ERASMUS UNIVERSITY ROTTERDAM
ERASMUS SCHOOL OF ECONOMICS
MSc Economics and Business
Master specialisation Financial Economics

The price impact of share repurchases and the managerial timing ability on the Hong Kong Stock Exchange

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Date: 05-03-2017

Abstract: This thesis examines the price impact and the management's ability to repurchase shares at a discount for repurchases on the Hong Kong Stock Exchange between 2004 and 2012. Evidence is found for information signalling and return reversal on the short-term. For the long horizon no evidence is found for the buyback anomaly. Value stocks outperform glamour stocks on the long-term. When analysing the repurchase price relative to the average market price, a discount of 1.685% is observed, which can be explained partly by abnormal returns, prior and following the repurchase, book-to-market ratio and repurchase size relative to trading volume.

Keywords: Share repurchases, cumulative abnormal returns, calendar-time method, relative repurchase price, discount, Hong Kong Stock Exchange

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Acknowledgements

First, I want to thank dr. S Obernberger for being my thesis supervisor even though I took some time off to take an internship. It was always pleasant to work with dr. Obernberger, due to his timely replies whenever I had questions. Second, I want to show my gratitude to the Erasmus Data Service Center for giving the students the option to use Datastream. The research done in this thesis would have been impossible to perform without this database.

1. Introduction

In the last few decades the focus on rewarding stockholders by paying dividends shifted to share repurchases. Share repurchases gained traction since the 1980's and are a common corporate event nowadays. The increase in popularity sparked the interest of academics and a new research field arises. In this thesis I research the price performance following a share repurchase, in the short and long horizon. Furthermore, I analyse whether or not management is able to buy back shares at a discount compared to the average market price.

Exercising a buyback is a method for a firm's management to distribute excess cash to the shareholder. The selling shareholders end up with more cash and fewer shares and the holding shareholders end up with a bigger fraction of the outstanding shares. The underlying value of the company does not change, because this mainly depends on the future cash flows and their riskiness. Therefore, theoretically no market reaction is expected following the repurchase of stocks according to the efficient market hypothesis.

However, studies have shown a positive price reaction on both the short-term and long-term (e.g. Vermaelen, 1981; Ikenberry, Lakonishok and Vermaelen, 1995; Zhang, 2005; Peyer and Vermaelen, 2009). These findings are explained by several hypotheses, information signalling hypothesis, agency theory, capital restructuring and dividend substitution. The information signalling hypothesis is the most popular, and will be researched throughout this thesis. This hypothesis is built on the assumption that a firm's management is able to signal undervaluation, due to the information asymmetry between the firm and the market.

Furthermore, researchers studied whether management is able to time repurchases based on the management's private information. If management does possess superior information, it is plausible to think that they are able to time the market when exercising the repurchase. Studies have shown that firms are able to repurchase shares at a discount compared to the average market price (e.g. Ben-Rephael, Oded and Wohl, 2014; Obernberger, 2014).

This thesis focusses on repurchase transactions on the Hong Kong Stock Exchange. The majority of stock markets require firms to announce repurchase programs, however the firms are not obliged to commit and fully exercise the announced buyback program. Firms on the Hong Kong Stock Exchange are not required to announce their programs, but are obliged to inform the exchange the

following day prior to the opening of the market. This regulation allows for researchers to analyse the actual exercised repurchases opposed to the announcements that potentially will not get exercised fully.

Throughout this thesis the focus lies on three distinct concepts regarding share repurchases. First, the price performance is analysed for the short and the long horizon. Existing literature has shown that the share repurchases are followed by abnormal returns on the short-term. However, when abnormal returns maintain to exist on the long-term, it is called the buyback anomaly. Zhang (2005) analyses the price performance of share repurchases on the Hong Kong Stock Exchange between September 1993 and August 1997. The author does find strong price performance on the short-term, however no long-term abnormal returns are observed. Peyer and Vermaelen (2009) do find significantly positive long-term returns for their US sample. Thus, the first objective of thesis is to analyse the price impact of a share repurchase and to examine which hypotheses and factors are able to explain the observed abnormal returns, either on the short-term or the long-term.

Are share repurchases followed by abnormal returns on the short-term and/or the long-term?

The second concept of interest throughout this thesis is the signalling of undervaluation. Management can choose to repurchase shares to signal undervaluation to the market, due to the information asymmetry. Small firms are covered less by analysts, thus are more likely to be mispriced. Firms with a high book-to-market ratio are more often undervalued, due to the low market value of equity compared to the book value of equity. Moreover, management of firms with poor past performance might judge their stock as undervalued due to an overreaction by the market. Management of firms that meet one of the before mentioned criteria have the option to buy back stock and signal inside information regarding the stock its value to the market. Zhang (2005) finds evidence for information signalling on the short-term regarding size and book-to-market. Moreover, Peyer and Vermaelen (2009) find long-term evidence for mispricing with regard to size, book-to-market and past returns. It is expected that firms that have a low market capitalization, high book-to-market ratio or poor past performance are able to realise abnormal returns following a repurchase.

Are managers able to use a share repurchase as an information signal?

The third and last objective is to whether management is able to repurchase shares at a discount compared to the average market price. A firm's management is expected to possess superior information compared to the market participators, due to the existence of an information asymmetry between the management and the investors. Existing literature (e.g. Obernberger, 2014; Ben-Rephael, Oded and Wohl, 2014) has shown that management is able to buy back shares at a discount. Therefore, I am interested to examine this sample of share repurchases on the Hong Kong Stock Exchange for the discount.

Is management able to repurchase shares at a discount compared to the average market price?

The dataset used for the analysis on the abnormal returns throughout this sample consists of 1,542 daily open market repurchases on the Hong Kong Stock Exchange. The 297 sample-firms buy back shares from February 2004 to April 2012. However, a different sample is used to analyse the repurchase price relative to the average market price, also called the Discount. The sample used for the analysis regarding the managerial timing consists of 15,528 buybacks by 372 firms. The 372 sample firms repurchase from September 2004 to July 2015.

The papers of Zhang (2005) and Peyer and Vermaelen (2009) serve as a red line throughout this thesis, regarding the performed price performance analyses. Abnormal returns are observed in the month following the share repurchase. I find evidence on the short horizon for the information signalling hypothesis with regard to size, book-to-market and past returns. Firms in the smallest firm quintile realise a cumulative abnormal return (CAR) of 4.269% significant at the 1% confidence level in the month following the repurchase, whereas large firms do not realise significant CAR. Furthermore, high book-to-market firm return a 2.022% CAR significant at the 1% confidence level and low book-to-market do not realise a significant CAR. Supporting evidence is found for a return reversal while analysing the short horizon. Firms with the lowest past returns have a CAR of 3.415% with a *p*-value of 0.001, in contrast with the firms with the highest past returns with a -1.600% CAR and a *p*-value 0.048. Moreover, the short-term CARs are examined in the cross section. A set of variables is used to explain the nature of the CARs found for the two post event windows. I find that a firm's size, past returns and trading volume explain the realised CAR for month following the repurchase.

When analysing the price performance on the long horizon no positive abnormal returns are observed, and therefore no support for the buyback anomaly. However, when I study the book-to-

market quintiles I find evidence for information signalling. The majority of the long-term results across the book-to-market quintiles are significant, except quintile 5 with value stocks. Moreover, the first quintile with glamour stocks returns a 48 months average abnormal return of -0.799%, significant at the 1% confidence level. Whereas, book-to-market quintile 4 returns -0.488% average abnormal return with a *p*-value of 0.021. There is a consistent pattern across the book-to-market quintiles for all long-term event windows. Namely, the higher the book-to-market ratio, the higher the monthly average abnormal returns. Therefore, evidence is found of high book-to-market firms outperforming low book-to-market firms. Contrarily, no evidence of outperformance across for small or beaten up firms is found, when analysing the long-term price performance regarding size and past returns.

Ben-Rephael, Oded and Wohl (2014) and Obernberger (2014) among others, research whether or not management is able to repurchase shares below the average market price. Obernberger (2014) finds a Bargain of 0.56% and Ben-Rephael, Oded and Wohl (2014) report a Diff of -0.27%. The papers of Obernberger (2014) and Ben-Rephael, Oded and Wohl (2014) are used as benchmark for the analyses of the Discount variable in this thesis.

The last analysis performed in this thesis is on the repurchase price relative to the average market price. I find that for the used sample managers have been able to repurchase shares at a discount of 1.685% significant at the confidence level of 1%. Furthermore, the cross section is examined regarding the realised discount. The abnormal returns prior and following the repurchase, book-to-market ratio and repurchase size relative to trading volume explain the observed discount that management is able to realise.

The remainder of this paper is build up as follows: Section 2 discusses the theoretical framework regarding share repurchases and gives an overview of the existing literature. Furthermore a collection of hypotheses is drawn up to help and answer the research questions drawn up in the introduction. Section 3 explains the data collection, manipulating of the data and presents descriptive statistics. Section 4 presents the methodology used for the various analyses throughout the thesis. Section 5 reports the results regarding the analyses performed in this thesis and answers the hypotheses that are drawn up in Section 2. Section 6 summarizes the findings and elaborates on the limitations of this thesis. Moreover, suggestions are given regarding any future research.

2. Theoretical framework

2.1 Background

A share repurchase is a common corporate event where the managers decide to use the excess cash to dilute wealth to the shareholders by buying back an amount of the firm's outstanding equity. A buyback results in a lower amount of outstanding shares and therefore a higher earnings-per-share ratio. For repurchases done on the Hong Kong Stock Exchange, the repurchased shares must be cancelled on completion of the repurchase program. A repurchase program is to be paid with distributable profits or the proceeds of a share issuance. A share repurchase program is preferred to a dividend pay-out method, because of its flexible nature (Grullon & Michealy, 2004).

When dividend is paid a direct tax effect arises due to the dividend tax. However, with share repurchases such a direct tax effect is absent. A buyback reduces the amount of outstanding shares and therefore is expected to cause an increase of the stock price, because of the basic economic concept of supply and demand. The tax effect arises only when the shareholder chooses to sell the owned shares (i.e. tax on capital gains). Contrary to a dividend program, share repurchases are not required to be done on a regular basis, which provides more flexibility to the management of the firms (Dittmar, 2000).

After management decides that a repurchase program is the best method of paying out cash, some options arise. There are multiple types of repurchase programs, from which managers can choose to pay the shareholders of the firm. Four forms of repurchasing shares are an on-market repurchase, off-market repurchase and repurchase by general offer.

2.2 Methods of repurchasing in Hong Kong

As described in the document *The Codes on Takeovers and Mergers and Share Repurchases* of the Securities and Futures Commission (SFC)[1] there are three allowed methods of executing a

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[1] *The Codes on Takeovers and Mergers and Share Repurchases*
http://www.sfc.hk/web/EN/assets/components/codes/files-previous/web/codes/the-codes-on-takeovers-and-mergers-and-share-buy-backs/The%20Codes%20on%20Takeovers%20and%20Mergers%20and%20Share%20Buy-backs%20-%202010-06-25%2000:00:00.pdf

repurchase program by a company listed on the Hong Kong Stock Exchange: (1) an on-market share repurchase, (2) an off-market share repurchase and (3) a share repurchase by general offer.

2.2.1 On-market share repurchase

An on-market share repurchase is a repurchase method where a firm does a buyback of stock on the stock market. The firm executes the repurchase anonymously through a broker. The repurchase is paid in cash and this amount is equal to the sum of the market price for the amount of share bought, the brokerage fee and the commission. This method offers some flexibility, because management is able to choose the moment of repurchasing and the size of the buyback. This approach of buying back shares is comparable to the open market repurchase in the United States. An on-market share repurchase is the most common method for repurchasing shares and makes up for 98% of all repurchases done on the Hong Kong Stock Exchange (Firth & Yeung, 2005).

2.2.2 Share repurchase by general offer

Shares can also be bought back by a method called share repurchase by general offer, which is comparable with a fixed-price tender offer in the United States. The firm makes an announcement of the size of the repurchase program, the class of the security it seeks, the price the firm is willing to pay per share and the end date of the offer. The shares that the firm seeks to repurchase will not be bought on the exchange, but directly from the shareholders. The offer price is often higher than the market price, so the shareholders receive a premium for the shares they submit. The shareholders can tender an amount of their shares for a price offered by the firm. Often, the company has the flexibility to change the end date for when an insufficient amount of shares is tendered by the shareholders. If the amount of shares tendered by the shareholders is greater than the amount that the firm wishes to repurchase, then the firm often buys the shares pro-rata from the shareholders. If the tendered amount is lower than the sought after amount, then the firm is not able to cancel the initial offer and is obliged to buy the tendered shares, contrary to firms in the United States which do have the possibility to cancel the offer. This method is often used to repurchase large portion of shares from unidentified shareholders to strengthen the controlling position of the firm.

2.2.3 Off-market share repurchase

A different method of repurchasing shares is the off-market share buyback. This method is used when the goal of management is to strengthen their position and take away controlling power from

one or more shareholders. When executing an off-market repurchase a price, generally higher than the market price, is negotiated with the identified shareholders. The shares will be bought directly from the selected shareholders at the specified price.

2.3 Hong Kong disclosure requirements

Share buybacks are permitted on the Hong Kong Stock Exchange by the Companies Ordinance 1991. The management of a firm needs approval from the board at its annual meeting, by securing the majority of the votes, to initiate a share repurchase program for the following 12 months. The firm is obliged to report this approval to the exchange and the Securities and Futures Commission, a supervisory body in Hong Kong. A renewal is needed after the 12 months when the approval is expired

There are some limitations to an on-market share buyback program as described in The Codes on Takeovers and Mergers and Share Repurchases. The volume per year of the buyback program may not exceed 10% of the shares that exist at the date of the board's annual meeting. The buyback per month must be less than 25% of the trading volume of the previous month. The limit of an on-market buyback is reached when 25% of the firm's shares are owned by the public. The firm is prohibited to buy back any shares in the month prior to an earnings announcement to impede the management's timing ability. Rule 10.06 (4)(a) of the Hong Kong Stock Exchange Listing Rules says that the firm is obliged to report the repurchase to the exchange before 9:30 am the day after the actual repurchase. The exchange will then make this information public before the opening of the market at 10:00 am. The shares that are bought back by the firm are automatically cancelled after the buyback, thus are not held as treasury stock. The firm is prohibited to repurchase shares from a connected person. Furthermore, the firm is not allowed to buy back shares during a period when information, that is expected to have an impact on the share price, has not been made public yet. Moreover, firms cannot repurchase stock during the month preceding the release of a performance report (e.g. annual earnings report).

Firms in Hong Kong do not need to announce a repurchase program in contrast to US firms. However, Hong Kong firms are obliged to disclose their repurchasing activity on the daily basis, which is not the case for US firms. For this reason, Zhang (2005) was able to use the dates of the actual share repurchase, instead of the announcement date used in previous papers.

2.4 Price behaviour

The main purpose of this thesis is to do research on the price behaviour following an on-market share repurchase on the Hong Kong Stock Exchange. Miller and Modigliani (1961) argue that, under the assumption of perfect capital markets, the pay-out policy of a firm does not have an effect on the value of the firm. However, the assumptions of perfect capital markets do not hold in reality.

2.4.1 Short-term price performance

The efficient market hypothesis states that all public information is incorporated in the market price. This theory implies that the repurchase announcement will be processed by the market and that the asset prices will adjust instantaneously. When information is not directly incorporated into the price of an asset it violates the efficient market hypothesis. Empirical evidence shows that a positive drift is found for the stock prices following a share buyback.

Several papers show a positive return around the repurchase announcement or actual repurchase day. Vermaelen (1981) find in their research on repurchase announcements a 3.67% CAR significant at a 1% confidence level for repurchase announcements in the United States from 1970 to 1978. Ray and Vermaelen (2002) show that for repurchases announced between 1985 and 1998 in the United Kingdom result in an average CAR of 1.08% again significant at the 1% confidence level. Zhang (2005) studies the actual repurchased shares and finds a significant CAR of 0.43% for shares repurchased on the Hong Kong Stock Exchange. Buybacks in Norway between 1998 and 2001 return a CAR of 0.88% significant at a confidence level of 1% (Skjeltorp, 2004).

2.4.2 Long-term price performance

The stock price should theoretically adjust to the newly released information on the short-term and reflect the new fair value of the stock. It is interesting to see whether the repurchase signal is fully incorporated in the share price around the announcement by analysing the price performance for the long horizon. Fama (1998) argued that the long-term return anomalies are sensitive to the methodology used when analysing. However, the empirical findings for the long term are robust for several expected return benchmarks. A clear consensus regarding estimation of long-term abnormal returns is still absent. The existence of long-run drifts tells us that there is an under reaction to a share repurchase on the short horizon. The ability of managers to to realise significant returns on the long-run by using a certain investment strategy is called the buyback anomaly.

Researching the price reaction over an event window of four years following the announcement the papers of Ikenberry, Lakonishok and Vermaelen (1995) and Peyer and Vermaelen (2005) show CARs of 12.14% and 24.25% respectively. Repurchase announcements in Canada return a significant CAR of 21.40% over three years. These findings confirm the existence of the buyback anomaly for the samples used. However, studying the long-term price performance of actual share repurchases on the Hong Kong Stock Exchange, Zhang (2005) finds a -1.10% CAR, however not significant. Therefore, finds no evidence of the existence of the buyback anomaly.

2.4.3 Persistence of the buyback anomaly

Fu and Huang (2016) state in their research on price performance following repurchases and seasoned equity offerings that they find long run abnormal returns for the dataset until 2002, but that these abnormal returns disappear thereafter. They argue that this disappearance is a result of the stock market becoming more efficient. Technology has become more advanced and trading costs decreased over time. This could be the case regarding share repurchase activity, as well. Besides, empirical evidence shows that institutional ownership and trading activity has risen and when institutional ownership and trading increases price efficiency increases as well (Boehmer & Kelley, 2009).

2.4.4 Return reversal

Return reversal is a phenomenon that is researched extensively in existing literature. Shiller (1984), Stiglitz (1989) and Subrahmanyam (2005), among others argue that the return reversal is due to an initial overreaction of the market to new information and that this overreaction will revert.

Lakonishok, Schleifer and Vishny (1994) show in their research that the market overreacts to past growth. A reversal is observed, because the market's overreaction is not sustainable. Earnings-to-price, cash flow-to-price and book-to-market ratios are used as a proxy for performance. These ratios tend to be high for firms with poor past price performance and vice versa. The firms with high ratios experience high future returns and the firms with low ratios experience low future returns, due to the earnings growth mean reversal.

Ikenberry, Lakonishok and Vermaelen (2000) argue that firms that experienced poor stock price performance prior to a repurchase are more inclined to signal undervaluation through a share repurchase. Prior returns are the best proxy for long-term performance according to the overreaction hypothesis in the paper of Peyer and Vermaelen (2009). When a stock performed

poorly and the firm chooses to do a repurchase, this can be seen as a signal that management believes their firm's stock is undervalued by the market. They find evidence that repurchasing firms in the lowest prior returns quintile experience the highest long-term returns.

2.4.5 Managerial timing

A firm intends to complete a share repurchase program at the lowest cost possible. Therefore, more shares are bought after a period where the stock performs poorly and the amount of sell transactions increases after periods of higher returns.

Several studies have shown that management is able to time the market when exercising share repurchases. Peyer and Vermaelen (2005) come up with the U-index that serves as a proxy for undervaluation. Size, book-to-market and prior returns are known factors that can influence the mispricing of a stock. However, they also include the management's stated motivation in their U-index, where firms that state that the reason for the repurchase is because of "undervaluation" or "best use of money" receive a high U-index score of 5. The results in their paper show that repurchasing firms with a high U-index perform stronger than those with a low U-index in the long run. This result implies that the private information that management releases to the public has value with respect to the value of the firm's stock. Therefore, management should be able to anticipate future stock performance.

Jagannathan, Stephens and Weisbach (2000) show that buybacks are driven by decreasing share prices. Dittmar and Field (2015) show in their research on open market stock repurchases in the US between 2004 and 2011 that managers are able to time the market. The average reported monthly repurchase price is compared to the average daily closing price of the same stock for different time periods prior and following the share repurchase. They find evidence that managers are able to buy back stock significantly lower than the average market price for the various time windows. Obernberger (2014) shows that managers are not able to time the market ex-ante, however empirical results show that managers are able to repurchase stock below the average market price.

Obernberger (2014) studies managerial timing by researching the Bargain variable he came up with, which reflects the relative difference between the monthly repurchase price and the monthly average market price. The author argues that when management is able to time repurchases, this causes to generate two hypotheses, the market-timing hypothesis and the contrarian-trading

hypothesis. The market-timing hypothesis focusses on the stock's performance following the repurchase, where the contrarian trading hypothesis focusses on the increased repurchase activity following a price decrease. The paper shows that the firms are able to repurchase shares at a discount when compared to the monthly average market price. The subsequent abnormal returns (AR+) are positively correlated with the Bargain variable, however the CAR(+1, +6) coefficient shows to be significantly negative.

Ben-Rephael, Oded and Wohl (2014) also research management's ability of timing the market by comparing the monthly repurchase price to the monthly average stock price. The discount management is able to realise is -0.266%, significant at the 1% confidence level. The found Diff variable is subsequently regressed on a set of variables in order to explain the nature of the discount. Coefficients are significant at a 1% confidence lever for the size, book-to-market, bid-ask spread, repurchase frequency and repurchase intensity variable.

2.5 Information signalling hypothesis

There is an extensive amount of literature that gives an overview of the motives management can have for implementing a repurchase program (e.g., Dittmar, 2000; and Grullon and Ikenberry, 2000). For this thesis the focus will be on the theoretical concept of information signalling and its underlying concepts.

2.5.1 Mispricing

One of the most popular explanations for the positive price performance following a buyback is that a repurchase can be used by management to release inside information to the market. The concept of information signalling is built on the existence of an information asymmetry between the management and the investors.

Signalling theories argue that a release of information should be accompanied by costs, for an information signal to be deemed credible. A share repurchase program is often not fully realized and therefore it should not be judged as a credible information signal. However, Ikenberry and Vermaelen (1996) argue that a share repurchase program gives management the ability to repurchase stock and that this flexibility should be valued. Zhang (2005) states that this valuation should depend on the management's ability to take advantages of the mispricing their actual repurchases. An actual share buyback is paid for with distributable profits or proceeds from a new issuance and can therefore be seen as a credible information signal (Oded, 2005).

A firm's management usually has more information about the future of the firm than outside investors and therefore have incentives to signal private firm information. A firm's pay-out policy can be used to signal future performance. Cash distribution to the shareholders, as in a share buyback, can be used as an information signal. According to the information signalling hypothesis managers use share buybacks to signal the undervaluation of the firm's stock, because management believes that the market price is below the intrinsic value of the share (Vermaelen, 1981). The hypothesis also suggests that managers can use a repurchase program to reveal that the firm's prospects are favourable. Several papers show share price increases in the period of announcing a share repurchase program (e.g. Asquith and Mullins, 1986; Lakonishok and Vermaelen (1990); Ikenberry Lakonishok and Vermaelen, 1995, 2000). These positive price effects are in line with the theory of signalling mispricing, because the market adjusts for the undervaluation of the stock (Vermaelen, 1981).

2.5.2 Book-to-market premium

The ratio of book value of equity to market value of equity is used to test whether undervaluation can explain the abnormal returns. It is expected that firms with high book-to-market ratios, also called value stocks, experience larger abnormal returns than firms with low book-to-market ratios, also called glamour stocks.

Zhang (2005) reports a CAR of 1.90% for value stocks in contrast of a -2.78% CAR for glamour stocks for the month after the repurchase, both significant at the 5% confidence level. Ikenberry, Lakonishok and Vermaelen (1995) find a CAR if 3.36% for glamour stocks and a CAR 3.56% for value stocks. Ikenberry, Lakonishok and Vermaelen (1995) show in their research that they find a long run abnormal return of 45.29% for value stocks. For firms with a low book-to-market ratio, also called glamour stocks, an insignificant abnormal return is found of -4.31%. Peyer and Vermaelen (2009) find a statistically significant four-year Fama-French IRATS CAR of 28.89% for value stocks in contrast to 14.87% for glamour stocks, which is not statistically significant. Zhang (2005) implements a buy-and-hold strategy and does not find evidence, for the full sample, that supports the concept of superior performance following a share repurchase. However, when the sample is divided in quartiles based on the firm's book-to-market ratio long-term superior performance is found for the value firms. Namely, a buy-and-hold abnormal return of 20.66% for a holding period of three years.

2.5.3 Size premium

Vermaelen (1981) shows that the abnormal returns around the announcement are larger for firms with a lower market capitalization. This is in line with the information asymmetry theory. The information asymmetry is larger for small firms than for large firms, because of the lack of institutional investors and coverage by media and analysts. He argues that small firms get less coverage by analysts and therefore are more likely to be mispriced. Ikenberry, Lakonishok and Vermaelen (1995) find a CAR difference between the smallest and largest quintile of 6.10% for an event period starting two days before the announcement and ending two days after the announcement. Zhang (2005) argues that a small firm repurchases stock to take advantage of the future increasing performance of the firm, while a price rundown is the reason of a buyback for large firms. More studies find evidence in line with the size effect (e.g. Otchere and Ross, 2002; Zhang, 2002; Firth and Yeung, 2005).

The previously discussed papers use event studies on returns following a repurchase and cross-sectional comparisons of the characteristics of repurchasing firms to find evidence that is in line with the hypotheses. However, there are also studies that use surveys to find the reasoning of management. Several articles show supporting evidence for the signalling and undervaluation hypotheses (e.g. Wansley Lane and Shankar, 1989; Bancel, Bhattacharyya and Mittoo, 2005; Brav, Graham, Harvey and Michaely, 2005; Tsetsekos, Kaufman and Gitman, 2011).

2.6 Literature Review

Prior researches have shown empirical evidence that firms experience an increase in the share price following a share repurchase. Panel A to Panel D show an overview of the prior studies that researched share repurchase programs. The studies in the overview are summarised and categorised in short or long term studies and announcement and actual repurchase studies.

Table 1: Overview of existing literature

An overview of the empirical results from earlier studies regarding the price performance following a share repurchase (announcement), the CARs shown in the table are for the full sample in the paper

Panel A: Short-term price reaction on announcement share repurchase program

Country	Author(s)	Sample period	Obs.	Event window (day)	CAR
US	Vermaelen (1981)	1970-1978	243	(-1, +1)	3.67%***
	Ikenberry, Lakonishok and Vermaelen (1995)	1980-1990	1,239	(-2, +2)	3.54%***
	Stephens and Weisbach (1998)	1981-1990	591	(-1, +1)	2.69%***
	Grullon and Michaely (2004)	1980-1984	4.443	(-1, +1)	2.71%***
	Peyer and Vermaelen (2009)	1991-2001	6,470	(-1, +1)	2.39%***
UK	Rau and Vermaelen (2002)	1985-1998	126	(-2, +2)	1.08%***
Japan	Zhang (2002)	1995-1999	126	(-1, +2)	4.58%***
Korea	Lee, Jung and Thornton (2005)	1994-2000	268	(-1, +1)	1.60%***
France	Ginglinger and L'Her (2006)	1998-1999	363	(0, +1)	0.57%***
Australia	Otchere and Ross (2002)	1991-1999	100	(-2, 2)	4.30%***

Panel B: Long-term price reaction on announcement share repurchase program

Country	Author(s)	Sample period	Obs.	Event window (year)	CAR
US	Ikenberry, Lakonishok and Vermaelen (1995)	1980-1990	1,239	4	12.14%***
	Peyer and Vermaelen (2005)	1991-2001	3,481	4	24.25%***
Canada	Ikenberry, Lakonishok and Vermaelen (2000)	1990-1998	1,060	3	21.40%***

Panel C: Short-term price reaction on actual share repurchases

Country	Author(s)	Sample period	Obs.	Event window (day)	CAR
UK	Rees (1996)	1981-1990	882	(-2, +2)	0.30%***
Norway	Skjeltorp (2004)	1998-2001	318	(-1, +1)	0.88%***
Hong Kong	Zhang (2005)	1993-1997	800	(0, +2)	0.43%***
	Firth and Yeung (2005)	1991-1997	677	(-1, +1)	1.30%***
Australia	Akyol and Foo (2013)	1998-2008	927	(0, +1)	0.43%***

Panel D: Long-term price reaction on actual share repurchases

Country	Author(s)	Sample period	Obs.	Event window (year)	CAR
Hong Kong	Zhang (2005)	1993-1997	800	3	-1.10%

2.7 Hypotheses

2.7.1 Price performance

The price performance following share repurchases will be of great importance for the analyses performed throughout this thesis. Existing literature has shown that repurchases are often followed by significantly positive abnormal returns, both on the short and the long horizon. The realised returns on the short-term are caused by the market that recognizes the value of the information signal that gets released by the buyback. The stock price reflects the fair value on the short-term and therefore, no long-term abnormal returns should be observed. However, this is not the case when looking at previous studies. The abnormal return realised on the long horizon is called the buyback anomaly.

Research on actual exercised repurchases is limited due to the regulations of the majority of exchanges that do not demand managers to commit to a buyback program. This thesis, therefore focusses on the actual repurchases on the Hong Kong Stock Exchange. First, I examine the price performance on the short-term. Second, I study the long-term price performance to analyse whether the buyback anomaly exists for share repurchases. In case the anomaly still exists I expect abnormal long-term returns following a share repurchase. The following two hypotheses are drawn up to examine the price performance on the short horizon and the existence of the buyback anomaly on the long horizon:

H1.1 Firms that repurchase shares are followed by significant positive abnormal returns on the short-term

H1.2 Firms that repurchase shares are followed by significant positive abnormal returns on the long-term

2.7.2 Book-to-market premium

When firms decide to buy back shares they signal information that management believes that the firm's shares are undervalued. This information signalling is based on an information asymmetry between the managers of the firm and the investors. Share repurchases can be used by managers to signal information about the fact that the stock is mispriced. The book-to-market ratio is often used in research as a proxy for undervaluation. Undervaluation is particularly present for out-of-favour stocks, which most of the time have a high book-to-market value. When a firm has a high book-to-market value, it has a high book value of equity relative to the market value of the firm's

equity. Expectation is that the market will respond more positively to share repurchases done by firms with a high book-to-market value, as shown in various studies. The following two hypotheses are drawn up on the basis of the before mentioned theory:

H2.1 Share repurchases done by high book-to-market firms experience higher abnormal returns on the short-term than low book-to-market firms

H2.2 Share repurchases done by high book-to-market firms experience higher abnormal returns on the long-term than low book-to-market firms

Subsequently, the cross section is analysed to examine the nature of the observed CARs. I expect that the book-to-market variable is able to significantly explain part of the found CARs. Therefore, to test this the following hypothesis is drawn up:

H2.3 The book-to-market factor is positively correlated with the short-term abnormal returns

2.7.3 Size premium

As discussed previously in Section 2.5.3 smaller firms are more likely to be mispriced, due to experiencing less coverage by the press and analysts. The market capitalisation of a firm will be used as a firm's size and a proxy for mispricing. Due to the higher probability of mispricing smaller firms should receive a more positive reaction from the market than the larger firms. On the basis of this theory the following two hypotheses are drawn up:

H3.1 Share repurchases done by small firms experience higher short-term abnormal returns than large firms

H3.2 Share repurchases done by small firms experience higher long-term abnormal returns than large firms

Subsequently, the cross section is analysed to examine the nature of the CARs. I expect that the size variable is able to partly explain the found CARs. Therefore, to test this the following hypothesis is drawn up:

H3.3 The size factor is negatively correlated with the short-term abnormal returns

2.7.4 Return reversal

Return reversal shows that the past losers become winners in the future and vice versa. This is argued due to the overreaction of the market to the initial release of information. When a stock has performed poorly it is more likely to be undervalued. Therefore, prior returns are used to proxy undervaluation. It is expected that undervaluation is followed by a more positive market reaction. The following hypotheses are drawn up based on the overreaction hypothesis from the paper of Peyer and Vermaelen (2009):

> *H4.1 Share repurchases done by firms with low past returns experience higher short-term abnormal returns than firms with high past returns*
>
> *H4.2 Share repurchases done by firms with low past returns experience higher long-term abnormal returns than firms with high past returns*

Subsequently, the cross section is analysed to examine the nature of the abnormal returns. I expect that the past returns are able to partly explain the observed abnormal. Therefore, to test this the following hypothesis is drawn up:

> *H4.3 The past returns factor is negatively correlated with the short-term abnormal returns*

2.7.5 Managerial timing

Obernberger (2014), among others, argues that management possesses private information regarding the performance of a firm and are able to predict the firm's stock performance based on this information. Therefore, management should be able to time share repurchases and acquire shares at a discount compared to the average market price. In this thesis a Discount variable is used to examine whether there exists a difference between the repurchase price and the average monthly market price. Ben-Rephael, Oded and Wohl (2014) and Obernberger (2014) find that management is able to repurchase shares at a low price relative to the average market price. The following hypothesis are drawn up on the basis of Obernberger (2014) and Ben-Rephael, Oded and Wohl (2014):

> *H5.1 Management is able to repurchase shares at a discount compared to the average market price*

It is expected that a discount is realised due to a stock price decrease prior to a share repurchase. Therefore, a variable for the abnormal returns prior to the buyback of stock is used to explain the realised discount. The following hypothesis is drawn up based on this assumption:

H5.2 The abnormal returns prior to the repurchase are negatively correlated with the discount realised by the management

Obernberger (2014) predicted in his market-timing hypothesis that the covariance between the Bargain variable and subsequent returns is larger than zero, due to the positive autocorrelation of returns. In contrast to his prediction the bargain management realises is correlated negatively with the subsequent abnormal returns. The following hypothesis is drawn up, to examine the relation between the Discount and the subsequent returns:

H5.3 The abnormal returns following the repurchase are positively correlated with the discount realised by the management

Following Ben-Rephael, Oded and Wohl (2014) some additional variables are used that can proxy the mispricing of a stock. As discussed before, small firms are less scrutinized and therefore more likely to be undervalued. Furthermore, firms with a high book-to-market ratio are also more likely to be undervalued, as said earlier. It is expected that the bargain will be higher for small firms and for firms with a high book-to-market ratio. The following hypotheses are drawn up based on the undervaluation through size and book-to-market:

H5.4 The size factor is negatively correlated with the discount realised by the management

H5.5 The size factor is positively correlated with the discount realised by the management

3. Data

3.1 Data collection

This thesis focuses on the research on actual open market share repurchase in Hong Kong. Studying actual repurchases in Hong Kong is feasible, due to the legislation and disclosing requirements in Hong Kong.

To do research on share repurchases data is obtained from several databases. Time series data of all firms trading on the Hong Kong Stock Exchange (e.g. prices, total returns, book-to-market values, market capitalisation, trading volume) is obtained from Datastream and Worldscope. Share repurchase data (e.g. trading date, average repurchase price, volume of repurchase) is obtained from the disclosures on the Hong Kong Stock Exchange. The Hang Seng total return index is obtained from Datastream, which will be used for estimation of the market model parameters. To conduct the calendar-time method monthly Fama-French factors for Hong Kong are obtained from Andrea Frazzini's data library of AQR Capital Management[2].

In this thesis, the shares repurchased through the Hong Kong Stock Exchange from February 2004 to April 2012 were examined. The buybacks in the sample are open market repurchases of ordinary shares.

3.2 Data manipulation

The initial sample consists of 19,605 repurchases done by 473 firms from 31 December 2002 to 30 December 2015. However, repurchases are discarded from the sample when required data like market capitalisation, book-to-market ratio, stock price, total stock return and total market return is missing. Repurchases are trimmed from the sample when the stock price of a repurchasing firm is below the 1st percentile to correct for extreme returns. Moreover, the repurchases in the sample are required to have stock price information for the estimation and event windows used in the analysis. For the short-term analysis at least 270 days of stock price data prior to the event and 20 days after the event is required to calculate abnormal returns. For the long-term analysis at least 48 months of stock price data following the event month is required to calculate the abnormal

[2] Fama and French factors are obtained from the AQR Capital Management data library to conduct the calendar-time method - https://www.aqr.com/library/data-sets/quality-minus-junk-factors-monthly

returns using the calendar-time method. This results in the exclusion of repurchases before 31 December 2003 and after 30 April 2012.

Following Zhang (2005) the first repurchase per firm will be used as the event day and the second event day is at least 30 days later. The sample is adjusted for confounding events without losing all the subsequent repurchases by doing this. Doing this results in shrinking the sample from 19,605 to 1,889 repurchases. Moreover, the sample is adjusted as said for missing data, causing the sample to shrink by 347 repurchases. The final sample for the price performance analysis consists of 1,542 repurchases from February 2004 to 31 December 2012. There are 23,997 unique firm-months for 297 repurchasing firms.

A different sample is used for the analysis of the Discount variable, due to the different requirements for this analysis compared to the analysis of abnormal returns. The main difference is the sample selection, as before mentioned following Zhang (2005), is that firms are not limited to one repurchase per month. Therefore, the amount of repurchases in this sample exceeds the price performance sample significantly. Moreover, the sample requires shorter event windows, because there no long-term performance is estimated. However, the sample is still adjusted for missing stock data. The final sample used in the Discount analysis consists of 372 firms exercising 15,528 repurchases.

Quintiles are formed based on book-to-market ratio, market capitalisation and prior 6-month raw log returns to examine the hypotheses regarding the short-term and long-term abnormal returns. The thresholds of the quintiles are calculated using stock price information of all trading firms at the event days.

STATA is used to match the repurchase data with the stock data, the market data and the Fama-French factors. Thereafter, all data manipulations and analyses are performed in STATA.

3.3 Descriptive statistics

Table 2, Panel A shows the initial sample with repurchases before the data manipulation process started. The initial sample consisted of 19,605 repurchase days exercised by 473 firms. Panel B reports the samples used in the analyses of the abnormal returns following the share repurchases and the discount realised at the repurchase. After correcting for the availability of cross-sectional and stock price data for the event windows.

Table 2: Sample descriptives

This table gives an overview of the initial sample of repurchases and the used sample after adjusting for missing data. Panel A reports descriptives of the initial sample and Panel B reports the sample used for the abnormal returns and Discount analyses.

Panel A - Initial sample	
Number of firms	473
Number of daily repurchases	19,605
Total number of shares repurchased	33,847,902,208
Total dollar value repurchased	HKD 101,898,985,472
Number of firms with 1 repurchase day	27
Number of firms with 2-5 repurchase days	82
Number of firms with 6-10 repurchase days	70
Number of firms with 11-15 repurchase days	53
Number of firms with 16-20 repurchase days	34
Number of firms with over 20 repurchase days	207
Average repurchase days per firm	41

Panel B - After eliminations for missing data	*Abnormal returns*	*Discount*
Number of firms	297	372
Number of repurchases	1542	15,528
Total number of shares repurchased	2,724,314,624	25,158,084,608
Total dollar value repurchased	HKD 8,595,851,264	HKD 79,768,199,168
Number of firms with 1 repurchase day	76	25
Number of firms with 2-5 repurchase days	143	65
Number of firms with 6-10 repurchase days	41	59
Number of firms with 11-15 repurchase days	13	38
Number of firms with 16-20 repurchase days	7	25
Number of firms with over 20 repurchase days	17	160
Average repurchase days per firm	5.19	41.74

Table 3 reports the statistics regarding the variables used in the analyses throughout this thesis. The table presents the amount of observation, the mean, the 25^{th}, 50^{th} and 75^{th} percentile, the minimum and the maximum.

Table 3: Descriptive statistics

This table gives an overview of the descriptive statistics of the variables used in the various analyses. The repurchase price is denoted in Hong Kong Dollars. The Book-to-market, Prior 6-month and Size quintiles are categorical variables that can only be assigned a value of 1, 2, 3, 4 or 5. The thresholds for the quintiles are based on the data for all firms listed on the exchange for all repurchase days in the sample. Log return – daily is the log return between day *t* and *t-1* in % using the total return of a stock, winsorized at the 1st and 99th percentile. Log market return – daily is the log return in % between day *t* and *t-1* using the total return of the Hang Seng index, winsorized at the 1st and 99th percentile. The abnormal return – daily is the difference between the predicted return using the market model and the actual return in %. The CARs are the sum of the abnormal returns for the different time windows. Ln(Size) is the natural logarithm of the market capitalization of a firm on the repurchase day. BM is the ratio of the book value per share divided by the stock price on the repurchase day. Prior6m is the raw log return of the stock its total return between 6 months to 1 month prior to the repurchase day. RepSize is the ratio of the number of shares repurchased relative to the shares outstanding at the moment of the signed resolution at the beginning of the year. RepVolume is the ratio of number of shares repurchased relative to the total trading volume on the repurchase day. The discount is the relative difference between the repurchase price and the average market price during the repurchase month. CAR(-6, -1) and CAR(+1, +6) are the cumulative abnormal returns from 6 to 1 months prior to the repurchase month and from 1 to 6 months following the repurchase month.

	Obs.	Mean	25th	50th	75th	Min	Max
Abnormal return							
Repurchase price	1,542	5.190	0.700	1.735	4.850	0.095	188.378
Book-to-market quintile	1,542	3.515	3.000	4.000	5.000	1.000	5.000
Prior 6-month quintile	1,542	3.104	2.000	3.000	4.000	1.000	5.000
Size quintile	1,542	3.598	3.000	4.000	5.000	1.000	5.000
Short-term							
Log return	63,222	-0.130	-1.381	0.000	1.063	-8.191	9.531
Log market return	63,222	-0.090	-0.988	0.000	0.944	-4.364	3.828
Abnormal return	63,222	-0.042	-1.251	-0.032	1.040	-12.829	14.862
CAR(0, +2) and CAR(0, +20) cross-section							
CAR(-20, -1)	1,542	-2.973	-9.352	-2.334	3.361	-60.120	60.920
CAR(0, +2)	1,542	0.539	-2.279	0.232	3.300	-21.412	26.663
CAR(0, +20)	1,542	1.238	-5.409	0.816	7.514	-51.541	48.663
Market capitalisation	1,542	7.613	6.365	7.351	8.573	3.844	13.315
Book-to-market	1,542	2.155	0.743	1.245	2.090	-0.025	534.749
Prior 6-month returns	1,542	-11.941	-31.955	-7.359	9.418	-191.262	230.598
RepSize	1,542	0.115	0.012	0.032	0.091	0.000	6.937
RepVolume	1,542	23.945	9.160	21.059	36.756	0.038	99.940

Table 3 continued	Obs.	Mean	25th	50th	75th	Min	Max
Calendar time method							
Log return	75,392	0.459	-5.717	0.000	6.669	-43.907	42.053
Log market return	75,392	0.510	-2.944	1.296	3.927	-25.390	16.850
Discount							
Discount	15,528	1.685	-1.258	0.966	3.836	-57.493	90.187
CAR(-6, -1) months	15,528	-7.940	-27.071	-5.503	13.906	-251.746	165.685
CAR(+1, +6) months	15,528	-2.154	-21.433	-0.168	22.887	-332.400	169.382
Book-to-market	15,528	1.864	0.751	1.221	2.010	-0.025	563.224
Market capitalisation	15,528	7.947	6.668	7.758	9.132	3.807	13.748
RepSize	15,528	0.068	0.010	0.025	0.063	0.000	6.937
RepVolume	15,528	24.014	9.836	21.704	36.343	0.000	100.000

Table 4 gives an overview of the amount of repurchases over the years in the used sample, as well as the distribution over the different quintile specifications. The thresholds of the size, book-to-market and prior 6-month raw log return quintiles are calculated based on all trading firms on the event day. Large firms are more represented in the sample than small firms, as are high book-to-market firms compared to low book-to-market firms, this is consistent with Zhang (2005).[3]

Table 4: Repurchase frequency over various quintile specifications

This table gives an overview of the repurchases over the years and different characteristics quintiles

Year	Repurchase events	Size quintile					BM quintile					Prior 6-month quintile				
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
2004	60	7	4	12	11	26	0	4	16	21	19	8	10	13	13	16
2005	98	13	6	26	25	28	1	12	31	23	31	8	18	37	25	10
2006	123	7	12	21	53	30	1	21	41	32	28	20	32	16	27	28
2007	169	7	25	34	51	52	7	33	47	35	47	41	36	41	32	19
2008	446	31	89	104	129	93	23	54	97	123	149	37	81	126	122	80
2009	156	15	13	29	57	42	15	21	37	40	43	16	45	42	36	17
2010	129	7	17	27	33	45	17	14	28	35	35	22	18	26	35	28
2011	291	20	55	81	67	68	17	37	84	81	72	47	52	76	65	51
2012	70	7	9	16	18	20	2	8	24	18	18	12	15	13	24	6
All years	1,542	114	230	350	444	404	83	204	405	408	442	211	307	390	379	255

[3] Book-to-market quintile 5 in this thesis consists of the high book-to-market firms in contrast of Zhang (2005), where quartile 1 consists of high book-to-market firms

4. Methodology

4.1 Short-term

4.1.1 Univariate analysis

Event study methodology is used to analyse the short-term reaction to the repurchase (McKinlay, 1997). The total return index is used for the stock and the market to calculate the returns as in Equation (1). The market model as in Equation (2) is used to estimate abnormal returns, where the stock i total return index is used to calculate the stock's return R_{it} and the Hang Seng Total Return Index is used to calculate the market return R_{mt}. The returns are winsorized at the 1st and 99th percentile to mitigate the effect of outliers. An ordinary least squares regression is used to estimate the parameters of the model. An estimation window is used of 250 days prior to the event window (-20, +20) with the repurchase day as day 0 to estimate the parameters of the market model.

$$R_{it} = \log\left(\frac{TotRet_t}{TotRet_{t-1}}\right) \qquad R_{mt} = \log\left(\frac{HangSengTotRet_t}{HangSengTotRet_{t-1}}\right) \tag{1}$$

$$\begin{gathered} R_{it} = \alpha_i + \beta_i R_{mt} + \epsilon_{it} \\ E(\epsilon_{it}) = 0 \qquad var(\epsilon_{it}) = \sigma_{\epsilon_i}^2 \end{gathered} \tag{2}$$

Furthermore, the returns predicted by the market model are subtracted from the actual realised returns to calculate the abnormal returns AR_{it} as in Equation (3) below.

$$AR_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_i R_{mt} \tag{3}$$

Cumulative abnormal return (CAR) is calculated for three windows, (-20, 0), (0, +2) and (0, +20), using Equation (4) to measure the price impact of the actual repurchase. $CAR_i(t_1,\ t_2)$ is the sum of the AR_{it}'s starting from day t_1 to day t_2.

$$CAR_i(\tau_1, \tau_2) = \sum_{t_1}^{t_2} AR_{it} \tag{4}$$

The ex-ante CAR is calculated to research whether share repurchases are preceded by negative abnormal returns. The window of (0, +2) is the information release window, because a firm is obliged to report a repurchase, exercised on day 0, to the exchange on day +1, subsequently the press informs the general public on day +2. Furthermore, the (0, +20) window is researched to examine the price performance in the month following the repurchase day.

4.1.2 Cumulative abnormal returns on firm-level

Zhang (2005) argues that firms may have very different repurchase behaviour. Some firms may repurchase more often and those firms could distort the results of the less repurchasing firms. Therefore, the CARs are averaged per firm as presented in Equation (5) and subsequently tested for significance. This is to test whether the CARs for the three short-term event windows are robust on firm-level.

$$CAR_i = \frac{\sum_0^{N_i} CAR_i(t_1, t_2)}{N_i} \tag{5}$$

Where CAR_i is the average CAR for firm *i*, $\sum_0^{N_i} CAR_i(t_1, t_2)$ is the sum of the CARs for firm *i* and N_i is the amount of repurchases by firm *i*.

4.1.3 Significance testing

The calculated CARs are tested for significance using the *t*-test as in Equation (6) to examine whether or not share repurchases are followed by periods of strong price performance.

$$t_{CAR_{t_1,t_2}} = \frac{CAR(t_1, t_2)}{SE_{CAR(t_1,t_2)}} \tag{6}$$

Where $t_{CAR_{t_1,t_2}}$ is the calculated t-value, $CAR(t_1, t_2)$ is the cumulative abnormal return from day t_1 to t_2, $SE_{CAR(t_1,t_2)}$ is the standard error of $CAR(t_1, t_2)$

4.1.4 Cross-sectional regression

For the short-term analysis a cross-sectional regression analysis is performed to research the hypothesis in Section 2.7.2 to 2.7.4. Following Zhang (2005) the dependent variables are CAR(0,

+2) and CAR(0, +20). The hypotheses described in Section 2.7.2 to 2.7.3 lead to the following multivariate regression:

$$CAR_i(t_1, t_2) = \alpha + \beta_1 CAR_i(-20, -1) + \beta_2 ln(Size_{i,t_1}) + \beta_3 BM_{i,t_1} + \beta_4 Prior6m_{i,t_1} + \beta_5 RepSize_{i,t_1} + \beta_6 RepVolume_{i,t_1} \quad (7)$$

where $CAR_i(t_1, t_2)$ is the CAR of firm *i* over the event window (0, +2) or (0, +20), α is the intercept coefficient, $CAR_i(-20, -1)$ is the cumulative abnormal return for firm *i* over day -20 to day -1, $ln(Size_{i,t_1})$ is the natural logarithm of the market capitalisation on event day t_1 for firm *i*, BM_{i,t_1} is the book-to-market ratio on event day t_1 for firm *i*, $Prior6m_{i,t_1}$is the logarithm of the 6-month raw return prior to month of the event of firm *i*,$\beta_5 RepSize_{i,t_1}$is the ratio of the number of repurchased shares to the amount of outstanding shares at the resolution made at the beginning of the year on event day t_1 for firm *i* and $RepVolume_{i,t_1}$ is the ratio of the number of repurchased shares to the total number of shares traded on event day t_1 for firm *i*.

Following Zhang (2005) $CAR_i(-20, -1)$ is incorporated in the regression analysis to account for possible mean reversion due to the poor stock performance in the 20 trading days prior to the event. Furthermore, the RepSize variable is added, which denotes the number of shares repurchased scaled by the shares outstanding at the beginning of the program (Zhang, 2005). RepVolume is added to the cross-sectional regression to analyse if the repurchase scaled by trading volume can explain CAR(0, +2) or CAR(0, +20).

4.2 Long-term

For the research on the long-term price performance the calendar-time method is used to calculate monthly abnormal returns. Said method has the advantage that it controls for cross-sectional dependence of the firms that experience an event. However, the disadvantage of the calendar-time method is the lack of measuring investor experience (Lyon, Barber, & Tsai, 1999). An event portfolio is formed for each month with firms that bought back shares in the prior 12 (24, 36 or 48) months (Ang & Zhang, 2011). Peyer and Vermaelen (2009) prefer the use of an equally-weighted portfolio over the use of a value-weighted portfolio for two reasons. First, the power of identifying is less when using value-weighting, due to the fact that large firms are less likely to be

mispriced. Second, the objective is to examine this small group of repurchasing firms and not so much the market efficiency.

The monthly abnormal returns are calculated using the following formula:

$$AR_{p,t} = R_{p,t} - R_{f,t} \quad (8)$$

Where $AR_{p,t}$ is the abnormal return of sample portfolio *p* for month *t*, $R_{r,p}$ is the return of sample portfolio *p* for month *t* and $R_{f,t}$ is the yield on a treasury bond for month *t*.

The calculated abnormal returns are regressed on Fama and French (1993) risk factors using their three factor model obtained from the AQR Capital Management data library. This model incorporates premiums for the market risk, value and size factors. The factors are calculated using the following regression:

$$AR_{p,t} = a_t + b_t(R_{m,t} - R_{f,t}) + c_t HML_t + d_t SMB_t + \varepsilon_t \quad (9)$$

Where $R_{m,t} - R_{f,t}$ is the factor of the market risk premium, HML_t is the monthly return on the value factor in month *t* and SMB_t the monthly return related to the firm's size at month *t*. The intercept a_t represents the average monthly excess return in the event period that cannot be contributed to the three factors (Peyer & Vermaelen, 2009).

4.3 Size, book-to-market and prior 6-month return quintiles

Quintiles are formed to examine the cross-sectional differences in the research on returns. For each repurchase day quintiles are formed based on the market capitalisation, book-to-market ratio and prior 6-month returns. The quintile thresholds are calculated based on the characteristics of all the firms traded on the Hong Kong Stock Exchange on every repurchase day. The repurchasing firms in the sample are then assigned to the appropriate quintile on the event day.

4.4 Discount

4.4.1 Univariate analysis

To examine whether management is able to buy back stocks at a discount I will investigate whether there is a significant difference between the repurchase price and the average market price. The following formulas are used to calculate the Discount variable that is used for analysing the timing ability:

$$AvgPrice_{i,t} = \frac{\sum_{t_2}^{t_1} Price}{N_{t_1 - t_2}} \quad (10)$$

$$Discount_{i,t} = 1 - \frac{RepPrice_{i,\mathrm{t}}}{AvgPrice_{i,t}} \quad (11)$$

Where $\sum_{t_2}^{t_1} Price$ is the sum of the closing stock prices from the first trading day of the month t_1 to the last trading day of the month t_2, $N_{t_1 - t_2}$ is the number of trading days of the repurchase month, $Discount_{i,t}$ is the discount in percentage on event day t and for firm i, $RepPrice_{i,t}$ is the average price paid for the repurchased shares on event day t and for firm i and $AvgPrice_{i,t}$ is the average closing price of the stock during the repurchase month t.

Suppose, a firm repurchases shares at a price of HKD 3 while the average price during the event month is equal to HKD 4, then the Discount variable is equal to $1 - {}^{3}/_{4} = 0.25$. Management was in this example to repurchase shares at a 25% discount compared to the average stock price during that month.

The Discount variable is similar to the Diff variable in the paper of Ben-Rephael, Oded and Wohl (2014). The Discount variable used in my research is the negative equivalent to the Diff measure by Ben-Rephael, Oded and Wohl (2014). In their paper the repurchase is more favourable for the repurchasing firm is when Diff is more negative. The variable used in this thesis is more positive when shares are repurchased at a larger discount. The coefficients from the cross-sectional regression from Section 4.4.3 also appear to be more logical with respect to other undervaluation analyses in this thesis.

4.4.2 Testing significance

The calculated Discount is tested for significance using the following *t*-test to examine whether or not share repurchases are followed by periods of strong price performance.

$$t_{Discount_{i,t}} = \frac{Discount_{i,t}}{SE_{Discount_{i,t}}} \quad (12)$$

Where $t_{Discount_{i,t}}$ is the calculated *t*-value, $Discount_{i,t}$ is the discount in percentage realised by management of firm *i* at repurchase day *t*, $SE_{Discount_{i,t}}$ is the standard error of $Discount_{i,t}$

4.4.3 Cross-sectional analysis

The following formula is used to explain the nature of the discount that management is able to realise:

$$Discount_{i,t} = \alpha_t + \beta_1 CAR_{i,t}(-6,-1) + \beta_2 CAR_{i,t}(+1,+6) + \beta_3 ln(Size_{i,t}) + \beta_4 BM_{i,t} + \beta_5 RepSize_{i,t} + \beta_6 RepVolume_{i,t} \quad (13)$$

where α is the intercept coefficient, $CAR_{i,t}(-6,-1)$ is the CAR of firm *i* over the 6 months prior to the repurchase month with respect to event day *t*, $CAR_{i,t}(+1,+6)$ is the CAR of firm *i* over the 6 months following the repurchase month with respect to event day *t*, $ln(Size_{i,t})$ is the natural logarithm of the market capitalisation of firm *i* on event day *t*, $BM_{i,t}$ is the book-to-market ratio of firm *i* on event day *t*, $Prior6m_{i,t}$ is the logarithm of the 6-month raw return of firm *i* prior to the event day *t*,$RepSize_{i,t}$ is the ratio of the repurchased shares by firm *i* at event day *t* to the amount of outstanding shares at the beginning of the program and $RepVolume_{i,t}$ is the ratio of the repurchased shares to the total trading volume of that day of firm *i* on the event day t_1.

As said in Section 2.4.5 following Ben-Rephael, Oded and Wohl (2014) undervaluation may be a determinant to the discount management is able to realize. $ln(Size)$ and BM are the variables used in the cross-sectional regression to proxy undervaluation. Following the Bargain analysis by Obernberger (2014), the variables $CAR(+1,+6)$, $RepSize$ and $RepVolume$ are added to the cross-sectional regression. The $CAR(+1,+6)$ $CAR(-6,-1)$ are added to analyse whether the discount realised by the management can be explained by either a decreasing stock price prior to the repurchase or an increasing stock price following the repurchase. $RepSize$ and $RepVolume$ are included in the regression as control variables and are expected to both have a significant negative coefficient, because when large repurchases will be followed by positive price pressure.

Moreover, Table A1 in the Appendix reports an overview of the variables used for the analyses throughout this thesis.

5. Results

5.1 Short-term

5.1.1 Abnormal returns

An estimation window is used of 250 days until 20 days prior to the days of the repurchase day. Stock total returns and market total returns are used to estimate the return without an event. Abnormal returns are calculated by subtracting the predicted returns from the actual returns.

Table 5 reports the abnormal returns for the (-20, +20) event window with the repurchase day as day 0. The ARs on the days prior to the repurchase day often are negative, with multiple days prior to the repurchase day having negative ARs that are significant at a 1% confidence level (day -1, -2, -3, -4, -6 and -8). Repurchasing firms are obliged to report their share repurchase in the morning on day +1, the market therefore shows a positive reaction starting at day +1. The press receives the information regarding the repurchase on day +1 and publish their articles on day +2. The ARs on the 4 days following the repurchase day are all significantly positive, which results in a CAR(+1, +4) value of 0.895%.

Table 5: Abnormal returns per day

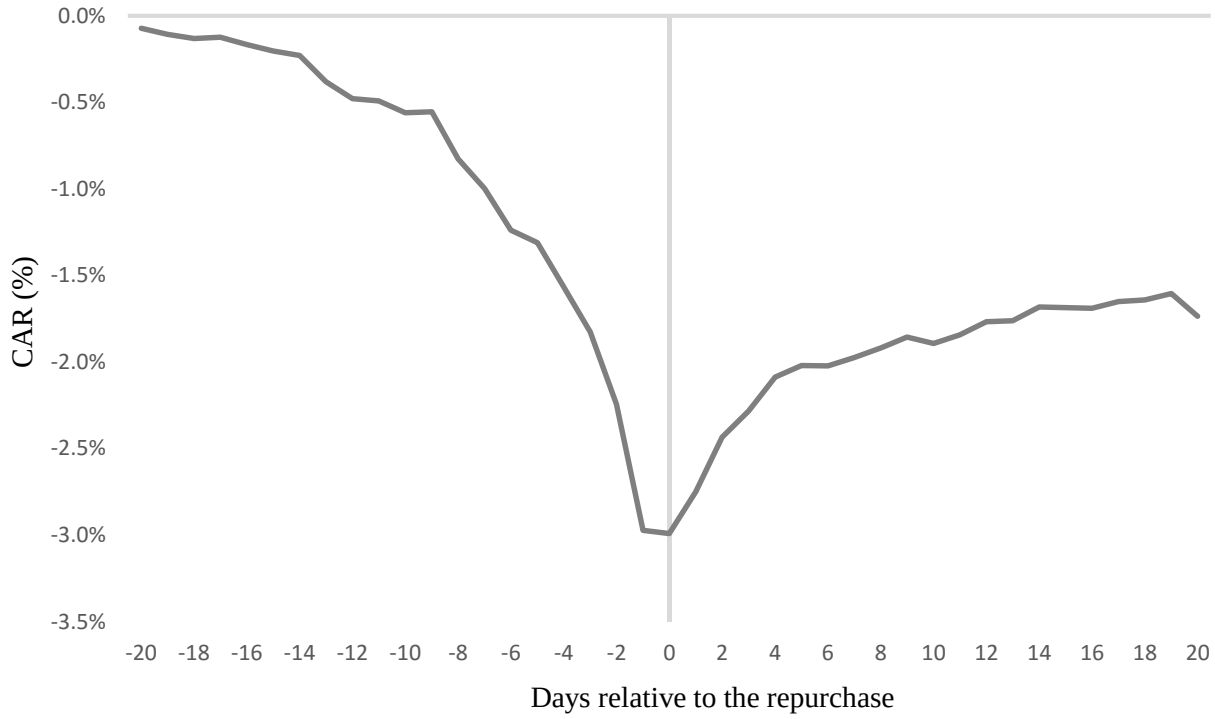
The average abnormal returns (AR) are presented in percentages with its corresponding *p*-values in parentheses and cumulative average abnormal return (CAR) in percentages for 20 trading days before and after the repurchase day of 1,542 share repurchases. The CARs are estimated using the market model with an estimation window starting from 270 to 21 days prior to the repurchase day. The CARs are averaged per day and subsequently a *t*-test is performed.

Day	AR (%)	*p-value*	CAR (%)	Day	AR (%)	*p-value*	CAR (%)
-20	-0.069	(0.315)	-0.069	0	-0.022	(0.808)	-2.923
-19	-0.040	(0.531)	-0.108	+1	0.230***	(0.002)	-2.693
-18	-0.014	(0.827)	-0.123	+2	0.317***	(0.000)	-2.376
-17	0.004	(0.956)	-0.119	+3	0.148**	(0.024)	-2.228
-16	-0.051	(0.445)	-0.170	+4	0.200***	(0.005)	-2.028
-15	-0.044	(0.496)	-0.214	+5	0.078	(0.276)	-1.950
-14	0.000	(0.998)	-0.214	+6	0.003	(0.961)	-1.947
-13	-0.156**	(0.019)	-0.370	+7	0.046	(0.480)	-1.902
-12	-0.098	(0.136)	-0.467	+8	0.059	(0.386)	-1.843
-11	-0.010	(0.883)	-0.477	+9	0.061	(0.356)	-1.782
-10	-0.049	(0.463)	-0.526	+10	-0.035	(0.616)	-1.817
-9	0.013	(0.846)	-0.513	+11	0.047	(0.493)	-1.770
-8	-0.271***	(0.000)	-0.784	+12	0.087	(0.199)	-1.683
-7	-0.171**	(0.012)	-0.955	+13	0.001	(0.923)	-1.682
-6	-0.237***	(0.001)	-1.192	+14	0.084	(0.221)	-1.598
-5	-0.067	(0.342)	-1.258	+15	0.004	(0.951)	-1.594
-4	-0.251***	(0.000)	-1.509	+16	0.011	(0.874)	-1.583
-3	-0.259***	(0.000)	-1.768	+17	0.037	(0.583)	-1.546
-2	-0.409***	(0.000)	-2.177	+18	0.000	(0.917)	-1.546
-1	-0.724***	(0.000)	-2.901	+19	0.030	(0.670)	-1.516
				+20	-0.135**	(0.044)	-1.651

Below in Figure 1 is seen that share repurchases are preceded by an abnormal negative market performance by repurchasing firms, which results in a CAR(-20,-1) of -2.973%, significant at the 1% confidence level. Repurchasing firms experience an abnormal positive market performance after the repurchasing day, with a CAR(0, +20) of 1.238%, also significant at the 1% confidence level. The finding of poor ex-ante performance and strong ex-post performance is in line with the paper of Vermaelen (1981) which studies the performance of open market share repurchases.

Figure 1: Cumulative abnormal return from day -20 to +20

Cumulative average abnormal return (CAR) in percentages for 20 trading days before and after the repurchase day of 1,542 share repurchases. The CARs are estimated using the market model with an estimation window starting from 270 to 21 days prior to the repurchase day.



5.1.2 Cumulative abnormal returns

Following Zhang (2005) I used three event windows: (-20, -1), (0, +2) and (0, +20). The chosen windows cover approximately one month prior until one month after the repurchase day. The event window (0, +2) is chosen to capture the effect of the information of a repurchase becoming public knowledge. The repurchasing firms are obliged to disclose the repurchase to the exchange on the morning following the repurchase. Therefore, on day +1 the repurchase is common knowledge to the trading floor and the information is published in the press on day +2.

Table 6 shows the CARs for the before mentioned windows across different criteria. First, Panel A presents the CARs for the full sample. Second, in Panel B the CARs are shown when quintiles are formed based on firm size to test the hypothesis regarding the undervaluation of small firms. Third, in Panel C the CARs are shown based on book-to-market to test the hypothesis regarding the undervaluation of value stocks (Zhang, 2005). Fourth, in Panel D the CARs are shown where quintiles are formed based on the stock's performance during the preceding six months to test hypothesis H4.1 regarding undervaluation due to overreaction (Peyer & Vermaelen, 2009).

The main numbers in the table are the average CARs in percentages with the *p*-value assigned to this value below the CAR between parentheses.

5.1.3 Full sample

The full sample CARs in Panel A for all three event windows are significant at a confidence level of 1%. The month prior to the event returns an average CAR of -2.973%. This result implies that management chooses to buy back stock following a period where their stock underperformed. The window that covers the release of information, from the repurchase day to the day the newspapers cover the repurchase (0, +2), returns an average CAR of 0.539%. Furthermore, the mean CAR for the month following the repurchase is 1.238%. Share repurchases do not seem to be a valid investment strategy on the short horizon. The return realised is the average when invested in all 1,542 repurchases and therefore, probably not large enough for the risk and transaction costs associated with such an investment. These findings are not in line with the efficient market hypothesis of Ikenberry, Lakonishok and Vermaelen (2000) that states that all information should be incorporated into the stock price by the market around the event. However, these empirical results are in line with the findings of Vermaelen (1981) as said earlier, due to the poor ex-ante performance and strong ex-post performance. The findings for the first two event windows are in

line with Zhang (2005). However, the CAR(0, +20) found by the author is 0.69% with a *p*-value of 0.102 and thus not significant in contrast with the findings in this thesis.

Hypothesis H1.1 states that repurchasing firms experience significantly positive abnormal returns on the short-term. Hypothesis H1.1 is not to be rejected due to the CAR(0, +2) and CAR(0, +20), reported in Panel A of Table 6, being 0.539% and 1.238% both statistically significant at the 1% confidence level.

5.1.4 Size quintiles

Panel B of Table 6 reports the returns for the size quintiles for the different event windows. Quintiles 3, 4 and 5 experience large negative CARs, -2.887%, -4.255% and -3.042% respectively, that are significant at a confidence level of 1% during the month prior to the event. This indicates that larger firms tend to repurchase shares after the stock's poor performance, in contrast with smaller firms in quintile 1 and 2 that do not experience CARs that are significantly different from zero.

Furthermore, firms in size quintile 1 experience a CAR of 1.378% with a *p*-value of 0.041 during the information release window of (0, +2). This CAR is larger than the CAR of any other size quintile. To illustrate, the CAR for size quintile 5 is 0.501% significant at a 5% confidence level.

The month following the repurchase shows positive CARs for all quintiles, with size quintile 2, 4 and 1 significant at a confidence level of 10%, 5% and 1% respectively. The CAR for the small firms in quintile 1 is 4.269% with a p-level of 0.006 in contrast to the CAR for the large firms in quintile 5 that is, not statistically significant, equal to 0.858%. The CAR for the small firm quintile seems is more of economic significance in comparison with the full sample results and therefore could be used for an investment strategy.

Hypothesis H3.1 states that small firms experience higher abnormal returns than large firms on the short-term. The findings regarding the analysis on size quintiles on the three event windows are all in line with the results of Zhang (2005) and show that small firms do indeed experience a larger CAR(0, +20). Therefore, hypothesis H3.1 is not to be rejected.

5.1.5 Book-to-market quintiles

The results regarding the BM quintiles are reported in Panel C of Table 6. For the event windows surrounding the repurchase and the month after the repurchase Panel C shows a clear and

consistent pattern across the BM quintiles. Quintile 5 with value stocks return the highest CAR(0, +2) and CAR(0, +20), 0.664% and 2.022% respectively, that are both significant at the 1% confidence level. Whereas, firms in BM quintile 1 return insignificant post-event CARs. These findings indicate that the market reacts more favourable to value stocks than glamour stocks. The observed returns are economically not large enough to justify a value investing strategy.

Hypothesis H2.1 states that high book-to-market firms experience higher abnormal returns than low book-to-market firms on the short-term. The CAR(0, +20) is 2.022% and significant at the 1% confidence level in contrast with an insignificant result for the low book-to-market firms in quintile 1. Therefore, hypothesis H2.1 is not to be rejected.

5.1.6 Prior 6-month return quintiles

Panel D shows the returns for the different past returns quintiles. Quintile 1 consists of firms with the lowest past returns and quintile 5 consists of firms with the highest past returns. Across all the quintiles negative CAR(-20, -1) values are reported with a *p*-value assigned of 0.000. The CARs for the information release window from the repurchase to two days after the repurchase show significant positive CARs for quintile 1 and 2, +1.141% and +0.902% respectively. Moreover, the CARs for quintile 3 to 5 are not statistically significant at a confidence level of 10%. The CARs for the month following the repurchase show a more consistent pattern across the quintiles. Quintile 5 reports a CAR(0, +20) of -1.600% with an assigned *p*-value of 0.048, whereas the CAR(0, +20) of quintile 1 is +3.415% with a *p*-value of 0.001. These results are consistent with the overreaction hypothesis of Peyer and Vermaelen (2009) and the findings of earlier studies.

Hypothesis H4.1 regarding the return reversal states that firms with low prior 6-month returns experience a higher short-term abnormal returns than firms with high prior 6-month returns. The CAR(0, +20) of quintile 1 is 3.415% significant at the 1% confidence level and the CAR(0, +20) of quintile 5 is -1.600% significant at the 5% confidence level. Therefore, hypothesis 4.1 is not to be rejected.

Table 6: Univariate analysis CARs full sample and various quintiles

Below Cumulative average abnormal return (CAR) are shown for three event windows of 1,542 share repurchases. The CARs are estimated using the market model with an estimation window starting from 270 to 21 days prior to the repurchase day. Panel A presents the CARs for the full sample. Panel B, C and D present respectively the Size, BM and Prior 6-month return CARs over the appropriate quintile specifications and event windows

			Window		
	Obs.	Quintile	(-20, -1)	(0, +2)	(0, +20)
Panel A: Full sample					
CAR	1542		-2.973***	0.539***	1.238***
			(0.000)	(0.000)	(0.000)
Panel B: Size quintiles					
CAR	114	1	-1.368	1.378**	4.269***
			(0.263)	(0.041)	(0.006)
CAR	230	2	-1.086	0.399	1.629*
			(0.229)	(0.274)	(0.051)
CAR	350	3	-2.887***	0.641**	0.772
			(0.000)	(0.017)	(0.232)
CAR	444	4	-4.255***	0.379	1.302**
			(0.000)	(0.148)	(0.034)
CAR	404	5	-3.042***	0.501**	0.858
			(0.000)	(0.032)	(0.116)
Panel C: BM quintiles					
CAR	83	1	-2.211*	0.218	0.222
			(0.054)	(0.667)	(0.859)
CAR	204	2	-3.912***	0.517	0.200
			(0.000)	(0.191)	(0.816)
CAR	405	3	-3.885***	0.550**	1.169*
			(0.000)	(0.043)	(0.085)
CAR	408	4	-2.933***	0.512**	1.380**
			(0.000)	(0.037)	(0.017)
CAR	442	5	-1.908***	0.664***	2.022***
			(0.001)	(0.008)	(0.000)
Panel D: Prior 6-month return quintiles					
CAR	211	1	-4.195***	1.141***	3.415***
			(0.000)	(0.008)	(0.001)
CAR	307	2	-1.771***	0.902***	3.303***
			(0.004)	(0.002)	(0.000)
CAR	390	3	-3.037***	0.312	2.068***
			(0.000)	(0.249)	(0.001)
CAR	379	4	-2.476***	0.194	-0.589
			(0.000)	(0.429)	(0.289)
CAR	255	5	-4.051***	0.464	-1.600**
			(0.000)	(0.142)	(0.048)

5.1.7 CARs on firm-level

Repurchase activity may differ per firm, as can be derived from Panel B in Table 2. Some firms in the sample will repurchase often, where others might repurchase once. The results might be overrepresented by firms that choose to repurchase more frequent, therefore following Zhang (2005), I analyze the CARs for the three short-term event windows on firm-level. Table 7 reports the CARs per firm for the three event windows. The CARs are averaged on firm-level and subsequently a *t*-test is conducted across the 297 sample-firms.

Table 7: Univariate analysis CARs on firm-level

This table reports the CARs averaged on firm-level for the different event windows and with the assigned *p*-values below the CARs in parentheses. The CARs are estimated using the market model with an estimation window starting from 270 to 21 days prior to the repurchase day. The CARs are averaged on firm-level for 297 firms and subsequently a *t*-test is performed.

		Window		
	Obs.	(-20, -1)	(0, +2)	(0, +20)
Full sample firms				
CAR	297	-5.240***	0.917***	1.909***
		(0.000)	(0.001)	(0.001)

The CAR for the month prior to the event is -5.240%, the information release window returns a CAR of 0.917% and for the month following the repurchase a 1.909% CAR is calculated. The abnormal returns for the three event windows are all significant at the 1% confidence level. Higher CARs are shown in Table 7 when compared to the full sample results from section 5.1.3, as in line with the results of Zhang (2005). The results show poor ex-ante price performance and strong ex-post performance. Thus, these findings are consistent with the full sample results of Table 6.

5.1.8 Cross-sectional results

Panel A of Table 6 has shown that the CARs for the post-event windows are significantly positive. Therefore, repurchases are followed by strong price performance. The nature of the CAR(0, +2) and CAR(0, +20) is examined for the cross section. Table 8 reports the coefficients and *p*-values of the used variables in the cross-sectional regression. The regression uses robust standard errors due to the regression being subjected to heteroscedasticity problems. Table A3 in the Appendix reports the results of the performed multicollinearity tests.

Table 8: Cross-sectional regression on CARs

This table reports the estimates from the cross-sectional regression in which CAR(0, +2) and CAR(0, +20) are regressed on a set of variables regarding the repurchase or the repurchasing firm. The CARs are estimated using the market model. The coefficients are the main entries of this table, with the *p*-values in parentheses. The CAR(-20, -1) is added as a control variable to account for possible mean reversion from ex-ante returns. ln(Size) is the natural logarithm of the firm's market capitalization on the repurchase day. BM is the firm's book-to-market on the repurchase day. Prior6m are the raw log returns from 6 months prior to 1 month prior to the repurchase month. RepSize is the number of repurchased shares relative to the outstanding shares on the repurchase day. RepVolume is the number of repurchased shares relative to the trading volume on the repurchase day. The sample consists of 1,542 repurchases.

	CAR(0, +2)	CAR(0, +20)
Independent variables		
Intercept	0.724	4.089**
	(0.355)	(0.022)
CAR(-20, -1)	-0.002	0.086**
	(0.912)	(0.013)
ln(Size)	-0.047	-0.316*
	(0.572)	(0.093)
BM	0.003	0.001
	(0.747)	(0.959)
Prior6m	0.000	-0.049***
	(0.947)	(0.000)
RepSize	0.328	0.166
	(0.480)	(0.875)
RepVolume	0.005	-0.033*
	(0.548)	(0.098)
Adj. R^2	-0.002	0.033

Table 8 reports that CAR(0, +2) is not significantly correlated with any of the chosen variables to explain the observed abnormal returns in the first two days following the repurchase. The first model shows a model that poorly fits the data, due to the adjusted R^2 of -0.2%. The cross-sectional regression of CAR(0, +20) reports an adjusted R^2 of 3.3%, which is consistent with the adjusted R^2 of Zhang (2005) at 4.3%. The analysis of the cross section of CAR(0,+20) does return significant coefficients for the variables CAR(-20, -1), ln(Size), Prior 6-month return and RepVolume. The correlation between CAR(0, +20) and control variable CAR(-20, -1) is significantly positive and in line with the findings of Zhang (2005). Moreover, the coefficient of ln(Size) is negative and significant at the 10% confidence level. This indicates that small firms are more likely to realise a more positive post-event market performance, consistent with undervaluation theory and the findings of Zhang (2005). Hypothesis H3.3 states that the size factor is negatively correlated with the short-term abnormal returns. Therefore, hypothesis H3.3 is not to be rejected.

In contrast with the findings of Zhang (2005) the BM variable does not return a significant positive coefficient. Therefore, the result regarding the BM variable from the cross-sectional regression analysis is not consistent with the univariate analysis in Table 6 or the findings of Zhang (2005). Hypothesis H2.3 states that the book-to-market factor is positive correlated with the short-term abnormal returns. Therefore, hypothesis H2.3 is to be rejected due to the lack of a significant BM coefficient.

The coefficient of the Prior 6-month return variable is -0.049 with an assigned *p*-value of 0.000. This result is in line with the univariate analysis on the prior 6-month quintiles in Table 8 and indicates that beaten up stocks experience a higher post-event return. Hypothesis H4.3 states that the coefficient of the prior 6-month returns variable is significantly negative. Therefore, hypothesis H4.3 is not to be rejected due to the found significant negative coefficient.

Concluding this section, the control variables will be discussed. There is no significant correlation found between the repurchase size relative to shares outstanding (RepSize) and the observed abnormal returns. However, the repurchase to total trading volume on the repurchase day (RepVol) does return a negative coefficient significant at a confidence level of 10%. This indicates that when the amount of repurchased shares makes up for a large part of the total volume on the repurchase

day, the subsequent returns are lower. Due to the fact that the total trading volume on the event day is part of the RepVolume variable and it could be approached from a different point of view.

Namely, that when the total trading volume on the repurchase day is lower, the subsequent abnormal returns are lower. A possible reason for this could be that the stock suffers from illiquidity problems. When a stock is illiquid, the prices are driven down and therefore, causes returns to be negative. This is purely hypothetical and could be interesting to study in future research.

5.2 Long-term

5.2.1 Full sample

In the first column of Table 9 the results of the calendar-time method on the full sample are shown. The found coefficients are all economically and statistically significant. The monthly average ARs for 12 (-0.548%), 36 (-0.539%) and 48 months (-0.551%) are significant at a confidence level of 1% and the result for 24 months (-0.443%) is significant at a confidence level of 5%. The results from my research on the full sample are not in line with earlier research. Peyer and Vermaelen (2009) find solely significant positive monthly average ARs, whereas I find negative monthly average ARs. Hypothesis H1.2 states that repurchasing firms experience significant positive abnormal returns on the long-term. Therefore, hypothesis H1.2 is to be rejected.

A possible explanation for the found negative monthly average ARs could be the effect of the financial crisis that started at the end of 2008. The sample used in my research covers the time window of the financial crisis from 2008 to 2013. It is plausible that the stocks used in my sample have experienced negative price pressure and therefore have seen poor price performance. However, this is purely hypothetical and could be of interest for future research.

5.2.2 Book-to-market quintiles

The last five columns of Table 9 show the results the monthly average ARs when the sample is divided across BM quintiles based on the BM ratio on the repurchase day. The stocks in quintile BM 1 have a low book-to-market ratio and are called glamour stocks and those in BM 5 have a high book-to-market ratio and are called value stocks.

The majority of the monthly average ARs for quintile BM 1 to BM 4 show significant results. Yet, the quintile BM 5 does not show significant monthly average ARs, which is not in line with Peyer

and Vermaelen (2009). No concluding remarks can be made regarding the value stocks, due to the lack of significant results. However, quintile 5 consists solely of abnormal monthly returns that are the highest across all the quintiles for each event window. Furthermore, the coefficients for the first 12 months increase from -1.003% in BM 1 to 0.268% in BM 5. The BM 5 coefficient may not be statistically significant from 0, there is a clear difference between the monthly abnormal returns between the quintiles. However, what can be derived from the results for the different event windows of quintile BM 1 to BM 4 is that the monthly average ARs increase with the increase of each BM quintile. Therefore, I can conclude that stocks with a high book-to-market ratio experience higher average abnormal monthly returns on the long-term following a share repurchase than the stocks with a low book-to-market ratio, which leads me to not reject the H2.2 hypothesis.

5.2.3 Size quintiles

The results for the five size quintiles are shown in Table 10. Firms are assigned to the different quintiles based on the market capitalisation of the firm on the day of the repurchase. The thresholds of the quintiles are based on the market capitalisation of all trading stocks on the repurchase day.

The coefficients for the event windows of quintile 4 are statistically significant at least at a 5% confidence level. Furthermore, the coefficient for 48 months in the third quintile is significant at the confidence level of 10%. When observing the results across the quintiles, a consistent pattern is lacking. No sensible remarks can be made regarding the coefficients across the different quintiles and event windows, due to the lack of statistically significant results. Therefore, I have to reject the H3.2 hypothesis that states that smaller firms experience higher abnormal returns than larger firms in the long run.

5.2.4 Prior 6-month return quintile

Table 11 shows the results regarding the long-term performance of repurchasing firms per prior 6-month raw return quintile. Repurchasing firms are assigned to the quintiles based on the 6-month raw returns of repurchasing firms relative to the raw returns of all trading firms over the same period.

Prior 6-month quintile 1 shows monthly average ARs for all four event windows at a 1% confidence level. For quintile 2 and 3 only the monthly average ARs of event windows 36 and 48 months are significant at a confidence level of at least 5%. However, when looking at the ARs for

quintile 1, the ARs become more positive from -1.756% for the 12-months to -1.004% for the 36-months event window. For the event windows of 36 and 48 months of quintile 2 and 3 the ARs also show a slight increase. The ARs of quintile 4 and 5 seem to become more negative each time the event window increases. However, these ARs are not significant and are therefore not used to draw a conclusion. The results for the first quintile are in line with the findings of Jegadeesh and Titman (1995), who find return reversals on the long-term. Although the fact that the return reversal exists on the long-term, Hypothesis H4.2, that states that firms with low past returns experience higher long-term abnormal returns than firms with high past returns, need to be rejected, since quintile 1 reports significant negative average ARs and quintile 5 reports no significant results for the various event windows.

Table 9: Calendar-time method for full sample and book-to-market quintiles

Long run monthly average abnormal returns obtained from the calendar-time method for the full sample and book-to-market quintiles

	Full sample		BM 1		BM 2		BM 3		BM 4		BM 5	
	Monthly average AR	*p-value*	Monthly average AR	*p-value*	Monthly average AR	*p-value*	Monthly average AR	*p-value*	Monthly average AR	*p-value*	Monthly average AR	*p-value*
12 mths	-0.548***	(0.009)	-1.003*	(0.068)	-1.029**	(0.011)	-0.690**	(0.032)	-0.645**	(0.027)	0.268	(0.387)
24 mths	-0.443**	(0.012)	-0.938**	(0.028)	-0.658*	(0.054)	-0.689***	(0.008)	-0.292	(0.239)	0.130	(0.613)
36 mths	-0.539***	(0.001)	-0.616	(0.104)	-0.768***	(0.007)	-0.809***	(0.001)	-0.514**	(0.026)	0.092	(0.716)
48 mths	-0.551***	(0.000)	-0.799***	(0.008)	-0.805***	(0.001)	-0.708***	(0.001)	-0.488**	(0.021)	-0.007	(0.975)
obs	1542		83		204		405		408		442	

Table 10: Calendar-time method for size quintiles

Long run monthly average abnormal returns obtained from the calendar-time method for the size quintiles

	Size 1		Size 2		Size 3		Size 4		Size 5	
	Monthly average AR	*p-value*	Monthly average AR	*p-value*	Monthly average AR	*p-value*	Monthly average AR	*p-value*	Monthly average AR	*p-value*
12 mths	-0.091	(0.907)	0.588	(0.209)	-0.275	(0.417)	-1.341***	(0.003)	-0.238	(0.524)
24 mths	0.599	(0.441)	0.370	(0.351)	-0.197	(0.490)	-0.872**	(0.024)	-0.415	(0.184)
36 mths	0.361	(0.619)	0.432	(0.256)	-0.298	(0.248)	-1.099***	(0.003)	-0.464	(0.122)
48 mths	0.151	(0.821)	0.235	(0.492)	-0.397*	(0.095)	-0.969***	(0.004)	-0.407	(0.136)
obs	114		230		350		444		404	

Table 11: Calendar-time method for prior 6-month quintiles

Long run monthly average abnormal returns obtained from the calendar-time method for the prior 6-month return quintiles

	Prior 6-month 1		Prior 6-month 2		Prior 6-month 3		Prior 6-month 4		Prior 6-month 5	
	Monthly average AR	*p-value*	Monthly average AR	*p-value*	Monthly average AR	*p-value*	Monthly average AR	*p-value*	Monthly average AR	*p-value*
12 mths	-1.756***	(0.000)	-0.285	(0.386)	-0.239	(0.424)	0.160	(0.568)	-0.348	(0.334)
24 mths	-1.355***	(0.000)	-0.362	(0.177)	-0.282	(0.243)	0.063	(0.797)	0.002	(0.995)
36 mths	-1.004***	(0.000)	-0.602**	(0.012)	-0.488**	(0.025)	-0.064	(0.786)	-0.022	(0.941)
48 mths	-1.259***	(0.000)	-0.594***	(0.007)	-0.457**	(0.028)	-0.036	(0.859)	-0.125	(0.641)
obs	211		307		390		379		255	

Table 9: Results of monthly average abnormal returns for the full sample and the subsamples by book-to-market (BM) quintiles. Quintiles are formed based on the BM ratios of all firms traded on the event days. Firms then are assigned to quintiles based on their BM ratio on the repurchase day relative to the computed breakpoints.

Table 10: Results of monthly average abnormal returns for the full sample and the subsamples by market capitalization (size) quintiles. Quintiles are formed based on the size of all firms traded on the event days. Firms then are assigned to quintiles based on their size on the repurchase day relative to the computed breakpoints.

Table 11: Results of monthly average abnormal returns for the full sample and the subsamples by prior 6-month return quintiles. Quintiles are formed based on the raw prior 6-month returns of all firms traded relative to each event date. Firms then are assigned to quintiles based on their prior 6-month raw return on the repurchase day relative to the computed breakpoints.

To compute the monthly AR equally-weighted calendar-time portfolios are used. In this method, event firms that have announced a share repurchase in the past 12 (24, 36, 48) months form a basis for the calendar-month portfolio. A single time-series regression is run with the excess return as dependent variable and the Fama & French (1993) three-factor model as independent variables. This leads to the following regression with α as the monthly AR:

$$AR_{p,t} = a_t + b_t\left(R_{m,t} - R_{f,t}\right) + c_t HML_t + d_t SMB_t + \varepsilon_t$$

*, ** and *** represent the significance level on 10%, 5% and 1%, respectively. Table A2 in the Appendix shows the adjusted R^2 for every regression performed with the calendar-time method.

5.3 Discount

5.3.1 Univariate results

Existing literature has shown that management is able to repurchase shares cheaply compared to the average market price. This thesis analyses the timing ability on the Hong Kong Stock Exchange and if this timing ability can be explained by a certain set of variables.

Table 12 reports the result of the Discount variable that is the repurchase price relative to the average market price. The average discount over 15,528 repurchases is, as expected, significantly larger than zero at 1.685% with a p-value of 0.000. This indicates that management is able to repurchase shares at a discount compared to the average market price during the repurchase month. Therefore, hypothesis H5.1 that states that firms are able to repurchase shares at a discount is not to be rejected.

Table 12: Univariate analysis Discount variable

This table reports the Discount variable, which reflects the relative difference between the repurchase price and the average market price during the repurchase month. The discounts are averaged per repurchase and then the *t*-test is performed across 15,528 repurchases.

	Discount
Coefficient	1.685***
	(0.000)

The fact that management is able to repurchase share at a discount is consistent with existing literature, however the observed magnitude of the Discount variable is nog in line with those of the variables from existing literature. Obernberger (2014) finds a Bargain of 0.56% and Ben-Rephael, Oded and Wohl (2014) find a Diff of -0.266%.

5.3.2 Cross-sectional results

Table 12 in Section 5.3.1 has shown that the Discount variable is significantly positive. Therefore, management is able to time the market when repurchasing shares. Subsequently, the cross section is analysed to examine the nature of the Discount variable. Table 13 reports the coefficient estimates and the *p*-values of the cross-sectional regression on the Discount variable that was found to be significantly positive. The regression suffered from heteroscedasticity, therefore robust

standard errors are used when running the regression. Table A4 in the Appendix also reports the results of the performed multicollinearity tests and shows that there are regarding multicollinearity across the variables used.

Table 13: Cross-sectional regression of Discount variable

This table reports the estimates from the cross-sectional regression in which the Discount is regressed on a set of variables regarding the repurchase or the repurchasing firm. The coefficients are the main entries of this table, with the *p*-values in parentheses. CAR(-6, -1) is the 6-month CAR prior the repurchase and is estimated using the market model. CAR(+1, +6) is the 6-month CAR following the repurchase. ln(Size) is the natural logarithm of the firm's market capitalization on the repurchase day. BM is the firm's book-to-market ratio on the repurchase day. RepSize is the number of repurchased shares relative to the outstanding shares on the repurchase day. RepVolume is the number of repurchased shares relative to the trading volume on the repurchase day. The sample consists of 1,542 repurchases.

	Discount
Independent variables	
Intercept	2.136***
	(0.000)
CAR (-6, -1)	-0.012***
	(0.000)
CAR (+1, +6)	0.004**
	(0.030)
ln(Size)	-0.031
	(0.422)
BM	0.012***
	(0.004)
RepSize	1.227*
	(0.078)
RepVolume	-0.016***
	(0.002)
Adj. R^2	0.005

The cross-sectional analysis on the Discount variable returns an adjusted R^2 of just 0.5%. The R^2 found here is smaller than the R^2 in the Bargain regression of Obernberger (2014) at 1.1% and Ben-Rephael, Oded and Wohl (2014) at 1.5%. Therefore, less of the response variable variation is explained by the model used in this thesis, when compared to the studies previously mentioned.

The CAR(-6, -1) coefficient is negative and significant at the 1% confidence level. Therefore, the found Discount is partly explained due to the abnormal returns in the months prior to the repurchase. Moreover, the decrease in stock price gives management the ability to buy back at a discount. However, the economic significance of this coefficient is debatable, due to the coefficient of -0.012. Therefore, hypothesis H5.2 that states that the abnormal returns prior to the repurchase are negatively correlated with discount realised by the management is not to be rejected.

The CAR(+1, +6) coefficient is significantly positive, as expected, therefore the found Discount is partly explained due to the abnormal returns in the months following the repurchase. This finding is not in line with that of Obernberger (2014), who find a significant negative correlation even though a positive correlation was expected. However, this finding is in line with the original hypothesis drawn up by the author regarding the subsequent returns. Namely, that the subsequent returns are positively correlated with the Bargain variable. The economic significance found in this thesis of this variable is doubtful, due to the CAR(+1, +6) coefficient of 0.004. Therefore, hypothesis H5.3 that states that the abnormal returns following the repurchase are positively correlated with the discount realised by the management is not to be rejected.

Following Ben-Rephael, Oded and Wohl (2014) the $ln(Size)$ and BM variables are incorporated in the cross-sectional regression as a proxy for undervaluation. The coefficient of $ln(Size)$ is negative, however not significant. This finding causes me to reject hypothesis H5.4 that states that states that the Discount variable is negatively correlated with the size variable. The BM variable returns a coefficient of 0.012 that is significant at a confidence level of 1%. This coefficient has the opposite sign when compared to the results of Ben-Rephael, Oded and Wohl (2014). This is due to the fact that the *Diff* is calculated in the same way as the Discount variable in this thesis, however with the opposite sign, as discussed in Section 4.4.1. The signs of the coefficients in the Discount variable analysis and the CAR analyses are alike, due to the methodology of the construction of the Discount variable. The empirical results that the BM variable is positively correlated with the Discount variable is consistent with the findings of Ben-Rephael, Oded and Wohl (2014). Hypothesis H5.5 that states that the coefficient of the book-to-market variable is significantly positive, therefore is not to be rejected.

The *RepSize* coefficient of 1.227 shows a positive correlation between the relative number of shares repurchased and the discount significant at the 10% confidence level. This finding does not

seem logical and furthermore, is not in line with the results of Ben-Rephael, Oded and Wohl (2014) and Obernberger (2014). Both studies argue that the size of a repurchase causes an increase in price, which makes it more difficult to exercise a buyback at a discount relative to the average market price.

Finally, the coefficient of RepVolume, which reflects the number of shares repurchased relative to the volume of that day, is negative and significant at the 1% confidence level. Therefore, on average the larger the repurchased amount relative to the total trading value on the repurchase day, the smaller the realised discount.

6. Concluding remarks

The following sections will serve as a summary of the thesis. In Section 6.1 the main findings are presented that are derived from the analyses performed throughout this thesis. Furthermore, Section 6.2 will present some limitations to the research and additional research concepts that potentially can be of interest.

6.1 Conclusion

6.1.1 Short-term

The first analyses of this thesis are on the short-term price performance following a share repurchase, the following conclusions can be made from the findings from these analyses. Buybacks are preceded by poor ex-ante performance and followed by strong ex-post performance. The poor performance preceding the repurchase implies that management is inclined to repurchase when the firm's stock underperformed. For the short-term I found evidence that supported the information signalling theory. Firms that are more likely to be mispriced, like small or high book-to-market firms, experience a more positive price effect than the large or low book-to-market firms. These findings are consistent with those of Zhang (2005). Firms with low past returns see a larger post-event abnormal return on the short-term, and vice-versa, as in line with the overreaction hypothesis of Peyer and Vermaelen (2009).

The strong ex-post performance confirms that the market adjusts to the information signal and moreover reflects the new fair value of the stock. The firm's size, past returns and repurchase size to trading volume are able to explain the abnormal return from the set of chosen variables.

6.1.2 Long-term

When analysing the effects of a share repurchase on the long-term, no evidence was found in support of the buyback anomaly. Over a long horizon, buybacks are followed by negative returns in contrast to existing literature. However, evidence was found supporting the undervaluation theory regarding the book-to-market ratio of firms. High book-to-market firms have higher returns than low book-to-market firms. In contrast with the short-term analysis, small firms do not perform superior compared to large firms on the long-term. Moreover, no evidence is found regarding the return reversal for the long horizon.

6.1.3 Discount

When comparing the repurchase price to the average market price during the repurchase month, I can conclude that a firm's management is able to repurchase shares at a discount. This finding consistent with existing literature (e.g. Ben-Rephael, Oded and Wohl, 2014 and Obernberger 2014). The firm's abnormal returns, both preceding and following the repurchase, explain the discount realised partly. Moreover, the variables for book-to-market ratio and repurchased shares relative to outstanding shares explain the discount management is able to realise. The positive correlation between the book-to-market ratio and the Discount supports the theory that value stocks are more likely to be undervalued. Furthermore, firms that repurchased a larger fraction of the outstanding shares were able to realise a larger discount. This result is puzzling and not evident as to why this result is found.

6.2 Limitations and future research

The analyses performed in this thesis are subjected to certain limitations. The sample covers a time period where the financial crisis takes place, namely 2008 to 2013. Financial crises cause stock prices to fall and are followed by an increase repurchase volume. It is possible that this influenced the performance of the stocks, and that therefore negative returns are observed on the long-term. Moreover, the decline of share prices, due to the turmoil in financial markets, could influence the repurchase behaviour of firm's management. Therefore, choosing a sample without these difficulties could be beneficial for the research of long-term abnormal returns.

The RepSize coefficient in the cross-sectional regression of the Discount variable in Table 13 return a puzzling finding. It was expected that the correlation would be positive, because the more shares are repurchased the higher the market price. Therefore, the discount should be smaller. A hypothetical explanation for this result could be the following. RepSize is the number of repurchased shares scaled by the shares outstanding at the beginning of the repurchase program. Less shares outstanding could lead to illiquidity problems, which would cause the stock price to decrease. Subsequently, management would be able to repurchase shares at a greater discount. However, this is explanation is purely hypothetical and could be researched more extensively.

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Appendix

Table A1: Description of used variables

This table reports the descriptions of the variables used in the various analyses throughout this thesis.

Description of variables	
BM	Book-to-market of a firm on the repurchase day, calculated by dividing the closing stock price by the book value per share on a given
AR	Abnormal return in percentage calculated using the market model
CAR(-6, -1)	Cumulative abnormal return in percentage from 6 months to 1 month prior to the repurchase month
CAR(-20, -1)	Cumulative abnormal return in percentage from 20 days to 1 day prior to the repurchase day
CAR(0, +2)	Cumulative abnormal return in percentage from the repurchase day to 2 days after the repurchase day
CAR(0, +20)	Cumulative abnormal return in percentage from the repurchase day to 20 days after the repurchase day
CAR(+1, +6)	Cumulative abnormal return in percentage from the month after the repurchase month to 6 months after the repurchase month
ln(Size)	Natural logarithm of the market capitalization of a firm on the repurchase day
Prior6m	Raw log returns from 6 months prior to 1 month prior to the repurchase
RepSize	Ratio of number of shares repurchased relative to the shares outstanding at the moment of the signed resolution at the beginning of the year
RepVolume	Ratio of number of shares repurchased relative to the total trading volume on the repurchase day
Discount	The relative difference between the repurchase price and the average market price during the repurchase month

Table A2: R^2 of the calendar-time regressions

This table reports adjusted R^2 for the calendar-time method regressions used for analysing the long-term price performance.

Panel A: Adjusted R^2 for the calendar-time method for the full sample and the BM quintiles

Months	Full sample	BM 1	BM 2	BM 3	BM 4	BM 5
	Adj R^2	Adj R^2	Adj R^2	Adj R^2	Adj R^2	Adj R^2
12 mths	0.930	0.644	0.771	0.812	0.860	0.827
24 mths	0.936	0.684	0.802	0.842	0.864	0.845
36 mths	0.934	0.717	0.834	0.850	0.874	0.830
48 mths	0.941	0.760	0.861	0.867	0.886	0.855
obs	1542	83	204	405	408	442

Panel B: Adjusted R^2 for the calendar-time method for the size quintiles

	Size 1	Size 2	Size 3	Size 4	Size 5
	Adj R^2	Adj R^2	Adj R^2	Adj R^2	Adj R^2
12 mths	0.330	0.668	0.794	0.758	0.787
24 mths	0.318	0.662	0.821	0.766	0.814
36 mths	0.406	0.656	0.830	0.747	0.814
48 mths	0.440	0.713	0.845	0.789	0.823
obs	114	230	350	444	404

Panel C: Adjusted R^2 for the calendar-time method for the prior 6-month returns quintiles

	Prior 6-month 1	Prior 6-month 2	Prior 6-month 3	Prior 6-month 4	Prior 6-month 5
	Adj R^2	Adj R^2	Adj R^2	Adj R^2	Adj R^2
12 mths	0.855	0.845	0.842	0.817	0.756
24 mths	0.904	0.861	0.867	0.827	0.762
36 mths	0.903	0.863	0.884	0.824	0.793
48 mths	0.915	0.882	0.886	0.853	0.803
obs	211	307	390	379	255

Table A3: Multicollinearity test on the CAR(t_1, t_2) regression

This table reports the results regarding the multicollinearity test of the variables used in the cross-sectional regression on the CARs for the two post-event windows.

Multicollinearity test on cross-sectional regression	
CAR(0, +2) and CAR(0, +20)	VIF
Independent variables	
CAR (-20, -1)	1.01
ln(Size)	1.15
BM	1.01
Prior 6-month return	1.02
RepSize	1.04
RepVolume	1.17

Table A4: Multicollinearity test on the Discount regression

Appendix A4: This table reports the results regarding the multicollinearity test of the variables used in the cross-sectional regression on the Discount variable.

Multicollinearity test on cross-sectional regression	
Discount	VIF
Independent variables	
CAR (-6, -1)	1.16
CAR (+1, +6)	1.16
ln(Size)	1.11
BM	1.00
RepSize	1.05
RepVolume	1.15