Actual Share Repurchases and Price Efficiency in Canada

Master's Thesis in Financial Economics

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Abstract

In this master thesis, I explore the influence of actual share repurchases on price efficiency, using a manually collected data set regarding the Canadian market. In the main analysis, I regress measures of price efficiency on measures of repurchase activity. I find that share repurchases increase price efficiency, this depending on the measure of repurchase activity used in the analysis. Moreover, by examining the impact of share repurchases in up and down markets, I conclude that share repurchases improve efficiency especially in down markets, this indicating that firms use them to provide price support at fundamental values.

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1. Introduction

Recently, share repurchases became the dominant form of payout, not only in the US as reported by Busch and Obernberger (2016), but also in other markets, such as the Canadian (Manconi et al., 2015). Most of the buyback programs are executed in the open market via open market repurchases. This practice has been questioned by the relevant bibliography that examined whether share repurchases are used by managers to manipulate stock prices (Vermaelen, 1981; Chan et al., 2010).

In a sample containing the 250 firms of S&P/TSX Composite Index, the total amount spent by Canadian companies on repurchasing their own shares between 1996 and 2016 amounts to 178 billion dollars. On average, repurchases through the open market represent almost 5% of firms' annual trading volume, this providing evidence that share repurchases can affect share prices and possibly be used to manipulate them.

Busch and Obernberger (2016) consider whether share repurchases are used to influence stock pricing by examining whether they make prices more efficient. Using several measures of price efficiency for US repurchase programs, they conclude that share repurchases make prices more efficient by providing price support at fundamental values, while on the other hand they find no evidence suggesting that managers use share repurchases to manipulate stock prices.

The US market is the most active market concerning share repurchases, however, since the mid-90s, buyback programs became popular in other markets as stated by Manconi et al. (2015). In their paper, the authors explore the consequences of open market repurchases globally, using announcements from thirty two different countries, reporting that Canada comes third to repurchases announcements (2841 SDC announcements), only behind the US and Japan, for the period between 1998 and 2010. Since the Canadian market seems to be extremely active regarding share repurchases, my goal in this thesis paper is to examine the impact of actual share repurchases on price efficiency in this specific market.

Moreover, another interesting aspect about the Canadian market is that, in comparison to the US market, it is governed by a different set of rules and regulations. Share repurchases in Canada are regulated by laws of each stock exchange (Li and McNally, 1999). The focus of my thesis is on

the Toronto Stock Exchange (henceforth the TSX), which is the largest Canadian stock exchange (Kim et al., 2005).

Four main differences arise when comparing the Canadian open market share repurchases- which are called Normal Course Issuer Bids (henceforth NCIBs)- to US open market share repurchases, as stated by Li and McNally (1999). First, the announcement of a NCIB always refers to the maximum number of shares that a firm is legally allowed to repurchase, rather than the proportion of shares the firm intends to repurchase. Second, Canadian firms are obliged to publicly announce NCIBs, while for US firms the announcement of their intention to initiate a program is not mandatory (Stephens and Weisbach, 1998). Third, Canadian NCIBs are completed maximum twelve months after they commence (Kim et al., 2005), whereas US programs can last for more than one year (Vermaelen, 1981). Finally, another key difference between the two markets is that the Canadian securities law prohibits Canadian firms from issuing new shares when they have a NCIB in force (Li and McNally, 1999).

The aim of my thesis is to investigate how share repurchases influence price efficiency. To reach this goal, I rely on the two hypotheses proposed and developed by Busch and Obernberger (2016). The first hypothesis suggests that share repurchases increase prices beyond stocks' fundamental value, this resulting in a decrease in price efficiency. This hypothesis is based on that managers frequently use share repurchases to increase prices, especially when their compensation is partly equity based and their performance relates to their ability to create value for shareholders. If repurchases are conducted above fundamental values, they will increase the delay with which information is incorporated in the stock price and consequently, price efficiency will decrease. Alternatively, if price support is provided below fundamental values, price delay will be reduced and prices will become more efficient.

The second hypothesis claims that share repurchases make prices more efficient by increasing either the speed or the accuracy with which available information is incorporated in stock prices. A key trait of share repurchases is that they can only incorporate positive news into stock prices, since firms that buy back are buyers of their stock. Some stocks are less visible and get no or little attention by investors (Hou and Moskowitz, 2005) and thus, share repurchases can help them become more efficiently priced by improving the speed with which positive information is incorporated into the stock price. This is because firms that repurchase their own stock can affect

investors' neglect on their stock. Furthermore, when firms repurchase their shares at a price below the 'true' value, they can improve the accuracy of the incorporation of information and thus, increase price efficiency. Related literature suggests that buying back when the stock is underpriced is the most common and crucial reason to buy back shares (Dittmar, 2000).

For the empirical analysis, I initially try to estimate actual share repurchases using two methods widely used in the actual share repurchases literature (Stephens and Weisbach, 1998; Banyi et al., 2008). First, I estimate repurchases using the monthly *Decreases in Shares Outstanding*, with data retrieved from Datastream. The second method adopted is *Compustat quarterly Purchases of Common Stock* which is, in comparison to the first method, extensively used by previous researchers. Both methods are considered as good and accurate measures of actual shares repurchased. However, none of them delivers reasonable results regarding actual share repurchases. The number of repurchase months represents only 0.4% of the total sample in the first method, while the number of repurchase quarters represents only 5% of the total sample using the second method.[1] Therefore, the small fraction of repurchases to the total sample, would result in poor conclusions in the empirical analysis.

Consequently, the data concerning actual share repurchases are manually collected, since this is the best and most precise method available. I obtain data from: a) firms audited annual Financial Statements (mainly the statement of Cash Flows), b) information disclosed in the notes to Financial Statements or in the Management Discussion and Analysis (MD&A), or c) through news releases published by the companies. I retrieve the maximum number of shares that can be purchased and the actual number of shares repurchased under each NCIB, the dollar volume of shares repurchased and the average price per share, as well as the date of commencement of each NCIB. My unique data set contains the 250 firms listed in the S&P/TSX Composite Index as of May 2017, which initially contains 4,111 firm years and 1,230 NCIBs for the period between 1996 and 2016. I also retrieve financial and accounting data that are used as control variables from Datastream and Compustat. After the merging process with the other datasets, I end up with 232 firms, 3,651 firm years and 918 repurchase years.

[1] Repurchase months (quarters) are months (quarters) in which the dollar volume spent on repurchases is positive.

I use two measures of price delay that are extensively used in the share repurchases -as well as in the short selling- literature to capture price efficiency (cf. Hou and Moskowitz, 2005; Saffi and Sigurdsson, 2010; Phillips, 2011; Boehmer and Wu, 2012; Busch and Obernberger, 2016). Price efficiency is defined as the degree to which available information is incorporated in the stock price (Busch and Obernberger, 2016). The two measures of price delay are proposed by Hou and Moskowitz (2005) and compare the explanatory power of a market model with lagged weekly market returns against that of a simple market model. The higher the explanatory power of the lagged market model, the higher the delay with which information is incorporated into prices and thus, the lower the price efficiency. Additionally, I use *Repurchase Intensity* and *Remaining Volume* as measures of repurchase activity (Busch and Obernberger, 2016). *Repurchase Intensity* is defined as the number of shares repurchased scaled by shares outstanding, and *Remaining Volume* represents the remaining volume that can be repurchased under a NCIB scaled by shares outstanding.

My main analysis is based on regressing the delay measures explained above on the two measures of repurchase activity and on additional control variables, to examine whether share repurchases improve price efficiency. I find evidence supporting that share repurchases decrease price delay and as a result, improve price efficiency, when using *Remaining Volume* as a proxy for repurchases. However, *Repurchase Intensity* seems to have no impact on any of the delay measures adopted, suggesting that the results are driven by the repurchase variable used in the analysis.

Furthermore, I extend my analysis by splitting the sample into years in which the market goes up (positive return) or down (negative return), using the returns of the S&P/TSX Composite Index. By using this approach, I investigate whether firms buy shares back to move prices towards fundamental values by trading on new positive information, or preventing them from dropping below fundamental values by improving the accuracy with which negative information is incorporated in stock prices. Again, the results regarding *Repurchase Intensity* report no statistical significance on any of the delay measures. On the other hand, when *Remaining Volume* is used, I find that share repurchases make prices more efficient, especially when the market goes down, suggesting that share repurchases mainly improve efficiency by providing price support at fundamental values.

The rest of the paper is structured as follows; Section 2 presents the theoretical framework concerning share repurchases, as well as the hypotheses tested and the regulatory background in Canada. Section 3 describes the method of data collection and the sample construction, as well as it explains how the measures used in the analysis are created, and provides an insight on the research methodology. Section 4 contains the empirical analysis concerning the impact of actual share repurchases on price efficiency. Section 5 presents the main conclusion of the study.

2. Theoretical Framework

The research question I investigate in this thesis paper, is whether share repurchases make prices more efficient for Canadian firms that buy back their own shares. Price efficiency is defined as the degree to which available information is incorporated in the stock price (Busch and Obernberger, 2016). The main price delay and repurchase measures used, as well as the main analyses, derive from the paper of Busch and Obernberger (2016), who find that share repurchases improve price efficiency in the US. In their paper, beyond regressing delay measures on repurchase measures and concluding that share repurchases decrease the delay with which new market information is incorporated in stock prices, evidence is consistent with the fact that share repurchases provide price support at fundamental values. They reach this conclusion, by using market returns to distinguish between months in which the market goes up or down and they state that repurchases increase price efficiency, especially in months in which the market goes down.

2.1. Hypotheses

In my paper, I employ the two hypotheses proposed and developed by Busch and Obernberger (2016), which help me examine whether there is evidence reliable enough to answer the main research question.

The first hypothesis suggests that share repurchases increase prices beyond stocks' fundamental value and thus, decrease the information content in stock prices making them less efficient. This hypothesis is based on the management incentive hypothesis, which assumes that managers benefit from increasing the share price beyond fundamental value when their compensation is based on equity (Dittmar, 2000). As a result, managers are highly motivated to use share repurchases to manipulate stock prices and influence their compensation.

Except from the managers' holdings -shares, stock options etc.- in a firm, an increase in the stock price might benefit them indirectly, since their performance relates to their ability to create value for shareholders (Busch and Obernberger, 2016). When prices increase, shareholders' satisfaction is high, since they realize more capital gains. The reacquisition of shares might increase stock price above fundamental values, this reducing the information content in stock prices and delaying the incorporation of information, resulting in a decrease in price efficiency.

The second hypothesis claims that share repurchases improve price efficiency by increasing either the speed or the accuracy with which available information is incorporated in stock prices. A key trait of share repurchases is that they can only incorporate positive news into stock prices, since firms that buy back are buyers of their stock.

As proposed by Hou and Moskowitz (2005), some stocks receive less attention and are less visible by investors. Consequently, share repurchases can result in prices becoming more efficient by improving the speed with which positive information is incorporated into stock prices, since repurchasing firms can affect investors' neglect on their stock. Furthermore, if firms provide price support at fundamental values, share repurchases can improve the accuracy of the stock price. When firms repurchase at a price lower than the 'true' value, price efficiency increases, while on the other hand, repurchasing above fundamental value reduces price efficiency. Dittmar (2000) suggests that valuation is one of the most common and crucial reasons in the repurchase decision, and thus, firms tend to buy back shares when their stock is undervalued.

Hong et al. (2008) assume that firms intervene and buy their shares back when there is a significant drop in the stock price, that drives it below fundamental value, due to an exogenous demand shock.[2] They predict that firms with a higher ability to intervene (not financially constrained firms) and repurchase shares when the price is below fundamental value, will have lower short-horizon return variances than other firms. This relation becomes more profound in markets with less strict regulations regarding share repurchases. The timing at which a firm provides price support is critical. If price support is provided below fundamental values, share

[2] Firms are not market makers, they only intervene when demand shocks are sufficiently large (Hong et al., 2008).

repurchases will increase price efficiency, while on the other hand, if price support is provided above fundamental values, price efficiency will be reduced. (Busch and Obernberger, 2016).

The price support argument is in line with the literature related to managerial timing ability of actual share repurchases, which suggests that firms decide to repurchase below average market prices. For example, Ben-Rephael et al. (2014) conclude that firms tend to buy back their shares at a price significantly lower than the average market price, realizing positive and significant abnormal returns. In his paper related to the timing of actual share repurchases, Obernberger (2014) provides evidence supporting the contrarian-trading hypothesis, which postulates that firms buy back at lower stock prices since share repurchases are driven by negative returns. However, there is no evidence supporting the existence of post-actual share repurchases abnormal returns. As expected, the results of my paper are in line with the price support argument, since repurchase prices are on average significantly lower than the market prices. More specifically, in my sample, firms tend to repurchase at prices almost three times lower than the average market price.

2.2. Literature Review

As stated by Manconi et al. (2015), share repurchases have become extremely popular since the mid-90s in a lot of developed markets (such as the US, Canada, France, UK, Germany, Hong Kong, Japan). As a result, there is a rich literature related to share repurchases, examining their effects with respect to both repurchase announcements and actual share repurchases.

2.2.1. Repurchase announcements

Ikenberry et al. (2000) investigate the Canadian market and they find evidence suggesting that share repurchases result in a low positive abnormal return in the announcement month and higher positive abnormal return over a three-year holding period. They also find that undervaluation is the main motive behind repurchasing stock, with undervalued firms (high book-to-market ratios) performing better in the long-run. Li and McNally (2007) explore repurchases made by TSX-listed companies and their results are in line with the abovementioned findings, suggesting that share repurchases post-announcement abnormal returns are positive. They also examine the determinants of the repurchase decision, concluding that firms with high free cash flows, high book-to-market ratios and poor prior performance, are more likely to repurchase their own shares. Moore (2011) also studies announcements by TSX-listed firms, and presents evidence suggesting

repurchases announcements result in a significant market reaction followed by positive abnormal returns, with firms that have high cash flows experiencing greater returns. Another interesting finding is that the TSX requirements to publish actual shares repurchased monthly, provides useful information to investors when they interpret posterior NCIBs.

Apart from the studies related to the Canadian market, there is a long list of studies examining the impact of repurchase announcements on firm's post-announcement performance concerning markets all over the world. For example, Stephens and Weisbach (1998) and Jagannathan and Stephens (2003) explore the US market which is the world's most active market regarding share repurchases (Manconi et al., 2015). Ginglinger and L'her (2006) investigate the effects of repurchase announcements in the French market, while Oswald and Young (2004) conduct a study for the UK market, as well as Hackethal and Zdantchouk (2006) for the German market. Share repurchases are also popular in the Asian market, with Hatakeda and Isagawa (2004) studying the Japanese market, which is the second most active share repurchases market worldwide (Manconi et al., 2015), and Zhang (2005) evaluates the impact of repurchase announcements in the Hong Kong market. The general outcome of these studies is that share repurchases result in positive abnormal returns, with stock prices going up after the repurchase announcements.

2.2.2. Actual Share Repurchases

Beyond examining the effects of repurchase announcements, the share repurchases literature extends to the actual number of shares repurchased by firms and their interaction with other economic factors, such as capital gains, liquidity, earnings management, as well as the reason and the timing of the repurchase.

Dittmar (2000) uses a proxy to measure actual share repurchases (Compustat data item *Purchase of Stock*) and investigates the different motives behind the firms' decision to repurchase their stock. The author examines several hypotheses, such as the excess capital hypothesis, the undervaluation hypothesis, the optimal leverage hypothesis, the management incentive hypothesis and the takeover deterrence hypothesis. He concludes that firms buy back to distribute excess capital, to take advantage of potential undervaluation, to change their leverage ratio, to counter the dilution effects of stock options, or to defend against takeovers. However, the author finds no evidence supporting that share repurchases are substitutes of dividends.

Hribar et al. (2006) consider whether share repurchases can be used as a device of earnings management. They estimate actual share repurchases by subtracting decreases in preferred stock from the Compustat item *Purchase of Stock*. The paper's main goal is to identify whether firms repurchase stock to meet or beat analysts' earnings per share (EPS) forecasts, indicating that share repurchases help firms increase their EPS, while they conclude that firms with low book-to-market ratios (overvalued) would have missed analysts' forecasts if they wouldn't buy back their shares.

In their paper, Cohn and Sikes (2011) measure the effect of capital gains lock-in on repurchases, using the method used by Hribar et al. (2006) to estimate actual share repurchases.[3] They state that the capital gains lock-in affects a firm's stock price and thus, the number of shares to be repurchased. They find that the capital gains lock-in reduces share repurchases and that the level of the reduction decreases when the capital gains tax rate decreases. Finally, they report that this negative relationship is more profound when the supply of firm's shares is inelastic.

Another economic factor that shares repurchases may affect is liquidity. Hillert et al. (2016) analyze the impact of share repurchases on firms' liquidity, using actual numbers of shares repurchased for US companies, manually obtained from SEC published filings.[4] They use several liquidity measures, as well as instrumental variable approach to control for reverse causality and omitted variables, to conclude that realized repurchases unequivocally improve firms' liquidity.

2.3. Regulatory Background in Canada

Share repurchases in Canada are regulated by laws of each stock exchange (Li and McNally, 1999). Since my thesis paper examines share repurchases conducted by TSX listed firms, I focus on the TSX's general by-laws. The TSX's Company Manual (Policy 5.6 about Normal Course

[3] The term capital gains lock-in refers to investors who are unwilling or unable to sell their shares, because they will face large capital gains tax bills upon doing so.

[4] New disclosure requirements in the US mandate the publication of monthly share repurchases under the new item 2(e) of Form 10-Q and under the item 5(c) of Form 10-K, since March 15, 2004. Under these rules firms should report the total number of shares repurchased, the average price paid per share, the number of shares purchased under repurchase programs, and either the maximum dollar amount or the maximum number of shares that could be repurchased under these programs (Hillert et al., 2016).

Issuer Bids) thoroughly explains the regulatory environment that surrounds share repurchases in the respective stock exchange.

2.3.1 Normal Course Issuer Bid

Open market share repurchases in Canada are called Normal Course Issuer Bids (NCIBs). As reported in the TSX Company Manual (Policy 5.6, Paragraph 3), a NCIB is an offer to acquire listed voting shares or listed equity securities made by an issuer, for securities issued by the issuer and it can last for up to one year. Under a NCIB, for a thirty day period, purchases cannot exceed 2% of the total issued and outstanding shares and for the twelve months period of each program, they cannot exceed the greater of 10% of public float or 5% of shares outstanding.[5] Issuer bids for more than 5% at prices greater than the most recent trade price are called Substantial Issuer Bids and they include fixed price offers, Dutch auctions and takeover bids (Li and McNally, 1999).

2.3.2. Procedure for commencing a Normal Course Issuer Bid

Any firm that wants to commence a NCIB must get through specific steps (Policy 5.6, Paragraph 5). Like in the US, a board approval is sufficient to initiate a NCIB (Kim et al., 2005). After the board approval, any issuer wishing to conduct a NCIB must submit a Notice of Intention to Make a NCIB (Form 5G) to the Exchange.[6] As mentioned above, a NCIB must not extend for a period of more than one year from the time of commencement. When the notice of intention is filed to the Exchange and it is approved, the firm is obliged to issue a press release summarizing the content of its TSX filing. The NCIB may commence two trading days after the latest of: (1) the date of acceptance of the notice of intention or (2) the date of the press release. The issuer can amend its notice of intention to increase the number of shares to be purchased under the bid during the year (if it does not exceed the maximum amounts mentioned in Section 3.1) and is not required to announce the termination of the NCIB. During the year that the NCIB is in force, a repurchasing firm should file a repurchase activity report with the TSX within ten days after the

[5] Public float is equal to the total shares outstanding excluding the insider shareholdings.

[6] According to the TSX Company Manual, the notice of intention should include information such as: the name of the issuer, the class and maximum number of shares that may be acquired under the bid, the duration of the bid including commencement and termination date, the method of acquisition (such as, the names of exchanges involved and the repurchase price, the reason for the bid, possible previous purchases, and any other material information about the bid).

end of each month (Policy 5.6, Paragraph 8). Once a month, the Exchange publishes comprehensive records of the status of all authorized NCIBs, and this report is called the TSX eReview (Kim et al., 2005).[7]

3. Data and Methodology

3.1. Measures of Share Repurchases

Announcements of NCIBs are available on SDC (ThomsonOne). However, this database does not provide data regarding actual share repurchases and such data are not directly accessible.

As a result, at the beginning of my research I try to estimate actual share repurchases using two of the most common methods used by previous researchers (cf. Stephens and Weisbach, 1998; Banyi et al., 2008). The two methods are considered good and accurate measures of actual shares repurchased.

3.1.1. Datastream Decreases in Shares Outstanding

The first measure employed to estimate the actual number of shares repurchased by each firm under a specific NCIB, is the decrease in shares outstanding reported by CRSP. Since CRSP only contains stock and treasury data of US companies, I construct a similar measure with data of Canadian companies gathered from Datastream. Monthly decreases in shares outstanding are not offset with increases (such as new stock issues and exercise of stock options) in other months, because increases are not related to repurchase activity and thus, I record monthly increases in shares outstanding as a zero decrease, as in Banyi et al. (2008). However, if increases and decreases occur in the same month, this measure is likely to understate actual shares repurchased.

It is important to state that decreases in shares outstanding are calculated only for one year after the announcement, since NCIBs in Canada can only last for one year after their commencement, as explained above. To create variables such as the *Repurchase Volume* (dollar volume of shares

[7] According to the TSX Company Manual, firms should include in their report to the TSX, which subsequently publishes the TSX eReview: the expiry date of the bid, the number of shares that may be acquired under the bid, the number of shares purchased in the preceding month, and the shares purchased up to date.

repurchased during the month) and the *Remaining Volume* (remaining volume at the beginning of the months that can be repurchased under a program), I assume that shares were repurchased at the most recent trade price, since shares cannot be bought at a price greater than that (Kim et al., 2005).

Even though this method is considered as a good measure of actual share repurchases, it does not seem to deliver reasonable results for my sample. For a sample containing 67,799 firm months, there are only 262 months in which firms conduct repurchases, which represents only 0.4% of the total sample (Table A2, Panel A of the Appendix). As a consequence, the empirical analysis would result in poor results and conclusions.

3.1.2. Compustat Purchases of Common Stock

The second measure used was initially implemented by Stephens and Weisbach (1998), and Banyi et al. (2008) find that this measure is the most accurate method to calculate actual share repurchases. First, I gather the quarterly purchases of common and preferred stock from Compustat. I assume that shares were repurchased at the lowest price during the quarter, which might overstate the actual number of shares repurchased. Thereafter, I subtract decreases in the value of preferred stock from the Compustat quarterly purchases of common and preferred stock to reduce the overstatement caused by the retirement, conversion, and/or redemption of preferred stock, as in Grullon and Michaely (2002) and Kahle (2002). Since purchases of common and preferred stock item is reported each quarter on a year-to-date basis, I subtract the value of purchase of common and preferred stock in the prior quarter from its value for the current quarter to compute the *Repurchase Volume* during each quarter (Cohn and Sikes, 2011). As explained in Section 3.1, this repurchases' measure is calculated only for one year after the commencement date.

This is a method widely used in the actual share repurchases bibliography (cf. Stephens and Weisbach, 1998; Dittmar, 2000; Grullon and Michaely, 2002; Hribar et al., 2006; Banyi et al., 2008; Cohn and Sikes, 2011). However, as in the first method adopted, the results do not seem reliable enough. For the total sample which includes 7,496 firm quarters, there are only 402 repurchase quarters, representing 5% of the total sample (Table A2, Panel B of the Appendix). Even if this method resulted in a larger proportion of repurchase activity compared to the total

sample, again, the small number of repurchase quarters would not result in reliable conclusions through the analysis.

Since none of these two methods delivers the expected results, the best and most precise method to get actual share repurchases data is to manually collect them. As stated in the Toronto Stock Exchange Company Manual, each firm with a NCIB in charge is obliged to file a repurchase activity report -the TSX eReview- with the TSX each month. The TSX eReview is published monthly by the TSX and is available since 2005. However, access to this report comes at a really high cost and hence, with the limited resources available, I decide to retrieve data through firms' filings.

3.2. Sample Construction

I obtain data regarding actual share repurchases from: a) firms audited annual Financial Statements (mainly the statement of Cash Flows), b) information disclosed in the notes to Financial Statements or in the Management Discussion and Analysis (MD&A), or c) through news releases published by the companies. I analyze shares repurchased in the open market (NCIBs) and exclude shares repurchased under Substantial Issuer Bids.[8]

Since this is a time-consuming procedure, I limit my sample to firms listed in the S&P/TSX Composite Index as of May 2017. The S&P/TSX Composite Index is a Canadian index which is comprised of 250 companies, representing around 70% of the total market capitalization on the TSX. As mentioned above, I obtain the data through firms' filings. I use the System for Electronic Document Analysis and Retrieval (SEDAR), which is a mandatory document filing and retrieval system for Canadian public companies (like EDGAR for the US), which includes documents from 1996 up to date.

I gather data of the 250 companies for the period between 1996 to 2016. For some of the companies, documents are not available for the whole period for several reasons. For example, there are companies that started their operations after the beginning of the sample period or their

[8] According to the TSX Company Manual (Policy 5.6, Paragraph 2), a Substantial Issuer Bid is a bid in which an Issuer can repurchase more of its shares than the number permitted under the Normal Course Issuer Bid rules by making a formal bid under Securities Laws.

documents are not available on SEDAR. For those companies, that their filings are not recorded in SEDAR, I try to locate and obtain them through their official websites.

More specifically, through this procedure I retrieve the maximum number of shares to be purchased and the actual number of shares repurchased under each NCIB, the dollar volume spent on shares repurchases and the average price paid per share, and the date of commencement of each program. The main source used is the firms' Financial Statements and notes to Financial Statements, but when there is not enough information available, I collect data through firms' press releases.

My initial dataset consists of 4,111 firm years, 1,230 NCIBs and 1,013 repurchase years. All the firms for which I obtain actual share repurchases data are available on Datastream, and thus, no loss of observations occurs, when merging with annual financial and accounting data retrieved from this database. I also collect annual data concerning options -more specifically, I obtain *Options exercised* and *Options outstanding*- and after adding them to the initial dataset, I end up with a sample of 232 firms and 3,651 firm years. These firms have 1,116 NCIBs in force during the sample period and repurchase shares back in 918 years.

Table 1 presents the distribution of NCIBs during the sample period and the total dollar volume spent on repurchasing shares. The number of NCIBs increases by 318% since the beginning of the sample period, however the number of NCIBs is not increasing monotonically. The number of NCIBs drops in periods in which the economy experiences recessions, such as in 2001, following the dot-com bubble or in 2009, following the world financial crisis of 2007-2008. The effect of the external economic conditions also affects the total dollars spent in share repurchases. More specifically, in 2008, total repurchases decrease by almost 42%. In line with the number of NCIBs, the total amount spent on share repurchases seems not to be evenly spread over the sample period, supporting the findings of Grullon and Michaely (2002), who state that the growth of share repurchases is volatile and closely linked with dividends. Another interesting finding of Table 1, is that total repurchases in 2016 decrease by 59% in comparison to 2015. This can be explained by the fact that some of the NCIBs that commenced in 2016 have not been completed yet.

Table 1: Sample distribution by announcement year

The table contains all the NCIBs announced by the S&P/TSX Composite Index firms between 1996 and 2016, as well as the total dollar volume spent on share repurchases per year and the mean of the dollar volume spent on share repurchases per year. The repurchases data were obtained through: a) firms audited annual Financial Statements (mainly the statement of cash flows), b) information disclosed in the notes to Financial Statements or in the Management Discussion and Analysis (MD&A), or c) through news releases published by the companies.

Announcement Year	NCIBs	Total Repurchases (mil.)	Mean
1996	22	2398.7	28.5
1997	27	1517.5	16.9
1998	36	1417.3	14.0
1999	46	3968.7	33.9
2000	50	3602.1	28.1
2001	44	3165.9	22.9
2002	49	5501.1	36.2
2003	48	6471.8	40.4
2004	45	10504.4	64.0
2005	53	13486.5	77.5
2006	52	14949.6	82.1
2007	64	13749.6	73.5
2008	70	5754.4	29.7
2009	48	4799.4	23.7
2010	54	9269.8	43.9
2011	66	6962.7	31.8
2012	57	7568.1	33.6
2013	68	12826.5	56.2
2014	71	12906.6	55.9
2015	76	14942.1	64.4
2016	70	8884.3	38.3
Total	**1,116**	**164647.3**	**45.1**

3.3. Research Design

The main purpose of my thesis is to examine whether share repurchases make prices more efficient. To answer the research question, I regress measures of price efficiency on measures of repurchase activity and some control variables:

$$Efficiency_{j,t} = a + \beta\, Efficiency_{j,t-1} + \gamma\, Repurchases_{j,t} + \sum_{i=1} \delta\, Control_{j,i,t} + \mu_i + \eta_t + \varepsilon_{j,t}$$

where *Efficiency* is a measure of price delay (explained in Section 3.4) and *Repurchases* is a measure of repurchase activity. *Repurchases* can be either *Repurchase Intensity* or *Remaining Volume. Repurchase Intensity* represents the number of shares repurchased under a NCIB and is scaled by shares outstanding in the previous year. *Remaining Volume* represents the remaining shares that can be repurchased under a NCIB scaled by shares outstanding. *Control* denotes control variables, while μ and η represent firm and year fixed effects respectively.

As explained by Busch and Obernberger (2016), *Repurchase intensity* is a sharp measure of the repurchase activity of each firm, and it can be the outcome of current, unobserved market conditions. The authors state that, since price efficiency does not change dramatically, in comparison to the previously observed price efficiency, *Repurchase Intensity* will be endogenously determined by the unobserved counterfactual level of efficiency. Consequently, the use of contemporaneous *Repurchase Intensity* will not have a significant effect on price delay, raising issues of endogeneity and reverse causality when firms provide price support to fundamental values.

I try to exclude potential endogeneity and reverse causality using two proxies of repurchase activity, proposed by Busch and Obernberger (2016). The first is the lag of *Repurchase Intensity* and the second one is *Remaining Volume*. The use of lagged *Repurchase Intensity* can tackle reverse causality, as well as *Remaining Volume*. *Remaining Volume* is already determined and thus, does not suffer by reverse causality. Consequently, *Remaining Volume* should be a good proxy of share repurchases and as discussed later, the results align with this argument. Moreover, I use firm fixed effects and year fixed effects to exclude the possibility of presence of unobserved heterogeneity in the cross-section or unobserved macroeconomic factors. Finally, I include a variable that indicates the month that the NCIB commences, to exclude the possibility that the results are driven by announcement effects.

3.4. Measures of price delay

Price efficiency refers to the degree to which available information is incorporated in the stock price (Busch and Obernberger, 2016). I measure price efficiency using two price delay measures proposed by Hou and Moskowitz (2005). These two measures capture the delay with which a stock price changes due to new market-wide information. To construct those measures, I compare the explanatory power of a market model with lagged weekly market returns -as in Hou and

Moskowitz (2005) and Saffi and Sigurdsson (2010)- against that of a simple market model. For each year and each firm, I run a regression of weekly stock returns on contemporaneous market returns and four weeks of lagged market returns:

$$r_{j,t} = a_j + \beta_j R_{m.t} + \varepsilon_{j,t} \quad \text{(Market Model)}$$

$$r_{j,t} = a_j + \beta_j R_{m,t} + \sum_{n=1}^{4} \beta_j^n R_{m,t-n} + \varepsilon_{j,t} \quad \text{(Extended Market Model)}$$

where $r_{j,t}$ denotes the return of firm j on week t and $R_{m.t}$ denotes the return on the S&P/TSX Composite Index on week *t*. If market news is immediately incorporated into the stock price, then β_j will be different from zero and would be approaching one, while β_j^n would be equal to zero. If market news is not immediately incorporated into prices and thus, there is a delay in the incorporation, β_j^n will be approaching zero. I use four lags to include all trading weeks per month.

The first measure is the fraction of contemporaneous stock returns explained by lagged market returns (Hou & Moskowitz, 2005), which is captured by the ratio of the R-squared estimates of the two models:

$$Delay = 1 - \frac{R^2_{market}}{R^2_{extended}}$$

The faster new information is incorporated into prices, the lower the return variation is captured by lagged returns and the lower the delay is. Therefore, price efficiency and *Delay* are negatively correlated.

The second measure uses the coefficients of the two regressions, as well as their standard errors. It is the ratio of the lag-weighted sum of the absolute coefficients of the extended market model relative to the sum of all coefficients, divided by the coefficient's standard errors:

$$Coefficient - based\ delay = \frac{\sum_{n=1}^{4} n * \frac{abs(\beta_j^n)}{se(\beta_j^n)}}{\frac{abs(\beta_j)}{se(\beta_j)} + \sum_{n=1}^{4} \frac{abs(\beta_j^n)}{se(\beta_j^n)}}$$

The *Coefficient-based delay* measure is also negatively related to price efficiency. Therefore, the faster information is incorporated into prices, the lower the explanatory power of the coefficients of the extended market model is, and thus, the lower the *Coefficient-based delay* is.

3.5. Descriptive Statistics

Table 2 provides descriptive statistics for the variables used in the analysis. More specifically, the table presents summary statistics for the data obtained as explained in Section 3.2, for 232 firms, 3,651 firm months, 918 repurchase years and 1,116 NCIBs.

The two price delay measures are constructed using weekly stock and S&P/TSX Composite Index returns. *Delay* takes values between 0 and 1 with a mean of 0.4, while *Coefficient-based delay* ranges between 0.1 and 3.3 with a mean of 1.4.

Table 2: Descriptive Statistics

The table provides descriptive statistics for the delay measures used, for the repurchase measures and for the control variables for S&P/TSX Composite Index firms between 1996 and 2016. It also provides statistics on the repurchase measures in repurchase years. The variables are defined in Table A1 of the Appendix. More specifically, the table reports the mean, the median, the standard deviation (SD), the 1st and the 99th percentile of the distribution for each variable.

	Mean	Median	SD	1st Perc.	99th Perc.	N
Dependent Variables						
Delay	0.418	0.342	0.303	0.019	1.000	3,522
Coefficient-based delay	1.401	1.346	0.551	0.412	2.799	3,522
Repurchase Measures						
Rep. volume (mil.)	45.1	0.00	213.5	0.00	1160.1	3,651
Repurchase Intensity	0.49%	0.00%	2.22%	0.00%	6.61%	3,512
Rep. Intensity (TV)	1.02%	0.00%	4.49%	0.00%	12.98%	3,530
Remaining volume	1.07%	0.00%	3.45%	0.00%	9.71%	3,626
Repurchase Measures in repurchase years						
Rep. volume (mil.)	179.3	31.1	396.6	0.0	2000.0	918
Repurchase Intensity	1.94%	0.96%	4.09%	0.00%	10.02%	894
Rep. Intensity (TV)	3.98%	1.97%	8.19%	0.01%	29.37%	903
Remaining volume	3.10%	2.18%	5.60%	0.00%	12.27%	905
Control Variables						
Analysts	6.5	6.0	4.5	0.0	19.0	3,621
Book to Market	0.639	0.524	0.605	0.033	2.779	3,523
Deviation from $30	19.5	17.2	32.1	0.4	91.1	3,537
Dividends to assets	2.26%	0.98%	3.76%	0.00%	18.17%	3,610
EBITDA to assets	10.12%	10.83%	14.04%	-33.06%	40.72%	3,464
Leverage	0.410	0.395	0.250	0.003	0.946	3,523

Market cap (mil.)	5709.5	1730.4	10972.2	28.2	50898.5	3,523
Options exercised	0.29%	0.00%	0.77%	0.00%	2.81%	3,651
Options outstanding	2.13%	0.47%	5.71%	0.00%	12.84%	3,651
Return	8.72%	10.94%	43.78%	-131.08%	128.09%	3,404
Total assets (mil.)	20199.6	2024.6	81247.9	15.1	410538.0	3,632
Trading volume	13.96%	8.69%	2.01%	0.01%	9.64%	3,507

Repurchase volume equals $45.1 million, on average, over 3,651 firm years and $179.3 million, on average, over 918 repurchase years. This is equal to 1.2% of the annual trading volume for the whole sample, while shares repurchased equal 0.5% of total shares outstanding. The average *Remaining Volume* equals 1% of shares outstanding for the whole sample, increasing to 3.1% of shares outstanding in the repurchase years. *Repurchase Intensity* is, on average, 0.5% of shares outstanding and represents 1% of shares traded over each year. These numbers increase to 1.9% and 4% respectively in repurchase years. The descriptive statistics of the control variables are reasonable and align with the related literature.

4. Empirical Analysis and Discussion

In the empirical analysis, I explore *Repurchase Intensity* and *Remaining Volume* and the determinants of those repurchase variables, while I also test the hypotheses developed earlier and discuss the results of the analysis.

4.1. Analysis of share repurchases

The analysis of the repurchase activity helps in understanding whether lagged *Repurchase Intensity* is a good proxy for contemporaneous *Repurchase Intensity* and whether *Remaining Volume* can be used as a repurchase variable. Moreover, I observe the impact of other control variables on repurchase activity and compare my results with the results of the relevant literature. Table 3 presents regressions of *Repurchase Intensity* and *Remaining Volume* on several control variables.

In Column A, I analyze the lagged *Repurchase Intensity,* to assess whether it can be used as a proxy for contemporaneous *Repurchase Intensity*. If the coefficient is not statistically significant, then lagged *Repurchase Intensity* will be a weak proxy for contemporaneous *Repurchase Intensity*. However, the coefficient of *Repurchase Intensity* is 0.17 and highly significant,

suggesting that lagged *Repurchase Intensity* is a good predictor of contemporaneous *Repurchase Intensity*.

The coefficients of the control variables mostly align with the relevant bibliography. Babenko (2009) finds that repurchases tend to increase pay-performance sensitivity of employee compensation. In line with this, I find that *Options Exercised* positively affect repurchases, as well as *Options Outstanding*, however, the latter lacks statistical significance. The positive coefficient of *Options Exercised* suggests that when employees exercise their stake in the firm, share repurchases increase. Stephens and Weisbach (1998) find that lagged returns have a negative impact on repurchases. In contrast, I find no statistical significance regarding lagged positive returns, whereas I find that lagged negative returns positively affect *Repurchase Intensity*. This result might be different from that reported in relevant studies, since I use annual returns, which are less informative than monthly, weekly, or daily returns. For that reason, I also regress repurchases on contemporaneous returns in Column B, however, the results remain qualitatively similar. Dittmar (2000) reports that firms buy back more to take advantage of potential undervaluation. Similarly, I find that *Book to market* increases repurchases, this suggesting that valuation is an important driver to the repurchase decision. Jensen (1986) concludes that firms with strong cash flows tend to be repurchasing more and this is reflected to the positive and statistically significant coefficient of *EBITDA to assets*. *Total assets* and *dividends to assets* have no impact on repurchases, the latter providing evidence that dividends and repurchases are used by firms as complements, rather than as substitutes (Busch and Obernberger, 2016). Finally, high leveraged firms seem to be repurchasing less, supporting the conclusions of Dittmar (2000), who states that firms repurchase to change their leverage ratio.

In Column C, I analyze *Remaining Volume*, which is used as an alternative repurchase variable. I find that *Remaining Volume* is strongly correlated to contemporaneous *Repurchase Intensity*, with its coefficient being equal to 0.31 and thus, it can be used as a proxy of repurchase activity. Most of the coefficients of the control variables are not statistically significant or exhibit similar results to those reported in Column A. However, I find that *Options Outstanding* negatively affect repurchases, meaning that when employees hold a large fraction of stock options, repurchases decline, against to the findings of Babenko (2009). Furthermore, the coefficient of positive lagged

returns is negative and statistically significant, this aligning with the findings of Stephens and Weisbach (1998).

Table 3: Analysis of repurchase activity

The table presents OLS regressions of *Repurchase Intensity* and *Remaining Volume* on several control variables. In columns A and B, the dependent variable is *Repurchase Intensity*, while in columns C and D, the dependent variable is *Remaining Volume*. The variables are defined in Table A1 of the Appendix. *T-statistics* are provided below each coefficient in parentheses. Respectively, ***, ** and * denote statistical significance at the 1%, 5%, and 10% level.

Dependent Variable:	Repurchase Intensity		Remaining Volume	
	A	B	C	D
Repurchase Intensity$_{t-1}$	0.1675***	0.1664***		
	(9.66)	(9.58)		
Repurchase Intensity$_t$			0.3099***	0.3091***
			(11.73)	(11.71)
Options Exercised$_t$	0.7505***	0.7622***	0.4818***	0.4898***
	(11.61)	(11.79)	(5.05)	(5.14)
Options Outstanding$_t$	0.0027	0.0019	-0.1381***	-0.1363***
	(0.23)	(0.16)	(-8.27)	(-8.20)
Return$_{t-1} > 0$	-0.0013		-0.0044*	
	(-0.79)		(-1.83)	
Return$_{t-1} < 0$	0.0035*		0.0018	
	(1.88)		(0.66)	
Return$_t > 0$		-0.0018		-0.0068***
		(1.08)		(-2.84)
Return$_t < 0$		0.0002		0.0056*
		(0.08)		(1.89)
Book to market$_t$	0.0069***	0.0067***	0.0013	0.0020
	(7.57)	(6.89)	(1.07)	(1.53)
EBITDA to assets$_t$	0.0131***	0.0137***	0.0205***	0.0200***
	(3.61)	(3.74)	(3.95)	(3.85)
Total assets$_t$ (ln)	0.0006	0.0005	0.0000	-0.0004
	(0.79)	(0.76)	(0.04)	(-0.40)
Dividends to assets$_t$	-0.0047	-0.0057	0.0119	0.0105
	(-0.29)	(-0.34)	(0.51)	(0.45)
Leverage$_t$	-0.0115***	-0.0125***	0.0015	0.0028
	(-2.79)	(-3.04)	(0.28)	(0.49)
R-squared	0.2675	0.2669	0.3303	0.3317
Observations	3,177	3,177	3,284	3,284
Firm and year FE	Y	Y	Y	Y

Additionally, in Columns B and D, I replace lagged positive and negative returns with current positive and negative returns, to investigate whether including them increases the fit of the model. In Column B, both the coefficients of positive and negative returns are statistically insignificant. On the other hand, in Column D, I find that current positive returns decrease repurchases, while current negative returns increase repurchases, the latter supporting the notion that firms repurchase their shares to provide price support to fundamental values. The rest of the control variables' coefficients exhibit the same sign and significance as in Columns A and C.

4.2. Share repurchases and price efficiency

Table 4 presents the impact of actual share repurchases on price efficiency, using the two measures of price delay discussed in Section 3.4 as dependent variables. In Columns A, B and C, the dependent variable is *Delay* and in Columns D, E and F, the dependent variable is *Coefficient-based delay*. In Column A and D, I use lagged *Repurchase Intensity* as a measure of repurchase activity, while in Columns B and E the repurchase variable is contemporaneous *Remaining Volume*, and in Columns C and F, I use the two variables combined to examine their impact on delay when used simultaneously.

I find that the impact of price delay on repurchases depends on which repurchase variable is used as an independent variable. First, in Column A, lagged *Repurchase Intensity* has a positive coefficient, but it lacks statistical significance and thus, I conclude that it does not affect price efficiency. Similarly, in Column D, I observe that an increase in *Repurchase Intensity* increases price delay, however, the coefficient is not statistically significant.

In Columns B and E, *Remaining Volume* is used to measure the ability of firms to buy back shares by participating in the stock market. When using *Remaining Volume*, the results suggest that repurchases decrease delay and thus, increase price efficiency. An increase by one within-firm standard deviation in *Remaining Volume* decreases *Delay* by 1.24% (0.0293 x 0.4229, where 0.0293 is the within-firm standard deviation and 0.4229 is the coefficient of *Remaining Volume* in Column B) and consequently, price efficiency increases by the same amount. Furthermore, an increase by one within-firm standard deviation in *Remaining Volume* decreases *Coefficient-based delay* and thus, improves efficiency by 2.68% (0.0293 x 0.9136, where 0.0293 is the within-firm standard deviation and 0.9136 is the coefficient of *Remaining Volume* in Column E).

In Columns C and F, I include *Repurchase Intensity* and *Remaining Volume* in the same regression, to investigate whether using them simultaneously would deliver significant results regarding *Repurchase Intensity*. As presented in the two columns, the results are similar to those discussed above. *Repurchase Intensity* does not significantly affect price delay, while *Remaining Volume* reduces both *Delay* and *Coefficient-based delay*.

To conclude, my results regarding the impact of share repurchases on price efficiency are ambiguous and depend on the repurchase variable used in the analysis. When using lagged *Repurchase Intensity*, the results suggest that share repurchases have no significant impact on price delay. When using *Remaining Volume*, I find evidence supporting that share repurchases increase the speed and accuracy with which information is incorporated into the stock price, and price efficiency is improved. In line with Busch and Obernberger (2016), the results recommend that share repurchases are not used to manipulate share prices, since in the price manipulation scenario, delay should be much higher.

Most of the results of the control variables of Table 4 are consistent with the corresponding bibliography. In Columns A and B, *Delay* decreases with positive prior returns, market capitalization and trading volume, while it increases with analyst coverage. Hou and Moskowitz (2005) examine the interaction between delay and other firm characteristics, such as momentum (past one-year returns) and firm's size. The coefficients of lagged positive returns and *Market cap* report the same signs as in Hou and Moskowitz (2005) and are statistically significant. The sign of the coefficient of *Book to market* is positive as in Phillips (2011), however, as in this paper, it lacks statistical significance. Boehmer and Wu (2013) investigate the impact of short-selling on price delay and they also examine the impact of various firm characteristics on delay. They find that analyst coverage does not improve efficiency, this aligning with the results of Table 4, which indicate that price delay increases with analyst coverage. Moreover, they also report that the higher the trading volume, the lower the delay. Similarly, I observe that the coefficient of *Trading Volume* decreases with *Delay* and is statistically different from zero. Finally, the amount by which stock prices deviate from $30 increases *Delay*, as reported in the paper of Busch and Obernberger (2016). I also include a variable that indicates the initiation month of each NCIB, to examine whether the commencement month explains the impact of the repurchases variables on delay. However, the coefficient of *Program Initiation* lacks statistical significance in all the

specifications, supporting that the month in which each NCIB begins does not affect delay. The results in Columns D and E, as well as those in Columns C and F, are qualitatively similar to those in Columns A and B, apart from *Trading Volume,* which has the same negative sign but is statistically insignificant.

Table 4: The influence of repurchases on delay

The table presents OLS regressions of *Delay* and *Coefficient-based delay* on either *Repurchase Intensity* or *Remaining Volume,* and other control variables. In columns A - C, the dependent variable is *Delay,* while in columns D - F, the dependent variable is *Coefficient-based delay*. The variables are defined in Table A1 of the Appendix. *T-statistics* are provided below each coefficient in parentheses. Respectively, ***, ** and * denote statistical significance at the 1%, 5%, and 10% level.

Dependent Variable:	Delay			Coefficient based delay		
	A	B	C	D	E	F
Repurchase Intensity$_{t-1}$	0.1085		0.1289	0.2570		0.3173
	(0.52)		(0.62)	(0.66)		(0.81)
Remaining volume$_t$		-0.4229***	-0.4459***		-0.9136***	-0.9403***
		(-2.81)	(-2.95)		(-3.23)	(-3.32)
Delay$_{t-1}$	0.0936***	0.0920***	0.0925***			
	(5.20)	(5.18)	(5.13)			
Coefficient based delay$_{t-1}$				0.0619***	0.0615***	0.0595***
				(3.39)	(3.44)	(3.27)
Return$_{t-1} > 0$	-0.0464**	-0.0473**	-0.0477**	-0.0607*	-0.0673*	-0.0633*
	(-2.43)	(-2.51)	(-2.50)	(-1.69)	(-1.91)	(-1.77)
Return$_{t-1} < 0$	0.0233	0.0298	0.0265	-0.0235	-0.0082	-0.0184
	(0.98)	(1.27)	(1.11)	(-0.52)	(-0.19)	(-0.41)
Program Initiation$_t$	0.0004	0.0021	0.0020	-0.0028	0.0015	0.0008
	(0.26)	(1.28)	(1.25)	(-0.96)	(0.48)	(0.25)
Market Cap$_{t-1}$(ln)	-0.0581***	-0.0607***	-0.0591***	-0.1003***	-0.1074***	-0.1029***
	(-6.66)	(-7.28)	(-6.76)	(-6.13)	(-6.88)	(-6.29)
Book to market$_{t-1}$	0.0114	0.0138	0.0106	0.0045	0.0071	0.0021
	(1.12)	(1.37)	(1.04)	(0.24)	(0.38)	(0.11)
Analysts$_{t-1}$ (ln)	0.0203**	0.0197**	0.0202**	0.0588***	0.0574***	0.0593***
	(2.03)	(2.01)	(2.02)	(3.12)	(3.12)	(3.15)
Deviation from \$30$_{t-1}$	0.0011***	0.0011***	0.0010***	0.0021***	0.0021***	0.0021***
	(3.85)	(3.90)	(3.82)	(4.05)	(4.04)	(4.03)
Trading volume$_{t-1}$	-0.8930**	-0.8104**	-0.8228**	-1.2651	-0.9901	-1.1175
(scaled)	(-2.16)	(-2.01)	(-1.99)	(-1.63)	(-1.31)	(-1.44)
R-squared	0.3871	0.3937	0.3887	0.3428	0.3505	0.3455
Observations	3,185	3,246	3,183	3,185	3,246	3,183
Firm and year FE	Y	Y	Y	Y	Y	Y

4.3. Share repurchases and price efficiency in up and down markets

The results reported in the previous sections suggest that price efficiency increases with share repurchases, however, it is interesting to investigate the channels that lead to that conclusion. As explained in the second hypothesis, share repurchases improve price efficiency by increasing either the speed or the accuracy with which available information is incorporated in stock prices. That is, firms either buy back shares to move prices towards fundamental values, or they buy back to prevent prices from moving below fundamental values. The first channel suggests that firms trade on new positive information, since they believe their stock is worth more, while the second channel recommends that firms try to improve the accuracy with which negative information is incorporated in the stock price.

If firms incorporate positive information in the stock price, then price efficiency should improve when the market reflects positive news. On the other hand, if firms incorporate negative information in the stock price, then price efficiency should increase, as a response to new market negative news. I use the annual return of the S&P/TSX Composite Index to divide my sample into years in which the market goes up (positive return) or down (negative return). I create a dummy variable, that indicates whether the market goes up or down. By splitting the sample like that, I analyze the impact of share repurchases on price efficiency in up markets (positive returns) and down markets (negative returns).

Table 5 reports results related to the impact of actual share repurchases on price efficiency, using interaction terms of the repurchase variables with the dummy variable that distinguishes between up and down markets. In Columns A and B, the dependent variable is *Delay* and in Columns C and D, the dependent variable is *Coefficient-based delay*. In Columns A and C, I use the interaction terms of lagged *Repurchase Intensity* as a measure of repurchase activity, while in Columns B and D, the repurchase variable is reflected by the interaction terms of contemporaneous *Remaining Volume*.

In Columns A and C, the coefficients of lagged *Repurchase Intensity* are not statistically significant, either in up or down markets, suggesting that *Repurchase Intensity* does not affect price delay. In Columns B and D, the coefficients of *Remaining Volume* unequivocally indicate that share repurchases decrease price delay and thus, increase price efficiency, in both up and down markets. However, repurchases in down markets seem to have a higher impact on price

delay, as well as they possess higher statistical significance. More specifically, *Remaining Volume* decreases *Delay* in down markets almost twice as much as it does in up markets. Similarly, *Remaining Volume* reduces *Coefficient-based delay* in down markets by a factor of 2.2 times higher compared to up markets. For the control variables, the results are similar to those in Table 4, regarding both signs and statistical significance.

Since this Section deals with the impact of share repurchases on price delay in up and down markets, it is important to examine whether the coefficients obtained for up and down markets are statistically different from each other. I conduct a Wald test, which tests whether the parameters of interest are simultaneously equal to zero. If they are, then removing them from the model will not substantially reduce the fit of that model. In Columns A and C, the p-values (bottom of Table 5) suggest that the coefficients of *Repurchase Intensity* are simultaneously equal to zero. On the other hand, in Columns B and D, the Wald test indicates that the null hypothesis can be rejected, and the differences between up and down markets are statistically significant.

As a conclusion, share repurchases (as proxied by *Remaining Volume*) decrease both *Delay* and *Coefficient-based delay* and consequently, increase price efficiency. This is explained by the results regarding up and down markets, which strongly support that share repurchases provide price support to fundamental values, by preventing the price to drop below those values. That is, repurchases make prices more accurate and as a result, more efficient, especially when there is new negative market-wide information.

Table 5: The influence of repurchases on delay in up and down markets

The table presents OLS regressions of *Delay* and *Coefficient-based delay* on interaction terms of either *Repurchase Intensity* or *Remaining Volume* and dummy variables that identify up and down markets and control variables. In columns A and B, the dependent variable is *Delay*, while in columns C and D, the dependent variable is *Coefficient-based delay*. The variables are defined in Table A1 of the Appendix. *T-statistics* are provided below each coefficient in parentheses. Respectively, ***, ** and * denote statistical significance at the 1%, 5%, and 10% level.

Dependent Variable:	Delay		Coefficient based delay	
	A	B	C	D
Repurchase Intensity$_{t-1}$ x UpMarket$_t$	0.1035		0.2899	
	(0.48)		(0.72)	
Repurchase Intensity$_{t-1}$ x DownMarket$_t$	0.1691		-0.1406	
	(0.26)		(-0.12)	
Remaining Volume$_t$ x UpMarket$_t$		-0.3487**		-0.7238**
		(-2.12)		(-2.34)
Remaining Volume$_t$ x DownMarket$_t$		-0.6641**		-1.5302***
		(-2.52)		(3.10)
Delay$_{t-1}$	0.0936***	0.0918***		
	(5.19)	(5.17)		
Coefficient based delay$_{t-1}$			0.0621***	0.0613***
			(3.40)	(3.44)
Return$_{t-1} > 0$	-0.0464**	-0.0475**	-0.0610*	-0.0680*
	(-2.43)	(-2.52)	(-1.70)	(-1.92)
Return$_{t-1} < 0$	0.0233	0.0299	-0.0233	-0.0081
	(0.98)	(1.27)	(-0.52)	(-0.18)
Program Initiation$_t$	0.0004	0.0022	-0.0027	0.0017
	(0.26)	(1.34)	(-0.93)	(0.56)
Market Cap$_{t-1}$(ln)	-0.0581***	-0.0604***	-0.1003***	-0.1066***
	(-6.66)	(-7.24)	(-6.13)	(-6.83)
Book to market$_{t-1}$	0.0114	0.0141	0.0045	0.0079
	(1.12)	(1.40)	(0.24)	(0.42)
Analysts$_{t-1}$ (ln)	0.0203**	0.0192*	0.0586***	0.0562***
	(2.03)	(1.96)	(3.11)	(3.05)
Deviation from \$30$_{t-1}$	0.0011***	0.0011***	0.0021***	0.0021***
	(3.85)	(3.90)	(4.06)	(4.05)
Trading volume$_{t-1}$(scaled)	-0.8929**	-0.8165**	-1.2655	-1.0056
	(-2.16)	(-2.02)	(-1.63)	(-1.33)
R-squared	0.3871	0.3940	0.3428	0.3510
Observations	3,185	3,246	3,185	3,246
Firm and year FE	Y	Y	Y	Y
Wald (up-down) F-statistic	0.14	4.56	0.28	6.39
Wald (up-down) p-value	0.8684	0.0105	0.7590	0.0017

4.4. Contemporaneous share repurchases and price efficiency

Table 6 presents results of the influence of contemporaneous repurchases on delay, using contemporaneous *Repurchase Intensity* and *Repurchase Dummy* as the main repurchase variables. As explained in Section 3.3, contemporaneous *Repurchase Intensity* might cause endogeneity and reverse causality. However, I include it in the regressions of Panel A, to investigate whether it affects price delay. *Repurchase Dummy* is a dummy variable which indicates years in which *Repurchase Volume* is positive and thus, firms conduct repurchases during the year.

In Panel A, as in Table 4 and 5 and the results regarding lagged *Repurchase Intensity*, I observe no statistical significance on the coefficients of contemporaneous *Repurchase Intensity*, neither on *Delay* nor on *Coefficient-based delay*, even if the coefficient in Column B is negative as expected. In Panel B, the coefficient of the *Repurchase Dummy* on both *Delay* and *Coefficient-based delay* is positive, however, it lacks statistical significance in both cases.

In Panel C, I use interactions of the *Repurchase Dummy* with a dummy variable that indicates the size of each NCIB, where a NCIB is classified large if the program size is higher than its mean, to examine whether the size of each NCIB drives the results of Panel B.[9] Nevertheless, I observe the same signs obtained in Panel B, with the coefficients being statistically insignificant, with only the coefficient of the interaction of *Repurchase Dummy* and small program being negative but not statistically significant. I also conduct a Wald test, which recommends that the differences between large and small programs are simultaneously equal to zero (in both Columns A and B) and consequently, removing them would not reduce the fit of the model.

In Panel D, I use interactions of the *Repurchase Dummy* with the dummy variable that distinguishes between up and down markets, as explained in Section 4.3. I expect that the effect of repurchases will be higher in down markets. In Column A, I find a positive, but not statistical significant impact of repurchases on *Delay*, while, on the other hand, the coefficient of the *Repurchase Dummy* in down markets is negative, but also statistically insignificant. In Column B, the results align with the predicted sign and the evidence presented in Section 4.3. Share

[9] Program size is defined as the maximum number of shares that can be purchased under a NCIB scaled by shares outstanding.

repurchases decrease price delay and provide price support at fundamental values when the market goes down, that improving price efficiency.

Table 6: The influence of contemporaneous repurchases on delay

The table presents OLS regressions of *Delay* and *Coefficient-based delay* on either *Repurchase Intensity* or *Remaining Volume*, on contemporaneous repurchase variables and control variables. In column A, the dependent variable is *Delay*, while in column B, the dependent variable is *Coefficient-based delay*. Panel A includes contemporaneous *Repurchase Intensity*, Panel B includes *Repurchase Dummy*, Panel C includes the interaction of *Repurchase Dummy* with dummy variables that identify large and small NCIBs and Panel D includes the interaction of *Repurchase Dummy* with dummy variables that identify up and down markets. The control variables are the same as in Table 4 and Table 5. The variables are defined in Table A1 of the Appendix. *T-statistics* are provided below each coefficient in parentheses. Respectively, ***, ** and * denote statistical significance at the 1%, 5%, and 10% level.

A. Contemporaneous *Repurchase Intensity*

Dependent Variable:	Delay	Coefficient Based Delay
	A	B
Repurchase Intensity$_t$	0.0896	-0.0387
	(0.42)	(-0.10)
R-squared	0.3926	0.3483
Observations	3,250	3,250
Firm and year FE	Y	Y
Controls	Y	Y

B. Contemporaneous *Repurchase Dummy*

Dependent Variable:	Delay	Coefficient Based Delay
	A	B
Repurchase Dummy$_t$	0.0134	0.0093
	(0.83)	(0.31)
R-squared	0.3927	0.3483
Observations	3,250	3,250
Firm and year FE	Y	Y
Controls	Y	Y

C. Contemporaneous *Repurchase Dummy* for large and small programs

Dependent Variable:	Delay	Coefficient Based Delay
	A	B
Repurchase Dummy_t x	0.0149	0.0132
Large Program_t	(0.89)	(0.42)
Repurchase Dummy_t x	0.0059	-0.0106
Small Program_t	(0.21)	(-0.20)
R-squared	0.3927	0.3483
Observations	3,250	3,250
Firm and year FE	Y	Y
Controls	Y	Y
Wald (up-down) F-statistic	0.40	0.16
Wald (up-down) p-value	0.6680	0.8521

D. Contemporaneous *Repurchase Dummy* in up and down markets

Dependent Variable:	Delay	Coefficient Based Delay
	A	B
Repurchase Dummy_t x	0.0272	0.0191
UpMarket_t	(1.57)	(0.73)
Repurchase Dummy_t x	-0.0186	-0.0604*
DownMarket_t	(-0.84)	(-1.66)
R-squared	0.3936	0.3490
Observations	3,250	3,250
Firm and year FE	Y	Y
Controls	Y	Y
Wald (up-down) F-statistic	2.56	1.92
Wald (up-down) p-value	0.0778	0.1474

5. Conclusion

In this paper, I explore the impact of actual share repurchases on price efficiency in the Canadian market. I manually collect repurchase data for the 250 companies of S&P/TSX Composite Index (as of May 2017) for the period 1996-2016. I use two price delay measures that proxy for price efficiency and regress them on measures of repurchase activity, such as *Repurchase Intensity* and *Remaining Volume*.

The evidence suggests that share repurchases decrease price delay and consequently, improve price efficiency, the results depending on which repurchase variable is used in the analysis, with *Remaining Volume* increasing efficiency. Moreover, I split the sample into years in which the market goes up or down and find that share repurchases increase price efficiency in down markets more than they increase it in up markets. This indicates that firms use repurchases to provide price support at fundamental values and is consistent with the notion that share repurchases improve the accuracy with which negative information is incorporated into share prices.

For the empirical analysis, I use annual share repurchases data, which are available in: a) firms audited annual Financial Statements, b) notes to Financial Statements or c) news releases published by the firms. However, since TSX publishes monthly reports with the exact numbers of shares repurchased, it would be interesting to use such data in future research. The use of monthly data could increase the accuracy of the results, this possibly driving in more reliable conclusions, regarding the impact of share repurchases on price efficiency.

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7. Appendix

Table A1: Description of variables

The table describes the variables used in the analysis. The table includes the definition of the variables, the source used to obtain the data and the unit of measurement.

Variable	Definition	Source	Unit
Analysts	Number of analysts by EPS estimates (ln)	Datastream	Unit
Book to market	Book value equity / Market cap	Datastream	Ratio
Book value equity	Book value per share x Shares outstanding	Datastream	Million
Delay	Price efficiency measure constructed as the ratio of the R^2estimates of the market model and the extended market model	Datastream	Ratio
Coefficient-based delay	Price efficiency measure constructed as the ratio of the lag-weighted sum of the absolute coefficients of the lagged weekly market returns relative to the sum of all coefficients	Datastream	Ratio
Deviation from $30	Absolute difference between *Price* and $30	Datastream	Unit
Dividends	Cash Dividends paid	Datastream	Million
EBITDA	Earnings before interest, tax, depreciation, and amortization	Datastream	Million
Leverage	(Total Assets – Book value equity) / (Total Assets – Book value equity + Market cap)	Datastream	Ratio
Market cap	Price x Shares Outstanding	Datastream	Million
Options Exercised	Number of options exercised by employees scaled by Shares outstanding	Compustat	Ratio
Options Outstanding	Outstanding options scaled by Shares outstanding	Compustat	Ratio
Program Size	Size of NCIB scaled by Shares outstanding	Manually/ Datastream	Ratio
Remaining Volume	Remaining volume that can be repurchased under the program scaled by Shares outstanding	Manually/ Datastream	Ratio
Repurchase Volume	Dollar volume of shares repurchased during the year	Manually	Million
Repurchase Dummy	1 if Repurchase Volume is positive	Manually	Binary
Repurchase Intensity	Number of shares repurchased during the year scaled by the number of Shares outstanding at the last trading day of the previous month	Manually/ Datastream	Ratio
Repurchase Intensity (TV)	Number of shares repurchased during the year scaled by the number of Shares traded over the year	Manually/ Datastream	Ratio
Return	Annual stock return	Datastream	Unit
Return >0	Annual stock return if positive, else zero	Datastream	Unit
Return <0	Annual stock return if negative, else zero	Datastream	Unit
Return Index	Annual S&P/TSX Composite Index return	Datastream	Unit
Shares Outstanding	Number of shares outstanding at the last trading day of the year	Datastream	Million
Shares Traded	Number of shares traded over the year	Datastream	Million
Total Assets	Total assets (ln)	Datastream	Million
Trading Volume	Annual total trading volume excluding repurchases scaled by Shares outstanding	Datastream	Ratio

Table A2: Descriptive statistics

The table provides descriptive statistics for the delay measures and the repurchase measures for S&P/TSX Composite Index firms between 1990 and 2016, as estimated by two methods used by previous researchers (Stephens and Weisbach, 1998; Banyi et al., 2008). Panel A includes the repurchase measures as estimated using Datastream *Decreases in Shares Outstanding*. Panel B includes the repurchase measures as estimated using Compustat *Purchases of Common Stock*. The table also provides statistics on the repurchase measures in repurchase years. The variables are defined in Table A1 of the Appendix. More specifically, the table reports the mean, the median, the standard deviation (SD), the 1st and the 99th percentile of the distribution for each variable.

A. Datastream Data (Decreases in Shares Outstanding)

	Mean	Median	SD	Min	Max	N
Dependent Variables						
Delay	0.352	0.253	0.288	0.004	1.000	67,799
Coefficient-based delay	1.294	1.244	0.525	0.196	3.054	67,799
Repurchase Measures						
Repurchase volume (mil.)	1.09	0.00	33.00	0.00	2786.11	67,794
Repurchase Intensity	0.01%	0.00%	0.41%	0.00%	49.68%	67,171
Repurchase Intensity (TV)	0.03%	0.00%	1.25%	0.00%	69.86%	67,677
Remaining volume	4.47%	0.00%	15.48%	0.00%	64.68%	67,593
Repurchase Measures in repurchase months						
Repurchase volume (mil.)	283.27	86.69	450.25	0.01	2786.11	262
Repurchase Intensity	3.05%	1.78%	5.62%	0.00%	49.68%	275
Repurchase Intensity (TV)	7.61%	4.03%	18.19%	0.00%	69.85%	274
Remaining volume	35.98%	37.83%	27.83%	0.00%	64.68%	261

B. Compustat Data (Purchases of Common Stock)

	Mean	Median	SD	Min	Max	N
Dependent Variables						
Delay	0.368	0.266	0.297	0.003	1.000	7,496
Coefficient-based delay	1.310	1.245	0.535	0.196	3.054	7,496
Repurchase Measures						
Repurchase volume (mil.)	4.94	0.00	48.29	0.00	1440	7,496
Repurchase Intensity	0.05%	0.00%	0.45%	0.00%	17.29%	6,968
Repurchase Intensity (TV)	0.23%	0.00%	1.16%	0.00%	7.35%	7,429
Remaining volume	7.28%	0.00%	24.44%	0.00%	95.98%	7,224
Repurchase Measures in repurchase quarters						
Repurchase volume (mil.)	92.10	16.80	188.53	0.00	1440	402
Repurchase Intensity	1.02%	0.45%	1.69%	0.00%	17.29%	367
Repurchase Intensity (TV)	4.18%	4.31%	2.91%	0.00%	7.35%	402
Remaining volume	73.79%	95.98%	34.98%	0.00%	95.98%	373