Do Open-market Share Repurchases Supply or Demand Immediacy?*

Sanja Jankovic
Luxembourg School of Finance

Kalle Rinne
Luxembourg Institute of Science and Technology

ABSTRACT

This paper studies whether open-market share repurchases provide or demand immediacy. Our measure for the predicted return from providing immediacy is constructed to be uncorrelated with other potential determinants of daily executions, namely cost minimization, the provision of liquidity, and the strategic use of inside information. In average, repurchase executions provide immediacy but some repurchases demand immediacy. The results are robust to controlling for the aforementioned other potential determinants, and also earlier used measures. Repurchase executions affect the future provision of immediacy through their effect on the inventories of other immediacy providers and, therefore, the effect is smaller after past repurchases.

Keywords: Open-market repurchases, immediacy, short-term reversal, liquidity

JEL Classifications: G12, G35

* We are especially grateful to Matti Suominen for his detailed comments. We thank Ilona Babenko, Geir Bjønnes, Hubert de la Bruslerie, Sudipto Dasgupta, Narly Dwarkasing, Thierry Foucault, Nickolay Gantchev, José Miguel Gaspar, Edith Ginglinger, Alexander Hillert, Karel Hrazdil, Petri Jylhä, Oguzhan Karakas, Timo Korkeamäki, Antti Lehtoranta, Semyon Malamud, Loriano Mancini, Josh Pollet, Konrad Raff, Kristian Rydqvist, Lukas Schmidt, Peter Norman Sørensen, Mika Vaihekoski, Jos van Bommel, Ulf von Lilienfeld-Toal, Henk von Eije, Rene Wells, and seminar participants at Arne Ryde Workshop in Lund, EBC workshop in Lancaster, EEA-ESEM meetings in Malaga, French Finance Association Conference in Lyon, IFMA Conference in Bali, Luxembourg School of Finance, and NFN workshop in Oslo for their comments. We thank also Mikko Niemenmaa for helping us to collect the repurchase execution data. Financial support from the Yrjö Jahnsson Foundation is gratefully acknowledged. Contact: Kalle Rinne, Address: 5, avenue des Hauts-Fourneaux, L-4362 Esch-sur-Alzette, Luxembourg. e-mail : kalle.rinne@list.lu, tel: +352 275 888 2784.

1. Introduction

The concerted wave of buyback announcements following the September 11 attacks shows that companies repurchasing their shares can operate as buyers of last resort for their own shares (Hong et al., 2008). Similarly, in the aftermath of the stock market crash of October 1987, a buyback wave emerged when companies act to stabilize their stocks prices. Netter and Mitchell (1989) find that repurchase announcements during this time period characterized with extensive selling pressure are associated with large positive stock returns consistent with repurchases supporting the stock price. On the other hand, companies can inflate their stocks prices temporarily by placing excessively large repurchase offers e.g. to benefit executives with stock options (Fenn and Liang, 2001). In this paper, we study whether companies supply immediacy for their own stocks or whether repurchase executions tend to demand immediacy.[1]

Nowadays, most of the stock exchanges are electronic limit order book markets in which nobody has the obligatory duty to provide immediacy. Instead, immediacy is provided by investors willing to act as market makers but only when the expected profit of the trade is positive taking account the associated risks (Grossman and Miller, 1988). For instance, at the time of selling pressure, market makers require extensive discount to the current stock price and expect to profit when the price reverts back to the price at which supply and demand for the stock match. Companies having an outstanding open-market repurchase program are well-equipped to provide immediacy for the following three reasons. First, companies are better informed than other investors whether sell pressures are due to information or liquidity shocks leading them to have smaller risk of being adversely picked up by an informed trader. Second, companies repurchasing their shares do so to accumulate shares and, therefore, are less concerned about the risks related to the fluctuating value of their share inventory. Third, companies are buying back their shares to distribute their profits back to investors and not to have high expected (short-term) trading profits. However, the exactly same reasons also enable them to demand immediacy through their repurchases. To conclude, repurchase executions are expected to have a large effect on the stocks market dynamics of companies with outstanding repurchase program, but the direction of the effect is an empirical question.

Why would companies be motivated to affect the short-term fluctuations in their stock price? First, companies ensuring reasonably priced exit for their investors with a negative liquidity shock should have more liquid stock. Amihud and Mendelson (1986) associate higher stock market liquidity with lower cost of capital, and therefore, companies expecting to issue equity in the future could benefit from the provision of immediacy (Bond and Zhong, 2016). In addition, Butler et al. (2005) find that the companies with liquid stock have significantly lower costs of seasoned equity offerings. The incentives of companies to ensure

[1] In this paper, using the terminology of Grossman and Miller (1988), the supply of immediacy refers to trades targeting to clear excessive order imbalances driving the stock price closer to the price at which the supply and demand for the stock match. Similarly, the demand of immediacy refers to trades creating the excessive order imbalances.

reasonably priced exit for their investors is expected be magnified when company is mainly hold by short-term investors. Consistently, Gaspar et al. (2012) find that these companies are more likely to repurchase their shares. However, this reasoning might not apply just before the equity offering as then companies might be tempted to try to inflate their stock price by demanding immediacy.

Second, companies may benefit from ensuring reasonably priced exit for their employees and executives. Babenko (2009) finds that share repurchases benefit companies due to the increase in pay-performance sensitivity of employees via their unvested stock options. However, this leads both managers and employees to require more compensation to bear the extra risk. By providing immediacy through their repurchase executions, companies can ensure fair prices to their employees and managers when exercising their options and, therefore, compensate them for the higher compensation risk. Consistently, repurchase executions are more common when employees have exercisable stock options (Kahle, 2002), executives have stock options (Fenn and Liang, 2001), or when insiders are selling (Bonaimé and Ryngaert, 2013). However, this evidence would also be supportive to explanations on self-interested executives and insiders who would like to maximize the stock price temporarily by demanding immediacy.

Finally, third alternative explanation for why repurchases might be timed to provide immediacy is a consequence of delegating repurchase executions to an external broker. Edelen and Kadlec (2012) propose that delegated trading leads to contrarian trading as performance benchmarks provide traders incentives to buy into falling prices. Unfortunately, the contracts between brokers in charge of executing repurchases and companies are not disclosed to public, and therefore the validity of this explanation cannot be asserted.

This paper builds on the literature studying the determinants of daily share repurchase executions, see e.g. Brockman and Chung (2001) and Zhang (2005) using Hong Kong data, Cook et al. (2004) using US survey data, and Ginglinger and Hamon (2007) using French data.[2] Cook et al. (2004) propose that, in addition to the provision of immediacy, there are three other potential determinants for repurchases executions. Therefore, it is necessary to control for the other determinants to be able to analyze whether companies provide immediacy through their repurchase executions. More specifically, the other determinants of Cook et al. (2004) are 1) cost minimization, i.e. to repurchase when the stock price is low without considering the expected future returns 2) the provision of liquidity, i.e. to place frequently limit orders in order to keep the quoted bid-ask spread small enough[3], and 3) the strategic use of inside

[2] Before the end of year 2003, U.S. companies were not required to disclose any information related to actual repurchase executions, see Stephens and Weisbach (1998). In addition, Banyi et al. (2008) show that the estimates of actual repurchases based on CRSP and Compustat data are far from accurate. Current SEC regulations require companies to disclose the monthly volume and value of repurchases in their quarterly filings, see e.g. De Cesari et al. (2012). However, within a month variation is clearly essential for an econometrician to be able to study whether repurchase executions provide or demand immediacy.

[3] The concepts of immediacy provision and liquidity provision are clearly related. However, the timing of repurchase executions determined by the provision of liquidity differs considerably from the timing determined by the provision

information., i.e. to repurchase when a company is possessing positive inside information likely to lead positive future returns[4]. Earlier literature, see e.g. Cook et al. (2004), Zhang (2005), and Ginglinger and Hamon (2007), has used past returns and volume to study daily repurchase executions. These measures are likely to be correlated with many of the potential determinants mentioned above and, therefore, do not allow an econometrician to distinguish between the mutually non-exclusive determinants. We contribute to this literature by using a measure for the provision of immediacy which allows us to distinguish between these determinants. This paper is, to our best knowledge, first to study whether daily repurchase executions provide or demand immediacy.

Our measure for the predicted return from providing immediacy utilizes the short-term return reversal phenomenon (see e.g. Jegadeesh, 1990, and Lehmann, 1990). Earlier literature, see Campbell et al. (1993), and Jegadeesh and Titman (1995), has shown that short-term return reversals are related to the imperfect liquidity in financial markets. Using this insight, Nagel (2012) and Jylhä et al. (2014) construct proxies for returns from providing immediacy based on their contrarian trading strategies utilizing short-term return reversals. The Nagel (2012)'s measure uses only past returns making it unsuitable for our purposes. On the other hand, Jylhä et al. (2014)'s measure is based on the observed market level pattern of short-term return reversals and past *daily* returns. The additional information required by this measure is relevant only for the provision of immediacy allowing us to distinguish between the proposed determinants of daily repurchase executions. In addition, this measure allows us to control separately for past *cumulative* returns. More specifically, our measure for the predicted return from providing immediacy, based on Jylhä et al. (2014), is the stock's predicted weekly return evaluated using past estimates of market level pattern of short-term return reversals and stock's past daily returns.

The predicted return on the contrarian trading strategy utilizing short-term reversals gives us a time-varying measure for the stock-specific inventory of market makers. Companies timing their repurchases to provide (demand) immediacy would act when the expected returns to contrarian trader are clearly larger (smaller) than zero, i.e. on times when market makers' inventory is above (below) its target. First, we test whether repurchases are in average timed to provide immediacy by regressing the repurchases' share of stock's trading volume on the predicted returns from providing immediacy, and variables controlling for

of immediacy. Company timing their repurchase executions to provide liquidity would place limit bid orders above the current best bid almost constantly to keep the bid-ask spread lower or equal to the target set by the company. On the other hand, company timing their repurchase executions to provide immediacy would only be active in rare occasions when its stock is suffering from selling pressure, i.e. order imbalance due to excessive sell orders.

[4] Stocks suffering from selling pressures experience a (temporary) decline in price. This decline can happen when a stock is overvalued, valued correctly or undervalued. In the case of latter two, the selling pressures as a determinant of repurchase executions are related to misvaluation. However, the value of potential inside information can be controlled using past returns allowing us to distinguish the two concepts. The same reasoning also applies to cost minimization. Interestingly, Dittmar and Dittmar (2008) show that undervaluation does not drive repurchase waves, instead repurchase executions peak during economic expansions.

other potential determinants. If the regression coefficient for the predicted returns from providing immediacy is significantly positive (negative), we conclude that the repurchases are typically timed to provide (demand) immediacy. The results show that in average companies significantly time their repurchase executions to provide immediacy as they are more likely to execute repurchases when the predicted return from providing immediacy is high. Next, we split our measure into two variables conditioning on the sign of the predicted return from providing immediacy, positive (negative) values measuring the provision (demand) of immediacy. This specification allows us to show that some repurchases are timed to demand immediacy, but other repurchases are timed to provide immediacy. Consistent with the average effect, the latter one is larger and more significant.

Very frequently executed repurchases are unlikely to provide immediacy. Our conjecture is that previously executed repurchases affect the future provision of immediacy through their effect on the inventories of other immediacy providers. Past selling pressures have not affected their inventories as strongly as without any previous repurchases, and, therefore, they should be more willing to provide immediacy in the future decreasing the need for immediacy providing repurchases. Earlier literature, see e.g. Grossman and Miller (1988), Hendershott and Seasholes (2007), and Rinne and Suominen (2012), has shown that previous day's order imbalance affects today's order imbalance through the inventories of immediacy providers. We find, as expected, that past repurchase activity decreases the significance of immediacy provision as a determinant of daily repurchase executions.

Our main results are robust to controlling for both quarterly and weekly horizon cost minimization. A cost minimizer should only be interested in the current price, i.e. past *cumulative* returns. Therefore, with a separate control for past cumulative returns, our measure for the predicted returns from providing immediacy - based on the observed market level pattern of short-term return reversals and past *daily* returns - should be uncorrelated with the cost minimization. In addition, by controlling for past returns and volume separately we can show that our results are not only replicating results found by earlier literature.

Our measure for the predicted returns from providing immediacy should be also uncorrelated with the provision of liquidity, i.e. placing frequently limit orders in order to keep the quoted bid-ask spread small enough. To provide evidence supporting the robustness of this assumption, we study the repurchases of companies with a Liquidity Provider contract requiring a brokerage firm to provide liquidity for their share. These companies are paying a brokerage firm to place constantly limit orders for their stock and, therefore, they are less likely to be motivated to provide liquidity through their repurchase executions. To back up this idea, we find, as expected, that repurchase executions in this subsample have smaller auto-correlation and are more volatile. The evidence based on this subsample analysis shows that our main results are robust related to the provision of liquidity.

Finally, our measure for the predicted returns from providing immediacy should be uncorrelated with the strategic use of inside information. We study the robustness of this assumption using two subsamples consisting of companies which are less likely to time their repurchases to take advantage of (positive) inside information. The first subsample consists of repurchases executed during the quiet periods preceding the quarterly earnings announcement. Daily disclosure requirement related to realized open-market share repurchases expose Finnish companies executing repurchases to a considerable risk of being caught in illegal insider trading and, therefore, only companies *not* holding significant inside information are expected to execute repurchases during those periods. Consistently, we find that the earnings announcement effects following these repurchases are (insignificantly) negative. Our second subsample consists of companies which are estimated to be overvalued using the either the method of Rhodes-Kropf et al. (2005) or Residual Income model of Ohlson (1990, 1995). These companies should not have any incentives to time their repurchases to take advantage of inside information. The results of both subsample analyses show that our main results are robust related to the strategic use of inside information.

Our results contribute to the literature studying repurchasing companies as a buyer of last resort. Hong et al. (2008) extend Grossman and Miller (1988) model to allow companies to be buyers of last resort when their stock price drops below fundamental price due to large liquidity shocks. In their difference-in-difference test, they find that companies more able to repurchase have smaller transitory volatility consistent with immediacy providing repurchases. Hillert et al. (2016) extend Hong et al. (2008) by providing evidence using monthly repurchase data that companies repurchase more when other investors sell or short sell, and also at the crisis times. Campello and Saffi (2015) show that increases in lendable stocks lead to repurchases. Finally, Busch and Obernberger (2016) find that actual share repurchases increase price efficiency and decrease both volatility and kurtosis of stock returns. Compared to these papers, we contribute to this literature by showing that not all repurchases provide immediacy, instead some repurchases demand immediacy. In addition, we disentangle the provision of immediacy and misvaluation, and show that for example also overvalued companies provide immediacy through their repurchases to smooth out their share price. Finally, their focus is on monthly / quarterly horizon, instead we show that the immediacy provision can explain also daily variation in repurchase executions.

Our paper is also closely related to the literature studying the daily repurchase executions. This literature, see Cook et al. (2004), Zhang (2005), and Ginglinger and Hamon (2007), has found that repurchases are often executed following poor stock performance, consistent with all potential determinants proposed by Cook et al. (2004). Using lower frequency data, Stephens and Weisbach (1998) show that quarterly repurchase executions are negatively correlated with previous quarter's stock returns. Similarly, Ikenberry et al. (2000) find using Canadian monthly disclosure data that poor stock performance leads to an increase in repurchase executions. The literature also studies the short-term returns following repurchase

executions with mixed results. Zhang (2005) and Chung et al. (2007) show that stocks returns following repurchases are positive, but Cook et al. (2004) and Ginglinger and Hamon (2007) do not find any significant returns afterwards. Finally, Cook et al. (2004) and Brockman and Chung (2001) find that companies repurchasing their stocks have substantial market timing abilities. See also De Cesari et al. (2012), Ben-Rephael et al. (2014), and Dittmar and Field (2015) who show using US monthly disclosure data that companies are able to repurchase their shares at a significantly lower price than the average market price.

The literature on repurchase executions has also studied the effect of repurchases on stock liquidity. Brockman and Chung (2001) and Ginglinger and Hamon (2007) show using Hong Kong and French daily disclosure data respectively that liquidity is poorer on days when repurchases are executed.[5] According to their interpretation, repurchases deteriorate liquidity. Our results suggest an alternative explanation, namely repurchases are often executed on days with extensive selling pressures. These days might have lower than average liquidity as immediacy providing repurchases are unlikely to absorb selling pressures fully due to for example volume and execution restrictions. On the other hand, Cook et al. (2004) find using U.S. survey data that repurchase executions improve liquidity. This would be consistent with our expectations if repurchase executions are also timed to provide liquidity in addition to immediacy. Consistent with this explanation, McNally and Smith (2011) find that more than 70% of repurchase executions are done using standing limit orders. Hiller et al. (2016) propose that the conflicting results obtained in the literature are due to the use of endogenous controls, more detailed liquidity and repurchases are simultaneously determined. They show using U.S monthly repurchase execution data that after taking endogeneity into account repurchase executions improve liquidity. Finally, Nayar et al. (2008) present evidence on a transitory increase in liquidity using a sample of Dutch auction and fixed price tender offer repurchases.

Finally, this paper is related to the literature studying the effects of other corporate finance events on the provision of immediacy. For example, equity offerings demand immediacy, see Rinne and Suominen (2009). They show that seasoned equity offerings, especially rights offerings targeted to existing shareholders, demand immediacy. Their conjecture is that public equity offerings demand less immediacy than rights offerings, as new investors attracted by the marketing efforts of investment banks reduce the order imbalance at the time of the offering. Gao and Ritter (2010) also posit that the marketing efforts by investment banks flatten the issuer's short-run demand curve. Consistently, they find that companies conducting fully marketed public equity offerings are associated with a large temporary increase in their elasticity of demand. De Jong et al. (2011) study combinations of convertible bond offerings and repurchase announcements. They argue that companies issuing convertible bonds try to counteract the selling pressure

[5] See also Oded (2009) who finds that the bid-ask spread is negatively correlated with the completion rate of repurchase program.

due to convertible arbitrage related short selling by announcing repurchase programs. Consistent with immediacy providing repurchases, they find that combined offerings are associated with smaller price pressure than uncombined offerings.

Our paper is organized as follows. Section 2 describes the Finnish institutional setting related to the open-market share repurchases and Section 3 documents our data. In Section 4, we explain our method to estimate the predicted returns from providing immediacy. In Section 5, we present our main empirical results. Section 6 shows that our main results are robust. Finally, Section 7 concludes the paper.

2. Open-market share repurchases in Finland

In Finland, a company can start repurchasing its shares when the following three conditions are satisfied. First, a Board of Directors has proposed an authorization for a repurchase program at the Annual General Meeting (AGM) of a company. Second, the AGM has approved the authorization, and finally, the company's Board of Directors has disclosed that the program will be executed.[6] The first potential day of repurchase execution is usually one week after the program execution release. Companies are also required to disclose daily an overview of their repurchase executions before the opening time of next trading day. More specifically, companies are required to disclose the average, the maximum, and the minimum price they have paid. In addition, they need to disclose the number of shares bought, the total value of their trades, and the total number of shares owned by the company after the trades. Our daily execution data is manually collected using these compulsory daily releases.

3. Sample

Our sample consists of all open-market share repurchase programs executed in the Helsinki Stock Exchange in which the potential first execution day is between January 1, 1999 and December 31, 2009. Before 1999, the availability of stock exchange release data is limited. We have also excluded the programs in which a company, with a dual-listed stock, has executed repurchases simultaneously in more than one stock exchange. The stock exchange releases on daily repurchase executions are collected mainly from OMX Newsclient and Kauppalehti archive. The sum of shares repurchased should equal the number of shares repurchased as reported on annual and quarterly earnings announcements. This comparison allows us to find the days with missing repurchase executions and manually fill up all the missing repurchase executions

[6] The company is not obliged to make any repurchases after a program execution release. However, in nine programs in our sample, an execution release or a program authorization have also stated the minimum number of shares to be repurchased. In all of these cases, the minimum number has been small compared to the maximum number; an average (median) of minimum number of shares to be repurchased is only 2.23% (0.01%) of the maximum. Among these programs, realized repurchases always total to at least the stated minimum number of shares.

by using information from company webpages, other newswire services, or directly from companies. Table 1 shows the summary statistics of the repurchase programs.

[INSERT TABLE 1]

The announced (maximum) size of repurchase programs in our sample totals to €57.3 billion out of which €23.5 billion is actually executed. Yearly, the number of repurchase programs varies between 19 and 50, with an average of 27 programs. In average, the announced size of the repurchase program is €193.5 million. It should be noted, however, that the average is strongly affected by a few very large repurchase programs as shown by the median size of €5.7 million. More than 80% of the repurchase programs are not fully executed, and in average completion rate is 47.5%.[7] The repurchase programs in our sample last usually between one quarter and one year, with an average of seven months. During the repurchase program, average company repurchases its shares on 37 days. The average (median) value of daily repurchase on the days when company has repurchased at least one share is €1.4 (0.05) million, which accounts for approximately 30% of daily trading volume.

4. The predicted returns from providing immediacy

To study whether open-market repurchases are timed to provide or demand immediacy, a measure for the predicted returns from providing immediacy is needed. In addition, this measure should be uncorrelated with other potential determinants of daily repurchase executions (see Cook et al., 2004). Jylhä et al. (2014)'s measure offers us exactly these requested properties as it takes the observed market level pattern of short-term reversals into account in addition to past daily returns. The additional information obtained using individual daily returns instead of cumulative returns is relevant only for the provision of immediacy, not for other proposed determinants of daily repurchase executions. In addition, Rinne and Suominen (2012) show that individual daily returns have significantly higher explanatory power over short-horizon returns than cumulative returns.

Our measure for the predicted return from providing immediacy, PR_{IMM}, is a stock's predicted weekly return evaluated using past estimates of market level pattern of short-term return reversals and the stock's past daily returns. This measure closely resemblances expected 5-day returns used in Jylhä et al. (2014) as portfolio weights in their measure for the returns from providing liquidity. The market level pattern of the short-term reversals is estimated similarly as in Jylhä et al. (2014) using all stocks listed in the Helsinki

[7] Realized repurchases exceed the announced program size in five repurchase programs in our sample. Unreported tests show that our results are qualitatively similar if these programs are excluded from the sample.

Stock Exchange from the January 1, 1998 to the December 31, 2009. The required data is obtained from OMX / HEX database.[8] More specifically, we estimate the return reversal pattern in excess returns by performing daily a cross-sectional regression, in which stock's (indexed by *i*) next 5-day's excess returns following the close on day *t*, $R5_{i,t}$, are regressed on the each of the stocks' past 10 days' excess returns, $R_{i,t-\tau}$, where $\tau \in \{0, \dots, 9\}$, and controls $\boldsymbol{C}_{i,t.}$

$$R5_{i,t} = \alpha_t + \sum_{\tau=0}^{9} \beta_{t-\tau} R_{i,t-\tau} + \boldsymbol{\beta}_{t,C} \boldsymbol{C}_{i,t} + \varepsilon_{i,t} \quad (1)$$

Here α_t is the intercept in the regression, while $\varepsilon_{i,t}$ is a stock specific error term. Control vector $\boldsymbol{C}_{i,t}$ consists of three variables, first, there are two variables that are constructed by multiplying the past 10-day's excess returns with either the stock's past 10-day's (log of) trading volume or the stock's (log of) market capitalization at day *t*, and finally there is $ln(RP_{10})$, in which RP_{10} is the maximum of the value of repurchases by company *i* during the past 10 days and 1€.[9] Excess returns are calculated by deducting from the stock's returns the returns to the equal-weighted stock market index.[10]

$ln(RP_{10})$, controlling for past repurchase activity, is motivated by two factors. First, past repurchases can be positively correlated with future returns if a company faces an upward-sloping supply curve when it repurchases its shares (see Brown and Ryngaert, 1992, and Bagwell, 1992, for evidence based on fixed price and Dutch auction repurchases) and tends to repurchase on consecutive days (Karhunen, 2002). Second, assuming that a company's repurchases are at least partly determined by the provision of immediacy, past repurchase activity should be (positively) correlated with future returns.[11]

Rinne and Suominen (2012) show evidence that return reversals in excess returns are gradual, suggesting that optimal contrarian trading strategies might have a longer trading horizon than one day. Jylhä et al. (2014) present evidence that a strategy with a 5-day holding period has the highest Sharpe ratio after accounting for transaction costs implying that companies providing immediacy through their repurchases are likely to use the predicted 5-day return from providing immediacy as their trading signals. In addition, Jylhä et al. (2014) find that the estimated holding period of hedge funds providing systematically immediacy is consistent with 5-day holding period.

---

[8] We thank Antti Lehtinen for providing us the data.

[9] The first two controls allow the magnitude of return reversals to vary with the trading volume and market capitalization consistent with the evidence shown in Campbell et al. (1993), Pastor and Stambaugh (2003), and Khandani and Lo (2011).

[10] This is the standard method to calculate excess return in the short-term return reversal literature. See for example, Lehmann (1990), Lo and MacKinlay (1990), Khandani and Lo (2007, 2011), and Nagel (2012).

[11] Including $\ln(\mathrm{RP}_{10})$ to the Equation (1) affects PR_{IMM} figures for stocks with past repurchase activity. Therefore, we are controlling for past repurchases in all our tests. See also Section 5.3 which shows that frequent repurchases, i.e. stocks mainly affected by $\ln(\mathrm{RP}_{10})$, are not significantly providing immediacy consistent with our expectations.

The estimated average coefficients $\hat{\beta}_{t-\tau}$ from the cross-sectional regressions of Equation (1) are all negative and statistically highly significant. The size of these coefficients also suggests that the return reversal phenomenon in the Helsinki Stock Exchange is economically highly significant. The regression results are presented in Table 2.

[INSERT TABLE 2]

Stock *i*'s predicted return from proving immediacy, PR_{IMM}, at day *t* is estimated as follows. First, 120-day (i.e. past 6 months) moving averages of coefficients based on cross-sectional regressions of Equation (1) are calculated. Then, the moving averages at day *t-6* (i.e. the last day on which it is possible to observe 5-day future return data and to have one additional day to run the estimations using data only up to day *t*) are multiplied with the stock's past 10 days' excess returns up to day *t* and the value of controls at day *t*, calculated using the stock's market capitalization at day *t*, and the past 10-day's cumulative return, value of repurchases, and trading volume.

5. Repurchases and the provision of immediacy

It is not clear in advance whether repurchase executions provide immediacy. Instead, the timing of repurchases could be entirely determined by other motives of daily executions proposed by Cook et al. (2004), namely cost minimization, the provision of liquidity, and the strategic use of inside information. Finally, it is also possible that at least some stock repurchases demand immediacy. Repurchases can be used to maximize the current stock price temporarily by placing excessively large buy offers driving the price upwards.[12]

First, we provide preliminary evidence that repurchases are providing immediacy by studying whether repurchases are more common and more frequent on days with positive predicted returns from providing immediacy, PR_{IMM}, than on days with negative PR_{IMM}. We find that days with positive PR_{IMM} have in average 21% more repurchases as a proportion of trading volume than days with negative PR_{IMM} (statistically significant at 0.1% significance level). Similarly, the proportion of days with repurchases is 24% larger on days with positive PR_{IMM} compared to days with negative PR_{IMM} (again, statistically significant at 0.1% significance level). Second, we study in more detail, the relation between repurchases and PR_{IMM} by dividing all observations in our sample into deciles based on their PR_{IMM} figures. The results, shown in Figure 1 below, provide evidence that repurchase executions increase with PR_{IMM} when PR_{IMM} is

[12] Note that Helsinki Stock Exchange regulations forbid companies to manipulate their stock price by executing repurchases, and to execute trades just before the closing time. However, there is no uptick rule restricting companies' repurchases (see McNally and Smith, 2011).

positive consistent with the immediacy provision. However, when PR_{IMM} is negative, repurchase executions also increase when PR_{IMM} decreases consistent the immediacy demanding repurchases.

[INSERT FIGURE 1]

Next, we provide more comprehensive evidence on the relation between repurchases and immediacy using a regression setup allowing us to control for numerous other potential variables. First, we regress *Repurchases / Volume*, the repurchases' share of trading volume in stock *i* on day *t*, on one-day lagged predicted returns from providing immediacy, $PR_{IMM,t-1,}$ described in Section 4, and control variables described below.[13]

$$Repurchases/Volume_{i,t} = \alpha + \beta \times PR_{IMM,i,t-1} + \sum_{n=1}^{N} \gamma_n Control\, n_{i,t} + \varepsilon_{i,t} \qquad (2)$$

If the estimated coefficient for PR_{IMM} is significantly positive, repurchases are in average timed to provide immediacy. However, the limitation of this specification is that the nonlinear relation between repurchases and PR_{IMM} documented in Figure 1 is not taken into account. Therefore, in most of our tests PR_{IMM} is split into two variables: $PosPR_{IMM}$ and $NegPR_{IMM}$, absolute value of PR_{IMM} when PR_{IMM} is positive and negative, respectively. Interestingly, this specification allows us to show that some repurchases are timed to demand immediacy if $NegPR_{IMM}$ has significantly positive coefficient, and that other repurchases are timed to provide immediacy, if $PosPR_{IMM}$ has significantly positive coefficient.

The regression is run as a panel regression using all trading days on which stock *i* has an active repurchase program as observations. The standard OLS estimator would be inconsistent in this setup as the value of *Repurchases / Volume* is limited to be between zero and one, and especially as approximately 75% of observations are equal to zero. Therefore, we use a Tobit model with left censoring at zero.[14] Note that PR_{IMM}, $PosPR_{IMM}$, $NegPR_{IMM,}$ and all control variables are measured using only data, which has been observable at the close of day *t-1*.

The denominator in *Repurchases / Volume* is the number of shares traded and therefore the value of *Repurchases / Volume* is undefined on days without any trades in stock *i*. There are two alternative ways to solve this problem. First, the value of *Repurchases / Volume* on days with zero trading volume can be replaced with zeros. This replacement assumes that a trade would have been executed if a company

[13] The unreported results based on alternative measures for repurchase executions such as repurchases divided by the number of shares outstanding or logarithm of daily value of repurchases are qualitatively similar.

[14] The unreported results based on a Tobit regression with both left censoring at zero and right censoring at one are qualitatively similar. This is not surprising as there are only few observations with *Repurchases / Volume* equaling to one.

repurchasing its own shares had placed an offer to buy its shares. This assumption is likely to overestimate the percentage of days with zero repurchase volume. Second, observations with zero trading volume can be excluded from the sample. This exclusion assumes that a trade would not have been executed even if a company had placed an offer to buy its shares and, therefore, this assumption is likely to underestimate the percentage of days with zero repurchase volume. The true percentage of days with zero repurchase volume lies between these limiting cases.

Finally, following the recommendations of Petersen (2009), clustered standard errors are used. Residuals of our regression model might be correlated either across stocks, across time or across both. Therefore, to avoid potentially false statistical inference, we use two-way clustered standard errors (stock and day). Later, we also show that some unobservable company-specific variables are not driving our results by adding company fixed effects. As explained in section 6.3, company fixed effects are not included to our main specification as the inclusion require us to eliminate companies without any realized repurchase in any of their repurchase programs.

5.1. Control variables

Cook et al. (2004) propose that cost minimization is one of the main determinants for daily repurchase executions. We control for this determinant in two ways. First, a cost minimizer with a long horizon, e.g. quarterly, should be more active repurchasing its stock when the stock price is closer to the lowest price observed during the past 60 trading days (i.e., the last quarter). *Price / quarterly low*, price on day *t-1* divided by the lowest price observed during the past 60 days, is controlling for this.[15] Second, a cost minimizer with a short horizon, e.g. weekly, should be more active repurchasing its stock following recent poor stock performance. Controlling for past 10-day returns takes care of short-horizon cost minimizers.[16] With a separate control for past returns, $PR_{IMM,}$ $PosPR_{IMM}$, and $NegPR_{IMM}$ are reflecting only observed market level pattern of short-term reversals and the structure of *daily* returns (remember that PR_{IMM} uses daily returns separately during the last 10 days instead of cumulative 10-day return). These factors should be uncorrelated with cost minimization when cumulative returns are controlled. Note also that the separate controls for past return and volume show that $PR_{IMM,}$ $PosPR_{IMM}$, and $NegPR_{IMM}$ are not only replicating earlier results (see e.g. Cook et al., 2004, and Zhang, 2005), which have shown that these variables are individually significant predictors for repurchase executions. Both *Price / quarterly low* and past returns are likely be correlated with the magnitude of potential undervaluation. Therefore, these variables are at least partially controlling for repurchases motivated by the strategic use of inside information, another main determinant of daily repurchase executions according to Cook et al. (2004).

[15] Results are qualitatively similar if the lowest price observed during the last six months is used instead of last quarter.
[16] Results are qualitatively similar if the past 20-day returns (and volume) is used instead of past 10-days figures.

The regulations of the Helsinki Stock Exchange forbid share repurchases when a company holds significant inside information and recommend companies not to execute repurchases during the two weeks preceding their earnings announcements. The daily disclosure allows authorities to easily investigate whether companies are timing their repurchases to take advantage of significant information to be released in the near future.[17] These regulations should make companies reluctant to execute repurchases just before earnings announcements. To control for this reluctance, we have used three dummies as control variables, 1) *Earnings Announcement*, equaling one on quarterly earnings announcement days, 2) *Quiet period (10D)*, equaling one during ten trading days preceding quarterly earnings announcement days, and 3) *Quiet period (15D)*, equaling one during the five trading day period preceding the 10-day quiet period. The length of the quiet period is determined by the company, and most of the companies in the Helsinki Stock Exchange have chosen the length to be 10 to 15 trading days. Earnings announcement dates are obtained from the I/B/E/S and Kauppalehti's release archive.

The Helsinki Stock Exchange regulations also restrict the daily repurchase volume to be less than 50% of the average daily trading volume over the last four weeks.[18] Illiquidity of the stock can make it difficult to comply with this restriction and therefore illiquid companies are allowed to waive this restriction if the waiver is disclosed beforehand. The *high repurchases allowed* dummy equals one if a company has disclosed that it waives the restriction.

Finally, earlier repurchase executions, and first and last days of the program might affect repurchase executions. Karhunen (2002) shows that the probability of executing repurchases increases if a company has repurchased its shares during the previous day. The lagged value of *Repurchases / Volume* controls for this effect. This variable should also partly control for the provision of liquidity. Companies motivated by liquidity provision should place frequently limit orders in order to keep the quoted bid-ask spread small enough, and therefore it is likely that these companies have executed repurchases also during the previous day. The *First day* dummy equaling one on the first day of the repurchase program is controlling for the potential effect related to the start of the program. Repurchase executions might be limited when the cumulative sum of realized repurchases is close to the announced (maximum) size of the program. *5% left of program* dummy equals one on days when the cumulative sum of realized repurchases is exceeding 95% of the announced (maximum) size of the program.[19]

---

[17] See, e.g. news related to the investigations concerning Talentum's 1999 repurchase program (http://www2.hs.fi/english/archive/news.asp?id=20011115IE4).

[18] Before the October 1, 1999, there were no restrictions related to the daily repurchase volume. Before the April 2, 2001, the reference volume was measured using the average daily trading volume over the last 12 months (Karhunen, 2002).

[19] Companies' tendency to execute repurchases is not evenly distributed around the year. The activity peaks especially during the fall but also during the late spring following the start of new repurchase programs. Unreported results controlling for this finding through calendar month dummies are qualitatively similar.

5.2. Results

Table 3 shows the results of the Tobit regression based on Equation (2). First, the predicted return from providing immediacy $PR_{IMM,}$ is significantly positive. In average, companies are more likely to execute repurchases when the predicted return from providing immediacy is high, i.e. on times when their stock is suffering from selling pressure. This suggests that companies typically provide immediacy through their repurchase executions.

Second, we take into account the nonlinear relation between repurchases and PR_{IMM} documented in Figure 1 by replacing PR_{IMM} with $PosPR_{IMM}$ and $NegPR_{IMM,}$ absolute value of PR_{IMM} when PR_{IMM} is positive and negative respectively. The results based on this specification are even stronger and provide evidence that that many repurchases are timed to provide immediacy as $PosPR_{IMM}$ has highly significant positive coefficient. In addition, some repurchases are timed to demand immediacy as $NegPR_{IMM}$ has also significantly positive coefficient. Consistent with the first specification, the coefficient of $PosPR_{IMM}$ is significantly larger than $NegPR_{IMM.}$ As Table 3 shows, it is important to take the non-linear relation into account and, therefore, we select to use mainly $PosPR_{IMM}$ and $NegPR_{IMM}$ instread of PR_{IMM} in additional tests. Two standard deviation increase in $PosPR_{IMM}$ ($NegPR_{IMM}$) leads to a 2.1 (0.8) percentage point increase in *Repurchases / Volume*. This shows that the effect is also economically significant taking into account that in average repurchase executions total to 7.8% of daily trading volume. To conclude, in average companies provide immediacy through their repurchase executions, but some repurchases are executed at the time of buying pressure.

Companies repurchase significantly more when the current price is relatively low compared to the lowest price observed during the last quarter consistent with long horizon cost minimization. The results are also robust to controlling for (short-term) cost minimization using past 10-day excess returns.[20] In addition, the specifications including past return and volume confirm that our measures, $PR_{IMM,}$ $PosPR_{IMM}$, and $NegPR_{IMM,}$ are not only replicating results found by earlier literature. Instead, our results provide new variables which are able to predict significantly the timing of repurchase executions.

Companies tend to repurchase in consecutive days, consistent with Karhunen (2002). Earnings announcement days and the preceding days are associated with fewer repurchase executions, consistent with Cook et al. (2004). On the first day of the repurchase program, companies are likely to repurchase more than usual.

[INSERT TABLE 3]

[20] The results are qualitatively similar if the past 10-day excess return is replaced with the stock's past 10-day return and past 10-day market return.

Table 4 shows the results based on the alternative way to handle zero trading volume days, namely these days are excluded from the sample. The results are qualitatively similar to those in Table 3. This confirms that our results are robust to alternative ways to handle zero trading volume days.

[INSERT TABLE 4]

5.3. Past repurchases and the provision of immediacy

In this section, we study how past repurchase activity is affecting the timing of repurchase executions. Our conjecture is that frequently executed repurchases are unlikely to provide immediacy as previous immediacy providing repurchases reduce the future need to provide immediacy through their effect to the inventory of other providers of immediacy. The intuition is the following, when repurchases provide immediacy, other immediacy providers do not need to increase their inventories so extensively as without repurchases to clear the market. Therefore, the inventories of other immediacy providers should be closer to their target level, and they should be more willing to provide immediacy in the future. This suggests that past repurchase executions are expected to decrease the significance of $PR_{IMM,}$ and $PosPR_{IMM}$ as a determinant of daily repurchase executions.

Interestingly, the inventory explanation also suggests that companies timing their repurchases to demand immediacy should be active on consecutive days to inflate buying pressures. Past repurchases executed at the time of buying pressures should move immediacy providers' inventories further away from their target level. Therefore, past repurchase executions are expected to increase the significance of $NegPR_{IMM}$ as a determinant of daily repurchase executions.

First, we study the returns preceding repurchase executions conditional on past repurchase activity. Figure 2 shows that non-continuous repurchases (repurchase executions without any repurchases executed during the past week) are preceded by significantly smaller return on a day *t-1* than continuous repurchases (repurchases executed following at least one repurchase execution during the past week) at 1% significance level. Interestingly, this result is due to a significant drop in price on day *t-1* preceding non-continuous repurchases. Consistent with our conjecture, non-continuous repurchases seem to provide more immediacy than continuous repurchases. On the other hand, the returns preceding continuous repurchases are approximately zero during the last five days failing to provide preliminary evidence on good performance preceding immediacy demanding repurchases executed continuously to inflate buying pressures. Note that this evidence based on past returns could also be driven by other potential determinants for daily repurchase executions and, therefore, regression analysis is needed.

[INSERT FIGURE 2]

First, we study the effect of past repurchase executions on immediacy provision by interacting dummy variable *Following*, equaling one when a company has executed repurchases during the past week, with PR_{IMM} (first column) or $PosPR_{IMM}$ (second column). Coefficients of PR_{IMM} and $PosPR_{IMM,}$ measuring whether non-continuous repurchases are timed to provide immediacy, are expected to be significantly positive as before. The interaction term, on the other hand, is expected to be negative as past repurchase executions are expected to decrease the significance of immediacy provision. The sum of coefficients shows whether continuous repurchases are timed to provide immediacy. The results shown in Table 5 are consistent with these hypotheses. Non-continuous repurchases are timed to provide immediacy. The interaction term is significantly negative consistent with past repurchases decreasing the significance of the effect of immediacy provision. The results also suggest that continuous repurchases are not statistically significantly timed to provide immediacy. The evidence presented here is consistent with the findings of Dittmar and Field (2015) who find, using monthly repurchase volumes and average prices, that infrequent repurchasers pay significantly less on their stock than frequent repurchasers.

Finally, we study how past repurchase executions affect the significance of $NegPR_{IMM}$ as a determinant of daily repurchase executions. As expected, $NegPR_{IMM}$ is larger following past repurchase activity. However, this effect is not statistically significant at any conventional level. In the case of non-continuous repurchases, the coefficient of $NegPR_{IMM}$ is (insignificantly) negative. To ease the interpretation, we present the results related to $NegPR_{IMM}$ and $PosPR_{IMM}$ separately, however, note that the results are similar if both $NegPR_{IMM}$ and $PosPR_{IMM}$, and their interactions with *Following* are controlled simultaneously.

[INSERT TABLE 5]

6. Robustness checks

This sections presents result based on subsample analyses showing that our main results are robust related to numerous alternative explanations.

6.1. The provision of immediacy vs. the provision of liquidity

Our measure for the predicted returns from providing immediacy should be uncorrelated with the provision of liquidity, i.e. placing frequently limit orders in order to keep the quoted bid-ask spread small enough. Controlling for past returns, past volume, and lagged *Repurchases / Volume* should alleviate this concern as the observed market level pattern of short-term reversals and the structure of daily returns are unlikely to be correlated with the provision of liquidity. This section covers two robustness checks confirming the

validity of this assumption and shows that daily repurchase executions provide immediacy also in these subsamples.

First robustness check tests whether repurchase executions are significantly timed to provide immediacy among stocks having lower than median relative bid-ask spread (compared to all stocks listed in the Helsinki Stock Exchange). In this test, bid-ask spread is measured using the closing bid and ask prices of day *t-1*. These companies should be less motivated to time their repurchases to provide liquidity and, therefore, potential correlation of $PosPR_{IMM}$ and the provision of liquidity should be less concern in this subsample. Table 6 provides evidence that our earlier results are due to the timing of repurchase executions to provide immediacy and not related to the provision of liquidity.[21] Interestingly, the coefficient of $PosPR_{IMM}$ is qualitatively equivalent among stocks with higher than median relative bid-ask spread (unreported). This suggests, consistent with our conjecture, that bid-ask spread and $PosPR_{IMM}$ are not correlated.

Our second test allows us to provide even more conclusive evidence on the robustness of our main results by creating a subsample of companies for which the provision of liquidity should not be a significant determinant of their daily repurchase executions. The Helsinki Stock Exchange is an electronic limit order book market without designated market makers but since year 2004 listed companies have had the possibility to sign a Liquidity Provider contract with a brokerage firm. This contract requires the brokerage firm to provide continuously, i.e. at least 85% of the time, bid and ask prices for the stock. In addition, the bid-ask spread and the depth available on bid and ask prices need to stay within the limits set in the contract. Essentially, companies with the Liquidity Provider contract are paying the brokerage firm for the provision of liquidity to keep their share liquid enough, see Anand et al. (2009), and Menkveld and Wang (2013) for evidence based on Swedish and Dutch data, respectively. These companies could easily request tighter limits by resetting the contract with the brokerage firm. Therefore, we can assume that the provision of liquidity is not determining their daily repurchase executions. Consistent with this assumption, we find that repurchase executions in this subsample have smaller auto-correlation and are more volatile (unreported).

This subsample including only stocks with an outstanding Liquidity Provider contract allows us to study the validity of our assumption that $PosPR_{IMM}$ is uncorrelated with the provision of liquidity. As companies with Liquidity Provider contract are not expected to time their repurchases to provide liquidity, coefficient of $PosPR_{IMM}$ should reflect only their intention to time their repurchase executions to provide immediacy. Using hand collected Liquidity Provider contract data obtained from Kauppalehti's release archive, Table 6 shows that our main results are robust. Note also that the effect remains statistically

[21] We also test whether our results are robust to controlling for relative bid-ask spread as an additional control variable. Unreported results are qualitatively similar to the results shown in Table 3. Relative bid-ask spread has negative coefficient in predicting *Repurchases / Volume,* but it is not statistically significant at any conventional level.

significant even when the number of observations is 90% smaller compared to the full sample.[22] Interestingly, the coefficient for lagged *Repurchases / Volume* is smaller and less significant in this sample consistent with our claim that this variable is partly controlling for the provision of liquidity.

[INSERT TABLE 6]

Finally, we study the effect of $NegPR_{IMM}$ on repurchase executions in these subsamples. Table 6 shows that among stocks with low relative bid-ask spread, many repurchases are timed to demand immediacy. On the other hand, companies with LP-contract or with high bid-ask spread (unreported) do not time their repurchases to demand immediacy as in these subsamples $NegPR_{IMM}$ is insignificantly negative. We expect that this surprising result is due to two reasons. First, the immediacy demanding repurchases by illiquid companies might be interpreted more easily as illegal stock price manipulation. Second, illiquid companies in the Helsinki Stock Exchange usually have controlling shareholder who would suffer from these repurchases if she is not selling her stocks.

6.2. The provision of immediacy vs. the strategic use of inside information

Our measure for the predicted returns from providing immediacy should be uncorrelated with the strategic use of inside information. This claim is based on the conjecture that with a separate control for past (cumulative) returns the inside information is not correlated with observed market level pattern of short-term reversals and the structure of daily returns. In this section, we show that this claim is robust by providing additional evidence that the provision of immediacy is a significant determinant of daily repurchase executions in subsamples in which companies should not time their repurchases to take advantage of their (positive) inside information.

6.2.1. Repurchases executed just before earnings announcements

As noted above, the Helsinki Stock Exchange regulations forbid share repurchases if companies hold significant (positive) inside information and recommend companies not to execute repurchases during the two weeks preceding the earnings announcements. Therefore, repurchases executed just before the quarterly earnings announcements expose companies to a risk being caught in illegal insider trading, if they

[22] Companies having the Liquidity Provider contract are usually Small-Cap companies with illiquid stock, see e.g. Anand et al. (2009). This means that the comparison of results shown in Tables 3 and 6 is not possible without correcting for sample selection.

possess significant inside information. This is especially true as the daily disclosure of repurchase executions makes it easy for authorities to check the compliance of companies.[23]

Most companies do not execute any repurchases during the quiet period preceding the quarterly earnings announcements. However, some companies continue their repurchases also during the quiet period. We claim that a company is likely to continue its repurchases only if it does not possess significant inside information and, therefore, these repurchase executions are not expected to be timed to take advantage of inside information. Consistent with this claim, we find that the average earnings announcement effect and weekly return following the announcement days preceded by repurchases executions are both insignificantly negative and smaller than around earnings announcements without repurchase executions. Significantly positive coefficient for $PosPR_{IMM}$ in this subsample would confirm the robustness of our findings by showing that our earlier results are not due to the potential correlation of our measure for the predicted returns from providing immediacy with the strategic use of inside information.

Table 7 shows that daily repurchases are timed to provide immediacy also in this subsample. It is interesting to note that the coefficient for $PosPR_{IMM}$ is considerably larger in this subsample than in Table 3. This suggests that repurchases executed just before earnings announcements are especially strongly motivated by the immediacy provision. Finally, the repurchases executed just before earnings announcements do not seem to demand immediacy as $NegPR_{IMM}$ is insignificantly negative.

[INSERT TABLE 7]

6.2.2. Repurchases by overvalued companies

Companies can also time their repurchases to take advantage of inside information not related to earnings announcements. Using a subsample of stocks which are estimated to be overvalued, i.e. companies having no incentives to time their repurchases to take advantage of (positive) inside information, it is possible to show that our results are robust also related to more general timing based on inside information.[24] We estimate firm-specific misvaluation using two alternative methods, Rhodes-Kropf et al. (2005) and Residual Income model of Ohlson (1990, 1995), explained below.[25]

[23] See Cook, Krigman and Leach (2003) for U.S. evidence that not all repurchasing companies comply with the Securities and Exchange Commission Guidelines. The conformity of Finnish companies is expected to be considerably larger due to tighter disclosure requirements. However, perfect conformity is unlikely especially as Ginglinger and Hamon (2009) find that French companies exposed also to extensive disclosure requirements are not always complying with the regulation. To eliminate potential concerns that non-compliant companies are taking advantage of inside information, we study the earnings announcement effects associated with repurchase executions below.

[24] See Liu and Swanson (2016) for evidence that also overvalued companies repurchase their shares.

[25] The unreported test results show that $PosPR_{IMM}$ is significantly positive also among undervalued companies and that the coefficient is larger than in the overvalued sample (Table 8) consistent with the idea that companies are more motivated to provide immediacy if they can buy their stock at low price.

First, we estimate the firm-specific misvaluation following the method of Rhodes-Kropf et al. (2005) using the latest available accounting data obtained from Datastream. More specifically, this method divides companies' market-to-book ratio into three components, firm-specific error, our estimate of misvaluation on year *y*, sector error, and long-run market-to-book ratio.[26] Our first specification denotes company to be overvalued if the sign of firm-specific error on year *y* is positive. Our second specification includes only companies whose firm-specific error on year *y* is larger than the 75th percentile of firm-specific errors on year *y*. This specification allows us to have a sample of stocks which are considerably overvalued and less likely to be denoted as overvalued due to noise in the estimation of misvaluation. Table 8 documents that the coefficient of $PosPR_{IMM}$ is significantly positive in both specifications showing the robustness of our main result.

[INSERT TABLE 8]

Second, we estimate the firm-specific fundamental value using Residual Income model following Frankel and Lee (1998), and Kokkonen and Suominen (2015), except that the cost of equity is estimated as in D'Mello and Shroff (2000). Fundamental value of company *i* on month *m* is estimated as follows:

$$\hat{V}_{i,m} = B_{i,m} + \frac{(FROE_{i,m} - r_e)}{(1-r_e)} B_{i,m} + \frac{(FROE_{i,m+1} - r_e)}{(1-r_e)r_e} B_{i,m+1} \quad (3)$$

Here, $FROE_m$ $(FROE_{m+1})$, forecasted return on equity, is estimated using the one-year-ahead (two-years-ahead) consensus earnings forecasts from the I/B/E/S monthly summary file and past annual book values obtained from Datastream. Future book values B_m (B_{m+1}) is estimated using $FROE_m$ $(FROE_{m+1})$ and historical dividend payout ratio. Following D'Mello and Shroff (2000), we have used a constant cost of equity, r_e, which is estimated assuming that the population of firms is in average correctly priced. Finally, firm-specific misvaluation is the natural logarithm of market capitalization to fundamental value ratio.[27] The use of monthly summary file allows us to have monthly time series of misvaluation estimates. As past months' performance can have a large effect on the magnitude of misvaluation, the monthly estimates

[26] We use Rhodes-Kropf et al. (2005)'s model 3 in which the market value of equity is regressed on the book value of equity, logarithm of abs(net income), sign of net income, and leverage. Listed companies are divided into six industries based on their ICB industry classification.

[27] The unreported results using misvaluation estimates based on firm-specific cost of equity, $r_{e,i}$, are qualitatively similar. Firm-specific cost of equity, $r_{e,i,}$ is estimated using the Capital Asset Pricing Model. As our population of stocks include lots of small illiquid stocks, we estimate betas using the Scholes and Williams (1977) method which takes non-synchronous trading into account. We thank Peter Nyberg for providing us the Finnish market risk premium data, see Nyberg and Vaihekoski (2014).

should be superior to annual estimates obtained with the Rhodes-Kropf et al. (2005) method. However, the coverage of I/B/E/S is limited leading to more than 40% smaller sample size consisting mainly of liquid large and mid-cap stocks.

The third specification in Table 8 denotes company to be overvalued if the sign of firm-specific misvaluation, estimated using Residual Income model, on month *m* is positive. Finally, the fourth specification consists only of companies whose firm-specific misvaluation on month *m* exceeds the 75th percentile of firm-specific misvaluation estimates in the cross-section of stocks listed in the Helsinki Stock exchange. Again, this specification allows us to focus on a sample of stocks which are considerably overvalued and less likely to be denoted as overvalued due to noise in the estimation of misvaluation. Table 8 confirms the robustness of our results related to inside information as the coefficient of $PosPR_{IMM}$ is significantly positive in both specifications. $NegPR_{IMM}$ is positive, but significant only in the third specification. Interestingly, the $NegPR_{IMM}$ results are qualitatively similar in the case of undervalued companies (unreported).

6.3. Additional robustness checks

Table 9 collects the results based on numerous additional robustness checks. First, Table 9 shows that the repurchase executions are significantly timed to provide immediacy in both early and latter part of our sample period. Note, however, that the results are clearly stronger in the first half of our sample period. Some repurchases are timed to demand immediacy but the effect is significant only during the early part of our sample period. Second, both small-cap and large-cap companies significantly time their repurchases to provide immediacy. On the other hand, $NegPR_{IMM}$ is significantly positive only among large-caps consistent with our earlier findings related to bid-ask spread. Third, both liquid and illiquid companies, classified using the illiquidity measure of Amihud (2002), provide immediacy with their repurchase executions. Consistent with our expectations, the size of the effect is larger among illiquid companies, i.e. companies which have fewer (other) immediacy providers. Consistent with our earlier results, $NegPR_{IMM}$ is significantly positive only among liquid companies.

The fourth robustness check tests whether our main result is robust to excluding Nokia's repurchase programs. Nokia's share of the Helsinki Stock Exchange' aggregate market capitalization used to be extraordinary high. In addition, Nokia has been very active in repurchasing its shares. Due to these two facts, repurchase programs of Nokia account for very large proportion of our sample. More specifically, Nokia's announced (realized) repurchases total €41.7 (18.8) billion, which accounts for almost 73% (80%) of the total announced (realized) repurchases in our sample. Table 9 shows that excluding Nokia's repurchases do not change our results.

The fifth robustness test checks whether our results are driven by some unobservable company-specific variables, e.g. variables related to ownership structure or corporate governance. As our sample includes three companies without any realized repurchase in any of their repurchase programs, company-fixed effects, controlling for unobservable company-specific variables, cannot be included in our basic regression shown in Table 3. However, after excluding these companies we can add company fixed effects and test whether our results are robust to any company-specific variables. Table 9 shows that the results of this specification are qualitatively similar to the full-sample results shown in Table 3.

[INSERT TABLE 9]

Note also that repurchase programs without any realized repurchases, totaling to 26 programs, form an interesting subsample to analyze. Companies timing their repurchases to provide immediacy should repurchase their shares only if large enough selling pressures are observed during the program. Consistent with this idea, the predicted return from providing immediacy is significantly smaller in programs without any repurchase executions compared to programs with realized repurchases. Figure 3 shows that this difference is mainly due to a smaller probability of large positive values of PR_{IMM} on programs without any repurchase executions.

[INSERT FIGURE 3]

7. Conclusions

This paper studies using Finnish daily disclosure data on open-market share repurchases whether repurchase executions provide or demand immediacy. Earlier used measures, past returns and volume, do not allow an econometrician to distinguish between the provision of immediacy and other proposed determinants, namely cost minimization, the provision of liquidity, and the strategic use of inside information. Therefore, we use a measure for the predicted return from providing immediacy which is uncorrelated with the other proposed determinants. In addition, this measure allows us to control separately for earlier used measures.

We find that companies are in average providing immediacy through their repurchase executions. However, we also show that some repurchases demand immediacy. Frequently executed repurchases are unlikely to provide immediacy as previously executed repurchases affect the future provision of immediacy through their effect to the inventories of other immediacy providers. As

expected, we find that past repurchase activity decreases the significance of immediacy provision as a determinant of daily repurchase executions.

References

Amihud Y (2002) Illiquidity and stock returns: cross-section and time-series effects. *J. Financial Markets* 5: 31-56.

Amihud Y, Mendelson H (1986) Asset pricing and the bid-ask spread. *J. Financial Econom.* 17: 223-249.

Anand A, Tanggaard C, Weaver D (2009) Paying for market quality. *J. Financial Quant. Anal.* 44: 1427-1457.

Babenko I (2009) Share repurchases and pay-performance sensitivity of employee compensation contracts. *J. Finance* 64: 117-150.

Bagwell L (1992) Dutch auction repurchases: an analysis of shareholder heterogeneity. *J. Finance* 47: 71-105.

Banyi M, Dyl E, Kahle K (2008) Errors in estimating share repurchases. *J. Corporate Finance* 14: 460-474.

Ben-Rephael A, Oded J, Wohl A (2014) Do firms buy their stock at bargain prices? Evidence from actual stock repurchase disclosures. *Rev. Finance* 18: 1299-1340.

Bonaimé A, Ryngaert M (2013) Insider trading and share repurchases: do insiders and firms trade in the same direction? *J. Corporate Finance* 22: 35-53.

Bond P, Zhong H (2016) Buying high and selling low: stock repurchases and persistent asymmetric information. *Rev. Financial Stud.* 29: 1409-1452.

Brockman P, Chung D (2001) Managerial timing and corporate liquidity: evidence from actual share repurchases. *J. Financial Econom.* 61: 417-448.

Brown D, Ryngaert M (1992) The determinants of tendering rates in interfirm and self-tender offers. *J. Bus.* 65: 529-556

Busch P, Obernberger S (2016) Actual share repurchases, price efficiency, and the information content of stock prices. *Rev. Financial Stud.* (Forthcoming).

Butler A, Grullon G, Weston J (2005) Stock market liquidity and the cost of issuing equity. *J. Financial Quant. Anal.* 40: 331-348.

Campbell J, Grossman S, Wang J (1993) Trading volume and serial correlation in stock returns. *Quart. J. Econom.* 108: 905-939.

Campello M, Saffi P (2015) The rise of the equity lending market: implications for corporate financial policies. Working paper, Cornell University, Ithaca.

Chung D, Isakov D, Pérignon C (2007) Repurchasing shares on a second trading line. *Rev. Finance* 11: 253-285.

Cook D, Krigman L, Leach J (2003) An analysis of SEC Guidelines for executing open market repurchases. *J. Bus.* 76: 289-315.

Cook D, Krigman L, Leach J (2004) On the timing and execution of open-market repurchases. *Rev. Financial Stud.* 17: 463-498.

De Cesari A, Espenlaub S, Khurshed A, Simkovic M (2012) The effects of ownership and stock liquidity on the timing of repurchase transactions. *J. Corporate Finance* 18: 1023-1050.

de Jong A, Dutordoir M, Verwijmeren P (2011) Why do convertible issuers simultaneously repurchase stock? An arbitrage-based explanation. *J. Financial Econom.* 100: 113-129.

Dittmar A, Dittmar R (2008) The timing of financing decisions: an examination of the correlation in financing waves. *J. Financial Econom.* 90: 59-83.

Dittmar, Amy and Laura Casares Field, 2015, Can managers time the market? Evidence using repurchase price data, *Journal of Financial Economics* 115, 261-282.

D'Mello R, Shroff P (2000) Equity undervaluation and decisions related to repurchase tender offers: an empirical investigation. *J. Finance* 55: 2399-2424.

Edelen R, Kadlec G (2012) Delegated trading and the speed of adjustment in security prices. *J. Financial Econom.* 103: 294-307.

Fenn G, Liang N (2001) Corporate payout policy and managerial stock incentives. *J. Financial Econom.* 60: 45-72.

Frankel R, Lee C (1998) Accounting valuation, market expectation, and cross-sectional stock returns. *J. Accounting Econom.* 25: 283-319.

Gao X, Ritter J (2010) The marketing of seasoned equity offerings. *J. Financial Econom.* 97: 33-52.

Gaspar J, Massa M, Matos P, Patgiri R, Rehman Z (2012) Payout policy choices and shareholder investment horizons. *Rev. Finance* 17: 261-320.

Ginglinger E, Hamon J (2007) Actual share repurchases timing and liquidity. *J. Banking Finance* 31: 915-938.

Ginglinger E, Hamon J (2009) Share repurchase regulations: Do firms play by the rules? *Internat. Rev. Law Econom.* 29: 81-96.

Grossman S, Miller M (1988) Liquidity and market structure. *J. Finance* 43: 617-633.

Hendershott T, Seasholes M (2007) Market maker inventories and stock prices. *Amer. Econom. Rev. Papers Proc.* 97: 210-214.

Hillert A, Maug E, Obernberger S (2016) Stock repurchases and liquidity. *J. Financial Econom.* 119: 186-209.

Hong H, Wang J, Yu J (2008) Firms as buyers of last resort. *J. Financial Econom.* 88: 119-145.

Ikenberry D, Lakonishok J, Vermaelen T (2000) Stock Repurchases in Canada: performance and strategic trading. *J. Finance* 55: 2373-2397.

Jegadeesh N (1990) Evidence of predictable behavior of security returns. *J. Finance* 45: 881-898.

Jegadeesh N, Titman S (1995) Short-horizon return reversals and the bid-ask spread. *J. Financial Intermediation* 4: 116-132.

Jylhä P, Rinne K, Suominen M (2014) Do hedge funds supply or demand liquidity? *Rev. Finance* 18: 1259-1298.

Kahle K (2002) When a buyback isn't a buyback: open market repurchases and employee options. *J. Financial Econom.* 63: 235-261.

Karhunen J (2002) Essays on tender offers and share repurchases. PhD-thesis, Helsinki School of Economics, Helsinki.

Khandani A, Lo A (2007) What happened to the quants in August 2007? *J. Investment Management* 5: 5-54.

Khandani A, Lo A (2011) What happened to the quants in August 2007?: Evidence from factors and transactions data. *J. Financial Markets* 14: 1-46.

Kokkonen J, Suominen M (2015) Hedge funds and stock market efficiency. *Management Sci.* 61: 2890-2904.

Lehmann B (1990) Fads, martingales, and market efficiency. *Quart. J. Econom.* 105: 1-28.

Liu H, Swanson E (2016) Is price support a motive for increasing share repurchases? *J. Corporate Finance* 38: 77-91.

Lo A, MacKinlay A (1990) When are contrarian profits due to stock market overreaction? *Rev. Financial Stud.* 3: 175-205.

McNally W, Smith B (2011) A microstructure analysis of the liquidity impact of open market repurchases. *J. Financial Res.* 34: 481-501.

Menkveld A, Wang T (2013) How do designated market makers create value for small-caps? *J. Financial Markets* 16: 571-603.

Nagel S (2012) Evaporating liquidity. *Rev. Financial Stud.* 25: 2005-2039.

Nayar N, Singh A, Zebedee A (2008) Share repurchase offers and liquidity: an examination of temporary and permanent effects. *Financial Management* 37: 251-270.

Netter J, Mitchell M (1989) Stock-repurchase announcements and insider transactions after October 1987 stock market crash. *Financial Management* 18: 84-96.

Nyberg P, Vaihekoski M (2014) Equity premium in Finland and long-term performance of the Finnish equity and money markets. *Cliometrica* 2: 241-268.

Oded J (2009) Optimal execution of open-market stock repurchase programs. *J. Financial Markets* 12: 832-869.

Ohlson J (1990) A synthesis of security valuation theory and the role of dividends, cash flows, and earnings. *Contemporary Accounting Res.* 6: 648-676.

Ohlson J (1995) Earnings, book values, and dividends in equity valuation. *Contemporary Accounting Res.* 11: 661-687.

Pastor L, Stambaugh R (2003) Liquidity risk and expected stock returns. *J. Political Econom.* 111: 642-685.

Petersen M (2009) Estimating standard errors in finance panel data sets: comparing approaches. *Rev. Financial Stud.* 22: 435-480.

Rhodes-Kropf M, Robinson D, Viswanathan S (2005) Valuation waves and merger activity: The empirical evidence. *J. Financial Econom.* 77: 561-603.

Rinne K, Suominen M (2009) Value uncertainty, price impact and the choice of equity issuing method. Working paper, Helsinki School of Economics, Helsinki.

Rinne K, Suominen M (2012) A structural model of short-term reversals. Working paper, Aalto University, Helsinki.

Scholes M, Williams J (1977) Estimating betas from nonsynchronous data. *J. Financial Econom.* 5: 309-327.

Stephens C, Weisbach M (1998) Actual share reacquisitions in open-market repurchase programs. *J. Finance* 53: 313-333.

Zhang L (2005) Share price performance following actual share repurchases. *J. Banking Finance* 29: 1887-1901.

Table 1. Summary statistics

Panel A of this table shows the number of announced repurchase programs and the aggregate size of the programs by year. *Announced maximum program size* in million euro is the announced maximum number of shares to be repurchased multiplied with a stock price measured one day before the program execution release. *Realized program size* in million euro is the total value of repurchase executions. All the executions of repurchase programs are classified based on the announcement year, regardless of the actual execution day. *% of maximum used* is either the number of shares repurchased (adjusted for splits) divided by the maximum number of shares to be repurchased. Panel B of this table shows the summary statistics of repurchase programs executed during our sample period, from January 1999 through December 2009. *Announced maximum size / market capitalization* is *announced maximum program size* divided by market capitalization of a stock measured one day before the program execution release. *Length of repurchase program* is the length of the program measured in trading days from the official starting day. Ending day of the program is the earliest of the following days: ending day stated at the program execution release, ending day of the repurchase authorization approved by the AGM, updated ending day based on a new stock exchange release, the day on which the realized program size equals the announced maximum program size, or one day before the starting day of the next repurchase program. *Number of repurchase days* is the number of days on which the company has executed a repurchase trade(s). *Mean value of daily repurchase* is a program-specific average value of daily repurchase executions in thousand euro. *Conditional mean value of daily repurchase* is a program-specific average value of daily repurchase executions in thousand euro including only days on which a company has bought at least one share. *Mean daily repurchase / daily volume* is a program-specific average of daily number of shares repurchased divided by daily trading volume. *Conditional mean daily repurchase / daily volume* is a program-specific average of daily number of shares repurchased divided by daily trading volume including only days on which a company has bought at least one share.

Panel A: Number of programs and program size

Year	# of announced programs	Sum of announced maximum program sizes	Sum of realized program sizes	% of maximum used
1999	19	686.2	376.6	61.4
2000	27	3,764.3	921.8	48.0
2001	35	2,767.6	365.8	37.5
2002	33	1,358.2	521.2	44.2
2003	20	3,714.6	2,280.8	42.4
2004	16	4,435.0	3,128.7	34.9
2005	25	7,505.4	5,632.3	34.1
2006	21	8,393.2	3,112.2	28.2
2007	24	9,288.3	3,869.6	42.4
2008	50	14,723.3	3,277.3	41.5
2009	26	647.5	53.5	38.9
Total	296	57,283.5	23,539.9	41.1

Panel B: Summary statistics of repurchase programs

	Mean	Median	Min	Max
Announced maximum program size (MEUR)	193.5	5.7	0.0	7,229.8
Announced maximum size/ market capitalization (%)	4.1	4.6	0.0	31.2
Realized program size (MEUR)	79.5	1.0	0.0	4,993.5
% of maximum used	47.5	38.1	0.0	168.2
Length of repurchase program (in trading days)	152.0	156.0	1.0	374.0
Number of repurchase days	36.6	25.5	0.0	206.0
Number of repurchase days / length (%)	35.7	26.2	0.0	100.0
Mean value of daily repurchase (kEUR)	593.0	11.5	0.0	25,968.2
Conditional mean value of daily repurchase (kEUR)	1,409.1	52.4	0.0	36,185.0
Mean daily repurchase / daily volume (%)	13.2	8.3	0.0	88.1
Conditional mean daily repurchase/ daily volume (%)	33.0	29.4	0.0	100.0

Table 2. The pattern of return reversal

This table shows the average coefficients of $\hat{\beta}_{t-\tau}$, from daily cross-sectional regressions of Equation (1) in which stock's 5-day future excess returns $R5_t$ are regressed on each of the stock's past ten days' excess returns, $R_{t-\tau}$, where $\tau \in \{0, \ldots, 9\}$, and controls *ln(Volume)x$R_{t,t-9}$*, *ln(Market Capitalization)x$R_{t,t-9}$*, and $ln(RP_{10})$. First two controls are constructed by multiplying the past 10-day excess returns with either the stock's past 10-day (log of) trading volume or the stock's (log of) market capitalization at day *t*, and RP_{10} is the maximum of the value of repurchases during the past 10 days and 1€. The excess returns are calculated relative to equal-weighted market index. *t*-statistics based on Fama-Macbeth standard errors are shown next to the coefficients in parentheses. Here ***, ** or * are used to denote figures that are statistically significantly different from zero at 1%, 5% or 10% level.

	$R5_t$	*t*-stat	
R_t	**-0.247**	(-14.58)	***
R_{t-1}	**-0.157**	(-9.13)	***
R_{t-2}	**-0.122**	(-7.43)	***
R_{t-3}	**-0.095**	(-5.79)	***
R_{t-4}	**-0.081**	(-4.97)	***
R_{t-5}	**-0.073**	(-4.54)	***
R_{t-6}	**-0.066**	(-4.07)	***
R_{t-7}	**-0.054**	(-3.32)	***
R_{t-8}	**-0.049**	(-3.03)	***
R_{t-9}	**-0.043**	(-2.65)	***
$ln(RP_{10})$[1]	**0.115**	(3.43)	***
ln(Volume)x$R_{t,t-9}$	**0.017**	(21.33)	***
ln(Market Capitalization)x$R_{t,t-9}$	**-0.011**	(-9.19)	***
Intercept	**-0.001**	(-15.46)	***
Number of daily regressions	2,997		
Average number of observations	160		
Average R^2	0.209		

[1] Coefficient multiplied by 10^3

Table 3. Repurchases and the provision of immediacy

This table shows the results of Tobit regression on which *Repurchases / Volume*, the share of repurchases of trading volume in stock *i* on day *t*, is regressed on our provision of immediacy measure(s), and controls. First, our immediacy provision measure is PR_{IMMt-1}, one-day lagged predicted return from providing immediacy, and then, we use $PosPR_{IMM,t-1}$ and $NegPR_{IMM,t-1}$, absolute value of PR_{IMMt-1} when PR_{IMMt-1} is either positive or negative. PR_{IMMt-1} is stock's predicted weekly return evaluated using 120-day moving average of coefficients for short-term return reversal (Equation 1), stock's past daily returns, and controls as explained in the text. *Earnings Announcement* dummy equals one on quarterly earnings announcement days, *Quiet Period (10D)* equals one during 10 trading days preceding quarterly earnings announcement days, and *Quiet period (15D)* equals one during the five trading day period preceding the 10-day quiet period. The *High repurchases allowed* dummy equals one if a company has disclosed that it waives the restriction that daily repurchase volume needs to be less than 50% of the average daily trading volume over the last four weeks. *Price / quarterly low* is price on day *t-1* divided by the lowest price observed during the past 60 days. The *First day* dummy equals one on the first day of the repurchase program, and *5% left of program* dummy equals one on days when the cumulative sum of realized repurchases is exceeding 95% of the announced (maximum) size of the program. The *Liquidity Provider* dummy equals one if a company has outstanding liquidity provider contract with a broker. *Past 10-day excess return* is a company's past 10-day return in excess of 10-day market return and *Ln(past 10 days' volume)* is (log of) past 10 days' trading volume in euros. Year dummies are included in columns 2 and 4. *z*-statistics based on two-way clustered (stock and day) standard errors are shown below in parentheses. Here ***, ** or * are used to denote figures that are statistically significantly different from zero at 1%, 5% or 10% level.

PR_{IMM}	5.608	***	3.174	***				
	(3.21)		(3.51)					
$PosPR_{IMM}$					16.855	***	10.013	***
					(5.39)		(8.10)	
$NegPR_{IMM}$					6.696	**	3.863	***
					(2.51)		(2.83)	
Earnings Announcement			-0.135	***			-0.131	***
			(-3.75)				(-3.60)	
Quiet Period (10D)			-0.304	***			-0.303	***
			(-9.85)				(-9.72)	
Quiet Period (15D)			-0.088	***			-0.090	***
			(-4.53)				(-4.76)	
High repurchases allowed			0.041				0.044	
			(0.94)				(0.99)	
Price / quarterly low			-0.313	***			-0.326	***
			(-3.83)				(-4.01)	
First Day			0.264	***			0.264	***
			(7.48)				(7.47)	
Lagged Repurchases / Volume			1.259	***			1.250	***
			(28.15)				(28.50)	
5% left of program			-0.011				-0.015	
			(-0.14)				(-0.21)	
Liquidity Provider			0.044				0.051	
			(1.22)				(1.38)	
Past 10-day excess return			0.334	***			0.371	***
			(3.32)				(3.87)	
Ln (past 10 days' volume)			0.009	**			0.009	**
			(2.07)				(2.24)	
Intercept	-0.375	***	-0.471	***	-0.439	***	-0.528	***
	(-7.64)		(-6.08)		(-8.00)		(-6.65)	
N	44,100		44,100		44,100		44,100	
% of zero observations	75.4%		75.4%		75.4%		75.4%	

Table 4. Repurchases and the provision of immediacy excluding zero trading volume days

This table shows the results of Tobit regression on which *Repurchases / Volume*, the share of repurchases of trading volume in stock *i* on day *t*, is regressed on $PosPR_{IMM,t-1}$, $NegPR_{IMM,t-1}$ and controls. Days with zero trading volume are excluded. $PosPR_{IMM,t-1}$ ($NegPR_{IMM,t-1}$) is absolute value of PR_{IMMt-1} when PR_{IMMt-1} is positive (negative), where PR_{IMMt-1} is one-day lagged stock's predicted weekly return evaluated using 120-day moving average of coefficients for short-term return reversal (Equation 1), stock's past daily returns, and controls as explained in the text. *Earnings Announcement* dummy equals one on quarterly earnings announcement days, *Quiet Period (10D)* equals one during 10 trading days preceding quarterly earnings announcement days, and *Quiet period (15D)* equals one during the five trading day period preceding the 10-day quiet period. The *High repurchases allowed* dummy equals one if a company has disclosed that it waives the restriction that daily repurchase volume needs to be less than 50% of the average daily trading volume over the last four weeks. *Price / quarterly low* is price on day *t-1* divided by the previous 60 days' lowest price. The *First day* dummy equals one on the first day of the repurchase program, and *5% left of program* dummy equals one on days when the cumulative sum of realized repurchases is exceeding 95% of the announced (maximum) size of the program. The *Liquidity Provider* dummy equals one if a company has outstanding liquidity provider contract with a broker. *Past 10-day excess return* is a company's past 10-day return in excess of 10-day market return and *Ln(past 10 days' volume)* is (log of) past 10 days' trading volume in euros. *z*-statistics based on two-way clustered (stock and day) standard errors are shown below in parentheses. Here ***, ** or * are used to denote figures that are statistically significantly different from zero at 1%, 5% or 10% level.

$PosPR_{IMM}$	18.436	***	9.640	***
	(6.09)		(8.52)	
$NegPR_{IMM}$	8.591	***	4.510	***
	(3.41)		(3.80)	
Earnings Announcement			-0.142	***
			(-4.15)	
Quiet Period (10D)			-0.287	***
			(-9.97)	
Quiet Period (15D)			-0.088	***
			(-4.79)	
High repurchases allowed			0.110	**
			(2.55)	
Price / quarterly low			-0.331	***
			(-4.22)	
First Day			0.246	***
			(7.44)	
Lagged Repurchases / Volume			1.222	***
			(31.93)	
5% left of program			0.005	
			(0.07)	
Liquidity Provider			-0.005	
			(-0.14)	
Past 10-day excess return			0.365	***
			(4.07)	
Ln (past 10 days' volume)			-0.004	
			(-0.74)	
Intercept	-0.393	***	-0.290	***
	(-7.87)		(-4.00)	
Year dummies	NO		YES	
N	39,723		39,723	
% of zero observations	72.7%		72.7%	

Table 5. Past repurchases and the provision of immediacy

This table shows the results of Tobit regression on which *Repurchases / Volume*, the share of repurchases of trading volume in stock *i* on day *t*, is regressed on 1) PR_{IMMt-1}, $PosPR_{IMMt-1}$ or $NegPR_{IMMt-1}$, 2) *Following*, equaling one when a company has executed repurchases during the past week, 3) the interaction of *Following* with one of our provision of immediacy proxies, and 4) earlier used controls. PR_{IMMt-1} is stock's one-day lagged predicted weekly return evaluated using 120-day moving average of coefficients for short-term return reversal (Equation 1), stock's past daily returns, and controls as explained in the text. $PosPR_{IMM,t-1}$ ($NegPR_{IMM,t-1}$) is absolute value of PR_{IMMt-1} when PR_{IMMt-1} is positive (negative). Unreported control variables are the same as in Table 3 except *Lagged Repurchases / Volume* is excluded. *z*-statistics based on two-way clustered (stock and day) standard errors are shown below in parentheses. Here ***, ** or * are used to denote figures that are statistically significantly different from zero at 1%, 5% or 10% level.

PR_{IMMt-1}	3.638	***				
	(4.16)					
Following	0.853	***				
	(14.86)					
PR_{IMMt-1} x Following	-3.491	***				
	(-2.77)					
$PosPR_{IMMt-1}$			6.710	***		
			(4.70)			
Following			0.868	***		
			(14.73)			
$PosPR_{IMMt-1}$ x Following			-6.098	***		
			(-2.84)			
$NegPR_{IMMt-1}$					-1.786	
					(-1.15)	
Following					0.848	***
					(14.78)	
$NegPR_{IMMt-1}$ x Following					2.129	
					(0.96)	
Intercept	-0.630	***	-0.652	***	-0.624	***
	(-6.76)		(-6.88)		(-6.60)	
Controls	YES		YES		YES	
Year dummies	YES		YES		YES	
N	44,100		44,100		44,100	
% of zero observations	75.4%		75.4%		75.4%	

Table 6. Repurchase executions and the provision of liquidity

This table shows the results of Tobit regression on which *Repurchases / Volume*, the share of repurchases of trading volume in stock *i* on day *t*, is regressed on $PosPR_{IMMt-1}$, $NegPR_{IMMt-1}$, and controls, based on two alternative subsamples. First subsample consists of stocks with lower than median relative bid-ask spread measured using the closing bid and ask prices in day *t-1*. Second subsample includes only stocks with an outstanding Liquidity Provider contract. $PosPR_{IMM,t-1}$ ($NegPR_{IMM,t-1}$) is absolute value of PR_{IMMt-1} when PR_{IMMt-1} is positive (negative), where PR_{IMMt-1} is one-day lagged stock's predicted weekly return evaluated using 120-day moving average of coefficients for short-term return reversal (Equation 1), stock's past daily returns, and controls as explained in the text. *Earnings Announcement* dummy equals one on quarterly earnings announcement days, *Quiet Period (10D)* equals one during 10 trading days preceding quarterly earnings announcement days, and *Quiet period (15D)* equals one during the five trading day period preceding the 10-day quiet period. The *High repurchases allowed* dummy equals one if a company has disclosed that it waives the restriction that daily repurchase volume needs to be less than 50% of the average daily trading volume over the last four weeks. *Price / quarterly low* is price on day *t-1* divided by the previous 60 days' lowest price. The *First day* dummy equals one on the first day of the repurchase program, and *5% left of program* dummy equals one on days when the cumulative sum of realized repurchases is exceeding 95% of the announced (maximum) size of the program. *Past 10-day excess return* is a company's past 10-day return in excess of 10-day market return and *Ln(past 10 days' volume)* is (log of) past 10 days' trading volume in euros. *z*-statistics based on two-way clustered (stock and day) standard errors are shown below in parentheses. Here ***, ** or * are used to denote figures that are statistically significantly different from zero at 1%, 5% or 10% level.

	Low bid-ask spread		LP-contract	
$PosPR_{IMM}$	10.173	***	10.325	***
	(7.45)		(3.24)	
$NegPR_{IMM}$	6.884	***	-0.635	
	(6.85)		(-0.18)	
Earnings Announcement	-0.064	**	-0.259	***
	(-2.04)		(-3.35)	
Quiet Period (10D)	-0.258	***	-0.445	***
	(-8.81)		(-6.47)	
Quiet Period (15D)	-0.091	***	-0.070	*
	(-4.77)		(-1.94)	
High repurchases allowed	0.091	***	0.032	
	(2.98)		(0.94)	
Price / quarterly low	-0.327	***	-0.377	
	(-4.73)		(-1.27)	
First Day	0.209	***	0.208	**
	(6.71)		(1.99)	
Lagged Repurchases / Volume	1.208	***	0.981	***
	(26.49)		(10.67)	
5% left of program	-0.009		-0.013	
	(-0.16)		(-1.22)	
Past 10-day excess return	0.296	***	1.024	***
	(3.29)		(2.62)	
Ln (past 10 days' volume)	0.002		0.003	**
	(0.51)		(1.96)	
Intercept	-0.343	***	-0.341	*
	(-5.04)		(-1.74)	
Year dummies	YES		YES	
N	28,564		4,414	
% of zero observations	74.9%		65.4%	

Table 7. Repurchases executed before earnings announcements

This table shows the results of Tobit regression on which *Repurchases / Volume*, the share of repurchases of trading volume in stock *i* on day *t*, is regressed on $PosPR_{IMMt-1}$, $NegPR_{IMMt-1}$, and controls, based on a subsample including only observations during the quiet period preceding the quarterly earnings announcement. $PosPR_{IMM,t-1}$ ($NegPR_{IMM,t-1}$) is absolute value of PR_{IMMt-1} when PR_{IMMt-1} is positive (negative), where PR_{IMMt-1} is one-day lagged stock's predicted weekly return evaluated using 120-day moving average of coefficients for short-term return reversal (Equation 1), stock's past daily returns, and controls as explained in the text. The *High repurchases allowed* dummy equals one if a company has disclosed that it waives the restriction that daily repurchase volume needs to be less than 50% of the average daily trading volume over the last four weeks. *Price / quarterly low* is price on day *t-1* divided by the previous 60 days' lowest price. The *First day* dummy equals one on the first day of the repurchase program, and *5% left of program* dummy equals one on days when the cumulative sum of realized repurchases is exceeding 95% of the announced (maximum) size of the program. The *Liquidity Provider* dummy equals one if a company has outstanding liquidity provider contract with a broker. *Past 10-day excess return* is a company's past 10-day return in excess of 10-day market return and *Ln(past 10 days' volume)* is (log of) past 10 days' trading volume in euros. *z*-statistics based on two-way clustered (stock and day) standard errors are shown below in parentheses. Here ***, ** or * are used to denote figures that are statistically significantly different from zero at 1%, 5% or 10% level.

	15D quiet period		10D quiet period	
$PosPR_{IMM}$	14.822	***	14.616	***
	(5.39)		(3.63)	
$NegPR_{IMM}$	5.065		-2.226	
	(1.51)		(-0.36)	
High repurchases allowed	0.029		0.130	
	(0.47)		(1.02)	
Price / quarterly low	-0.474	***	-0.602	**
	(-3.29)		(-2.58)	
First Day	0.375	***	0.140	
	(3.72)		(0.56)	
Lagged Repurchases / Volume	1.659	***	1.878	***
	(22.42)		(14.38)	
5% left of program	-0.500	**	-0.399	
	(-2.47)		(-1.53)	
Liquidity Provider	-0.007		-0.292	*
	(-0.11)		(-1.86)	
Past 10-day excess return	0.828	***	1.248	***
	(3.08)		(2.68)	
Ln (past 10 days' volume)	-0.008		-0.014	
	(-0.92)		(-1.42)	
Intercept	-0.605	***	-0.719	***
	(-4.24)		(-3.78)	
Year dummies	YES		YES	
N	9,595		6,395	
% of zero observations	89.5 %		93.9 %	

Table 8. Repurchases by overvalued companies

This table shows the results of Tobit regression on which *Repurchases / Volume*, the share of repurchases of trading volume in stock *i* on day *t*, is regressed on $PosPR_{IMMt-1,}$ $NegPR_{IMMt-1}$, and controls, based on a subsample including only repurchases executed by companies estimated to be overvalued. In first two specifications, firm-specific misvaluation estimate is based on the Rhodes-Kropf et al. (2005) (RRV) method and in last two the misvaluation estimate is based on Residual income (RI) model. $PosPR_{IMM,t-1}$ ($NegPR_{IMM,t-1}$) is absolute value of PR_{IMMt-1} when PR_{IMMt-1} is positive (negative), where PR_{IMMt-1} is one-day lagged stock's predicted weekly return evaluated using 120-day moving average of coefficients for short-term return reversal (Equation 1), stock's past daily returns, and controls as explained in the text. *Earnings Announcement* dummy equals one on quarterly earnings announcement days, *Quiet Period (10D)* equals one during 10 trading days preceding quarterly earnings announcement days, and *Quiet period (15D)* equals one during the five trading day period preceding the 10-day quiet period. The *High repurchases allowed* dummy equals one if a company has disclosed that it waives the restriction that daily repurchase volume needs to be less than 50% of the average daily trading volume over the last four weeks. *Price / quarterly low* is price on day *t-1* divided by the previous 60 days' lowest price. The *First day* dummy equals one on the first day of the repurchase program, and *5% left of program* dummy equals one on days when the cumulative sum of realized repurchases is exceeding 95% of the announced (maximum) size of the program. The *Liquidity Provider* dummy equals one if a company has outstanding liquidity provider contract with a broker. *Past 10-day excess return* is a company's past 10-day return in excess of 10-day market return and *Ln(past 10 days' volume)* is (log of) past 10 days' trading volume in euros. *z*-statistics based on two-way clustered (stock and day) standard errors are shown below in parentheses. Here ***, ** or * are used to denote figures that are statistically significantly different from zero at 1%, 5% or 10% level.

	Sign / RRV		4th quartile / RRV		Sign / RI		4th quartile / RI	
$PosPR_{IMM}$	8.261	***	8.042	***	9.872	***	6.651	***
	(5.50)		(3.55)		(5.24)		(4.13)	
$NegPR_{IMM}$	3.042	*	3.052		6.737	***	1.588	
	(1.88)		(1.64)		(3.99)		(0.80)	
Earnings Announcement	-0.191	***	-0.195	***	-0.184	***	-0.162	***
	(-3.80)		(-3.06)		(-3.47)		(-2.67)	
Quiet Period (10D)	-0.355	***	-0.320	***	-0.233	***	-0.206	***
	(-8.00)		(-4.51)		(-7.19)		(-5.64)	
Quiet Period (15D)	-0.091	***	-0.122	***	-0.090	***	-0.067	***
	(-3.08)		(-2.66)		(-3.59)		(-3.22)	
High repurchases allowed	0.069		0.129		0.031		0.055	
	(1.38)		(1.19)		(0.41)		(0.69)	
Price / quarterly low	-0.318	***	-0.305	**	-0.345	***	-0.191	
	(-3.43)		(-2.07)		(-2.70)		(-1.54)	
First Day	0.217	***	0.217	***	0.183	**	0.251	***
	(4.43)		(2.86)		(2.59)		(3.08)	
Lagged Repurchases / Volume	1.171	***	1.231	***	1.207	***	1.134	***
	(18.83)		(10.57)		(19.22)		(16.40)	
5% left of program	0.001		0.113		0.023		0.014	
	(0.01)		(1.49)		(0.18)		(0.13)	
Liquidity Provider	0.065		0.180	***	-0.011		-0.077	
	(1.30)		(3.12)		(-0.28)		(-0.87)	
Past 10-day excess return	0.363	***	0.140		0.148		0.187	
	(3.01)		(0.97)		(1.03)		(1.11)	
Ln (past 10 days' volume)	0.008		0.009		0.004		0.001	
	(1.60)		(1.37)		(0.89)		(0.08)	
Intercept	-0.503	***	-0.481	***	-0.351	***	-0.217	**
	(-4.42)		(-2.92)		(-3.83)		(-2.01)	
Year dummies	YES		YES		YES		YES	
N	22,781		11,067		13,475		7,327	
% of zero observations	74.1%		78.7%		77.0%		74.3%	

Table 9. Other robustness checks

This table shows the coefficient of $PosPR_{IMMt-1}$ and $NegPR_{IMMt-1}$ based on numerous alternative specifications. The results are based on Tobit regressions in which *Repurchases / Volume*, the share of repurchases of trading volume in stock *i* on day *t*, is regressed on $PosPR_{IMMt-1}$, $NegPR_{IMMt-1}$, and earlier used controls (the 4th specification in Table 3 with the exceptions explained below). First, two subsamples divide the sample into two based on the execution year. In these specifications, earlier used controls exclude year dummies and Liquidity Provider dummy. Second, two subsamples divide the sample into two based on the market capitalization at the end of previous year. Third, two subsamples divide the sample into two based on the Amihud (2002) *ILLIQ* measured using the previous year's data. Fourth, this subsample excludes repurchase programs of Nokia. The fifth specification excludes companies without any realized repurchases and the sixth specification using the same subsample as the fifth specification adds company fixed effects. *z*-statistics based on two-way clustered (stock and day) standard errors are shown below in parentheses. Here ***, ** or * are used to denote figures that are statistically significantly different from zero at 1%, 5% or 10% level.

	$PosPR_{IMM}$		$NegPR_{IMM}$	
1999-2004	14.018	***	5.156	***
	(6.40)		(2.61)	
2005-2009	7.483	***	2.351	
	(5.51)		(1.52)	
Small-Cap stocks	9.399	***	-1.091	
	(4.49)		(-0.48)	
Large-Cap stocks	9.111	***	5.009	***
	(6.85)		(3.69)	
Illiquid stocks	11.172	***	0.266	
	(5.63)		(0.10)	
Liquid stocks	8.130	***	5.519	***
	(6.88)		(5.82)	
Excluding Nokia	10.182	***	3.421	**
	(7.82)		(2.28)	
Excluding companies without	9.418	***	3.673	***
any realized repurchases	(7.92)		(2.68)	
Company fixed effects	7.564	***	3.747	***
	(8.19)		(3.30)	

Figure 1. Repurchases executions in the predicted return from providing immediacy deciles
This figure shows how repurchases' share of trading volume varies in the predicted return from providing immediacy, PR_{IMMt}, deciles. PR_{IMM} is stock's one-day lagged predicted weekly return evaluated using 120-day moving average of coefficients for short-term return reversal (Equation 1), stock's past daily returns, and controls as explained in the text. Observations in our sample, consisting of all days when a stock has outstanding repurchase program, are divided into deciles based on PR_{IMM} values.

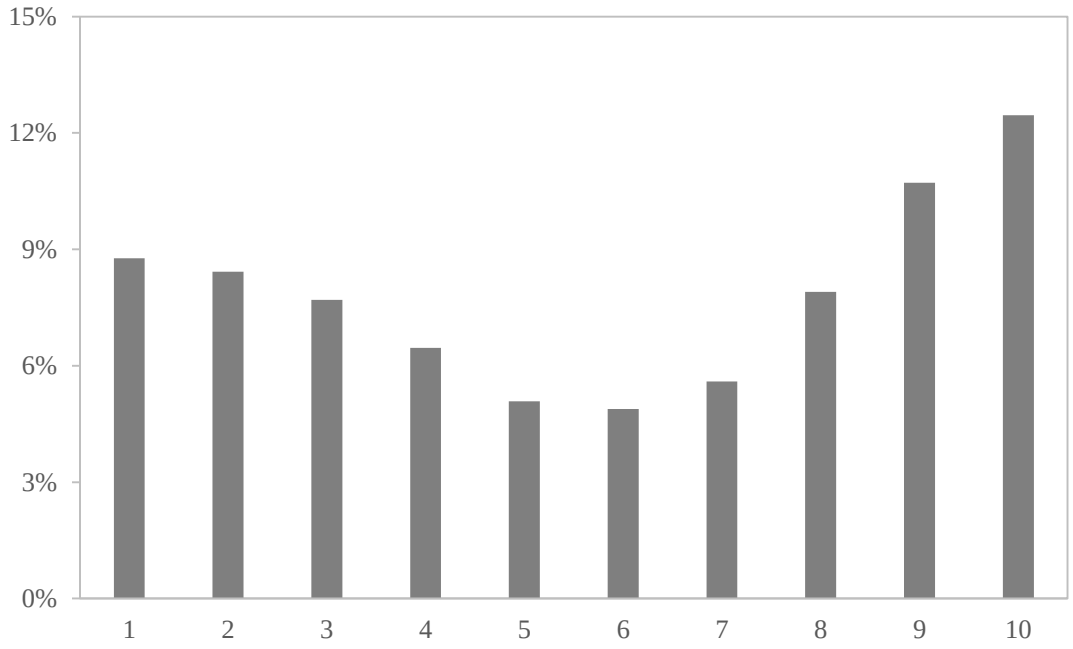

Figure 2. Returns preceding repurchase executions conditional on past repurchases
This figure shows the average cumulative excess returns preceding repurchase execution at day *t* conditional on whether there have been any repurchase executions during the past week (5 trading days).

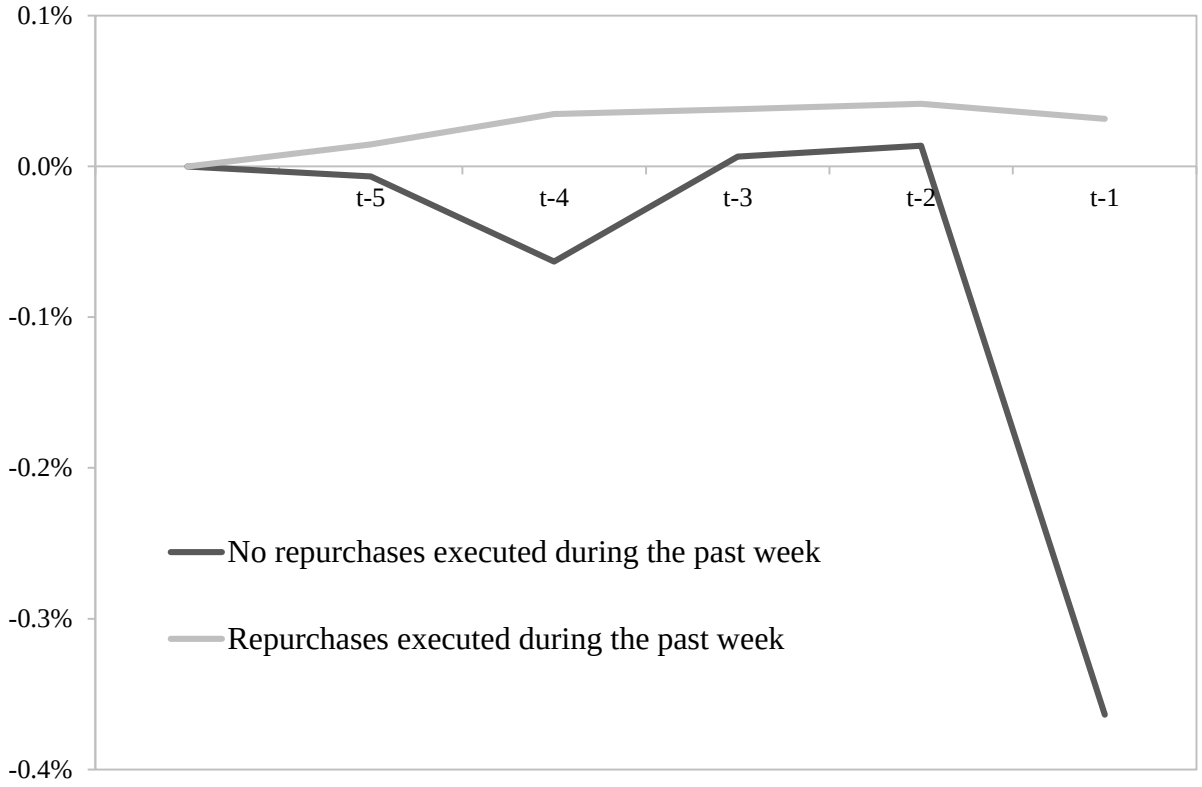

Figure 3. Cumulative distribution for PR_{IMM}

This figure shows the cumulative distribution for PR_{IMM} conditional on whether there have been any repurchase executions during the repurchase program.