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MASTER THESIS FINANCIAL ECONOMICS

ABNORMAL STOCK PERFORMANCE FOLLOWING OPEN-MARKET SHARE REPURCHASE ANNOUNCEMENTS

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ABSTRACT

This paper evaluates the existence of short- and long-run abnormal stock-price performance following open-market share repurchase announcements and assesses the validity of various motivations involved in these events. Firms announcing open-market share repurchases achieve a significant positive initial market reaction. I find evidence supporting certain aspects of signaling, mispricing, altering capital structure and agency costs being associated with the initial market reaction. Firms announcing open-market repurchases are unable to out-perform a variety of benchmark models in prolonged periods following the event. I find evidence regarding predictions concerning relative performance amongst event-firms, put forward by distinctive hypotheses. Firms with recent price shocks prior to announcement out-perform recent ”winners”. Long-run performance is highly conditional on actual repurchases for firms involved in open-market share repurchases in the interest of altering capital structure or avoiding agency costs. Findings are robust to a change in benchmark methodology.

Keywords: Abnormal Stock Performance, Open-Market Share Repurchase Announcement, Event Study, Short-run Stock Performance, Long-run Stock Performance, Signaling, Mispricing, Altering Capital Structure, Disgorging Free-Cash-Flow, Overreaction-hypothesis

Contents

1 Introduction

On the 17^{th} of February 2021, the paint and performance coating company AkzoNobel (AKZA) announced a share repurchase program budgeted at EUR 1 billion. The firm motivated this action as "best use of corporate fund" following a failed merger earlier that year. On the day of announcement, share prices surged by roughly 3.3%. Events like these have drawn the attention of academics for decades. The empirical literature delivered profound evidence documenting anomalous share-price performance following share repurchase announcements. Also, myriad time and effort was devoted to understanding the nature of buyback decisions. Is the decision of managers deploying share repurchases justified? Do firms motivate these programs with a rational argument from a firm's perspective? Or are firms inclined to send (false) signals to the marketplace?

This paper starts an inquiry into the impact of open-market share repurchases on short- and long-run stock-price performance. Since anomalous stock-price performance is thoroughly documented in the mature literature, one would expect anomalous returns associated with these events to have deteriorated over time (Schwert, 2003). In this paper I test the notion of anomalous stock-price patterns still existing in more recent data. Simultaneously, I add to previous literature explaining the nature of share repurchases. An ongoing debate in the academic literature answering the question "why do managers repurchase company stock?" exists still. Next to classical corporate finance arguments explaining these events, behavioural aspects have recently entered the discussion (Andriosopoulos et al., 2013). Evaluating the current state of the literature demonstrates that there is yet room for improvement in the understanding of such corporate events. Central in this research is answering the following research question (RQ):

RQ: Do firms experience abnormal stock price performance following the announcement of open-market share repurchases and do common reasons involved in manager's decision making relate to ex-post stock-performance?

I test four leading motivations explaining the initial market reaction associated with these events. Managers often motivate repurchases as either (or a combination) of the reasons: signaling, mispricing, altering capital structure and disgorging cash to avoid agency related costs. In this paper, I seek to identify if any of these motivations can be traced back to share-price behaviour. I utilize comprehensive data pertaining to U.S. based firms repurchasing company stock in the open market during the period 2004-2019. By applying various methods measuring abnormal stock-price performance I find a positive initial market reaction within firms announcing open-market share repurchases. I find evidence supporting aspects of all motivations examined in this paper. Small firms announcing open-market share repurchases experience a more pronounced initial market reaction as compared to larger counterparts, in line with the predictions of signaling. Also, firms with high book-to-market-ratios and firms announcing large programs experience significant initial market reactions, in line with the mispricing argument. Testing the implications of the capital altering- and the agency-argument shows that firms with low-leverage, recent declines in leverage and firms with high free-cash-flow have either a significant initial market reaction or achieve positive returns in the few trading days following the announcement. Since false signaling is redeemed ineffective in the framework of altering capital structure or agency theory, I find positive returns to be conditional on a firm's repurchasing activity.

Inspecting long-run return drift in event-firms delivers strong contrast to the existing empirical literature. Firms seem to under-perform the benchmark over various horizons following an announcement. These results question the idea of share repurchases being a value enhancing corporate tool and any motivation provoking these events will essentially become redundant if firms perform worse after announcing buybacks. Yet, the analysis yields evidence supporting certain predictions of distinctive hypotheses. Firms with most recent price shocks out-perform ”winners” by a noteworthy margin (*Overreaction Hypothesis*). Such pattern is robust to a change in benchmark methodology. I find event-firms with low leverage or recent declines in leverage to significantly out-perform peers whenever firms actually repurchase stock in the period following the announcement. I find a similar effect of actual buyback activity on stock-performance pertaining to firms with high-free-cash flow. Again, these findings are robust to a change in benchmark methodology.

This paper proceeds as follows. The section hereafter, Section 2, summarizes the empirical literature and formulates hypotheses. Section 3 describes data and variables used in the analysis. Section 4 establishes the analytical framework assessing abnormal performance and addresses the process for statistical inference. Section 5 portrays the results and Section 6 assesses robustness of these results. I conclude and discuss the findings in Section 7.

2 Theoretical Framework

2.1 Signaling

The *Traditional Signaling Hypothesis (TSH)* builds on the notion of Miller and Modigliani (1961) stating that conditional on imperfect markets and the existence of asymmetric information, a firm's management can convey information (signal) to the less informed marketplace via corporate events. This signal release is often associated with future company performance, thus having an expected effect on share prices. The degree to which market actors anticipate the information content involved in corporate events affects the magnitude of stock price reaction. Corporate events releasing private information generally yield larger magnitudes of stock price fluctuations compared to events involving public information.

Open-market share repurchases (OMSR) are a category corporate events and reviewing the literature confirms that information in these events is not merely a random by-product. Instead, the literature affirms the notion of OMSR-announcements delivering valuable (private) information or signals (Vermaelen, 1981; Miller and Rock, 1985). This study, like several others, starts an inquiry into the information content involved in OMSR-announcements and how distinct signals affect stock-price performance differently. TSH produces three implications with regard to firms announcing OMSR.

First (1), conditional on unanticipated information being released, firms announcing OMSR are projected to experience abnormal stock price changes on the day of the event. Second (2), not all actions by management are equally informative nor are all signals to the market equally credible. Theoretical models rely on the idea that signaling entails a cost on management and this cost to be lesser for managers with favourable information. For example, if the signal of an expected increase in earnings is actually false, then distributing cash can lead to financial distress or even sacrificing investment opportunities (Grullon and Ikenberry, 2000; Grullon and Michaely, 2004). Since firms announcing OMSR-programs do not have any real obligation to actually repurchase shares, the credibility of OMSR-announcements is often questionable. Under the assumption that, on average, firms send credible signals about future company performance while also actually repurchasing shares, then the second prediction of TSH postulates that repurchase announcements should be followed by positive changes in profitability or cash-flows. And lastly (3), assuming that the market efficiently incorporates the signal tied to an OMSR event, OMSR-announcements should be immediately followed by positive changes in the market's expectation about future profitability (Grullon and Michaely, 2004).

The positive initial market reaction following an OMSR-announcements is a stylized fact in the empirical literature suggesting that, on average, markets perceive the revealed information positively (Ikenberry et al., 1995; Chan et al., 2004). In the period 1970-1990 the average 3-day cumulative abnormal return following OMSR-announcement was a significant 2-3 percent. As the initial market reaction to OMSR-announcements is evident, the existence of such an initial reaction is tested in the upcoming analysis. The first hypothesis of this paper states that firms in the vicinity of OMSR-announcements should experience significant abnormal returns (H1a).

The TSH framework postulates that the initial market reaction to OMSR-announcements depends on the degree of information asymmetry and market anticipation. Some have conjectured that firm size is a proxy for information asymmetry arguably because smaller firms experience less analyst coverage (Ikenberry et al., 1995; Hackethal and Zdantchouk, 2004). Assuming that the information asymmetry indeed exists more strongly amongst small firms, small firms should have larger announcement returns as compared to relatively large firms (H1b).

Empirical evidence regarding the second prediction of TSH yields mixed results. Grullon and Michaely (2004) find no support for the idea of share repurchases being followed by improvements in profitability. In the period 1980-1997 company's earnings following OMSR-announcement remained essentially unchanged. In their study, both future operating profitability and cash flows showed aspects of mean reversion rather than the expected increases. Also, Guay and Harford (2000) found insufficient evidence to support the notion of an increase in cash flows following the event. While Lie (2005) finds enhancements in operating performance the year after open market share repurchases, these enhanced levels stabilize rapidly in the second year following the event.

With regard to the third prediction of TSH (3), Peyer and Vermaelen (2009) and Grullon and Michaely (2004) show that firms announcing open market repurchases do not experience a significant change in analyst's EPS forecast on the announcement day. Instead, EPS forecasts improve only gradually (*Analyst Mistake Hypothesis*). All-together does the above suggest that TSH helps explaining some aspects of abnormal stock price behaviour in the event of OMSR, for example by predicting the initial market reaction. Yet incomplete understanding of the relationship between stock-price- and corporate-performance following OMSR-announcements exists. In particular, evidence suggest that firms must be repurchasing stock with motivations other than merely signaling favourable future prospects of company performance.

2.2 Mispricing

Building on the theoretical implications of TSH, mispricing remains a prominent motivation for firms deploying buy-back programs. The *Mispricing Hypothesis* rationalizes the action of management announcing OMSR, as they act in the believe[1] of markets under-valuing the true long-run value of the firm. If managers successfully repurchases undervalued stock, then buying back shares can be seen as a value enhancing way to allocate capital. As was pointed out by Warren Buffet himself (Buffett and Cunningham, 2001): *"managers recognizing the purchase of share price 1$ but with value 2$...is rarely inferior to any other use of corporate fund (p.19)"*. The action of managers repurchasing undervalued stock, therefore creating value, arguably serves as a positive signal to the marketplace. Derived from the prediction of TSH, if market actors were to agree on a positive signal, firms involved in OMSR-announcements should experience positive announcement returns.

Separating the motivation of mispricing from various other motivations driving OMSR is difficult. One approach is to examine announcement returns with respect to book-to-market (B/M) rankings. The argument goes as follows: value-stocks (also known as "out of favour" stocks), which tend to have high book-to-market ratios, should be particularly prone to repurchase stocks for the reason of mispricing. I conjecture that the initial market reaction is larger within firms repurchasing stock because of undervaluation and therefore, firms with high B/M (value stocks) are expected to have a more pronounced initial market reaction (H2a).

There exists a certain paradox within the framework of mispriced driven share repurchases. If markets were fully efficient in the initial market reaction, such that prices reflect the fair value of the company, buying back shares after the announcement would serve no purpose. Put differently, in an efficient market, stock prices would reach the equilibrium price on the day of authorization and the stock would no longer be undervalued. Repurchasing shares following the announcement would become unnecessary. Given that share repurchases offer the flexibility of not having a real obligation to actually repurchase stock, a firm would have no intend to actually go through by repurchasing stock unless there exist a real mispricing opportunity.

Consequently, mispricing theory predicts abnormal stock performance whenever actual repurchases occur, as such entails an additional signaling effect (Yook, 2010; Chan et al., 2007; Bhattacharya and E. Jacobsen, 2016). In the analysis, I test this notion of repurchasing activity being associated with abnormal returns. Firms with repurchasing activity should have greater abnormal returns in the initial market reaction as compared to non-repurchasing firms (H2b). Empirical evidence regarding the role of buyback activity in OMSR is ambiguous. Stephens and Weisbach (1998) find that most repurchase programs are completed and a significant fraction of firms (30%) buy twice as much shares as intended. In contrast, Bhattacharya and E. Jacobsen (2016) find that 24% of firms do not repurchase a single share within the first fiscal year and 13% did not repurchase a single share in the four fiscal years following announcement.

An array of studies find the initiated program size relating to the credibility of firms repurchasing shares in the future (Mikkelson and Partch, 1988; Stephens and Weisbach, 1998; Comment and Jarrell, 1991). Depending on the size of a program the market may project some programs as too optimistic

[1] Managers involved in OMSR-announcements exhibit higher hubris (Andriosopoulos et al., 2013). As a result, OMSR with associated mispricing opportunities are frequently of optimistic nature.

given the financial position of the firm. On the other hand, the program size may indicate mispricing opportunities, where larger programs are associated with larger mispricing opportunities. Using the argument of mispricing, firms announcing large programs are more likely to convey credible signals of undervaluation. I conjecture to find a positive relationship between program size and abnormal returns in the data (H2c). Since there might exist an interaction effect between the size of the program and buyback activity, I will test whether firms with large programs *and* considerable buyback activity experience abnormal stock returns following OMSR-announcements (H2d).

If markets where fully efficient, prices following OMSR-announcements should reflect the true long-term value of the firm. In contradiction to what the theory predicts, markets seem to under-react to information conveyed during these events. In other words, markets struggle to efficiently price-in the information content revealed in these events (Ikenberry and Ramnath, 2002). A rich arsenal of studies documents a significant positive long-term price drift within repurchasing firms. Empirically, this drift is more pronounced among high B/M firms (value firms) and small firms. Finding more pronounced abnormal return drift in small firms supports the earlier notion of markets evidently responding only gradually to announcements associated with larger information asymmetries. At the extreme, (Ikenberry et al., 1995) find 4-year abnormal returns following OMSR mounting to significant 45% in value stocks. Chan et al. (2004) and Chan et al. (2007) find the 4-year buy and hold returns to be positive and significant in the range of 12,1% to 27%. Peyer and Vermaelen (2009) find average 1% monthly abnormal returns up to 3 years following the event. Since long term drift in these studies is evident, I will test whether a positive long-term drift exists amongst repurchasing firms in more recent data (H3).

The *Overreaction Hypothesis* explains long-term abnormal performance following OMSR- announcements as a correction to bad news which prevailed in the period preceding the event (Peyer and Vermaelen, 2009). The core prediction of the hypothesis states that abnormal returns achieved in the period before the buyback should be a good predictor of long-term abnormal returns. If past returns are a valid predictor of future returns, then firms with the most severe negative price shocks should perform most outstanding in periods following the announcement. Earlier Grullon and Michaely (2004) found evidence of both profitability and cash flows recovering from a negative shock prior to announcements. Peyer and Vermaelen (2009) find that analysts have downgraded their expectations because of the bad news prior to announcement and fail to update believes accordingly, therefore allowing the positive drift to persist. In the analysis I test the notion of negative pre-announcement returns possessing significant explanatory power in long term drift (H4).

2.3 Altering Capital Structure

While mispricing stands as a prominent argument explaining corporate motivation for OMSR-programs, still other motivations may apply. Since a company deciding to buy back stock is effectively lowering the equity base, repurchasing stock embodies a corporate instrument to alter capital structure. Firms reducing the capital base essentially increase the leverage-ratio. The *Leverage Hypothesis* appeals that under the circumstances of managers viewing the current capital structure sub-optimal to some target level then share repurchase programs can increase the leverage-ratio to the optimal level. Managers involved in leverage-driven repurchases often motivate new repurchase programs with the dilutive effects of option grants/exercise, dividend reinvestment plans (DRIPs) and employee stock ownership plans (ESOPs) (Grullon and Ikenberry, 2000). Deviations from optimal capital structure are generally avoided, as preventable high costs are otherwise incurred. Examples of such costs are increases in the tax-rate, or higher weighted average cost of capital (Hackethal and Zdantchouk, 2004, 2006).

The leverage theory predicts that firms involved in OMSR for the reason of altering capital structure experience a positive initial market reaction. Prices spike at the announcement since market actors anticipate positive capital gains associated with the transition to optimal capital structure (e.g., tax rate reduction or decrease in wacc). The theory makes following prediction about firms involved in OMSR for the reason of altering capital structure. Namely, firms with *low leverage* and firms with *recent declines in leverage* stand to benefit most from OMSR. Empirical evidence, however, find the initial market reaction for firms with low leverage (decline in leverage) not to be significantly different from zero (Chan et al., 2004). To reaffirm earlier evidence, in the upcoming analysis I hypothesise that firms with low leverage experience a positive significant initial market reaction (H5a). Also, firms with recent declines in leverage-ratio are expected to show a significant initial market reaction (H5b).

Potential gains achieved by improving capital structure are conditional on firms actually buying back shares in the periods after OMSR-announcement. False signaling to the marketplace should, theoretically, not yield abnormal stock returns. To be tested in the analysis is the hypothesis of an interaction between firms with low leverage (or recent declines thereof) *and* measurable buyback activity having a combined effect on the initial market reaction (H5c & H5d).

Limited evidence was established to support the notion of leverage-firms experiencing significant long term drift (Dittmar, 2000; Opler and Titman, 1994; Hovakimian et al., 2001) when actually repurchasing shares. Empirical literature finds repurchasing firms to have below average leverage-ratio, yet, they do not have any higher drift as compared to high leverage firms. Also, returns do not appear to be higher in firms that had a sharp decline in leverage-ratio in the period prior to announcement (Chan et al., 2004). In the analysis I test whether firms repurchasing stock motivated by the leverage argument experience significant drift in the months following the announcement (H5e).

2.4 Disgorging Free-Cash-Flow

Yet another acknowledged motive for firms buying back company stock evolves from classical agency theory developed by Jensen (1968) and Easterbrook (1984). Agency theory helps explain positive announcement returns with the following argument: if management's interests conflict with shareholder's interests, then the pay-out of excessive funds via OMSR mitigates the adverse effects of manager's behaviour. In other words, disgorging excessive cash via OMSR enforces the controlling power of debt, preventing managers from excessive spending (Lang and Litzenberger, 1989).

The *Free-Cash-Flow Hypothesis* conjectures potential benefits for a firm distributing excessive funds to shareholders via OMSR in form of reductions in the cost of capital and systematic risk (Grullon and Michaely, 2004; Peyer and Vermaelen, 2009). When the potential benefits of OMSR-announcements are recognised by the market, one expects to find a positive initial market reaction. More precisely, abnormal returns are expected to subsist in firms announcing OMSR with high free-cash flow. Grullon and Michaely (2004) find the initial reaction to OMSR more positively among firms generating high free-cash-flow. In contrast, Chan et al. (2004) find insignificant announcement

Table 1: Overview of hypothesis, variables of interest and expected effect on short/long term stock-price performance.

Hypothesis Overview			
Panel A: Short Term			
Hypothesis	Hypothesis Number	Variable Of Interest	Initial Market Reaction
TSH	H1a	All Firms	+
TSH	H1b	Size	-
Mispricing	H2a	B/M	+
Mispricing	H2b	Buyback Activity	+
Mispricing	H2c	Program Size	+
Mispricing	H2d	Buyback Activity & Large Program Size	+
Altering Capital Structure	H5a	Leverage-Ratio	-
Altering Capital Structure	H5b	Change in Leverage-Ratio	-
Altering Capital Structure	H5c	Low Leverage-Ratio & Buyback Activity	+
Altering Capital Structure	H5d	Decline in Leverage-Ratio & Buyback Activity	+
Agency Theory	H6a	Free-Cash-Flow	+
Agency Theory	H6b	High Free-Cash-Flow & Buyback Activity	+
Panel B: Long Term			
Hypothesis	Hypothesis Number	Variable Of Interest	Long Term Drift
Mispricing	H3	All Firms	+
Overreaction	H4	Past Returns	-
Altering Capital Structure	H5e	Low (Decline in) Leverage & Buyback Activity	+
Agency Theory	H6c	High Free-Cash-Flow & Buyback Activity	+

returns amongst high free-cash-flow firms. Considering such mixed evidence, I will test whether firms with high free-cash-flow experience a positive and significant market reaction (H6a).

An important feature of the agency theory, similarly to the leverage story, is the premise of firms actually repurchasing stock in order to appreciate the gains of share repurchases. Therefore, neglecting the interaction effect between high free-cash-flow *and* repurchasing activity, potentially explains the mixed evidence earlier. In the upcoming analysis, I hypothesise an interaction between firms having high free-cash-flow *and* measurable buyback activity, having a combined effect on the initial market reaction (H6b).

As repurchasing activity unveils gradually over time, the interaction buyback activity and free-cash-flow are expected to be associated with long-run abnormal returns. Empirical evidence analysing long-term abnormal returns achieved by firms in the tails of the cash-flow generating spectrum (high vs low) yielded indistinguishable long-term return differential (34- versus 32%-4 year buy-and-hold return). No statistically significant relationship between abnormal returns and the actual buyback activity was found (Chan et al., 2004). Using Chan et al. (2004) framework, I conjecture a positive cross-sectional relationship between free-cash-flow and long-term drift (H6c).

3 Data

There exist several channels through which a firm can repurchase its own shares. Examples of different share repurchase types are: open market share repurchases (OMSR), privately negotiated transactions and tender-offers (Dutch auction or fixed price). In recent years, OMSR stands as the most common type of repurchase transactions. During the last two decades roughly 90% of total repurchase volume was acquired in the open market (Stephens and Weisbach, 1998; Busch and Obernberger, 2017). While this study is particularly interested in open market share repurchase programs, frameworks allowing for multiple repurchase types in financial theory exist (Dittmar, 2000; Skinner, 2008).

Comprehensive data concerning publicly announced buyback programs is collected from the SEC EDGAR database. More specifically, OMSR information is gathered for firms that have reported 10-K and 10-Q filings to the SEC during the period 2004-2019. Included in the data-set are firms exclusively listed on either NYSE (stock exchange code 11), NASDAQ (stock exchange code 14) or AMEX (stock exchange code 12). For a particular firm with OMSR-announcement to be included in the master data-set (henceforth "the master"), the program must have a valid authorization date.

If signaling inside information (or undervaluation) is an important motive behind share repurchases, it is implausible that a firm sends such a signal on a frequent or regular basis (Yook, 2010). Therefore, I take into account the total number of repurchase programs announced by a firm during the sampling period. Firms in the master are restricted to have no more than one publicly announced program per year. If a firm is found to have multiple announcements in one calendar year, all announcements occurring following the first authorization in that calendar-year are excluded from the data.

In addition to authorization dates, plan specific variables are distilled from the individual filing items 2(e) and 5(c). Examples of plan specific variables are announced size of the program (in dollar or shares) and shares repurchased in the month following the announcement (in shares). Also, data on the average price paid per share (in dollars) is obtained from the individual filings. From all announcements in the initial universe, I match plan specific data regarding program size and repurchasing activity [2].

The buyback data is transformed into a general variable defining repurchase activity. Based on the assumption that markets exhibiting some degree of foresight regarding the eventual repurchasing activity, repurchasing activity is defined as the one month forward looking number of shares repurchased, expressed as percentage of the initial program size in the previous month. Calculating buyback activity for firms that have announced the program size in terms of dollars is done by multiplying the amount of shares repurchased in the first month with the average price paid per share, yielding the dollar value of the repurchased shares. This amount is divided by the initial program size in terms of dollars, yielding the percentage of shares repurchased in the first month following the announcement. Buyback activity for firms stating the program in terms of shares is the simple ratio of shares acquired in the month following announcement over the initial program size in terms of shares.

Firms may state the initiated program size as a maximum volume both in terms of dollars and shares. In the process of calculating buyback activity of firms who state two parameters, this some-

[2] With great thanks, data regarding firm specific announcement dates and actual repurchases were provided by, and are property of, PhD candidate Y. Li.

times yielded large discrepancies in the buyback activity variable while still concerning the same authorization. I delete authorizations from the data-set where the differences in the buyback-activity measure were larger than 100%. I cap the buyback activity to 3 times the original amount intended, as beyond this threshold information regarding buyback activity is unlikely to be accurate.

The initial program size is standardized in either of two ways. First, for a firm with stated authorization in terms of shares, program size is defined as the stated amount divided by the number of shares outstanding from the most recent accounting period. Second, for a firm stating the program size in terms of dollars, the program size is expressed as the stated amount divided by market value (market cap.) from the month prior to announcement (i.e., percentage of market value). For firms announcing the initial program both in terms of dollars and shares, I standardize depending on the available information pertaining to the variables of shares outstanding and market capitalization.

Firms in the announcement data-set are matched with price and accounting data. Price data is obtained from the WRDS CRSP-Compustat tapes. The database includes both active and inactive stocks mitigating survivorship bias. The data-set is cleaned from de-listing returns and other prevailing outliers[3]. I do not follow the notion of Fama and French (1993) where small cap firms are deleted from the universe to prevent that results are driven by price movements in small stocks. This paper aims to make a general statement about OMSR repurchases, and hence, small firms with OMSR also convey valuable information about stock-price performance in the event of OMSR.

I match accounting data using the Compustat Capital IQ database. First, following Fama and French (1993, 1997) I define book value of equity (B) as total shareholders' equity, minus preferred stock, plus deferred taxes (if available), plus investment tax credit (when available), plus post-retirement benefit liabilities (if available). If the above yields no valid book equity, I measure stockholders's equity as the book value of common equity plus the par value of preferred stock, or the book value of assets minus total liabilities (in that order). Book equity data is matched with the announcement data-set using a reporting lag of one calendar quarter. Firms must have non-negative book values of equity data prior to the announcement month on Compustat Capital IQ, enabling the calculation of book-to-market ratio.

$$B = Shareholders'Equity(TEQQ) - PreferredStock(PSTKQ) + DeferredTaxes(TXDBQ) \\ + InvestmentTaxCredit(TXDITCQ) + PostRetirementBenefitLiabilities(PRCAQ) \quad (1)$$

If total shareholders' equity is unavailable I use book value of common equity plus the par value of preferred stock (items CEQQ & PSTKQ) , or I use book value of assets minus total liabilities (items ACTQ & LTQ).

I define the size of a firm, i.e., market equity, as market capitalization. Market capitalization (M) is calculated as the number of shares outstanding in the month prior to announcement times the stated closing price of the announcement month. Book to market (B/M) is the ratio of one quarter lagged book equity divided by one month lagged market capitalization of common stock.

The leverage-ratio is defined as total debt over total assets matched also considering a reporting lag of one calendar quarter. Data used for calculating leverage-ratio stems from Compustat Capital

[3]Other outliers may prevail in form of missing data such that the time-gap allows prices to have increased/decreased considerably between two consecutive observations. Or else, firms may have been de-listed previously and become listed again with identical firm identifier, allowing the price to have changed considerably in the time between the two listings.

IQ. Recent changes in leverage are expressed as the change in debt-to-asset ratio in the year prior to the announcement.

Free-cash-flow (FCF) is defined as operating income before depreciation, minus total income taxes, minus the change in deferred taxes from the previous year to the current year, gross interest expense on short- and long-term debt, minus total amount of preferred dividend requirement on cumulative preferred stock and dividends paid on noncumulative preferred stock, minus total dollar amount of dividends declared on common stock (Lehn and Poulsen, 1989).

$$FCF = INC\text{-}TAX\text{-}INTEXP\text{-}PFDDIV\text{-}COMDIV \quad (2)$$

where (Compustat item):
INC = Operating Income before Depreciation (OIBDPY)
TAX = Total Income Tax (TXTY) - Δ Deferred Taxes (ΔTXDBY)
INTEXP = Interest Expense on Short & Long-Term Debt (XINTY)
PFDDIV = Total Preferred Dividend Requirement on Cumulative Preferred Stock (UDVPY)+ Dividends Paid on Noncumulative Preferred Stock (PDVCY)
COMDIV = Dividends on Ordinary Stock (CDVCY)

Table 2 displays summary statistics. The number of OMSR-announcements and the number of firms involved in such events remains largely constant throughout the sample period, corresponding to 500 announcements per sample year on average. In favor of this study, comparing the grand total of 7832 observations in the master to previous research shows a significant increase in the available data regarding OMSR. Matching firms with the necessary plan specific variables lead to a significant loss in the amount of announcements that can be considered later in the analysis. Figures show the fraction of firms with OMSR-announcements and repurchasing activity. I find an increasing trend in available data in more recent observations (50% versus 65%). On average, firms with buyback information repurchase 7.42 percent of the initial program size in the first month following the announcements.

The average program size is centred at around 6 percent of outstanding shares/market cap., which is similar to findings in the existing literature. Summary statistics show that the the average size of firms with announcements has increased steadily since the start of the sample period (increase of 50%). Otherwise, little variation is observed in the book to market- and leverage-ratio. Values remain relatively stable throughout the sample period, 0.63 and 0.56, respectively. The impact of the financial crisis on the change in leverage-ratio is observable in the table. While the one-year change in leverage-ratio is positive for 15 years in the sample period (3.30%), in 2009 firms de-levered (-0.86%) possibly as a consequence of legislative changes. Lastly, an increasing trend in free-cash-flow is going hand in hand with the increasing trend identified in market capitalization (larger firms are naturally inclined to have larger cash flows).

Table 2: The table reports summary statistics pertaining to firms involved in open market share repurchases (OMSR) over the period 2004-2019. Firms are exclusively listed on NYSE, NASDAQ or AMEX.

	# Announcements	# Firms with Announcements	# Announcements with buyback information	# Announcements with actual repurchases	Actual Repurchases (in %)	Buyback Activity (in %)	Program size (in%)	Market Cap. (in million $)	B/M	Leverage Ratio	Leverage Ratio Change (in %)	Free-Cash-Flow (in million $)
year												
2004	373	340	140	68	48.57	6.67	5.54	7998.47	0.65	0.53	2.62	649.84
2005	510	452	182	104	57.14	8.88	5.59	7750.79	0.66	0.55	1.93	782.89
2006	536	492	188	94	50.00	7.38	6.26	9724.86	0.62	0.54	4.78	829.57
2007	625	560	210	98	46.67	7.44	6.57	6775.55	0.63	0.57	5.02	608.52
2008	637	587	196	92	46.94	7.89	6.69	5440.01	0.75	0.50	4.95	434.67
2009	248	225	68	32	47.06	8.34	6.66	6639.05	0.85	0.52	-0.86	744.20
2010	408	376	130	69	53.08	7.12	6.91	6627.32	0.65	0.50	1.16	811.93
2011	531	493	162	90	55.56	9.51	6.88	8282.78	0.60	0.53	3.26	1077.41
2012	472	437	148	65	43.92	7.55	6.69	8484.28	0.70	0.52	1.62	934.20
2013	503	469	109	42	38.53	3.56	6.66	12416.96	0.63	0.55	3.11	1217.08
2014	572	528	164	85	51.83	7.09	6.24	11329.25	0.55	0.56	2.99	1083.74
2015	541	509	122	48	39.34	6.56	6.54	10359.34	0.55	0.60	8.15	922.47
2016	456	432	132	75	56.82	6.78	6.65	9713.31	0.60	0.62	3.55	1043.43
2017	392	369	148	74	50.00	7.32	5.94	13274.27	0.54	0.62	1.69	1343.35
2018	486	455	155	102	65.81	9.14	5.95	14331.27	0.52	0.63	1.85	1263.97
2019	407	399	133	91	68.42	7.56	6.19	11611.58	0.61	0.66	2.28	947.36
Total *(Average)*	7832	7123	2387	1229	51.23	*(7.42)*	*(6.37)*	*(9422.44)*	*(0.63)*	*(0.56)*	*(3.30)*	*(903.74)*

4 Methodology

4.1 Short-Run Abnormal Performance

4.1.1 Initial Market Reaction

I follow (Ikenberry et al., 1995; Brown and Warner, 1985) to test if the initial market reaction amongst event-firms is positive and significant. I define the initial market reaction, i.e. ”the event”, as returns on the authorization day (t = 0) and the 2 days surrounding the authorization (t = -1; t = +1). Expected daily returns ($R^*_{i,t}$) are derived from a standard market-model (CAPM). Trading days -270 to -30 relative to announcement date (t = -270 to t = -30) serve as the *estimation period* [4] for return variances. The consecutive 40 trading days are designated the *event period* (-29, 10). A natural consequence of using 280 trading days as total horizon is that firms must have at least that amount of price data available in CRSP/Compustat in order to be considered in the analysis.

I calculate daily returns for day *t* by subtracting the natural logarithm of the share price at the end of day t-1 from the natural logarithm of the share price at the end of day *t*. Prices are adjusted for stock splits. Market portfolio returns ($R_{m,t}$) are based on daily CRSP value- & equal weighted-index returns.

$$R_{i,t} = \alpha_i - \beta_i R_{m,t} + \epsilon_{it} \tag{3}$$

for t = -270,-269,...,-30, E($\epsilon_{i,t}$)=0 and Var($\epsilon_{i,t}$) $= \sigma^2$ ($\epsilon_{I,t}$)

Coefficient estimates from (3) and daily market returns are entered into (4) to obtain expected returns $R^*_{i,t}$ for firm *i* at time *t*.

$$R^*_{i,t} = a_i + b_i * R_{m,t} \tag{4}$$

for t = -29,...,+29,+10.

Abnormal returns for day *t* are defined as the difference between the observed return and the expected return for that day (see 3).

$$AR_{i,t} = R_{i,t} - R^*_{i,t} \tag{5}$$

for t = -29, ..., +29, +30.

Under the null hypothesis I state that abnormal returns on a particular day and cumulative abnormal returns for a given period [t; t+n], are not different from 0. Alternatively, returns on a particular day and cumulative abnormal returns for a given period [t; t+n], are different from 0. The t statistic is calculated as stipulated by equation (6) and (7).

$$H_0 : AR_t = 0 \mid H_A : AR_t \neq 0$$

$$t = \frac{AR_{i,t}}{\sigma(AR_i)} \tag{6}$$

with $\sigma(AR_i)$ equal to the robust standard error estimates from (5).

[4] Armitage (1995); MacKinlay (1997) suggest the use of 100 to 300 trading days as estimation period when using daily observations.

For cumulative abnormal returns (CAR_i^{t+n}) I use similar approach:

$$H_0 : CAR_{t,t+n} = 0 \mid H_A : CAR_{t,t+n} \neq 0$$

$$t = \frac{CAR_i^{t+n}}{(\sqrt{n} * \sigma(AR_i))} \tag{7}$$

with:

$$CAR_i^{t+n} = \sum_{j=t}^{t+n} AR_{i,j}. \tag{8}$$

4.1.2 Single & Double Sorts

The previous methodology assesses initial market reaction considering all firms in the sample with OMSR-announcements (H1a). This section establishes the framework to distill specific characteristics that may contribute positively to the initial market reaction abnormal returns. I expect the initial market reaction to be larger in: *small* firms (H1b), *value* firms (H2a), firms with *repurchasing activity* (H2b), firms with *large programs* (H2c) and firms with both *repurchasing activity* and *large programs* (H2d). Alternatively, firms with *low leverage*, *recent declines in leverage* (H5a & H5b) and firms with *high free-cash-flow* (H6a) are expected to achieve significant announcement returns. The effect of leverage-ratio, recent declines in leverage-ratio and free-cash-flow are tested on a interaction effect with repurchasing activity as having a combined effect on the initial market reaction (H5c & H5d, H6b).

To make certain characteristics evident, I perform single- and double-sorts along one or two characteristics. Considering the large size of the master, I conjecture that sample firms are a reasonable description of firms in the whole universe and hence, quintile breakpoints can be determined from all firms that exist in the master. For each year, firms are stratified into 5 quintiles along the variable of market capitalization, which is the proxy for firms' size. Similarly, for each year in the sample, firms are sorted into 5 quintiles based on the book-to-market ratio.

Since a considerable fraction of firms do not repurchase a single share in the first month following the announcement (almost halve of the time, 47%), I sort firms according to a dummy variable that carries value 1 for firms with repurchasing activity and 0 for firms who do not repurchase shares in the month following the announcement.

I define program size as announced program size in terms of dollar value (or number of shares) standardized by market equity in the month prior to the announcement (or standardize by total shares outstanding). Per year, firms are stratified into 5 quintiles.

The first double sort including the variables program size and repurchasing activity pertains to hypothesis H2d, yielding a total of 10 deciles (5 program size quintiles * 2 buyback quintiles).

Testing for alternative motivations is done in similar fashion. Each year, firms are stratified into 5 quintiles along the variables of leverage-ratio and the change in leverage-ratio (see description of the variables in *Data*). Using identical approach as the double sort testing hypothesis H2d, firms are sorted first on leverage-ratio (change in leverage-ratio) and afterwards on buyback activity. This double sort yields 10 deciles.

Lastly, to test the effect of free-cash-flow, I first standardize FCF by sales, adapting to the idea of bigger firms naturally being inclined to issue bigger programs. Then, using standardized cashflows, firms are sorted into 5 quintiles using a yearly frequency. The double sort of hypothesis H6b, where firms are stratified by FCF and buyback activity yields 10 deciles.

I report the return difference and accompanied z-statistic between the return in the tail quintiles. To make the initial market reaction more evident, I provide graphic evidence of the development in CARs prior to and following OMSR-announcements. Each graph pertains to a specific hypothesis and plots the CAR time series for firms which are expected to have the least pronounced return versus firms where the initial market reaction is expected to be of largest magnitude.

The double sorting methodology encounters a major drawback which has to be addressed before interpreting the results. Matching firms with the variable of buyback activity lead to the necessary loss in observations that can be used in the double sort. That is, the double sort relies on the assumption that firms used in the single sort have similar return characteristics as the firms used for the double sort. Since this assumption is potentially violated, evidence gathered testing the effect of various variables via double sorts are merely used as indications. To test the robustness of the buyback effect, a cross-sectional approach is applied in the long-run analysis to validate the initial results.

4.2 Long-Run Abnormal Performance

4.2.1 Uncertain Inference from Long-Run Abnormal Returns

The literature concerning event-study methodology has produced several issues regarding statistical inference in long term event studies, which are explained briefly in advance of formulating the necessary models. Among these issues are proper risk adjustment, expected/abnormal return modelling, the aggregation of security-specific abnormal returns and the calibration of the statistical inference. These issues become vital with long horizons.

Fama (1970) brings to attention that all tests measuring abnormal performance are joint tests. That is, event study methodologies are joint tests of market efficiency/mispricing (whether abnormal returns average about zero) and whether the assumed models of expected returns measure abnormal performance appropriately. Moreover, assumptions concerning the statistical properties of the abnormal return measures must also be correct. For example, an assumption of t-test's is that the mean abnormal performance in the cross-section is normally distributed. When the underlying return distribution is actually skewed, then variance and standard deviations are biased, consequently biasing the test statistic as well.

Many other model-specifications attribute to the ”bad model problem”(Fama, 1998), further imposing problems regarding statistical inference from long-horizon returns. So are additional assumptions required to preserve time-series independence between observations. Namely, the degree of cross-dependence decreases the effectiveness of any test and increases the homogeneity of the sample firms examined (Brav et al., 2000; Mitchell and Stafford, 2000; Jegadeesh and Karceski, 2009). In particular, the test will reject the null of no effect far more often than the size of the test (Collins and Dent, 1984; Bernard, 1987). The over-rejection is caused by the downward biased estimate of the standard deviation of the cross-sectional distribution. Independence might be violated because of either reason: (1) abnormal returns of the sample firms share a common calendar period (2) corporate events occur waves and (3) some industries are over-represented in the event sample (Kothari and Warner, 2007).

In pioneering event studies, researchers have often assumed abnormal returns to be independent. Empirical evidence suggests however, that long-horizon abnormal returns exhibit strong signs of cross-correlation, time-series dependence or clustering, violating the assumption of independent and identically distributed (i.i.d.) returns. If test statistics in an event-study are calculated ignoring cross-dependence or clustering, then even a minimal amount of cross-correlation in the data will lead to serious misspecification of the test.

4.2.2 Measuring Long Horizon Returns, Cumulative Abnormal Returns

To determine what depicts abnormal long horizon return, I use multiple methodologies formulating adequate risk adjustment of excess returns. Concretely, these methods correspond to the traditional single factor CAPM (Sharpe, 1964; Lintner, 1965; Treynor, 1961), multi-factor methodologies such as Fama French 3 & 5 factor model (Fama and French, 1993, 2015) and a 4-factor model accounting for recent price trends (Jegadeesh and Titman, 1993; Carhart, 1997). The (multi)-factor approach commonly employed in event-studies consists of a cross-sectional regression where monthly excess returns are regressed on certain risk premia. The intercept (also known as alpha) characterizes abnormal return. I deviate from the classical approach to build on the notion of Fama and MacBeth (1973), arguing that this approach suffers from a simultaneous estimation problem when using panel data. That is, risk exposure does not solely contain a cross-sectional attribute, it also inherits a time-series element. Therefore, employing merely the cross-sectional approach to measure risk exposures ignores the time variability of such risk exposure.

To incorporate time variability of risk exposure, I proceed by regressing monthly security excess returns on specified risk factors using a 36-month estimation horizon. The beta estimates are used to predict the expected return ($R^*_{i,t}$) for one period. For example, the abnormal return achieved in the repurchasing month (t=0) is the difference between the expected return using a 36-month estimation period (t=-36 ; t=-1) and the excess return in the month of announcement (t=0). Similarly, to estimate expected return for the month following the announcement (t=1), the 36-month window is rolled over one month such that the period (t=-35 ; t=0) serves as estimation period. The excess return of the month following OMSR-announcement minus the predicted return is the abnormal return for that month. The above steps are repeated to predict returns for the period 6 months prior to the event, up to 48 months following the event.

A natural consequence in the long-horizons analysis is the requirement of firms to have at least 42 months of data available prior to the event, in order to be able to predict the return 6-months prior to repurchase month (t=-6). To predicting returns over the various event windows (t=-6 ; t=12),(t=-6 ; t=24), (t=-6 ; t=36) and (t=-6 ; t=48), firms are required to have at least 55, 67, 79 and 91 months return data available, respectively. By the time of writing this paper, WRDS CRSP/Compustat tapes offered available data up until the end of calendar year 2019. Consequently, firms with announcements occurring after 2016 shall not be considered in the long-run analysis[5].

The advantage of using a rolling window lies in the fact that it allows for changes in the riskiness of the equity in the prolonged period after the event[6]. One major drawback of this method is that it

[5]Implications of the loss in events occurring after 2016 are discussed in the section 7

[6]Peyer and Vermaelen (2009) argue that OMSR-announcement may signal changes in systemic risk caused by maturity

does not resolve the heteroscedasticity problem discussed in the previous section. To somewhat relax this issue, I use robust standard errors when calculating t-statistics.

$$R^*_{i,t} = \alpha_{i,t} + \beta_1(R_{m,t} - R_{f,t}) + \epsilon_t \tag{9}$$

$$R^*_{i,t} = \alpha_{i,t} + \beta_1(R_{m,t} - R_{f,t}) + \beta_2(SMB)_t + \beta_3(HML)_t + \epsilon_t \tag{10}$$

$$R^*_{i,t} = \alpha_{i,t} + \beta_1(R_{m,t} - R_{f,t}) + \beta_2(SMB)_t + \beta_3(HML)_t + \beta_4(RMW)_t + \beta_5(CMA)_t + \epsilon_t \tag{11}$$

$$R^*_{i,t} = \alpha_{i,t} + \beta_1(R_{m,t} - R_{f,t}) + \beta_2(SMB)_t + \beta_3(HML)_t + \beta_6(MOM)_t + \epsilon_t \tag{12}$$

Where $R^*_{i,t}$ is the expected monthly return on security *i* in the calendar month *t* that corresponds to the event month *j*. $R_{f,t}$ and $R_{m,t}$ are the risk-free rate and the return on the equally weighted CRSP index potfolio, respectively. SMB_t (small minus big) and HML_t (high minus low) are monthly returns on the size and B/M factor portfolios in month *t*, respectively. UMD_t (up minus down) is the return on a zero-investment portfolio consisting of a long position in recent winners and a short position in recent losers. RMW_t (robust minus weak) and CMA_t (conservative minus aggressive) are the monthly returns on profitability and investment intensity factor portfolios. Values pertaining to individual risk factors and risk-free rates (30-day treasury yields) stem from the Kenneth R. French Library [7]. Reported figures are averages of the sum of the individual CARs over the applicable event-time period, expressed in percentages.

To test the implications of the *Overreaction Hypothesis* (H4), long-horizon (5-factor) CARs are used to sort firms according to abnormal returns achieved in the 6 months prior to the event. I form 5 quintile portfolio and calculate z-statistics assessing statistical significance of the difference in return achieved in the tail portfolios.

4.2.3 Cross-Sectional Approach

In the pursuit of finding evidence supporting alternative hypotheses involved in open-market share repurchases, I ascertain the validity of the leverage- and the agency-story for the long horizon next. The analysis consists of a multivariate cross-sectional test, where the leverage-ratio, recent changes thereof and free-cash-flow are examined on an (inverse) relationship with long term returns. I deploy a cross-sectional regression as an answer to the problem encountered in the double sort methodology, which was the significant loss of observations when matching firms with the buyback variable.

I follow Chan et al. (2004) multivariate cross-sectional approach. The dependent variable is defined as the 3-year average monthly CAR from the Fama-and French 5-factor regression. Amongst the independent variables are leverage-ratio quintile ranks. Also, a dummy is added to indicate whether a firm belongs to the quintile in the left tail. This dummy is put in place to test whether having low leverage adds to the initial market reaction. The dummy is one for the lowest leverage-ratio quintile and 0 for the remaining firms in the sample. Similarly, recent change in leverage is expressed as the previous year's change in debt to asset-ratio. I rank firms into quintiles according to the changes in leverage-ratio (Δ-*leverage*) used in H5c. A dummy variable classifying firms with most severe recent

of a company. Using a multivariate method accounts for the *risk change hypothesis*.

[7] https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

declines in leverage is one for firms in the lowest quintile and 0 otherwise. Using the predictions of the leverage-hypothesis, I expect this dummy to be positive and significant.

Further, a second inquiry in the analysis pertaining alternative reasons involved in OMSR considers agency theory. Recall, larger free-cash-flows are associated with higher agency costs, and hence, firms with high free-cash-flow announcing OMSR are expected to have positive long-term drift. In the same fashion, I add quintile rankings characterizing firm's free-cash-flow. To find whether being in the right tail of the distribution adds significantly to abnormal performance, firms are assigned a dummy designated value one for the top FCF quintile ranking and zero otherwise.

Since both the hypotheses (leverage and FCF) rely on the premise that abnormal returns are achieved conditionally on firms actually repurchasing shares, the variable buyback-activity is added to the regression. More importantly, a variable measuring the interaction effect between (change in) leverage-ratio, FCF and buyback activity is added to the regression. Buyback activity was constructed earlier and is defined as the percentage of shares sought from the initial program size, one month following the announcement. In the regression I control for firm- and program-size and valuation effects (B/M quintile ranks). Also, a dummy indicating the top B/M quintile (one for the top quintile and zero otherwise) is supplemented in the regression. Six month lagged CARs are added to control for the co-founding effects of momentum (i.e., the overreaction hypothesis). Six month lagged returns are calculated as cumulative abnormal monthly return in the 6 months prior to announcement. Year dummy variables are included, but not reported (2004 serves the baseline estimate). Numbers in parentheses are robust standard error t-statistics.

Short-Run Evidence, Single Sorts

	Days relative to the announcement					Days relative to the announcement			
	[-20 : -3]	[-1 : + 1]	[+2 : +10]	n		[-20 : -3]	[-1 : + 1]	[+2 : +10]	n
All Firms					**Buyback**				
EW	-1.05%***	0.83%***	0.86%***	7832	0 (No)	-1.12%***	0.56%***	0.67%***	1043
VW	-1.35%***	0.74%***	0.73%***	7832	1 (Yes)	-1.34%***	0.80%***	0.79%***	1344
Dif [EW-VW]	*0.35%**	*0.09%*	*0.13%*		*Dif [1-0] (Total)*	*-0.12%*	*0.24%**	*0.12%*	*(2387)*
Size					**Leverage-Ratio**				
1 (Small)	-1.63%***	1.13%***	1.39%***	1545	1 (Low)	-1.52%***	0.75%***	1.34%***	1567
2	-0.93%***	0.96%***	1.46%***	1537	2	-1.35%***	0.88%***	0.80%***	1561
3	-1.08%***	0.98%***	0.64%***	1538	3	-0.74%***	0.93%***	0.70%***	1561
4	-1.22%***	0.56%***	0.61%***	1537	4	-0.97%***	0.83%***	0.65%***	1561
5 (Large)	-0.59%***	0.55%***	0.16%	1532	5 (High)	-0.70%***	0.73%***	0.72%***	1556
Dif [5-1] (Total)	*1.04%****	*-0.57%****	*-1.27%****	*(7689)*	*Dif [5-1] (Total)*	*0.82%***	*-0.02%*	*-0.62%****	*(7806)*
B/M					**Leverage-Ratio Change**				
1 (Low)	-1.87%***	0.62%***	0.29%	1423	1 (Low)	-1.83%***	0.76%***	1.09%***	1567
2	-1.01%***	0.84%***	0.72%***	1416	2	-0.69%***	0.73%***	0.83%***	1561
3	-1.23%***	0.78%***	0.88%***	1416	3	-0.63%***	0.65%***	0.87%***	1561
4	-0.85%***	0.79%***	1.18%***	1416	4	-1.04%***	0.87%***	0.73%***	1561
5 (High)	-0.49%**	1.19%***	1.23%***	1410	5 (High)	-0.78%***	0.72%***	0.62%***	1556
Dif [5-1] (Total)	*1.38%****	*0.57%****	*0.95%****	*(7081)*	*Dif [5-1] (Total)*	*0.80%***	*-0.41%**	*-0.50%**	*(7806)*
Program Size					**Free-Cash-Flow**				
1 (Small)	-1.90%***	0.41%***	0.37%*	1460	1 (Low)	-1.83%***	1.13%***	1.12%***	1410
2	-1.49%***	0.75%***	0.60%***	1460	2	-0.71%***	0.77%***	1.00%***	1410
3	-1.09%***	0.54%***	1.25%***	1460	3	-1.04%***	0.59%***	0.80%***	1400
4	-0.74%**	1.12%***	0.74%***	1460	4	-0.80%***	0.81%***	0.70%***	1399
5 (Large)	-0.55%	1.09%***	1.11%***	1459	5 (High)	-0.78%***	0.72%***	0.62%***	1394
Dif [5-1] (Total)	*1.35%****	*0.68%***	*0.74%****	*(7299)*	*Dif [5-1] (Total)*	*0.80%***	*-0.41%**	*-0.50%**	*(7013)*

Table 3: The table reports information pertaining to firms involved in open market share repurchases (OMSR) over the period 2004-2019. CARs are calculated using a standard market-model. All firms in the sample are exclusively listed on NYSE, AMEX or NASDAQ. CI levels: 10%*, 5%**, 1%***

5 Results

5.1 Initial Market Reaction, TSH

Table 3 reports short-run evidence regarding the predictions of *TSH* (H1a & H1b). Overall, the output yields evidence consistent with the predictions. First, the initial market reaction amongst event-firms is both positive and significant. Considering all 7832 event-firms in panel A, in the 3 days surrounding OMSR-announcement event-firms achieve CAR of 0.83% and 0.74% using equal- and value-weighted benchmark returns, respectively. Both figures are statistically significant at a 1% level. Since both benchmark methods essentially deliver identical results, Table 3 reports output using solely equal-weighted benchmark returns henceforth. Comparing the numbers to previous empirical evidence I find the initial market reaction to have decreased by a magnitude of 50% in more recent data.

Two additional remarks should be considered in panel A. First, pre-announcement returns achieved in the 17 trading days prior to the event are negative and significant (-1.05% & -1.35%). Finding significant negative pre-announcement returns followed by positive announcement returns suggest a mean reverting process in line with overreaction to bad news prior to the event (Peyer and Vermaelen, 2009). Second, in the 8 trading days following the event an upward trend in stock prices establishes amidst event-firms, suggesting that the initial market reaction may not be complete.

Panel B of Table 3 showcases output regarding the second prediction of TSH, stating that small firms should experience greater announcement returns as compared to larger firms. Stratifying firms according to size yields an initial market reaction of 1.13% pertaining to the smallest firms versus 0.55% for large firms. Announcement returns exist statistically significant at the 1% level for both groups. The return differential (large-small) delivers CAR of -0.57% (significant at the 1% level). These figures suggests that small firms indeed achieve more pronounced announcement returns as compared to their larger counterparts, in line with the prediction. Again, I compare figures to previous empirical literature and find that announcement returns in the tail of the size distribution has decreased considerably in more recent data. For example, Ikenberry et al. (1995) find announcement returns of small firms to be in the range of 8%, corresponding to a decrease of nearly 85% in more recent data.

In the 8 trading days following the announcement, small firms exhibit a persistent upward price trend. This price trend is not visible for large firms in the sample. More precisely, firms in the smallest size quintile display significant positive returns of 1.39% versus insignificant 0.16% in the largest quintile. The corresponding differential (large-small) of the tail quintiles (-1.27%) is significant at the 1% level. Similar as before, the figures propose that the initial market reaction may not be complete such that the positive trend could be visible in the long-term analysis. Furthermore, since the initial market reaction seems less complete for small firms, using the TSH argument, information asymmetry apparently adds significantly to the speed at which markets are able to price in the information content involved in OMSR-announcements.

Finally, output of panel B yields evidence consistent with the notion of pre-announcement returns exhibiting predictive power in the initial market reaction. Firms who have experienced larger price shocks display a more pronounced initial market reaction. That is, firms in the smallest quintiles, where the initial market reaction is the largest, have most severe negative pre-announcement returns in the range of -0.93% to -1,63%.

I conclude the evidence of panel A & B as being consistent with the predictions advocated by TSH theory. I find a significant positive initial market reaction in event-firms, where small firms with presumably larger information asymmetries bear larger initial market reactions.

5.2 Initial Market Reaction, Mispricing

Panels C-E of Table 3 illustrate output regarding the predictions of the *Mispricing Hypothesis* (H2a-d). Firms are sorted according to the B/M ratio, where firms with relatively high book-to-market ratio are expected to experience larger announcement returns (H2a). Figures in panel C find event-firms with low book-to-market ratios to experience a positive and significant initial market reaction of 0.62%. Event-firms with high book-to-market ratios experience a larger initial market reaction of 1.19%. Comparing firms in the highest- versus the lowest-B/M quintile yields a positive 0.57% return differential. Finding this return differential to be positive and significant supports the undervaluation argument of mispriced driven OMSR. Aligning the above figures to previous empirical research reveals that returns achieved by the whole range of B/M firms has declined drastically in recent years. Returns have declined by a magnitude of 50%-75% compared to returns achieved by firms announcing OMSR during the late 1990's (Ikenberry et al., 1995).

Noteworthy is the development of returns in the 8 trading days subsequent the event. Event-firms in the lowest B/M quintile achieve insignificant 0.29% CAR whereas firms in the highest quintile achieve significant 1.23% CAR. The return differential in the tail quintiles enhances to a positive and significant 0.95%. Overall, these figures deliver additional evidence regarding the mispricing story. The positive trend in high B/M firms also initiates the thought of markets incompletely responding to information conveyed by the sole announcement of OMSR.

A final observation from panel C relates to past returns having explanatory power in the initial market reaction. While we saw previously that firms who have experienced more severe negative pre-announcement returns are accompanied with a larger initial market reaction, this is not the case here. Firms in the lowest B/M quintile have most severe negative pre-announcement returns of -1.87% and yet, a modest initial market reaction. Similarly, firms in the highest B/M quintile experienced a small decline of -0.59% in the 17 trading days prior to the event, while having the biggest initial market reaction.

Within the framework of mispriced driven OMSR, panel D shows output regarding the notion of buyback activity being associated with the initial market reaction (H2b). The evidence seems consistent with this notion as firms with buyback activity experience an initial market reaction of 0.80% versus 0.56% for firms who do not repurchase shares. The difference of 0.24% is positive and significant, albeit in economic terms the difference is only marginal. As time passes the return differential between event-firms with buyback activity and no buyback activity diminishes. In the 8 trading days following the event, firms with projected buyback activity achieve positive and significant CAR of 0.79%. Firms with no repurchase activity display CAR of 0.67% during the same period. The differential is an insignificant 0.12%. It appears that the sole effect of repurchasing shares is insufficient for markets to judge a real mispricing opportunity to exist in the days following the event.

Caution must be put in place when placing the role of buyback activity with respect to the initial market reaction. Recall, in the analysis buyback activity is defined as a one month forward looking variable which may develop over horizons longer than the 10 trading days used here. Also, market actors might experience difficulties judging the one-month forward buyback activity of firms announcing OMSR. In the long-run analysis I gather additional evidence to test the notion of buyback activity being associated with long-run performance. The notion of mean-reversal is also not clearly visible in this context and will be tested more thoroughly in the long-run analysis.

Sorting firms according to program size delivers additional evidence in line with the predictions of mispriced driven OMSR (H2c). The prediction states that small programs are less positively perceived by the market as compared to larger programs and thus larger programs should experience larger announcement returns. Event-firms announcing relatively small programs show a positive and significant market reaction of 0.41% versus 1.09% for event-firms announcing large programs. This difference of 0.68% is positive and significant, in line with the predictions of the mispricing theory.

In the trading days following the announcement the differential expands to significant 0.74%. Notice from the table that the positive trend within firms in quintile 5 persists, corresponding to significant CAR of 1.11%, whereas the positive announcement returns within quintile 1 decreases to 0.37%. The question remains whether the differential increases because of markets incompletely responding to the initial information content or that additional information in form of buyback activity unveils in the trading days following the event. This question is tested next in the double sort. With respect to pre-announcement returns, I find firms with small programs experience the most severe negative price shock while firms with large programs do not experience such shock in the days prior to the event. Therefore, the notion of pre-announcement returns exhibiting explanatory power in the initial market reaction cannot be identified here either. Also, the idea that firms announce large programs based on poor past performance cannot be inferred solely from single sorting according to the initiated program size.

The final prediction of mispriced driven OMSR is assessed with a double sort displayed in Table 4 (panel A). Here firms are stratified according to program size and buyback activity (H2d). Projected are firms announcing large programs while also actually repurchasing stock should display most pronounced announcement returns. The output yields evidence in line with this hypothesis. Firms with repurchasing activity announcing large programs experience a significant initial market reaction of 1.39%, which remains the largest announcement return of all 10 deciles. To put into perspective, firms with small programs and no repurchase activity are found to have insignificant announcement returns of merely 0.21%. While not reported, the differential of these two tail portfolios is a positive and significant 1.08%. Nevertheless, most of the difference in the initial market reaction difference seems to be driven by the effect of announcing large programs. Firms announcing large programs while not repurchasing stock experience a positive and significant initial market reaction of 1.14%. The return difference between the two group of event-firms that belong to the largest program size quintile is an insignificant 0.25%. Therefore, the effect of repurchasing stock while also announcing large programs is limited with regard to the initial market reaction.

Since buyback activity develops only gradually, the period following the announcement unveils valuable information about the role of repurchasing activity and abnormal returns. In the 8 trading days following the event it becomes evident that actual repurchasing activity does play a crucial role in the development of CARs. Firms with actual repurchases realize statistically significant CARs in the order of 1.64%. The difference opposed to firms with no repurchasing activity expands to significant 1.37%.

I conclude, buyback activity is not immediately evident for market actors at OMSR-announcement such that it has only limited impact on the initial market reaction. However, firms buying back shares in the days following the event delivers important information. Market participants react positively to the firm's action of repurchasing shares.

To summarize, in order to distinguish mispriced driven share repurchases from other motivations driving these events I identify the role of 3 variables potentially explaining the effect of undervaluation. First, sorting firms according to the book-to-market ratio delivers evidence supporting the notion of mispriced driven share repurchases. Firm with high book to market ratio (or ”out of favour” firms) have significantly larger announcement returns as compared to firms with low book-to-market ratios. High B/M firms outperform firms with low B/M ratio in the period following the announcement. Second, sorting firms according to future buyback activity does not support the notion of firms who repurchase stock signal larger mispricing opportunities. Even in the trading days following the event, buying back shares does not add to stock-price performance. Instead, it seems that the signal of mispricing opportunities, and thus the driver of the initial market reaction, is the size of the program. Firms with larger programs achieve significantly larger announcement returns as compared to firms announcing small programs. In the days following the event, firms with larger programs keep outperforming counterpart firms with small programs.

To test the notion of mispricing becoming evident through the combined effect of future buyback activity and program size, firms are double sorted according to 2 variables. The effect of buyback activity remains marginal. While firms with large programs do achieve the largest announcement return when repurchasing stock, second largest announcement returns are found within firms with large programs and no such repurchasing activity. However, while the role of repurchasing activity is not immediately visible at announcement, in the days following the event-firms with large programs and actual repurchasing activity considerably outperform firms with no repurchasing activity. This is of no surprise as buyback activity takes time develop. I conclude that buyback activity adds significantly to the performance of the stock, however, only in the days following the announcement and not in the initial market reaction. Overall, I judge the evidence to support the mispricing theory of OMSR.

5.3 Initial Market Reaction, Alternative Motivations

Panel F-H of Table 3 and panels B-D of Table 4 displays output testing the implications of alternative motivations driving OMSR. Panel F of Table 3 shows preliminary evidence pertaining to firms pursuing OMSR as a tool to alter capital structure. The theory predicts that firms with low leverage can benefit from repurchasing shares in the open market (H5a). Stratifying firms according to the leverage-ratio yields an initial market reaction of 0.75% for firms with low leverage-ratio, while firms with high leverage experience an initial market reaction of 0.73%. The difference of -0.02% is statistically insignificant revealing that the initial market reaction seems to be independent of a firm's capital structure. Therefore, I find no immediate support for the leverage hypothesis.

Inspecting CAR estimates in the days following the event paints a different picture. It is only after a few trading days that firms with low leverage experience a substantial increase in returns (1.34%), whereas firms in the highest quintile have CAR of 0.72%. The difference (high-low) becomes a significant -0.62%. Returns achieved in the days following the event supports the notion of additional information being conveyed as time passes. In the context of this paper, future buyback activity potentially plays a crucial role explaining the upward return trend in low leverage firms. I will examine the interaction effect of repurchasing activity and the leverage-ratio next.

Examining panel B of Table 4 shows the output testing the interaction effect between the initial market reaction, the leverage-ratio and buyback activity (H5c). Similar to previous findings, announcement returns achieved by firms with low leverage versus returns achieved by firms with high leverage are, ceteris paribus, indistinguishable from each other. For example, event-firms with low leverage and buyback activity achieve an initial market reaction of 0.77%. Event-firms without repurchasing activity belonging to the highest leverage-ratio quintile achieved CAR of 0.75% in the same period. While not reported here, the return difference between these two quintiles is an insignificant 0.02%. Adding the effect of buyback activity does not yield different results. Generally, neither of the difference in the initial market reaction between firms that have repurchased stock as compared to firms who did not, are significant. Decile differentials are in the range of -0.14% to positive 0.56% and do not follow a apparent pattern.

While the initial market reaction in leverage firms seems to be independent of the leverage-ratio and future buyback activity, returns achieved in the period following the event does yield evidence supporting the leverage story. That is, firms with low leverage who have also repurchase stock in the weeks after announcing OMSR, experience CAR of 1.74%. In contrast, firms with low leverage and no repurchasing activity show CAR of 0.85% in the same period. The difference is a significant 0.89%. Important to note here is the role of buyback activity especially within firms contained in the low leverage quintile. The return differential between firms that have repurchased shares versus those who have not is solely significant for firms contained in the low leverage quintile, supporting the prediction of the leverage hypothesis. Not only is this differential statistically significant, however it is also significant in economic terms.

The leverage hypothesis also expects firms with recent declines in leverage to benefit from repurchasing shares in the open market (H5b). Figures in Table 3 (panel G) do not suggest that this is indeed the case. Event-firms with recent declines in leverage- ratio (quintiles 1 and 2) experience CAR in the range of 0.76% and 0.73%, while firms with recent increases in leverage-ratio (quintiles 4 and 5) experience CAR of 0.87% and 1.10% (all significant at the 1% level). The difference between the tail portfolios is 0.35%, positive and statistically significant at the 10% level. Therefore, the notion of recent declines in leverage- ratio adding positively to the initial market reaction is not supported in the data.

Evidence supporting the notion of the leverage change story is found in the days following the announcement. Post-announcement returns are more pronounced for firms with decreases in leverage (1.09%) versus firms with increases in leverage-ratio (0.70%). The difference (increase-decrease) is a statistically significant -0.39%. Using similar reasoning as before, it appears that time conveys additional information such that the initial market reaction was less complete for firms in the lowest leverage-ratio change quintile. The combined effect of leverage-ratio changes and buyback activity on the initial market reaction is examined next.

Panel C of Table 4 shows the interaction effect of the variables leverage-ratio change and buyback activity (H5d) on the initial market reaction. I find no evidence supporting the idea that buyback activity adds to stock performance of firms with recent declines in leverage-ratio. Not only are returns similar across leverage change deciles, also does buyback not add to the performance when solely considering firms with recent declines in leverage. The difference in returns contained in the decile of firms with recent declines in leverage seems to be independent of the actual repurchasing activity. The difference between those two groups is exactly 0% for the initial market reaction. In the days following the event, firms with no repurchasing activity even seem to outperform firms with actual repurchasing activity. It stands that most of the difference in the initial market reaction in leverage change firms is driven by recent changes in leverage and not by actual repurchasing activity, and hence, does not support the theory of OMSR as tool to alter capital structure.

I summarize the above findings as mixed support for the leverage argument motivating firms to initiate OMSR-programs. First, the initial market reaction seems to be independent of both leverage-ratio and recent changes thereof, counter to what theory predicts. The theory also predicts low leverage firms to outperform high leverage firms, however this is only applicable after some trading days following the event. Double sorting firms according to buyback activity establishes buyback activity as important factor for firms with low leverage, but not for firms with recent declines in leverage.

A final inquiry in the short-run analysis is to test the predictions of agency theory and the *Free-Cash-Flow hypothesis*. The theory predicts high free-cash-flow adding positively to the initial market reaction (H6a). By examining panel H of Table 3, I find no support for this notion. Namely, firms with relatively low free-cash-flow have larger returns in the vicinity of OMSR-announcements. The average CAR achieved in the 2 trading days around the event corresponds to 1.13%. Firms with high free-cash-flow have an average market reaction of 0.72%. Both CAR figures are significant at the 1% level. The difference of -0.41% is statistically significant. Also, in the period [+2:+10] low free-cash-flow firms persistently out-performed high free-cash-flow firms.

Double sorting firms into free-cash-flow and repurchase activity deciles shows the effect of repurchase activity being especially important for firms with high-free-cash flow (Table 4, panel D). The difference in return between firms with high free-cash-flow and subsequent repurchasing activity and firms with no repurchasing activity and high free-cash-flow, is a statistically significant 0.73%. However, in the 8 trading days following the event the sign of the differential changes and also becomes insignificant (-0.32%). Therefore, the analysis yields no concrete support for free-cash-flow affecting stock-price performance in the short-run. Also, the role of buyback activity is not evident.

Table 4: Figures in the table display CAR achieved by event-firms. CARs are calculated using a standard market-model. CI levels: 10%*, 5%**, 1%***

Short Run Evidence, Double Sort

Panel A: Program Size & Buyback

[-20 : -3]	Program Size Quintile					
Buyback Activity	1	2	3	4	5	Dif [5-1]
0 (No)	-1.38%**	-1.01%	-1.06%	-1.49%***	-0.73%	0.63%
1 (Yes)	-2.39%***	-1.64%***	-0.99%	-0.95%	-0.52%	1.86%*
Dif [1-0] (Total)	0.64%	-0.63%	0.07%	0.54%	0.21%	
[-1 : +1]						
Buyback Activity	1	2	3	4	5	Dif [5-1]
0 (No)	0.21%	0.06%	0.70%	0.61%	1.14%**	0.93%*
1 (Yes)	0.07%	0.84%***	1.09%***	0.26%	1.39%***	1.32%***
Dif [1-0] (Total)	-0.14%	0.78%*	0.39%	-0.35%	0.25%	
[+2 : +10]						
Buyback Activity	1	2	3	4	5	Dif [5-1]
0 (No)	0.42%	0.60%	0.60%	1.48%***	0.27%	-0.15%
1 (Yes)	0.32%	0.58%	0.89%**	0.19%	1.64%***	1.32%**
Dif [1-0] (Total)	-0.10%	-0.02%	0.39%	-1.29%*	1.37%**	

Panel B: Leverage Ratio & Buyback

[-20 : -3]	Leverage-Ratio Quintile					
Buyback Activity	1	2	3	4	5	Dif [5-1]
0 (No)	-2.23%***	-0.70%	-0.96%	-0.48%	-0.56%	1.67%*
1 (Yes)	-2.02%***	-1.72%**	-0.59%	-0.87%	-1.27%**	0.75%
Dif [1-0] (Total)	0.21%	-1.02%	0.37%	-0.39%	-0.71%	
[-1 : +1]						
Buyback Activity	1	2	3	4	5	Dif [5-1]
0 (No)	0.91%**	0.83%**	0.21%	0.49%	0.75%**	-0.16%
1 (Yes)	0.77%**	0.80%**	0.77%**	0.61%***	0.84%***	0.07%
Dif [1-0] (Total)	-0.14%	-0.03%	0.56%	0.12%	0.09%	
[+2 : +10]						
Buyback Activity	1	2	3	4	5	Dif [5-1]
0 (No)	0.49%	0.37%	0.91%*	0.62%	0.47%	-0.02%
1 (Yes)	1.74%***	-0.23%	0.86%**	0.38%	0.85%**	-0.89%
Dif [1-0] (Total)	1.25%*	-0.60%	-0.05%	-0.24%	0.38%	

Panel C: Leverage-Ratio Change & Buyback

[-20 : -3]	Leverage-Ratio Change Quintile					
Buyback Activity	1	2	3	4	5	Dif [5-1]
0 (No)	-2.61%***	-0.77%	-0.25%	-0.40%	-1.83%**	0.78%
1 (Yes)	-3.26***	-0.74%	-0.45%	-0.76%	-1.54%**	1.72%*
Dif [1-0] (Total)	-0.65%	0.03%	-0.20%	-0.36%	0.29%	
[-1 : +1]						
Buyback Activity	1	2	3	4	5	Dif [5-1]
0 (No)	1.11%***	0.59%*	0.61%**	-0.02%	0.89%**	-0.22%
1 (Yes)	1.11%***	0.47%**	0.78%***	0.58%*	0.91%***	-0.20%
Dif [1-0] (Total)	0.00%	0.12%	0.17%	0.60%	0.02%	
[+2 : +10]						
Buyback Activity	1	2	3	4	5	Dif [5-1]
0 (No)	1.11%**	1.02%**	0.18%	0.85%*	-0.34%	1.44%**
1 (Yes)	0.76%	0.45%	1.07%***	1.53%***	-0.24%	-1.00%
Dif [1-0] (Total)	-0.35%	-0.57%	0.89%*	0.68%	0.10%	

Panel D: Free-Cash-Flow & Buyback

[-20 : -3]	Free-Cash-Flow Quintile					
Buyback Activity	1	2	3	4	5	Dif [5-1]
0 (No)	-1.78%***	-1.55%**	-1.65%**	-1.21%*	-0.39%	2.17%***
1 (Yes)	-3.20%***	-2.50%***	-0.64%	-0.80%***	0.38%	2.82%***
Dif [1-0] (Total)	-1.42%	-0.95%	1.01%	0.41%	0.77%	
[-1 : +1]						
Buyback Activity	1	2	3	4	5	Dif [5-1]
0 (No)	0.50%	0.47%	1.02%***	0.74%**	0.02%	0.48%
1 (Yes)	0.90%**	1.00%***	0.87%***	0.58%***	0.75%***	-0.15%
Dif [1-0] (Total)	0.40%	0.53%	-0.15%	-0.16%	0.73%**	
[+2 : +10]						
Buyback Activity	1	2	3	4	5	Dif [5-1]
0 (No)	0.35%	0.76%	0.51%	1.23%***	0.40%	0.05%
1 (Yes)	1.06%**	1.65%***	0.96%**	0.63%**	0.08%	-0.98%
Dif [1-0] (Total)	0.71%	0.89%	0.45%	-0.60%	-0.32%	

5.4 Long-Run Returns, CAR

Table 5 displays long-run cumulative abnormal returns achieved by event-firms. The first column of panels A-D show CAR pertaining to the full sample of 6319 repurchasing firms. Event-firms seem to under-perform in the years following the announcement, regardless of the choice of benchmark methodology. More concretely, counter to what was expected in H3, firms with repurchase announcements under-perform the benchmark consistently throughout the 4 years following the event. Including returns achieved in the announcement month, event-firm under-performance corresponds to a statistically significant -2.75% to -3.62% in the first 12 months following the event. These figures are economically meaningful. In the second year the under-performance endures and CAR accumulates to significant -4.94% using the FF3 model, up to -6.08% using the single factor model. In year 3 the under-performance expands and reaches values in the range of -7.63% and -4.94%. In the fourth year, under-performance reaches maximum values in the range of -9.01% and -3.75%. CAR values in year 3 and 4 are statistically significant and may also be interpreted as economically noteworthy.

In columns 2-4 event-firms are stratified according to the B/M ratio to test for additional implications of *Mispricing Theory* in long-horizon returns. Firms with high B/M ratios are expected to have larger risk-adjusted post-announcement returns. I find evidence in line with the TSH argument. In the first year following the announcement the difference in CAR between firms in the highest B/M quintile as compared to firms in the lowest quintile is a statistically significant 10.78%-11.79%. Important to note here, while firms in the lowest B/M quintile achieve economically- and statistically-significant negative returns in the range of -9.22% and -8.68%, firms with high B/M achieve positive returns mounting to 2.10%-2.78%. As high B/M firms out-perform the benchmark marginally and low B/M firms significantly under-perform, the return differential between these two groups of event-firms sums to double digits. The double digit out-performance by high B/M event-firms is a persistent pattern in the 4 years following the announcement. In the second, third and fourth year following the announcement, event-firms with low B/M achieve CAR of approximately -14%, -13% and -13,5%, respectively. Firms with otherwise similar high B/M achieve CAR of 4% in the second year, between 0.68% and 4.34% in the third year and -0.91%-4.78% in the fourth year following the announcement. The difference in performance during these periods is a statistically- economically-significant 13.17%-18.20%. Since high B/M event-firms have positive CAR, while also out-preforming firms with low B/M, the output supports the mispricing story. Yet, out-performance of high B/M event-firms is merely marginal. Judging the output as strong support for the hypothesis would be flawed and I am cautious making such call.

Testing the implications of *TSH*, columns 5-7 report returns achieved by event-firms resulting from stratifying according to market value. I find little evidence supporting the hypothesis. While small firms seem to outperform larger firms significantly in the 4-years following the announcement, they are not able to outperform the benchmark consistently. In the first year following the announcement small firms achieve CAR in the range of -0.78% to -2.07%. At the same time, event-firms with large market value achieve returns of -4.35% to -4.83%. The difference is a statistically significant -3.74% to -2.28%. In the second year small firms experience a surge in returns to the levels of -1.08% to 1.31%. Nonetheless, these returns are not significantly different from zero. Larger firms achieve returns in the range of -8.30% to -7.02% in the same period. The return differential suggest that small firms out-perform large firms by roughly 5% to 7% percent during a 2-year event-period. Irrespective of the choice of the benchmark methodology, small firms achieve negative returns in the range of -3.83% to -0.29% in the third year. Large firms achieved CAR of -7.36% to -8.69% in the same period. The difference is statistically significant and in the range of -3.35% to -7.84%. In the fourth year small firms achieve cumulative abnormal returns of large -4.13% up to small positive 0.85%. Similarly, large firms achieve significant negative returns of -8.70% to -10.04%. The difference remains economically large in the range of -4.57% to -10.30%. Altogether, the evidence seems more in line with the predictions of mispriced driven repurchases rather than the TSH argument. Crucially important is the fact that comparing results from the table to previous studies, I find statistical- and economical- long-run under-performance of firms announcing repurchases. Essentially, finding under-performance of event-firms questions the favourable aspects of firms repurchasing stock. Potential gains achieved through repurchasing stock seems to remain unrecognized by the market, doubting that any of the motivations (mispricing or signaling) driving OMSR-programs are justified.

5.5 Long-Run Returns, Overreaction-hypothesis

Panel E of Table 5 tests the predictions of the *Overreaction Hypothesis* (Peyer and Vermaelen, 2009). Firms are stratified according to 6-month (5-factor) CAR prior to OMSR-announcement. I find mixed evidence supporting the hypothesis (H4). Namely, firms with most severe negative price shocks display more positive returns in the announcement month as compared to firms with positive pre-announcement returns. The CAR differential is 0.75%. The difference is significant at the 10% level and in line with the prediction. In subsequent years, firms with most severe negative price shocks seem to out-perform firms with positive pre-announcement returns. The difference is increasing in time, corresponding to -4.86% in the first year up to -11.79% in year 4 (all differences are statistically significant at the 1% level). The overreaction theory implicitly argues that the OMSR-announcement initiates market actors to update beliefs such that a mean reversal would cause positive abnormal performance amongst firms with negative price shocks in the period following the announcement. I judge the evidence to be mixed as firms with negative price shocks are able to out-perform firms with positive pre-announcement returns, however they are not able to show positive drift except in the announcement month.

5.6 Long-Run Returns, Cross-section

Table 6 shows multivariate cross-sectional output testing multiple motivations for firms repurchasing stock. First to note is the coefficient of firm size, the main indicator variable characterizing signal-driven share repurchases. The coefficient is positive in 5 out of 5 model specifications, indicating that larger firms out-perform smaller firms in the 3-years following the event. Finding positive coefficients for the variable of firm size is counter to previous findings in 5, where smaller firms out-performed larger counterparts. This demonstrates that performance is not a linear function of firm size and performance seems especially affected for firms contained in the tails of the distribution. Moreover, size coefficients are not statistically significant. Therefore, I am unable to state that coefficients could not actually negative such that previous results from the CAR analysis could be in line with the results displayed in the table. I conclude the cross-sectional evidence failing to support the notion of TSH.

Table 5: Long-run cumulative abnormal return (CAR) following OMSR-announcements in the period 2004-2016. Expected returns are estimated using a factor model according to equations (9) - (12). Beta exposures are estimates using a 36-month rolling window. Reported figures are averages of the sum of individual CARs over the applicable event-time period. CI levels: 10%*, 5%**, 1%***

Long-run abnormal returns following OMSR-announcement

Panel A: Market-model

	Full Sample	Low B/M	High B/M	Dif (High-Low)	Small Size	Large Size	Dif (Large-Small)
Months relative to announcement							
(+1 : +12)	-3.62%***	-9.01%***	2.78%***	11.79%***	-2.07%*	-4.35%***	-2.28%**
(+1 : +24)	-6.08%***	-13.51%***	3.82%***	17.33%***	-1.08%*	-7.02%***	-5.94%***
(+1 : +36)	-7.63%***	-13.03%***	0.68%	13.71%***	-3.83%**	-7.36%***	-3.53%***
(+1 : +48)	-9.01%***	-13.71%***	-0.91%	12.80%***	-4.13%**	-8.70%***	-4.57%***
obs	6319	1138	1126		1138	1126	

Panel B: Fama&French 3-factor model

	Full Sample	Low B/M	High B/M	Dif (High-Low)	Small Size	Large Size	Dif (Large-Small)
Months relative to announcement							
(+1 : +12)	-3.08%***	-9.22%***	2.41%**	11.63%***	-1.32%***	-4.64%***	-3.32%**
(+1 : +24)	-4.94%***	-14.17%***	4.16%***	18.33%***	0.32%	-7.85%***	-8.17%***
(+1 : +36)	-5.63%***	-14.08%***	3.28%**	17.36%***	-1.84%	-8.47%***	-6.63%***
(+1 : +48)	-4.64%***	-13.99%***	4.03%***	18.02%***	-0.54%	-9.56%***	-9.02%***
obs	6319	1138	1126		1138	1126	

Panel C: Fama&French 5-factor model

	Full Sample	Low B/M	High B/M	Dif (High-Low)	Small Size	Large Size	Dif (Large-Small)
Months relative to announcement							
(+1 : +12)	-2.85%***	-8.68%***	2.10%	10.78%***	-1.15%	-4.83%***	-3.68%**
(+1 : +24)	-4.86%***	-13.90%***	3.54%**	17.44%***	0.52%	-8.30%***	-7.78%***
(+1 : +36)	-5.56%***	-13.55%***	2.58%	16.13%***	-1.68%	-8.69%***	-7.01%***
(+1 : +48)	-4.60%***	-13.39%***	3.65%**	17.04%***	0.29%	-10.04%***	-9.75%***
obs	6319	1138	1126		1138	1126	

Panel D: Carhart 4 -factor model

	Full Sample	Low B/M	High B/M	Dif (High-Low)	Small Size	Large Size	Dif (Large-Small)
Months relative to announcement							
(+1 : +12)	-2.75%***	-8.88%***	2.54%**	11.42%***	-0.78%	-4.52%***	-3.74%**
(+1 : +24)	-4.73%***	-14.18%***	4.32%***	18.50%***	1.31%	-7.61%***	-8.92%***
(+1 : +36)	-4.94%***	-13.69%***	4.34%***	18.03%***	-0.29%	-8.13%***	-7.84%***
(+1 : +48)	-3.75%***	-13.42%***	4.78%***	18.20%***	0.85%	-9.45%***	-10.30%***
obs	6319	1138	1126		1138	1126	

Panel E: Prior 6-month return sort

	Prior return Lowest	Prior return 2	Prior return 3	Prior return 4	Prior return Largest	Dif (High-Low)
Months relative to announcement						
(-6 : -1)	-39.02%***	-14.46***	-4.33%***	4.99%***	24.92%***	63.94%***
(-5 : -1)	-33.39%***	-12.32%***	-4.03%***	4.07%***	20.03%***	53.42%***
(-4 : -1)	-28.29%***	-10.49%***	-3.51%***	3.23%***	16.28%***	44.57%***
(-3 : -1)	-21.58%***	-7.72%***	-2.49%***	2.06%***	12.23%***	33.81%***
(-2 : -1)	-15.00%***	-4.95%***	-1.60%***	1.54%***	8.27%***	23.27%***
(-1 : -1)	-7.90%***	-2.36%***	-0.27%	1.03%***	4.63%***	12.53%***
(0 : 0)	1.24%***	0.67%**	0.35%	0.36%	0.49%	-0.75%*
(+1 : +12)	-4.88%***	-2.00%**	-0.81%	-2.37%***	-4.17%***	0.71%***
(+1 : +24)	-5.06%***	-2.71%**	-1.96%	-4.65%***	-9.92%***	-4.86%***
(+1 : +36)	-4.06%**	-2.41%*	-0.43%	-6.48%***	-14.61%***	-10.55%***
(+1 : +48)	-1.20%	-1.29%	-2.33%*	-5.21%***	-12.99%***	-11.79%***
obs	1264	1264	1264	1264	1264	1263

I find economic- and statistical-evidence for mispriced driven share repurchases when considering valuation effects. The indicator variable ”B/M quintile ranking” returns positive and significant in 3 model specifications, adding up to 2.44% to 3-year abnormal performance for each one step increase in quintile rank. Put differently, firms in the highest B/M quintile experience CAR expansion in the order of 10.02%-12.26%, measured by the ”High B/M dummy”. The variables program size and repurchasing activity both add, in economic terms, considerably to the out-performance of event-firms. A one step increase in ”program size quintile ranking” surges estimated CAR by 1%. Interesting to note regarding the buyback variable is the manner in which model specifications 4 & 5 capture most of the buyback effect when adding interaction terms. The augmenting effect of repurchasing shares on abnormal performance seems greatly dependent on firm characteristics and is large for firms with high B/M. Firms with high B/M and repurchasing activity, as compared to firms with similar B/M characteristics and no repurchasing activity, achieve gains in 3-year CAR of approximately 29%.

With regard to the principles conveyed by the *Overreaction Hypothesis*, I find firms with positive pre-announcement returns to achieve CAR minor in size as compared to firms with negative pre-announcement returns. The figures are similar to previous evidence found in the long-horizon analysis (Table 5). A one percentage point increase in prior 6-month CAR corresponds to a decrease of 3-year abnormal return in the range of approximately 0.2%-0.21%. Coefficients are statistically significant at the 1% level in all model specifications. Overall, I judge the coefficients from the table to support the hypothesis' expectation.

In pursuit of testing alternative motivations explaining OMSR, I am particularly interested in the coefficients pertaining to the variables of free-cash-flow and leverage (change). First, I find that the effect of high leverage on 3-year abnormal performance is limited. A one step increase in ”Leverage quintile ranking” adds -0.12% up to 1.17% to out-performance. Neither of the coefficients are statistically significant, yet the upper bound of 1.17% can be considered as economically significant. As coefficients are statistically indistinguishable from 0, I disregard the figures as being evidence describing a (consistent) positive relationship between the leverage-ratio and abnormal return. Still, the dummy representing firms with low leverage recovers support for the hypothesis. Firms belonging to the left tail of the leverage-ratio distribution achieve higher CARs as compared to otherwise similar event-firms with high leverage, conform expectations. For firms contained in the low-leverage quintile the coefficients suggest increases in 3-year CAR corresponding to positive and significant 5.95% to 6.80%. Likewise, firms with low leverage and actual repurchasing activity, as compared to firms with low leverage and no such repurchasing activity, achieve additional 23% CAR.

Model specification 5 assesses whether the leverage effect is limited to firms' leverage-ratio characteristics or if recent changes in leverage-ratio inclines firms to repurchase stock as well. An increase in one ”Leverage change quintile” adds insignificant 0.49% to 3-year cumulative abnormal performance. In other words, firms with most severe recent declines in leverage (quintile 1) under-perform firms with recent increases (quintiles 3-5) in leverage, albeit by a small margin. Also, firms with most severe recent declines in leverage and repurchasing activity are found to out-perform otherwise similar leverage firms with no repurchasing activity by 1.68%. Altogether, I conclude that there exists mixed support for the leverage story of OMSR (H5e). Contrary to what is expected in the hypothesis, the effect of leverage-ratio alone does not support the idea that firms with low-leverage perform better as compared to firms with high leverage. There exists strong evidence that firms with low leverage and buyback activity out-perform otherwise similar firms without repurchasing activity, this is in line with the hypothesis. Lastly, I find no support for the idea that firms with recent declines in leverage-ratio out-perform firms with recent increases in leverage. Also, firms with recent declines in leverage while actually repurchasing stock following the event, are not able to outperform similar firms without repurchasing activity.

A final inquiry in the cross-sectional analysis pertains to the *Free-Cash-Flow Hypothesis*. The coefficient of the variable ”FCF quintile ranking” suggest that a one quintile increase in the FCF distribution affects 36-month CAR negatively between 4% and 5%. This decrease is statistically significant. The relationship measured via quintile rankings seems non-linear as the corresponding dummy characterizing firms with most superior free-cash-flow is positive and significant. According to the figure, firms in the right tail of the FCF distribution, i.e., firms contained in quintile 5, out-perform firms with lower FCF by 3.78% to 6.52%. Also, firms with high FCF and actual repurchasing activity out-perform similar firms with no repurchasing activity by a large margin, adding approximately 28% to stock-performance. It remains questionable whether the out-performance found within high FCF firms depends on benefits of repurchasing shares, or simply because high free-cash-flow firms perform better in general. This question greatly relies on the risk adjusting method and whether the effect is captured appropriately by the benchmark framework. Assuming that the risk-adjustment for high-free-cash flow firms is adequately captured in the quality-minus-junk factor (QMJ) of the FF5 model, I judge the output to support the agency theory of OMSR (H6c).

Cross-sectional regression of long-term cumulative abnormal returns following OMSR-announcements					
	Model Specification				
	1	2	3	4	5
Intercept	-0.2667	-0.2460	-0.2734	-0.2511	-0.2624
	*(-4.09)****	*(-4.01)****	*(-3.48)****	*(-3.65)****	*-(3.64)****
Size quintile ranking	0.0172	0.0243	0.0142	0.0149	0.0148
	(1.13)	*(1.97)***	*(0.93)*	*(0.97)*	*(0.97)*
B/M quintile ranking	0.0244		0.0109	0.0206	0.0213
	*(3.19)****		*(1.20)*	*(2.57)****	*(2.64)****
FCF quintile ranking	-0.0419		-0.0500	-0.0451	-0.0450
	*(-2.81)****		*(-3.13)****	*(-3.02)****	*(-3.02)****
Leverage quintile ranking	-0.0012		0.0117	0.0032	0.0029
	(-0.16)		*(1.15)*	*(0.38)*	*(0.34)*
Leverage change quintile ranking					0.0049
					(0.76)
High B/M dummy		0.1226	0.1002		
		*(3.59)****	*(2.46)***		
High FCF dummy		0.0378	0.0652		
		*(1.68)**	*(2.70)****		
Low leverage dummy		0.0595	0.0680		
		*(2.76)****	*(2.30)***		
Program size quintile	0.0096	0.0109	0.0104	0.0100	0.0094
	(1.50)	*(1.68)**	*(1.62)*	*(1.55)*	*(1.45)*
Log (1+%actual buy)	0.1366	0.1471	0.1485	0.0038	0.0030
	*(1.76)**	*(1.90)**	*(1.93)***	*(0.04)*	*(0.03)*
Log (1+%actual buy)*High B/M dummy				0.2691	0.2629
				(1.06)	*(1.04)*
Log (1+%actual buy)*High FCF dummy				0.2899	0.2862
				*(2.32)***	*(2.26)***
Log (1+%actual buy)*Low Leverage dummy				0.2259	0.2300
				(1.27)	*(1.32)*
Log (1+%actual buy)*Leverage decline dummy					-0.0168
					(-0.10)
Prior 6-month CAR	-0.2148	-0.2139	-0.2079	-0.2154	-0.2157
	*(-4.63)****	*(-4.62)****	*(-4.51)****	*(-4.66)****	*(-4.66)****
n	3142	3142	3142	3142	3142
R^2	0.0414	0.0443	0.0402	0.0317	0.0440

Table 6: The table displays multivariate cross-sectional output. The dependent variable are Fama&French 5-factor CARs achieved in the 3 years following OMSR-announcements. Year dummies are included but not reported (with 2004 as baseline). T-statistics are calculated using robust standard errors. CI levels: 10%*, 5%**, 1%***

6 Robustness

6.1 Buy-and-hold

The Robustness section is dedicated to address notion of Fama (1998)'s ”bad model problem” and the joint-hypothesis problem. Both problems stress that the approach identifying abnormal performance over long horizons faces some difficulties. Concretely, statistical inference from long-horizon returns involves a test of both market efficiency and the pricing-model assumptions. Neglecting or inadequately considering these issues may cause statistical inference from long-term returns to be biased. Under the circumstance that previous findings regarding stock price behaviour yields considerable different evidence when using different test methodology, then such bias is essentially present and the robustness of earlier findings is in doubt.

I formulate a new method measuring long-horizon stock performance regarding the hypotheses H3, H4, H5e and H6c. Recall, short term evidence is not overly sensitive to benchmark methodology. As short-run results are expected to remain similar regardless of the choice of distinctive methods, I omit using a different methodology in the short-term analysis. In the upcoming robustness check, the framework measuring long-run abnormal performance pertains to the *buy-and hold* approach. Event-study literature utilizing the buy-and-hold approach is rich. A favourable aspect of this method is that the output yields something which can be contemplated as return achieved on a feasible investment strategy, albeit not considering transaction costs.

The buy-and-hold approach, as compared to the CAR approach described earlier, measures the multi-period return from investing in a portfolio consisting of event-firms and selling the same portfolio at the end of the holding period. A comparable strategy using otherwise similar non-event-firms serves the benchmark ($R_{b,t}$). The abnormal holding period return ($BHAR$) for firm i measured over period T is:

$$BHAR_{i,T} = \prod_{t=1}^{T}(1 + R_{i,t}) - \prod_{t=1}^{T}(1 + R_{b,t}) \tag{13}$$

The mean buy-and hold abnormal return ($\overline{BHAR}$) of a portfolio is the weighted average of individual BHARs ($BHAR_{i,T}$):

$$\overline{BHAR}_T = \sum_{i=1}^{N} w_i * BHAR_{i,T} \tag{14}$$

Standard arrangements for the weighting operator (w_i) are value- and equal-weighting. Event studies are generally concerned with the sample distribution of mean abnormal BHARs. Barber and Lyon (1997) and Lyon et al. (1999) show that $\overline{BHAR}$ exhibit unfavourable statistical properties like skewness and kurtosis. Fortunately, a considerable part of this bias is mitigated with large sample sizes (applies here). Also, a proper use of the benchmark methodology and adequate t-testing is crucial for statistical inference from mean abnormal BHARs.

I follow Lee (1997) *control firm* approach to determine benchmark returns ($R_{b,t}$). From all firms within the NYSE, AMEX and NASDAQ-universe, 25 diversified equal-weighted portfolios along the characteristics of size and B/M serve the benchmark. In the spirit of Fama and French (1993) the double sort is designed to adapt the empirical relationship between risk factors and abnormal returns. Each month, all 25 portfolios are re-balanced. For each event, I identify a portfolio with similar size and B/M characteristics and the average monthly buy-and-hold return of these sorted portfolios is designated as the initial benchmark return ($R_{b,t}$). I obtain returns and break-off points of 25 sorted CRSP portfolios from the Kenneth R. French data library. Earlier, break-off points were established based on the distribution of event-firms. As a result from using different break-off points matching the sorted portfolios, firms are assigned into new quintiles in the robustness check. Once a benchmark is assigned in the announcement month, I re-assign benchmark returns on a yearly basis accounting for the reporting frequency.

Abnormal buy-and-hold returns are calculated over various holding periods, ranging from 6-months prior, to 48 months ex-post to the OMSR-announcement, using monthly compounding. Next to measuring buy-and-hold returns for the full sample, event-firms are sorted according to prior 6-month holding period return to test the implications of the *Overreaction Hypothesis*. Previously in the cross-sectional test of hypothesis 5 & 6, the dependent variable were 3-year average cumulative abnormal returns stemming from the FF5 multi-factor model. To test if both CAR and buy-and hold approach properly capture abnormal performance, CARs are replaced by 3-year BHAR returns. Explanatory variables are left unchanged.

While t-statistics in the initial CAR model were estimated from parametric t-test, statistical inference from BHARs is optimally derived under non-parametric bootstrapping (Ikenberry et al., 1995; Mitchell and Stafford, 2000). Statistical inference from bootstrapping depends on an empirical distribution simulated under the null. Within this framework, the implied model of expected buy-and-hold return is the average X-year return of firms that have similar size and B/M characteristics. In Brock et al. (1992) and Ikenberry et al. (1995), for each event-firm the authors act as if the announcement date applies also to a randomly selected firm with the same size-B/E characteristics at that time. This procedure yields a pseudo-sample that has the same size- B/E distribution, the same number of observations and the same calendar-time frequency as the original sample. They then proceed by calculating the mean BHAR for the pseudo-sample in the same way as for the original sample. This results in one BHAR under the null of the model. Steps are repeated to generate the empirical distribution of $\overline{BHAR}$ under the null. A p-value (CI; 1%, 5% and 10%) is calculated as the fraction of the BHARs from the pseudo-sample that are larger in magnitude (but with the same sign) than the original BHAR.

I recognize favourable statistical aspects of the bootstrapping method nevertheless judge it inappropriate in my analysis. First, while the method may seem attractive for small sample sizes of event-firms, increasing the number of event-firms into the thousands eventually decreases the choice of non-event-firms used as matching control firms. Choosing a random firm with no repurchasing event in the same period and similar B/M and size characteristics is limited, such that the approach would eventually suffer from pseudo-random sampling. Also, considering the substantial increase in share repurchases, I cannot ensure control firms to actually having no repurchasing event (or other corporate events) simply because firms are not included in the master. Lastly, the bootstrapping method is especially important whenever the empirical distribution of BHAR is skewed or exhibits large degrees of kurtosis. Figure 3 plots 3-year BHAR. Inspecting the distribution of 3-year BHAR shows positive skewness and kurtosis, still the distribution is not too different from a conventional normal distribution. This makes the distribution of BHARs suitable for parametric t-testing.

Table 7: Abnormal buy-and-hold returns pertaining to firms announcing OMSR-programs, measured over various horizons. Holding period returns following the announcement month include the initial market reaction. Average monthly figures are calculated as $BHAR^{(1/t)}$, where t is the number of months contained in the particular event period. CI levels: 10%*, 5%**, 1%***

Long-run abnormal returns after open market repurchase announcements (BHAR)

Panel A: BHAR

Months relative to announcements	Full Sample	n	Low B/M	n	High B/M	n	Dif (High-Low)	Small Size	n	Large Size	n	Dif (Large-Small)
(+1 : +12)	-11.03%***	5543	-12.27%***	479	-6.00%*	636	6.27%*	-5.75%	103	-10.00%***	2703	-4.25%
(+1 : +24)	-23.89%***	5417	-23.36%***	457	-15.07%***	614	8.29%*	-19.07%	91	-24.41%***	2676	-5.34%
(+1 : +36)	-45.09%***	5347	-32.29%***	445	-16.05%**	597	16.24%***	-39.51%	92	-43.38%***	2647	-3.87%
(+1 : +48)	-69.02%***	4950	-53.34%***	388	-49.86%***	537	3.48%	-15.79%	81	-64.02%***	2301	-48.23%***

Panel B: Average Monthly BHAR

Months relative to announcements	Full Sample	n	Low B/M	n	High B/M	n	Dif (High-Low)	Small Size	n	Large Size	n	Dif (Large-Small)
(+1 : +12)	-1,22%***	5543	-1.23%***	479	-1.16*	636	1.17%*	-1.15%	103	-1.21%***	2703	-1.13%
(+1 : +24)	-1.14%***	5417	-1.14%***	457	-1.12%***	614	1.09%*	-1.13%	91	-1.14%***	2676	-1.07%
(+1 : +36)	-1.11%***	5347	-1.10%***	445	-1.08%**	597	1.08%***	-1.11%	92	-1.11%***	2647	-1.04%
(+1 : +48)	-1.09%***	4950	-1.09%***	388	-1.08%***	537	1.03%	-1.06%	81	-1.09%***	2301	-1.08%

Panel C: Prior BHAR sort

	Prior Return Quintile					
Months relative to announcements	Prior return Lowest	Prior return 2	Prior retun 3	Prior retun 4	Prior return Largest	Dif (High-Low)
(-6 : -1)	-61.26%***	-25.16%***	-9.17%***	7.57%***	43.04%***	104.3%***
(-5 : -1)	-48.20%***	-20.25%***	-6.81%***	7.17%***	37.01%***	85.21%***
(-4 : -1)	-36.04%***	-14.80%***	-4.11%***	6.74%***	30.63%***	66.67%***
(-3 : -1)	-25.27%***	-2.37%*	-9.74%***	5.48%***	23.70%***	48.97%***
(-2 : -1)	-15.67%***	-5.24%**	-1.18%*	4.12%**	16.37%***	32.04%***
(-1 : -1)	-7.69%***	-2.40%*	-0.65%	2.06%*	8.95%***	16.64%**
(0 : 0)	2.37%***	0.65%**	0.67%*	2.69%	0.91%***	-1.46%*
(+1 : +12)	-17.84%***	-15.72%***	-10.47%***	-7.86%***	-0.33%	17.51%***
(+1 : +24)	-18.18%***	-27.05%***	-29.78%***	-23.77%***	-16.83%***	1.35%
(+1 : +36)	-26.60%***	-54.36%***	-47.51%***	-48.54%***	-43.45%***	-16.85%*
(+1 : +48)	-36.96%***	-53.56%***	-55.91%***	-51.12%***	-66.39%***	-26.43%***
obs	1064	1085	1085	1087	1082	

6.2 Results Robustness

Panel A & B of Table 7 display abnormal buy-and-hold returns over various horizons following OMSR-announcements. Similar to previous findings, firms announcing OMSR are not able to outperform the benchmark on average. In particular, during the first year following announcement, event-firms under-perform the benchmark significantly by 11.03% (-1.22% per month). These figures include the positive initial market reaction in the announcement month. In years 2 (3, 4) event-firms achieve negative BHAR of -23.89% (-45.09%, -69.02%). The average monthly under-performance in years 2,3 and 4 corresponds to -1.14%, -1.11% and -1.09%, respectively. Contrary to the expectations of H3, the evidence shows a persistent negative long-term drift within event-firms. Evidence from the buy-and-hold approach stresses the importance of benchmark methodologies used in event-studies. While I find under-performance regardless of the method, the drift's magnitude is significantly larger using the BHAR- as compared to the CAR-approach.

Stratifying firms according to the indicator variable (B/M ratio), yields mixed evidence supporting the *Mispricing Hypothesis*. I judge evidence as being mixed due to the fact that despite firms with high B/M outperforming firms with low B/M, firms with high B/M are unable to out-perform the benchmark in any of the years following OMSR-announcements. Stock performance of high B/M event-firms in years 1,2,3 and 4, amounts to -6.00%, -15.07%, -16.05% and -49.86% , respectively. In the previous CAR approach, firms with high B/M were found to marginally outperform the benchmark. The BHAR approach establishes that the margin of out-performance was indeed close to nil in these firms. Numbers in the table advocate that separating high B/M firms from low B/M firms yields a return differential of 6.27%, 8.29%, 16.24% and 3.48% in the years 1,2,3 and 4, respectively. The respective monthly average out-performance corresponds to 1.17%, 1.09%, 1.08% and 1.03%.

Sub-dividing firms according to market capitalisation, serving the purpose of testing the implications of *TSH*, again yields mixed evidence supporting the hypothesis. In line with the expectation, small firms out-perform large firms throughout the 4 years following announcement. For the duration of years 1,2 and 3, the out-performance by small firms is statistically insignificant 4.25%, 5.34% and 3.87%. Put differently, in the years 1,2 and 3, small firms outperform large firms by 1.13% 1.07% and 1.04% on a monthly basis. In year 4, small firms succeed in reducing the under-performance substantially, while large firms keep under-performing the benchmark significantly. The BHAR return differential is economically- and statistically-significant -48.23% (monthly -1.08%). Finding small firms to out-perform large firms conforms expectations, yet it remains evident that neither of the group of firms are capable to out-perform the benchmark. If signaling favourable information thrives firms to implement OMSR-programs, firms should (on average) achieve positive post-announcement returns.

Panel C of Table 7 shows evidence pertaining to the *Overreaction Hypothesis*. The output affirms the expectations of H4, yet the drift is not as homogeneous as in the CAR analysis. In the announcement month [0:0] firms with most severe negative price shocks achieve BHAR of 2.37%, while firms with large prior returns achieve BHAR of 0.91% in the same month. The difference (high-low) is statistically significant BHAR of 1.46%. Throughout the first year following announcement, firms with negative pre-announcement returns sustain the already existing negative trend and achieve BHAR of -17.84%. Firms with large positive pre-announcement returns confront BHAR indistinguishable from 0. The difference (high-low) is a statistically significant and positive 17.51%. In the 24 months following announcement, firms with positive pre-announcement returns experience a significant drop in BHAR mounting to -16.83%. BHAR of firms with negative pre-announcement returns remain close to constant, at -18.18%. The return differential is reduced to positive 1.35% BHAR. In years 3 and 4, firms in quintile 5 achieve BHAR of -43.45% and -66.39%, respectively. Event-firms in quintile 1 achieve BHAR of -26.60% and -36.96% during the same period. Starting from year 3 the return differential changes sign and aggregates to -16.85% BHAR in the third year and -26.43% BHAR in year 4. The return differential in years 3 and 4 are statistically (and economical) significant. To conclude, firms with negative pre-announcement returns initially under-perform firms with large positive pre-announcement returns, yet the trend reverses in year 3, eventually causing a large negative return differential between these two groups. The figures are in line with the expectations of the overreaction hypothesis.

The multivariate cross-sectional regression using 36-month BHAR as dependent variable is displayed in Table 8. First to note are regression coefficients pertaining to firm size. The importance of using certain benchmark method becomes evident when comparing coefficients obtained in the CAR analysis versus those identified in the table. While I found firm size to be positively related to stock performance in the CAR approach, I find an inverse relationship in the BHAR approach. The majority of model specifications, 4 out of 5, return negative coefficients estimates. For each one step increase in "Size quintile ranking", 36-month BHAR decreases by approximately 7%. Coefficients are not statistically different from 0 using a 95% confidence interval. Economically speaking the decrease in performance is noteworthy. Assuming that the benchmark method adequately adjusts for risk inherited in small firms, I find support for the *TSH* story.

Judged by figures in the table, firms with high B/M seem to outperform firms with low B/M, albeit only by the margin. B/M coefficients comply with CAR evidence found earlier. Increasing "B/M quintile rank" by one step increases 3-year BHAR in the range of 2.35%-2.86%. Firms contained in the high B/M quintile, characterized by the "High B/M dummy", do not significantly out-perform firms belonging to other quintiles. If at all, the difference in BHAR between firms with highest B/M and all other firms lies between 0% and 6%. The manner in which valuation effects are captured by the benchmark methodology is shown to be of great importance judged by numbers pertaining to the right tail B/M firms. While the B/M coefficient does not display clear-cut support for *Misprcing Theory* in first instance, I find evidence supporting the hypothesis when considering the combined effect of repurchasing activity and high B/M on abnormal stock performance. Firms with high B/M and actual repurchasing activity achieve an increase in BHAR of 23%-29% as compared to firms with firms with similarly high B/M and no repurchasing activity. In economic terms, this increase is substantial. Also, favouring the story of mispriced driven share repurchases are coefficients pertaining to announced program size. A one step increase in "Program size quintile" yields a significant increase in BHAR of approximately 4%.

Coefficients pertaining to the *Overreaction Hypothesis*, "Prior 6-month BHAR", reaffirm the notion of firms with previous negative price shocks achieving larger BHAR as compared to firms with positive prior return. A one percentage point increase in prior 6-month BHAR decreases 36-month BHAR by approximately 0.1%. This is in line with previous CAR evidence and in line with the expectations of the *Overreaction Hypothesis*.

The table displays output supporting certain respects of agency theory (H5e) in the decision of firms repurchasing stock, yet the evidence is dissimilar in some aspects compared to previous CAR findings. First, a one-step increase in ”Leverage quintile ranking” increases 36-month BHAR in the range of 0%-4.25%. Similar to previous CAR evidence, coefficients are not significantly different from 0. Contrasting the CAR analysis, coefficients pertaining to the ”Low leverage dummy” are negative, indicating that solely having low leverage does not add to stock performance. As a matter of fact, performance of event-firms with low-leverage is inversely affected in the range of -9.07% to -13.71%. Most important is finding firms with low leverage and repurchasing activity to massively outperform firms with low leverage and no repurchasing activity. The difference in BHAR between these two groups is 66.49%-70.34%. Because of large standard errors pertaining to the variable, firms are not able to outperform firms in a statistical sense, however certainly in an economical one. The second prediction the leverage story, the notion of firms with recent changes in leverage stand to benefit from repurchasing shares, finds mixed evidence in the table (model specification 5). A one step increase in ”Leverage Change quintile ranking” decreases 36-month BHAR by -2.06%, counter to the predictions of the hypothesis. Yet, firms with recent declines in leverage and actual repurchase activity outperform firms with similar leverage and no repurchasing activity by economical significant 34.33%.

Similar to evidence obtained using the CAR approach, I find strong evidence supporting the *Free-Cash- Flow Hypothesis* (H6c). A one step increase in "FCF quintile ranking" increases 36-month performance by approximately 12%. Also, firms with belonging to the high FCF quintile (High FCF dummy) achieve additional 3.63%-4.77% as compared to event-firms in other FCF quintiles. The role of repurchasing activity seems especially important for high FCF firms, adding up to 29.82% to 36-month BHAR as compared to firms with similar FCF and no repurchasing activity.

Comparing the results of the robustness analysis with results previously obtained in the CAR analysis yields important insights. I conclude the choice of the benchmark methodology to matter significantly. While I find both long-run under-performance of firms announcing share repurchases, the magnitude of under-performance is greatly larger using the buy-and-hold approach. The role of B/M in testing the predictions of mispriced driven share repurchases is ambiguous. It remains true that event-firms with high B/M outperform firms with low B/M using single sorts for both CAR and BHAR. However, high B/M firms are merely able to outperform the benchmark in the CAR approach while being unable to do so using the buy-and-hold approach. Using both 36-month CAR and BHAR in the cross-sectional analysis, B/M coefficients suggest a positive relationship between valuation effects and abnormal performance. Firms announcing larger programs are found to outperform firms with smaller programs using both benchmark methods. Both benchmark models agree on the fact that firms with high B/M, while also repurchasing shares, experience a significant increase in abnormal performance as compared to firms who do not repurchase.

Single sorting firms according to firm size, the indicator variable testing the predictions of TSH, yields an inverse relationship with abnormal performance. This inverse relationship is robust to a change in benchmark methodology. Yet, the relationship seems non-linear, i.e., ambiguous, such that coefficients in the cross-section are returned positive in the CAR approach and negative in the BHAR approach. Event-firms with recent price shocks outperform firms with recent increases in stock prices regardless of the choice of the benchmark.

With regard to the predictions of the leverage story, I find similar evidence across both benchmark methods. Using ”Leverage-ratio quintile ranks” as explanatory variable, firms with high leverage-ratio

Cross-sectional regression of long-term abnormal buy-and-hold returns following OMSR-announcements					
	Model Specification				
	1	2	3	4	5
Intercept	-0.6027	-0.3600	-0.54165	-0.6325	-0.5962
	*(-3.66)****	*(-2.42)***	*(-2.60)****	*(-3.56)****	*(-2.90)****
Size quintile ranking	-0.0739	0.0170	-0.0713	-0.0773	-0.0756
	(-1.48)	*(0.57)*	*(-1.41)*	*(-1.53)*	*(-1.61)*
B/M quintile ranking	0.0286		0.0299	0.0270	0.0235
	(1.24)		*(1.08)*	*(1.10)*	*(0.96)*
FCF quintile ranking	0.1243		0.1298	0.1231	0.1219
	*(2.44)***		*(2.43)***	*(2.39)***	*(2.61)****
Leverage quintile ranking	0.0224		-0.0000	0.0397	0.0425
	(0.82)		*(-0.00)*	*(1.32)*	*(1.48)*
Leverage change quintile ranking					-0.0206
					(-1.00)
High B/M dummy		0.0660	-0.0199		
		(0.69)	*(-0.17)*		
High FCF dummy		0.0363	0.0477		
		(0.44)	*(0.55)*		
Low leverage dummy		-0.1371	-0.0907		
		(-1.90)	*(-0.94)*		
Program size quintile	0.0359	0.0376	0.0358	0.0365	0.0396
	*(1.91)**	*(1.98)***	*(1.89)**	*(1.93)**	*(1.98)***
Log (1+%actual buy)	-0.0540	-0.0295	-0.0591	-0.2818	-0.3259
	(-0.26)	*(-0.14)*	*(-0.28)*	*(-1.08)*	*(-1.11)*
Log (1+%actual buy)*High B/M dummy				0.2335	0.2918
				(0.39)	*(0.46)*
Log (1+%actual buy)*High FCF dummy				0.2794	0.2982
				(0.66)	*(0.60)*
Log (1+%actual buy)*Low Leverage dummy				0.7034	0.6649
				(1.54)	*(1.42)*
Log (1+%actual buy)*Leverage decline dummy					0.3433
					(0.69)
Prior 6-month CAR	-0.1110	-0.1135	-0.1167	-0.1010	-0.0462
	(-1.36)	*(-1.36)*	*(-1.41)*	*(-1.22)*	*(-0.80)*
n	3254	3317	3254	3254	3254
R^2	0.0230	0.0127	0.0219	0.0218	0.0223

Table 8: The table displays multivariate cross-sectional output. The dependent variable are abnormal buy-and-hold returns achieved in the 3 years following open market share repurchase announcements. Year dummies are included but not reported. T-statistics are calculated using robust standard errors. CI levels: 10%*, 5%**, 1%***

out-perform otherwise similar firms with low-leverage. Dummy coefficients pertaining to firms with low leverage-ratio are returned positive in the CAR approach and negative in the BHAR approach. Both models agree on the fact that firms with low leverage who simultaneously repurchase shares experience a significant increase in abnormal performance as compared to firms who do not repurchase shares.Evaluating evidence supporting the idea of recent declines in leverage adding positively to long-horizon drift yields different insights under the two approaches. Using the CAR approach shows recent changes in leverage to be independent from abnormal performance, while the BHAR approach suggests that there exists a positive relationship between recent declines in leverage and abnormal performance.

Finally, assessing robustness pertaining to agency theory, that is *FCF hypothesis*, also stresses the importance of the benchmark methodology. The CAR approach proposes a significant negative relationship between free-cash-flow and abnormal performance while the BHAR approach suggests the exact opposite. Both models agree on the most fundamental idea of FCF theory stating that event-firms with greatest FCF experience superior abnormal returns as compared to all other event-firms. Also, high FCF firms with repurchasing activity out-perform otherwise similar FCF firms with no repurchasing activity in both models.

7 Conclusion & Discussion

In recent decades, firms repurchasing company stock via various types of programs has become the rule rather than the exception. Academics responded with myriad time and effort documenting both stock performance and possible explanations to the question why firms engage in such corporate events. As the nature of these events might have changed since the beginning of academic documentation and market actors became aware of abnormal stock-price performance associated with these events, the aim of this paper was twofold. Most trivial in this paper was an inquiry into short- and long-term stock-price performance of firms announcing open-market share repurchases (OMSR). Subsequently, the second purpose of this paper was to link a set of motivations provoking managers to persuade OMSR in the framework of stock-price performance. I tested 4 leading motivations for managers announcing OMSR: signaling, mispricing, altering capital structure and agency theory. I report evidence for a comprehensive set of U.S. based firms announcing OMSR in the period 2004-2019.

Considering the short-run, I find evidence for the signaling effect of OMSR. Output from the analysis produced a significant positive initial market reaction amongst event-firms, where small firms with presumably larger information asymmetries bared larger initial market reactions. Market actors seem to experience difficulties when pricing in the information content involved in these events, as short-run abnormal stock-price performance endures in the 10 trading days following the event. Comparing the initial market reaction to evidence found in previous research shows returns to have declined drastically in recent data. After all, once the market becomes aware that positive returns can be harvested by investing in repurchasing firms, one would expect the anomaly to disappear unless market frictions prevent investors from acting on it (Schwert, 2003).

Distinguishing mispriced driven share repurchases from other motivations involved in these events is complex. To tackle this issue, I formulated 3 indicator variables which could signal under-valuation at the time of announcement. First, I find firms with high book-to-market ratio (out-of-favour firms) out-performing otherwise similar firms with low B/M, in line with the mispricing argument. Future buyback activity served as second indicator variable and I was unable to identify a significant role of this characteristic in the initial market reaction. I treat the evidence pertaining to buyback activity with special caution, as testing the impact of this variable relies on the assumption of market actors being able to anticipate actual repurchases following announcement. Less ambiguous was testing the effect of program size on the initial market reaction. Announcing large programs potentially serves as an indicator for the size of the mispricing opportunity. The initial market reaction amidst firms announcing relatively large programs is considerably greater as compared to firms announcing small programs. As firms have no real obligation to actually go through with repurchasing shares, therefore yielding the opportunity of false signaling, I test the interaction effect of large programs and buyback activity. I find no evidence suggesting that firms with large programs must repurchase shares in order to signal under-valuation at the time of announcement. Yet, in the days following the event, firms with large programs and actual repurchasing activity significantly out-perform peers with no repurchasing activity. Overall, I conclude the analysis to be in line with most of the aspects put forward by mispriced motivated share repurchases.

Inspecting the initial market reaction of firms likely involved in OMSR to alter capital structure yielded mixed support for the hypothesis. Returns achieved in the 2 days surrounding the event seem to be independent of leverage-ratio, declines in leverage and combinations of leverage (change) and buyback activity. Yet, in the few trading days following announcement I find firms with low-leverage (recent declines in leverage) to significantly out-perform firms with high leverage (recent increases in leverage). Also, firms with low leverage (recent declines in leverage) and future buyback activity, out-perform firms with otherwise similar characteristics and no repurchasing activity by a significant margin. I infer from these results the fact that as time passes, additional information reveals to market actors such that the potential benefits of OMSR are not immediately evident at announcement. The argument that repurchasing shares following announcement serves as valuable information content to market actors, is evident in the case of leverage-firms.

To avoid agency related costs such as excessive spending, firms with high free-cash-flow may benefit from distributing cash to shareholders. Sorting firms according to free-cash-flow shows no direct impact on the initial market reaction. Even during trading days following the event, firms with high free-cash-flow are unable to out-perform peers with relatively low free-cash-flow. Nevertheless, benefits from OMSR in free-cash-flow firms relies on the premise of actually repurchasing shares following the event (i.e., actually disgorging cash). Double sorting firms according to free-cash-flow and actual buyback activity reveals evidence in line with agency theory. Firms with relatively large free-cash-flow and buyback activity out-perform peers with high free-cash-flow and no such repurchasing activity.

Increasing the investment horizon up to 4 years following the event produces output in stark contrast to the empirical literature. On average, firms announcing OMSR-programs are unable to out-perform the benchmark in prolonged periods following the event. The identified under-performance measured over various horizons is robust to a set of methods measuring long-run abnormal performance. Testing the notion of past returns exhibiting predictive power in post-announcement returns generated mixed results. While firms with most severe negative price stocks did out-perform recent ”winners”, it remains that even firms with negative price shocks are unable to out-perform the benchmark. Using a cross-sectional- or buy-and-hold-approach yielded similar evidence.

Since buyback activity unveils gradually over time, therefore conveying important information to the market, I tested the relation between low leverage (change in leverage), free-cash-flow and buy-back activity having a combined effect on long-horizon stock-price performance. The cross-sectional approach finds evidence in line with the predictions pertaining to relative performance amongst event-firms. Long-horizon performance was affected only marginally by factors such as (the change in) leverage-ratio and free-cash-flow, yet the interaction of these factors with actual buyback activity added significantly to stock performance. Nevertheless, leverage- or free-cash-flow-firms remained unable to out-perform the benchmark as a whole. The robustness of evidence pertaining to the interaction effect of (change in) leverage, free-cash-flow and actual repurchases on stock performance endures a change in benchmark methodology.

This paper encounters a number of merits which should be addressed in future research. While this paper focuses on 4 possible motives explaining why firms engage in repurchasing stock, numerous other motives may still apply. Examples of other motives discussed by the financial literature are: takeover defence (Billett and Xue, 2007; Handa and Radhakrishnan, 1991; Dann and DeAngelo, 1988), repurchases as substitute for cash dividend (Bernheim, 1990; Allen et al., 2000) or a tool to transfer wealth from bond- to stock-holders (Maxwell and Stephens, 2003; Nishikawa et al., 2011). Simply because these motives are not considered here, does not imply that they do not play a key-role in management's decision-making.

Reflecting on analytical methods used in this research provides scope for advancements. First, repurchasing activity was defined as a static variable measuring one month repurchasing activity in the announcement month and was held constant throughout the short- and long-run analysis. To adequately measure the impact of repurchase activity on stock-price performance it is crucially important to gather continuous time-series data pertaining this variable. Additionally, matching firms with accounting- and price-data caused necessary losses in observations that could be considered in the analysis. As a consequence, the number of events involved in testing the predictions of distinctive hypotheses varied throughout the analysis. I proceeded the analysis relying on the assumption of event-firm sub-samples carrying identical characteristics as the master. In other words, I relied on the assumption of sub-samples being a reasonable description of all event-firms. In retrospect, I judge this assumption of strong nature. For example, when matching firms with repurchasing data I cannot eliminate with complete certainty the fact that a systematic pattern exists within the data pertaining to firms who do not report actual repurchases (e.g. firms who know in advance that they will repurchase shares in the future may be more inclined to adequately report repurchasing data). Or else, the data gathering process might exhibit systematic shortcomings regarding a particular set of firms, such that the data eventually biases firms with certain reporting styles. For future references I suggest using a consistent set of firms in the analysis.

Secondly, in section 4.3.1 I addressed the uncertainty involved in statistical inference from long-horizon returns. In the analysis however, efforts to decrease potential biases are held to a minimum. More sophisticated methods, e.g., heteroskedasticity adjusted standard error tests and bootstrapping, would significantly enhance statistical validity of future papers. Also, event-study methodology has produced several other methods to measure long-run abnormal performance. Two additional tests mitigate the issues of calendar-time event clustering and the associated cross-correlation problem. Implementing Ibbotson (1975)'s approach, where only one event per calendar month is included in the cross-sectional regressions, solves the issue of event clustering. Fama (1998); Mitchell and Stafford (2000); Peyer and Vermaelen (2009)'s calendar-time portfolio methodology alleviates the issues of coefficient estimates not being minimum variance because of the heteroskedastic distribution of returns.

And lastly, this paper allowed firms to have a maximum of one event per calendar year. I designed this restriction as a response to the notion of frequent repurchases presumably not conveying the same type of information as infrequent ones. Restricting firms to have a maximum amount of 1 observation per calendar year eventually lead to a loss of an important feature in firms announcing share repurchases, which is the frequency of these events. The financial literature has shown the frequency in which firms announce repurchases to be of great importance in stock-price performance (De Ridder and Råsbrant, 2014; Jagannathan et al., 2000) and should be taken into account in future studies examining stock-price performance.

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A Appendix

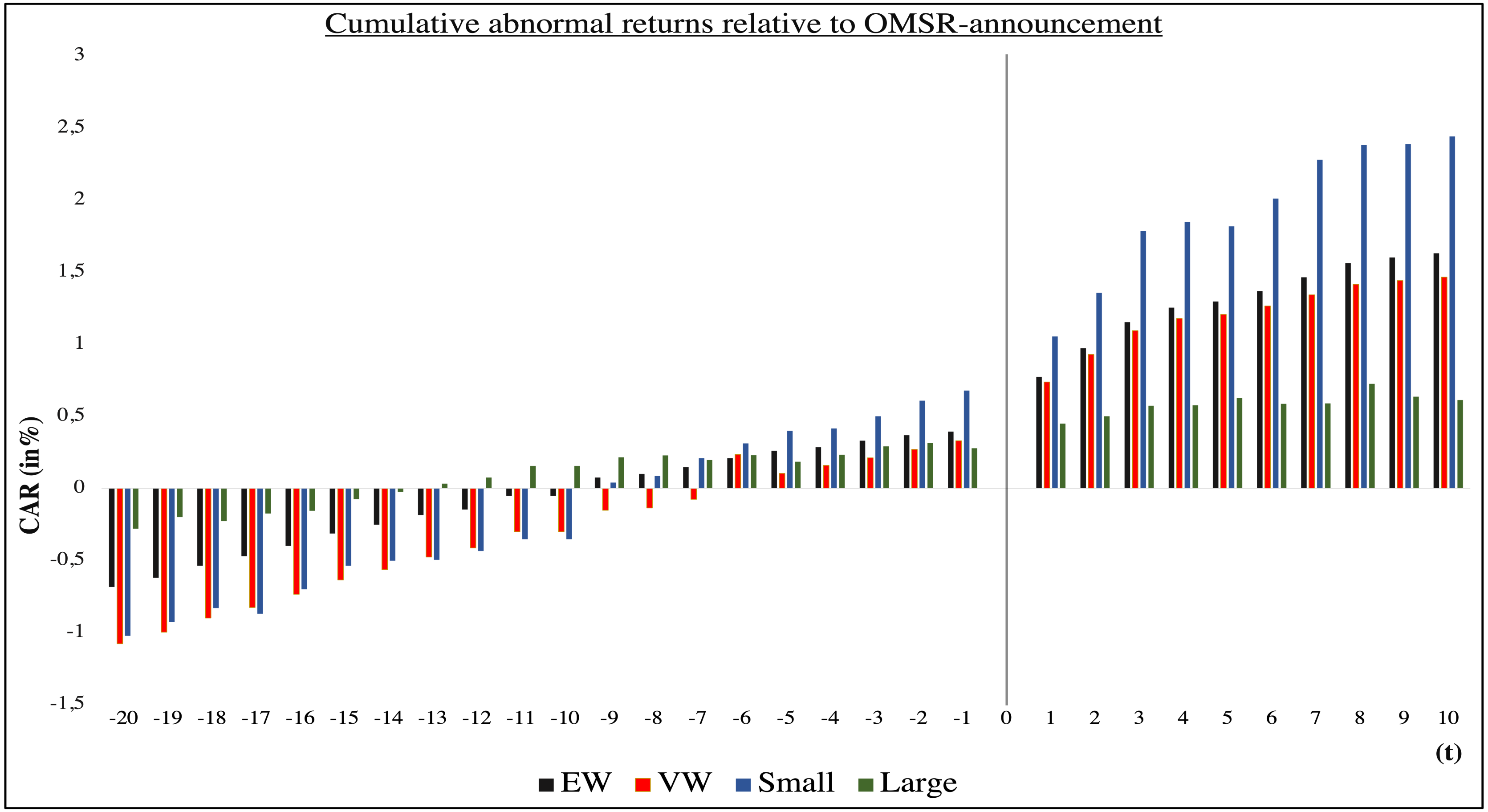

Figure 1: Testing the predictions of TSH. The figure plots cumulative abnormal returns for firms announcing open-market share-repurchases. The figure displays CAR achieved for all firms in the sample using (1) a CRSP-equal-weighted and (2) a CRSP-value-weighted benchmark return.

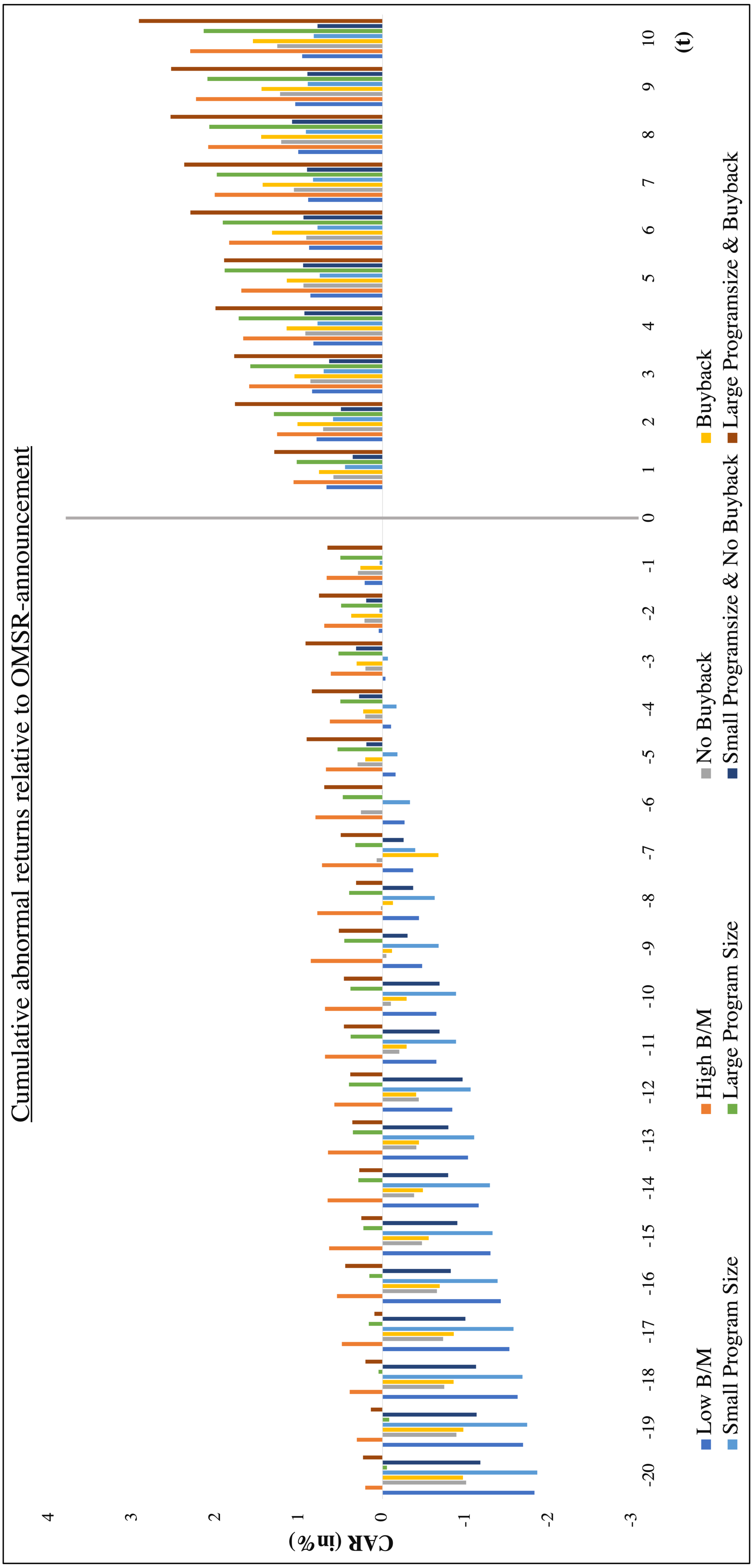

Figure 2: Testing the implications of mispricing. The figure plots cumulative abnormal returns for firms announcing open-market share-repurchases.

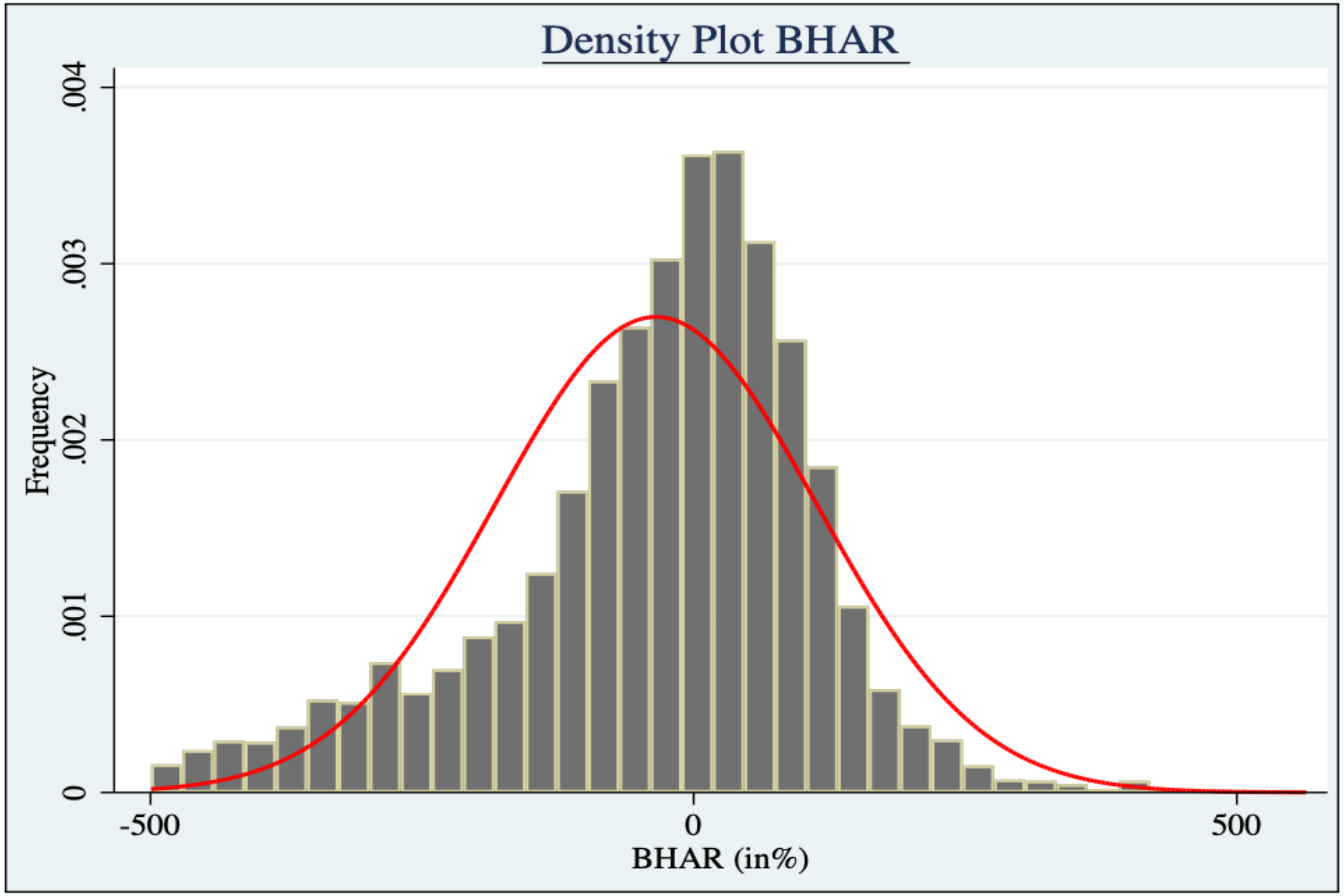

Figure 3: Density plot of abnormal buy-and-hold returns achieved in the 3-years following OMSR-announcements. The red line indicates a normal density plot.