated by the short-run and long-run abnormal returns. This is contrary to the evidence from markets like the US. Further, the cross-sectional variations in the cost savings from repurchase execution in India are explained by the overall market returns and not by firm characteristics. These findings contrast with that of US, where the firm characteristics significantly explain the cross-sectional variation in the savings measure. It appears that the more frequent disclosure of repurchase activity in India cripples the market timing ability by reducing the information asymmetry between the firm and the outsiders. This conclusion is further supported by the irrelevance of the past or concurrent stock returns in explaining the time variation in the repurchase activity of firms.

Key words: Repurchase, market timing, information asymmetry, emerging markets, regulatory disclosure

JEL classifications: G12, G14, G15

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1 Introduction

Information asymmetry between firms and investors may present insiders with the opportunity to repurchase shares at favorable prices from the market before an anticipated price rise, and thus transfer wealth from outside shareholders to insiders. This possibility has been examined in a number of studies on open market repurchases (for instance, [Brockman and Chung, 2001](#); [Cook et al., 2003](#); [De Cesari et al., 2012](#)). [Brockman and Chung \(2001\)](#) found that managers repurchase stock at significantly lower costs relative to several other benchmarks in Hong Kong. [Cook et al. \(2003\)](#), with a small set of voluntarily disclosed open market repurchases in the US, found some degree of support for opportunistic repurchase by the NYSE firms. [De Cesari et al. \(2012\)](#) by using the mandatory disclosures of monthly repurchase activity enforced in the US from 2004, documented a strong evidence in favor of opportunistic repurchase. They found that the average repurchasing firm saves about 0.25% of its market capitalization. These evidences of cost savings in repurchases were widely regarded as supportive of the ability of managers to time the market. However, the recent research (for instance, [Ginglinger and Hamon, 2007](#); [Oberberger, 2012](#)) attributed the cost savings to the contrarian trading strategies of the repurchasing firms and found evidence for price support rather than for market timing. The notion of market timing during open market repurchases still remains contested.

We examine the market timing ability through open market repurchases in India, motivated by the unique features of the Indian empirical context, which could offer insights into the interaction between the frequency of information disclosure and the market timing ability. These unique regulatory features of the Indian repurchase environment are as follows.

Firstly, an important element of the repurchase environment, the disclosure of the open market repurchases is much more frequent in India than in most other markets. This occurs as the repurchasing firm, when employing limit orders for repurchase, should identify itself as the buyer in an otherwise anonymous order-driven market. Repurchasing firms are also bound to disclose both the number of shares repurchased and the average price paid on a daily basis. A similar disclosure is required only at a monthly frequency in the US. These apart, every time when the cumulative incremental repurchase reaches 5% of the equity, a public announcement is required. These disclosure features in India could significantly reduce the information advantage and hence the market timing ability of the repurchasing firms, relative to those in markets with less frequent disclosures. Further,

the high-frequency disclosure of repurchases also allows us to measure the market timing ability with greater reliability than in other markets as we can estimate the costs associated with repurchases using daily data.

Secondly, in India the maximum period allowed for open market repurchase is limited to 12-months from the date of approval of repurchase. This maximum mandated period, within which the repurchase option lapses, provides the opportunity to objectively assess the market timing behavior. Absent such a deadline, it is not evident whether a firm's repurchase is active or closed at any point of time, which makes it difficult to measure the timing ability of ongoing repurchases.

Finally, several features of the Indian financial market are similar to the other emerging markets, which suggest the prevalence of a greater degree of information asymmetry between insiders and the outsiders. These features include the divergence between control and ownership (for instance, [Shleifer and Vishny, 1986](#); [Claessens et al., 2000](#)) and the poor information environment ([Morck et al., 2000](#)) etc. Further in India, the promoter-managers have significant wealth effects from successfully timing the market unlike the US, where the firms are mostly managed by the agents. These features could lead to stronger incentives for the promoter-managers to time the market. Against this backdrop, the examination of the timing ability would help to improve the understanding of the interaction between information asymmetry and greater degree of disclosure.

We begin our analysis by measuring the cost savings to the firms from open market repurchases by comparing the actual costs of repurchase with other cost benchmarks. We find economically and statistically significant cost savings for the repurchasing firms in India. However, as the cost savings alone are not universally accepted as indicative of the market timing ability, we further investigate whether the increased holdings of the insiders translates into wealth by examining the short-run and long-run abnormal returns. We find no evidence of abnormal returns for the repurchase stocks in the Indian market. This evidence is contrary to the significant abnormal returns earned by the US repurchase stocks. We also analyze the cross-sectional variation in the cost savings to find if they are related to proxies of information asymmetry. We find that cost savings in India are explained by overall market returns and are not related to any firm-specific characteristics. This finding, contrary to the US market, suggests limited market timing in India. Perhaps the frequent disclosure requirement in India reduces the information advantage required by insiders for timing the market. Further, we investigate the time variation in the repurchase activity of firms in India. We find no role

of concurrent or past stock returns in explaining the repurchase activity. This evidence strengthens our argument that frequent disclosure in India possibly limits market timing as it hampers the firms ability to follow any consistent trading strategy.

The remainder of the paper is organized as follows. Section 2 discusses the related literature on the evidence of market timing with open market repurchases. Section 3 describes the data and Section 4 details the empirical approach. Section 5 discusses the important findings and Section 6 concludes.

2 Literature Review

The early research on market timing associated with open market repurchases include [Barclay and Smith Jr \(1988\)](#), [Vermaelen \(1981\)](#), [Dann \(1981\)](#), [Ikenberry et al. \(1995\)](#) and [Ikenberry et al. \(2000\)](#). These studies focused on repurchase announcements and examined abnormal returns on repurchase stocks for a long-period following the repurchases. Substantial abnormal returns earned by the repurchase stocks were taken as evidence in support of market timing. For instance, [Ikenberry et al. \(1995\)](#) found that the 4-year abnormal ‘buy-and-hold’ return following open market repurchase announcements is about 12% in the US between January 1980 and December 1990. However, as argued by [Schultz \(2003\)](#) more repurchases are likely to be announced following price declines than price increases, the evidence of positive cross-sectional returns could then provide misleading evidence in favor of market timing, when none exists. [Chan et al. \(2007\)](#) examined repurchase timing behavior employing calendar-time method on long-term abnormal returns which is considered robust to such issues and still found significant evidence for long-term abnormal stock returns.

While the announcement based studies collectively provide some evidence to support the managerial timing ability, they are not conclusive as the actual repurchase execution could significantly differ from the announcements. Ascertaining direct evidence from the repurchase execution was difficult due to the lenient disclosure requirements of open market repurchases. This was especially true in the US, where until 2004 firms were required to disclose the number of share repurchases only on a quarterly basis.

With the availability of actual repurchase data, a number of research papers have examined the market timing issue further. [Brockman and Chung \(2001\)](#) is perhaps the first paper to examine

market timing ability with a reasonably large actual repurchase data from Hong Kong. They used benchmarks of repurchase cost through bootstrapping to compare with the actual repurchase costs. They found that the actual repurchase costs are significantly lower than their benchmarks and regarded the savings as indicative of the market timing ability. Further, they found that the market timing ability is subject to market conditions and firm-specific factors, such as market volatility, interest rates, and firm liquidity. [Cook et al. \(2004\)](#), with the data of 64 voluntarily disclosed repurchases in the US, examined whether firms were able to repurchase at a cheaper rate from the market compared to a benchmark of volume-weighted average price of non-repurchase transactions. They found some degree of support for market timing by the larger NYSE listed firms and at the same time no such evidence in the case of small firms. Contrary to [Cook et al.](#), [Brockman and Chung \(2001\)](#) did not find the firm size as an explanatory variable of the market timing. [De Cesari et al. \(2012\)](#), with the recently available monthly data of open market repurchases, re-examined the issue of managerial timing in the US. They found economically significant cost savings by the US firms through their comparison of the repurchase costs with many cost benchmarks. The average cost savings during the 19-month period following the repurchase announcements was about 0.25% of the market value of the firm. Similar to [Cook et al. \(2004\)](#), [De Cesari et al.](#) interpreted this cost savings measure as indicative of managerial timing ability. Further, they broadly found that the ownership structure substantially explains the cross-sectional variation in their market timing measure, with higher institutional ownership reducing the market timing ability. In the case of small S&P 500 firms, [Ben-Rephael et al. \(2011\)](#) also found evidence supportive of substantial market timing.

However, the cost savings from repurchases are not universally accepted as evidence of managerial timing as repurchases at low prices could be induced by price support where the managers follow a contrarian strategy and repurchase following price declines. The cost savings in this case will still be significant as the prices paid for repurchases will be lower than the prices during earlier periods. On the contrary, managerial timing requires the prices to be higher both prior and after the repurchase. [Ginglinger and Hamon \(2007\)](#) examined such a possibility with the actual monthly disclosed repurchase data of 352 French firms listed at Euronext Paris. Their proprietary dataset allowed them to identify the repurchase transactions on a daily basis, which were undisclosed to the market. They attributed the favorable prices paid by firms during their repurchase to a contrarian trading strategy, which involved repurchases following price declines. Further, they found that repurchase transactions were not followed by significant price rise. Their results primarily found evidence for price support hypothesis and not necessarily managerial timing ability. Similar results on the US

data are obtained by [Oberberger \(2012\)](#), who found that while there are significant cost savings through open market repurchases, most of it could be attributed to the price support behavior, evident in the contrarian trading approach. [Oberberger](#) further attributed the cost advantage of repurchasing firms to the widespread use of limit orders, which allows firms to partly earn the bid-ask spread. While the study by [Oberberger](#) supports the finding on cost savings, it contradicts the cross-sectional explanatory power of the ownership structure found in [De Cesari et al.](#) Overall, it appears that the available evidence on market timing remains inconclusive, as alternative motivations are also offered to explain the repurchase outcomes.

Existing research on open market repurchases does not explore the possible influence of disclosure frequency on the market timing ability. Several researches bring out that greater public disclosure of information leads to reduced information asymmetry in the market (for instance, [Eleswarapu et al., 2004](#); [Healy and Palepu, 2001](#)). As the market timing ability is related to the information asymmetry between the insiders and the outsiders, the frequent disclosure requirement in India is likely to reduce the asymmetry and hence the timing ability. Further, in such an environment the savings would be more likely from the asymmetry prevailing in the entire market rather than from firm-specific information asymmetry. Frequent disclosure of repurchases is also likely to prevent firms from following any consistent trading strategy, such as a contrarian strategy, as the market can better anticipate the presence of the firm based on their disclosures.

3 Data

The study considers all the open market repurchases in India ever since they were allowed in 1998. Data on 176 repurchase announcements, carried out until June 2012, involving 122 firms are used in the analysis. There are multiple repurchase announcements by 36 firms with the maximum number of repurchase announcements by any firm in the sample being seven*. The repurchase data are compiled from various sources. Most of the data, including the daily repurchase details are taken from the widely used database of Indian public firms - CMIE Prowess. Prowess gives the average repurchase price and quantity on every repurchase day for each repurchase. However, it does not give the closing date of repurchases (closure date). As firms could choose to close an on-going repurchase anytime within the 12 months allowed, it was not possible to locate the closure date, without

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accessing the formal declaration of closure. The closure dates for most of the repurchases are taken from the annual reports. For the more recent repurchases, where annual reports were unavailable, the closure dates are obtained from the public statement issued on the completion of each repurchase available from the SEBI's website[†]. Using this data we estimate the extent of repurchase carried out relative to the offer amount. Out of the 176, key data such as the extent of repurchase completion, weighted average repurchase price and the total number of shares bought back were not available for one repurchase and hence it was dropped from the sample. All the remaining 175 repurchase announcements constitute our sample.

The repurchase data suggests that relatively fewer firms in India announce repurchases compared to the US market. For instance, only about 2% of the BSE listed firms announced repurchases during this period as compared to about 84% during 2000 in the US (Grullon and Michaely, 2002). The total amount distributed to shareholders by way of repurchases compared to the dividends is also relatively low in India. For instance, the repurchase to dividends ratio in the US is about 58% (Grullon and Michaely, 2002) compared to 2% in India when all the repurchases are considered. The total repurchase offer amount is about ₹297 billion while the actual repurchased amount is about ₹121 billion corresponding to a repurchase completion rate of nearly 41%. This completion rate is slightly lower than the 54% reported from the US during the first year of repurchase (Stephen and Weisbach, 1998).

Details of the daily repurchase execution such as the daily volume and daily repurchase price are unavailable in some cases. For all the 175 repurchase announcements (referred as Sample-1) the total number of shares repurchased and the weighted average repurchase price paid are available. Prowess provides only partial data of daily repurchases price and volume prior to 2004. Hence, to ensure the optimal use of the available data of repurchases in India, we create sub-samples that include all the repurchases which are above a minimum cut-off in terms of the availability of daily price and volume data. These sub-samples are as follows. Sample-2 has all the repurchases where the daily buy back volume data covers at least 95% of the total repurchase volume for each repurchase. Sample-3 includes all the repurchases from Sample-2 where the daily average repurchase price is available for at least 80% of the repurchase days. Sample-2 has 123 repurchases and Sample-3 has

[†]<http://www.sebi.gov.in/sebiweb/>

93 repurchases[‡]. The study employs the three different samples as required in the empirical analysis.

The key features of the samples and the characteristics of the associated firms are provided in [Table 1](#). Panel A describes key characteristics of the firms announcing repurchase in India. As the market capitalization figures indicate, these firms are larger relative to the average listed firm in India. For instance, the repurchase firms in Sample-1 have an average market capitalization of ₹45.4 billion compared to ₹6.4 billion of the firms listed in the BSE. While these firms are bigger relative to the benchmark of the average listed firm in India, by their absolute size, most of them can only be regarded as small firms, as the market capitalization dramatically falls after the top most decile in India.[§] The repurchase firms are also more liquid relative to the market average, as indicated by their daily trading volume and the trading frequency. The stock returns during the one-year period prior to repurchase tend to suggest that firms experience a price decline prior to the repurchase announcement. On the other hand, the firms experience positive excess returns over the one-year period immediately following the commencement of the repurchase.

Panel B provides the summary of the repurchase announcements based on the three samples. The average repurchase offer amount based on Sample-1 is about ₹1.7 billion, which corresponds to nearly 3.7% of the market capitalization. The average offer size is relatively larger in the case of the smaller samples (samples 2 & 3) as they are composed of relatively bigger firms. It seems that at the announcement, firms offer a significant premium to the market price. For instance, the maximum offer price is at a premium of nearly 40% relative to the value weighted average price one-week prior to the repurchase (sample-3). Perhaps firms are encouraged to announce high premiums due to the non-obligatory feature of the open market repurchases. While the firms announce repurchases at a significant premium to the market price, the actual repurchases, however, take place at prices nearly 24% below the maximum offer price.

Panel C provides the summary of the actual repurchases carried out by firms based on samples 2 & 3. Based on Sample-2, the aggregate average repurchase per firm is only ₹0.69 billion compared to offer of ₹1.7 billion. However, the extent of repurchase carried out varies significantly across the firms. Only in about 9% (15 offers) of the repurchase announcements the entire offer amount is

[‡]The unavailability of daily price and volume data leads to the exclusion of some instances of multiple repurchases by firms. This leaves us with a greater proportion of firms in Samples 2 and 3 as compared to the sample of repurchase announcements.

[§]The market capitalization of the largest firm in India is about 250 times compared to that of the 90-th percentile firm.

bought back. For about 45% of the offers (80 offers) the extent of buyback is between 50-100%. About 14% offers end up with buyback in the range of 25-50% and the remaining buybacks (32%) range 0-25%, with 6% offers having no buy back. The number of firms without any repurchase after the announcement appears to be lower in India relative to the US, where this proportion is nearly 18-27% (Bhattacharya and Dittmar, 2003).

Panel D provides the key features of the repurchase execution. On an average firms buyback nearly 77 thousand shares per day, corresponding to about 16% of the average daily trading volume during the period of repurchase (based on Sample-2). Compared to 16% of volume as above, the ‘average of the ratio of daily repurchase volume to daily trading volume’ of nearly 39% suggests that on the repurchase day a large part of the volume is contributed by the firm.

Panel E summarizes the time taken to execute the repurchases. The average repurchase takes about 57 trading days, spanning nearly five calendar months (157 calendar days which corresponds to approximately 100 trading days). During the actual repurchase period from the first repurchase day to the last repurchase day, the firms buyback at least one share on nearly 59% of the trading days. Figure 1 gives the distribution of the time taken by firms to complete repurchases. About 20% of the repurchases are completed within about four weeks. Majority of the repurchases takes between 21 to 100 trading days and about 12% takes more than 100 trading days. As indicated by the figure, nearly one-third of the repurchases take more than 201 calendar days to complete. The longer time span taken by firms tends to suggest that firms attempt to time the repurchases as reported from other markets.

4 Methodology

4.1 Cost savings

In the initial part of the study we assess the possible cost savings to the firms by comparing the actual cost of repurchase with several other benchmark costs. These benchmarks include (a) repurchase costs based on prices bootstrapped from the distribution of actual market prices during the repurchase period and (b) volume weighted average price during the repurchase period. For each benchmark, the cost comparison is performed over two reference periods. Firstly, the maximum

allowed period of 12 months after the announcement. Secondly, the actual period of repurchase, the period between first repurchase day and the last repurchase day. These approaches are detailed below.

4.1.1 Cost saving comparison with bootstrapped results

Firms can carry out repurchases anytime during the 12 months following the announcement date. However, most of the repurchases are carried out in a much shorter time (average repurchase takes 5 months for completion) and it appears that repurchases are concentrated on a small fraction of the available trading days. A firm could accumulate shares employing many different strategies over the period, in the absence of any price specific information or liquidity constraints. Ideally, then, a benchmark to compare the repurchase cost of firms would be one which reflects the outcome of numerous accumulation possibilities. In this spirit, a benchmark cost is estimated through a bootstrapping approach similar to [Brockman and Chung \(2001\)](#).

Through the bootstrapping, 50,000 randomized repurchase cost outcomes are generated for each repurchase in the sample, using the price data corresponding to the repurchase period. Each bootstrapping generates a randomized repurchase sequence to mirror the actual repurchase. Each sequence involves, exactly the same number of repurchase days and the same repurchase volume on the repurchase days, as involved in the actual repurchase it represents. Essentially, it randomizes the days on which the repurchase takes place. On each randomized repurchase day shares are bought back at the volume weighted average price of the day. The cost of each one of the 50,000 randomized repurchase cost outcomes is compared with the actual repurchase cost. If the actual repurchase cost turns out to be cheaper for a critical number out of the 50,000 comparisons, it would be evidence in support of cost savings through repurchases.

4.1.2 Savings based on alternative benchmarks

The evidence of market timing by firms engaged in repurchase is also attempted through the comparison of the cost of repurchase with a set of average cost benchmarks in the lines of [De Cesari et al. \(2012\)](#). As in the case of the bootstrapping, we use the two reference periods to estimate the cost benchmarks. The cost benchmarks used for comparison are (a) the weighted average price during the allowed period of repurchase and (b) the weighted average price during the actual period

of repurchase.

The overall cost savings (SO), measured in comparison to any one of these benchmarks is given below:

$$SO = \frac{1}{N} \sum_{i=1}^N \frac{(\bar{p}_i^m - \bar{p}_i^r)}{\bar{p}_i^m} \quad (1)$$

where \bar{p}_i^m , is the volume weighted average market price of the stock i during the period (allowed or actual), \bar{p}_i^r the volume weighted average repurchase price of the stock, and N the total number of repurchases in the sample. We also break-down the measure of overall cost savings, SO , into cost savings due to concentrating repurchases over the relatively low-priced (a) months in the period (allowed or actual), called inter-month savings (SM) (b) days within a repurchase month, called intra-month savings (SIM) and (c) time periods within a repurchase day, called intra-day savings (SID).

The inter-month savings (SM) is the measure of the cost comparison of uniform monthly repurchase relative to the actual quantity of monthly repurchase when both are assumed to be executed at the average monthly price. It is calculated as below:

$$SM = \frac{1}{N} \sum_{i=1}^N \left[\frac{\bar{p}_i^m \times V_i - \sum_{t=1}^T \bar{p}_{i,t}^m \times V_{i,t}}{\bar{p}_i^m \times V_i} \right] \quad (2)$$

where, $\bar{p}_{i,t}^m$ is the monthly volume weighted average market price of stock i in the month t , V_i the total repurchase volume of stock i , $V_{i,t}$, the total repurchase volume of stock i in the month t , and T the total number of months in the period.

The inter-month savings (SIM) measures the cost savings that arises out of the choice of repurchase days within the months of repurchase with lower prices than the average prices in the month. It compares the cost of uniform repurchase during the repurchase months to the actual quantity of daily repurchase when both are assumed to be executed at average weighted price. This measure is given below:

$$SIM = \frac{1}{N} \sum_{i=1}^N \left[\frac{\sum_{t=1}^T \left(\bar{p}_{i,t}^m \times V_{i,t} - \sum_{d=1}^D \bar{p}_{i,td}^m \times V_{i,td} \right)}{\bar{p}_i^m \times V_i} \right] \quad (3)$$

where $\bar{p}_{i,td}^m$ is the volume weighted average market price of stock i during day d of month t , $V_{i,td}$ the repurchase volume during the day d of month t , and D is the total number of days in month t .

Intra-day savings (SID) is the cost savings from repurchasing below the weighted average price on the repurchase days. It is measured as below:

$$SID = \frac{1}{N} \sum_{i=1}^N \left\{ \frac{\sum_{t=1}^T \sum_{d=1}^D \left[\left(\bar{p}_{i,td}^m - \bar{p}_{i,td}^r \right) \times V_{i,td} \right]}{\bar{p}_i^m \times V_i} \right\} \quad (4)$$

where $\bar{p}_{i,td}^r$ is the volume weighted average repurchase price during the day d of month t for stock i . The sum of SM , SIM and SID is equal to SO .

The cost saving measures as above, do not take into account the possible difference in the repurchase size as a fraction of market capitalization across firms. As a result, these measures do not differentiate between a firm which buys back a large fraction of its equity from a firm which buys back only a small fraction. Even if both the firms manage to have the same percentage of cost savings, the total benefit to the promoter-shareholders would vary due to the extent of share capital involved. Hence, cost savings are also examined with the overall rupee savings measured against the market capitalization of the firm prior to repurchase. To reflect the extent of repurchase carried out as a fraction of the market value, the overall cost savings (SO), is modified as below:

$$SO_{MCAP} = \frac{1}{N} \sum_{i=1}^N \left[\frac{(\bar{p}_i^m - \bar{p}_i^r) \times V_i}{E_i} \right] \quad (5)$$

where, E_i is the average market capitalization of the repurchase firm i during the week immediately prior to the repurchase announcement.

4.2 Long-term abnormal returns: Calendar-time method

We further investigate whether the accumulation of shares through repurchase leads to positive wealth impact for the insiders. This is examined with long-term abnormal returns. Evidence of positive long-run abnormal returns would be supportive of the market timing ability of insiders. The abnormal returns are examined over 1-year, 2-year and 3-year periods starting either from the repurchase announcement date or from the completion date. We adopt the calendar-time method to examine the long-term abnormal returns as it is considered robust to the ‘pseudo-market timing’ argument of [Schultz \(2003\)](#). The methodology followed here is similar to [Chan et al. \(2007\)](#), where an equally weighted portfolio of repurchase stocks is formed during every calendar month. For each calendar-month t , the portfolio is formed by including all the repurchase stocks for which the repurchase related event (announcement or close of the repurchase) has occurred within a prior period of n -years (1,2 or 3 years) from month t . The abnormal returns (α s) are estimated by regressing the monthly return series of the equally weighted portfolio with the returns on the Fama-French 3-factor model as below.

$$R_t - RF_t = \alpha + \beta_{MktPrem} MktPrem_t + \beta_{SMB} SMB_t + \beta_{HML} HML_t + \eta_t \quad (6)$$

where R_t is the return on the portfolio of repurchase stocks and RF_t is the risk-free rate for the month t . $MktPrem_t$, SMB_t , and HML_t are the returns on the Fama-French 3-factors. The risk-free rate and the factor returns for the Indian market are taken from [Agarwalla et al. \(2013\)](#).

4.3 Cross-sectional determinants of cost savings

Understanding the key elements which distinguish a firm with significant repurchase cost savings from a firm with relatively low savings could be insightful for several reasons. The cross-sectional dependence of cost saving measures on firm-specific characteristics, such as information asymmetry with the outside shareholders, could indicate the timing ability of managers. Broadly, the empirical

approach employed is cross-sectional regressions of various cost saving measures. The independent variables used can be broadly classified as (a) market characteristics during the repurchase period (b) firm specific variables such as size, cash, promoter holdings etc. (c) stock specific character such as volatility, liquidity etc., and (d) repurchase characteristics such as the extent of equity bought back in the repurchase. This regression is given below:

$$CostSaving_{i,j} = \gamma_{0j} + \gamma_{1i}|RM_i| + \sum_{x=1}^n \gamma_{xi}FirmChar_{xi} + \sum_{y=1}^n \gamma_{yi}StockChar_{yi} + \sum_{z=1}^n \gamma_{zi}RepChar_{zi} + e_i \quad (7)$$

where, $CostSaving_{i,j}$ is one of the measures of cost savings of repurchase i measured as SO (Equation 1), SO_{MCAP} and Bootstrap Savings Measure (BS). SO_{MCAP} is the measure of overall cost savings expressed as a percentage of market capitalization defined in Equation 5. BS is the $1-p$ -value of the distribution of the ratio of repurchase costs to the actual costs obtained through the bootstrapping[¶].

The choice of the independent variables included in the regression is motivated by related studies on market timing such as De Cesari et al. (2012); Brockman and Chung (2001); Cook et al. (2004); Ginglinger and Hamon (2007). $|RM_i|$ is the absolute market return over the period of repurchase i . The absolute of market return is employed as a measure of the uncertainty prevailing in the overall market. The firm-specific characteristics included are (a) one-week average market capitalization before the start of repurchase (b) balance of cash and other liquid assets of the financial year immediately prior to the repurchase year, scaled by the total assets (c) free cash flow of the financial year immediately prior to the repurchase year, scaled by the total assets (d) presence of equity options measured as the ratio of the outstanding equity options to the total number of equity shares and (e) the promoter holding immediately prior to repurchase. The stock characteristics included are the (a) average volatility and (b) illiquidity during the repurchase period. The repurchase characteristics included are (a) the size of repurchase relative to market capitalization (b) the maximum offer premium (c) the extent of repurchase completed as a percentage of the target and (d) the number

[¶]Following the methodology of Cook et al. (2004). As p -value represents the critical number of cases for which repurchase cost exceeds the bootstrapped costs for each repurchase, $1-p$ -value is taken as a measure of savings.

of repurchase days.

4.4 Determinants of repurchase execution

We attempt to identify the determinants of the variation in daily repurchase undertaken by firms with the help of time series regressions of daily repurchase volume. Increase in repurchase activity is expected to follow price decline and precede price increases if the firm is timing the market (Cook et al., 2004; Ginglinger and Hamon, 2007). If the firm is also targeting price and liquidity support, the repurchase activity is expected to increase during days of low non-repurchase volume (Cook et al., 2004). For each repurchase i , we run the following Tobit regression on the daily ratio of repurchase volume to the total repurchase volume with independent variables to represent the potential determinants.

$$RVol_{it} = \beta_{0i} + \beta_{1i}RM_t + \beta_{2i} \sum_{j=1}^n RM_{t-j} + \beta_{3i}XR_{it} + \beta_{4i} \sum_{k=1}^n XR_{i,t-k} + \beta_{5i} \sum_{l=1}^n XR_{i,t+l} + \beta_{6i}Amihud_{it} + \beta_{7i}NRVol_{it} + \beta_{8i}TimeLeft_{it} + \beta_{9i}Announce_{it,-2,2} + e_{it} \quad (8)$$

where, $RVol_{it}$ is the ratio of day t repurchase volume to the total repurchase volume of stock i , RM_t is the market return on day t , RM_{t-j} , the j^{th} lag market return, XR_{it} , the excess stock return, $XR_{i,t-k}$, the k^{th} lag excess stock return, $XR_{i,t+l}$, the l^{th} lead excess stock return, $Amihud_{it}$, the Amihud's illiquidity measure of the day, $NRVol_{it}$, ratio of the non-repurchase volume to total volume of the day, $TimeLeft_{it}$, the percentage of time left out of the allowed 12-month repurchase period, $Announce_{it}$, a dummy variable indicating any firm-related announcements made on day t through the stock exchanges, and $Announce_{it,-2,2}$ is the same for announcements made during $t - 2$ to $t + 2$. These announcements made to the stock exchange, unrelated to the repurchases, are sourced from the CMIE Prowess.

The Tobit regression in Equation 8 is run for each repurchase in our sample. The coefficients of the repurchase-specific regressions are averaged as advocated in Fama and MacBeth (1973) to interpret the results, an approach similar to Cook et al. (2004).

5 Findings and discussion

5.1 Cost savings

5.1.1 Comparison with the bootstrapped costs

The results of the comparison of the actual costs with the bootstrapped costs are given in [Table 2](#). Panel A presents the results assuming that firms have the opportunity to repurchase over the allowed period of 12 months and Panel B gives the results of cost savings only over the actual repurchase period.

Panel A suggests that the repurchasing firms on an average make an overall savings of 14% (median 6%) over the bootstrapped cost. The actual repurchase cost turns out to be lower for 40% of the repurchase instances at the 5% significance level and for 34% at the 1% significant level. The extent of the cost savings is similar to those found by [Brockman and Chung \(2001\)](#) in the Hong Kong market. Overall cost savings are substantially positive and consistent for repurchases in most of the years. The savings appears to be greater during years 2005 and 2009. Possibly, the substantial market rise during these years could be behind the higher savings. However, for those repurchases initiated in the three years, 2006, 2010 and 2011, the overall bootstrapped costs turns out be greater than the actual costs. As the sample period covers the sub-prime induced financial market crisis of 2008, the repurchases announced during this period could substantially bias our results. Hence, we also examine the cost savings after excluding the repurchases announced during this period. Similar approach is adopted in the research on repurchases elsewhere (for instance, [Grullon and Michaely, 2004](#)). These repurchases corresponds to a seven month period from September 2008 to March 2009^{||} and excludes 32 (31) repurchases from Sample-1 (Sample-2).

When these 31 repurchases are excluded, the overall cost savings declines to 9%. The median firm in the sample then does not make any cost savings. The savings after excluding the crisis period is limited to fewer firms as compared to the savings when these firms are included. For instance, the actual cost turns out to be lower for only about 34% of the instances at the 5% significance level and for about 27% at the 1% significant level.

^{||}The choice of the seven months period is based on the widely circulated sub-prime crisis timelines.

As presented in Panel B of the table, if the actual period of repurchase is considered, the savings almost fully disappear for most of the firms. The repurchases end up paying the same as the bootstrapped benchmark. Most of the firms repurchase shares at a cost greater than the bootstrapped benchmark as indicated by the percentage firms with actual repurchase costs below the bootstrapped at various pseudo p-values. For instance, at the 5% (1%) significance level only about 22% (about 17%) have costs below the bootstrapped benchmarks. The drop in savings measure in the actual period of repurchase indicates that firms are able to concentrate their repurchase in specific months of the allowed 12 months period of repurchase when prices are lower.

5.1.2 Comparison with the weighted average costs

The results of the comparison of actual repurchase costs relative to the weighted average price benchmarks (equations 1-5) are given in [Table 3](#) and [Table 4](#). The cost saving measures in [Table 3](#) are computed over the allowed period of 12 months. [Table 4](#) gives the estimate of the cost savings over the actual period of repurchase.

Comparison with the benchmark costs suggests that there are statistically and economically significant gains for the repurchasing firms. The comparison of the actual repurchase costs to the weighted average benchmarks suggests that there is nearly 9% savings for the repurchasing firms. This corresponds to an aggregate savings of nearly 2% on the total repurchase value of ₹121 billion. This extent of the cost savings are similar to those reported by [De Cesari et al. \(2012\)](#). Majority of the sample firms are able to have cost savings through open market repurchases. Even when the crisis induced repurchases are excluded, the overall savings are significant around 5%. However, these figures might overstate the actual wealth impact for the insiders from the repurchases as transaction costs are ignored.

We also attempt to examine whether the firms are able to concentrate the repurchases around those time periods with relatively low valuations. The average inter-month savings are around 10.5%. On the other hand, the savings from the choice of specific repurchase days within a month appears to be relatively low, as suggested by the magnitude of the intra-month savings (0.9%). The intra-day savings measure (*SID*) is negligible. Evidently, most of the savings can be attributed to the choice of months with relatively low average prices. This is similar to the result obtained with bootstrapping where the drop in savings from the allowed repurchase period to the actual period indicates the

ability of firms to choose specific periods. We also observe that the overall savings measure drops from 9% to 2% when the benchmarks are measured in the actual period of repurchase (Table 4). This possibly suggests that the signaling effect and the price impact due to the repurchases plays out in the market gradually along with pace of the repurchase rather than in a burst at the initial phase. Such a market response would have lifted prices in the initial phase leaving little advantage for extending repurchases. Table 5 gives the cost savings (SO) by the repurchasing firms on yearly basis. Similar to the results found in the bootstrapping, the maximum cost savings are observed in the case of firms which announced repurchases in the years 2005 and 2009. It is likely that the overall market returns during these periods (BSE Sensex surged 41% in 2005 and 76% in 2009) drive up the cost savings for the firms.

Overall, we find evidence of significant cost savings from the open market repurchase, similar to markets such as the US, France and Hong Kong. We further investigate whether the cost effective accumulation of shares lead to wealth impact for the insiders. This is examined with short-run and long-run abnormal returns. Evidence of positive long-run abnormal returns would be supportive of the market timing ability of insiders. We examine this aspect of repurchases below.

5.2 Long-term abnormal returns: Calendar-time method

The abnormal returns are examined over 1-year, 2-year and 3-year periods starting either from the repurchase announcement date or from the completion date. The estimated α s based on the Fama-French three-factor model are given in Table 6. The results indicate that the repurchase stocks do not earn significant positive abnormal returns over a long-run. As indicated by the α s, the abnormal stock performance deteriorate over longer periods. The evidence of no abnormal returns contrasts those from many other markets including the US (for instance, Chan et al., 2007; Peyer and Vermaelen, 2009). Even for the one-year period from the repurchase announcement, which almost overlaps with the repurchase execution period, the α is not significant. This result suggests while the cost saving measures as above indicate significant savings, they do not translate into positive risk-adjusted returns for the insiders.

The cost savings over the repurchase period which suggest some market timing ability need to be examined through cross-sectional and time-series regressions involving various aspects of the repur-

chase activity. The results are discussed in the following sections.

5.3 Cross-sectional variation in cost savings

The study attempts to further examine the observed cross-sectional variation in the cost savings to ascertain whether there is evidence supportive of market timing. The significant cost savings found in the Indian market would be attributable to the market timing ability if they are explained by firm-specific variables commonly used to measure information asymmetry. On the other hand, the frequent disclosure requirement in India might reduce the asymmetry between insiders and outsiders, leaving limited scope for market timing. In this case, the observed variation in the cost savings would be explained by the overall market uncertainty and the repurchase characteristics rather than the firm-specific variables.

The results of the regressions (Equation 7) are given in Table 7. It appears that most of the stock and the firm characteristics do not offer any significant explanation for the cross-sectional variation in the cost savings. The firm size (*LogMcap*) has low significance in some regressions. The negative coefficient of *LogMcap* is consistent with a lower information asymmetry of the larger stocks. Obernberger (2012); Cook et al. (2004) found a similar role of size on market timing in the US. However, *LogMcap* turns out insignificant for market timing regressions of the repurchase sample excluding repurchases during the 2008 crisis period. This tends to suggest that larger firms have higher ability to time the market during the crisis period. The significance of the stock volatility (*Vol*) indicates better cost savings with less volatile stocks. However, the stock volatility is also not significant across the regressions. De Cesari et al. also report negative coefficients for some of their cross-sectional regressions. Noticeably, unlike De Cesari et al., we do not find any significant influence of insider ownership on the cost savings.

The insignificance of the firm variables, which proxy for information asymmetry, suggests that the market timing ability does not vary significantly with the firm-specific information environment. This is despite the documented evidence of greater information asymmetry in the emerging markets.

On the other hand, we find that the absolute market return during the period significantly explains the cross-sectional variation in the cost saving measures, a result similar to Brockman and Chung (2001) in the Hong Kong market. The other significant variable in the regressions is the extent of

repurchase completed relative to the target (*Success*), which negatively influences the cost savings. This result is somewhat intuitive as a larger quantity of repurchase would reduce the opportunity to time the market.

This finding that the cost savings is explained primarily by market conditions and not by the firm-specific factors, contrary to the US market, possibly suggests that the greater degree of disclosure requirement counters the information asymmetry induced market timing ability of insiders.

5.4 Determinants of repurchase execution

Figure 2 plots some of the repurchase styles along with the adjusted stock prices, when the repurchases are sorted on the (a) frequency of repurchase (b) stock liquidity and (c) ratio of the target volume to the average trading volume. We observe significant variation in the repurchase execution styles across firms. The firm that ranks the highest on liquidity appears to concentrate its repurchase relative to the least liquid firm.

The results of the Fama-MacBeth regressions, which examine the possible determinants of the repurchase execution (described in Section 4.4) are given in Table 8. The results indicate that neither the contemporaneous nor the lagged excess stock returns offer any significant explanation for the variation in daily repurchase volumes. This is contrary to the results found in the other markets. For example, Cook et al. (2004) found that the NYSE firms increase their repurchase activity when the contemporaneous excess return and the lagged 3-day cumulative excess returns are lower. Ginglinger and Hamon (2007) found that repurchases are preceded by 2-day price drop and not followed by any price increase suggesting a contrarian trading in the French market. Unlike the US and France, the frequent disclosure requirement in the Indian market is likely to limit firms from following any consistent trading strategy, thus limiting both the market timing ability and contrarian trading.

The lagged market return also provides only limited explanation, suggesting that the firms increase repurchase activity following market rise. However, the results do not hold uniformly across the different regressions. On the other hand, we find a negative relation between the repurchase activity and the stock illiquidity, as reflected in the significant negative coefficients of $Amihud_{it}$. The increase in the liquidity on heightened repurchase is also evident in the significant negative coefficients

of the non-repurchase volume. This is perhaps due to the firms' choice of days with the maximum price impact, which provides evidence for price and liquidity support as motivating factors. The period left has a positive coefficient suggesting greater repurchases in the early stages.

We find no evidence in support of market timing or contrarian trading based on the results. However, we find that the price or liquidity support could be behind the repurchase executions, both of which we intend to examine in a later study.

6 Conclusions

Our study contributes to the understanding of the cost saving ability of insiders through open market repurchases in a regulatory environment of frequent disclosures. Indian firms are required to disclose their repurchase activity on a daily basis to the market. We study all the open market repurchases initiated in India until June 2012. We find the presence of significant cost savings for firms from open market repurchases in India against various benchmarks. The comparison of the actual repurchase costs to the weighted average benchmarks suggests that there are significant savings for the repurchasing firms. Similar results are obtained using bootstrapping where for each repurchase we generate 50,000 random sequence of repurchase and compare the costs of these sequences with actual repurchase costs.

We also observe that most of the savings are attributable to the choice of months as is evident from (a) significant drop in savings when we use the period between the start of repurchase to end of repurchase as reference period instead of the allowed 12-months period of repurchase (b) the large and significant inter-month cost savings and (c) the negligible intra-day cost savings. More importantly, most of the cross-sectional variations in the cost savings are explained by the overall market returns in India and not by the firm characteristics. This finding is contrary to the findings from the US where the firm characteristics significantly explain the variation in the cost savings across firms. For instance, in the US a greater degree of insider ownership is associated with greater savings ability. This provides evidence that more frequent disclosure of repurchase activity in India possibly reduces the information asymmetry between the insiders and the outsiders thereby limiting the market timing ability of insiders.

We also study the time variation in the repurchase activity by firms. Contrary to the findings from the US and French market we do not find any role of past or concurrent stock returns in explaining the repurchase activity. This evidence tends to suggest that the frequent disclosures in India limit the ability of managers to follow a consistent strategy of trading such as contrarian trading found in the US and French markets. The inverse relation between repurchase activity and non-repurchase volume possibly suggests price support over market timing. This empirical outcome brought about by the stricter regulatory disclosure requirements could offer useful lessons to the rest of the world in regulating the execution of open market repurchases.

While the cost savings appear significant its realistic wealth impact on the insiders is likely to be lower as transaction costs are not considered in the analysis. It is also possible that the cost savings are overestimated for the less liquid firms where the impact of the repurchase transactions could significantly influence the prices upwardly. This enquiry is part of an on-going work undertaken by us. Moreover, there are no risk-adjusted excess returns earned by the insiders on their holdings either in the short-run (one-year) or in the long-run (three years) when examined with calendar-time regression approach. These results cast doubts on the market timing ability of repurchasing firms in India.

We intend to develop this research in several ways. Firstly, as our results tend to indicate that frequent disclosure of repurchases possibly reduces the information asymmetry, we expect the same to be reflected in the market microstructure variables which capture information asymmetry. Particularly, we intend to examine the behavior of (a) bid-ask spreads (b) adverse selection component of the bid-ask spreads and (c) depth, around the repurchase days. Secondly, we intend to examine how the employment of disclosed limit orders by firms for repurchases impact the order characteristics of the firm on a real-time basis. Finally, we also intend to explore the role of price support in repurchase execution. These aspects are part of an on-going research undertaken by the authors.

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Figure 1: Time taken for repurchase execution

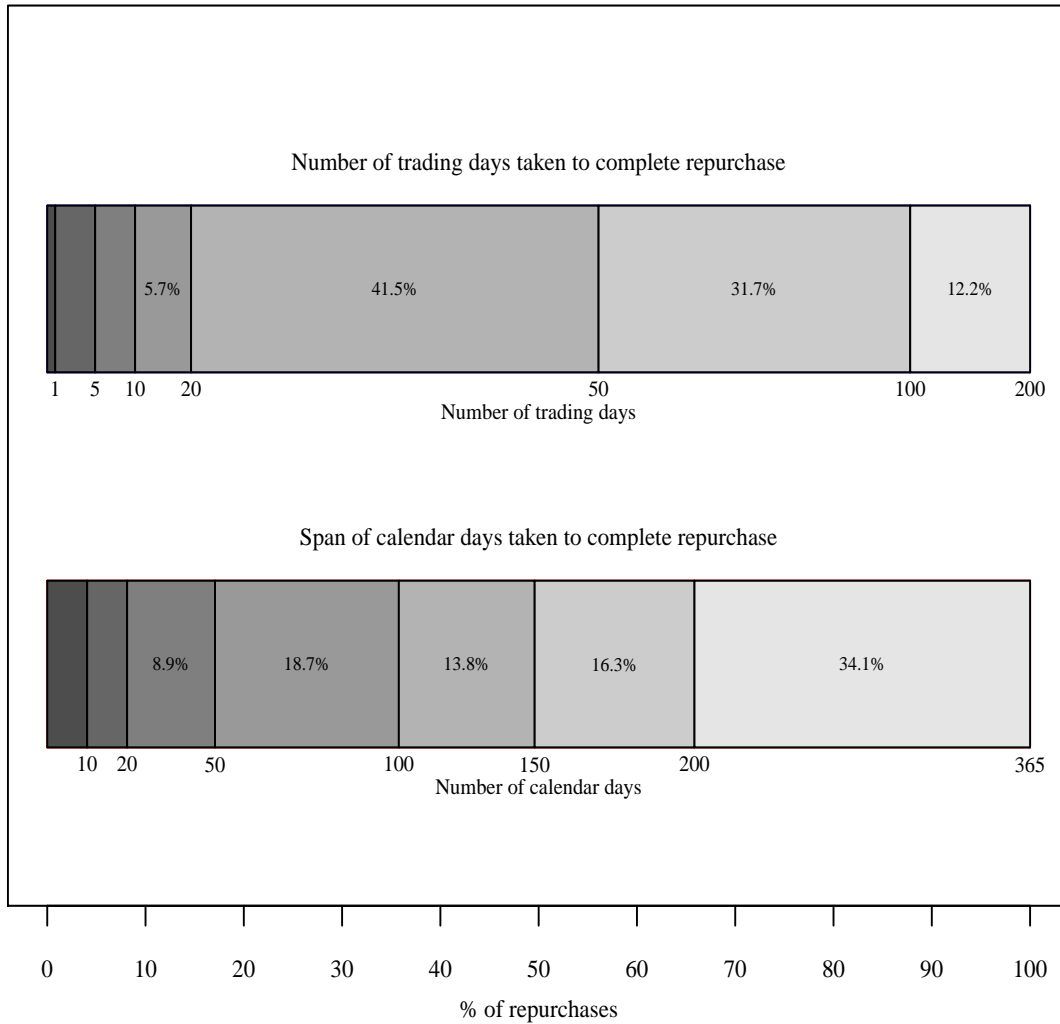
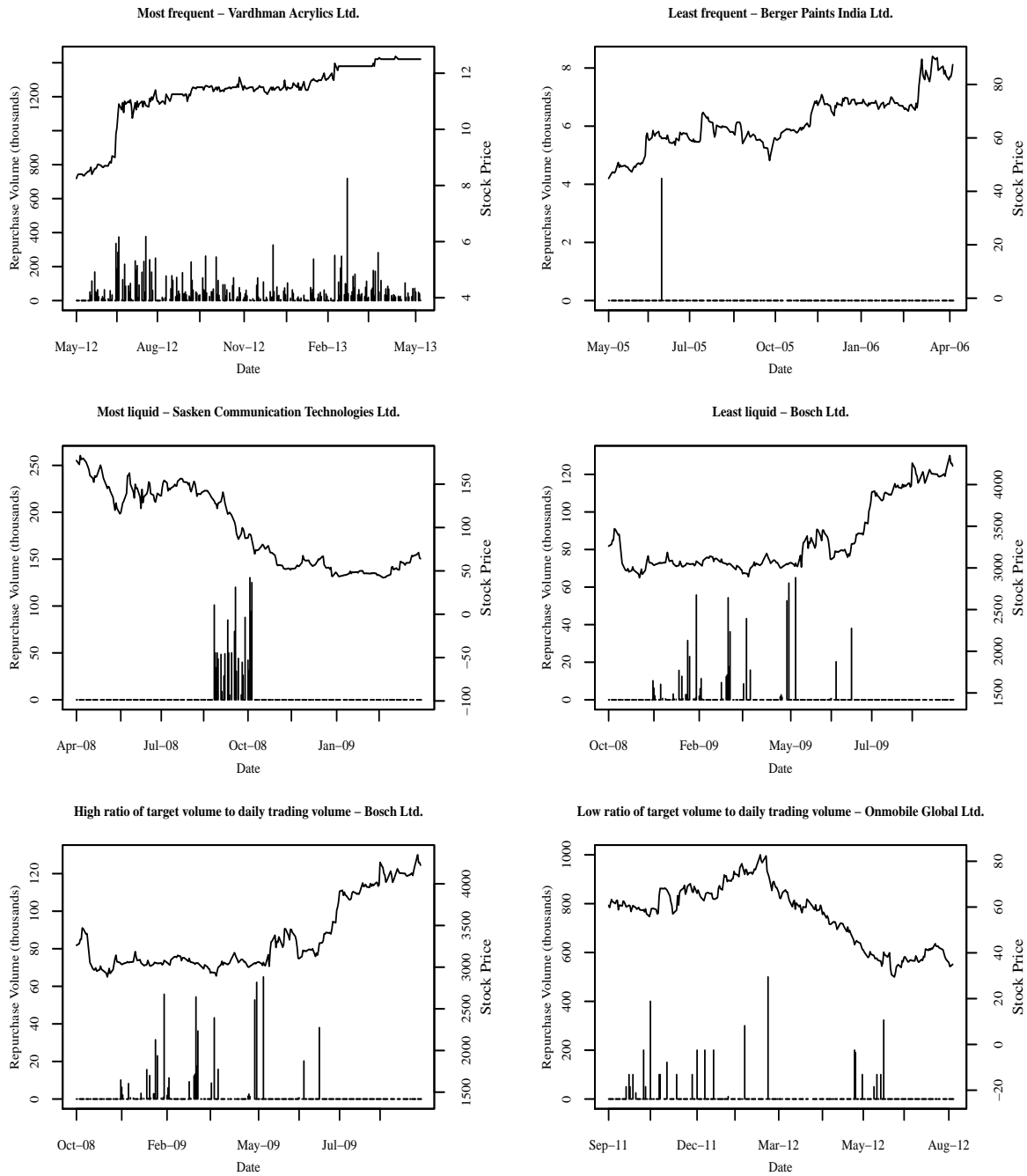


Figure 2: Repurchase styles across firms in the sample



The bar represents the repurchase volume in thousands and the line represents the adjusted stock price. The repurchases selected here are extremes of sorting based on (a) frequency of repurchase (b) stock liquidity (c) ratio of target repurchase volume to daily volume.

Table 1: Summary of repurchase announcements and execution

Measure		Overall Sample (Sample-1)	Subsample with daily repurchase volume data (Sample-2)	Subsample with both daily volume and price data (Sample-3)
Total number of repurchases		175	123	93
Number of firms	No. of listed firms = 5,179	121	96	73
Panel A: Firm characteristics (figures are averages across the repurchase sample)				
Market capitalization (₹ bn)	Market Avg. = 6.4	45.4	58.6	75.7
Market capitalization decile w.r.t all BSE stocks (10 is largest)		8.4	8.4	8.8
Daily trading volume (thousand shares)	Market Avg. = 47.8	644.9	802.6	952.0
Daily trading volume (₹ million)	Market Avg. = 6.8	171.3	221.4	282.0
% of trading days with one or more shares traded during the year of repurchase		98.5	99.7	99.9
Stock return over the one-year period prior to repurchase (%)		2.4 (-8.3)	-11.5 (-18.1)	-13.5 (-19.7)
Excess stock return over one-year period prior to repurchase (%)		5.9 (-5.8)	-5.5 (-9.4)	-5.6 (-9.4)
Stock return over the one-year period from the start of repurchase (%)		37.5 (22.5)	41.4 (24.2)	44.1 (27.2)
Excess return over the one-year period from the start of repurchase (%)		10 (-4.3)	12.5 (-6.2)	16.1 (1)
Cross-sectional std. deviation of the sock returns over the one-year period from the start of repurchase (%)		74.7	79.8	82.9
Panel B: Characteristics of repurchase offers				
Offer amount per repurchase (₹ bn)		1.7	2.1	2.7
Sum of repurchase offer amounts / Sum of market capitalization of repurchase firms		3.7%	3.6%	3.6%
Average of offer amount to market capitalization ratios		10.3%	8.8%	8.1%
Average of maximum premium proposed as % of 1-week vwap before announcement		41.3%	36.8%	36.5%
Panel C: Repurchase characteristics				
Total value repurchases made by all firms (₹ bn)		121.1	111.6	104.4
Average amount per repurchase (₹ billion)		0.7	0.9	1.1
Overall completion rate (ratio of repurchased amount to offer amount)		41.3%	42.3%	40.6%
Total number of shares repurchased (thousands)		683,229	539,147	469,642
Average deviation of vwap repurchase price relative to the maximum offer price		-23.7%	-24.3%	-25.3%
Panel D: Repurchase execution characteristics				
Number of shares purchased per repurchase day (thousands)			77.5	91.1
Value of shares purchased per repurchase day (₹ million)			NA	19.2
Total no. of shares repurchased to total trading volume during the repurchase days			15.6%	15.2%
Avg. of the ratio of daily repurchase volume to daily trading volume during the repurchase days			39.5%	35.2%
Avg. of the ratio of daily repurchase value to market capitalization during the repurchase days			NA	0.2%

Continued on next page

Table 1 – continued from previous page

Measure	Overall Sample (Sample-1)	Subsample with daily repurchase volume data (Sample-2)	Subsample with both daily volume and price data (Sample-3)
Panel E: Time duration of repurchases			
Number of trading days covered by the sample period		2,181	2,043
Repurchase firm-days over the sample period = sum of the no. of repurchase days across firms		6,950	5,147
Average number of trading days taken to complete repurchase		56.5	55.3
Average span for each repurchase (calendar days)		156.5	151.8
Average span for each repurchase (trading days)		106.2	103.5
Average % of repurchase days in the span		58.6%	58.9%

No. of listed firms refers to the average of the yearly number of listed firms in the Bombay Stock Exchange (BSE) during the period from 2000 - 2012. All the figures of firm characteristics are averages across firms involved in the sample of repurchases and the figures in the parentheses, wherever given, are their corresponding medians. The market capitalization of firms is the average market capitalization during the week immediately prior to the repurchase related board meeting. The market capitalization decile of each firm is assigned with respect to the population of firms listed in the BSE during the financial year of the repurchase announcement. The 'repurchase period' refers to the period between the announced start of the repurchase (announced opening date) and its announced close. The measures of daily trading volume, expressed in terms of the number of shares as well the value, both represent the overall averages during the repurchase periods covered by the sample. The turnover related 'Market Avg.' denotes the average figure for all the firms listed in the BSE during the 2000-2012 period. The 'year of repurchase' refers to the calendar year of a repurchase. The average (median) stock return is the price return on a stock. The excess stock return is measured against Sensex, a stock index on the BSE listed firms in India. Offer amount is the maximum value of shares targeted in each repurchase. 'vwap' is the volume weighted average price. The sample period is the number of calendar days covered by the repurchase periods in the sample. 'repurchase day' refers to days within the repurchase period with a non-zero repurchase volume. The overall completion rate is the ratio of total repurchase amount to the total offer amount. The number of shares purchased per repurchase day is estimated as the ratio between the total number shares repurchased to the number of repurchase days. The value of shares purchased per repurchase day is estimated as the total rupee value of repurchases divided by the total number of days taken for the repurchase. Number of trading days covered by the sample period is the total number of non-overlapping trading days during the sample period. The span of repurchase is the calendar time between the date of first repurchase and the date of last repurchase.

Table 2: Market timing ability based on bootstrapped costs

Year	Number of repurchase		Ratio of bootstrapped cost to actual cost			Number (%) of repurchases with pseudo-p-value less than		
	Count	Days	Min	Mean (Median)	Max	1%	5%	10%
Panel: A - Allowed period of repurchase								
2004	2	48	0.95	1.16 (1.16)	1.55	1 (50.00)	2 (100.00)	2 (100.00)
2005	3	44	0.95	1.39 (1.44)	1.85	2 (66.67)	3 (100.00)	3 (100.00)
2006	4	196	0.62	0.96 (0.96)	1.30	0 (0.00)	0 (0.00)	0 (0.00)
2007	6	332	0.57	1.13 (1.10)	1.93	3 (50.00)	3 (50.00)	3 (50.00)
2008	39	2,376	0.28	1.14 (1.05)	3.58	14 (35.90)	14 (35.90)	14 (35.90)
2008*	17	1,117	0.38	0.97 (0.95)	2.61	3 (17.65)	3 (17.65)	3 (17.65)
2009	23	973	0.77	1.26 (1.18)	2.46	11 (47.83)	13 (56.52)	15 (65.22)
2009*	14	696	0.81	1.12 (1.06)	2.09	5 (35.71)	6 (42.86)	7 (50.00)
2010	10	406	0.71	0.98 (0.96)	1.40	1 (10.00)	1 (10.00)	1 (10.00)
2011	25	1,502	0.37	1.01 (0.98)	2.30	6 (24.00)	9 (36.00)	10 (40.00)
2012	11	1,073	0.80	1.07 (0.99)	2.30	4 (36.36)	4 (36.36)	4 (36.36)
Overall	123	6,950	0.28	1.14 (1.06)	3.58	42 (34.15)	49 (39.84)	52 (42.28)
Overall*	92	5,414	0.37	1.09 (0.99)	2.61	25 (27.17)	31 (33.70)	33 (35.87)
Panel: B - Actual period of repurchase								
2004	2	48	0.96	0.98 (0.98)	1.01	0 (0.00)	0 (0.00)	0 (0.00)
2005	3	44	0.92	1.06 (1.00)	1.24	1 (33.33)	1 (33.33)	1 (33.33)
2006	4	196	0.94	1.05 (1.00)	1.30	1 (25.00)	1 (25.00)	1 (25.00)
2007	6	332	0.86	0.99 (0.99)	1.24	0 (0.00)	0 (0.00)	0 (0.00)
2008	39	2,376	0.65	1.00 (1.00)	1.55	7 (17.95)	10 (25.64)	12 (30.77)
2008*	17	1,117	0.65	0.98 (0.98)	1.55	1 (5.88)	2 (11.76)	3 (17.65)
2009	23	973	0.68	1.01 (1.00)	1.66	2 (8.70)	4 (17.39)	4 (17.39)
2009*	14	696	0.90	1.00 (1.00)	1.18	0 (0.00)	2 (14.29)	2 (14.29)
2010	10	406	0.86	1.00 (1.00)	1.13	4 (40.00)	4 (40.00)	5 (50.00)
2011	25	1,502	0.47	1.00 (1.00)	2.27	4 (16.00)	5 (20.00)	6 (24.00)
2012	11	1,073	0.88	0.98 (0.98)	1.07	2 (18.18)	2 (18.18)	2 (18.18)
Overall	123	6,950	0.47	1.01 (1.00)	2.27	21 (17.07)	27 (21.95)	31 (25.20)
Overall*	92	5,414	0.47	1.01 (1.00)	2.27	13 (14.13)	17 (18.48)	20 (21.74)

The allowed period of a repurchase is the 12 months period from the announcement of the repurchase. The actual period of a repurchase is the calendar time between the first repurchase and the last repurchase in an announced repurchase program. Repurchase days denote the total number of trading days with a non-zero repurchase volume during the repurchase period. The bootstrapped cost is estimated by randomizing the each of the actual repurchase sequence over the allowed repurchase period or over the actual repurchase period 50,000 times. The cost measures are bootstrapped costs scaled by the actual cost of repurchase. The number (%) of repurchases below a certain pseudo p-value indicates the number (%) of repurchases out of the sample having its repurchase cost above the bootstrapped cost in only p% cases out of the 50,000 bootstrapped accumulation strategies. The number of repurchases shown in any year are the repurchases announced in that year. The ‘*’ indicates the repurchases after excluding the 31 repurchases from Sample-2 within the sub-prime crisis period. This corresponds to a period of seven months between September 2008 and March 2009.

Table 3: Savings estimated w.r.t. benchmark calculated over the allowed period of repurchase

Variable	Number	% Cost savings					% Repurchase with	
		Mean	Median	SD	Max	Min	positive savings	>5% savings
Panel: A - All repurchases								
<i>SO</i> - Sample 1	165	8.9***	5.5***	19.7	61.3	-66.7	68.5	50.9
<i>SO_{MCA}P</i> - Sample 1	165	0.5***	0.1***	1.2	7.0	-1.7	68.5	1.8
<i>SO</i> - Sample 3	93	11.4***	7.2***	22.4	61.4	-66.2	72.0	60.2
<i>SM</i> - Sample 3	93	10.5***	6.8***	21.6	56.1	-63.2	69.9	58.1
<i>SIM</i> - Sample 3	93	0.9***	0.6***	2.3	9.3	-7.0	68.8	5.4
<i>SID</i> - Sample 3	93	-0.0	-0.0	0.5	1.9	-1.8	47.3	0.0
Panel: B - All repurchases excluding 2008 crisis								
<i>SO</i> - Sample 1	133	4.8**	2.2***	16.9	52.6	-66.7	63.2	43.6
<i>SO_{MCA}P</i> - Sample 1	133	0.2**	0.1***	0.9	6.4	-1.7	63.2	0.8
<i>SO</i> - Sample 3	70	6.2*	6.4**	19.7	42.9	-66.2	67.1	55.7
<i>SM</i> - Sample 3	70	5.8*	5.3**	19.0	42.9	-63.2	65.7	52.9
<i>SIM</i> - Sample 3	70	0.4.	0.3*	1.9	8.3	-7.0	61.4	2.9
<i>SID</i> - Sample 3	70	-0.0	-0.0.	0.5	1.9	-1.8	44.3	0.0

Sample-1 is the set of 165 repurchases where only the overall weighted average repurchase price and total volume are available (excluding 10 announcements without any repurchase). Sample-3 is a subset of Sample-1, where the daily weighted repurchase price and daily volume are also available. *SO* is the overall cost savings as defined in Equation 1. *SM* is the cost savings due to concentrating repurchases over the relatively low-priced months, calculated as per Equation 2. *SIM* is the cost savings due to concentrating repurchases over the relatively low-priced days, defined as per equation Equation 4. *SID* denotes the cost savings due to concentrating repurchases over the relatively low-priced time periods within a repurchase calculated as per Equation 4. The non-crash savings figures are estimated by excluding repurchases within the sub-prime crisis period. This corresponds to a period of seven months between September 2008 and March 2009. This eliminates 32 from Sample-1 and 23 from Sample-3. '***', '**', '*', and '.' indicate the 0.1%, 1%, 5%, and 10% significance levels respectively.

Table 4: Savings estimated w.r.t. benchmark calculated over the actual period of repurchase

Variable	Number	% Cost savings					% Repurchase with	
		Mean	Median	SD	Max	Min	positive savings	>5% savings
Panel: A - All repurchases								
<i>SO</i> - Sample 2	123	2.2**	0.8***	8.5	32.1	-34.7	61.8	22.8
<i>SO_MCAP</i> - Sample 2	123	0.1*	0.0**	0.5	5.1	-1.7	61.8	0.8
<i>SO</i> - Sample 3	93	2.7**	1.1***	7.8	32.1	-17.1	64.5	26.9
<i>SM</i> - Sample 3	93	1.9*	0.1**	7.0	31.9	-20.1	55.9	17.2
<i>SIM</i> - Sample 3	93	0.8**	0.4***	2.5	18.1	-6.5	68.8	3.2
<i>SID</i> - Sample 3	93	0.0	-0.0	0.6	2.3	-1.8	47.3	0.0
Panel: B - All repurchases excluding 2008 crisis								
<i>SO</i> - Sample 2	92	1.0	0.3*	7.7	32.1	-34.7	57.6	16.3
<i>SO_MCAP</i> - Sample 2	92	0.0	0.0.	0.3	0.6	-1.7	57.6	0.0
<i>SO</i> - Sample 3	70	1.7*	0.8*	7.1	32.1	-17.1	58.6	22.9
<i>SM</i> - Sample 3	70	1.2	0.1.	6.4	31.9	-20.1	55.7	17.1
<i>SIM</i> - Sample 3	70	0.5*	0.2**	1.8	7.3	-6.5	67.1	2.9
<i>SID</i> - Sample 3	70	-0.0	-0.0.	0.6	2.3	-1.8	44.3	0.0

Sample-2 is the set of 123 repurchases, where the overall weighted average repurchase price, total volume and daily repurchase volume are available. Sample-3 is a subset of Sample-2, where the daily weighted repurchase price is also available. *SO* is the overall cost savings as defined in Equation 1. *SM* is the cost savings due to concentrating repurchases over the relatively low-priced months, calculated as per Equation 2. *SIM* is the cost savings due to concentrating repurchases over the relatively low-priced days, defined as per equation Equation 4. *SID* denotes the cost savings due to concentrating repurchases over the relatively low-priced time periods within a repurchase calculated as per Equation 4. The non-crash savings figures are estimated by excluding repurchases within the sub-prime crisis period. This corresponds to a period of seven months between September 2008 and March 2009. This eliminates 31 from Sample-2 and 23 from Sample-3. ‘***’, ‘**’, ‘*’, and ‘.’ indicate the 0.1%, 1%, 5%, and 10% significance levels respectively.

Table 5: Yearly Distribution of Savings

Variable	Number	% Cost savings					% Repurchase with	
		Mean	Median	SD	Max	Min	positive savings	>5% savings
Panel: A - Cost savings during the allowed repurchase period								
1999	1	8.4	8.4		8.4	8.4	100.0	100.0
2000	4	-2.5	-4.4	5.4	5.5	-6.6	25.0	25.0
2001	11	6.6	4.5	9.2	19.2	-8.8	81.8	45.5
2002	13	6.7	0.5	17.8	43.8	-18.1	53.8	38.5
2003	5	2.2	1.0	6.6	13.2	-3.1	60.0	20.0
2004	3	15.0	16.2	6.4	20.7	8.2	100.0	100.0
2005	6	20.1	26.0	17.1	33.7	-11.5	83.3	83.3
2006	5	-0.7	0.1	4.5	3.5	-7.3	60.0	0.0
2007	6	14.0	15.3	22.0	37.2	-19.8	83.3	66.7
2008	40	11.5	10.5	24.1	61.3	-66.7	75.0	68.1
2008*	17	-3.3	2.2	25.3	31.0	-66.7	58.8	47.1
2009	23	22.0	22.0	14.1	56.3	-4.5	91.3	87.9
2009*	14	13.8	7.4	15.8	52.6	-4.5	85.7	64.3
2010	10	1.5	-0.4	5.6	12.8	-5.6	50.0	30.0
2011	27	-0.4	-0.7	16.3	38.9	-36.1	44.4	33.3
2012	11	7.5	1.8	15.0	36.5	-9.1	72.7	36.4
SO	165	8.9	5.5	19.7	61.3	-66.7	68.5	50.9
SO*	133	4.8	2.2	16.9	52.6	-66.7	63.2	43.6
Panel: B - Cost savings during the actual repurchase period								
2004	2	-0.3	-0.3	0.8	0.2	-0.9	50.0	0.0
2005	3	5.8	-0.4	11.5	19.0	-1.2	33.3	33.3
2006	4	4.9	0.7	9.8	19.5	-1.3	50.0	25.0
2007	6	0.3	0.5	3.2	4.8	-5.2	66.7	0.0
2008	39	3.1	2.0	8.6	28.1	-22.5	66.7	60.7
2008*	17	1.0	0.3	9.3	15.3	-22.5	52.9	29.4
2009	23	4.4	1.1	8.3	28.0	-6.3	73.9	76.7
2009*	14	2.2	1.2	2.5	6.3	-1.6	78.6	14.3
2010	10	1.4	0.3	2.9	6.7	-1.8	60.0	10.0
2011	25	-0.1	-0.0	11.1	32.1	-34.7	48.0	20.0
2012	11	-0.1	0.5	3.5	2.7	-9.8	63.6	0.0
SO	123	2.2	0.8	8.5	32.1	-34.7	61.8	22.8
SO*	92	1.1	0.3	7.7	32.1	-34.7	57.6	16.3

The cost savings represent the overall cost savings (*SO*) measured as per Equation 1. Sample-1 is the set of 165 repurchases where only the overall weighted average repurchase price and total volume are available. The actual period results are for Sample-2, which is a set of 123 repurchases where the overall weighted average repurchase price, total volume and daily repurchase volume are available. The ‘*’ indicates the repurchases after excluding 32 repurchases from Sample-1 and 31 repurchases from Sample-2 that are initiated within the crisis period (from September 2008 to March 2009).

Table 6: Calendar time regression – long-term returns

	Announcement date as event			Close of repurchase as event		
	1-Year	2-Year	3-Year	1-Year	2-Year	3-Year
α	1.08	1.34	1.00	1.05	0.35	0.06
$\beta_{MktPrem}$	0.84***	0.84***	0.85***	0.96***	0.94***	0.96***
β_{SMB}	0.57**	0.59**	0.61**	0.61***	0.56***	0.52***
β_{HML}	0.03	0.13	0.17	0.23*	0.24**	0.23***
Adj. R ²	0.24	0.26	0.27	0.58	0.68	0.73
Num. obs.	166	169	169	152	153	153

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

The α s and β s are estimated by regressing the monthly return series of equally weighted portfolios of the repurchase stocks, with the return on the Market (*MktPrem*), *SMB* and *HML* factors. For each calendar-month t , the portfolio is formed by including all the repurchase stocks for which the repurchase related event (announcement or close of the repurchase) has occurred within a period of n -years (1,2 or 3 years) before that month t . The number of observations is the number of calendar-months for which we find at least one repurchase stock with event within n -years.

Table 7: Cross-sectional regressions of the measures of cost savings

Variable	All repurchases			All repurchases excluding 2008 crisis		
	<i>SO</i>	<i>SO_{MCA}P</i>	<i>BS</i>	<i>SO</i>	<i>SO_{MCA}P</i>	<i>BS</i>
	Sample-2	Sample-2	Sample-2	Sample-2	Sample-2	Sample-2
Intercept	55.67**	1.92	139.14***	25.78	0.99	105.85*
<i>RM</i>	0.22***	0.01***	0.35**	0.16*	0.01**	0.36*
Firm Characteristics						
<i>LogMcap</i>	-2.95**	-0.16*	-1.97	-1.43	-0.12	0.32
<i>Cash</i>	-0.09	-0.01	-0.33	-0.10	-0.01	-0.66*
<i>Cashflow</i>	0.15	0.01	0.33	0.14	0.01	-0.01
<i>Options</i>	-0.93	-0.08	-3.21	-0.63	-0.05	-2.98
<i>PromHolding</i>	-0.02	-0.01	-0.25	0.23	0.01	0.22
Stock Characteristics						
<i>Vol</i>	-3.84*	-0.09	-10.35*	-4.93*	-0.08	-14.47**
<i>Amihud</i>	-0.01	0.00	-0.01	0.00	0.00	-0.01
Repurchase Characteristics						
<i>PerOffer</i>	-0.06	0.05	-0.37	0.25	0.05	0.34
<i>PremOffer</i>	-0.10	0.00	-0.17	-0.02	0.00	-0.19
<i>Success</i>	-0.21***	0.00	-0.26*	-0.17*	0.00	-0.18
<i>Freq</i>	0.00	0.00	-0.18	-0.02	0.00	-0.25*
Adj. <i>R</i> ²	0.28	0.22	0.20	0.14	0.08	0.20
Num. obs.	123	123	123	92	92	92

The 2008 crisis corresponds to the seven months between September 2008 and March 2009. Sample-1 and Sample-2 are the set of repurchases as defined in Section 4. *SO* is the overall cost savings measure calculated as per Equation 1. *SO_{MCA}P* is the cost savings measure considering the extent of repurchase as a fraction of market value calculated as per Equation 5. *BS* is the $1 - p$ -value of the distribution of the ratio of repurchase costs to the actual costs, obtained through bootstrapping as mentioned in Subsection 4.1.1. *|RM|* is the absolute market return over the repurchase period, *Vol*, the standard deviation of daily stock returns, *Amihud*, the average of daily Amihud's illiquidity, *PerOffer*, the percentage of equity targeted through repurchase, *PremOffer*, the maximum premium proposed in the offer, *Success*, the extent of repurchase completed, *Freq* is the number of repurchase days and *LogMcap*, the one-week average market cap. before the start of the repurchase. The *Cash* and *Cashflow* (scaled by the total assets) are of the immediately prior financial year. *Options* is the ratio of the outstanding equity options to the total number of equity shares, *PromHolding* and the promoter holding immediately prior to repurchase. '***', '**' and '*' indicate the 0.1%, 1% and 5% significance levels respectively.

Table 8: Tobit regressions on repurchase volume

Variable	Means					Medians				
	Model-1	Model-2	Model-3	Model-4	Model-5	Model-1	Model-2	Model-3	Model-4	Model-5
Intercept	12.72**	12.18**	12.09**	12.67**	12.14***	5.17***	5.23***	5.57***	5.08***	5.51***
<i>RM</i>	-0.08	-0.05	-0.12	-0.08	-0.13	0.01	0.00	0.00	0.01	-0.01
<i>RM</i> ₋₁		0.05	0.07				0.03*	0.03*		
<i>RM</i> _{-3,-1}				0.08	0.07*				0.02*	0.03**
<i>XR</i>	0.02	0.04	0.03	0.01	0.02	0.00	0.00	0.01	-0.01	0.00
<i>XR</i> _{-3,-1}	0.05	0.06		0.04		-0.01	0.00		-0.01	
<i>XR</i> _{1,3}	0.00	0.01		0.00		-0.02*	-0.02.		-0.02*	
<i>XR</i> _{-5,-1}			0.04		0.04			0.00		0.00
<i>XR</i> _{+1,+5}			0.00		0.00			-0.01		-0.01
<i>Amihud</i>	-18.14*	-20.54*	-20.92*	-16.73*	-19.18*	-0.23***	-0.21***	-0.27***	-0.22***	-0.25***
<i>NRVol</i>	-0.22***	-0.22***	-0.22***	-0.22***	-0.22***	-0.12***	-0.12***	-0.12***	-0.12***	-0.12***
<i>TimeLeft</i>	0.06*	0.07*	0.06*	0.06*	0.06*	0.00*	0.00*	0.00*	0.00*	0.00*
<i>Announce</i>	-0.84	-0.88	-0.91	-0.80	-0.89	-0.01	0.00	-0.06	-0.02	-0.07
<i>Announce</i> _{-2,+2}	-0.43	-0.39	-0.46	-0.36	-0.39	0.12	0.16	0.13	0.12	0.11
Num. obs.	89	89	89	89	89	89	89	89	89	89

Table gives the Fama-MacBeth cross-sectional means and medians of the coefficients of Tobit regressions (Equation 8) run on the time series of daily volume of each repurchase. The daily repurchase volume is defined as a percentage of the total repurchase. Regression Models 1–5 represent various combinations of lead and lag return variables employed as independent variables in the Tobit regressions. *RM* is the market return on day *t*, *RM*₋₁, the first-lag market return, *RM*_{-3,-1}, the 3-day lagged cumulative market return, *XR*, the excess stock return on day *t*, *XR*_{-3,-1}, the 3-day lagged cumulative excess stock return, *XR*_{+1,+3}, the 3-day lead cumulative excess stock returns, *Amihud*, the Amihud’s illiquidity measure of the day, *NRVol*, ratio of the non-repurchase volume to total volume of the day, *TimeLeft*, the percentage of time left out of the allowed 12-month repurchase period, *Announce*, a dummy variable indicating any firm-related announcements made on day *t* through the stock exchanges, and *Announce*_{-2,+2} is the same for announcements made during *t* – 2 to *t* + 2. ‘***’, ‘**’, ‘*’, and ‘.’ indicate the 0.1%, 1%, 5%, and 10% significance levels respectively.