Share Repurchases on the Hong Kong Exchange

Price Support of Overvalued Stock

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Monday 24th July, 2017

Abstract

This thesis examines whether firms on the Hong Kong Exchange (HKEX) have been using share repurchases to provide price support to overvalued stock from 2004 until 2015. Short interest is used as overvaluation proxy and the study uses daily share repurchase and short selling data. HKEX firms repurchase more frequently following periods of high short interest. These repurchases on average provide price support in the medium-term, but the price support is less effective when short interest increases. The results show that short interest is positively related to repurchase intensity, but the direction of the relation can not be determined with certainty. Thus, I have not unearthed enough evidence to conclude that managers have been providing price support to overvalued stock on the HKEX from 2004 until 2015.

Keywords: Share Repurchases, Short Selling

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I. Introduction

There is an upward trend in repurchase activity by firms all over the world (Grullon and Michaely, 2004; Skinner, 2008). This has drawn the attention of researchers and share repurchases are now a popular topic for empirical research. The information content of buybacks is widely examined and it turns out that share repurchases are followed by periods of positive abnormal performance, see e.g. Ikenberry, Lakonishok, and Vermaelen (1995); Bargeron, Bonaime, and Thomas (2017). Researchers report several motives for repurchases. Repurchases can reduce agency costs (Jensen, 1986), replace dividends (Dittmar, 2000), alter a firm's capital structure (Bonaime, Oztekin, and Warr, 2014), function as takeover defense (Sinha, 1991), and firms can use repurchases to signal undervaluation (Vermaelen, 1981). Liu and Swanson (2016) state that managers also use repurchases to support overvalued stock. I find this an interesting motive since it implies that they repurchase shares for prices above fundamental value and thus pay "too much". This conflicts with the interests of the shareholders.

Overvaluation is not easily measured, because how do you determine overvaluation? Short selling, however, has often been used as proxy for overvaluation (Ben-David, Drake, and Roulstone, 2015; Liu and Swanson, 2016). In the literature a lot of evidence exists to show that short sellers are well-informed since heavily shorted stocks significantly underperform lightly shorted stocks (Boehmer, Jones, and Zhang, 2008; Boehmer, Huszar, and Jordan, 2010). Christophe, Ferri, and Angel (2004) report that short sellers are informed in advance of public announcements and Karpoff and Lou (2010) find evidence that short sellers observe misrepresentations in financial statements before they are publicly announced. Thus, researchers overall agree in the short selling literature that short sellers can be seen as sophisticated investors. However, informed parties (like short sellers) do not always agree with each other. Bargeron and Bonaime (2017) report that short sellers sometimes disagree with firms. This trading against each other is similar as the findings of price support of overvalued stock found by Liu and Swanson (2016).

Repurchase disclosure requirements on the Hong Kong Exchange (HKEX) require that listed firms report repurchases on a daily basis to the exchange. This makes the HKEX very suitable for empirical research in this field. Researchers often use repurchase programs in their research, but the major flaw here is that firms are not obliged to fully execute the program. The HKEX data furthermore is actually repurchase data. This means that the repurchases are actually executed. The HKEX data therefore gives better insights in the behaviour of firms than repurchase program data. The central question in my thesis examines whether HKEX firms effectively gave price support to overvalued stock through

repurchases. The key question is constructed as follows.

Did firms on the Hong Kong Exchange use share repurchases to provide effective price support to overvalued stock from 2004 until 2015?

Firstly, I start by examining whether firms repurchase more frequent following periods of high short interest. I analyse the joint frequencies of repurchases and short interest. In my sample, firms indeed repurchase more often following periods of high short interest. Since I use short interest as proxy for overvaluation, this brings me to the conclusion that firms repurchase relatively frequently following times of overvaluation. In line with this, I find that cumulative abnormal returns (CARs) in the pre-repurchase period are negative which implies that managers on average repurchase after periods of underperformance. This is the first indication of a price support motive for overvalued stock on the HKEX. However, it is too soon to conclude that the overvaluation leads to repurchases and not the other way around.

Following the potential existence of a price support motive for overvalued stock, I test the effectiveness of repurchases as price support with the use of an event study. In general, repurchases turn out to boost performance during the initial reaction period (0,+2), as well as in the medium-term (0,+20). Although this conflicts with the efficient market hypothesis, it implies that price support can be given through buybacks. My findings show that prior short interest negatively influences the CARs and thus the effectiveness of the price support. Firms can provide price support for heavily shorted stocks during the initial reaction period, but it is not sustainable in the medium-term. In line with the existing literature I find that the price support is most effective for stocks that have a short interest of zero and second best are the lightiest shorted stocks. Concluding, the price support does not hold in the medium-term for highly overvalued stock. If managers would indeed gave price support to overvalued stock, I should find negative post-repurchase CARs since prices eventually return to fundamental value.

My final analysis examines whether firms indeed repurchase based on overvaluation (short interest). I use a fixed effects model. Repurchase intensity is positively related to both short interest and prior short interest. Short interest is not dependent on prior levels of repurchase intensity. This gives rise to the assumption that managers give price support to overvalued stock through repurchases. However, I can not conclude with certainty on the direction of the relation going from short interest to repurchase intensity. Among other things, when I rerun the analysis on a monthly level, the significance of the positive relation between prior short interest and repurchase intensity disappears.

The overall conclusions based on my research are that HKEX firms repurchase more often if their stock is overvalued. A repurchase on average provides price support. However, the effectiveness is negligible for overvalued stock (heavily shorted stock), since no abnormal returns are shown in the medium-term. It is hard to say that overvaluation is definitely the reason for managers to decide on a repurchase, but there are indications that point towards this conclusion. My advice to managers is that they should be careful to give price support to overvalued stock, for the desired effects are not achieved and the repurchases are relatively costly during periods of overvaluation.

This thesis contributes to three flows in academic literature: the repurchase literature, the short selling literature, and the literature about disagreement between informed parties. My thesis adds to the existing literature by: (i) examining the existence of a price support motive in the case of overvalued stock on the HKEX, (ii) examining the effectiveness of this price support, and (iii) using daily actual repurchase data to get more detailed insights into actual repurchase behaviour.

The outline of the thesis is as follows. The next chapter (Chapter II) discusses the background of share repurchases and short selling on the HKEX. Chapter III consists of a review of the relevant literature and the development of the hypotheses. I describe the data and used methodology in Chapter IV. Chapter V analyzes the interaction between share repurchases and short selling. Concluding remarks are discussed in Chapter VI.

II. Background

This chapter starts with discussing overall information about the HKEX. Then I set out the various methods of share repurchases and the disclosure requirements on the HKEX. Next I explain the rules and restrictions on short selling. Finally I shortly touch upon the monitoring of short selling activity by the authorities.

The HKEX consist of two different exchanges: the Main Board (MB) and the Growth Enterprise Market (GEM). The MB is intended for companies that meet higher financial requirements.[1] A new MB applicant must have a trading record of not less than three financial years. Furthermore, there are three tests of which the company should pass at least one: (i) the Profit Test, (ii) the Market Cap/Revenue Test, and (iii) the Market Cap/Revenue/Cashflow Test. Only one of these have to be be passed in order to qualify for the MB. The Profit Test demands a profit from more than HK$50 million over the last three years and a market capitalisation of HK$200 million. The Market Cap/Revenue

[1]The requirements for the MB and GEM are stated in respectively chapter 8 of the 'MB Listing Rules' and chapter 11 of the 'GEM Listing Rules'.

Test requires a market capitalisation of HK$4 billion and revenues of HK$500 million for the most recent audited financial year. The Market Cap/Revenue/Cashflow Test demands a minimum market capitalisation of HK$2 billion, HK$500 million revenue in the most recent audited financial year, and a positive cashflow of at least HK$100 million from operating activities in aggregate for the three preceding financial years. Equity securities can be listed on the MB in the form of shares or depositary receipts (HDRs).

The requirements for the GEM are easier to meet. An applicant must have a trading record of at least two financial years consisting of a positive cashflow of at least HK$20 million and a Market Cap of at least HK$100 million. Equities can be listed on the GEM of shares. The GEM is positioned as a second board since July 1st, 2008. The GEM should be seen as the first step towards a listing on the MB. Since this thesis only contains MB stocks, from here onwards I will only discuss the relevant MB aspects.

A. Share repurchase regulation

The Securities and Futures Commission (SFC) is an independent statutory body set up in 1989 to regulate Hong Kong's securities and futures markets. The SFC issued *The Codes on Takeovers and Mergers and Share Buy-backs* (the Codes) in consultation with the Takeovers and Mergers Panel. The Codes does not have force of law, but market participants have a consensus of opinions that it should be considered as acceptable behaviour. Rule 1 of the Codes states that only four types of share buybacks are allowed: (i) an on-market share buyback, (ii) an off-market share buy-back approved in accordance with Rule 2 of the Codes, (iii) an exempt share buyback, and (iv) a share buyback by general offer in accordance with the General Principles and Rules of the Codes.

The on-market share buy-back is by far the most common way of buying back shares. It is the situation in which a company buys back shares in the regular way through the facilities of the Stock Exchange Hong Kong (SEHK) or another recognised exchange. This enables the company to buy the shares anonymously. The shareholders of a company whose primary listing is on the MB must provide a specific approval or general mandate through an ordinary resolution at a general meeting before repurchasing shares. Therefore, the company should also send an Explanatory Statement to it's shareholders containing all information necessary to make an informed decision concerning the approval or mandate. The number of shares that can be repurchased under the mandate may not exceed 10% of the issued shares. Furthermore, there are some dealing restrictions for repurchasing firms. Some examples are that an issuer can only buy if the market price is less than 5% above the average closing market price of the past 5 trading days, stocks may not be bought back from core connected

persons, and that the issuer shall not purchase after inside information came to his knowledge and not yet been distributed to the public.

Very interesting disclosure requirements apply on the HKEX regarding share repurchases. Companies are obliged to report buyback information on a particular day at latest 30 minutes before the start of the next trading day. This information includes among other things the total number of shares bought back and the purchase price per share (or the highest and lowest price paid when relevant). These disclosure requirements create insights on a daily level. The availability of daily actual repurchase data makes the HKEX stocks very suitable for empirical research since the actual repurchase behaviour can be studied instead of announcements that may never be executed.

B. Short selling regulation

Short selling was only allowed since January 1994 on the HKEX. At first, only 17 securities were eligible for short selling under the pilot scheme and short sales could only be made for prices higher than the best current ask price ("the tick-rule"). In March 1996 extra securities were added to the list of designated securities and the tick-rule abolished. However, the tick-rule was reintroduced in a modified form in September 1998 because of turbulent market conditions. For stock option market makers the tick-rule does not apply in the context of performing their duty. Since then, the list of designated securities for short selling is updated on quarterly basis. Securities eligible for short selling are among others: constituent stocks of indices traded on the exchanges, stocks with market capitalisation higher than HK$3 million and turnover to market capitalisation ratios of at least 60%, approved Exchange Traded Funds (ETFs), securities traded under the Pilot Program, and stocks that are traded for less than 60 trading days which had a public float capitalisation of at least HK$20 billion during 20 consecutive trading days as well as an aggregate turnover of at least HK$500 million during this period.

Market makers are obliged to report short selling transactions to the exchange when placing a short sales order. The exchange keeps track of all short sales transactions per stock. It then makes a daily summary of all the transactions with both short sales volumes and values. It takes around one day for this information to become publicly available. Thus, HKEX short selling data is also available on a daily basis.

III. Theoretical framework

This chapter starts with a literature review of the relevant academic papers for my thesis. After discussing the literature, I develop hypotheses which I use during my research.

A. Literature review

The literature review consists of three parts. The first parts discusses both the information content and the motives of share repurchases. In the second part, I discuss the academic literature about short sellers being sophisticated investors. The final part introduces the literature which describes disagreement among well-informed parties.

Share repurchases: information and motives

Share repurchases are an interesting phenomenon since it both increases demand and decreases supply at the same time. Simple economic theory states that both these changes (in demand and supply) push prices up. Firms can use this knowledge to influence the price of their stock and thus investors' return. Another way in which buybacks draw the attention of investors, is through the fact that they lower the number of shares outstanding. If earnings stay constant and the number of shares outstanding lowers, the earnings per share (EPS) go up. This is a KPI investors often look at and it seems that the firm's performance improves. However, a rational investor should ask himself the question whether this improvement in performance measure is a true reflection of a company's performance.

There is an overall upward trend in share repurchase activity (Grullon and Michaely, 2004; Skinner, 2008). These buybacks are more often executed as part of repurchase programs (Stephens and Weisbach, 1998). The content of the announcement of such programs consists of a time period in which the firm plans to repurchase a certain number of shares. A problem which arises when using repurchase programs for empirical research, lies in the fact that these announcements do not oblige firms to execute the proposed share buybacks. Stephens and Weisbach (1998) report that the completion rates[2] average between 74% and 82% in a sample from 1981 to 1990. These findings suggest that using actual repurchase data could be more precise when examining firms' motives for repurchases. The research of Babenko, Tserlukevich, and Vedrashko (2012) is although an example in which repurchase programs are used whereby they investigate a link to insider purchases.

One part of the repurchase literature examines the relation between repurchases and

[2]Completion rate is the realized number of shares repurchased as percentage of the announced number of shares under the program.

undervaluation. Vermaelen (1981); Comment and Jarrell (1991); Ikenberry et al. (1995); Stephens and Weisbach (1998); Jagannathan and Stephens (2003); Chan, Ikenberry, and Lee (2004); Bargeron et al. (2017); Manconi, Peyer, and Vermaelen (2017) all report positive abnormal returns following repurchases. Thus, it could be the case that managers use repurchases to signal undervaluation. In my opinion, it makes sense to assume that managers can be classified as well-informed regarding their own firm. They are responsible for the day-to-day business and thus acquire private information about the firm's performance through their role in the organisation. Peyer and Vermaelen (2009); Bonaime (2012) come to the conclusion that managers indeed communicate undervaluation during public events as motive for repurchases. The undervaluation motive is also widely reported in the academic literature (Vermaelen, 1981; Ofer and Thakor, 1987; Ikenberry et al., 1995; Grullon and Michaely, 2004; Brav, Graham, Harvey, and Michaely, 2005; Louis and White, 2007; Babenko et al., 2012). When firms buyback shares, and especially when they pay a premium on top of the market price, it could be interpreted as management believing that stocks are undervalued (Vermaelen, 1981). If managers are indeed able to observe undervaluation and to use share repurchases to signal this to the market, the expectation is that repurchase prices are relatively low to average market prices. Ben-Raphael, Oded, and Wohl (2013) find evidence that only small S&P 500 fimrs buyback at prices relatively low compared to other investors. This could potentially be caused by the fact that analyst coverage of small firms is less and thus the prices could easier deviate from fundamental value which gives the firm the opportunity to buy below the average price. Hence, they state that small firms probably repurchase strategically while large firms use repurchases to disburse free cash. Ben-Raphael et al. (2013) also find that repurchase intensity goes up following a period of poor stock price performance and this increase in repurchase intensity lasts two months. They report a positive abnormal return following repurchases for small firms. Large firms, however, do not show significant abnormal returns. Dittmar and Field (2015) find similar results. They find that firms are able to buy at prices significantly lower than average prices. However, they specify that this is particularly the case for firms that repurchase less frequently.

The *traditional signaling hypothesis* is also researched by Ikenberry et al. (1995). They find positive abnormal returns of 12.1% over a period of 48 months after repurchases. Firms considered to be "value stocks", which are more likely to repurchase because of undervaluation, even show an average abnormal return of 45.3%. Ikenberry et al. (1995), however, state that markets are reacting very slowly after repurchases which they call the *underreaction hypothesis*. Babenko et al. (2012) add to this field by concluding that the credibility of an undervaluation signal increases if insiders buy shares prior to the repurchase announcement.

The signalling hypothesis, as discussed above, basically states that repurchase announce-

ments signal positive information about the firm to the market. This implies that the returns of both stockholders and bondholders go up and are thus positively correlated. However, the wealth transfer hypothesis proposes a negative correlation between the returns of these two stakeholders. Share repurchases can be financed by decreasing assets or by increasing debt. If the buybacks cause a decline in assets, it means that the value of the claim of the bondholders decreases. Therefore, the repurchase can be seen as a wealth transfer from bondholders to shareholders. If the firm decides to finance the share repurchase with debt, the assets stay constant, but the number of bondholders who have a claim on the value of the assets increase. This is also unfavorable for existing bondholders and thus also implies a wealth transfer from bondholders to stockholders.

Jensen (1986) report that repurchases are used to reduce agency costs. Firms with a lot of free cash can eliminate low-return investment opportunities by distributing the free cash back to their shareholders using share repurchases. The firms can achieve the same result by paying out dividend. However, there are some advantages to using buybacks over dividend payouts. If a firm announces a dividend increase, this does not create an obligation to act upon it. If the firm decides at a later date to reduce the dividend, the market will punish this with a large stock price reduction. In the case of the announcement of a repurchase program this equally does not create an obligation to execute the repurchases. If the firm decides to repurchase less than previously announced, the market however does not make such a sharp stock price correction as it does in the case of a dividend cut (Jensen, 1986). Furthermore, using a share repurchase has some tax advantages. This is especially relevant if the buyback is financed with debt since interest payments are often tax deductible for the firm. Furthermore, from an investors' perspective capital gains are often taxed at a lower rate than dividend income (Dittmar, 2000).

Repurchase literature furthermore states that buybacks can be used to alter the capital structure (Dittmar, 2000; Bonaime et al., 2014). Firms can finance repurchases by lowering assets or by increasing debt. Both methods push a firm's leverage ratio up. Assuming that there is an optimal leverage ratio, implies that share repurchases could be used to increase the leverage if the current ratio is below the target level. Dittmar (2000) assumes in his research that there is indeed such an optimal level. He uses the mean net debt-to-asset ratio of all the firms with the same two-digit SIC code as optimal target leverage level. He proposes that by including the difference between the actual leverage and the optimal leverage should have a more negative relation with repurchases in the case of a repurchasing firm than a non-repurchasing firm. He concludes that firms indeed use share repurchases to alter their leverage ratio (Dittmar, 2000). Baker and Wurgler (2002) add to this field by stating that there is no optimal leverage ratio and that the capital structure is just the

cumulative outcome of past attempts to time stock markets.

Almost all firms have takeover defenses that could prevent or slow down a hostile takeover. At the time of writing this is hot topic in the Netherlands with the attempt of Kraft Heinz to buy Unilever and subsequently PPG trying to acquire AkzoNobel. There are different methods which could be used as defense mechanism for instance the existence of preference shares, poison pills, but also share repurchases could function to lower the attractiveness of an acquisition. As explained earlier, buybacks are often financed with debt and thus increase a firm's leverage ratio. Sinha (1991) presents the theory that this makes the target less attractive to the acquirer and thus could be used as takeover defense mechanism. Managers should consider the trade off between the advantages of the takeover protection and the disadvantages of a higher leverage ratio. After all, increasing debt also increases the probability of bankruptcy which entails costs. Billett and Xue (2007) add to this field of research by claiming that prior research fails in measuring the accurate effectiveness of share repurchases as takeover deterrent. They state that prior research fails to address the situations in which the acquiring firm is deterred to make an attempt in the first place. In my opinion this indeed seems like a legitimate observation. They find a positive relation between share repurchases and takeover probability which, as they suggest, gives rise to the existence of takeover threats as motivation for share repurchases (Billett and Xue, 2007). Bagwell (1991) already wrote about share repurchases as being a takeover deterrent. She concludes that it indeed can drive up the cost to an acquirer since a repurchase eliminates the shareholders with the lowest reservation values, leaving the ones with a relatively high valuation. Bagwell (1991) links the effectiveness as takeover deterrent to, among others, capital gains taxation. The effect is more favourable in a situation of relatively high taxes.

Liu and Swanson (2016) come up with an additional explanation, stating that managers use share repurchases to support overvalued stock. Hribar, Jenkins, and Johnson (2006); Almeida, Fos, and Kronlund (2016) state that managers use repurchases to meet earnings per share (EPS) thresholds since it reduces the number of shares outstanding. Since executives' compensation is often partly based on these kind of threshold, buybacks can be used to boost compensation (Cheng, Harford, and Zhang, 2015). The stock price is relevant for managers since they often own stocks and options of the firm they work for. They benefit from preventing stock prices to decrease. This is even more relevant in times of overvaluation, since the expectation is that the market will make a downward correction in the future. Vermaelen (1981); Ofer and Thakor (1987); Ikenberry et al. (1995); Babenko et al. (2012) argue that managers have more insights than regular investors whether their stock is under- or overvalued.

If we assume that fundamental values drive stock prices, highly informed traders like

managers and short sellers should on average make similar valuations of stocks. Since short sellers gain on downward price movement and repurchasing firms on upward price movements, the firm and short sellers should be contrarian trading parties. However, the repurchasing decision is made by a manager who could potentially have other incentives than the stockholders since he does not repurchase with his own capital (Liu and Swanson, 2016). The relation between managers and stockholders can be seen as an agent-principal relationship. Agency costs arise due to the fact that managers' incentives are not fully aligned with the interest of the stockholders. Liu and Swanson (2016) find evidence that executives use share repurchases to support overvalued stock. Buying back overvalued stock is unfavourable for stockholders since the market on average makes a downward price correction towards fundamental value. In my opinion, the price support of overvalued stock is an undesired motive for repurchases.

Well-informed short sellers

In order to determine whether stock is overvalued, an overvaluation measure is needed. Short interest is often linked to negative abnormal returns (Seneca, 1967; Figlewski, 1981). Also Desai, Ramesh, Thiagarajan, and Balachandran (2002); Asquith, Pathak, and Ritter (2005) report similar results. Therefore, short interest is a usual proxy for overvaluation (Ben-David et al., 2015; Liu and Swanson, 2016). Boehmer et al. (2008) find that heavily shorted stocks underperform lightly shorted stocks with 1.16% over the 20 following trading days. This difference is even larger for short sales performed by institutions. Leung and Wang (2009) investigated short selling and stock returns for HKEX stocks. They conclude that short selling indeed contains negative information which signals a future price decrease. They observe cumulative abnormal losses after short selling transactions. Boehmer et al. (2010) show partly similar results. They find that stock with relatively high levels of short interest subsequently experience negative abnormal returns. Heavily traded stocks with low short interest levels, however, show positive abnormal returns in their research. They propose that short selling barriers potentially cause this outcome. The overall trend in the literature is that short selling is followed by negative subsequent returns and thus that short interest is negatively associated with abnormal returns. Christophe et al. (2004) report informed short selling in pre-announcement periods. Misrepresentation in financial statements is noticed by short sellers before even publicly revealed, since short interest increases in a period of more than one year before the announcement in the research of Karpoff and Lou (2010). Also Fang, Huang, and Karpoff (2016) report that short sellers are well-informed and that short selling can improve price efficiency, since the short sellers are able to detect fraud and

curb earnings management. All these studies show that short sellers can be considered as sophisticated investors (Christophe et al., 2004; Karpoff and Lou, 2010; Fang et al., 2016). Therefore, I use short selling as overvaluation proxy.

Disagreement among informed parties

There are more well-informed parties than just short sellers. The literature shows that these informed parties do not always agree with each other. Diether, Malloy, and Scherbina (2002) come to the conclusion that subsequent returns turn out substantially lower if analysts disagree on the forecast of earnings of a firm. This phenomenon is even stronger for stocks that are more illiquid (Sadka and Scherbina, 2007). On the other hand, Carlin, Longstaff, and Matoba (2014) investigate the mortgage-backed security market and find that disagreement comes with higher expected returns, higher return volatility, and larger trading volume. Two other groups of informed parties are short sellers and hedge funds. Hedge funds also short stocks in the same way as short sellers do. These two parties, however, do not always short a stock based on the same reason. Jiao, Massa, and Zhang (2016) states that hedge funds also establish short positions together with a long position as part of a hedging strategy. In line with the theory of hedge funds shorting as part of a hedging strategy, Nezafat, Shen, Wang, and Wu (2016) find that negative performance associated with short selling disappears if the short positions are held by hedge funds.

The disagreement between short sellers and firms is examined by Bargeron and Bonaime (2017). They admit that short sellers are well-informed and that agency problems can bias managerial decisions. Their conclusion is that repurchases contain enough positive information to dominate the effect of short interest since positive abnormal performance is shown after repurchases. On the other hand, repurchases are not informative if the firm has an anti-dillution motive (Bargeron and Bonaime, 2017). The motive that firms use repurchases to cancel dillution do to the exercise of stock options is also examined by Kahle (2002).

Earlier in this chapter, I spoke about the research of Liu and Swanson (2016). They examine the price support motive of repurchasing firms and find a positive association between quarterly changes in repurchases and quarterly changes in short interest. They report positive abnormal returns after a repurchase which indicates that the repurchases are effective as price support. Furthermore, Liu and Swanson (2016) involve insider trades in their research. It seems that insiders often follow short sellers, because on average they sell during increases in short interest. They report, however, that insiders hold their positions during the price support which implies that they believe the price support will work (Liu and Swanson, 2016).

B. Hypotheses

Following Liu and Swanson (2016) I expect that share repurchases are used to support overvalued stock. This implies that firms repurchase following relatively high levels of short interest. Hence, I construct the following hypothesis.

Hypothesis 1 (H1)**.** *Firms repurchase more frequently following periods of high short interest.*

The price support motive assumes that share repurchases push prices up. In other words, repurchases are followed by periods of positive abnormal returns. Ikenberry et al. (1995) and Zhang (2005) are just two examples of research in which these periods of high returns are shown following firms buying back their own shares. Busch and Obernberger (2016) examine US stocks and find that share repurchases make prices more efficient by providing price support at fundamental values. In the case of price support the repurchases make price less efficient. The similarity between these studies lies in the fact that repurchases can be used to influence prices. In the short-term, repurchases are likely to cause positive abnormal returns due to the fact that the firm signals information about undervaluation to the market. An efficient market should react on this which causes an upward price correction and thus a positive abnormal return. Therefore, I construct the following hypothesis.

Hypothesis 2 (H2)**.** *Share repurchases provide price support.*

As discussed earlier, short selling is a widely respected proxy for overvaluation in the literature. High short interest is associated with negative abnormal returns in a lot of studies (Seneca, 1967; Figlewski, 1981; Desai et al., 2002; Asquith et al., 2005; Boehmer et al., 2008). Hence, I expect that post-repurchase CARs are also lower in times of high short interest. I therefore expect that the price support through share repurchases is less effective for heavily shorted stocks. This leads to the following hypothesis.

Hypothesis 3 (H3)**.** *Price support through share repurchases is less effective for heavily shorted stock.*

The last step of this thesis tries to explain patterns in repurchase intensity and short interest. I start with explaining repurchase intensity with short interest. This is quite a rare process in the repurchase literature, since often the effects of repurchases are examined instead of the other way around. However, Liu and Swanson (2016) do examine this relationship with quarterly data. They find a posive relation between $\Delta Short\ Interest$ and $\Delta Repurchase\ Intensity$ which suggests that managers indeed increase share repurchases in times of overvaluation. In line with Liu and Swanson (2016) I construct the following hypothesis.

Hypothesis 4 (H4)**.** *Repurchase Intensity is positively related to Short Interest.*

It is often very hard to conclude the existence of a causal relationship, but I try to obtain arguments to state that short interest indeed leads to repurchases instead of the other way around. I therefore test whether repurchase intensity is positively related to prior short interest. This helps me identifying the direction of the relation. Finding evidence of a relation between short interest in the past and repurchase intensity in the present suggests that short interest leads to repurchase intensity and not the other way around. In my opinion, it does make sense to assume that the relation goes from short interest to repurchase intensity and not the other way around, because of the potential managerial bias caused by the fact that managers do not repurchase with their own money. The last part of identification strategy consists of examining the influence of repurchase intensity on short interest. If the causal relation goes from short interest to repurchase intensity, I should find no significant relation between short interest and prior repurchase intensity.

In the last part of the analysis, I try to explain repurchase intensity and short interest. There are, however, of course many more factors than just these two with an effect on these two variables. Hillert, Maug, and Obernberger (2016) find that repurchases improve liquidity. Furthermore, they find that lower liquidity leads to lower repurchase intensities. This implies a positive association between repurchase intensity and liquidity. I use the Amihud (2002) measure which is actually an illiquidity measure. Therefore, I expect a negative association between Amihud and repurchase intensity. Market capitalisation is also often used as explaining variable for repurchase intensity. A negative association is reported between prior market capitalisation and repurchase intensity (Vermaelen, 1981; Ofer and Thakor, 1987; Ikenberry et al., 1995). In my opinion, this makes sense, because higher market capitalisation often implies higher stock prices and thus repurchases are more expensive. Therefore, I also expect a negative association between market capitalisation and repurchase intensity. Furthermore, Liu and Swanson (2016) report a negative relation between repurchase intensity and prior returns. I expect similar results since after periods of high returns there is less need to provide price support through repurchases. Furthermore, the price is probably relatively high.

Earlier in this chapter, I already touched upon the short selling literature. Kot (2006) describes that short sellers behave as momentum traders on the NASDAQ. The momentum theory of Jegadeesh and Titman (1993) states that well performing stocks on average remain well performing stocks. If short sellers act as momentum traders, this implies that they increase their short positions if prior returns decrease. Therefore, I expect a negative association between prior return and short interest. The same argument can be made for market capitalisation. Higher market capitalisation probably means that the stock performed well

and thus short sellers will decrease their position. Hence, I expect a negative sign between market capitalisation and short interest. Furthermore, I expect that lower liquidity leads to more short selling, because I assume that investors will be less likely to buy the stock. This implies that I expect a positive relation between short interest and Amihud.

IV. Data and methodology

This chapter describes the data collection, the sample construction, and the methodology which I use during my thesis.

A. Data collection

The initial sample consists of all daily repurchases on the HKEX from January 2003 to December 2015. As mentioned earlier in the Background chapter, the disclosure requirements on the HKEX are really favourable for empirical research. Due to the daily obligation to disclose repurchases on a daily basis, I am able to obtain actual daily repurchase data per firm. The repurchase data can be obtained for free from the HKEX-website[3]. My thesis supervisor, Stefan Obernberger[4], provided me with a combined dataset of all repurchases on the HKEX from January 2004 to December 2014. I manually downloaded all the daily files of repurchase in the years 2003 and 2015, together with Thim Donkervoort[5]. Only repurchase transactions done in Hong Kong Dollars (HKD) on the HKEX are kept for my thesis.

Next, I match the repurchase data with all kind of company data. I first create a linking table that contains (i) the name of the company (as denoted in the repurchase data set), (ii) the firm ID, and (iii) the Datastream name. I merge the linking table based on name of the company to the repurchase data. Now, my repurchase data has the ID which gives unique combinations when combined with a date variable. Hence, I merge the company data to the repurchase data based on ID and date. The company data is obtained from two data sources: Datastream and Worldscope. I use the Datastream database to obtain daily prices, market capitalisation, and stock split adjustment factors, among other things. The Worldscope database provides me with annual financial statement data like bookvalue per share, the number of shares outstanding, etc. Since annual reports are by definition published only once a year, the variables which are obtained from the financial statements only vary once a year.

[3]HKEX website: www.hkex.com.hk

[4]Dr. Stefan Obernberger is an assistant professor at the Erasmus School of Economics.

[5]Thim Donkervoort is a master student at the Erasmus University Rotterdam.

The third part of my initial sample contains short selling data. The HKEX offers many different data products on their website, but the short selling data is not for free. I was able to obtain the short selling data from January 2004 to December 2015 on the HKEX, with the help of my thesis supervisor. The reader should notice that we were not able to obtain short selling data for 2003. The short sales data is daily and is produced in files per month. I first combine all the different short selling data files into one file and then merge this with the other data. Again, I first had to make a linking table since the short selling data contained stock codes instead of IDs. Then, I compute the merge based on ID and date combinations.

Sample construction

My initial sample consists of 6,300,469 observations and 1,811 unique firms. I start by removing all observations before 2004 and after 2015 since those are the years that I have repurchase and short selling data for. This brings me to 5,670,241 observations and 1,811 unique firms. After looking through the data, I find 10 firms[6] for which the repurchase prices are totally different to actual stock prices based on Datastream data. Thus, I exclude those firms from my sample. Next, I manually adjust three observations for which it seems that the HKEX wrongly inserted the prices with a factor 10. I also set the average repurchase price to missing if it is higher than the highest price paid in that transaction with a margin of 1%. A similar check is done with the lowest price paid. This adjustment is relevant for 18 observations. Next, I drop 44,705 observations because of a smaller ask price than bid price which does not make sense. In the next step I lose 225 observations, because the calculated *Repurchase Intensity* is higher than 100% which means they bought back more shares than there are shares outstanding. I now have 5,597,132 observations and 1,802 unique firms. Next, I remove all observations which have missing variables needed for my analyses. This results in 3,522,111 observation and 1,650 unique firms. Furthermore, I only keep the firms that have at least one repurchase and short selling transaction during my sample period. This brings me to 859,183 observations and 350 unique firms. Lastly, I remove firms with only one repurchase (singletons). Correia (2015) states that singletons can overstate statistical significance in fixed effects models, because those models look at the within group variation. If a firm has only one observation, there is no within variation. My final sample consists of 827,075 observations and 338 unique firms which is my final sample used in the analyses.

Table 1 shows the number of repurchasing firms, the number of repurchase transactions, the total repurchase volume (number of shares), and the total repurchase value (HKD) per

[6]This was the case for the IDs: SSSH, FIRE, MISE, FIRM, CHOR, LUCK, CHEI, QTEC, CONH, GDEV.

Table 1

Repurchases on the HKEX in 2004-2015

This table shows the repurchase activity on the HKEX in the years 2004 until 2015. It contains four columns per year with respectively: the number of firms, the number of repurchases, total repurchasing volume in million stocks, and total repurchasing value in million HKD.

Year	Number of repurchasing firms	Number of repurchases	Total repurchase volume (million stocks)	Total repurchase value (million HKD)
2004	22	274	273	1,105
2005	31	435	572	3,230
2006	35	398	523	1,582
2007	53	819	847	4,255
2008	143	3,041	4,825	16,277
2009	52	1,015	1,965	5,594
2010	52	648	1,049	4,401
2011	120	1,885	3,372	9,408
2012	87	1,719	2,370	5,226
2013	65	1,172	1,735	9,460
2014	100	1,589	4,541	14,138
2015	101	1,723	5,464	22,040
Total	338	14,718	27,537	96,717

year. This table clearly shows that repurchase activity is increasing from 2004 until 2015. Something else that immediately draws my attention is the peak during the financial crisis in 2008. I can imagine that firms tried to act against the falling stock prices.

Construction of the variables

The most important variables of my thesis are *Repurchase Intensity* and *Short Interest*. *Repurchase Intensity* is defined as the number of shares repurchased during a day divided by the number of shares outstanding. The number of shares outstanding is daily calculated by taking the *Market Cap* of a stock divided by the adjusted price. The adjusted price is the stock price corrected for stock splits. I add up repurchases per month and divide this number by the average number of shares outstanding to calculate *Repurchase Intensity* on a monthly level. *Short Interest* is calculated in a similar way. It is the number of shares sold short divided by the number of shares outstanding. Monthly *Short Interest* is also calculated by taking the total number of shares sold short during a month divided by the average number of shares outstanding.

I follow Amihud (2002) to construct my liquidity measure. *Amihud* is defined as the average absolute daily stock return divided by the daily turnover in millions over 247 trading days[7] *Market Cap* needs no calculations since it is taken straight from Datastream. I take the average *Market Cap* in a month to compute the monthly *Market Cap*. *Return* is the daily stock return and is calculated with the use of the return index which already takes stock splits into account. Monthly *Return* is calculated with the return index on the last day

[7]One year consists on average of around 247 trading days.

of each month. I winsor *Return* and *Amihud* on the 1% level to limit the effect of outliers. Furthermore, I take the natural logarithm of *Amihud* and *Market Cap* to reduce the effect of outliers even further and to make sure the variables are more normally distributed. Monthly *Amihud* is just the average *Amihud* in a month. Further information about the variables can be found in Table 7 in the Appendix.

Descriptive statistics

Table 2 shows the desriptive statistics of my final sample. Panel A and C show the descriptive statistics over all observations, while Panel B and D average on firm level. Panel C and D only contain observation for which *Repurchase Dummy* equals 1. My final sample consists of 827,075 firm-days from which only 14,718 repurchase firm-days. The overall mean (median) of *Repurchase Intensity* is 0.00% (0.00%) due to the fact that the number of days with a repurchase is relatively small compared to the whole sample. Only taking days with repurchases into account, *Repurchase Intensity* averages 0.06%, which is equivalent to 1.87 million stocks. The median of *Repurchase Intensity* is 0.03% or 0.46 million stocks. *Short Interest* averages 0.01%, which means that the daily short sales transactions are on average 0.01% of shares outstanding, which is equivalent to 288,853 stocks. The median of *Short Interest* is 0.00% since only 279,982 out of the 827,075 have short sales. The liquidity measure *Amihud* is on average (median) 27.52 (0.72) in my sample. The *Market Cap* ranges from 8.64 million HKD to 1.60 trillion HKD with an average (median) of 13.54 (3.27) billion HKD. Furthermore, *Return* varies from -10.00% to +13.20% with an average (median) of 0.05% (0.00%).

Panel B and D of table 2 thus show the descriptive statistics after averaging on firm level. These statistics give insights into the "average firm". The average (median) *Repurchase Intensity* of firms on days with repurchases is 0.09% (0.06%), which is equivalent to 3,089,585 (1,001,750) stocks. *Short Interest* averages (median) 0.01% (0.00%) which is equivalent to 298,942 (59,998) stocks. The mean (median) of *Amihud* is 23.36 (164.56). The average firm has an average *Market Cap* of 12.52 billion HKD and median of 4.16 billion HKD. *Return* averages (median) 0.04% (0.04%). More detailed descriptive statistics can be found in Table 2.

B. Methodology

The empirical analysis of my thesis consists of three sections. In the first section, I examine whether firms repurchase more often following periods of high short interest. The second section consist of looking at the effect of repurchases on subsequent performance and

Table 2

Descriptive statistics

This table presents the descriptive statistics of HKEX stocks that repurchased shares during 2004-2015. I report the arithmetic mean, the median, the standard deviation, the minumum, the maximum, the 1st percentile, the 99th percentile, and the number of observations. Panel A and B consist of all the observations, but show the overall statistics and the statistics by firm respectively. Panel C and D are show the statistics of observations for which the repurchase dummy is equal to one. Panel C shows the overall statistics and Panel D consists of the statistics by firm. *Return* and *Amihud* are winsorized at the 1% and 99% level.

Panel A: Descriptive statistics (all observations)

	Mean	Standard Deviation	Minimum	5th Percentile	Median	95th Percentile	Maximum	N
Repurchase Intensity	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%	5.67%	827,075
Repurchase Volume	33,295	1,558,792	0	0	0	0	902,000,000	827,075
Short Interest	0.01%	0.03%	0.00%	0.00%	0.00%	0.04%	2.32%	827,075
Moving Average Short Interest	0.01%	0.02%	0.00%	0.00%	0.00%	0.04%	0.48%	827,075
Short Interest (TV)	2.60%	6.02%	0.00%	0.00%	0.00%	15.92%	92.55%	827,075
Moving Average Short Interest (TV)	2.58%	4.57%	0.00%	0.00%	0.00%	12.53%	62.00%	827,075
Short Sales Volume	288,853	1,690,965	0	0	0	1,245,800	247,000,000	827,075
Amihud	27.52	172.93	0.00	0.02	0.72	84.34	3,570.77	827,075
Market Cap (millions HKD)	13,541.84	51,133.66	8.64	329.27	3,272.10	49,741.74	1,598,383.00	827,075
Return	0.05%	2.97%	-10.00%	-4.41%	0.00%	5.02%	13.20%	827,075

Panel B: Descriptive statistics by firm (all observations)

	Mean	Standard Deviation	Minimum	5th Percentile	Median	95th Percentile	Maximum	N
Repurchase Intensity	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	338
Repurchase Volume	44,603	186,695	40	393	10,679	142,637	2,339,811	338
Short Interest	0.01%	0.01%	0.00%	0.00%	0.00%	0.03%	0.06%	338
Moving Average Short Interest	0.01%	0.01%	0.00%	0.00%	0.00%	0.03%	0.06%	338
Short Interest (TV)	2.61%	3.16%	0.00%	0.01%	1.24%	8.94%	19.45%	338
Moving Average Short Interest (TV)	2.59%	3.14%	0.00%	0.01%	1.23%	8.91%	19.40%	338
Short Sales Volume	298,942	804,289	1	76	59,998	1,073,963	6,919,166	338
Amihud	23.36	68.11	0.00	0.04	1.74	164.56	578.66	338
Market Cap (millions HKD)	12,516.10	36,880.66	255.44	840.04	4,164.56	48,181.89	475,674.75	338
Return	0.04%	0.06%	-0.22%	-0.08%	0.04%	0.13%	0.29%	338

Panel C: Descriptive statistics (Repurchase Dummy = 1)

	Mean	Standard Deviation	Minimum	5th Percentile	Median	95th Percentile	Maximum	N
Repurchase Intensity	0.06%	0.16%	0.00%	0.00%	0.03%	0.23%	5.67%	14,718
Repurchase Volume	1,870,982	11,537,526	300	20,000	406,000	5,900,000	902,000,000	14,718
Short Interest	0.01%	0.04%	0.00%	0.00%	0.00%	0.06%	1.59%	14,718
Moving Average Short Interest	0.01%	0.02%	0.00%	0.00%	0.00%	0.05%	0.32%	14,718
Short Interest (TV)	3.99%	7.64%	0.00%	0.00%	0.00%	20.86%	76.89%	14,718
Moving Average Short Interest (TV)	3.67%	5.60%	0.00%	0.00%	0.49%	16.38%	34.37%	14,718
Short Sales Volume	483,921	2,424,333	0	0	0	2,057,000	79,858,000	14,718
Amihud	10.20	43.62	0.00	0.01	0.58	42.67	1,706.50	14,718
Market Cap (millions HKD)	13,210.90	31,042.43	76.34	518.57	3,766.22	61,991.40	935,114.81	14,718
Return	-0.11%	3.05%	-10.00%	-5.33%	0.00%	4.55%	13.20%	14,718

Panel D: Descriptive statistics by firm (Repurchase Dummy = 1)

	Mean	Standard Deviation	Minimum	5th Percentile	Median	95th Percentile	Maximum	N
Repurchase Intensity	0.09%	0.12%	0.00%	0.01%	0.06%	0.25%	1.16%	338
Repurchase Volume	3,089,585	8,422,080	22,046	144,252	1,001,750	12,759,333	100,000,000	338
Short Interest	0.02%	0.03%	0.00%	0.00%	0.00%	0.06%	0.33%	338
Moving Average Short Interest	0.01%	0.02%	0.00%	0.00%	0.00%	0.06%	0.14%	338
Short Interest (TV)	3.64%	5.27%	0.00%	0.00%	1.04%	14.73%	29.68%	338
Moving Average Short Interest (TV)	3.32%	4.74%	0.00%	0.00%	1.01%	12.95%	29.75%	338
Short Sales Volume	656,807	2,142,899	0	0	32,354	3,463,125	24,307,166	338
Amihud	14.72	97.35	0.00	0.02	0.49	38.37	1,460.24	338
Market Cap (millions HKD)	10,840.61	28,705.46	154.34	634.99	3,575.36	44,690.41	409,214.66	338
Return	-0.12%	1.46%	-6.74%	-2.40%	-0.04%	1.97%	7.00%	338

how short interest influences this effect. My last section contains an analysis of deteminants of repurchase intensity and short interest.

Joint frequency testing

Again, the first section examines whether firms repurchase more frequently following periods of high short interest. This would imply that firms and short sellers are trading

against each other. The starting point is that both firms and short sellers act in thir own best interests. The assumption that managers are able to identify whether their stock is under- or overvalued would imply that repurchases should be clustered in times of undervaluation. This would create value for the firm and thus for their shareholders since prices are expected to go up in order to move closer to fundamental value. Short selling does the opposite and is often used by sophisticated investors if they think a stock is overvalued. One goes short into a stock in the expectations that the stock price goes down.

As described in the above paragraph, firms and short sellers should be contrarian traders. However, the fact that firms' executives are not trading with their own money, when repurchasing shares, could alter the outcome. As discussed in more detail in the Literature review, I expect managers not to act in the best interest of their shareholders, but to give price support to overvalued stock instead.

The analysis in this first section of my thesis consists of a joint frequency study in which I examine whether the frequency of a repurchase is independent of the prior level of *Short Interest*. I use two levels of short interest: (i) short interest on the prior trading day and (ii) the average short interest on the prior 20 trading days. The average levels of short interest differ quite a lot per firm, so therefore I use the relative difference between the actual short interest and the average short interest for that firm to construct groups. I call this the Δ*Short Interest* and calculate this with the Eq.1. The advantage of using this measure is that it controls for the fact that some stocks have much higher short interest on average. Furthermore, it controls for the fact that certain absolut increases in short interest mean relatively more for stocks with a lower average short interest.

$$\Delta ShortInterest_{i,t} = \frac{ShortInterest_{i,t} - AverageShortInterest_i}{AverageShortInterest_i} \tag{1}$$

where $Short\ Interest_{i,t}$ and $Average\ Short\ Interest_i$ represent the level of *Short Interest* and the average level of *Short Interest* per firm. Hence, $\Delta\ Short\ Interest_{i,t}$ is the relative difference of the *Short Interest* level and the average *Short Interest*. I create four groups based on the level of short interest. The first group consist of all observations with a *Short Interest* of zero. The other three groups are equally-sized groups based on Δ*Short Interest* (Low, Medium, and High).

So there are 8 combinations (2x4 groups) of the *Repurchase Dummy* and Δ*Short Interest* groups. I calculate three different numbers (Panel A, B, and C in Table 3) for each observations. The numbers represent the number of observations within each group as (i) percentage of the Grand Total, (ii) percentage of the Column Total, and (iii) percentage of the Row Total. To clarify point (ii) and (iii), the number of observation as percentage of

the Column Total (point (ii)) show the the distribution between the different groups conditionallu on the *Repurchase Dummy* being 0 or 1. The number of observation as percentage of the Row Total (point (iii)) represents the distribution between the *Repurchase Dummy* being 0 or 1 conditionally on the different $\Delta Short\ Interest$ groups. Furthermore, after computing the different numbers, I calculate the differences between the various combinations. The results of the first section of my analysis are discussed in Chapter V.A.

Event study of abnormal returns

The second section of my empirical analysis looks at the positive influence of repurchases event on abnormal returns. Furthermore, it looks at the effect of short interest on this positive influence of repurchases. Event studies typically try to examine the effect of an event on returns (Kothari and Warner, 2004). In my thesis, a share repurchase transaction counts as an event. As MacKinlay (1997) describes, the idea behind event studies is that you compare the returns around an event to the expected returns. Event studies work relatively well for short-horizon research since the outcome is less biased by potential wrong assumptions than in the situation of a long-horizon (Kothari and Warner, 2004).

The method studies abnormal returns, therefore I first need to decompose actual returns into expected returns and abnormal returns (see Eq.2). I can rewrite this equation into Eq.3.

$$R_{i,t} = E(R_{i,t}) + AR_{i,t} \tag{2}$$

$$AR_{i,t} = R_{i,t} - E(R_{i,t}) \tag{3}$$

where $R_{i,t}$ represent the actual return of security i for time t relative to the event; $E(R_{i,t})$ stands for the expected return of security i for time t relative to the event; and $AR_{i,t}$ represents the abnormal return (AR) of security i for time t relatively to the event. After obtaining the abnormal returns, the cumulative abnormal return for a certain event window can be easily calculated by totalling all abnormal returns in that event window. This process is shown in Eq.4.

$$CAR_i = \sum_{t=0}^{T} AR_{i,t} \tag{4}$$

in which CAR_i represents the CAR for event i and $AR_{i,t}$ stands for the AR of event i at t.

After calculating the CARs I test the hypothesis (H2) that share repurchases provide price support. I therefore examine whether post-repurchase CARs are significantly greater

than zero. Event studies, however, face the joint test problem. The joint test problem states that while testing your hypothesis, you automatically also test the accuracy of your model itself (Kothari and Warner, 2004). So, finding a statistical significance does not automatically mean that there is also an economic significance. The tests are well-specified to the extent that the underlying assumptions are correct. There are different assumptions to make during the analysis. An important one is the choice of an expected return model. The literature shows different models (e.g. the market model and the capital asset pricing model) which can be used to estimate the expected returns. So, during the analysis I not only test for abnormal performance, but also test whether the chosen model of expected returns is correct. All models have their flaws, but those flaws are not fatal from the point of event study analysis (Kothari and Warner, 2004). Especially at short-term horizon, which is the case in my thesis, the outcome is less biased by the choice in favour of a particular model. I start with using the capital asset pricing model (CAPM) to estimate expected returns. Later on I test the robustness of my results by repeating the analysis with other expected return models.

The CAPM assumes a stable linear relation between the excess return on the riskfree rate and the excess return on the market return. It can be summarized by Eq.5 whereby Eq.6 shows the assumptions that are related to the CAPM.

$$(R_{i,t} - r_{f,t}) = \alpha_i + \beta_i(R_{M,t} - r_{f,t}) + \varepsilon_{i,t} \tag{5}$$

$$E(\varepsilon_{i,t}) = 0 \qquad var(\varepsilon_{i,t}) = \sigma^2_{\varepsilon_i} \tag{6}$$

where $R_{i,t}$ is the actual return of security i on day t; $r_{f,t}$ is the riskfree rate on day t; $R_{M,t}$ is the market return on day t; $\varepsilon_{i,t}$ is the error term with a mean of zero; and α_i, β_i, and $\sigma^2_{\varepsilon_i}$ are the parameters of the CAPM. I use the return of the Hang Seng Index as market return which is also an assumption I make during my analysis. The parameters are estimated by ordinary least squares (OLS) during an estimation window for each event and are then applied to the event window.

In line with Chang, Cheng, and Yu (2007) I choose an estimation window of 250 trading days prior to the event window. The repurchase events are at $t = 0$, my estimation window is from t = -270 to t = -21, and my event window is from t = -20 to t = +20. The estimation window ends 20 trading days prior to the event day to avoid that the expected returns are potentially biased by trading based on insider information immediately prior to the event. After obtaining the parameters of the estimation windows per event, I apply these to the event windows to calculate the expected returns. Abnormal returns are then easily calculated

by taking the actual returns and subtract the expected returns (see Eq.3). In line with Zhang (2005), I construct three windows in the event period: (i) the pre-repurchase period from t = -20 to t = -1, (ii) the information release period from $t = 0$ to $t = +2$ to capture the initial reaction, and (iii) the post-repurchase period from $t = 0$ to $t = 20$. From now on I refer to these as (-20,-1), (0,+2), and (0,+20) respectively. Following Zhang (2005) I make sure that there are at least 20 trading days between two repurchase events of the same firm to avoid biases by confounding events which reduces the number of repurchasing events to 2,154 and 338 unique firms. Furthermore, I drop events that do not have data for at least 180 trading days in the estimation window and I also drop events which miss data for trading days during the event window. This brings my final sample to 2,028 repurchasing events of 320 unique firms.

As discussed, I calculate the CARs of the three time windows with Eq.4. I then use a t-test to test whether post-repurchase CARs are greater than zero. The T-value is calculated with Eq.7. Concluding that post-repurchase CARs are greater than zero implies that repurchases provide price support which is stated in the second hypothesis (H2).

$$T = \frac{\frac{1}{N}\sum_{i=1}^{N} CAR_i}{SD_{CAR}/\sqrt{N}} \tag{7}$$

where T represents the T-statistic; CAR_i represents the CAR of event i SD_{CAR} is the standard deviation of the CARs, and N is the number of observations.

As mentioned earlier, the event study method requires some assumptions and I start with the CAPM expected return model. To test whether my results are robust independently of the chosen expected return model, I rerun the analysis with the market model described in Sharpe (1964) and the four factor model of Carhart (1997). The market model and four factor model are shown in Eq.8 respectively Eq.9.

$$R_{i,t} = \alpha_i + \beta_i R_{M,t} + \varepsilon_{i,t} \tag{8}$$

$$(R_{i,t} - r_{f,t}) = \alpha_i + \beta_{i,M}(R_{M,t} - r_{f,t}) + \beta_{i,SMB} SMB_t + \beta_{i,HML} HML_t + \beta_{i,WML} WML_t + \varepsilon_{i,t} \tag{9}$$

where $R_{i,t}$ is the actual return of security i on day t; $R_{M,t}$ is the market return on day t; $r_{f,t}$ is the riskfree rate on day t; SMB, HML, and WML are the factor portfolio returns on a value weighted, zero-investment, portfolio for market capitalisation, book-to-market ratios, and one-day momentum.[8] The methods to estimate the parameters for these models are

[8]The factor returns are obtained from www.aqr.nl

similar as the method of the market model, except for different OLS regressions. Hence, the expected returns that result from the models are different. The last steps in which I compute T-statistics are similar.

Finally, I notice that the number of repurchases per firm differs a lot in my sample. This could bias the results since firms with a lot of repurchases are overrepresented in the event sample. My sample has 2,028 repurchases executed by 320 firms which averages 6.3 repurchases per firm. However, the difference in number of repurchases per firm ranges between 1 and 56 respectively. Therefore, I decide to do a robustness check by repeating the analyses as decribed in the above paragraphes, but averaging the CARs on firm-level as suggested by Zhang (2005). It causes all firms to have only one observation and thus equally weights them, no matter how many repurchases they make during the sample period. The results of the event study to abnormal returns can be found in Chapter V.B.

Fixed effects model

The relation between *Repurchase Intensity* and *Short Interest* is discussed in the last section of my thesis. There are of course different approaches that could be used in this kind of research. One of these methods is called the fixed effects method. The idea behind it is that the researcher is able to control for factors which can not be measured and stay constant (Allison, 2009). This is done by adding dummy variables to the regression. In this thesis I control for both time and firm fixed effects. Time fixed effects filter out all factors that are time related. One could think of the economic cycle (bull or bear market conditions) which influences the dependent variable. This is relevant for my sample since for example the time period in my thesis includes the financial crisis in 2008. It is conceivable that firms were more likely to execute repurchases during this period, because they deemed their stock to be in need of price support. This is also in line with the peak in 2008 which I report in Table 1. Firm fixed effects control for firm-specific characteristics that could influence the results. An example of a firm-specific characteristic could be a companies' culture. Some firms might have board members who prefer repurchases over dividend and therefore have a higher *Repurchase Intensity* on average. There can be a lot more firm-specific characteristics that stay constant that bias the results, therefore I think it is a good thing to include firm fixed effects. The research of Hillert et al. (2016) is an example which uses a fixed effect model when examining share repurchases and the relation to market liquidity.

I use a fixed effects model to examine the two possible directions of the relation between *Repurchase Intensity* and *Short Interest*. I start with regressing *Short Interest* on *Repurchase Intensity* which is shown in Eq.10. It consist of three regression in which I grad-

ually add control variables to the regression. Next, I do the same but change *Repurchase Intensity* into lagged *Repurchase Intensity*. This is shown in Eq.11.

$$RepurchaseIntensity_t = \beta_0 + \beta_1 ShortInterest_t + \beta_x Controls_x + \eta_{i,t} + \mu_{i,t} + \varepsilon_{i,t} \quad (10)$$

$$RepurchaseIntensity_t = \beta_0 + \beta_1 ShortInterest_{t-1} + \beta_x Controls_x + \eta_{i,t} + \mu_{i,t} + \varepsilon_{i,t} \quad (11)$$

where $\eta_{i,t}$ stands for the firm fixed effects, $\mu_{i,t}$ refers to the time fixed effects, and $\varepsilon_{i,t}$ is the error term.

As noted earlier in this thesis, I also examine the effect of *Repurchase Intensity* on *Short Interest*. Therefore, I regress *Repurchase Intensity* on *Short Interest*. Again, I also run the fixed effects model with the lagged independent variable (*Repurchase Intensity*). These regressions are shown in Eq.12 and Eq.13 respectively.

$$ShortInterest_t = \beta_0 + \beta_1 RepurchaseIntensity_t + \beta_x Controls_x + \eta_{i,t} + \mu_{i,t} + \varepsilon_{i,t} \quad (12)$$

$$ShortInterest_t = \beta_0 + \beta_1 RepurchaseIntensity_{t-1} + \beta_x Controls_x + \eta_{i,t} + \mu_{i,t} + \varepsilon_{i,t} \quad (13)$$

where $\eta_{i,t}$ stands for the firm fixed effects, $\mu_{i,t}$ refers to the time fixed effects, and $\varepsilon_{i,t}$ is the error term.

As mentioned earlier, a major advantage of a fixed effects model is that it controls for unobserved variables that stay constant (Allison, 2009). Macroeconomic changes are taken into account through time fixed effects. This means that the model controls for the different market conditions over time during bull as well as bear market conditions. The firm fixed effects control for cross-sectional variation. This relates to different firm-specific characteristics which stay constant over time for firms and influence the outcome of a normal regression. Concluding, firm fixed effects models measure within-variation and control for the between-variation (Allison, 2009).

V. Empirical analysis

In this chapter, I describe the results of my analyses. It contains of three sections. The first section consists of an analysis which examines whether firms trade more frequently following periods of high short interest. The second section describes the price support through share repurchases. It furthermore shows the influence of short interest on the effectiveness of the price support. The third and last section explains the determinants of both repurchase intensity and short interest.

A. Firms repurchase following periods of high short interest

In Chapter III, I introduce the agreement in the literature about both firms and short sellers being well-informed parties. As Liu and Swanson (2016) and Bargeron and Bonaime (2017) state, there seem to be situations in which these informed parties disagree. This is the case when firms repurchase during high short interest. I test the existence of this phenomenon by looking at joint frequencies of repurchases and short interest. If the firms indeed disagree with the short sellers, I find higher relative frequencies of repurchases for higher levels of short interest. One note of caution is that the disagreement could also be caused by the managerial bias which I already touched upon earlier in my thesis.

Hypothesis 1: firms repurchase more frequently following periods of high short interest

My first hypothesis (H1) states that firms repurchase more frequently following periods of high *Short Interest* levels. The test results of this analysis are shown in Table 3. It contains the joint frequencies of repurchases and Δ*Short Interest*. There are four groups of Δ*Short Interest*.[9] The first group consists of all observations with a *Short Interest* of zero, I call this group "Zero". The other three groups ("Low", "Medium", and "High") are equally sized groups based on Δ*Short Interest*. The repurchase variable is *Repurchase Dummy* that has value 0 if no repurchase is done and value 1 if a firm repurchases.

Panel A shows the joint frequencies as percentage of the Grand Total (827,075 observations). The Zero-group contains of 66.17% of the total sample which equals 547,240 observations. The Low-, Medium, and High-group contain 11.28% of the Grand Total per group, which is equivalent to 93,278 observations for the Mid- and High-group and 93,279 for the Low-group. My sample contains only 14,718 repurchase firm-days. This is equivalent to 1.78% of the Grand Total; the other 98.22% has no repurchases (a *Repurchase Intensity*

[9] See Chapter IV for an exact description of Δ*Short Interest*.

Table 3

Share repurchases and short interest

This table presents summary statistics of the interaction between share repurchases and short interest on the HKEX from 2004 until 2015. A repurchase dummy (*Repurchase Dummy*) is generated for each firm-day combination and has value 1 if the firm does a repurchase on that day and value 0 if no repurchase is done. *Short Interest* is the number of shares sold short divided by the number of shares outstanding. The sample is segmented into four groups based on levels of short selling. The first group (Zero) contains of observations with a *Short Interest* of zero, so no short sales during that day. The other three groups (Low, Medium, and High) are equally-sized groups based on Δ*Short Interest*. Δ*Short Interest* is defined as the difference between *Short Interest* and the average *Short Interest* per firm. The *Short Interest* groups in column (1) and (2) are based on the Δ*Short Interest* on the previous trading day (t-1). Column (3) and (4) are based on the average Δ*Short Interest* in the 20 trading days prior to the repurchase (t-20,t-1). *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Joint frequencies of share repurchases and short interest on the previous trading day.

Δ*Short Interest* Group	*Repurchase Dummy* = 0 (1)	*Repurchase Dummy* = 1 (2)	Row Total (1) + (2)	*Repurchase Dummy* = 0 (3)	*Repurchase Dummy* = 1 (4)	Row Total (3) + (4)
Zero	538,662	8,578	547,240	423,153	6,523	429,676
	65.13%	1.04%	66.17%	51.16%	0.79%	51.95%
Low	91,613	1,666	93,279	130,149	2,318	132,467
	11.08%	0.20%	11.28%	15.74%	0.28%	16.02%
Medium	91,275	2,003	93,278	129,656	2,810	132,466
	11.04%	0.24%	11.28%	15.68%	0.34%	16.02%
High	90,807	2,471	93,278	129,399	3,067	132,466
	10.98%	0.30%	11.28%	15.65%	0.37%	16.02%
Column Total	812,357	14,718	827,075	812,357	14,718	827,075
	98.22%	1.78%	100.00%	98.22%	1.78%	100.00%

Panel B: Short Interest conditional on share repurchases. The percentage represents the proportion of the column total.

Δ*Short Interest* Group	*Repurchase Dummy* = 0 (1)	*Repurchase Dummy* = 1 (2)	**Difference (2) - (1)**	*Repurchase Dummy* = 0 (3)	*Repurchase Dummy* = 1 (4)	**Difference (4) - (3)**
Zero	66.31%	58.28%	**-8.03%*** **	52.09%	44.32%	**-7.77%*** **
Low	11.28%	11.32%	**0.04%**	16.02%	15.75%	**-0.27%**
Medium	11.24%	13.61%	**2.37%*** **	15.96%	19.09%	**3.13%*** **
High	11.18%	16.79%	**5.61%*** **	15.93%	20.84%	**4.91%*** **
Column Total	100.00%	100.00%		100.00%	100.00%	

Panel C: Share repurchases conditional on short interest. The percentage represents the proportion of the row total.

Δ*Short Interest* Group	*Repurchase Dummy* = 0 (1)	*Repurchase Dummy* = 1 (2)	Row Total (1) + (2)	*Repurchase Dummy* = 0 (3)	*Repurchase Dummy* = 1 (4)	Row Total (3) + (4)
Zero	98.43%	1.57%	100.00%	98.48%	1.52%	100.00%
Low	98.21%	1.79%	100.00%	98.25%	1.75%	100.00%
Medium	97.85%	2.15%	100.00%	97.88%	2.12%	100.00%
High	97.35%	2.65%	100.00%	97.68%	2.32%	100.00%
Difference (High - Zero)	**-1.08%*** **	**1.08%*** **		**-0.80%*** **	**0.80%*** **	
Difference (High - Low)	**-0.86%*** **	**0.86%*** **		**-0.57%*** **	**0.57%*** **	

of 0% and *Repurchase Dummy* being 0), which stands for 812,357 firm-days. The joint frequencies of the short interest groups (Zero, Low, Medium, and High) of the observations for which the *Repurchase Dummy* equals 0 are: 65.13%, 11.08%, 11.04%, and 10.98% respectively. These percentages can be found in column (1) of Panel A in Table 3. These percentages represent the number of observations as percentage of the Grand Total. It is logical that the Zero-group is much larger than the other groups, since most of the firm-days show no short selling. Furthermore, I observe a small decrease in the numbers if the *Short Interest* goes up. In this phase of the analysis this is not yet a result from which I can draw useful conclusions. Column (2) of Panel A shows numbers which are obtained in the same way as observation for which my *Repurchase Dummy* is 1. The number of observations as percentage of the Grand Total for the Zero-, Low-, Medium-, and High-group are 1.04%, 0.20%, 0.24%, and 0.30% respectively. I notice that the Zero-group has the largest number and furthermore I observe an ascending number when *Short Interest* goes up.

Column (1) and (2) use the level of Δ*Short Interest* on the previous trading day to con-

struct the different groups. It is, however, conceivable that the repurchase decision depends on more than just the overvaluation on the day before. Therefore, I do the same analysis as described in the above paragraphe with another $\Delta Short\ Interest$ time window. In column (3) and (4), I calculate the average $\Delta Short\ Interest$ over the previous 20 trading days and use this to form the groups. Logically, the Zero-group shrinks, because observations which had a *Short Interest* of zero on the prior trading day can potentially have *Short Interest* larger than zero during the time window of 20 days. The Zero-group consists of 51.95% which equals 429,676 firm-days. The Low-, Medium-, and High-group all consist of 16.02% of the total number of observations. Column (3) which contains the observations with *Repurchase Dummy* being 0, shows numbers of 51.16%, 15.74%, 15.68%, and 15.65% for the Zero-, Low-, Medium-, and High-group respectively which represent the number of observations as percentage the Grand Total. The numbers are 0.79%, 0.28%, 0.34%, and 0.37% for observations with a *Repurchase Dummy* of 1 (column (4)).

It is hard to draw conclusions from the numbers as percentages of the Grand Total shown in Panel A of Table 3. Therefore, I show the numbers as percentage of the Column Total in Panel B. It can be interpreted as the distribution of the different $\Delta Short\ Interest$ groups conditional on share repurchases. Column (1) gives the distribution conditional on *Repurchase Dummy* being 0 and column (2) represents the distribution conditional on *Repurchase Dummy* being 1. I compare the number of each $\Delta Short\ Interest$ group in column (1) with the number in column (2). The difference ((2)-(1)) is shown in bold in the third column. If firms indeed repurchases more frequently following periods of high *Short Interest* levels (H1), I expect the difference between column (1) and (2) to increase if I go to a "higher" $\Delta Short\ Interest$ group. The difference between *Repurchase Dummy* being 0 or 1 is -8.03%, 0.04%, 2.37%, and 5.61% for the Zero-, Low-, Medium-, and High-group respectively. The differences of the Zero-, Medium-, and High-group are statistically significant at the 1% confidence level, but the difference for the Low-group is not statistically significantly different from zero. This is not problematic, because even if the difference is zero for the Low-group, I observe a clear trend. The difference between *Repurchase Dummy* being 0 or 1 is larger for higher $\Delta Short\ Interest$ groups. This implies that prior short interest levels are relatively high if *Repurchase Dummy* is 1. Column (3) and (4) of Panel B are showing similar results if I use the average *Short Interest* levels over the past 20 trading days. The differences are -7.77%, -0.27%, 3.13%, and 4.91% for the Zero-, Low-, Medium-, and High-group respectively. The numbers in column (3) and (4) differ slightly from those in column (1) and (2), but I observe a similar upward trend when short interest increases. The difference is negative for the Zero-group and increases in the higher $\Delta Short\ Interest$ groups. This panel implies that if we shift towards a repurchase (*Repurchase Dummy* going

from 0 to 1) this is associated with higher *Short Interest* levels in the prior period. This is the first indication of firms repurchasing more frequently following periods of high short interest, which is stated in my first hypothesis (H1).

Panel C of Table 3 examines the distribution of *Repurchase Dummy* being 0 or 1 conditional on the Δ*Short Interest* group. The numbers are thus the shares as percentage of the Row Total. The differences in bold at the bottom represent the differences between: (i) the High- and the Zero-group and (ii) the High- and the Low-group. The difference between the High- and Zero-group is 1.08% at the 1% confidence level for repurchase-observations (*Repurchase Dummy* being 1). This means that there are 1.08% more repurchases in the High-group than in the Zero-group when corrected for the different sizes of the groups. The difference between the High- and Low-group is 0.86%, which is also significant at the 1% confidence level. Given that an observation is part of a Δ*Short Interest* group, the number of repurchases is relatively large in the higher Δ*Short Interest* groups. The difference is 0.80% and 0.57% for the High-Low and High-Zero respectively when I use the average *Short Interest* level (column (3) and (4)). These results imply that when I shift towards a higher level of short interest, I observe relatively more repurchases. This is a second pointer which that indicates that firms repurchase more frequent following periods of high short interest.

So far, *Short Interest* is calculated as the number of shares sold short divided by the number of shares outstanding. Researchers sometimes, however, define *Short Interest* as the number of shares sold short scaled by the trading volume. Therefore, I also check whether this other definition of *Short Interest* changes the outcome. The results of this robustness check is shown in Table 11 in the Appendix and the results are similar. The lineair trend, however, has a small deviation for the Medium-group when condering the average Δ*Short Interest* (Panel B of Table 11: column (3) and (4)). Overall, I conclude that these additional results point into the same direction as the results shown in Table 3.

Analysing the results of my first analysis, I conclude that repurchases (*Repurchase Dummy* being 1) are associated with higher prior *Short Interest* levels than observations without a repurchase (*Repurchase Dummy* being 0). Furthermore, I conclude that a higher prior *Short Interest* is associated with more repurchases. These two findings combined, leads me to confirm my first hypothesis (H1) that firms repurchase more often following periods of high short interest. My findings are in line with the expectation I had based on the reported price support motive of overvalued stock in the research of Liu and Swanson (2016). Furthermore, my results are similar as the results of Bargeron and Bonaime (2017). They observe high repurchase levels more frequently within high short selling firm-quarters than low short selling firm-quarters.

B. Influence of short interest on price support through share repurchases

In the previous section, I show that firms repurchases more frequently following periods of high short interest. In the foorsteps of Liu and Swanson (2016) I link this to the potential price support of overvalued stock. The price support argument implies a positive impact of share repurchases on prices (or abnormal returns) which is a common phenomenon in the literature (Ikenberry et al., 1995; Zhang, 2005; Busch and Obernberger, 2016). I start testing the hypothesis that post-repurchase CARs are greater than zero, which implies that share repurchases provide price support. This is stated in my second hypothesis (H2). After that, I examine the influence of *Short Interest* on the post-repurchase CARs. I expect lower post-repurchase CARs for higher *Short Interest* levels, which is implied by my third hypothesis (H3): price support through share repurchases is less effective for heavily shorted stock. The negative influence of *Short Interest* on performance is widely examined in the literature (Seneca, 1967; Figlewski, 1981; Desai et al., 2002; Asquith et al., 2005; Boehmer et al., 2008).

Table 4 shows the results of the influence of *Short Interest* on repurchase signals and abnormal returns. Panel A uses the Δ*Short Interest* on the prior trading day to construct groups and in Panel B I use the average Δ*Short Interest* over the prior 20 trading days to construct the groups. I calculate CARs for three time windows: the pre-repurchase period (-20,-1), the information release period (0,+2), and the post-repurchase period (0,+20). I calculate the CARs for all observations to test hypothesis 2 and per Δ*Short Interest* group to test hypothesis 3. To easily distinguish between the different groups, I display the differences between the High-Zero and High-Low groups in bold at the bottom. Following Zhang (2005) I do a robustness check for the potential overrepresentation of firms that are very active in repurchasing by averaging the CARs on firm level. The results of the robustness check are shown in Table 12.

Hypothesis 2: share repurchases provide price support

Hypothesis 2 states that share repurchases provide price support. I therefore test whether post-repurchase CARs are greater than zero. The analysis starts with all 2,028 observations.[10] I find an average pre-repurchase CAR(-20,-1) of -1.41% (significant at the 1% confidence level). The negative pre-repurchase CAR implies that firms repurchase shares following a period of underperformance. Further on in my thesis, I address the question whether high short interest causes managers to buy back stock. The initial market reaction to a repurchase

[10]There are at least 20 trading days between two repurchase events to prevent a bias by confounding events.

Table 4

CARs around repurchases

This table presents the CARs around share repurchases on the HKEX from 2004 until 2015. The sample is adjusted for confounding events, so there are at least 20 trading days between two repurchase events of the same firm. I use the capital asset pricing model (CAPM) to estimate normal returns and calculate three CAR time windows: (-20,1), (0,+2), and (0,+20). The CARs are calculated for the whole sample and furthermore segmented into four groups based on levels of short selling. The first group (Zero) contains observations with a *Short Interest* of zero, so no short sales during the prior period. The other three groups (Low, Medium, and High) are equally-sized groups based on Δ*Short Interest* in the prior period. Δ*Short Interest* is defined as the difference between *Short Interest* and the average *Short Interest* per firm. Panel A segments based on Δ*Short Interest* on the prior trading day (-1) and Panel B segments based on the average Δ*Short Interest* on the prior 20 trading day (-20,-1). The T-statistics are provided in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: ΔShort Interest Groups are based on ΔShort Interest on the prior trading day (-1).

		CAR time windows		
Δ*Short Interest* Group	Number of observations	(-20,-1)	(0,+2)	(0,+20)
All	2,028	-1.41%***	0.93%***	3.34%***
		(-4.27)	(7.88)	(10.50)
Zero	1,158	-0.53%	1.10%***	4.24%***
		(-1.12)	(6.72)	(9.32)
Low	290	-1.24%*	0.56%**	1.93%***
		(-1.93)	(2.18)	(2.74)
Medium	290	-1.72%**	0.81%***	2.95%***
		(-2.58)	(3.05)	(4.46)
High	290	-4.78%***	0.79%**	1.54%*
		(-5.35)	(2.20)	(1.85)
Difference (High - Zero)		**-4.25%**	**-0.31%**	**-2.70%**
Difference (High - Low)		**-3.54%**	**0.23%**	**-0.39%**

Panel B: ΔShort Interest Groups are based on the average ΔShort Interest in the prior 20 trading days (-20,-1).

		CAR time windows		
Δ*Short Interest* Group	Number of observations	(-20,-1)	(0,+2)	(0,+20)
All	2,028	-1.41%***	0.93%***	3.34%***
		(-4.27)	(7.88)	(10.50)
Zero	865	-0.09%	1.11%***	4.67%***
		(-0.16)	(5.71)	(8.71)
Low	388	-2.29%***	0.83%***	3.31%***
		(-3.84)	(3.67)	(4.95)
Medium	388	-1.49%**	0.74%***	2.72%***
		(-2.32)	(2.86)	(4.62)
High	387	-3.41%***	0.83%***	1.01%
		(-4.46)	(2.99)	(1.40)
Difference (High - Zero)		**-3.32%**	**-0.28%**	**-3.66%**
Difference (High - Low)		**-1.12%**	**0.00%**	**-2.30%**

is positive since I find a CAR(0,+2) of 0.93% which is significant at the 1% confidence level. The post-repurchase CAR(0,+20) is 3.34% and significant at the 1% confidence level. My results have the same sign as the results of Zhang (2005) who reports -1.84%, 0.43%, and 0.69% for the three windows. However, especially the post-repurchase CAR(0,+20) in my research has a higher value. It seems like post-repurchase CARs are indeed greater than zero. The fact that I observe CAR(0,+20) of 3.34% conflicts with the efficient market hypothesis, since the market apparently not immediately processes the information content regarding a

repurchase.

In Chapter IV.B I describe that I follow the method used by Zhang (2005) to control for the repurchase frequency differences between firms. Firms with a lot of repurchases can potentially overrepresent the sample and thus bias the results. Therefore, I average the CARs on firm-level and do a robustness check. The results are shown in Table 12. The CAR(-20,-1) is -3.98% at the 1% confidence level which is larger absolute value than if I don't average by firm. The CAR(0,+2) and CAR(0,+20) are 1.42% and 3.61% respectively, both being significant at the 1% confidence level. The pattern in the CARs is similar since I again observe negative abnormal performance before repurchases (-20,-1) and positive abnormal performance immediately after a repurchase (0,+2) and in the medium-term (0,+20).

To calculate abnormal returns, I have to make assumptions about expected returns. Until now, I have described the results when using the CAPM to estimate expected returns. All expected return models have their flaws, but Kothari and Warner (2004) state that those flaws are not fatal from the point of event study analysis. Since I do want to check whether my results are robust independently of the chosen expected return model, I rerun the analysis for the Market Model (results can be found Table 13) and for the Four Factor Model of Carhart (1997) (results can be found in Table 14). When I use the Market Model the CAR(-20,-1) is -2.70%, the CAR(0,+2) is 0.71%, and the CAR(0,+20) is 1.62%. Using the Four Factor Model leads to a CAR(-20,-1) of -1.26%, a CAR(0,+2) of 1.10%, and a CAR(0,+20) of 2.75%. The CARs are all significant at the 1% confidence level. Again, I find that the post-repurchase CARs are greater than zero. I plotted the CARs for the three different expected return models in Figure 1. The pre-repurchase period is clearly characterized by negative abnormal performance and the post-repurchase priod clearly shows positive abnormal performance.

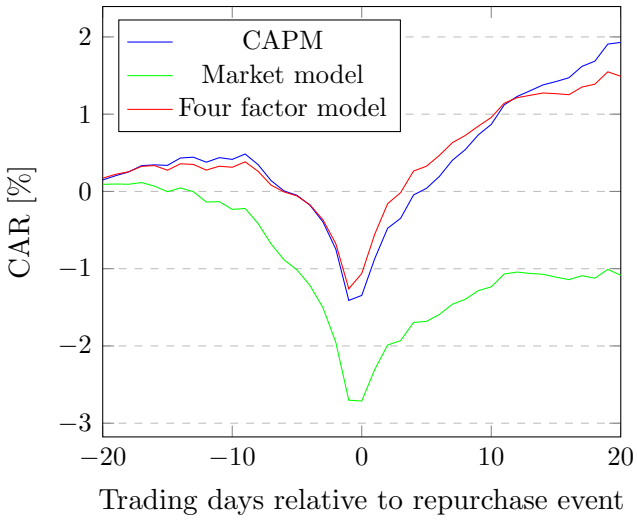

Figure 1: CARs during the event window (-20,+20)

Furthermore, I report the results when I apply the other definition of *Short Interest* (short selling as percentage of trading volume) in the Appendix. Again, the results turn out to be robust no matter which definition of *Short Interest* I apply. I therefore conclude that I confirm my second hypothesis (H2): share repurchases provide price support since repurchases are followed by positive abnormal performance in the short- and medium-term.

Hypothesis 3: price support through share repurchases is less effective for heavily shorted stock

Next, I split the CARs into the Δ*Short Interest* groups to test the hypothesis that price support through share repurchases is less effective for heavily shorted stock (H3). In order to confirm my third hypothesis, I am looking for lower CARs for higher Δ*Short Interest* groups. The results are thus also shown in Table 4. The most relevant numbers are shown in bold at the bottom. They represent the difference between the High-Zero and High-Low group. As mentioned earlier, I average the CARs on firm level as robustness check for which the results are shown in Table 12. Furthermore, the results with other expected return models can be found in the Appendix. My third hypothesis (H3) states that price support through share repurchases is less effective for heavily shorted stock.

The pre-repurchase period (-20,-1) shows a clear expected trend for the effect of short interest on the CARs. The Zero-group outperforms the High-group with 4.25% (difference is -4.25%) and the Low-group outperforms the High-group with 3.54% (difference is 3.54%). If I use the average *Short Interest* on the prior 20 trading days (Panel B) a similar pattern is shown. The High-Zero difference is -3.32% which means that the Zero-group outperforms the High-group on average with 3.32% during the (-20,-1) time window. The difference between the High- and Low-group is -1.12%. If I control for frequently repurchasing firms by averaging on firm-level, the differences increase even further. The High-Zero difference fluctuates between -6.08% and -6.23% and the High-Low fluctuates between -5.86% and 6.18%. I do several extra robustness checks which include other expected return models and the above mentioned other definition of *Short Interest* as percentage of trading volume. The results are very robust and only show one deviation from my expectation. When I use a Four Factor Model to estimate abnormal returns and look at the average *Short Interest* over 20 trading days, I find negative CAR for the High-group which is less negative than for the Low-group (Panel B of Table 14). All groups show negative CARs in the pre-repurchase periods which clearly shows that managers repurchase following periods of poor stock performance. In line with the short selling literature I observe in general more negative CARs if *Short Interest* increases.

The initial reaction period (0,+2) has an overall average CAR of 0.93%. The Zero-group has an average CAR(0,+2) of 1.10% which implies that the average CAR of the three short selling groups (Low, Medium, and High) taken together is by definition lower. The Low-, Medium, and High-group have a CAR(0,+2) of 0.56%, 0.81%, and 0.79% respectively. The Zero-group outperforms the High-group with 0.31% (difference is -0.31%) which is in line with my expectation of the influence of short interest on performance. However, the difference High-Low is 0.23% which means that the High-group outperforms the Low-group by 0.23%. This is not exactly the trend I expected, since I expected weaker performance for higher short interest levels. However, in my opinion it does make sense that the Zero-group clearly outperforms the other groups. This is also the case when I use the average *Short Interest* (Panel B): the difference High-Zero is -0.28%. The robustness checks show similar results: the Zero-group significantly outperforms the High-group in 90% of the checks, but the difference between the High-group and Low-group is not that straightforward. It depends on the chosen expected return model, the *Short Interest* definition, and the time window over which I measure the *Short Interest* to determine which group (Low, Medium, or High) does best. The overall conclusion I distill from analyzing the CARs(0,+2) is that the positive signal of repurchase wins over the potential negative signal of (high) short interest since the CARs for the different *Short Interest* levels are greater than zero and mostly significant at least at the 5% confidence level. Furthermore, the existence of short selling leads to lower CARs with the cautionary note that the intensity of short selling does not always explain the different performances in this short-term time window.

The efficient market hypothesis states that markets immediately process information and thus no abnormal returns can be obtained after the initial reaction. Zhang (2005) among others, however, reports abnormal performance in the time window (0,+20) after repurchases. As mentioned earlier I observe a CAR(0,+20) of 3.34% which is significant at the 1% confidence level. Splitting the post-repurchase period in different levels of *Short Interest* shows the results I expected. The Zero-group outperforms the High-group with 2.70% (difference -2.70%) and the Low-group outperforms the High-group with 0.39% (difference -0.39%). The differences are even larger if you take into account that the CAR(0,+20) for the High-group is not significantly different from zero. The High-Zero and the High-Low differences are -3.66% and -2.30% respectively when I use the average *Short Interest* to group the repurchase observations. A clear trend which I observe is that the Zero-groups have on average a CAR(0,+20) with a relatively high positive value, the Low- and Medium-groups have on average a slightly lower CAR(0,+20) which is still positive, and the CAR(0,+20) for the High-group is often not significantly different from zero. These results are in line with my expectation about the influence of short interest. These results are in line with

the underperformance of 1.16% by heavily shorted stock in the research of Boehmer et al. (2008).

Concluding, I observe underperformance in the pre-repurchase period (-20,-1) which indicates that managers decide to repurchase following periods of weak performance of their stock. This underperformance is at its most extreme for heavily shorted stocks. The initial market reaction (0,+2) after a repurchase is overall positive and shorted stocks clearly underperform stock which are not shorted. Comparing different levels of *Short Interest* shows some indication of relatively worse performance by heavily shorted stocks. However, the results are not clearly perceivable in this short-term window. It seems as if the market needs more time to process the intensity of short selling, because the post-repurchase period (0,+20) does show a clear trend. The price support seems effective for stocks in the medium-term. The Zero-, Low-, and Medium-group all have significantly positive CARs with the Medium-group doing well, the Low-group doing better, and the Zero-group doing best. However, the High-group does not show significant positive performance in the medium-term. This implies that the price support does not turn out to be effective for heavily shorted stocks. The differences between the levels of *Short Interest* are in line with what I expected. The post-repurchase CARs are negatively influenced by short interest. Therefore, I confirm my third hypothesis (H3) which states that price support through share repurchases is less effective for heavily shorted stock.

C. The relation between repurchase intensity and short interest

So far, I conclude that firms repurchase more often following periods of high short interest. Furthermore, I had already concluded that high short interest negatively influences the subsequent performance and thus the effectiveness of the price support. I observe that the price support is not effective for heavily shorted stocks. It is now prudent to examine whether firms indeed use repurchases to support overvalued stock. Therefore, I am looking for evidence which points towards increasing short interest levels leading to increasing repurchase intensity.

Hypothesis 4: repurchase intensity is positively related to short interest

Table 5 shows the results of fixed effect regressions with *Repurchase Intensity* as dependent variable. The columns (1)-(3) have *Short Interest* as most important independent variable and the columns (4)-(6) have lagged *Short Interest* as most important independent variable. Firstly, I run a regression with only (lagged) *Short Interest*. Secondly, I rerun with three control variables: *Amihud*, lagged *Market Cap*, and lagged *Return*. Lastly, I

add the lagged dependent variable.

Regressing *Repurchase Intensity* against *Short Interest* gives me a regression coefficient of 0.025 which is significant at the 1% confidence level. The coefficient reduces to 0.024 when I add my control variables. After adding the lagged dependent variable to the regression, the coefficient becomes 0.021 which is also significant at the 1% confidence level. This coefficient implies that if *Short Interest* goes up by 1% this is associated with *Repurchase Intensity* increasing on average with 0.021%. The positive sign is in line with the findings of Liu and Swanson (2016). In order to conclude on the economic significance of this result, I check for the effect of a one-standard deviation change of the explanatory variable on the dependent variable. Like Busch and Obernberger (2016) I compare this to the median of the dependent variable. An increase by one standard deviation in *Short Interest* is associated with an increase of 0.00063% (0.03%×0.021). The median *Repurchase Intensity* in the whole sample is 0 (since there are only 14,718 repurchase-days) so this seems like an economic significant result. On the other hand, it represents 2.1% (0.00063%÷0.03%) of the *Repurchase Intensity* median if we only look at observation with *Repurchase Dummy* being 1. The explanatory power of my model (on top of the fixed effects) is 0.008 which means that 0.8% of the variation in the dependent variable (on top of the fixed effects) is explained by the model. When I add lagged *Repurchase Intensity* the explanatory power (adjusted R-squared) increases to 6.8%.

The negative sign which I find for *Amihud* is in line with Hillert et al. (2016). However, my *Amihud* coefficient does not significantly differ from zero. Following Vermaelen (1981); Ofer and Thakor (1987); Ikenberry et al. (1995) I expected a negative relation between lagged *Market Cap* and my dependent variable. I do indeed observe a negative coefficient of -2.00E-09 which is statistically significant at the 1% confidence level. In line with Liu and Swanson (2016) I do find a negative coefficient for lagged *Return*, but my results are not statically significant. *Repurchase Intensity* turns out to be autocorrelated, because lagged *Repurchase Intensity* has a coefficient of 0.245 which is highly significant. If lagged *Repurchase Intensity* increases by 1%, *Repurchase Intensity* is on average 0.245% higher.

The positive relation which I report between *Short Interest* and *Repurchase Intensity* does not imply a causal relation. It is hard to form a conclusion as to the direction, but I attempt to discover evidence for which proves that short interest causes repurchase intensity. Therefore, I change *Short Interest* to lagged *Short Interest* which is prior in time to the *Repurchase Intensity* level. The results can be found in column (4)-(6) of Table 5. The regression coefficient is 0.018 and becomes 0.012 after adding my control variables and lagged *Repurchase Intensity*. The coefficients are both statistically significant at the 1% confidence level. If lagged *Short Interest* increases by one standard deviation, *Repurchase Intensity*

increases by 0.00036% (0.03%×0.012) which is 1.2% of the median *Repurchase Intensity* for observations with *Repurchase Dummy* being 1. The results of my control variables are similar to when I use *Short Interest* (the columns (1)-(3)). *Amihud* is not significantly related, *Market Cap* is significantly negatively related with a very small absolute value, and lagged *Repurchase Intensity* is again highly significant with a regression coefficient of 0.245.

As I did for the previous analyses, I rerun this analysis with the average *Short Interest* in (-20,-1). The result is similar with a highly significant regression coefficient of 0.016. The other definition of *Short Interest* as percentage of trading volume turns out not to be ideally suited to this analysis, since it is (through trading volume) correlated with my control variables. So far, all my analyses are computed on a daily level. I check, however, whether the results of these analyses are similar if I execute the analyses on a monthly basis. The regression results are shown in Table 27 which is located in the Appendix. I find a regression coefficient of 0.020 for *Short Interest* which is highly significant. An increase of one standard deviation in monthly *Short Interest* corresponds with an increase of 0.0074% (0.37%×0.020) of monthly *Repurchase Intensity*. This represents 4.93% of the median monthly *Repurchase Intensity* (solely looking at *Repurchase Dummy* being 1). Monthly lagged *Short Interest* seems to have a significant relation with monthly *Repurchase Intensity* with a coefficient of 0.012 and a T-value of 2.79. When I add my control variables, however, the significance disappears, especially when I add monthly lagged *Repurchase Intensity*. This is caused by the fact that monthly lagged *Repurchase Intensity* and monthly lagged *Short Interest* are correlated. Monthly lagged *Repurchase Intensity* has a coefficient of 0.218 which implies that an 1% increase in *Repurchase Intensity* in the previous month on average leads to a 0.218% increase in *Repurchase Intensity* in the next month.

Concluding on the patterns in share repurchases, I observe that repurchase intensity is positively related to short interest. The results are the same when I run the analysis on a monthly level. I thus confirm my fourth hypothesis (H4) which states that repurchase intensity is positively related to short interest. The signs of my control variables are in line with the literature, but not always statistically significant. I also find evidence for a positive relation between *Repurchase Intensity* and lagged *Short Interest*. To identify the direction of the relation between repurchase intensity and short interest, I also regress *Repurchase Intensity* on lagged *Short Interest*. I find a positive relation as well between *Repurchase Intensity* and lagged *Short Interest*. One cautionary note is the fact that this does not hold on a monthly level.

The key-question in this thesis addresses whether overvaluation causes firms to repurchase stocks. In other words, does the relation run from short interest to repurchase intensity and not the other way around? Therefore, I also regress *Short Interest* against *Repurchase*

Table 5

Effect of short interest on repurchase intensity

This table presents fixed effects regressions for HKEX firms that repurchase shares from 2004 until 2015 on the HKEX. The dependent variable is *Repurchase Intensity* (%). *Short Interest* is the most important independent variable. The columns (1)-(3) contain $Short\ Interest_t$ and the columns (4)-(6) contain $Short\ Interest_{t-1}$. Furthermore, I added some control variables: the natural logarithm of $Amihud_t$, the natural logarithm of $Market\ Cap_{t-1}$, $Return_{t-1}$, and the lagged dependent variable $Repurchase\ Intensity_{t-1}$. The T-statistics are provided in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. Furthermore, the bottom of the table provides: the number of observations, the adjusted r-squared, and the fixed effects. All standard errors are clustered at firm-level.

	Dependent variable: $Repurchase\ Intensity_t$					
	(1)	(2)	(3)	(4)	(5)	(6)
$Short\ Interest_t$	0.025***	0.024***	0.021***			
	(2.97)	(2.91)	(3.05)			
$Short\ Interest_{t-1}$				0.018***	0.018***	0.012***
				(3.28)	(3.18)	(3.17)
$Amihud_t$ (ln)		-6.55E-05	-4.24E-05		-7.99E-05	-6.28E-05
		(-1.13)	(-0.96)		(-1.39)	(-1.45)
$Market\ Cap_{t-1}$ (ln)		-2.70E-09***	-2.00E-09***		-2.60E-09***	-1.90E-09***
		(-2.77)	(-2.76)		(-2.77)	(-2.74)
$Return_{t-1}$		-3.24E-06	-2.34E-05*		1.99E-07	-2.03E-05*
		(-0.25)	(-1.90)		(0.02)	(-1.68)
$Repurchase\ Intensity_{t-1}$			0.245***			0.245***
			(5.23)			(5.22)
Number of observations	827,075	827,075	827,075	827,075	827,075	827,075
Adjusted R-squared	0.009	0.009	0.068	0.008	0.009	0.068
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Intensity and lagged *Repurchase Intensity*. The results of this analysis is shown in Table 5. The structure of Table 5 is similar as the one with *Repurchase Intensity* as dependent variable. In column (1)-(3) *Repurchase Intensity* is the main explanatory variable and in column (4)-(6) lagged *Repurchase Intensity* is the most important explanatory variable. The control variables are all similar with the exception of $Market\ Cap$, which is not lagged in this model.

The coefficient of *Repurchase Intensity* is 0.031 and reduces to 0.020 if I add the control variables and lagged *Short Interest*. An increase of one standard deviation of *Repurchase Intensity* corresponds with *Short Interest* increasing with 0.0004% (0.02%×0.020) or when I take the standard deviation of only repurchase-days 0.0032% (0.16%×0.020). These are substantial increases since the median *Short Interest* is 0.008043. 0.0004% represents 4.97% of the median value and 0.0032% represents 39.79% of the median value. It seems that lagged *Repurchase Intensity* is positively significantly related (coefficient of 0.017) to *Short Interest*, but the statistical significance disappears when I add lagged *Short Interest*. This result is in line with my expectations that short interest was not positively related to prior repurchase intensity.

My control variables have different signs than I expected. *Amihud* is significantly negatively related to *Short Interest* which means that *Short Interest* increases if liquidity increases. When I review my expectations, this can be explained by the fact that short

Table 6

Effect of repurchase intensity on short interest

This table presents fixed effects regressions for HKEX firms that repurchase shares from 2004 until 2015 on the HKEX. The dependent variable is *Short Interest* (%). *Repurchase Intensity* is the most important independent variable. The columns (1)-(3) contain $Repurchase\ Intensity_t$ and the columns (4)-(6) contain $Repurchase\ Intensity_{t-1}$. Furthermore, I added some control variables: the natural logarithm of $Amihud_t$, the natural logarithm of $Market\ Cap_t$, $Return_{t-1}$, and the lagged dependent variable $Short\ Interest_{t-1}$. The T-statistics are provided in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. Furthermore, the bottom of the table provides: the number of observations, the adjusted r-squared, and the fixed effects. All standard errors are clustered at firm-level.

	Dependent variable: *Short Interestt*					
	(1)	(2)	(3)	(4)	(5)	(6)
$Repurchase\ Intensity_t$	0.031***	0.030***	0.020***			
	(2.88)	(2.83)	(2.65)			
$Repurchase\ Intensity_{t-1}$				0.017**	0.016**	0.002
				(2.41)	(2.30)	(0.77)
$Amihud_t$ (ln)		-1.71E-03***	-9.03E-04***		-1.71E-03***	-9.05E-04***
		(-6.94)	(-6.99)		(-6.94)	(-7.01)
$Market\ Cap_t$ (ln)		1.43E-03**	7.73E-04**		1.43E-03**	7.71E-04**
		(2.07)	(2.09)		(2.07)	(2.09)
$Return_{t-1}$		1.48E-04***	1.44E-04***		1.47E-04***	1.44E-04***
		(6.00)	(7.52)		(5.95)	(7.52)
$Short\ Interest_{t-1}$			0.468***			0.469***
			(50.63)			(50.78)
Number of observations	827,075	827,075	827,075	827,075	827,075	827,075
Adjusted R-squared	0.166	0.178	0.358	0.166	0.177	0.358
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

selling becomes easier (cheaper) for more liquid stocks and thus increasing short selling. I expected $Market\ Cap$ to have a negative coefficient in line with the momentum theory of Jegadeesh and Titman (1993). I observe, however, a positive coefficient which is significant at the 5% confidence level. Higher $Market\ Cap$ apparently means that short sellers increase their short positions which could imply that they assume $Market\ Cap$ goes down in the future. Lagged *Return* has a negative coefficient which also conflicts with my expectation of the momentum theory.

As before, I compute several robustness checks. Running the analysis on a monthly level (see Table 28) gives a different result to what I hoped to find. I observe a positive relation between *Short Interest* and *Repurchase Intensity* which is significant at the 1% confidence level. I also observe, however, a negative relation between lagged *Repurchase Intensity* and *Short Interest* which implies that *Short Interest* goes up if lagged *Repurchase Intensity* goes down. Checking with the other definition of *Short Interest* (as percentage of trading volume) I again find a significant relation between lagged *Repurchase Intensity* and *Short Interest*. The difference between the robustness check on a monthly level and this robustness check is that the coefficient is positive now. Taking everything into account, I find evidence that short interest is positively related to prior repurchase intensity. Various robustness checks show significant results between short interest and prior repurchase intensity. I hoped to find no significant relation since it would help me in pointing the direction of the relation.

So, what do all my findings imply? I observe that HKEX firms repurchase more often following times of overvaluation, because they repurchase more often following periods of high short interest. Furthermore, firms repurchases on average following periods of underperformance. This gives rise to the the idea of a price support motive for overvalued stock. It turns out that repurchases can be used to accomplish price support since post-repurchase CARs are significantly positive on average. If the firms would support overvalued stock, the average abnormal performance should be negative. In the case of overvalued stock, the price support does not work since it does not counterbalance the downward market correction. Furthermore, I can not conclude with certainty that overvaluation is the real driver of stock repurchases. I have not unearthed enough evidence to conclude on the direction of the causal relation between overvaluation and repurchases.

VI. Conclusion and discussion

A. Conclusion

This thesis fits into the share repurchase and short selling literature. Firms repurchase for various reasons from distributing excess cash to a defense mechanism in the case of a takeover threat. Buybacks are often used to signal undervaluation to the market since on average they are followed by positive abnormal performance. Liu and Swanson (2016) state that U.S. firms use repurchases to support overvalued stock. The fact that the stock is overvalued implies that the firm pays more than fundamental value and thus pays too much. It can be explained by the managerial bias caused by the fact that managers do not repurchase with their own capital. HKEX repurchase disclosure requirements enables me to obtain daily data of actual repurchases. I examine whether HKEX firms have been using share repurchases to support overvalued stock. Furthermore, I examine whether the price support holds in the medium-term (20 trading days). My sample starts in January 2004 and ends in December 2015. In line with the short selling literature, I use short interest as proxy for overvaluation.

The first part of my analysis contains a joint frequency study of repurchases and prior short interest levels. I conclude that HKEX firms repurchase more often following periods of overvaluation (high levels of short interest). In line with this, I find an average CAR of -1.41% in the pre-repurchase period (-20,-1). Next, I examine the potential positive effect of repurchases on stock performance. I observe a positive CAR of 3.34% in the post-repurchase period (0,+20) and thus conclude that repurchases are on average effective to provide price support in the medium-term. Then, I look at the effect of short interest on the performance

after a repurchase. Lightly shorted stocks outperform heavily shorted stocks on average by 0.39%. The price support of the heavily shorted stocks turns out to disappear in the medium-term. This means that the repurchases are not effective to support highly overvalued stock. In the last part of my analysis, I examine whether the overvaluation (short interest) has led to the repurchases. I use a fixed effects model that controls for time and firm fixed effects. Short interest and lagged short interest are both positively related to repurchase intensity. This implies that higher levels of short interest corresponds with higher levels of repurchase intensity. I can not conclude, however, with certainty on the direction of the relation pointing from short interest to repurchase intensity since several robustness checks show different outcomes.

I conclude the following. In my opinion, it is likely that managers adjust their repurchase behaviour based on prior performance since the pre-repurchase performance is significantly negative. This is in line with the results I found regarding firms repurchasing more frequently following times of high short interest. The overall post-repurchase CARs are significantly positively, but the price support is not effective for highly overvalued stock since these CARs are not significantly different from zero. I have not found enough evidence, however, to state that the repurchases are executed to support the overvaluation. My results are not convincing to conclude on a causal relation. Furthermore, the post-repurchase CARs should have been negative if firms support overvalued stock and we believe in efficient markets.

B. Discussion

Each research is subjected to limitations, so this applies to my thesis as well. One major limitation which I did not address is the fact that a substantial amount of the short sales are done by hedge funds. These hedge funds obtain short positions in combinations with long positions as part of a hedging strategy. These short positions therefore do not necessarily imply that they believe the stock is overvalued. I expect that when future research corrects for the short sales which are part of a hedging strategy, the results be more defined. This argument is examined by Jiao et al. (2016); Nezafat et al. (2016) and they indeed come to the conclusion that short positions held by hedge funds are not associated with negative performance. Thus, simple short interest is not ideal as proxy for overvaluation. On the other hand, using a proxy is never 100% perfect.

Another shortcoming of my research is the fact that I was not able to obtain insights into short selling bans on the HKEX. I contacted the HKEX to obtain a list with stocks that were eligible for short selling over time, but they were not able to provide me with such a list. If one knows which stocks had a short selling ban during a particular period, this could really

add value to the research. One can use the short selling bans to examine the causal relation between short selling and repurchases. For instance, the instrumental variable method can be used to see if the short selling ban effects repurchase behaviour. This would indicate the relation going from short interest to repurchases since these bans probably do not directly influence repurchases.

Furthermore, the first part (joint frequencies) and the second part (CAR study) of my thesis uses a repurchase dummy which means that I treat all repurchases the same. Thus, I ignore the fact that the repurchase intensity differs between different repurchase transactions. Future research could possibly take these differences into account and examine whether the expected relations are stronger for higher levels of repuchase intensity. The third part (fixed effects regressions) uses repurchase intensity, because I do want to apply nuance to different levels of repurchase intensity. An additional analysis could be to use the repurchase dummy followed by a probit regression model to see whether short interest levels are related to the chance of a repurchase.

My last recommendation for future research is to include insider trading into the research. One of the reasons for giving price support to overvalued stock is because the executives possess stock themselves. When insider trading and insider positions are taken into account, it could be observed that managers are more inclined to provide price support if they hold (large) positions of their own stock. Furthermore, by examining insider trading around repurchases one could examine whether executives believe the price support will be effective.

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Appendix

A. Additional information

Table 7
Variable descriptions

This table presents all the relevant variables in this thesis. The table reports the name, the definition, the source, and the unit.

Name	Definition	Source	Unit
ΔShort Interest	Relative difference between Short Interest and the Average Short Interest of a firm	HKEX, Datastream	Ratio
Adjusted Price	Price divided by the Adjustment Factor	Datastream	Unit
Adjustment Factor	Factor that adjusts stock prices for stock splits	Datastream	Unit
Amihud	The absolute Return divided by Turnover winsorized at 1% (ln)	Datastream	Unit
Average Short Interest	Average Short Interest over the past 20 trading days (-20,-1)	HKEX, Datastream	Ratio
BTM	Book value per share divided by the stock price	Worldscope, Datastream	Ratio
Market Cap	Market value (ln)	Datastream	Millions
Price	Share price	Datastream	Unit
Repurchase Dummy	Dummy with value 1 if Repurchase Intensity is larger then zero	HKEX, Datastream	Binary
Repurchase Intensity	Repurchase Volume divided by Shares Outstanding	HKEX, Datastream	Ratio
Repurchase Volume	Number of shares repurchased	HKEX	Millions
Return	Return that is calculated using Total Return Index winsorized at 1%	Datastream	Unit
Shares Outstanding	Market Cap divided by the Adjusted Price per share	Datastream	Millions
Short Interest	Short Sales divided by Shares Outstanding	HKEX, Datastream	Ratio
Short Interest (TV)	Short Sales divided by Turnover	HKEX, Datastream	Ratio
Short Sales	Total number of shares short-sold for the stock in the day	HKEX	Unit
Turnover	Total trading volume in HKD of the stock in a day	Datastream	Millions

Table 8
Correlation matrix

This table presents the correlation matrix of the regression variables. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	$Repurchase\ Intensity_t$	$Repurchase\ Intensity_{t-1}$	$Short\ Interest_t$	$Short\ Interest_{t-1}$	$Amihud_t$ (ln)	$Market\ Cap_t$ (ln)	$Market\ Cap_{t-1}$ (ln)	$Return_{t-1}$
$Repurchase\ Intensity_t$	1.000							
$Repurchase\ Intensity_{t-1}$	0.251***	1.000						
$Short\ Interest_t$	0.028***	0.016***	1.000					
$Short\ Interest_{t-1}$	0.020***	0.028***	0.556***	1.000				
$Amihud_t$ (ln)	-0.006***	-0.006***	-0.290***	-0.290***	1.000			
$Market\ Cap_t$ (ln)	0.001	0.001	0.262***	0.261***	-0.837***	1.000		
$Market\ Cap_{t-1}$ (ln)	-0.003***	-0.003***	0.110***	0.110***	-0.353***	0.480***	1.000	
$Return_{t-1}$	0.002*	0.003***	-0.005***	-0.012***	0.014***	0.011***	-0.002	1.000

Table 9
Correlation matrix: monthly

This table presents the correlation matrix of the regression variables. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	$Repurchase\ Intensity_t$	$Repurchase\ Intensity_{t-1}$	$Short\ Interest_t$	$Short\ Interest_{t-1}$	$Amihud_t$ (ln)	$Market\ Cap_t$ (ln)	$Market\ Cap_{t-1}$ (ln)	$Return_{t-1}$
$Repurchase\ Intensity_t$	1.000							
$Repurchase\ Intensity_{t-1}$	0.259***	1.000						
$Short\ Interest_t$	0.034***	0.012**	1.000					
$Short\ Interest_{t-1}$	0.022***	0.034***	0.751***	1.000				
$Amihud_t$ (ln)	-0.017***	-0.014***	-0.443***	-0.443***	1.000			
$Market\ Cap_t$ (ln)	0.004	-0.000	0.405***	0.400***	-0.849***	1.000		
$Market\ Cap_{t-1}$ (ln)	0.009	0.004	0.408***	0.404***	-0.855***	0.996***	1.000	
$Return_{t-1}$	-0.038***	-0.033***	-0.025***	-0.032***	0.070***	0.018***	-0.004	1.000

Table 10

Descriptive statistics: monthly

This table presents the descriptive statistics of HKEX stocks that repurchased shares during 2004-2015. I report the arithmetic mean, the median, the standard deviation, the minumum, the maximum, the 1st percentile, the 99th percentile, and the number of observations. Panel A and B consist of all the observations, but show the overall statistics and the statistics by firm respectively. Panel C and D are show the statistics of observations for which the repurchase dummy is equal to one. Panel C shows the overall statistics and Panel D consists of the statistics by firm. *Return* and *Amihud* are winsorized at the 1% and 99% level.

Panel A: Descriptive statistics (all observations)

	Mean	Standard Deviation	Minimum	5th Percentile	Median	95th Percentile	Maximum	N
Repurchase Intensity	0.02%	0.18%	0.00%	0.00%	0.00%	0.04%	8.03%	35,172
Short Interest	0.15%	0.37%	0.00%	0.00%	0.00%	0.79%	7.93%	35,172
Amihud	42.55	241.50	0.00	0.02	0.88	133.80	3,570.77	35,172
Market Cap (millions HKD)	12,453.48	44,571.70	6.55	249.73	2,989.00	47,197.54	1,219,352.88	35,172
Return	2.01%	18.72%	-84.38%	-20.25%	0.00%	29.09%	669.23%	35,172

Panel B: Descriptive statistics by firm (all observations)

	Mean	Standard Deviation	Minimum	5th Percentile	Median	95th Percentile	Maximum	N
Repurchase Intensity	0.03%	0.05%	0.00%	0.00%	0.01%	0.11%	0.57%	338
Short Interest	0.15%	0.22%	0.00%	0.00%	0.05%	0.63%	1.34%	338
Amihud	33.23	94.38	0.00	0.03	1.90	229.95	881.02	338
Market Cap (millions HKD)	11,651.08	32,686.21	158.41	759.29	3,952.49	45,567.50	448,489.41	338
Return	1.61%	2.21%	-9.88%	-1.95%	1.79%	4.75%	10.99%	338

Panel C: Descriptive statistics (Repurchase Dummy = 1)

	Mean	Standard Deviation	Minimum	5th Percentile	Median	95th Percentile	Maximum	N
Repurchase Intensity	0.37%	0.61%	0.00%	0.01%	0.15%	1.41%	8.03%	2,250
Short Interest	0.20%	0.44%	0.00%	0.00%	0.00%	1.07%	4.98%	2,250
Amihud	12.91	63.52	0.00	0.01	0.66	56.18	1,717.56	2,250
Market Cap (millions HKD)	14,501.58	43,033.60	47.04	460.07	3,392.34	66,260.87	980,592.69	2,250
Return	-2.14%	15.91%	-66.54%	-30.12%	-1.31%	22.65%	115.66%	2,250

Panel D: Descriptive statistics by firm (Repurchase Dummy = 1)

	Mean	Standard Deviation	Minimum	5th Percentile	Median	95th Percentile	Maximum	N
Repurchase Intensity	0.42%	0.45%	0.00%	0.04%	0.29%	1.17%	3.02%	306
Short Interest	0.23%	0.42%	0.00%	0.00%	0.02%	1.21%	2.41%	306
Amihud	16.24	101.17	0.00	0.02	0.56	43.35	1,589.11	306
Market Cap (millions HKD)	11,334.53	28,415.82	131.60	560.74	3,259.33	45,216.77	339,435.12	306
Return	-4.52%	12.14%	-54.61%	-23.36%	-3.64%	9.37%	82.29%	306

B. Robustness checks

Table 11
Share repurchases and short interest (TV)

Robustness of share repurchases and short interest. This table presents summary statistics of the interaction between share repurchases and short interest on the HKEX from 2004 until 2015. A repurchase dummy (*Repurchase Dummy*) is generated for each firm-day combination and has value 1 if the firm does a repurchase on that day and value 0 if no repurchase is done. *Short Interest* is the number of shares sold short divided by the number of shares traded. The sample is segmented into four groups based on levels of short selling. The first group (Zero) contains of observations with a *Short Interest* of zero, so no short sales during that day. The other three groups (Low, Medium, and High) are equally-sized groups based on Δ*Short Interest*. Δ*Short Interest* is defined as the difference between *Short Interest* and the average *Short Interest* per firm. The *Short Interest* groups in column (1) and (2) are based on the Δ*Short Interest* on the previous trading day (t-1). Column (3) and (4) are based on the average Δ*Short Interest* in the 20 trading days prior to the repurchase (t-20,t-1).

Panel A: Joint frequencies of share repurchases and short interest on the previous trading day.

Δ*Short Interest* Group	*Repurchase Dummy* = 0 (1)	*Repurchase Dummy* = 1 (2)	Row Total (1) + (2)	*Repurchase Dummy* = 0 (3)	*Repurchase Dummy* = 1 (4)	Row Total (3) + (4)
Zero	538,662	8,578	547,240	423,153	6,523	429,676
	65.13%	1.04%	66.17%	51.16%	0.79%	51.95%
Low	91,428	1,851	93,279	130,203	2,264	132,467
	11.05%	0.22%	11.28%	15.74%	0.27%	16.02%
Medium	91,138	2,140	93,278	129,459	3,007	132,466
	11.02%	0.26%	11.28%	15.65%	0.36%	16.02%
High	91,129	2,149	93,278	129,542	2,924	132,466
	11.02%	0.26%	11.28%	15.66%	0.35%	16.02%
Column Total	812,357	14,718	827,075	812,357	14,718	827,075
	98.22%	1.78%	100.00%	98.22%	1.78%	100.00%

Panel B: Short Interest conditional on share repurchases. The percentage represents the proportion of the column total.

Δ*Short Interest* Group	*Repurchase Dummy* = 0 (1)	*Repurchase Dummy* = 1 (2)	**Difference (2) - (1)**	*Repurchase Dummy* = 0 (3)	*Repurchase Dummy* = 1 (4)	**Difference (4) - (3)**
Zero	66.31%	58.28%	**-8.03%*** **	52.09%	44.32%	**-7.77%*** **
Low	11.25%	12.58%	**1.32%*** **	16.03%	15.38%	**-0.65%** **
Medium	11.22%	14.54%	**3.32%*** **	15.94%	20.43%	**4.49%*** **
High	11.22%	14.60%	**3.38%*** **	15.95%	19.87%	**3.92%*** **
Column Total	100.00%	100.00%		100.00%	100.00%	

Panel C: Share repurchases conditional on short interest. The percentage represents the proportion of the row total.

Δ*Short Interest* Group	*Repurchase Dummy* = 0 (1)	*Repurchase Dummy* = 1 (2)	Row Total (1) + (2)	*Repurchase Dummy* = 0 (3)	*Repurchase Dummy* = 1 (4)	Row Total (3) + (4)
Zero	98.43%	1.57%	100.00%	98.48%	1.52%	100.00%
Low	98.02%	1.98%	100.00%	98.29%	1.71%	100.00%
Medium	97.71%	2.29%	100.00%	97.73%	2.27%	100.00%
High	97.70%	2.30%	100.00%	97.79%	2.21%	100.00%
Difference (High - Zero)	**-0.74%*** **	**0.74%*** **		**-0.69%*** **	**0.69%*** **	
Difference (High - Low)	**-0.32%*** **	**0.32%*** **		**-0.50%*** **	**0.50%*** **	

Table 12

CARs around repurchases (firm)

This table presents the CARs around share repurchases on the HKEX from 2004 until 2015. The sample is adjusted for confounding events, so there are at least 20 trading days between two repurchase events of the same firm. I use the capital asset pricing model (CAPM) to estimate normal returns and calculate three CAR time windows: (-20,1), (0,+2), and (0,+20). The CARs are calculated for the whole sample and furthermore segmented into four groups based on levels of short selling. The first group (Zero) contains observations with a *Short Interest* of zero, so no short sales during the prior period. The other three groups (Low, Medium, and High) are equally-sized groups based on Δ*Short Interest* in the prior period. Δ*Short Interest* is defined as the difference between *Short Interest* and the average *Short Interest* per firm. Panel A segments based on Δ*Short Interest* on the prior trading day (-1) and Panel B segments based on the average Δ*Short Interest* on the prior 20 trading day (-20,-1). The T-statistics are provided in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: ΔShort Interest Groups are based on ΔShort Interest on the prior trading day (-1).

		CAR time windows		
Δ*Short Interest* Group	Number of observations	(-20,-1)	(0,+2)	(0,+20)
All	320	-3.98%***	1.42%***	3.61%***
		(-5.54)	(5.91)	(6.39)
Zero	136	-2.15%	1.87%***	4.51%***
		(-1.62)	(4.85)	(4.87)
Low	62	-2.80%**	1.10%*	4.62%***
		(-2.07)	(1.97)	(3.46)
Medium	61	-4.24%***	0.89%**	3.39%***
		(-3.89)	(2.32)	(4.22)
High	61	-8.98%***	1.28%**	0.78%
		(-6.48)	(2.07)	(0.56)
Difference (High - Zero)		**-6.83%**	**-0.59%**	**-3.73%**
Difference (High - Low)		**-6.18%**	**0.18%**	**-3.84%**

Panel B: ΔShort Interest Groups are based on the average ΔShort Interest in the prior 20 trading days (-20,-1).

		CAR time windows		
Δ*Short Interest* Group	Number of observations	(-20,-1)	(0,+2)	(0,+20)
All	320	-3.98%***	1.42%***	3.61%***
		(-5.54)	(5.91)	(6.39)
Zero	96	-2.06%	1.42%***	3.60%***
		(-1.25)	(3.18)	(3.24)
Low	75	-2.28%*	1.71%***	5.42%***
		(-1.85)	(3.38)	(5.20)
Medium	75	-4.02%***	1.55%***	3.90%***
		(-3.96)	(3.16)	(3.36)
High	74	-8.14%***	0.99%**	1.49%
		(-5.52)	(2.03)	(1.28)
Difference (High - Zero)		**-6.08%**	**-0.43%**	**-2.11%**
Difference (High - Low)		**-5.86%**	**-0.72%**	**-3.93%**

Table 13

CARs around repurchases - Market Model

Robustness check for CARs around repurchases. This table presents the CARs around share repurchases on the HKEX from 2004 until 2015. The sample is adjusted for confounding events, so there are at least 20 trading days between two repurchase events of the same firm. I use the Market Model to estimate normal returns and calculate three CAR time windows: (-20,1), (0,+2), and (0,+20). The CARs are calculated for the whole sample and furthermore segmented into four groups based on levels of short selling. The first group (Zero) contains observations with a *Short Interest* of zero, so no short sales during the prior period. The other three groups (Low, Medium, and High) are equally-sized groups based on Δ*Short Interest* in the prior period. Δ*Short Interest* is defined as the difference between *Short Interest* and the average *Short Interest* per firm. Panel A segments based on Δ*Short Interest* on the prior trading day (-1) and Panel B segments based on the average Δ*Short Interest* on the prior 20 trading day (-20,-1). The T-statistics are provided in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: ΔShort Interest Groups are based on ΔShort Interest on the prior trading day (-1).

		CAR time windows		
Δ*Short Interest* Group	Number of observations	(-20,-1)	(0,+2)	(0,+20)
All	2,028	-2.70%***	0.71%***	1.62%***
		(-9.18)	(6.09)	(5.77)
Zero	1,158	-2.28%***	0.80%***	1.91%***
		(-5.49)	(4.96)	(4.92)
Low	290	-2.06%***	0.41%	0.75%
		(-3.54)	(1.58)	(1.15)
Medium	290	-2.33%***	0.69%***	2.25%***
		(-3.59)	(2.62)	(3.64)
High	290	-5.41%***	0.72%**	0.66%
		(-6.44)	(2.03)	(0.85)
Difference (High - Zero)		**-3.13%**	**-0.08%**	**-1.25%**
Difference (High - Low)		**-3.35%**	**0.31%**	**-0.09%**

Panel B: ΔShort Interest Groups are based on the average ΔShort Interest in the prior 20 trading days (-20,-1).

		CAR time windows		
Δ*Short Interest* Group	Number of observations	(-20,-1)	(0,+2)	(0,+20)
All	2,028	-2.70%***	0.71%***	1.62%***
		(-9.18)	(6.09)	(5.77)
Zero	865	-1.87%***	0.81%***	2.22%***
		(-3.80)	(4.20)	(4.83)
Low	388	-3.45%***	0.63%***	1.71%***
		(-6.50)	(2.83)	(2.92)
Medium	388	-2.21%***	0.62%**	1.68%***
		(-3.75)	(2.40)	(3.09)
High	387	-4.32%***	0.69%**	0.11%
		(-5.90)	(2.47)	(0.17)
Difference (High - Zero)		**-2.45%**	**-0.12%**	**-2.11%**
Difference (High - Low)		**-0.87%**	**0.06%**	**-1.60%**

Table 14

CARs around repurchases - 4 Factor Model

Robustness check for CARs around repurchases. This table presents the CARs around share repurchases on the HKEX from 2004 until 2015. The sample is adjusted for confounding events, so there are at least 20 trading days between two repurchase events of the same firm. I use the 4 Factor Model to estimate normal returns and calculate three CAR time windows: (-20,1), (0,+2), and (0,+20). The CARs are calculated for the whole sample and furthermore segmented into four groups based on levels of short selling. The first group (Zero) contains observations with a *Short Interest* of zero, so no short sales during the prior period. The other three groups (Low, Medium, and High) are equally-sized groups based on Δ*Short Interest* in the prior period. Δ*Short Interest* is defined as the difference between *Short Interest* and the average *Short Interest* per firm. Panel A segments based on Δ*Short Interest* on the prior trading day (-1) and Panel B segments based on the average Δ*Short Interest* on the prior 20 trading day (-20,-1). The T-statistics are provided in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: ΔShort Interest Groups are based on ΔShort Interest on the prior trading day (-1).

		CAR time windows		
Δ*Short Interest* Group	Number of observations	(-20,-1)	(0,+2)	(0,+20)
All	2,028	-1.26%***	1.10%***	2.75%***
		(-4.46)	(9.44)	(9.84)
Zero	1,158	-0.65%	1.21%***	3.15%***
		(-1.63)	(7.50)	(8.06)
Low	290	-0.99%*	0.75%***	2.23%***
		(-1.71)	(2.95)	(3.46)
Medium	290	-1.59%**	0.94%***	3.02%***
		(-2.50)	(3.62)	(5.02)
High	290	-3.63%***	1.18%***	1.39%*
		(-4.74)	(3.42)	(1.80)
Difference (High - Zero)		**-2.98%**	**-0.03%**	**-1.76%**
Difference (High - Low)		**-2.64%**	**0.43%**	**-0.84%**

Panel B: ΔShort Interest Groups are based on the average ΔShort Interest in the prior 20 trading days (-20,-1).

		CAR time windows		
Δ*Short Interest* Group	Number of observations	(-20,-1)	(0,+2)	(0,+20)
All	2,028	-1.26%***	1.10%***	2.75%***
		(-4.46)	(9.44)	(9.84)
Zero	865	-0.37%	1.18%***	3.22%***
		(-0.80)	(6.17)	(7.00)
Low	388	-2.39%***	0.99%***	2.91%***
		(-4.43)	(4.37)	(4.96)
Medium	388	-1.25%**	0.92%***	2.50%***
		(-2.26)	(3.60)	(4.63)
High	387	-2.12%***	1.21%***	1.81%***
		(-3.08)	(4.48)	(2.69)
Difference (High - Zero)		**-1.75%**	**0.03%**	**-1.41%**
Difference (High - Low)		**0.27%**	**0.22%**	**-1.10%**

Table 15

CARs around repurchases - Market Model (TV)

Robustness check for CARs around repurchases. This table presents the CARs around share repurchases on the HKEX from 2004 until 2015. The sample is adjusted for confounding events, so there are at least 20 trading days between two repurchase events of the same firm. I use the Market Model to estimate normal returns and calculate three CAR time windows: (-20,1), (0,+2), and (0,+20). The CARs are calculated for the whole sample and furthermore segmented into four groups based on levels of short selling. The first group (Zero) contains observations with a *Short Interest* of zero, so no short sales during the prior period. The other three groups (Low, Medium, and High) are equally-sized groups based on Δ*Short Interest* in the prior period. Δ*Short Interest* is defined as the difference between *Short Interest* and the average *Short Interest* per firm. Panel A segments based on Δ*Short Interest* on the prior trading day (-1) and Panel B segments based on the average Δ*Short Interest* on the prior 20 trading day (-20,-1). The T-statistics are provided in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: ΔShort Interest Groups are based on ΔShort Interest on the prior trading day (-1).

		CAR time windows		
Δ*Short Interest* Group	Number of observations	(-20,-1)	(0,+2)	(0,+20)
All	2,028	-2.70%***	0.71%***	1.62%***
		(-9.18)	(6.09)	(5.77)
Zero	1,158	-2.28%***	0.80%***	1.91%***
		(-5.49)	(4.96)	(4.92)
Low	290	-3.54%***	0.72%**	1.86%***
		(-4.80)	(2.44)	(2.66)
Medium	290	-1.80%***	0.87%***	1.71%**
		(-2.93)	(3.18)	(2.54)
High	290	-4.45%***	0.23%	0.09%
		(-5.98)	(0.73)	(0.13)
Difference (High - Zero)		**-2.17%**	**-0.57%**	**-1.82%**
Difference (High - Low)		**-0.91%**	**-0.49%**	**-1.77%**

Panel B: ΔShort Interest Groups are based on the average ΔShort Interest in the prior 20 trading days (-20,-1).

		CAR time windows		
Δ*Short Interest* Group	Number of observations	(-20,-1)	(0,+2)	(0,+20)
All	2,028	-2.70%***	0.71%***	1.62%***
		(-9.18)	(6.09)	(5.77)
Zero	865	-1.87%***	0.81%***	2.22%***
		(-3.80)	(4.20)	(4.83)
Low	388	-3.76%***	0.57%**	1.57%***
		(-5.76)	(2.32)	(2.67)
Medium	388	-1.38%**	0.79%***	1.58%***
		(-2.29)	(3.18)	(2.81)
High	387	-4.83%***	0.58%**	0.35%
		(-8.03)	(2.17)	(0.54)
Difference (High - Zero)		**-2.96%**	**-0.23%**	**-1.87%**
Difference (High - Low)		**-1.07%**	**0.01%**	**-1.22%**

Table 16

CARs around repurchases - CAPM (TV)

Robustness check for CARs around repurchases. This table presents the CARs around share repurchases on the HKEX from 2004 until 2015. The sample is adjusted for confounding events, so there are at least 20 trading days between two repurchase events of the same firm. I use the capital asset pricing model to estimate normal returns and calculate three CAR time windows: (-20,1), (0,+2), and (0,+20). The CARs are calculated for the whole sample and furthermore segmented into four groups based on levels of short selling. The first group (Zero) contains observations with a *Short Interest* of zero, so no short sales during the prior period. The other three groups (Low, Medium, and High) are equally-sized groups based on Δ*Short Interest* in the prior period. Δ*Short Interest* is defined as the difference between *Short Interest* and the average *Short Interest* per firm. Panel A segments based on Δ*Short Interest* on the prior trading day (-1) and Panel B segments based on the average Δ*Short Interest* on the prior 20 trading day (-20,-1). The T-statistics are provided in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: ΔShort Interest Groups are based on ΔShort Interest on the prior trading day (-1).

		CAR time windows		
Δ*Short Interest* Group	Number of observations	(-20,-1)	(0,+2)	(0,+20)
All	2,028	-1.41%***	0.93%***	3.34%***
		(-4.27)	(7.88)	(10.50)
Zero	1,158	-0.53%	1.10%***	4.24%***
		(-1.12)	(6.72)	(9.32)
Low	290	-2.73%***	0.85%***	2.91%***
		(-3.53)	(2.92)	(3.93)
Medium	290	-1.35%**	0.96%***	2.43%***
		(-2.03)	(3.57)	(3.40)
High	290	-3.65%***	0.34%	1.08%
		(-4.60)	(1.04)	(1.44)
Difference (High - Zero)		**-3.12%**	**-0.76%**	**-3.16%**
Difference (High - Low)		**-0.92%**	**-0.51%**	**-1.83%**

Panel B: ΔShort Interest Groups are based on the average ΔShort Interest in the prior 20 trading days (-20,-1).

		CAR time windows		
Δ*Short Interest* Group	Number of observations	(-20,-1)	(0,+2)	(0,+20)
All	2,028	-1.41%***	0.93%***	3.34%***
		(-4.27)	(7.88)	(10.50)
Zero	865	-0.09%	1.11%***	4.67%***
		(-0.16)	(5.71)	(8.71)
Low	388	-2.72%***	0.75%***	3.22%***
		(-3.79)	(3.06)	(4.91)
Medium	388	-0.49%	0.97%***	2.89%***
		(-0.75)	(3.91)	(4.51)
High	387	-3.98%***	0.69%**	0.93%
		(-6.33)	(2.52)	(1.36)
Difference (High - Zero)		**-3.89%**	**-0.42%**	**-3.74%**
Difference (High - Low)		**-1.26%**	**-0.06%**	**-2.29%**

Table 17

CARs around repurchases - 4 Factor Model (TV)

Robustness check for CARs around repurchases. This table presents the CARs around share repurchases on the HKEX from 2004 until 2015. The sample is adjusted for confounding events, so there are at least 20 trading days between two repurchase events of the same firm. I use the 4 Factor Model to estimate normal returns and calculate three CAR time windows: (-20,1), (0,+2), and (0,+20). The CARs are calculated for the whole sample and furthermore segmented into four groups based on levels of short selling. The first group (Zero) contains observations with a *Short Interest* of zero, so no short sales during the prior period. The other three groups (Low, Medium, and High) are equally-sized groups based on Δ*Short Interest* in the prior period. Δ*Short Interest* is defined as the difference between *Short Interest* and the average *Short Interest* per firm. Panel A segments based on Δ*Short Interest* on the prior trading day (-1) and Panel B segments based on the average Δ*Short Interest* on the prior 20 trading day (-20,-1). The T-statistics are provided in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: ΔShort Interest Groups are based on ΔShort Interest on the prior trading day (-1).

		CAR time windows		
Δ*Short Interest* Group	Number of observations	(-20,-1)	(0,+2)	(0,+20)
All	2,028	-1.26%***	1.10%***	2.75%***
		(-4.46)	(9.44)	(9.84)
Zero	1,158	-0.65%	1.21%***	3.15%***
		(-1.63)	(7.50)	(8.06)
Low	290	-2.01%***	1.03%***	3.18%***
		(-2.81)	(3.61)	(4.80)
Medium	290	-1.42%**	1.18%***	2.54%***
		(-2.31)	(4.29)	(3.67)
High	290	-2.78%***	0.66%**	0.92%
		(-4.15)	(2.16)	(1.37)
Difference (High - Zero)		**-2.13%**	**-0.55%**	**-2.23%**
Difference (High - Low)		**-0.77%**	**-0.37%**	**-2.26%**

Panel B: ΔShort Interest Groups are based on the average ΔShort Interest in the prior 20 trading days (-20,-1).

		CAR time windows		
Δ*Short Interest* Group	Number of observations	(-20,-1)	(0,+2)	(0,+20)
All	2,028	-1.26%***	1.10%***	2.75%***
		(-4.46)	(9.44)	(9.84)
Zero	865	-0.37%	1.18%***	3.22%***
		(-0.80)	(6.17)	(7.00)
Low	388	-2.39%***	1.06%***	3.20%***
		(-3.74)	(4.32)	(5.46)
Medium	388	-0.25%	1.11%***	2.57%***
		(-0.43)	(4.51)	(4.36)
High	387	-3.12%***	0.96%***	1.44%**
		(-5.49)	(3.63)	(2.29)
Difference (High - Zero)		**-2.75%**	**-0.22%**	**-1.78%**
Difference (High - Low)		**-0.73%**	**-0.10%**	**-1.76%**

Table 18

CARs around repurchases (firm) - Market Model

Robustness check for CARs around repurchases (firm). This table presents the CARs around share repurchases on the HKEX from 2004 until 2015. The sample is adjusted for confounding events, so there are at least 20 trading days between two repurchase events of the same firm. I use the Market model to estimate normal returns and calculate three CAR time windows: (-20,1), (0,+2), and (0,+20). The CARs are calculated for the whole sample and furthermore segmented into four groups based on levels of short selling. The first group (Zero) contains observations with a *Short Interest* of zero, so no short sales during the prior period. The other three groups (Low, Medium, and High) are equally-sized groups based on Δ*Short Interest* in the prior period. Δ*Short Interest* is defined as the difference between *Short Interest* and the average *Short Interest* per firm. Panel A segments based on Δ*Short Interest* on the prior trading day (-1) and Panel B segments based on the average Δ*Short Interest* on the prior 20 trading day (-20,-1). The T-statistics are provided in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: ΔShort Interest Groups are based on ΔShort Interest on the prior trading day (-1).

		CAR time windows		
Δ*Short Interest* Group	Number of observations	(-20,-1)	(0,+2)	(0,+20)
All	320	-4.97%***	1.26%***	2.05%***
		(-7.75)	(5.23)	(4.08)
Zero	136	-3.49%***	1.59%***	2.23%***
		(-3.00)	(4.12)	(2.85)
Low	62	-4.02%***	0.92%*	3.21%**
		(-3.21)	(1.68)	(2.62)
Medium	61	-5.04%***	0.78%**	2.46%***
		(-4.98)	(2.12)	(3.44)
High	61	-9.15%***	1.33%**	0.05%
		(-7.12)	(2.09)	(0.04)
Difference (High - Zero)		**-5.66%**	**-0.26%**	**-2.18%**
Difference (High - Low)		**-5.13%**	**0.41%**	**-3.16%**

Panel B: ΔShort Interest Groups are based on the average ΔShort Interest in the prior 20 trading days (-20,-1).

		CAR time windows		
Δ*Short Interest* Group	Number of observations	(-20,-1)	(0,+2)	(0,+20)
All	320	-4.97%***	1.26%***	2.05%***
		(-7.75)	(5.23)	(4.08)
Zero	96	-3.24%**	1.13%**	1.25%
		(-2.26)	(2.49)	(1.31)
Low	75	-4.04%***	1.48%***	3.50%***
		(-3.67)	(3.07)	(4.19)
Medium	75	-4.81%***	1.44%***	2.72%**
		(-5.21)	(2.95)	(2.47)
High	74	-8.30%***	1.01%*	0.95%
		(-5.90)	(1.99)	(0.85)
Difference (High - Zero)		**-5.06%**	**-0.12%**	**-0.30%**
Difference (High - Low)		**-4.26%**	**-0.47%**	**-2.55%**

Table 19

CARs around repurchases (firm) - 4 Factor Model

Robustness check for CARs around repurchases (firm). This table presents the CARs around share repurchases on the HKEX from 2004 until 2015. The sample is adjusted for confounding events, so there are at least 20 trading days between two repurchase events of the same firm. I use the 4 Factor Model to estimate normal returns and calculate three CAR time windows: (-20,1), (0,+2), and (0,+20). The CARs are calculated for the whole sample and furthermore segmented into four groups based on levels of short selling. The first group (Zero) contains observations with a *Short Interest* of zero, so no short sales during the prior period. The other three groups (Low, Medium, and High) are equally-sized groups based on Δ*Short Interest* in the prior period. Δ*Short Interest* is defined as the difference between *Short Interest* and the average *Short Interest* per firm. Panel A segments based on Δ*Short Interest* on the prior trading day (-1) and Panel B segments based on the average Δ*Short Interest* on the prior 20 trading day (-20,-1). The T-statistics are provided in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: ΔShort Interest Groups are based on ΔShort Interest on the prior trading day (-1).

		CAR time windows		
Δ*Short Interest* Group	Number of observations	(-20,-1)	(0,+2)	(0,+20)
All	320	-3.07%***	1.76%***	3.29%***
		(-5.15)	(7.22)	(6.38)
Zero	136	-1.44%	2.03%***	3.54%***
		(-1.36)	(4.84)	(4.16)
Low	62	-2.62%**	1.54%***	4.39%***
		(-2.21)	(2.89)	(3.59)
Medium	61	-3.20%***	1.21%***	3.34%***
		(-3.38)	(3.39)	(4.68)
High	61	-7.02%***	1.92%***	1.58%
		(-5.60)	(3.31)	(1.22)
Difference (High - Zero)		**-5.58%**	**-0.11%**	**-1.96%**
Difference (High - Low)		**-4.40%**	**0.38%**	**-2.81%**

Panel B: ΔShort Interest Groups are based on the average ΔShort Interest in the prior 20 trading days (-20,-1).

		CAR time windows		
Δ*Short Interest* Group	Number of observations	(-20,-1)	(0,+2)	(0,+20)
All	320	-3.07%***	1.76%***	3.29%***
		(-5.15)	(7.22)	(6.38)
Zero	96	-1.27%	1.56%***	2.27%**
		(-0.97)	(3.11)	(2.28)
Low	75	-2.14%**	1.98%***	4.88%***
		(-2.13)	(4.57)	(5.45)
Medium	75	-3.22%***	1.97%***	3.58%***
		(-3.79)	(3.74)	(3.17)
High	74	-6.19%***	1.58%***	2.71%**
		(-4.56)	(3.39)	(2.52)
Difference (High - Zero)		**-4.92%**	**0.02%**	**0.44%**
Difference (High - Low)		**-4.05%**	**-0.40%**	**-2.17%**

Table 20

CARs around repurchases (firm) - Market Model (TV)

Robustness check for CARs around repurchases (firm). This table presents the CARs around share repurchases on the HKEX from 2004 until 2015. The sample is adjusted for confounding events, so there are at least 20 trading days between two repurchase events of the same firm. I use the Market model to estimate normal returns and calculate three CAR time windows: (-20,1), (0,+2), and (0,+20). The CARs are calculated for the whole sample and furthermore segmented into four groups based on levels of short selling. The first group (Zero) contains observations with a *Short Interest* of zero, so no short sales during the prior period. The other three groups (Low, Medium, and High) are equally-sized groups based on Δ*Short Interest* in the prior period. Δ*Short Interest* is defined as the difference between *Short Interest* and the average *Short Interest* per firm. Panel A segments based on Δ*Short Interest* on the prior trading day (-1) and Panel B segments based on the average Δ*Short Interest* on the prior 20 trading day (-20,-1). The T-statistics are provided in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: ΔShort Interest Groups are based on ΔShort Interest on the prior trading day (-1).

		CAR time windows		
Δ*Short Interest* Group	Number of observations	(-20,-1)	(0,+2)	(0,+20)
All	320	-4.97%***	1.26%***	2.05%***
		(-7.75)	(5.23)	(4.08)
Zero	136	-3.49%***	1.59%***	2.23%***
		(-3.00)	(4.12)	(2.85)
Low	62	-6.30%***	1.00%	3.66%***
		(-4.28)	(1.60)	(2.87)
Medium	61	-4.59%***	0.96%**	1.89%*
		(-4.76)	(2.26)	(1.69)
High	61	-7.28%***	1.07%**	0.15%
		(-6.34)	(2.05)	(0.16)
Difference (High - Zero)		**-3.79%**	**-0.52%**	**-2.08%**
Difference (High - Low)		**-0.98%**	**0.07%**	**-3.51%**

Panel B: ΔShort Interest Groups are based on the average ΔShort Interest in the prior 20 trading days (-20,-1).

		CAR time windows		
Δ*Short Interest* Group	Number of observations	(-20,-1)	(0,+2)	(0,+20)
All	320	-4.97%***	1.26%***	2.05%***
		(-7.75)	(5.23)	(4.08)
Zero	96	-3.24%**	1.13%**	1.25%
		(-2.26)	(2.49)	(1.31)
Low	75	-5.36%***	1.23%***	2.93%***
		(-5.20)	(2.65)	(2.68)
Medium	75	-3.85%***	1.90%***	3.59%***
		(-3.06)	(3.57)	(3.79)
High	74	-7.95%***	0.80%*	0.64%
		(-6.70)	(1.69)	(0.64)
Difference (High - Zero)		**-4.71%**	**-0.33%**	**-0.61%**
Difference (High - Low)		**-2.59%**	**-0.43%**	**-2.29%**

Table 21

CARs around repurchases (firm) - CAPM (TV)

Robustness check for CARs around repurchases (firm). This table presents the CARs around share repurchases on the HKEX from 2004 until 2015. The sample is adjusted for confounding events, so there are at least 20 trading days between two repurchase events of the same firm. I use the capital asset pricing model to estimate normal returns and calculate three CAR time windows: (-20,1), (0,+2), and (0,+20). The CARs are calculated for the whole sample and furthermore segmented into four groups based on levels of short selling. The first group (Zero) contains observations with a *Short Interest* of zero, so no short sales during the prior period. The other three groups (Low, Medium, and High) are equally-sized groups based on Δ*Short Interest* in the prior period. Δ*Short Interest* is defined as the difference between *Short Interest* and the average *Short Interest* per firm. Panel A segments based on Δ*Short Interest* on the prior trading day (-1) and Panel B segments based on the average Δ*Short Interest* on the prior 20 trading day (-20,-1). The T-statistics are provided in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: ΔShort Interest Groups are based on ΔShort Interest on the prior trading day (-1).

		CAR time windows		
Δ*Short Interest* Group	Number of observations	(-20,-1)	(0,+2)	(0,+20)
All	320	-3.98%***	1.42%***	3.61%***
		(-5.54)	(5.91)	(6.39)
Zero	136	-2.15%	1.87%***	4.51%***
		(-1.62)	(4.85)	(4.87)
Low	62	-4.86%***	1.21%*	5.25%***
		(-3.03)	(1.92)	(3.89)
Medium	61	-3.95%***	0.99%**	2.93%**
		(-3.58)	(2.45)	(2.42)
High	61	-7.18%***	1.06%**	0.60%
		(-6.11)	(2.01)	(0.60)
Difference (High - Zero)		**-5.03%**	**-0.81%**	**-3.91%**
Difference (High - Low)		**-2.32%**	**-0.15%**	**-4.65%**

Panel B: ΔShort Interest Groups are based on the average ΔShort Interest in the prior 20 trading days (-20,-1).

		CAR time windows		
Δ*Short Interest* Group	Number of observations	(-20,-1)	(0,+2)	(0,+20)
All	320	-3.98%***	1.42%***	3.61%***
		(-5.54)	(5.91)	(6.39)
Zero	96	-2.06%	1.42%***	3.60%***
		(-1.25)	(3.18)	(3.24)
Low	75	-4.30%***	1.37%***	4.22%***
		(-3.62)	(2.92)	(3.57)
Medium	75	-2.97%**	2.01%***	5.07%***
		(-2.22)	(3.86)	(4.83)
High	74	-7.16%***	0.88%*	1.51%
		(-5.58)	(1.79)	(1.34)
Difference (High - Zero)		**-5.1%**	**-0.54%**	**-2.09%**
Difference (High - Low)		**-2.86%**	**-0.49%**	**-2.71%**

Table 22

CARs around repurchases (firm) - 4 Factor Model (TV)

Robustness check for CARs around repurchases (firm). This table presents the CARs around share repurchases on the HKEX from 2004 until 2015. The sample is adjusted for confounding events, so there are at least 20 trading days between two repurchase events of the same firm. I use the 4 Factor Model to estimate normal returns and calculate three CAR time windows: (-20,1), (0,+2), and (0,+20). The CARs are calculated for the whole sample and furthermore segmented into four groups based on levels of short selling. The first group (Zero) contains observations with a *Short Interest* of zero, so no short sales during the prior period. The other three groups (Low, Medium, and High) are equally-sized groups based on Δ*Short Interest* in the prior period. Δ*Short Interest* is defined as the difference between *Short Interest* and the average *Short Interest* per firm. Panel A segments based on Δ*Short Interest* on the prior trading day (-1) and Panel B segments based on the average Δ*Short Interest* on the prior 20 trading day (-20,-1). The T-statistics are provided in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: ΔShort Interest Groups are based on ΔShort Interest on the prior trading day (-1).

		CAR time windows		
Δ*Short Interest* Group	Number of observations	(-20,-1)	(0,+2)	(0,+20)
All	320	-3.07%***	1.76%***	3.29%***
		(-5.15)	(7.22)	(6.38)
Zero	136	-1.44%	2.03%***	3.54%***
		(-1.36)	(4.84)	(4.16)
Low	62	-4.27%***	1.63%***	4.98%***
		(-3.09)	(2.73)	(3.96)
Medium	61	-3.01%***	1.31%***	3.02%***
		(-3.22)	(3.36)	(2.71)
High	61	-5.53%***	1.73%***	1.29%
		(-5.02)	(3.51)	(1.45)
Difference (High - Zero)		**-4.09%**	**-0.30%**	**-2.25%**
Difference (High - Low)		**-1.26%**	**0.10%**	**-3.69%**

Panel B: ΔShort Interest Groups are based on the average ΔShort Interest in the prior 20 trading days (-20,-1).

		CAR time windows		
Δ*Short Interest* Group	Number of observations	(-20,-1)	(0,+2)	(0,+20)
All	320	-3.07%***	1.76%***	3.29%***
		(-5.15)	(7.22)	(6.38)
Zero	96	-1.27%	1.56%***	2.27%**
		(-0.97)	(3.11)	(2.28)
Low	75	-3.69%***	1.77%***	3.99%***
		(-3.87)	(3.96)	(3.49)
Medium	75	-2.16%*	2.29%***	4.72%***
		(-1.91)	(4.46)	(4.85)
High	74	-5.69%***	1.46%***	2.46%**
		(-4.79)	(3.16)	(2.49)
Difference (High - Zero)		**-4.42%**	**-0.10%**	**0.19%**
Difference (High - Low)		**-2%**	**-0.31%**	**-1.53%**

Table 23

Effect of average short interest on repurchase intensity

Robustness check for the effect of short interest on repurchase intensity. This table presents fixed effects regressions for HKEX firms that repurchase shares from 2004 until 2015 on the HKEX. The dependent variable is *Repurchase Intensity* (%). *Average Short Interest* is the most important independent variable. The columns (1)-(3) contain *Average Short Interest*$_t$ and the columns (4)-(6) contain *Average Short Interest*$_{t-1}$. Furthermore, I added some control variables: the natural logarithm of *Amihud*$_t$, the natural logarithm of *Market Cap*$_{t-1}$, *Return*$_{t-1}$, and the lagged dependent variable *Repurchase Intensity*$_{t-1}$. The T-statistics are provided in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. Furthermore, the bottom of the table provides: the number of observations, the adjusted r-squared, and the fixed effects. All standard errors are clustered at firm-level.

	Dependent variable: *Repurchase Intensity*$_t$					
	(1)	(2)	(3)	(4)	(5)	(6)
Moving Average Short Interest$_t$	0.024***	0.023***	0.016***			
	(2.91)	(2.69)	(2.69)			
Moving Average Short Interest$_{t-1}$				0.022***	0.021***	0.015***
				(2.85)	(2.61)	(2.60)
Amihud$_t$ (ln)		-6.73E-05	-5.17E-05		-7.24E-05	-5.49E-05
		(-1.14)	(-1.16)		(-1.23)	(-1.24)
Market Cap$_{t-1}$ (ln)		-2.60E-09***	-2.00E-09***		-2.60E-09***	-2.00E-09***
		(-2.78)	(-2.76)		(-2.78)	(-2.75)
Return$_{t-1}$		1.37E-06	-1.95E-05		1.36E-06	-1.96E-05
		(0.11)	(-1.62)		(0.10)	(-1.62)
Repurchase Intensity$_{t-1}$			0.245***			0.245***
			(5.22)			(5.22)
Number of observations	827,075	827,075	827,075	827,075	827,075	827,075
Adjusted R-squared	0.008	0.008	0.068	0.008	0.008	0.068
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Table 24

Effect of short interest (TV) on repurchase intensity

Robustness check of effect of short interest on repurchase intensity. This table presents fixed effects regressions for HKEX firms that repurchase shares from 2004 until 2015 on the HKEX. The dependent variable is *Repurchase Intensity* (%). *Short Interest* is the most important independent variable. The columns (1)-(3) contain *Short Interest*$_t$ and the columns (4)-(6) contain *Short Interest*$_{t-1}$. Furthermore, I added some control variables: the natural logarithm of *Amihud*$_t$, the natural logarithm of *Market Cap*$_{t-1}$, *Return*$_{t-1}$, and the lagged dependent variable *Repurchase Intensity*$_{t-1}$. The T-statistics are provided in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. Furthermore, the bottom of the table provides: the number of observations, the adjusted r-squared, and the fixed effects. All standard errors are clustered at firm-level.

	Dependent variable: *Repurchase Intensity*$_t$					
	(1)	(2)	(3)	(4)	(5)	(6)
Short Interest$_t$	2.15E-05**	1.87E-05*	1.32E-05			
	(1.98)	(1.77)	(1.65)			
Short Interest$_{t-1}$				3.13E-05***	2.87E-05***	2.40E-05***
				(2.95)	(2.78)	(3.07)
Amihud$_t$ (ln)		-1.09E-04*	-8.19E-05*		-1.05E-04*	-7.72E-05*
		(-1.94)	(-1.93)		(-1.87)	(-1.82)
Market Cap$_{t-1}$ (ln)		-2.60E-09***	-2.00E-09***		-2.70E-09***	-2.00E-09***
		(-2.81)	(-2.79)		(-2.85)	(-2.84)
Return$_{t-1}$		1.77E-07	-2.04E-05*		1.18E-06	-1.96E-05
		(0.01)	(-1.68)		(0.09)	(-1.62)
Repurchase Intensity$_{t-1}$			0.245***			0.245***
			(5.23)			(5.23)
Number of observations	827,075	827,075	827,075	827,075	827,075	827,075
Adjusted R-squared	0.008	0.008	0.068	0.008	0.008	0.068
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Table 25

Effect of avg short interest (TV) on repurchase intensity

Robustness check for the effect of short interest on repurchase intensity. This table presents fixed effects regressions for HKEX firms that repurchase shares from 2004 until 2015 on the HKEX. The dependent variable is *Repurchase Intensity* (%). *Average Short Interest* is the most important independent variable. The columns (1)-(3) contain $Average\ Short\ Interest_t$ and the columns (4)-(6) contain $Average\ Short\ Interest_{t-1}$. Furthermore, I added some control variables: the natural logarithm of $Amihud_t$, the natural logarithm of $Market\ Cap_{t-1}$, $Return_{t-1}$, and the lagged dependent variable $Repurchase\ Intensity_{t-1}$. The T-statistics are provided in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. Furthermore, the bottom of the table provides: the number of observations, the adjusted r-squared, and the fixed effects. All standard errors are clustered at firm-level.

	Dependent variable: $Repurchase\ Intensity_t$					
	(1)	(2)	(3)	(4)	(5)	(6)
$Moving\ Average\ Short\ Interest_t$	6.62E-05**	6.09E-05**	4.59E-05**			
	(2.57)	(2.38)	(2.41)			
$Moving\ Average\ Short\ Interest_{t-1}$				6.48E-05**	5.95E-05**	4.44E-05**
				(2.52)	(2.33)	(2.34)
$Amihud_t$ (ln)		-9.14E-05	-6.80E-05		-9.20E-05	-6.86E-05
		(-1.62)	(-1.60)		(-1.64)	(-1.62)
$Market\ Cap_{t-1}$ (ln)		-2.90E-09***	-2.20E-09***		-2.90E-09***	-2.20E-09***
		(-2.93)	(-2.91)		(-2.93)	(-2.91)
$Return_{t-1}$		1.43E-06	-1.95E-05		1.39E-06	-1.95E-05
		(0.11)	(-1.61)		(0.11)	(-1.61)
$Repurchase\ Intensity_{t-1}$			0.245***			0.245***
			(5.23)			(5.23)
Number of observations	827,075	827,075	827,075	827,075	827,075	827,075
Adjusted R-squared	0.008	0.008	0.068	0.008	0.008	0.068
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Table 26

Effect of repurchase intensity on short interest (TV)

This table presents fixed effects regressions for HKEX firms that repurchase shares from 2004 until 2015 on the HKEX. The dependent variable is *Short Interest* (%). *Repurchase Intensity* is the most important independent variable. The columns (1)-(3) contain $Repurchase\ Intensity_t$ and the columns (4)-(6) contain $Repurchase\ Intensity_{t-1}$. Furthermore, I added some control variables: the natural logarithm of $Amihud_t$, the natural logarithm of $Market\ Cap_t$, $Return_{t-1}$, and the lagged dependent variable $Short\ Interest_{t-1}$. The T-statistics are provided in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. Furthermore, the bottom of the table provides: the number of observations, the adjusted r-squared, and the fixed effects. All standard errors are clustered at firm-level.

	Dependent variable: $Short\ Interest_t$					
	(1)	(2)	(3)	(4)	(5)	(6)
$Repurchase\ Intensity_t$	0.972*	0.808*	0.146			
	(1.93)	(1.69)	(0.58)			
$Repurchase\ Intensity_{t-1}$				1.167**	0.971**	0.533**
				(2.32)	(2.04)	(2.20)
$Amihud_t$ (ln)		-3.38E-01***	-1.60E-01***		-3.38E-01***	-1.60E-01***
		(-6.97)	(-7.04)		(-6.97)	(-7.03)
$Market\ Cap_t$ (ln)		3.72E-01***	1.76E-01***		3.72E-01***	1.76E-01***
		(2.78)	(2.77)		(2.78)	(2.77)
$Return_{t-1}$		2.51E-02***	3.54E-02***		2.50E-02***	3.53E-02***
		(5.51)	(9.17)		(5.49)	(9.16)
$Short\ Interest_{t-1}$			0.528***			0.528***
			(71.42)			(71.42)
Number of observations	827,075	827,075	827,075	827,075	827,075	827,075
Adjusted R-squared	0.338	0.349	0.531	0.338	0.349	0.531
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Table 27

Effect of short interest on repurchase intensity: monthly

Robustness check of the effect of short interest on repurchase intensity. This table presents fixed effects regressions for HKEX firms that repurchase shares from 2004 until 2015 on the HKEX. The dependent variable is *Repurchase Intensity* (%). *Short Interest* is the most important independent variable. The columns (1)-(3) contain $Short\ Interest_t$ and the columns (4)-(6) contain $Short\ Interest_{t-1}$. Furthermore, I added some control variables: the natural logarithm of $Amihud_t$, the natural logarithm of $Market\ Cap_{t-1}$, $Return_{t-1}$, and the lagged dependent variable $Repurchase\ Intensity_{t-1}$. The T-statistics are provided in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. Furthermore, the bottom of the table provides: the number of observations, the adjusted r-squared, and the fixed effects. All standard errors are clustered at firm-level.

	Dependent variable: $Repurchase\ Intensity_t$					
	(1)	(2)	(3)	(4)	(5)	(6)
$Short\ Interest_t$	0.022***	0.021***	0.020***			
	(3.38)	(3.15)	(3.17)			
$Short\ Interest_{t-1}$				0.012***	0.010**	0.006*
				(2.79)	(2.41)	(1.92)
$Amihud_t$ (ln)		-2.35E-03	-1.58E-03		-2.67E-03*	-2.02E-03
		(-1.48)	(-1.31)		(-1.66)	(-1.64)
$Market\ Cap_{t-1}$ (ln)		-3.16E-03	-2.27E-03		-2.81E-03	-1.89E-03
		(-1.02)	(-0.93)		(-0.92)	(-0.79)
$Return_{t-1}$		-4.31E-05	-4.69E-05		-4.43E-05	-4.88E-05
		(-0.81)	(-0.93)		(-0.83)	(-0.96)
$Repurchase\ Intensity_{t-1}$			0.218***			0.218***
			(7.03)			(7.03)
Number of observations	35,172	35,172	35,172	35,172	35,172	35,172
Adjusted R-squared	0.050	0.050	0.095	0.049	0.049	0.094
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Table 28

Effect of rep. intensity on short interest: monthly

Robustness check of the effect of repurchase intensity on short interest. This table presents fixed effects regressions for HKEX firms that repurchase shares from 2004 until 2015 on the HKEX. The dependent variable is *Short Interest* (%). *Repurchase Intensity* is the most important independent variable. The columns (1)-(3) contain $Repurchase\ Intensity_t$ and the columns (4)-(6) contain $Repurchase\ Intensity_{t-1}$. Furthermore, I added some control variables: the natural logarithm of $Amihud_t$, the natural logarithm of $Market\ Cap_t$, $Return_{t-1}$, and the lagged dependent variable $Short\ Interest_{t-1}$. The T-statistics are provided in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. Furthermore, the bottom of the table provides: the number of observations, the adjusted r-squared, and the fixed effects. All standard errors are clustered at firm-level.

	Dependent variable: $Short\ Interest_t$					
	(1)	(2)	(3)	(4)	(5)	(6)
$Repurchase\ Intensity_t$	0.062***	0.056***	0.040***			
	(3.97)	(3.74)	(3.84)			
$Repurchase\ Intensity_{t-1}$				0.019**	0.013	-0.020**
				(2.04)	(1.50)	(-2.35)
$Amihud_t$ (ln)		-0.035***	-0.012***		-0.035***	-0.012***
		(-6.44)	(-5.65)		(-6.46)	(-5.71)
$Market\ Cap_t$ (ln)		0.019	0.014**		0.019	0.014**
		(1.34)	(2.42)		(1.34)	(2.39)
$Return_{t-1}$		-1.54E-04*	-5.56E-05		-1.56E-04*	-5.67E-05
		(-1.77)	(-0.79)		(-1.80)	(-0.80)
$Short\ Interest_{t-1}$			0.594***			0.595***
			(38.10)			(38.37)
Number of observations	35,172	35,172	35,172	35,172	35,172	35,172
Adjusted R-squared	0.373	0.398	0.608	0.372	0.397	0.608
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes