4-2014

TWO ESSAYS ON STOCK REPURCHASES AND INSIDER TRADING

Noel Pavel Nangatie Jeutang
University of Nebraska-Lincoln

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by

Noel Pavel N. Jeutang

A DISSERTATION

Presented to the Faculty of

The Graduate College at the University of Nebraska

In Partial Fulfillment of Requirements

For the Degree of Doctor of Philosophy

Major: Interdepartmental Area of Business

(Finance)

Under the Supervision of Professors Geoffrey C. Friesen and Emre Unlu

Lincoln, Nebraska

April, 2014

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Noel Pavel N. Jeutang, Ph.D.

University of Nebraska, 2014

Advisers: Geoffrey C. Friesen and Emre Unlu

The first essay examines how the outcome of prior repurchasing activity influences future repurchasing decisions. We find strong evidence that future decisions to repurchase equity are negatively influenced by poorly timed past repurchases. Specifically, we show that the past losses on stock repurchases reduce the propensity to engage in additional repurchases in the future. We find almost no evidence that past gains on repurchases positively or negatively influence future repurchasing activity. These results are robust to various firm characteristics, estimation and sampling methods. Further analyses show that losses on past repurchases influence dividend policy. We show that the dividend-repurchase substitution rate slows down for firms that experience losses in their past repurchase activities. Overall, results suggest that managerial behavioral biases have a strong influence on future repurchase decisions consistent with the loss-aversion concept of prospect theory.

The second essay examines the relation between insider (officers and directors) open market transactions and the outcome of past insider trading to better understand what motivates insiders to trade. We find strong evidence that open market purchases made by insiders are negatively influenced by poorly timed insider purchases. Specifically, we show that the losses on insider purchases reduce the intensity of open market purchases. We find almost no evidence that past gains from insider trading positively or negatively

influence open market purchases. These results are robust to various firm characteristics, estimation and sampling methods. The results suggest that managerial behavioral biases have a strong influence on future insider purchasing activity consistent with the loss-aversion concept of prospect theory. Further analyses show that loss aversion can enhance insider wealth by helping insiders avoid a loss of 5.7% over the course of the next year under certain circumstances while refraining from loss aversion under certain circumstances can help insiders to net an average of 8.14% over the following year.

Dedication

I dedicate this dissertation to my mother Emilia Forlemu Jeutong and my father Fabien Jeutong.

Acknowledgements

Thank you to my committee: Dr. Geoffrey Friesen (Co chair), Dr. Emre Unlu (Co chair), Dr. Richard DeFusco, and Dr. David Smith, for your time, energy, and advice. Drs. Friesen and Unlu, I could have never written this dissertation without your endless patience, profound knowledge, and extreme generosity of time. I cannot thank you enough for letting me study under your guidance and for sharing your experience with me. Your vision and hard work have inspired me every step of the way. Thank you. Dr. Friesen if it were not for you I probably wouldn't have joined the Finance program. Thanks for encouraging me and recommending me to join the Finance program.

To my family, there are no words to describe how grateful I am for your love, commitment and caring support. To my parents thanks for encouraging me to pursue my dreams and instilling in me a great work ethic.

To Papa and Mama Forlemu, at a very tender age you instilled in me the virtues of hard work and integrity which continue to shape my life till this day. Thank you. To Papa Stephen thanks for always being there and advising me throughout some of the most challenging times of my life. Without you I would not be half the person I am today. To my late grandparents, I hope you would have been proud of me and how I am trying to carry on our family legacy.

Dr. Karels and Dr. Zorn, thank you for admitting me to the program. I will always strive to contribute to the success of the department.

To Dr. Peterson, Dr. Geppert, Dr. Farrell, and Dr. Dudney, you have helped me gain the knowledge to move to the next step in my academic life. You welcomed me to the

department and I am grateful for your support. Kathy and Alice, thank you for your help, and hard work.

To Dr. Eric Thompson, thanks for all the support you provided me through the Bureau of Business Research while I was in the Economics Department. The world is certainly a better place with people like you.

To all other graduate students, before and after, I greatly appreciate the role you have played in my experience in the doctoral program: Thank you Chris, Thuy, Jiri, Jeff W., Kim, Cliff, Trevor, and Matt.

To Benita, thank you for the support and companionship throughout graduate school. You truly are a great person.

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Essay 1

Does Past Performance of Stock Repurchases Affect Future Repurchase Decisions?

1. Introduction

Stock repurchases are risky investments made by management on behalf of current shareholders. There is an extensive literature which documents "rational" motivations for managers repurchasing their firm's stock. By rational we simply mean stock repurchases are used as a tool that benefits the firm's shareholders in some way by increasing, or at least holding constant, firm value. DeAngelo, DeAngelo and Skinner (2008) provide anecdotal evidence of firms repurchasing their stocks at high prices prior to the 2008 financial crisis. They question managers' ability to time the market and ask whether repurchasing activity will ever return to pre-2008 levels.

At odds with this notion of rationality is the recent empirical work of Bonaime et al. (2012) who find that, on average, managers exhibit a propensity to mis-time stock repurchases and in the process destroy significant amounts of shareholder wealth. Their empirical findings suggest the possibility of additional behavioral factors that may influence repurchase activity. In particular, Bonaime et al. (2012) document a tendency of managers to repurchase more after their stock has gone up, and less after their firm's stock price has fallen, which leads to lower returns, on average. This finding suggests that managerial repurchase decisions may be influenced by prior stock returns, and may actually destroy shareholder value. The results of Bonaime et al. (2012) follow a line of research suggesting investment decisions may be influenced by past returns[1].

[1] Ippolito (1992) shows inflows to mutual funds are strongly correlated with past fund performance. Empirical work by Dichev (2007), Friesen and Sapp (2007) and Frazzini and Lamont (2008) indicates that poor investment-timing decisions, in which investors buy after past gains and sell after past losses, destroys investor wealth

We hypothesize that managerial stock repurchases are also influenced by the rate of return on the existing portfolio of repurchased stock generated from prior gains and losses from stock repurchases. This is consistent with research demonstrating that in a variety of contexts, decisions under uncertainty can be substantially affected by the outcomes of past decisions (see for example, Thaler 1980; Staw 1981; Arkes and Blumer 1985). Thaler and Johnson (1990) investigate how prior gains and losses affect risk taking behavior. Based on experimental data from Cornell undergraduate and MBA students they find increased willingness to take risk after prior gains, which they refer to as the "house money effect". However, after experiencing a prior loss, individuals showed increased loss aversion and reduced willingness to take risk.

If past gains and losses influence repurchase decisions, then only including recent stock returns in one's model may fail to capture this effect. This is because repurchases are not made smoothly, and thus the gains and losses on the portfolio are affected by past returns, as well as the timing of the cash flows used to purchase stock. Thus, we begin our empirical work by calculating firm-level gains and losses on repurchased stock, and examining the impact of past repurchase returns on the decision to repurchase new shares. In this empirical work, we examine gains and losses separately to allow for the possibility of an asymmetric response, which might obtain if managers exhibit loss aversion (Johnson and Thaler, 1990). We find evidence of loss aversion; specifically that firms are unlikely to repurchase stocks when they lose money from past stock repurchases; and almost no evidence that past gains on repurchases influence future repurchasing activity even after controlling for variables previously shown to affect

repurchase activity (e.g. cash, cash flow, book-to-market ratio, firm size, past one-quarter return, etc.).

To control for the possibility that our results are not actually due to managerial biases or loss aversion, but due to some unobservable firm-level feature, we examine cross-sectional variation in the results as a function of two CEO-level characteristics: tenure and age. We find that managers' decreased propensity to conduct stock repurchases given losses from prior stock repurchases (loss aversion) is more pronounced in firms whose CEOs have shorter tenure.

We also provide some evidence suggesting that given losses from prior stock repurchasing activity further increases in losses are associated with lower levels of spending on stock repurchases and no evidence that additional gains have any effect on the level of spending on stock repurchases.

Finally, we show that the "loss-aversion" effect on repurchases indirectly affects dividend payouts. Specifically, the dividend-repurchase substitution rate slows down for firms that experience losses in their past repurchase activities.

The findings in this study contribute to the literature in several ways. First, while Bonaime et al. (2012) provide evidence of managers unsuccessfully timing the markets, we show that the outcome of prior stock repurchases influences current repurchasing, and that managers respond differently to past gains and losses. In addition to managers' documented inability to time the markets, the "bad timing" subsequently decreases their propensity to conduct stock repurchases. Second, we present evidence of the substitution hypothesis between dividends and stocks repurchases, and show that the substitution rate is influenced by gains and losses on past repurchases. Finally, this study is the first study

to document a link between loss aversion and stock repurchases, and compliments existing work of Ben-David et al. (2007) and Baker and Wurgler (2012) which suggests overconfidence and optimism as behavioral determinants of stock repurchases. It also compliments Baker and Wurgler (2011) which relates prospect theory to payout policy by modeling dividends in a framework in which investors are loss averse to reductions in dividends.

The study proceeds as follows. Section 2 reviews the relevant literature on stock repurchases and develops the hypothesis. Section 3 describes the data used in the study. Section 4 presents the tests of our main hypothesis while section 5 provides the implications prior losses and gains from stock repurchased have on dividend policy. Section 6 concludes.

2. Literature Review and Motivation

2.1 Determinants of Stock Repurchases

This section provides a brief overview of the literature on the determinants of stock repurchases, which we organize into the following broad categories: firm cash flow, undervaluation, firm leverage, managerial stockholdings and corporate control.

2.1.1 Firm Cash Flow

Like dividends, repurchases can be used to alleviate agency problems associated with excess cash flow. The noncommittal nature of stock repurchases, particularly open market repurchases (the most popular type), gives repurchases an advantage over

dividends. Most papers hypothesize that high levels of excess cash or cash flow are positively related to both the decision to repurchase and the level of stock repurchases. Dittmar (2000) conducts tobit regressions by years and finds a positive and statistically significant relationship between cash, and the level of stock repurchases and between cash flow and the level of stock repurchases holding investment opportunities constant. Lie (2000) finds that in years prior to the announcement of tender offers firms tend to have higher levels of undistributed cash flows compared to their industry medians. Babenko et al (2011) find cash and cash flows are positively and significantly related to completion rates and the level of open market share repurchases. Finally Bonaime et al (2012) find that firms with higher levels of cash and cash flows are more likely to repurchase stocks.

Lie (2000) finds that dividend increases are used to disgorge permanent increases in cash flows while special dividends and tender offers are used to disgorge temporary increases. The paper also finds positive stock market reactions to the announcements of tender offers and special dividends and presents this as evidence that tender offers and special dividends can be used to mitigate the free cash flow problem (contrary to the signaling hypothesis according to which disbursements signal positive information about a firm's future cash flows). Grullon and Michaely (2002) show that firms finance repurchases with funds (cash) that otherwise would have been used to increase dividends, which supports the "substitution hypothesis".

2.1.2. Firm undervaluation

Dittmar (2000) suggests firms repurchase equity to correct and even signal undervaluation by timing the market. According to this motive, managers would repurchase the firm's stock when they believe the stock is undervalued. Such actions can be viewed by the market as a signal or as an investment and are followed by positive market reactions. According to this hypothesis increases in stock prices following the announcement of a repurchase program is due to information revealed by the announcement (Stephens and Weisbach, 1998).

One group of studies uses insider trading as a proxy for firm undervaluation. For example, Dann (1981) and Vermaelen (1981) examine market reactions to repurchase announcements and find that managers essentially waive their rights to sell shares in repurchase tender offers. This suggests managers announce tender offers when they believe the firm's stock is undervalued. Vermaelen (1981) holds that firms use stock repurchases to signal either that the firm has no positive NPV projects and has to pay out free cash flows (this would be consistent with the excess cash flow hypothesis discussed earlier) or that the firm is undervalued.

Instead of using market reaction to infer market timing, D'Mello and Shroff (2000) test the timing hypothesis directly by estimating a perfect foresight economic value (intrinsic value) of the firm and compare it to current market prices. They find that 74% of the firms in their sample conduct fixed-price tender repurchase offers when the market price is below the firm's intrinsic value. They also find that insiders of undervalued firms are net buyers while those of overvalued firms are net sellers. This result is consistent with Lee et al (1992) who find that managers adjust their personal

trading behavior prior to tender offer repurchases as though they had private information about their firm that is conveyed by the repurchase.

Babenko et al (2011) hypothesize and find that executives who buy back shares before an announcement add credibility to the undervaluation signal. Specifically they find that insiders of announcing firms purchase significantly more stock one and two years prior to the repurchase announcement than insiders of matching firms, especially when information asymmetry between insiders and investors is large. They test and find that program completion rates of such programs increase with insider purchases. Bonaime and Ryngaert (2011) examine whether firms and insiders trade in the same direction and find that insider trading at repurchasing firms is not always consistent with undervaluation. They find that insider buying and selling are more frequent in quarters when firms are repurchasing non-trivial amounts of stock. A puzzling result from this paper is that share repurchases are most frequent when insiders are net sellers. One explanation of this is that firm insiders generally trade in a contrarian manner. Thus repurchasing firms with net insider buying in the same quarter are more likely to be undervalued (earn positive abnormal returns after repurchases) than firms with net insider selling in that quarter.

Other proxies for firm undervaluation include asset size and past stock returns. Varmaelen (1981) holds that information asymmetry may be more pronounced in small firms because they are less covered by analysts and the popular press, and finds that smaller firms tend to have larger announcement returns. Dittmar (2000) hypothesizes a negative relationship between the natural log of assets and the level of repurchases but finds the opposite. On the other hand, Babenko et al (2011) find a negative and

significant effect on buy and hold announcements returns and a positive and significant effect on actual repurchases. Stephens and Weisbach (1998) hypothesize and find a negative relationship between stock performance and the level of repurchases and Bonaime et al (2012) find a negative relationship between a firm's returns in the prior quarter and the likelihood of repurchasing.

Another proxy for undervaluation is the market-to-book ratio (although it can also be used to control for a firm's investment opportunities[2]). Dittmar (2000) holds that while historical returns are a backward-looking measure of valuation and may not detect current misvaluation, a firm's market-to-book ratio may indicate a firm's potential for undervaluation. Thus Dittmar (2000) hypothesizes and finds a negative relationship between the market-to-book ratio and the level of stock repurchases, thus indicating managers may be using stock repurchases to take advantage of undervaluation. In contrast, Bonaime et al (2012) find a positive relationship between book-to-market and the likelihood of repurchasing and presents this as evidence that firms time the market badly.[3]

2.1.3. Firm Leverage

Stock repurchases increase firms' leverage ratios, ceteris paribus. To the extent that firms have an optimal capital structure, firms may use stock repurchase to achieve their target. Dittmar (2000) hypothesizes and finds lower optimal leverage ratios for repurchasing firms compared with non-repurchasing firms. Specifically if a firm's net leverage ratio is lower than its target, then it may repurchase to increase leverage.

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[2] Babenko et al (2011) use the market-to-book ratio as a proxy for Tobin's Q
[3] Based on the November 2011 draft

Baker and Wurgler (2002) offer a theory in which capital structure is the cumulative outcome of past attempts to time equity markets. The main finding of their study is that low (high) leverage firms raise funds when their market values (M/B) are high (low). In other words, low leverage firms repurchase stocks when their market values were low. Consistent with this, Bonaime et al (2012) find a negative relationship between leverage (total liabilities scaled by assets) and the decision to repurchase.

2.1.4. Other Cited Determinants of Repurchases

Since the shares provided to managers when they exercise their stock options come from treasury stock, preserving the stock value may be a motive for stock repurchases when management holds stock options. Dittmar (2000) finds a positive relationship between outstanding stock options and repurchasing activity. A potential target can use repurchases to increase acquisition costs hence stock repurchases can be used as a takeover defense. Stock repurchases increase acquisition costs because the selling shareholders are those with the lowest reservation price. Thus by repurchasing, a firm can increase the lowest price for which a stock is available (Dittmar, 2000).

2.2. The Effect of Past Gains & Losses on Risk-Taking Behavior

The extensive literature discussed above captures what we will label “rational” motivations for repurchasing the firm’s stock. By rational we simply mean that in each of the cited papers, repurchasing is used as a tool that benefits the firm’s shareholders in some way by increasing, or at least holding constant, firm value. At odds with this notion of rationality is the recent empirical work of Bonaime et al. (2012) who find that, on average, managers exhibit a propensity to mis-time stock repurchases and in the process

destroy significant amounts shareholder wealth. Their empirical findings suggest the possibility of additional behavioral factors that may influence repurchase activity. In particular, Bonaime et al. (2012) document a tendency of managers to repurchase more after their stock has gone up, and less after their firm's stock price has fallen, which leads to lower returns, on average. This finding suggests that managerial repurchase decisions may be influenced by prior stock returns, and may actually destroy shareholder value.

The results of Bonaime et al. (2012) follow a line of research suggesting investment decisions may be influenced by past returns. For instance, Ippolito (1992) shows inflows to mutual funds are strongly correlated with past fund performance. Empirical work by Friesen and Sapp (2007), Frazzini and Lamont (2008) and Dichev (2007) indicates that poor investment-timing decisions, in which investors buy after past gains and sell after past losses, destroy a significant percentage of investor wealth.

We hypothesize that in addition to being influenced by recent returns, managerial repurchases may also be influenced by gains and losses on the existing portfolio of repurchased stock. This is consistent with research demonstrating that in a variety of contexts decisions under uncertainty can be substantially affected by the outcomes of past decisions (see for example, Thaler 1980; Staw 1981; Arkes and Blumer 1985). Thaler and Johnson (1990) investigate how prior gains and losses affect risk taking behavior and find based on experimental data from Cornell undergraduate and MBA students an increased willingness to take risk after prior gains, which they refer to as the "house money effect". However, after experiencing a prior loss, individuals showed increased loss aversion, a phenomenon sometimes referred to as the "snakebite effect". Their results suggest that losses are more painful if they happen after prior losses and less

painful if they occur after prior gains, since prior gains act as cushions for future losses. Frino, Grant and Johnstone (2007) examine Australian futures traders and find supporting evidence, that traders take on more risk in the afternoon on days with morning gains. Low (2004) finds that prior losses are associated with increased loss aversion, which is consistent with the snakebite effect. However, the evidence on the effect of past gains and losses is mixed. Coval and Shumway (2005) find that traders with morning losses increase risk-taking in the afternoon.

Regardless of the precise nature of the relationship, if past gains and losses influence repurchase decisions, then including only recent stock returns in one's model may fail to capture this effect. This is because repurchases are not made smoothly, and thus the gains and losses on the portfolio are affected both by past returns, and the timing of the cash flows used to purchase stock. We begin our empirical work by calculating at the firm-level gains and losses on repurchased stock, and examining the impact of past repurchase returns on the decision to repurchase new shares and the amount of shares repurchased. In this empirical work, we examine gains and losses separately to allow for the possibility of an asymmetric response, which might obtain if CEOs exhibit loss aversion (Johnson and Thaler, 1990).

To control for the possibility that our results are not actually due to managerial biases or loss aversion, but to some unobservable firm-level feature, we examine cross-sectional variation in the results as a function of two CEO-level characteristics: tenure and age. Prendergast and Stole (1996) present a model in which individuals want to acquire a reputation for quickly learning a correct course of action. This desire leads to two types of sub-optimal behavior: exaggeration, in which individuals respond too much

to new information; and conservatism, in which behavior is not changed enough in the light of new information. In their model, individuals early in their job tenure tend to respond too much, while those with longer tenure respond too little. Drawing upon these results, we hypothesize that CEOs with the shortest tenure will exhibit behavior that is most sensitive to realized gains and losses, while long-tenure CEOs will be the least sensitive.

With respect to the link between age and loss aversion, Johnson et al. (2006) find an increasing relationship between risk aversion and age, while Hjorth and Fosgerau (2009) find that loss aversion increases with age up to around 55 years, and then declines rapidly. Because the majority of CEOs in the sample are in the 50 to 57 years age range, it is unclear whether one should expect a linear relationship between loss aversion and age.

Finally, to the extent that prior gains and losses from stock repurchases affect future repurchasing activity we test if the gains and losses have any effect on other corporate activities specifically, dividend policy and cash holdings of firms . With respect to dividend, can the outcome of past stock repurchases provide evidence consistent with the dividend substitution hypothesis documented by Grullon and Michaelly (2002)? We hypothesize that to the extent dividends and stock repurchases are substitutes, the substitution of stock repurchases for dividends will be weaker (stronger) for firms that repurchase their stock and have prior losses (gains).

3. Data and Sample Construction

We begin with US firms in COMPUSTAT and CRSP. The sample spans the period 1984-2011. A firm enters the sample the first quarter it repurchases at least 0.1 percent of its shares outstanding and remains in the sample until it either delists or until the end of 2011. We also limit the sample to nonfinancial and nonutility firms by dropping firms with SIC codes 6000 to 6999 and 4900 to 4999 and require firms to have CRSP share codes 10 and 11. This results in 232,308 firm-quarter observations and 6460 firms.

Following Banyi, Dyl, and Kahle (2008), we compute the dollars spent on stock repurchases as COMPUSTAT's quarterly purchase of common and preferred stock from the cash flow statement (PRSTKCY, adjusted for the fact that this variable is year to date) minus any decreases in reported balance sheet preferred stock (PSTKQ). Then following Bonaime (2012), we express the dollars spent on stock repurchases as a percentage of the firm's market capitalization in the prior quarter. A firm first enters the sample the first quarter this variable is at least 0.1 percent. Later we transform this variable into a binary variable which equals 1 if the condition is met else zero as the dependent variable in logit regressions.

The primary goal of this paper is to test if the returns from prior stock repurchases (*REPO_RET*) have any effect on future repurchasing activity and if yes, are managers more sensitive to prior losses than they are to prior gains. The main variable, *REPO_RET* is constructed as follows:

- Step 1: Following Banyi, Dyl, and Kahle (2008) we compute the quarterly cost of stock repurchases as COMPUSTAT's quarterly purchase of common and preferred stock from the cash flow statement (PRSTKCY, adjusted for the fact that this variable is year to date) minus any decreases in reported balance sheet preferred stock (PSTKQ).
- Step 2: Following Banyi, Dyl, and Kahle (2008) we estimate the numbers of shares repurchased in a given quarter by dividing the quarterly cost of stock repurchases (from step one) by the stock repurchase price which is the average closing stock prices for each month in a given quarter.
- Step 3: For each quarter, we cumulate the number of shares repurchased by each firm starting from the quarter the firm first enters the sample to the end of the current quarter while adjusting for stock splits. Then we multiply this by the closing stock price of the quarter to get the cumulative market value of shares repurchased. Conversely, we compute the associated cumulative cost of stock repurchases by cumulating the quarterly cost of stock repurchases from step 1.
- Step 4: Finally, to get the returns of repurchased stocks (*REPO_RET*), we subtract the cumulative cost of stock repurchases from the cumulative market value of stock repurchases and scale it by the end of quarter book value of assets. The rational for scaling by the book value of assets instead of the cumulative cost of stock repurchases is emphasize the role of the economic significance of prior gains and losses on future stock repurchasing activity. Two firms with identical dollar losses and cumulative costs of stock

repurchases but of different firm sizes may react differently. For example they may both have a loss of $1million dollars and a cumulative cost of $2 million resulting in a return of -50% each but if one has a firm size of $1 billion and the other $100 million the *REPO_RET* will be -0.001 and -0.01 respectively and hence both firms will feel the losses differently.

Table 1 presents an example of the calculation of repurchase portfolio returns (*REPO_RET*) of a firm over four years (16 quarters) assuming no stock splits. Thus *REPO_RET* is the cumulative return from stock repurchases from the first time a firm first repurchases 0.1% of its market capitalization.

The analysis and the variables in this study are based on 3 samples. The main sample is based on COMPUSTAT; a second sample which requires tenure and age data from EXECUCOMP; and a third sample which is used to test the dividend substitution hypothesis. Table 2 provides summary statistics for the variables used in the study.

Table 3 provides annual statistics on repurchasing activity and dollar gains from repurchases from 1984 to 2011. Table 3 starts by providing annual stock repurchase initiations (the number of firms that repurchase at least 0.1 percent of the previous quarter's market capitalization for the first time). Next the table 3 reports the total number of repurchasing firms in any given year. This is followed by the aggregate dollars spent on stock repurchases and the aggregate dollar gains from repurchases respectively

both in nominal and real terms[4]. The last two columns report the average dollars spent on repurchases and the average dollar gains from repurchases.

The main finding from table 3 is that repurchasing activity and the dollar gains tend to slow down at the onset of recessions. For example if we look at the last recession although the number of firms initiating stock repurchases and the number of firms conducting stock repurchases were still substantial, the dollars spent on repurchases went from $560.189 million to $168,056 million in 2007 compared to 2009, representing a 70% decrease. The most popular reason for the slowdown in repurchasing activity provided in the media is related to firms stock piling cash for precautionary reasons due to the uncertain macroeconomic environment. Likewise, the aggregate dollar gains from repurchases went from a peak of $7,515,406 million in 2007 to $2,285,522 million in 2009 which also corresponds to a 70% decrease. Could this decrease in gains from prior stock repurchases also explain the decrease in repurchasing activity?

4. Results and Discussion

In this section we examine the impact of past repurchase returns on the decision to repurchase new shares. In our empirical framework, we examine gains and losses separately to allow for the possibility of an asymmetric response, which might obtain if CEOs exhibit loss aversion. we start our analysis by computing the cumulative stock repurchase returns from the first time a firm repurchases its shares in our sample until the third quarter of 2011 or until a firm delists. Next we compute the stock repurchase returns

[4] The real values are in 2011 dollars using GDP deflator from FRED. The base year from FRED is 2005 but to use 2011 as the base year we divide the deflator series by the 2011 value.

using different horizons (three year rolling windows, 5 year rolling windows, and 10 year rolling windows). To control for the possibility that our results are not actually due to managerial biases or loss aversion, but to some unobservable firm-level feature, we examine cross-sectional variation in our results as a function of two CEO-level characteristics: tenure and age and measure the cumulative stock repurchase returns over CEO tenure in the third sub-section. Finally, we examine the relationship between prior gains and losses from past repurchasing activity and the level of repurchases.

4.1 The impact of past repurchase returns on the decision to repurchase new shares

In this sub-section we use multivariate fixed effects logit estimators first to test whether the probability that a firm repurchases its stock depends systematically on past stock repurchase returns (equation 1 below). Secondly, we examine gains and losses separately to allow for the possibility of an asymmetric response, which might obtain if managers exhibit loss aversion in other words we test whether managers are more sensitive to prior negative stock repurchase returns than they are to prior positive stock repurchase returns (equation 2 below). The dependent variable, $REPODUM_t$ equals to one in quarters where the firm repurchases at least 0.1 percent of its market capitalization. We estimate the following multivariate fixed effects logit models:

$$P(y_{it} = 1|\boldsymbol{X}_{it}, c_i) = \beta_1 CASH_{i(t-1)} + \beta_2 CF_{i(t-1)} + \beta_3 BM_{i(t-1)} + \beta_4 SIZE_{i(t-1)} +$$

$$\beta_5 RET_{i(t-1)} + \beta_6 LEV_{i(t-1)} + \beta_7 REPO\_RET_{i(t-1)} +$$

$$YearEffects \qquad \text{eq.1}$$

$$P(y_{it} = 1|\boldsymbol{X}_{it}, c_i) = \beta_1 CASH_{i(t-1)} + \beta_2 CF_{i(t-1)} + \beta_3 BM_{i(t-1)} + \beta_4 SIZE_{i(t-1)} + \beta_5 RET_{i(t-1)} + \beta_6 LEV_{i(t-1)} + \beta_7 REPO\_RET_{i(t-1)} + \beta_8 LOSS_{i(t-1)} + \beta_9 REPO\_RET\ x\ LOSS_{i(t-1)} + yearEffects \quad \text{eq.2}$$

In both equations, *i* represents the firm, *t* represents time measured at the end of a given quarter, and c_i is an unobserved time invariant firm fix effect. We control for prior determinants of stock repurchases found in the literature as follows:

To control for the agency hypothesis the following proxy variables are used:

- $CASH_{t-1}$: CHEQ/ ATQ: Cash and short-term investments (this represents cash and all securities readily transferable to cash as listed in the Current Asset section of the firm's balance sheet) scaled by total assets and lagged by one quarter.
- CF_{t-1}: OIBDPQ/ATQ: Operating income before depreciation scaled by total assets, and lagged by one quarter.

Consistent with prior research that uses excess cash flows as a motive for share repurchases to alleviate agency problems, we predict high levels of excess cash and cash flows are positively related to the decision to repurchase shares, ceteris paribus.

To control for undervaluation, we use the following proxy variables:

- $SIZE_{t-1}$: LN (ATQ): is the natural logarithm of a firm's total assets lagged by one quarter. Consistent with prior research we expect a positive relationship between size and the decision to repurchase stock. Especially because bigger firms are more likely to have the cash to repurchase stocks.

- RET_{t-1}: Quarterly stock return is the cumulative discrete quarter stock return based on the monthly returns from CRSP; lagged by one quarter. Consistent with prior research (for example Stephens and Weisbach 1998), if firms repurchase stocks to take advantage of or to signal undervaluation then we expect a negative relationship between stock performance and the decision to repurchase.
- BM_{t-1}: book-to-market ratio computed as CEQQ/marketCap, lagged by one quarter, where CEQQ is total Common or Ordinary Equity. This can also be used to control for a firm's investment opportunities. Dittmar (2000) holds while historical returns are a backward-looking measure of valuation and may not detect current misvaluation, a firm's book-to-market ratio may indicate a firm's potential for undervaluation. Thus we expect a positive relationship between book-to-market ratio and the decision to repurchase as firms take advantage of undervaluation.

To control for the optimal leverage hypothesis we use:

- *Lev t-1*: LTQ/ATQ: Total liabilities scaled by total assets. Stock repurchases reduce equity which increases the firm's leverage ratio, ceteris paribus. To the extent that firms have an optimal capital structure, firms may use stock repurchases to achieve their target capital structure (Dittmar 2000). Thus we expect a negative relationship between leverage and the decision to repurchase.

We use equation one to test whether the probability that a firm repurchases its stock depends systematically on past stock repurchase returns. In equation one the variable of interest is $REPO\_RET_{t-1}$ which is the cumulative value of all stocks a firm has repurchased minus the dollars spent on those repurchases scaled by the end of quarter value of total assets and lagged one quarter.

We also test for managerial loss aversion in the second equation by augmenting the first equation with two variables: (1) $LOSS_{t-1}$: an indicator which equals one if $REPO\_RET_{t-1}$ is negative and zero if positive; and (2) an interaction variable $REPO\_RET_{t-1} \times LOSS_{t-1}$. If firms are more sensitive to prior losses than prior gains when deciding to repurchase stocks then, the coefficient on $REPO\_RET_{t-1} \times LOSS_{t-1}$, β_9 will be positive and significant[5].

Also all explanatory variables are winsorized at the 1st and 99th percentile and year effects are included to help control for the effect of the business cycle on stock repurchases among other factors.

Table 4 presents the results from the logit regressions. Model 1 uses determinants found in prior literature. Model 2 tests whether past stock repurchases returns affect the probability that a firm repurchasing its stock while excluding prior determinants. Model 3 augments model 2 with the $REPO\_RET_{t-1} \times LOSS_{t-1}$ interaction variable to test for managerial loss aversion. Model 4 tests whether stock repurchase returns affect the

[5] The regression model presented in equation 2 is piecewise since holding all other variables constant, the coefficient on $REPO\_RET_{t-1}$ captures the slope in the region of positive stock repurchase returns (gains) while the coefficient on the interaction term $REPO\_RET_{t-1} \times LOSS_{t-1}$ plus that of $REPO\_RET_{t-1}$ is the slope in the region of prior negative stock repurchase returns (losses). Hence the coefficient on $REPO\_RET_{t-1} \times LOSS_{t-1}$ is a kink at the origin and if positive results in a steeper slope in the domain of losses. However, the coefficient on $LOSS_{t-1}$ captures a discontinuity at the origin or kink. we do not provide an economic interpretation of that parameter.

probability of stock repurchases while controlling for other determinants by combining models 1 and 2. Model 5, the main model tests whether the probability of repurchasing is more sensitive to negative stock repurchase returns (losses) compared with past positive stock repurchase returns (gains) while controlling for other determinant by combining models 1 and 3. Finally an alternative to testing model 5 (if the probability of repurchasing is more sensitive to prior losses compared to prior gains) is to split the sample by firms that have prior gains in any given quarter versus firms with prior losses and run model 4 on both subsamples (see model 6 and 7 respectively).

Across all models in Table 4, the prior determinants have their expected signs and they are all statistically significant at an alpha level of 1%. The analysis provides evidence that firms may use stock repurchases to mitigate agency problems as the probability of repurchasing is positively related to the level of cash and cash flows (scaled by total assets). There is also evidence of the undervaluation hypothesis as the probability of repurchasing is positively related to the book-to-market ratio, and firm size firm; and is negatively related to the stock return in the prior quarter. Finally leverage is associated with a negative probability of repurchasing.

With regards to the first question: does the probability that a firm repurchases its stock depends systematically on its cumulative returns from prior stock repurchases? Models 2 and 4 provide evidence suggesting a positive association between past stock repurchase returns and the probability of repurchasing new shares, ceteris paribus.

Turning to the next question: is the probability that a firm repurchases its stock more sensitive to past losses compared to past gains? That is, is there is an asymmetry

between prior cumulative negative and positive repurchase returns? Models 3 and 5 show that conditioning on prior losses, an increase in prior losses is associated with a decrease in the probability of stock repurchases (- 4.356 and – 3.202 in models 3 and 5 respectively). Conversely, given prior losses, a decrease in prior losses (if losses become less negative) is associated with an increase in the probability of repurchasing. On the other hand, given prior gains, an increase in gains has no significant effect on the probability of repurchasing. These results are confirmed in model 6 where we split the sample into firms quarters in which firms have prior accumulated gains versus prior accumulated losses.

Taken together the results suggest that the cumulative returns from prior stock repurchases are positively related to the probability of stock repurchases however, this effect seems to be primarily driven by prior negative stock repurchase returns. Managers tend to be sensitive to prior losses. These results also suggest that managers are loss averse.

4.2 The impact of past repurchase returns on the decision to repurchase new shares over different horizons

In the preceding analysis, returns from prior stock repurchases are measured from the time a firm enters the sample until the third quarter of 2011 or until the firm delists. A potential issue with measuring the repurchase returns this way is that we am assuming the outcome of all prior stock repurchasing decisions equally affect stock repurchases at time *t* which may be implausible. For example, for a firm that has repurchased stocks every quarter since 1984 we assume that repurchases conducted in 1984 and repurchases one

quarter ago equally influence the manager's decision today. we address this issue in this subsection by measuring the repurchase returns using three-, five-, and ten-year rolling windows (*REPO_RET3*$_{t-1}$, *REPO5_RET*$_{t-1}$, and *REPO10_RET*$_{t-1}$ respectively). The rational is that most open market repurchase programs take on average 3 to 4 years to complete and, as panel B of table 2 shows, the average CEO tenure in our sample is 5.3 years.

Table 5 presents fixed effect logit regression results for equation 2 using *REPO_RET3*$_{t-1}$, *REPO5_RET*$_{t-1}$, and *REPO10_RET*$_{t-1}$; and *LOSS3*$_{t-1}$, *LOSS5*$_{t-1}$, *and LOSS10*$_{t-1}$ respectively in lieu of *REPO_RET*$_{t-1}$ and *LOSS*$_{t-1}$.

Table 5 shows that given prior negative stock repurchase returns (losses), an increase in losses is associated with a lower probability of repurchasing across all rolling windows. On the other hand, for firms with positive stock repurchase returns (gains), further gains tend to produce small additional probability of repurchases; at least for the three-, and five-year rolling windows. Finally, the results in this table confirm the results in the preceding section as managers seem to be more sensitive to negative stock repurchase returns (losses) than positive stock repurchase returns (gains). Thus taken together, the decision to repurchase stock is driven by managers' sensitivity to past losses, ceteris paribus.

4.3. The impact of past repurchase returns on the decision to repurchase new shares – the effect of CEO characteristics

To control for the possibility that the results are not due to managerial biases or loss aversion, but due to some unobservable firm-level feature, (1) we measure the stock

repurchase returns over the tenure of a CEO in any given firm[6]; (2) we include CEO fixed effects in the multivariate logit analysis (Bertrand and Schoar 2003 find that manager fixed effects are related to a variety of corporate decisions including dividend policy.); and (3) we examine cross-sectional variation in our results as a function of two CEO-level characteristics: tenure and age. Prendergast and Stole (1996) present a model in which individuals want to acquire a reputation for quickly learning a correct course of action. This desire leads to two types of sub-optimal behavior: exaggeration, in which individuals respond too much to new information; and conservatism, in which behavior is not changed enough in the light of new information. In their model, individuals early in their job tenure tend to respond too much, while those with longer tenure respond too little. Drawing upon these results, we hypothesize that CEOs with the shortest tenure will exhibit behavior that is most sensitive to realized gains and losses, while long-tenure CEOs will be the least sensitive.

With respect to the link between age and loss aversion, Johnson et. al. (2006) find an increasing relationship between risk aversion and age, while Hjorth and Fosgerau (2009) find that loss aversion increases with age up to around 55 years, and then declines rapidly. Bertrand and Schoar (2003), after controlling for fixed differences across firms and other time varying firm factors, find that executives from earlier birth cohorts tend to

[6] The rational for measuring gains and losses from repurchases based on a CEO's tenure within the firm is an intuitive one. To the extent that CEOs influence their firm's payout policy what matters most to any CEO are the gains from repurchases under their tenure and not those their predecessors. A specific CEO may have cumulated losses which could induce that CEO to be loss averse and then a new CEO comes in and "does their own thing." For example Apple under Steve Jobs didn't payout but one year after Steve Job's death, Apple under the new CEO, Tim Cook announced a $2.65 quarterly dividend and a three year share repurchase program of about $45 billion. Besides the availability of excess cash some analysts attribute these payout decision to the new CEO and hold Steve Jobs philosophy on the contrary was to "hoard cash" and this was in part due to his "long memory" when he returned to Apple in 1997 at which point the firm was struggling and using more cash that it could earn. http://abcnews.go.com/Business/apple-aapl-changed-year-steve-jobs-death/story?id=17387066#.UJ1pb4Yau4q

be more conservative in corporate decision making. Because the majority of the CEO sample is in the 50 to 55 years age range, it is unclear whether there is enough age variation to find a linear relationship between loss aversion and age.

Table 6 presents CEO fixed effects logit regressions of quarterly stock repurchase activity from 1993-2011 using the Execucomp sample. The repurchase returns (*REPO_RET_CEO*) in this table are measured over the tenure of each CEO.

The first model shows that there is no evidence that returns from prior stock repurchases have any effect on the probability to repurchase stock. However the second model reveals that managers view losses differently from gains and that losses are what really matter. One can see that negative repurchase returns (losses) are negatively associated with the probability of repurchasing stocks. Also the coefficient on *REPO_RET_CEO x LOSS_RET_CEO* has the biggest magnitude. Although there is also a negative relationship between prior positive repurchase returns (gains) and the probability of repurchasing, the is effect not to be economically significant. The results in the first two columns are consistent with the findings in the preceding sections. Thus, regardless of how the repurchase returns are measured, the results show that managers are more sensitive to past losses than past gains.

The third to sixth models control for the possibility that the results are not due to managerial biases or loss aversion, but due to some unobservable firm-level feature, by separately controlling for CEO tenure and CEO age. The third and fourth model control for tenure by splitting the sample into CEOs who are below median tenure and CEOs whose tenure is greater or equal to the median, tenure and conduct the logit analysis on

each of these sub-samples. The results are consistent with the previous analysis in that prior negative repurchase returns are negatively associated with the probability of repurchasing across CEOs below or above median tenure. But this sensitivity is more pronounced in CEOs with lower tenure compared to CEOS above median tenure CEOs (the difference between both coefficients is statistically and economically significant).

Similarly, in the fifth and sixth model, the sample is split into CEOs whose ages are below the sample CEO median age and those whose ages are equal to or above the sample median age respectively. Once again, the results are consistent with the previous analysis in that prior negative repurchase returns are negatively associated with the probability of repurchasing across CEOs below or above the sample median age. But there is no evidence that age is a factor since the difference of coefficient on *REPO_RET_CEO x LOSS_RET_CEO* across both sample are neither statistically nor economically significant. This could be due to the fact that the majority of CEOs in our sample are between the ages of 50 and 57.

Taken together, the results up this point can be summarized as follows: when deciding to repurchase shares not only do managers seem to be more sensitive to losses from prior stock repurchase programs than prior gains but the losses are what seem to matter. We present this as evidence of managerial loss aversion. Secondly the loss aversion that we document seems to be related to CEO tenure as tenured CEOs seem to be less prone to loss aversion.

4.4. The impact of past repurchase returns on the level of stock repurchase

Up until this point the focus has been to test whether there is relationship between outcome of prior repurchasing activity and the decision to repurchase stocks in a given quarter. The focus of this subsection is to test whether there is a relationship between past repurchase returns and the level of stock repurchases in a given quarter. The dependent variable in this section is the dollars spent on stock repurchases in any given quarter scaled by the market capitalization at the end of the prior quarter. The dependent variables are the same as in the previous subsections with Logit analysis.

Given that there are many quarters in which firms do not conduct stock repurchases there are large clusters of zeroes in the dependent variable thus a linear regression would be in appropriate in this instance thus we use cross-sectional Tobit regressions, and Fama-Macbeth method to estimate the coefficients and the standard errors. The results of the Tobit Regressions are reported in table 7.

Across all models cash, cash flows, book-to-market and size, the prior quarter's stock return and leverage have their expected signs and for the most part are significantly different from zero. Table 7 also shows some evidence of loss aversion particularly in models three and four which reveals that given losses from prior stock repurchasing activity further increases in losses are associated with lower levels of spending on stock repurchases. On the other hand given prior gains there is no evidence that additional gains have any effect on the level of spending on stock repurchases. Thus taken together we provide evidence that when deciding to repurchase shares not only do firms seem to be more sensitive to losses from prior stock repurchase programs than prior gains but the losses are what seem to matter (loss aversion). Secondly the loss aversion that we document seems to be related to CEO tenure as tenured CEOs seem to be less prone to

loss aversion. Thirdly we provide some evidence which suggests that firms are also loss averse when deciding on how much to spend on stock repurchases.

5. Implication: The impact of past repurchase returns on the dividend-repurchase substitution

Up to this point we provide evidence supporting the idea that the outcome of past stock repurchasing activity as measured by the returns from past stock repurchases do influence future stock repurchasing decisions. Particularly we find evidence of managerial loss aversion namely that not only are managers more sensitive to prior losses than gains, but they seem to be entirely sensitive only to prior losses. In this section, we turn to the implications of the outcome of past stock repurchasing activities on dividend policy.

The analysis in this section is based on Grullon and Michaelly (2002) who compute a firm's dividend forecast error as the diffidence between a firm's actual dividend payment and the expected dividend payment based on Lintner's (1956) model. They find a negative correlation between firms dividend forecast errors and stock repurchase activity. This is presented as evidence of the substitution hypothesis, namely, that funds that would otherwise be used to increases dividends are used to repurchase stock.

We examine the role if any the outcome of prior repurchasing activity has on the dividend forecast error. Specifically, whether the substitution hypothesis documented by Grullon and Michaelly (2002) is weaker (stronger) for firms that repurchase their stock

and have prior negative realized repurchase returns (positive realized repurchase returns). We use the same methodology as Grullon and Michaelly (2002), but different preforecast and forecast windows. Their study uses 1973 to 1983 and 1973 to 1990 as their preforecast periods. We use 1985 to 1994 (this study begins from the period stock repurchases begin to be a competing payout choice[7] in this sample), and 1995 to 2010 as our forecast period.

For each firm we define the forecast error as:

$$Error_{i,t} = \frac{[\Delta Div_{i,t} - (\beta_{1,i} + \beta_{2,i} Earn_{i,t} + \beta_{3,i} Div_{i,t-1})]}{MV_{i,t-1}} \qquad \text{eq.3}$$

Where $\Delta Div_{i,t}$ is the actual change in dividends in year *t* for the *i'th* firm. $Earn_{i,t}$, is the earnings in year *t* for the *i'th* firm (defined as total earnings before extraordinary items – COMPUSTAT IB). $Div_{i,t-1}$ is the dividend level in year *t-1* (defined as the dollar amount of dividends declared on the common stock of a firm during the year – COMPUSTAT DVC). $MV_{i,t-1}$is the market value of equity in year *t-1* (defined as market value of common stock at end of year – COMPUSTAT PRCC_C multiplied by CSHO) . The coefficients $\beta_{2,i}$ and $\beta_{3,i}$are estimated for each firm over the preforecast period and are the parameters of earnings and lagged dividends, respectively, from Lintner's (1965) model. To enter the sample, each firm-year must have information on the following variables: *Earn*, *MV*, *Div*, and *RYIELD* (the total expenditure on share repurchases at time *t* scaled by the market value of equity at time *t – 1*)[8]. Finally each

[7] From 1985, the dollars spent on repurchase start to consistently increase in my sample

[8] To be consistent with Grullon and Michaelly (2002), stock repurchases are defined as total expenditure on the purchase of common and preferred stocks minus any reduction in the value of the net number of preferred stocks outstanding. (This variable is not available for banks, utilities, and insurance companies. Therefore, these types of firms are not included in our final sample.)

firm must have paid dividends continuously over the entire preforecast period of 1985 to 1994.

To examine the role of prior losses from stock repurchases on the dividend substitution hypothesis we estimate the following cross-sectional model based on Grullon and Michaelly (2002):

$$Error_i = \beta_{1,i} + \beta_{2,i}RYIELD_i + \beta_{3,i}LOG\_MV_i + \beta_{4,i}ROA_i + \beta_{5,i}SIGMA\_ROA_i + \beta_{6,i}NOPER_i + \beta_{7,i}DEBT_i + \beta_{8,i}LOSS_i + \beta_{9,i}RYIELD\ x\ LOSS_i + e_i \quad \text{eq.4}$$

The estimated model is a cross-sectional regression of the forecast error on the repurchase yield, the log of firm size, return on assets, the volatility of the return on assets, non-operating income scaled by total assets, the debt-to-total assets ratio augmented with our loss variable (a dummy variables that equals one when the stock repurchase return is negative and zero otherwise), and an interaction between the gain yield and loss dummy variable. We use the Fama and Macbeth method to estimate the coefficients and the standard errors. If firms experience losses in their portfolio of repurchased stocks, we expect less substitution of dividends with stock repurchases as managers may become wary of using stock repurchases and timing the market. Conversely, if firms experience gains from stock repurchases we expect the substitution of dividends with stock repurchases to strengthen. Thus while we expect $\beta_{2,i}$ to be negative and statistically significant we expect $\beta_{9,i}$to be positive and statistically significant. Table 8 reports the results with the losses from stock repurchases measured using three -, five-, ten-year rolling windows, and over the entire forecast period of 1995 to 2010 in models one to four respectively.

The results in table 8 show that the substitution of stock repurchases in lieu of dividends tends to be weaker when firms experience losses from past stock repurchases. Thus the findings are consistent with Grullon and Michaelly (2002) since the findings suggests that firms not only finance stock repurchases with funds that otherwise would have been used to increase dividends but less so when they have prior losses from stock repurchase and more so if they have prior gains.

6. Conclusion

Stock repurchases are risky investments made by management on behalf of current shareholders. There is an extensive literature which documents "rational" motivations for managers repurchasing their firm's stock. Where rational means stock repurchases are used as a tool that benefits the firm's shareholders in some way by increasing, or at least holding constant, firm value. DeAngelo, DeAngelo and Skinner (2008) provide anecdotal evidence of firms repurchasing their stocks at high prices prior to the 2008 financial crisis. They question managers' ability to time the market and ask whether repurchasing activity will ever return to pre-2008 levels.

At odds with the notion of rationality is the recent empirical work of Bonaime et al. (2012) who find that, on average, managers exhibit a propensity to mis-time stock repurchases and in the process destroy significant amounts shareholder wealth. Their results follow a line of research suggesting investment decisions may be influenced by past returns (outcome of prior investment decisions).

We hypothesize that in addition to being influenced by recent returns, managerial stock repurchases may also be influenced by the rate of return on the existing portfolio of repurchased stock generated from prior gains and losses from stock repurchases. This is consistent with research demonstrating that in a variety of contexts, decisions under uncertainty can be substantially affected by the outcomes of past decisions (see for example, Thaler 1980; Staw 1981; Arkes and Blumer 1985). Thaler and Johnson (1990) investigate how prior gains and losses affect risk taking behavior. Based on experimental data from Cornell undergraduate and MBA students they find increased willingness to take risk after prior gains, which they refer to as the "house money effect". However, after experiencing a prior loss, individuals showed increased loss aversion and a decreased willingness to take risk.

We begin our empirical work by calculating at the firm-level gains and losses on repurchased stock, and examining the impact of past repurchase returns on the decision to repurchase new shares. In this empirical work, we examine gains and losses separately to allow for the possibility of an asymmetric response, which might obtain if managers exhibit loss aversion (Johnson and Thaler, 1990). we find evidence of loss aversion; specifically, that firms are unlikely to repurchase stocks when they lose money from past stock repurchases; and almost no evidence that past gains on repurchases influence future repurchasing activity even after controlling for variables previously shown to affect repurchase activity (e.g. cash, cash flow, book-to-market ratio, firm size, past one-quarter return, etc.).

To control for the possibility that the results are not due to managerial biases or loss aversion, but due to some unobservable firm-level feature, we examine cross-

sectional variation in our results as a function of two CEO-level characteristics: tenure and age. We find that manager's decreased propensity to conduct stock repurchases given losses from prior stock repurchases (loss aversion) is more pronounced in firms whose CEOs have shorter tenure.

We also provide some evidence suggesting that given losses from prior stock repurchasing activity further increases in losses are associated with lower levels of spending on stock repurchases and no evidence that additional gains have any effect on the level of spending on stock repurchases.

Finally, we show that the "loss-aversion" effect on repurchases indirectly affects dividend payouts. Specifically, the dividend-repurchase substitution rate slows down for firms that experience losses in their past repurchase activities.

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portfolio returns, REPO_RET
for the calculation of repurchase portfolio returns *(REPO_RET)* of a firm that had made repurch

ost). s	Repo. Price per Share	# of Shares Repo.	Cum. # of Shares Repo	Closing Stock Price per Share	Cum. Value of Repo. Shares	Cum. Cost of Repo. Shares	Cum. Gains/Loss from Repo
0	$3.00	5	5	$2.00	$10.00	$15.00	-$5.00
0	$4.00	20	25	$3.00	$75.00	$95.00	-$20.00
'	$7.00	0	25	$5.00	$125.00	$95.00	$30.00
'	$9.00	0	25	$8.00	$200.00	$95.00	$105.00
0	$10.00	30	55	$10.00	$550.00	$395.00	$155.00
0	$7.00	40	95	$9.00	$855.00	$675.00	$180.00
0	$8.00	10	105	$7.00	$735.00	$755.00	-$20.00
'	$3.00	0	105	$4.00	$420.00	$755.00	-$335.00
'	$1.00	0	105	$2.00	$210.00	$755.00	-$545.00
0	$6.00	50	155	$5.00	$775.00	$1,055.00	-$280.00
0	$7.00	9	164	$9.00	$1,476.00	$1,118.00	$358.00
'	$8.00	0	164	$8.50	$1,394.00	$1,118.00	$276.00
0	$5.00	10	174	$8.00	$1,392.00	$1,168.00	$224.00
'	$7.00	0	174	$6.00	$1,044.00	$1,168.00	-$124.00
0	$3.00	30	204	$7.00	$1,428.00	$1,258.00	$170.00
'	$1.00	0	204	$6.00	$1,224.00	$1,258.00	-$34.00
'	$3.00	0	204	$6.50	$1,326.00	$1,258.00	$68.00

Table 2
Summary statistics
This table provides summary statistics for variables used in the study. Panel A is based on the largest sample from COMPUSTAT universe. Panel B is based on Execucomp firms, for which we can identify the tenure of the CEO. Panel C is based on dividend-repurchase substitution sample used in Grullon and Michaely (2002). Sample period is 1984-2011 and variables are winsorized at 1% on each tail. $REPODUM_t$ is a dummy variable that equals one when the firm buys back stock during the quarter and zero otherwise. $CASH_{t-1}$ is one-quarter lagged cash and short-term investments scaled by total assets (COMPUSTAT: CHEQ/ ATQ). CF_{t-1} is one-quarter lagged operating income before depreciation scaled by total assets (COMPUSTAT: OIBDPQ / ATQ). BM_{t-1} is one-quarter lagged book-to-market ratio. Book value is defined as total common or ordinary equity (COMPUSTAT: CEQQ) and the market value is defined as last trading day of the quarter shares outstanding (CRSP: SHROUT) multiplied by the closing price (CRSP: PRC). $SIZE_{t-1}$ is the natural log of total assets (COMPUSTAT: ATQ). RET_{t-1}, is the cumulative stock return for the past quarter based on the monthly returns from CRSP. LEV_{t-1} is one-quarter lagged total liabilities scaled by total assets (COMPUSTAT: LTQ/ATQ). *REPO_RET* is the cumulative value of all stocks a firm has repurchased minus the dollars spent on those repurchases (reference point) scaled by total assets. *LOSS* is a dummy variable that equals one when *REPO_RET* is negative and zero otherwise. *REPO_RET10*, *REPO_RET5*, and *REPO_RET3* are the cumulative values of all stocks a firm has repurchased minus the dollars spent on those repurchases (reference point) scaled by total assets using a 10 year, 5 year and 3 year rolling window respectively. *LOSS10*, *LOSS5* and *LOSS3* are dummy variables that equal one when *REPO_RET10*, *REPO_RET5* and *REPO_RET3* are negative respectively and zero otherwise. *TENURE* is the number of quarters the CEO has spent at the firm and *AGE* is the CEO's age in years. *REPO_RET_CEO* is the cumulative value of all stocks a firm has repurchased under the CEO minus the dollars spent on those repurchases (reference point) scaled by total assets. *LOSS_RET_CEO* is a

dummy variable that equals one when *REPO_RET_CEO* is negative and zero otherwise. *RYIELD* is the total expenditure on share repurchases at time *t* scaled by the market value of equity at time *t* - 1. *LOG_MV* is the natural log of the market value of equity. *ROA* is the operating income before depreciation scaled by the book value of the total. *SIGMA_ROA* is the standard deviation of *ROA* over the three years surrounding the firm year observation. *NOPER* is the nonoperating income before depreciation scaled by the book value of the total assets. *DEBT* is the book value of total long-term debt plus the book value of total short-term debt scaled by the book value of the total assets. In the dividend-repurchase substitution sample past accumulated returns on the repurchase portfolio is calculated by scaling with the market value of equity to be consistent with other variables used in Grullon and Michaely (2002). *RYIELD, NOPER*, and *DEBT* are truncated at the 99th percentile and *ROA* is truncated at the 1st and 99th percentiles.

Panel A: Summary statistics for the main sample

Variable	*N*	Mean	Std	1%	25%	50%	75%	99%
$REPODUM_t$	222,890	0.256	0.436	0.000	0.000	0.000	1.000	1.000
$CASH_{t-1}$	222,613	0.151	0.184	0.000	0.020	0.072	0.214	0.816
CF_{t-1}	200,810	0.026	0.044	-0.180	0.014	0.031	0.048	0.126
BM_{t-1}	221,797	0.687	0.611	-0.591	0.317	0.545	0.885	3.540
$SIZE_{t-1}$	222,890	5.458	2.067	1.138	3.945	5.340	6.875	10.481
RET_{t-1}	222,639	0.036	0.268	-0.564	-0.118	0.014	0.155	1.094
LEV_{t-1}	222,852	0.491	0.235	0.060	0.313	0.490	0.643	1.210
REPO_RET	222,890	0.058	0.233	-0.553	-0.006	0.003	0.054	1.377
LOSS	222,890	0.399	0.490	0.000	0.000	0.000	1.000	1.000
REPO_RET10	222,890	0.029	0.150	-0.447	-0.006	0.001	0.032	0.828
LOSS10	222,890	0.409	0.492	0.000	0.000	0.000	1.000	1.000
REPO_RET5	222,890	0.010	0.077	-0.269	-0.003	0.000	0.012	0.418
LOSS5	222,890	0.389	0.488	0.000	0.000	0.000	1.000	1.000
REPO_RET3	222,890	0.005	0.040	-0.147	-0.001	0.000	0.004	0.223
LOSS3	222,890	0.348	0.476	0.000	0.000	0.000	1.000	1.000

1-digit SIC	Industry definition	*N*
0	Agriculture	875
1	Mining, oil and const.	14,525
2	Food, beverage and chemicals	43,023
3	Plastics, computer and machinery	79,832
4	Railroads and airlines	12,803
5	Wholesale and retail	29,032
7	Arts, recreations, technical services	31,203
8	Healthcare, professional, social assistance and education services	10,230
9	Public administration services	1,367
	Total	222,890

Panel B: Summary statistics for the Execucomp sample

Variable	*N*	Mean	Std	1%	25%	50%	75%	99%
$REPODUM_t$	80,217	0.339	0.473	0.000	0.000	0.000	1.000	1.000
$CASH_{t-1}$	80,177	0.141	0.165	0.001	0.021	0.071	0.204	0.713
CF_{t-1}	74,695	0.038	0.028	-0.059	0.024	0.037	0.053	0.128
BM_{t-1}	79,927	0.521	0.388	-0.177	0.271	0.437	0.668	2.216
$SIZE_{t-1}$	80,217	7.073	1.603	3.576	5.925	6.947	8.099	11.199
RET_{t-1}	80,192	0.043	0.227	-0.509	-0.089	0.031	0.155	0.852
LEV_{t-1}	80,201	0.504	0.211	0.082	0.354	0.512	0.640	1.114
TENURE	80,217	21.249	17.486	1.000	8.000	17.000	30.000	80.000
AGE	79,948	53.520	7.853	37.000	48.000	53.000	58.000	76.000
REPO_RET_CEO	80,217	0.043	0.139	-0.256	0.000	0.001	0.036	0.827

LOSS_RET_CEO	80,217	0.285	0.452	0.000	0.000	0.000	1.000	1.000

1-digit SIC	Industry definition	*N*
0	Agriculture	290
1	Mining, oil and const.	4,995
2	Food, beverage and chemicals	17,635
3	Plastics, computer and machinery	27,454
4	Railroads and airlines	4,944
5	Wholesale and retail	11,070
7	Arts, recreations, technical services	10,457
8	Healthcare, professional, social assistance and education services	3,083
9	Public administration services	289
	Total	80,217

Panel C: Summary statistics for the dividend-repurchase substitution sample

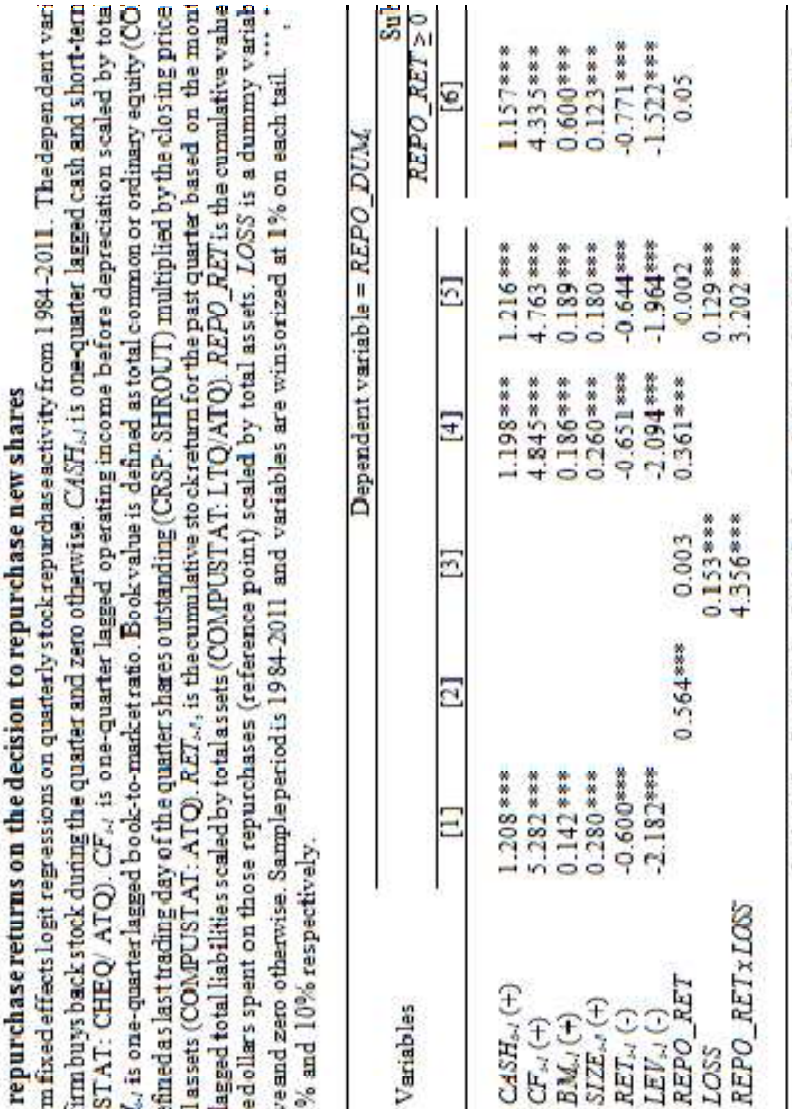
Variable	*N*	Mean	Std	1%	25%	50%	75%	99%
$REPODUM_t$	8,949	0.641	0.480	0.000	0.000	1.000	1.000	1.000
$RYIELD_t$	8,949	0.018	0.030	0.000	0.000	0.004	0.026	0.140
LOG_MV_t	8,949	7.260	1.964	2.639	5.964	7.275	8.570	11.881
ROA_t	8,758	0.138	0.066	0.002	0.094	0.131	0.177	0.331
$SIGMA\_ROA_t$	8,376	0.022	0.022	0.001	0.008	0.015	0.028	0.102
$NOPER_t$	8,945	0.006	0.010	-0.016	0.000	0.003	0.008	0.041
$DEBT_t$	8,671	0.213	0.144	0.000	0.092	0.213	0.315	0.568
REPO_RET	8,949	0.157	0.747	-0.843	0.012	0.098	0.270	1.491
LOSS	8,949	0.162	0.368	0.000	0.000	0.000	0.000	1.000
REPO_RET10	8,949	0.030	0.245	-0.475	-0.002	0.012	0.066	0.533
LOSS10	8,949	0.278	0.448	0.000	0.000	0.000	1.000	1.000
REPO_RET5	8,949	0.007	0.100	-0.208	-0.002	0.000	0.016	0.220
LOSS5	8,949	0.321	0.467	0.000	0.000	0.000	1.000	1.000
REPO_RET3	8,949	0.004	0.060	-0.097	-0.001	0.000	0.006	0.112
LOSS3	8,949	0.304	0.460	0.000	0.000	0.000	1.000	1.000

1-digit SIC	Industry definition	*N*
0	Agriculture	40
1	Mining, oil and const.	238
2	Food, beverage and chemicals	2,235
3	Plastics, computer and machinery	2,491
4	Railroads and airlines	1,556
5	Wholesale and retail	1,039
7	Arts, recreations, technical services	451
8	Healthcare, professional, social assistance and education services	102
9	Public administration services	50
	Total	8,202

Table 3
Annual stock repurchases and cumulative gains from repurchasing
This table provides annual statistics on stock repurchases and the cumulative dollar gains relative to repurchases prices (reference point) in our sample. A firm is said to repurchase its stock in a given quarter when it repurchases at least 0.1 percent of the previous quarter's market capitalization. *# Repo init.* are the total number of firms that enter the sample for the first time. It is the number of firms that repurchase at least 0.1 percent of the previous quarter's market capitalization for the first time. *# Repo firms* are the total number of firms that repurchased stocks at least once in any given year. *Sum qtrly. repo* are the total quarterly dollars spent on repurchases in a given year in nominal dollars(where quarterly repurchases are computed as COMPUSTAT purchase of common and preferred stock minus and increases in preferred stock measured in millions of dollars). *Sum qtrly. repo 2011$* are the total quarterly dollars spent on repurchases in a given year are in 2011 dollars using the 2011 GDP deflator. *Sum qtrly.$* gains are quarterly cumulative dollar gains/losses in repurchases relative to repurchase prices (reference point) measured in millions of dollars. *Sum qtrly. $ gains 2011$* are quarterly cumulative dollar gains/losses in repurchases relative to repurchase prices (reference point) measured in 2011 dollars using the 2011 GDP deflator. *Avg. qtrly. repo* and *Avg. qtrly. $ gains* are the average quarterly dollars spent on repurchases and average quarterly cumulative dollar gains/losses in repurchases relative to repurchase prices in a given year respectively. Recession years are shaded and are from the NBER (http://www.nber.org/cycles/). The first recession in the sample began in 3rd quarter of 1990 through the first quarter of 1991. The second recession spanned the first quarter of 2001 to the 4th quarter. The last recession spanned the 4th quarter of 2007 to the 2nd quarter of 2009. GDP deflator data are from the Federal Reserve Bank of St. Louis (http://research.stlouisfed.org/fred2/series/GDPDEF/downloaddata?cid=21)

Year	*# Repo.*	*# Repo.*	*Sum qtrly. repo. ($*	*Sum qtrly.*	*Sum qtrly. $ gains ($*	*Sum qtrly. $ gains*	*Avg. qtrly.*	*Avg. qtrly. $ gains ($*

	Init.	*firms*	*millions)*	*repo. 2011$ ($ millions)*	*millions)*	*2011$ ($ millions)*	*repo. ($ millions)*	*millions)*
1984	627	627	13,360	25,186	-3	-6	13.35	0
1985	509	936	38,568	70,747	11,245	20,628	10.34	3.03
1986	338	924	24,707	44,304	43,148	77,372	5.14	9.06
1987	558	1323	40,072	69,703	142,470	247,822	6.69	23.99
1988	303	1253	39,677	66,556	121,626	204,020	5.37	16.58
1989	166	994	41,762	67,698	242,637	393,326	5.54	32.42
1990	205	1090	36,746	57,190	233,849	363,956	4.81	30.83
1991	113	899	21,264	32,075	425,917	642,446	2.72	55.01
1992	151	795	25,523	37,679	556,412	821,402	3.23	71.18
1993	166	853	30,240	43,690	708,961	1,024,276	3.68	87.16
1994	188	962	36,240	51,267	728,550	1,030,645	4.25	86.22
1995	225	1100	62,854	87,166	1,173,877	1,627,918	7.05	132.84
1996	281	1246	74,519	101,471	1,781,840	2,426,312	7.94	191.29
1997	311	1405	110,499	148,086	2,769,400	3,711,429	11.12	281.39
1998	474	1819	141,711	187,854	3,769,418	4,996,797	13.52	363.35
1999	317	1845	153,548	200,475	4,592,154	5,995,600	13.96	422.58
2000	225	1649	153,639	195,790	4,790,722	6,105,068	14.28	450.98
2001	212	1412	130,471	163,013	3,716,220	4,643,116	12.54	363.2
2002	180	1250	123,401	151,420	2,924,393	3,588,421	12.01	289.8
2003	103	1142	137,059	164,768	3,101,653	3,728,703	13.56	313.84
2004	102	1025	195,751	227,978	4,387,941	5,110,327	19.98	458.27
2005	107	1117	322,241	362,592	4,991,193	5,616,189	33.62	531.43
2006	86	1191	442,080	483,667	5,720,283	6,258,402	47.29	621.77
2007	128	1293	560,189	597,003	7,515,406	8,009,299	62.25	845.76
2008	167	1437	430,507	448,968	4,430,676	4,620,672	48.16	499.68
2009	68	985	168,056	174,476	2,201,430	2,285,522	19.1	252.23
2010	68	1058	278,853	284,320	4,970,067	5,067,517	32.9	589.08
2011	82	1143	355,887	355,887	5,763,260	5,763,260	54.35	880.83



repurchase returns on the decision to repurchase new shares
m fixed effects logit regressions on quarterly stock repurchase activity from 1984-2011. The dependent var
irm buys back stock during the quarter and zero otherwise. $CASH_{t-1}$ is one-quarter lagged cash and short-ter
STAT: CHEQ/ ATQ). CF_{t-1} is one-quarter lagged operating income before depreciation scaled by tota
$_{t-1}$ is one-quarter lagged book-to-market ratio. Book value is defined as total common or ordinary equity (CO
fined as last trading day of the quarter shares outstanding (CRSP: SHROUT) multiplied by the closing price
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lagged total liabilities scaled by total assets (COMPUSTAT: LTQ/ATQ). *REPO_RET* is the cumulative value
ed dollars spent on those repurchases (reference point) scaled by total assets. *LOSS* is a dummy variab
re and zero otherwise. Sample period is 1984-2011 and variables are winsorized at 1% on each tail. ***
% and 10% respectively.

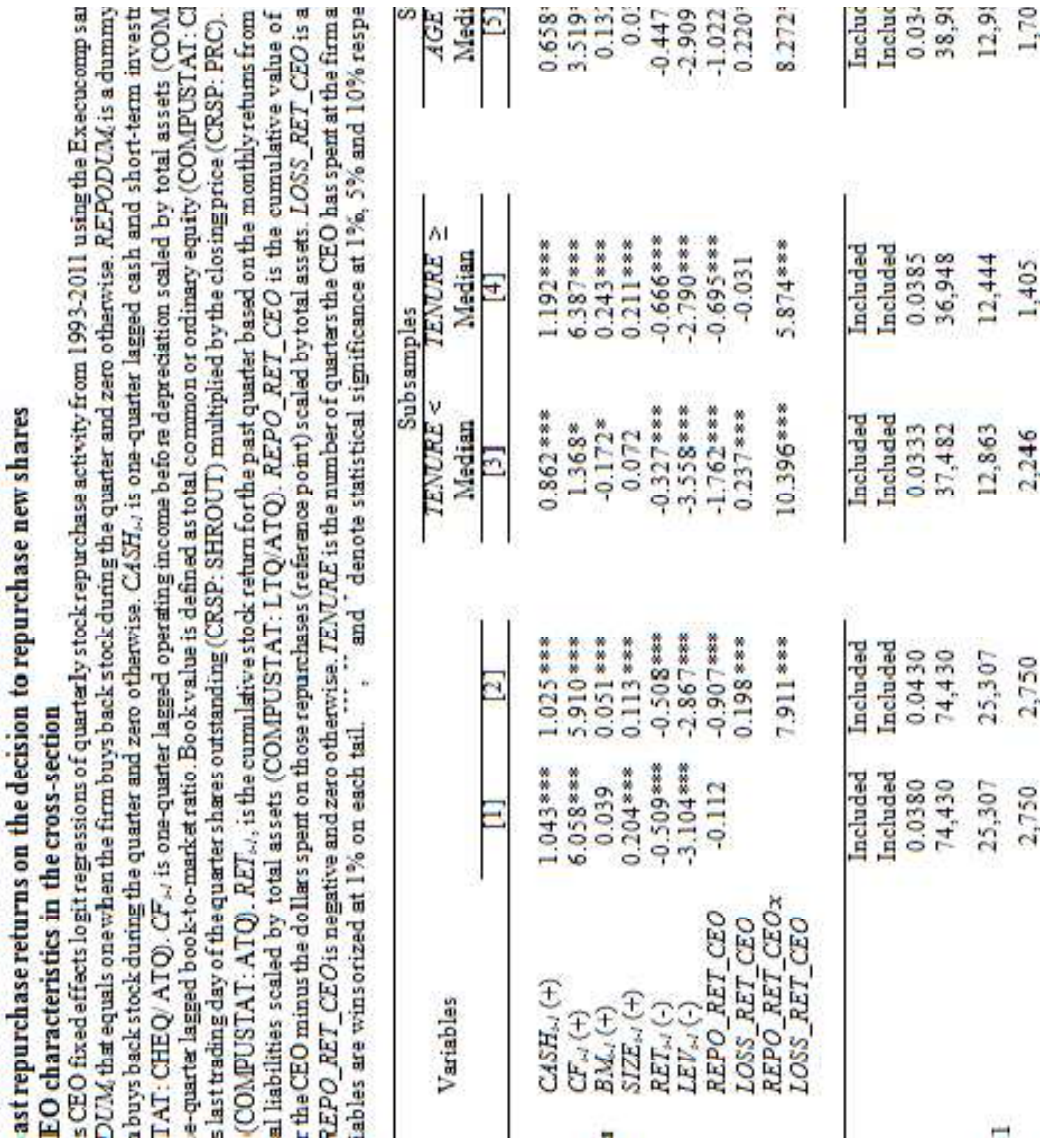
Variables	Dependent variable = *REPO_DUM*					Sub	
						REPO_RET ≥ 0	
	[1]	[2]	[3]	[4]	[5]	[6]	
$CASH_{t-1}$ (+)	1.208***			1.198***	1.216***	1.157***	
CF_{t-1} (+)	5.282***			4.845***	4.763***	4.335***	
BM_{t-1} (+)	0.142***			0.186***	0.189***	0.600***	
$SIZE_{t-1}$ (+)	0.280***			0.260***	0.180***	0.123***	
RET_{t-1} (-)	-0.600***			-0.651***	-0.644***	-0.771***	
LEV_{t-1} (-)	-2.182***			-2.094***	-1.964***	-1.522***	
REPO_RET		0.564***	0.003	0.361***	0.002	0.05	
LOSS			0.153***		0.129***		
REPO_RET x LOSS			4.356***		3.202***		
	Included	Included	Included	Included	Included	Included	
	Included	Included	Included	Included	Included	Included	
	0.0340	0.0165	0.0222	0.0344	0.0371	0.0267	
	199,660	222,890	222,890	199,660	199,660	120,230	
	51,197	57,003	57,003	51,197	51,197	34,822	

Table 5
The impact of past repurchase returns on the decision to repurchase new shares
Past returns are cumulated over different horizons

This table presents firm fixed effects logit regressions on quarterly stock repurchase activity from 1984-2011 using alternative horizons for past returns. The dependent variable is $REPODUM_t$ that equals one when the firm buys back stock during the quarter and zero otherwise. $CASH_{t-1}$ is one-quarter lagged cash and short-term investments scaled by total assets (COMPUSTAT: CHEQ/ ATQ). CF_{t-1} is one-quarter lagged operating income before depreciation scaled by total assets (COMPUSTAT: OIBDPQ / ATQ). BM_{t-1} is one-quarter lagged book-to-market ratio. Book value is defined as total common or ordinary equity (COMPUSTAT: CEQQ) and the market value is defined as last trading day of the quarter shares outstanding (CRSP: SHROUT) multiplied by the closing price (CRSP: PRC). $SIZE_{t-1}$ is the natural log of total assets (COMPUSTAT: ATQ). RET_{t-1}, is the cumulative stock return for the past quarter based on the monthly returns from CRSP. LEV_{t-1} is one-quarter lagged total liabilities scaled by total assets (COMPUSTAT: LTQ/ATQ). *REPO_RET10, REPO_RET5,* and *REPO_RET3* are the cumulative values of all stocks a firm has repurchased minus the dollars spent on those repurchases (reference point) scaled by total assets using a 10 year, 5 year and 3 year rolling window respectively. *LOSS10, LOSS5 and LOSS3* are dummy variables that equal one when *REPO_RET10, REPO_RET5* and *REPO_RET3* are negative respectively and zero otherwise. Variables

are winsorized at 1% on each tail. ***, ** and * denote statistical significance at 1%, 5% and 10% respectively.

Hypotheses	Variables	Dependent variable = $REPO\_DUM_t$		
		[1]	[2]	[3]
Agency	$CASH_{t-1}$ (+)	1.194***	1.210***	1.235***
	CF_{t-1} (+)	5.455***	5.221***	4.861***
Undervaluation	BM_{t-1} (+)	0.087***	0.118***	0.169***
	$SIZE_{t-1}$ (+)	0.270***	0.257***	0.212***
	RET_{t-1} (-)	-0.459***	-0.548***	-0.623***
Leverage	LEV_{t-1} (-)	-2.211***	-2.121***	-1.992***
Loss aversion	*REPO_RET3*	2.117***		
	LOSS3	0.445***		
	REPO_RET3 x LOSS3	2.451***		
	REPO_RET5		0.315***	
	LOSS5		0.279***	
	REPO_RET5 x LOSS5		3.842***	
	REPO_RET10			-0.108*
	LOSS10			0.138***
	REPO_RET10 x LOSS10			3.546***
Firm effects		Included	Included	Included
Year effects		Included	Included	Included
Pseudo-R^2		0.0383	0.0367	0.0369
N		199,660	199,660	199,660
# $REPO\_DUM_t$=1		51,197	51,197	51,197
# firms		4,859	4,859	4,859



ast repurchase returns on the decision to repurchase new shares
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REPO_RET_CEO is negative and zero otherwise. *TENURE* is the number of quarters the CEO has spent at the firm a
iables are winsorized at 1% on each tail. ***, **, and * denote statistical significance at 1%, 5% and 10% respe

Variables	[1]	[2]	Subsamples: *TENURE* < Median [3]	*TENURE* ≥ Median [4]	S: *AGE* Medi [5]
$CASH_{t-1}$ (+)	1.043***	1.025***	0.862***	1.192***	0.658'
CF_{t-1} (+)	6.058***	5.910***	1.368*	6.387***	3.519'
BM_{t-1} (+)	0.039	0.051***	-0.172*	0.243***	0.13'
$SIZE_{t-1}$ (+)	0.204***	0.113***	0.072	0.211***	0.0
RET_{t-1} (-)	-0.509***	-0.508***	-0.327***	-0.666***	-0.447
LEV_{t-1} (-)	-3.104***	-2.867***	-3.558***	-2.790***	-2.909
REPO_RET_CEO	-0.112	-0.907***	-1.762***	-0.695***	-1.022
LOSS_RET_CEO		0.198***	0.237***	-0.031	0.220'
REPO_RET_CEOx LOSS_RET_CEO		7.911***	10.396***	5.874***	8.272'
	Included	Included	Included	Included	Inclu
	Included	Included	Included	Included	Inclu
	0.0380	0.0430	0.0333	0.0385	0.03
	74,430	74,430	37,482	36,948	38,9
	25,307	25,307	12,863	12,444	12,9
	2,750	2,750	2,246	1,405	1,70

Table 7
Tobit Regression Analysis on the Intensity of Stock Repurchases
This table presents Tobit regression analysis on quarterly stock repurchase activity from 1984-2011. The dependent variable across all models is the dollars spent on the repurchase of common stock in any given quarter scaled by the market capitalization at the end of the prior quarter *(REPO$_t$)*. $CASH_{t-1}$ is one-quarter lagged cash and short-term investments scaled by total assets (COMPUSTAT: CHEQ/ ATQ). CF_{t-1} is one-quarter lagged operating income before depreciation scaled by total assets (COMPUSTAT: OIBDPQ / ATQ). BM_{t-1} is one-quarter lagged book-to-market ratio. Book value is defined as total common or ordinary equity (COMPUSTAT: CEQQ) and the market value is defined as last trading day of the quarter shares outstanding (CRSP: SHROUT) multiplied by the closing price (CRSP: PRC). $SIZE_{t-1}$ is the natural log of total assets (COMPUSTAT: ATQ). RET_{t-1}, is the cumulative stock return for the past quarter based on the monthly returns from CRSP. LEV_{t-1} is one-quarter lagged total liabilities scaled by total assets (COMPUSTAT: LTQ/ATQ). *REPO_RET* is the cumulative value of all stocks a firm has repurchased minus the dollars spent on those repurchases (reference point) scaled by lagged market value of equity. *LOSS* is a dummy variable that equals one when *REPO_RET* is negative and zero otherwise. *REPO_RET10*, *REPO_RET5*, and *REPO_RET3* are the cumulative

values of all stocks a firm has repurchased minus the dollars spent on those repurchases (reference point) scaled by the lagged market value of equity using a 10-year, 5-year and 3-year rolling window respectively. *LOSS10, LOSS5 and LOSS3* are dummy variables that equal one when *REPO_RET10, REPO_RET5* and *REPO_RET3* are negative respectively and zero otherwise. *REPO_RET_CEO* is the cumulative value of all stocks a firm has repurchased under the CEO minus the dollars spent on those repurchases (reference point) scaled by total assets. *LOSS_RET_CEO* is a dummy variable that equals one when *REPO_RET_CEO* is negative and zero otherwise. Coefficients are estimated based on two stage Fama-MacBeth regressions. ***, ** and * denote statistical significance at 1%, 5% and 10% respectively.

Hyp.	Variables	Dependent variable = $REPO_t$				
		[1]	[2]	[3]	[4]	[5]
	INTERCEPT	-8.01***	-7.87***	-7.69***	-7.58***	-4.19***
Agency	$CASH_{t-1}$ (+)	2.56***	2.68***	2.86***	2.98***	0.65***
	CF_{t-1} (+)	19.32***	18.98***	18.25***	18.42***	13.65***
Underval	BM_{t-1} (+)	0.62***	0.67***	0.77***	0.78***	-0.10
	$SIZE_{t-1}$ (+)	0.61***	0.61***	0.60 ***	0.58***	0.37***
	RET_{t-1} (-)	-0.20	-0.54**	-0.81***	-0.83***	-0.10
Leverage	LEV_{t-1} (-)	-2.08***	-2.07***	-1.91***	-1.82***	-1.32***
Loss aversion	*REPO_RET3*	-3211.40				
	LOSS3	1.39***				
	REPO_RET3 x LOSS3	-0.30				
	REPO_RET5		-3220.20			
	LOSS5		0.70***			
	REPO_RET5 x LOSS5		8.40			
	REPO_RET10			-3223.90		
	LOSS10			0.10		
	REPO_RET10 x LOSS10			11.85*		
	REPO_RET				-3225.10	
	LOSS				-0.06	
	REPO_RET3 x LOSS				13.47**	
	REPO_RET_CEO					2.34***
	LOSS_RET_CEO					0.72***
	REPO_RET_CEO x LOSS_RET_CEO					0.80

Table 8
The impact of past repurchase returns on the dividend-repurchase substitution
The dependent variable is dividend forecast error ($ERROR_{i,t}$) computed for the forecasting period of 1995-2010 consistent with Grullon and Michaely. $ERROR_t$ is defined as:

$$ERROR_{i,t} = \frac{\Delta Div_{i,t} - (\beta_{1,i} + \beta_{2,i} Earn_{i,t} + \beta_{3,i} Div_{i,t-1})}{MV_{i,t-1}}$$

where $\Delta Div_{i,t}$ is the actual change in dividends in year t; $Earn_{i,t}$ is the earnings in year t; $Div_{i,t}$ is the dividend level in year t-1, and $MV_{i,t-1}$ is the market value of equity in year t-1. $\beta_{1,i}$ $\beta_{2,i}$ and $\beta_{3,i}$ are estimated for each firm (denoted by i) over the preforecast period based on Lintner's (1965) model. To be included in the sample, each firm must have paid dividends continuously over the entire preforecast period of 1985 to 1994. To eliminate the effect of outliers forecast errors with absolute values greater than 5% are eliminated. *RYIELD* is the total expenditure on share repurchases at time *t* scaled by the market value of equity at time *t* - 1. *LOG_MV* is the natural log of the market value of equity. *ROA* is the operating income before depreciation scaled by the book value of the total. *SIGMA_ROA* is the standard deviation of *ROA* over the three years surrounding the firm year observation. *NOPER* is the

nonoperating income before depreciation scaled by the book value of the total assets. *DEBT* is the book value of total long-term debt plus the book value of total short-term debt scaled by the book value of the total assets. *REPO_RET* is the cumulative value of all stocks a firm has repurchased minus the dollars spent on those repurchases (reference point) scaled by lagged market value of equity. *LOSS* is a dummy variable that equals one when *REPO_RET* is negative and zero otherwise. *REPO_RET10, REPO_RET5,* and *REPO_RET3* are the cumulative values of all stocks a firm has repurchased minus the dollars spent on those repurchases (reference point) scaled by the lagged market value of equity using a 10-year, 5-year and 3-year rolling window respectively. *LOSS10, LOSS5 and LOSS3* are dummy variables that equal one when *REPO_RET10, REPO_RET5* and *REPO_RET3* are negative respectively and zero otherwise. Coefficients are estimated based on two stage Fama-MacBeth regressions. ***, ** and * denote statistical significance at 1%, 5% and 10% respectively.

Variables	Dependent variable = $ERROR_t$			
	[1]	[2]	[3]	[4]
Intercept	-0.00132*	-0.00111	-0.00038	0.00005
$RYIELD_t$	-0.02659***	-0.02831***	-0.03203***	-0.02850***
LOG_MV_t	0.00030***	0.00029***	0.00023**	0.00018**
ROA_t	0.00153	0.00131	0.00024	-0.00084
$SIGMA\_ROA_t$	-0.00367	-0.00301	-0.00033	0.00159
$NOPER_t$	-0.01772*	-0.01711*	-0.01709	-0.01740
$DEBT_t$	-0.00377***	-0.00362***	-0.00324***	-0.00299***
LOSS3	-0.00003			
$RYIELD_t$ *x LOSS3*	0.00894			
LOSS5		-0.00065**		
$RYIELD_t$ *x LOSS5*		0.02088*		
LOSS10			-0.00198***	
$RYIELD_t$ *x LOSS10*			0.03690***	
LOSS				-0.00339***
$RYIELD_t$ *x LOSS*				0.05058***
N	16	16	16	16
# firms	800	800	800	800

Essay 2

Does Past Performance of Insider Trading Affect Future Insider Trading Activity?

1. Introduction

This paper examines the relation between insider (officers and directors) open market transactions and the outcome of past insider trading to better understand what motivates insiders to trade. The primary goal of this paper is to test if insider trading experiences (as measured by insider trading returns) have any effect on open market

purchases made by insiders. If yes, are insiders more sensitive to prior losses than they are to prior gains (loss aversion) and to the extent that insiders exhibit loss aversion when conducting open market purchases, we examine the economic impact of insider loss aversion on insider wealth.

There is an extant literature documenting that insiders earn abnormal returns (e.g. Lorie and Niederhoffer 1968, Seyhun 1986, Rozeff and Zaman 1988, Lakonishok and Lee 2001, and Jeng, Metrick and Zeckhauser) which can be attributed to insiders' ability to recognize if their firm's stock is mispriced and also because they are privy to superior information about their firm's future performance. Despite these advantages, insider trading is still a risky proposition first because insiders stand to lose wealth if their opinion about the intrinsic value of the firm turns out to be wrong. Also insiders tend to have a significant amount of their wealth invested in their firm (both financial and human capital) and by purchasing additional shares they are de-diversifying their wealth and foregoing liquidity.

We hypothesize that in addition to being influenced by the perceived misvaluation of their firm's securities and having superior information about their firm's future prospects, open market purchases by insiders may also be influenced by gains and losses on their existing portfolio of shares held (which would capture the outcome of their past open market transactions). This is consistent with research demonstrating that in a variety of contexts decisions under uncertainty can be substantially affected by the outcomes of past decisions (see for example, Thaler 1980; Staw 1981; Arkes and Blumer 1985). Thaler and Johnson (1990) investigate how prior gains and losses affect risk taking behavior and find based on experimental data from Cornell undergraduate and

MBA students an increased willingness to take risk after prior gains, which they refer to as the “house money effect”. However, after experiencing a prior loss, individuals showed increased loss aversion and reduced willingness to take risk.

If past gains and losses influence open market purchasing activity, then including only recent stock returns and controlling for superior information at the disposal of insiders in one’s model may fail to capture this effect. This is because purchases are not made smoothly, and thus the gains and losses on the portfolio are affected both by past returns, and the timing of the cash flows used to purchase stock. We begin the empirical work by calculating at the firm-level insider trading returns (using the Modified Dietz method), and examining their impact on open market purchasing activity. In this empirical work, we examine gains and losses separately to allow for the possibility of an asymmetric response, which might obtain if insiders exhibit loss aversion (Johnson and Thaler, 1990).

We find insider trading returns to be positively related to insider purchase ratios even after controlling for variables previously shown to affect purchasing activity. However, this effect seems to be primarily driven by negative insider trading returns as conditioning on losses; an increase in insider trading losses is associated with decreased insider purchases while given gains from insider trading, an increase in gains has no significant effect on insider purchase ratios. Thus the findings suggest that insider loss aversion plays a role when insiders conduct open market purchases. We also find that loss aversion is more pronounced with directors compared to officers.

Finally we examine the economic impact of insider loss aversion by identify a subsample of insiders who have losses and are predicted not to purchase due to loss aversion. Then we spilt this subsample into two groups (1) one group that acts upon their loss aversion by not purchasing and (2) a second group with insiders predicted to be loss averse but decide to ignore their loss aversion by actually purchasing. We find that having inside information about poor future stock performance and acting on loss aversion by not purchasing the firm's stock today (the first group) helps such insiders to avoid an average loss of 5.7% over the next year. On the other hand, having inside information about good future stock performance and ignoring to act upon loss aversion by actually purchasing the firm's stock today despite insider trading losses (the second group) helps such insiders to earn an average of 8.14% the following year.

The findings in this study contribute to the literature in several ways. First this study helps us better understand why insiders engage in open market purchases. In addition to possessing superior information about their firm's future performance, poor timing decreases the intensity of open market purchases made by insiders as they are loss averse. Secondly this is the first study to document a link between loss aversion and insider trading thus suggesting that insider biases may affect insider trading behavior. Finally, the findings in this study confirms the existing literature that insiders have superior knowledge about their firm's future prospect since acting upon loss aversion when the firm's future prospects are less favorable helps insiders avoid a loss and ignoring loss aversion in situations of losses but favorable future prospects helps insiders enhance their wealth.

The study proceeds as follows. Section 2 reviews the relevant literature on the motives of insider trading and develops the hypothesis. Section 3 describes the data used in the study. Section 4 presents the tests of the main hypothesis while section 5 provides the economic impact of insider loss aversion on insider wealth. Section 6 concludes.

2. Literature Review and Motivation

2.1. Determinants of Insider Trading

This section provides a brief overview of the literature on the determinants of insider trading, which we organize into the following broad categories: stock price misvaluation, superior information about the firm's future performance, stock based compensation changes, and the demand by institutional and individual investors.

2.1.1. Stock Price Misvaluation

There is an extant literature which documents that insiders earn abnormal returns (e.g. Lorie and Niederhoffer 1968, Seyhun 1986, Rozeff and Zaman 1988, Lakonishok and Lee 2001, and Jeng, Metrick and Zeckhauser). Such returns can partially be achieved if insiders recognize mispricing. According to this motive, insiders would purchase (sell) their firm's security if they believe the security is undervalued (overvalued). In this vein Seyhun (1986) shows insider purchases tend to occur after stock price declines and insider sell trades tend to occur after stock price rises.

Similarly Rozeff and Zaman (1998) find evidence suggesting that insiders tend to buy undervalued stocks. The authors look at the direction of insider trading with respect to growth/value stocks and test if they are consistent with attempts to profit from market overreaction (price movements that predictably reverse). Rozeff and Zaman (1998) posit

if we assume that value stocks are undervalued and growth stocks are overvalued and /or provide profit opportunities to some investor then insiders who supposedly have superior information have the incentive to take advantage of such misvaluations within the bounds of legality by buying value stock more heavily and /or selling growth stock more heavily. But on the other hand, if growth and value stocks don't meaningfully measure deviations of stock prices from fundamental values then insider trades shouldn't be related to these categories. They find that as stocks increasingly move from value stocks to growth stocks there is an increase in insider purchasing activity compared to insider selling. Thus suggesting that the price of value stocks tend to be below intrinsic value while that of growth stocks above intrinsic value. They also find an increase in insider buying (selling) following low stock returns (high stock returns).

In the same vein, Piotroski and Roulstone (2005) find insiders to be contrarian specifically, they find a positive relationship between insider trading (purchases) and the firm's book-to-market value and a negative relationship between insider trading and recent stock returns. Both of these variables are used as measures of undervaluation. Similarly, Jenter (2005) finds insiders' perceived misvaluation of their stock is a motive for insider trading (insider purchasing is increasing in firms with low market-to-book values).

2.1.2. Superior Information about Firm's Future Performance

In addition to recognizing mispricing, it has been documented that insiders' abnormal returns from trading their firms' stock can be attributed to having an informational advantage about the firm's future performance (cash flow realizations and future earnings innovations). Piotroski and Roulstone (2005) use next year's annual

earnings innovation and next year's market-adjusted stock returns as measures of future unexpected cash flow changes unknown by the market but known by insiders. The authors find a positive relationship between these proxy variables and insiders' open market purchasing activity. Similarly, Ke, Huddart, and Petroni (2003) examine insider-trading patterns ahead of a break in quarterly earnings increases and find insider sales increase three to nine quarters before the earnings break. They use this as evidence suggesting that insiders trade ahead of earnings breaks, and avoid abnormal selling two quarters prior to the break to avoid potential legal issues.

2.1.3. Stock Based Compensation Changes

Ofek and Yermack (2000) show that insider trading is influenced by the changes in insider holdings due to stock and option grants and the exercising of stock options (For example, increased equity compensation to higher-ownership managers leads to the sale of previously owned shares). To this extent, Piotroski and Roulstone (2005) find an inverse relationship between insider purchasing activity and number of shares of restricted stock and stock options granted and number of stock options exercised.

2.1.4. Demand by Institutional and Individual Investors

Sias and Whidbee (2010) examine the relationship between insider trading and institutional and individual investors as a motive for insider trading. The authors hypothesize and find a negative association between inside trading and institutional demand and offer three possible explanations. First, since insider trades are usually large, institutional investors are more likely to provide the liquidity necessary for insiders to trade. Secondly, institutional investors are attracted to firms with high valuations and high recent stock return while insiders are attracted to the opposite. Finally, since insiders

are more likely to view their securities as overvalued (undervalued) following a period when institutions were net buyers (sellers) insiders will trade in the opposite direction of institutional investors.

2.2. The Effect of Insider Trading Returns (Gain and Losses) on Risk Taking Behavior

The literature discussed above captures what we will label "rational" motivations for insider trading. By rational we simply mean that in each of the cited papers, insider trading is conducted to benefit the insider in some way by increasing their wealth.

There is an extant literature documenting that insiders earn abnormal returns (e.g. Lorie and Niederhoffer 1968, Seyhun 1986, Rozeff and Zaman 1988, Lakonishok and Lee 2001, and Jeng, Metrick and Zeckhauser) which can be attributed to insiders' ability to recognize if their firm's stock is mispriced and also because they are privy to superior information about their firm's future performance. Despite these advantages insider trading is still a risky proposition first because insiders stand to lose wealth if their opinion about the intrinsic value of the firm turns out to be wrong. Also insiders tend to have a significant amount of their wealth invested in their firm (both financial and human capital) and by purchasing additional shares they are de-diversifying their wealth and foregoing liquidity.

There is also a line of research suggesting investment decisions may be influenced by past returns. For instance, Ippolito (1992) shows inflows to mutual funds are strongly correlated with past fund performance. Empirical work by Friesen and Sapp (2007), Frazzini and Lamont (2008) and Dichev (2007) indicates that poor investment-timing decisions, in which investors buy after past gains and sell after past losses, destroy a significant percentage of investor wealth.

We hypothesize that in addition to being influenced by the perceived misvaluation of their firm's securities and having superior information about their firm's future prospects, open market purchases by insiders may also be influenced by gains and losses on their existing portfolio of shares held (which would capture the outcome of their past open market transactions). This is consistent with research demonstrating that in a variety of contexts decisions under uncertainty can be substantially affected by the outcomes of past decisions (see for example, Thaler 1980; Staw 1981; Arkes and Blumer 1985). Thaler and Johnson (1990) investigate how prior gains and losses affect risk taking behavior and find based on experimental data from Cornell undergraduate and MBA students an increased willingness to take risk after prior gains, which they refer to as the "house money effect". However, after experiencing a prior loss, individuals showed increased loss aversion, a phenomenon sometimes referred to as the "snakebite effect". Their results suggest that losses are more painful if they happen after prior losses and less painful if they occur after prior gains, since prior gains act as cushions for future losses. Frino, Grant and Johnstone (2007) examine Australian futures traders and find supporting evidence, that traders take on more risk in the afternoon on days with morning gains. Low (2004) finds that prior losses are associated with increased loss aversion, which is consistent with the snakebite effect. However, the evidence on the effect of past gains and losses is mixed. Coval and Shumway (2005) find that traders with morning losses increase risk-taking in the afternoon.

Regardless of the precise nature of the relationship, if past gains and losses influence open market purchasing activity, then including only recent stock returns and controlling for superior information at the disposal of insiders in one's model may fail to

capture this effect. This is because purchases are not made smoothly, and thus the gains and losses on the portfolio are affected both by past returns, and the timing of the cash flows used to purchase stock. We begin the empirical work by calculating at the firm-level insider trading returns, and examining their purchasing activity. In this empirical work, we examine gains and losses separately to allow for the possibility of an asymmetric response, which might obtain if insiders exhibit loss aversion (Johnson and Thaler, 1990).

Finally, to the extent that insiders exhibit loss aversion when conducting open market purchases, we examine the economic impact of insider loss aversion on insider wealth.

3. Data and Sample Construction

The analysis in this study focuses on open market purchases and sales by directors and officers from Table 2 of Thomson Reuters (TFN) spanning 1986 to 2012. We impose the following screens on table 2 data: delete amendments and some cleansed observations[9]; keep transaction codes P and S as they are open market or private purchase and sales; ignore sales that are related to the exercise of an option[10]; and we keep transactions in firms for which we have COMPUSTAT and CRSP necessary to generate

[9] Thomson advises Cleanse Code (A) to be avoided from analysis. And also code (S) since data with a cleanse code of 'S' have a different security from the one they have been entered under

[10] The variable optionSell: Identifies a sale that is related to the exercise of options. Possible values include all (A), partial (P), none (N), or blank. We want open market sale of shares that were purchased for their account and not those that arose from option grants so we keep (N) and ignore (A) and (P) and Blanks

control variables. This results in 1,682,374 transactions over 27 years of which 442,882 (26%) are purchases and 1,239,492 (74%) are sales with 124,009 insiders[11].

Table 1 reports descriptive statistics on the number of shares purchased and sold; transaction values; and shares held after each transaction. The typical number of shares purchased is larger than the number of shares sold (with an average of 19,701 shares versus 16,650) however; the typical dollar transaction value for purchases is smaller than the sales value (with an average dollar value of $140,131 per purchase versus $469,564 per sale).

Table 2 reports the distribution and frequencies of insider transactions. From table two, 61 percent of insiders (76,026 insiders out 124,009) have one or zero purchase transactions which is similar for sales (76,159 insiders out of 124,009). From panel B of table 2, the average number of purchase transactions made by an insider is 4 compared to 10 for sales.

3.1. Measurement of Insider Trading Behavior

Following Piotroski and Roulstone (2005) we measure insider trading as the firm's purchase ratio defined as follows:

$$PR_{i,t} = \frac{BUY_{i,t}}{BUY_{i,t}+SELL_{i,t}}, \qquad \text{eq.1}$$

where $BUY_{i,t}(SELL_{i,t})$ is the number of shared purchased (sold) by insiders (officers and directors) of the i'th firm in year *t*.

[11] Some individuals are insiders in more than 1 firm. This number is the sum of insiders in any given firm and thus allows for some individuals to show up multiple times if they are insiders in more than 1 firm.

3.2. Measurement of Insider Trading returns

The primary goal of this paper is to test if the outcome of past insider trading (insider trading experience) as measure by insider trading returns (*InsiderRet$_t$*) have any effect on open market insider purchases. If yes, are insiders more sensitive to prior losses than they are to prior gains. The main variable, *InsiderRet$_t$* is constructed as follows:

$$InsiderRet_{i,t} = \frac{Gain\ net\ of\ external\ flows}{AverageCapital} = \frac{MV_1 - MV_0 - CF}{MV_0 + \sum_{i=1}^{n} w_i \times CF_i} \quad \text{eq. 2}$$

Where:

- MV_1 is the end of year market value of the portfolio of all shares held by insiders in the *i'th* firm. Computed as the number of shares held by all insiders at the end of the year multiplied by the closing stock price of the year.
- MV_0 is the beginning of year market value of the portfolio of all shares held by insiders in the *i'th* firm. Computed as the number of shares held by all insiders at the beginning of the year multiplied by the opening stock price of the year.
- CF is the net external inflows over year *t* made by insiders of the *i'th* firm. It is computed as total dollars spent on purchases minus the total dollars received from sales (Note contributions to portfolio are positive inflows and withdrawals form portfolio are negative flows)
- $\sum_{i=1}^{n} w_i \times CF_i$ is the sum each cash flow multiplied by its weight:
    - $w_i = \frac{CD - D_i}{CD}$ eq.3
    - CD is the number of calendar days during the return period being calculated (we use 365)

- D_i is the number of days from the start of the return period until the day on which the flow CF_i occurred. For example, if a purchase occurs on January 31 then it is 31 days, if on February 2nd then it is 33 days.

The above return, $InsiderRet_{i,t}$ is the Modified Dietz (see Dietz 1966) return and is an approximation of the IRR (the true dollar weighted return)[12]. The modified Dietz return has the advantage of having a closed form solution versus the IRR which requires numerical methods. Our choice of the Modified Dietz over the IRR is motivated by following reasons. First when computing the IRRs we had a convergence rate of about 70% thus we lose a significant amount of data. Secondly, in most cases we have more than one IRR due to the sign switches in the cash flows. In such cases the SAS IRR function reports one IRR and we are not sure which of the IRRs is reported. Even if we knew all the IRRs it is not sure which one of then we would use. This issue is exacerbated the more trades we have and/or the longer the period over which the IRR is computed. Finally, computing the "true" IRR requires that we have the correct initial value of an insider's portfolio but TFN begins in 1986 thus for some insiders we do not have their actual initial portfolio value. But with the Modified Dietz we need the beginning and ending value of the portfolio over the period for which we are computing the return.

A potential issue with the Modified Dietz return ($InsiderRet_{i,t}$) in this study is that some of the shares held in the insiders' portfolio may have resulted from other sources than open market purchases especially from the exercise of options. To control

[12] The Modified Dietz return assumes simple rate of interest and approximates the IRR which uses compounding principle. If the cash flows and rates of return are large enough, Modified Dietz would yield significantly different returns compared to the IRR.

for this we ignore sales that are related to the exercise of an option[13]. This may just take care of cases where the options are sold immediately and may not capture options that are exercised and sold at a later date (either because the insider has some insider information or the shares are held for some mechanical reason). We argue that such transactions will not bias the results in this study. First if the insider holds on to the shares because they have some inside information then they are making a conscious decision to increase their insider trading return. Secondly if they hold the shares for some mechanical reason we posit that such transactions are timing neutral and while they may add noise to results they will not bias the results. Finally, the number of such transactions should be small as Ofek and Yermack (2000) estimate that when executives exercise options to acquire stock, they keep almost none of the shares (see page 1376). Similarly Huddart, and Lang (1996) hold that while their data doesn't detail the ultimate disposition of options in their sample, the authors' discussions with the data providers suggests that employees do not keep the shares acquired on exercise (page 19).

Jeng, Metrick and Zeckhauser (2003) attempt to measure insiders actual return by creating a purchase (sale) value-weighted portfolio of all insiders for the duration of 6 months since the purchase (sale). However, they do not exactly measure what insiders earn for several reasons: they only measure returns over a holding of 6 months, and they do not account for subsequent trades that insiders may execute.

3.3. Control Variables

[13] TFN has a variable called optionSell which dentifies a sale that is related to the exercise of options. Possible values include all (A), partial (P), none (N), or blank. We want open market sale of shares that were purchased for their account and not those that arose from option grants so we keep (N) and ignore (A) and (P) and Blanks

In addition to insider trading data we collect a set of control variables used by Piotroski and Roulstone (2005) to explain insider purchasing activity. This allows us to compare our results to previous studies (e.g. Rozeff and Zaman 1988, and Sias and Whidbee 2010). We require securities to have Piotroski and Roulstone (2005) variables to be included in our sample. The following control variables are used in the study

- Measurements of future firm performance:
    - $GoodRet_{(t+1)}$: Is an indicator variable equal to 1 if the stock's next year's market adjusted return ($MaRet_{(t+1)}$) is greater than zero else equal to zero. This is a measure of the firm's future performance and measures the insiders' potential gain from trading the firm's stock as opposed to the market portfolio. To the extent that insiders have superior knowledge about information influencing future returns, it should be positively related to insider purchases. Stock return data are from CRSP.
    - $GoodRoA_{(t+1)}$: Is an indicator variable equal to one if next year's change in ROA ($\Delta ROA_{(t+1)}$) is greater than zero else equals to zero. This is also a measure of the firm's future performance (next year's earnings innovations) and it is expected to be positively related to insider purchases. Where $\Delta ROA_{(t+1)}$ is the next year's first difference in Return-on-Assets ($ROA_{(t+1)}$ - $ROA_{(t)}$) and ROA is COMPUSTAT's Income before Extraordinary items (IB) scaled by COMPUSTAT's total assets (AT)
    - $GoodRoA_{(t)}$: Is an indicator variable equal to one if the current year's change in ROA ($\Delta ROA_{(t)}$) is greater than zero else equals to zero.

- Measurements of undervaluation :
    - *$BM1_t$ to $BM4_t$:* Is an indicator variable equal to 1 if the book-to-market (BM) ratio is in the *i'th* quintile of year *t's* BM distribution (e.g. BM1=glamour firms). Where the BM is measured as the firm's book value of shareholders equity (COMPUSTAT's CEQ) at the end of year scaled by the market value of equity at the end of year *t* (COMPUSTAT's CSHO multiplied by the stock's closing stock price at the end of year from CRSP).
    - *HRet and Mret:* Is an indicator variable equal to 1 if market adjusted stock return is in the high trecile and middle trecile respectively of year *t's* distribution of realized market adjusted returns.

Table three presents descriptive statistics of the variables used in this study pooled over all firm-year observations. Although our sample is longer than Piotroski and Roulstone (2005) and Sias and Whidbee (2010) the descriptive statistics are close. The last six rows in table three report descriptive statistics of the insider trading returns for all insiders, directors only and officers only. From table three officers' returns are on average bigger than those of directors. Also about 59% of the time insiders have losses.

4. Results and Discussion

In this section we examine the impact of insider trading returns on open market purchasing activity. In the empirical framework, we examine gains and losses separately

to allow for the possibility of an asymmetric response, which might obtain if insiders exhibit loss aversion. We start the analysis by examining the relation between insiders purchase ratios ($PR_{i,t}$) and insider trading returns ($InsiderRet_{i,t}$). Next, given that the board of directors is a governing body and meets periodically it follows that officers are more likely to have superior and timely information about the firm's future performance. We test for equality of loss aversion across directors and officers. Finally, we examine the relationship between insider trading returns and the decision to conduct open market purchases.

4.1. The Relation between Insider Purchase Ratios and Insider Returns - All insiders

To test whether there is a relation between insider purchase ratios and insider returns we utilize the methodology in Piotroski and Roulstone (2005) and augment their variables with our insider trading returns variable ($InsiderRet_{i,t}$). Rozeff and Zaman (1988), and Sias and Whidbee (2010) utilize a similar methodology. We restrict transactions to open market transactions and do not include firm-years where insiders do not engage in open market transaction. Specifically, we estimate coefficients annually from the following cross-sectional model:

$$PR_{i,t} = \alpha + \beta_1 GoodRET_{i,t+1} + \beta_2 GoodROA_{i,t+1} + \beta_3 GoodROA_{i,t} + \beta_4 BM1_{i,t} + \beta_5 BM2_{i,t} + \beta_6 BM3_{i,t} + \beta_7 BM4_{i,t} + \beta_8 HRET_{i,t} + \beta_9 MRET_{i,t} + \beta_{10} InsiderRet_{i,t} + \varepsilon_{i,t} \quad \text{eq.4}$$

To control for cross-sectional dependencies, the model is estimated annually and the average annual coefficients are tested against the null of zero using standard errors from the empirically derived distribution of the annual coefficients. Average coefficients

are presented in panel A of table four. For robustness we estimate fixed effects regression (with firm fixed effects and year effects) in panel B.

To test for insider loss aversion we estimate equation 5 by augmenting equation 4 with two variables: (1) $LossDummy_{i,t}$, an indicator which equals one if $InsiderRet_{i,t}$ is negative and zero if positive; and (2) an interaction variable $InsiderRet_{i,t} \times LossDummyi,t$:

$$PR_{i,t} = \alpha + \beta_1 GoodRET_{i,t+1} + \beta_2 GoodROA_{i,t+1} + \beta_3 GoodROA_{i,t} + \beta_4 BM1_{i,t} + \beta_5 BM2_{i,t} + \beta_6 BM3_{i,t} + \beta_7 BM4_{i,t} + \beta_8 HRET_{i,t} + \beta_9 MRET_{i,t} + \beta_{10} InsiderRet_{i,t} + \beta_{11} LossDummy_{i,t} + \beta_{12}(InsiderRet_{i,t} \times LossDummy_{i,t}) + \varepsilon_{i,t} \quad \text{eq.5}$$

If insiders are more sensitive to prior losses than prior gains when conducting open market purchases then, the coefficient on $InsiderRet_{i,t} \times LossDummy_{i,t}$, β_{12} will be positive and significant[14]. Just as with equation 4, this model is estimated annually and the average annual coefficients are tested against the null of zero using standard errors from the empirically derived distribution of the annual coefficients. Average coefficients are presented in panel A of table four. For robustness we estimate fixed effects regression (with firm fixed effects and year effects) in panel B.

Table four shows that the prior determinants of insider purchases have their expected signs and are statistically significant at an alpha level of 1% but

[14] The regression model presented in equation 5 is a piecewise linear model since holding all other variables constant, the coefficient on $InsiderRet_{i,t}$ captures the slope in the region of positive insider returns (gains) while the coefficient on the interaction term $InsiderRet_{i,t} \times LossDummy_{i,t}$ plus that of $InsiderRet_{i,t}$ is the slope in the region of negative insider returns (losses). Hence the coefficient on $InsiderRet_{i,t} \times LossDummy_{i,t}$ is a kink at the origin and if positive results in a steeper slope in the domain of losses. However, the coefficient on $LossDummy_{i,t}$ captures a discontinuity at the origin or kink and we do not provide an economic interpretation of that parameter.

for $GoodROA_{i,t}$. Insider purchase ratios are positively related to the firm's future performance measures ($GoodRET_{i,t+1}$, and $GoodRoA_{i,t+1}$) thus suggesting insiders have superior knowledge about information influencing future returns and earnings innovations and take advantage of it. Also insiders tend to purchase shares when the firm's shares are undervalued as there is (1) a negative relationship between insider purchase ratios and the book-to-market quintiles and the magnitude of the book-to-market quintiles decrease monotonically as we move from high book-to-market quintiles to lower quintiles. (2) there is also a negative relationship between insider purchase ratios and the market-adjusted stock return treciles and the magnitude of the coefficients also decreases monotonically as we move from the high trecile to the medium trecile.

The second models in both panels of table four documents a positive relationship between insider purchase ratios and insider returns. This would suggest that insiders purchase more of their firm's shares if they have positive experiences from insider trading. The third models in both panels of table four shows that conditioning on losses; an increase in insider trading losses is associated with decreased insider purchases. On the other hand, given gains from insider trading, an increase in gains has no significant effect on insider purchase ratios. Taken together the results suggests that insider trading returns are positively related to the intensity of insider purchases, this effect seems to be primarily driven by negative insider trading returns and suggest that insiders are loss averse.

4.2. The Relation between Insider Purchase Ratios and Insider Returns – Officers versus Directors

The previous analysis combines officers and directors and implicitly assumes that officers and directors have access to similar information. Given that the board of directors is a monitoring body and meet periodically it is possible that officers have access to better performance related information and in a timelier manner than directors. Piotroski and Roulstone (2005) provide evidence confirming this by documenting that the magnitude of the coefficient on $GoodROA_{i,t+1}$is larger in magnitude for executives than directors. In the same vein, Enrichetta and Sapienza (2010) compare the returns to insider purchases (sales) of executives to that of independent directors to examine whether directors are informed of the firm. The authors find while both executives and independent directors in the same firm earn positive substantial abnormal returns, executives have slightly higher returns.

Thus in this section, we test which of the two groups of insiders (directors or officers) are more loss averse. Since officers are likely to have timelier information and presumably better quality information than directors one could expect directors to be more loss averse. On the other hand, officers could be more loss averse if they suffer from myopic loss aversion a la Bernatzi and Thaler (1995). Myopic loss aversion occurs when an investor computes gains and losses at more frequent intervals. Given that officers spend more time at the firm and are privy to information in a timelier manner they could suffer from myopic loss aversion if this causes them to trade more frequently than directors who meet periodically. Thus which group of insiders is more loss averse is an empirical issue that we address by re-estimating equation 5 for directors-only and officers-only and comparing the coefficients on $InsiderRet_{i,t} \times LossDummy_{i,t}$, in table five.

Models three and four of panels A and B of table five has the results for officers-only and directors-only respectively. The analysis shows that both groups are loss averse however loss aversion is more pronounced with the directors compared to officers. For example, panel A has a coefficient estimate of 0.0079 on $InsiderRet_{i,t} \times LossDummy_{i,t}$ for the officer-only sample versus 0.0107 for the director-only sample and the difference is statistically significant at an alpha level of 1%.

4.3. The Relation between Insider Returns and the Decision to Purchase

The previous sections established a relationship between insider returns and the level of insider purchases (insiders purchase ratios). We did not include firm-years where insiders did not engage in open market transactions thus the results thus far are predicated on insiders deciding to purchase. As a result, omission of no-trade firm-years ignores potential useful information about the decision to purchase. In this section we examine the relationship between insider trading returns and the decision to conduct open market purchases with the following conditional firm fixed effects logit model with year effects:

$$P(Purchase_{i,t} = 1 \big| X_{i,t}, c_{i.t}) =$$

$$\beta_1 GoodRET_{i,t+1} + \beta_2 GoodROA_{i,t+1} + \beta_3 GoodROA_{i,t} + \beta_4 BM1_{i,t} + \beta_5 BM2_{i,t} +$$

$$\beta_6 BM3_{i,t} + \beta_7 BM4_{i,t} + \beta_8 HRET_{i,t} + \beta_9 MRET_{i,t} + \beta_{10} InsiderRet_{i,t} +$$

$$\beta_{11} LossDummy_{i,t} + \beta_{12}(InsiderRet_{i,t} \times LossDummy_{i,t}) + yearEffects \qquad \text{eq.6}$$

The dependent variable, $Purchase_{i,t}$ is an indicator variable that equals one if shares are purchased in year *t* else it is equal to zero. The results of the logit analysis are in table six and are consistent with the findings in the preceding sections. The prior determinants of insider purchases have their expected signs and are statistically

significant at an alpha level of 1% but for $GoodROA_{i,t}$. The decision to purchase shares is positively related to the firm's future performance measures ($GoodRET_{i,t+1}$, and $GoodRoA_{i,t+1}$). Also, insiders tend to purchase shares when the firm's shares are undervalued as there is as there is a negative relationship between the decision to purchase shares and (1) the book-to-market quintiles and (2) the market-adjusted stock return treciles.

The second model in table six documents a positive relationship between the decision to purchase shares and insider returns. Thus suggesting that insiders tend to purchase their firm's shares when they have positive experiences from insider trading. The third model of table six shows that conditioning on losses; an increase in insider trading losses is associated with lower probability of insider purchasing. Likewise, given gains from insider trading, an increase in gains is also associated with a higher probability of purchasing. However there is still evidence of loss aversion as the decision to purchase is more sensitive to insider losses compared to gains.

5. Implication: The Economic Impact of Loss Aversion

In the preceding section we document that insider returns are positively related to insider purchasing activity and that insiders are loss averse. In this section we examine the economic impact of insider loss aversion, specifically if loss aversion benefits or hurts insider wealth. We use two approaches. The first approach is to identify a subsample of insiders who have losses and are predicted not to purchase due to loss aversion. Then we spilt this subsample into a group that acts upon their loss aversion by not purchasing and

a second group that are supposedly loss averse but decide to ignore their loss aversion by actually purchasing. Then we compare the returns of both groups. The second approach uses a mixed logistic model to get firm specific loss aversion coefficients and forming quartiles based on these coefficients to test the market timing ability.

5.1. Being Loss Averse and Acting upon it versus Being Loss Averse and ignoring it

In this section we examine the economic impact of loss aversion on the wealth of insiders by:

- Step 1: First identify a subsample of insiders who have losses and are predicted not to purchase due to loss aversion.
- Step 2: Split this subsample into a group that acts upon their loss aversion by not purchasing and a second group that are supposedly loss averse but decide to ignore their loss aversion by purchasing.
- Step 3: compare the returns of both groups

To identify a subsample of insiders who have losses and are predicted not to purchase due to loss aversion, we estimate two specifications of the the logit model in equation 6 as follows:

$$P(Purchase_{i,t} = 1 | X_{i,t}, c_{i.t}) =$$

$$\beta_1 GoodRET_{i,t+1} + \beta_2 GoodROA_{i,t+1} + \beta_3 GoodROA_{i,t} + \beta_4 BM1_{i,t} + \beta_5 BM2_{i,t} +$$

$$\beta_6 BM3_{i,t} + \beta_7 BM4_{i,t} + \beta_8 HRET_{i,t} + \beta_9 MRET_{i,t} + yearEffects \quad \text{eq.7}$$

$$P(Purchase_{i,t} = 1 | X_{i,t}, c_{i.t}) =$$

$$\beta_1 GoodRET_{i,t+1} + \beta_2 GoodROA_{i,t+1} + \beta_3 GoodROA_{i,t} + \beta_4 BM1_{i,t} + \beta_5 BM2_{i,t} +$$

$$\beta_6 BM3_{i,t} + \beta_7 BM4_{i,t} + \beta_8 HRET_{i,t} + \beta_9 MRET_{i,t} + \beta_{10} InsiderRet_{i,t} +$$

$$\beta_{11} LossDummy_{i,t} + \beta_{12}(InsiderRet_{i,t} \times LossDummy_{i,t}) + yearEffects \quad \text{eq.8}$$

In equation 7 we estimate the probability of purchasing without controlling for insider returns and loss aversion and save the predicted probabilities of purchasing. Next in equation 8 we augment equation 7 by controlling for insider returns and loss aversion and save the predicted probabilities of purchasing. Next we keep firm year observations with: (1) losses, (2) whose probability of purchasing decreases once we control for loss aversion in equation 8 and (3) they are predicted not to purchase[15]. We argue that the reason these observations have a decreased probability of purchasing and are predicted not to purchase is because they have losses and are loss averse. This results in 8,730 firm-year observations. Then we split this subsample into two groups (1) one group that actually does not purchase which results in 3,720 firm year observations (2) a second group that actually purchases which results in 5,010 firm year observations. The idea is that both groups are loss averse and are predicted not to purchase due to their loss aversion but one group actually acts upon their loss aversion by actually not purchasing and the other group despite being loss averse and predicted not to purchase ignores the loss aversion by actually purchasing. Next we compare the mean insider trading returns and next year's market adjusted stock return for both groups; the results are in table 7.

Table 7 shows that both groups have insider trading losses but those that act upon their loss aversion are worse off (mean $InsiderRet_t$ of -10.0501% versus -6.7995%). The key finding is with next year's mean market-adjusted stock return

[15] The cut off probability of purchasing used is 0.69 which represents the unconditional probability of purchasing since 33,983 firm-year observations have purchases out of 49,159.

($MktAdjStockRet_{t+1}$). Piotroski and Roulstone (2005) hold next year's market adjusted stock return is a measure of the firm's future performance and measures insiders' potential gain from trading the firm's stock as opposed to the market portfolio. Thus having inside information about poor future stock performance and acting on loss aversion by not purchasing the firm's stock today helps such insiders to avoid an average loss of 5.7% over the next year. On the other hand, having inside information about good future stock performance and ignoring to act upon loss aversion by actually purchasing the firm's stock today despite insider trading losses helps insider to earn an average of 8.14% the following year. This finding also confirms the existing literature that insiders have superior knowledge about their firm's future prospect since acting upon loss aversion when the firms future prospects are less favorable helps insiders avoid a loss and ignoring loss aversion in situations of losses but favorable future prospects helps insiders.

5.2. Firm Specific Loss Aversion Coefficients and Insider Market Timing Ability

Another approach we use to access the economic impact of insider loss aversion is to:

- use the following mixed logistic model to get firm specific coefficients of sensitivity to losses from insider trading:

$$P(Purchase_{i,t} = 1 \big| X_{i,t}, c_{i.t}) = \beta_1 GoodRET_{i,t+1} + \beta_2 GoodROA_{i,t+1} + \beta_3 GoodROA_{i,t} + \beta_4 BM1_{i,t} + \beta_5 BM2_{i,t} + \beta_6 BM3_{i,t} + \beta_7 BM4_{i,t} + \beta_8 HRET_{i,t} + \beta_9 MRET_{i,t} + \beta_{10} InsiderRet_{i,t} + \beta_{11} LossDummy_{i,t} + (\beta_{12} + \gamma_i)(InsiderRet_{i,t} \times LossDummy_{i,t}) + yearEffects\ , \quad \text{eq.9}$$

Where β_{12} is the average effect of losses which is the same for all firms and γ_i is the effect of losses that is unique to the *i'th* firm. Thus $(\beta_{12} + \gamma_i)$ is the *i'th* firm's sensitivity to past losses; if positive this is consistent with loss aversion and if negative it is consistent with risk seeking.

- For each firm year observation we take the difference between that year's dollar weighted return (we use $InsiderRet_{i,t}$ is our proxy) and time weighted return (we use that year's stock return). If insiders are good at timing then this difference is expected to be positive and negative if they exhibit poor timing
- Then we form quartiles based on the loss sensitivities[16]generate by the mixed model and get the mean of the difference between $InsiderRet_{i,t}$ and $AnnualRet_{i,t}$ in each quartile. The first quartile has the least loss averse insiders and the forth quartile has the most loss averse. If loss aversion is costly then we expect the average difference between $InsiderRet_{i,t}$ and $AnnualRet_{i,t}$ in the fourth quartile to be negative and that of the first quartile to be positive.

Table eight presents the results of the average difference between $InsiderRet_{i,t}$ and $AnnualRet_{i,t}$ across all four quartile. The results show that the most loss averse insiders on average tend to exhibit poor timing thus suggesting that loss aversion can be costly.

To reconcile the findings in this subsection with that of the preceding subsection, the results from this subsection suggests that at high levels, loss aversion can destroy wealth. However, the finding in the preceding subsection suggests that loss aversion can

[16] 500 out of 7,900 have negative loss coefficient thus are not loss averse but are risk seeking. These 500 firms are not included in the analysis

help insiders avoid future losses if they have information about looming unfavorable prospects with their firms.

6. Conclusion

There is an extant literature documenting that insiders earn abnormal returns (e.g. Lorie and Niederhoffer 1968, Seyhun 1986, Rozeff and Zaman 1988, Lakonishok and Lee 2001, and Jeng, Metrick and Zeckhauser) which can be attributed to insiders' ability to recognize if their firm's stock is mispriced and also because they are privy to superior information about their firm's future performance. Despite these advantages, insider trading is still a risky proposition first because insiders stand to lose wealth if their opinion about the intrinsic value of the firm turns out to be wrong. Also insiders tend to have a significant amount of their wealth invested in their firm (both financial and human capital) and by purchasing additional shares they are de-diversifying their wealth and foregoing liquidity.

We hypothesize that in addition to being influenced by the perceived misvaluation of their firm's securities and having superior information about their firm's future prospects, open market purchases by insiders may also be influenced by gains and losses on their existing portfolio of shares held (which would capture the outcome of their past open market transactions). This is consistent with research demonstrating that in a variety of contexts decisions under uncertainty can be substantially affected by the outcomes of past decisions (see for example, Thaler 1980; Staw 1981; Arkes and Blumer 1985). Thaler and Johnson (1990) investigate how prior gains and losses affect risk

taking behavior and find based on experimental data from Cornell undergraduate and MBA students an increased willingness to take risk after prior gains, which they refer to as the “house money effect”. However, after experiencing a prior loss, individuals showed increased loss aversion and reduced willingness to take risk.

We begin the empirical work by calculating at the firm-level insider trading returns, and examining their impact on open market purchasing activity. In this empirical work, we examine gains and losses separately to allow for the possibility of an asymmetric response, which might obtain if insiders exhibit loss aversion (Johnson and Thaler, 1990).

We find insider trading returns to be positively related to insider purchase ratios even after controlling for variables previously shown to affect purchasing activity. However, this effect seems to be primarily driven by negative insider trading returns as conditioning on losses; an increase in insider trading losses is associated with decreased insider purchases while given gains from insider trading, an increase in gains has no significant effect on insider purchase ratios. Thus suggesting that insider loss aversion plays a role when insiders conduct open market purchases. We also find that loss aversion is more pronounced with the directors compared to officers.

Finally we examine the economic impact of insider loss aversion by identify a subsample of insiders who have losses and are predicted not to purchase due to loss aversion. Then we spilt this subsample into a group that acts upon their loss aversion by not purchasing and a second group that are predicted to be loss averse but decide to ignore their loss aversion by actually purchasing. Then we compare the returns of both

groups. We find that having inside information about poor future stock performance and acting on loss aversion by not purchasing the firm's stock today helps such insiders to avoid an average loss of 5.7% over the next year. On the other hand, having inside information about good future stock performance and ignoring to act upon loss aversion by actually purchasing the firm's stock today despite insider trading losses helps insiders to earn an average of 8.14% the following year. This confirms the existing literature that insiders have superior knowledge about their firm's future prospect since acting upon loss aversion when the firms future prospects are less favorable helps insiders avoid a loss and ignoring loss aversion in situations of losses but favorable future prospects helps insiders enhance their wealth.

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Table 1
Descriptive Statistic by Transaction Type
This table reports descriptive statistics on the number of shares purchased, the number of shares sold, purchase transaction value, sales transaction value and the resulting number of shares held after a transaction.

Variable	*Mean*	*Std*	*5%*	*25%*	*50%*	*75%*	*99%*
# Shares Purchased	19,701	1,295,999	32	300	1,000	4,000	25,000
# Shares Sold	16,650	578,835	55	200	800	3,800	30,000
Purchase Transaction Value	$140,131	$5,634,479	$320	$2,595	$9,500	$32,000	$228,750
Sale Transaction Value	$469,564	$21,072,430	$1,428	$6,275	$22,345	$92,951	$851,840
Resulting Shares Held	2,290,197	69,945,542	612	7,776	43,227	295,000	3,821,240

Table 2
Distribution and Frequency of Transactions
This table provides the distribution and frequencies of insider transactions at the individual level. Panel A has the number of insiders with zero, 1, 2, 3 to 5, 6 to 10, 11 to 20 and more than 21 purchase and sales transaction along with their corresponding percentages. Panel B has the minimum number of transactions made by an insider, with the maximum, mean, 5th percentile, 25th percentile, median, 75th percentile and 99th percentile.

Panel A: Number of Transactions - Frequency

Variable	*Purchase Transactions*		*Sale Transactions*	
	Number of Insiders	*% of Insiders*	*Number of Insiders*	*% of Insiders*
Zero Transactions	44,514	36%	56,240	45%
1 Transaction	31,512	25%	19,919	16%
2 Transactions	13,891	11%	10,207	8%
3 to 5 Transactions	16,622	13%	13,949	11%
6 to 10 Transactions	8,966	7%	8,910	7%
11 to 20 Transactions$_1$	4,936	4%	6,510	5%
More than 21 Transactions	3,568	3%	8,274	7%

Panel B: Number of Transactions – Descriptive Statistics

Variable	*Min*	*Max*	*Mean*	*5%*	*25%*	*50%*	*75%*	*99%*
Individual Purchases	0	2,770	4	0	0	1	3	14
Individual Sales	0	48,889	10	0	0	1	4	17

Table 3
Summary Statistics

This table provides summary statistics for variables used in the study. The sample period is 1986-2012. *PR_All Insiders*$_t$ is the purchase ratio of all insiders (directors and officers) in year *t*, computed as the number of shares purchased by all insiders divided by the number of shares purchased and sold by all insiders. *PR_Officers*$_t$ and *PR_Directors*$_t$ are the purchases ratios for officers-only and directors only respectively in year *t*. BM_t is the book-to-market ratio in year *t* defined as the book value of equity (COMPUSTAT: CEQ) scaled by MVE_t. MVE_t is the market value of equity at the end of year *t* defined as common shares outstanding at the end of year *t* multiplied by the closing stock price of the year (COMPUSTAT: CSHO multiplied by the stock's closing stock price at the end of year from CRSP). $MARet_{(t+1)}$ is next year's market-adjusted stock return measured as the firm's 12-month cumulative return in year *t+1* minus the corresponding12-month return on the valued weighted index. $ROA_{(t+1)}$ is the return on asset for year *t+1* measured as income before extraordinary items (COMPUSTAT: IB) scaled by total assets (COMPUSTAT: AT). $\Delta ROA_{(t+1)}$ is next year's first difference in ROA measures as ROA in year *t+1* minus ROA in year *t*. $InsiderRet_t$ is the Modified Dietz return on the portfolio of the firm's shares held by all insiders (director and officers) computed over year *t*; it is our measure of insider trading returns. *Insider-lossDummy*$_t$ is an indicator which equals one if $InsiderRet_t$ is negative and zero if positive. $DirectorsRet_t$ and $OfficersRet_t$ are the insider returns for directors-only and officers-only. *Directors-lossDummy*$_t$ and *Officers-lossDummy*$_t$ are indicator variables if $DirectorsRet_t$ and $OfficersRet_t$ are respectively negative and zero if positive.

Variable	Mean	Std	5%	25%	50%	75%	95%
PR_All Insiders$_t$	0.462	0.452	0.000	0.000	0.296	1.000	1.000
PR_Officers$_t$	0.433	0.470	0.000	0.000	0.087	1.000	1.000
PR_Directors$_t$	0.523	0.468	0.000	0.000	0.613	1.000	1.000
BM_t	0.637	3.785	0.063	0.279	0.502	0.815	1.790
MVE_t	2,752	310,303	11.5	65.9	261.1	1,048.6	9,593.1
$MARet_{(t+1)}$	0.065	0.983	-0.740	-0.326	-0.053	0.242	1.116
$ROA_{(t+1)}$	-0.058	0.929	-0.515	-0.019	0.018	0.063	0.148
$\Delta ROA_{(t+1)}$	-0.021	0.926	-0.262	-0.029	0.000	0.019	0.203

InsiderRet$_t$	0.112	1.980	-0.996	-0.090	-0.028	0.089	1.613
Insider - lossDummy$_t$	0.587	0.492	0.000	0.000	1.000	1.000	1.000
DirectorsRet$_t$	0.086	1.431	-0.577	-0.083	-0.018	0.053	1.039
Directors - lossDummy$_t$	0.578	0.494	0.000	0.000	1.000	1.000	1.000
OfficersRet$_t$	0.107	1.566	-0.713	-0.079	-0.012	0.067	1.234
Officers - lossDummy$_t$	0.557	0.497	0.000	0.000	1.000	1.000	1.000

Table 4
The Impact of Insider Returns on the Purchase Ratios

This table presents multivariate regressions to assess the relation between insider trading returns and purchase ratios. The dependent variable is PR_t is the purchase ratio of all insiders (directors and officers) in year *t*, computed as the number of shares purchased by all insiders divided by the number of shares purchased and sold by all insiders. Panel A uses Fama-MacBeth regressions where the model is estimated annually and the average annual coefficients are tested against the null of zero using standard errors from the empirically derived distribution of the annual coefficients. Average coefficients are presented in panel A. Panel B employs fixed effects regressions with firm and year effects. $GoodRet_{(t+1)}$ is an indicator variable equal to 1 if the stock's next year's market adjusted return is greater than zero else equal to zero. $GoodRoA_{(t+1)}$ is an indicator variable equal to one if next year's change in ROA is greater than zero else equals to zero. $GoodRoA_t$ is an indicator variable equal to one if the current year's change in ROA is greater than zero else equals to zero. $BM1_t$ *to* $BM4_t$ is an indicator variable equal to 1 if the book-to-market ratio is in the *i'th* quintile of year *t's* book-to-market distribution. $HRet_t$ and $Mret_t$ is an indicator variable equal to 1 if the market adjusted stock return is in the high trecile and middle trecile respectively of year *t's* distribution of realized market adjusted returns. $InsiderRet_t$ is the Modified Dietz return on the portfolio of the firm's shares held by all insiders (director and officers) computed over year *t*; it is our measure of insider trading returns. $LossDummy_t$ is an indicator which equals one if $InsiderRet_t$ is negative and zero if positive. $(InsiderRet\ X\ Loss)_t$ is an interaction variable between $InsiderRet_t$ and $LossDummy_t$. The sample period is 1986-2012 and the insider trading returns variable, $InsiderRet_t$ is winsorized at 1% on each tail. ***, ** and * denote statistical significance at 1%, 5% and 10% respectively.

Panel A: Fama-MacBeth Regressions

Hypotheses	Variables	Dependent variable = PR_t		
		[1]	[2]	[3]
	Intercept	0.6383***	0.6005***	0.6143***
Superior Information	$GoodRet_{(t+1)}$ *(+)*	0.0056	0.012	0.0032
	$GoodRoA_{(t+1)}$ *(+)*	0.0320***	0.0366**	0.0330***
	$GoodRoA_t$ *(+)*	-0.0114	-0.014	-0.0066
Undervaluation	$BM1_t$ *(-)*	-0.2620***	-0.2289***	-0.2764***

	$BM2_t$ (-)	-0.2681***	-0.2560***	-0.2790***
	$BM3_t$ (-)	-0.1911***	-0.1446***	-0.1978***
	BM4t (-)	-0.1014***	-0.0665	-0.1196***
	$HRet_t$ (-)	-0.0775***	-0.0864***	-0.0655***
	$MRet_t$ (-)	-0.0539***	-0.0424**	-0.0505***
	$InsiderRet_t$		0.0021***	0.0002
	LossDummy			0.0248**
Loss Aversion	*$(InsiderRet\ X\ Loss)_t$*			0.0054***

Panel B: Firm Fixed Effects Regressions

Hypotheses	Variables	Dependent variable = PR_t		
		[1]	[2]	[3]
Superior Information	*Intercept*	0.0367***	0.0358***	0.0352***
	$GoodRet_{(t+1)}$ (+)	0.0386***	0.0384***	0.0400***
	$GoodRoA_{(t+1)}$ (+)	0.0005	0.0002	0.0012
Undervaluation	*$GoodRoA_t$ (+)*	-0.2716***	-0.2768***	-0.2682***
	$BM1_t$ (-)	-0.2249***	-0.2294***	-0.2239***
	$BM2_t$ (-)	-0.1539***	-0.1550***	-0.1520***
	$BM3_t$ (-)	-0.0805***	-0.0806***	-0.0793***
	BM4t (-)	-0.0497***	-0.0520***	-0.0395***
	$HRet_t$ (-)	-0.0363***	-0.0377***	-0.0331***
	$MRet_t$ (-)		0.0012***	-0.0002
	$InsiderRet_t$			0.0247***
Loss Aversion	*$(InsiderRet\ X\ Loss)_t$*			0.0044***
Firm effects		Included	Included	Included
Year effects		Included	Included	Included

Table 5
The Relation between Insider Purchase Ratios and Insider Returns – Officers versus Directors

This table presents multivariate regressions to compare the loss aversion of directors versus officers with respect to purchase ratios. The dependent variable is PR_t is the purchase ratio of officers-only in models 1 and 3; and directors-only in models 2 and 4 in year *t*,. Panel A uses Fama-MacBeth regressions where the model is estimated annually and the average annual coefficients are tested against the null of zero using standard errors from the empirically derived distribution of the annual coefficients. Average coefficients are presented in panel A. Panel B employs fixed effects regressions with firm and year effects. $GoodRet_{(t+1)}$ is an indicator variable equal to 1 if the stock's next year's market adjusted return is greater than zero else equal to zero. $GoodRoA_{(t+1)}$ is an indicator variable equal to one if next year's change in ROA is greater than zero else equals to zero. $GoodRoA_t$ is an indicator variable equal to one if the current year's change in ROA is greater than zero else equals to zero. $BM1_t$ *to* $BM4_t$ is an indicator variable equal to 1 if the book-to-market ratio is in the *i'th* quintile of year *t's* book-to-market distribution. $HRet_t$ and $Mret_t$ is an indicator variable equal to 1 if the market adjusted stock return is in the high trecile and middle trecile respectively of year *t's* distribution of realized market adjusted returns. $OfficersRet_t$ and $DirectorRet_t$ are the Modified Dietz returns on the portfolio of the firm's shares held by officers-only and directors only respectively computed over year *t*; they are our measures of officer-only and director only trading returns respectively. $OfficersLossDummy_t$ and $DirectorsLossDummy_t$ are indicators which equals one if $OfficersRet_t$ and $DirectorsRet_t$ are negative and zero if positive, respectively. $(OfficersRet\ X\ Loss)_t$ .and $(DirectorRet\ X\ Loss)_t$ are interaction variables between $OfficersRet_t$ and $OfficersLossDummy_t$; and $DirectorsRet_t$ and $DirectorsLossDummy_t$ respectively The sample period is 1986-2012. $OfficersRet_t$, and $DirectorsRet_t$ are winsorized at 1% on each tail. ***, ** and * denote statistical significance at 1%, 5% and 10% respectively.

Panel A: Fama-MacBeth Regressions

Hypotheses	Variables	Dependent variable = PR_t			
		[1]	[2]	[3]	[4]
	Intercept	0.6375***	0.6732***	0.6300***	0.6485***
Superior Information	$GoodRet_{(t+1)}$ *(+)*	-0.0029	0.0081238	-0.0044	0.0074274

	GoodRoA$_{(t+1)}$ (+)	0.0354***	0.0222***	0.0362***	0.0247***
	GoodRoA$_t$ (+)	-0.0117	-0.0136258	-0.0098	-0.0125439
	BM1$_t$ (-)	-0.3291***	-0.2494***	-0.3182***	-0.2377***
Undervaluation	*BM2$_t$ (-)*	-0.3276***	-0.2567***	-0.3189***	-0.2478***
	BM3$_t$ (-)	-0.2443***	-0.1584***	-0.2404***	-0.1540***
	BM4t (-)	-0.1389***	-0.0987***	-0.1370***	-0.0976***
	HRet$_t$ (-)	-0.0736***	-0.0898***	-0.0582***	-0.0618***
	MRet$_t$ (-)	-0.0657***	-0.0447**	-0.0592***	-0.0328v*
Loss Aversion	*OfficersRet$_t$*	0.0022***		0.0002	
	OfficersLossDummy$_t$			0.0277***	
	(OfficersRet X Loss)$_t$			0.0079***	
	DirectorsRet$_t$		0.0022***		-0.0007***
	DirectorsLossDummy$_t$				0.0541***
	(DirectorsRet X Loss)$_t$				0.0107***

Panel B: Firm Fixed Effects Regressions

Hypotheses	Variables	Dependent variable = *PR$_t$*			
		[1]	[2]	[3]	[4]
Superior Information	*GoodRet$_{(t+1)}$ (+)*	0.0329***	0.0313***	0.0318***	0.0304***
	GoodRoA$_{(t+1)}$ (+)	0.0445***	0.0246***	0.0451***	0.0267***
	GoodRoA$_t$ (+)	0.0003	-0.0039	0.001	-0.0031***
	BM1$_t$ (-)	-0.2919***	-0.2597***	-0.2829***	-0.2433***
Undervaluation	*BM2$_t$ (-)*	-0.2422***	-0.2198***	-0.2378***	-0.2089***
	BM3$_t$ (-)	-0.1725***	-0.1349***	-0.1699***	-0.1289***
	BM4t (-)	-0.0914***	-0.0722***	-0.0904***	-0.0688***
	HRet$_t$ (-)	-0.0469***	-0.0623***	-0.0356***	-0.0381***
	MRet$_t$ (-)	-0.0345***	-0.0400***	-0.0303***	-0.0295***
Loss Aversion	*OfficersRet$_t$*	0.0015***		-0.00004	
	LossDummy$_t$			0.0191***	
	(OfficersRet X Loss)$_t$			0.0052***	
	DirectorsRet$_t$		0.0015***		-0.0008***
	LossDummy$_t$				0.0516***
	(DirectorsRet X Loss)$_t$				0.0087***
Firm effects		Included	Included	Included	Included
Year effects		Included	Included	Included	Included

Table 6
The Relation between Insider Returns and the Decision to Purchase

This table presents firm fixed effects logit regressions to assess the relation between insider trading returns and insiders' decisions to purchase shares. The dependent variable is $Purchase_{i,t}$ is an indicator variable that equals one if shares are purchased in year *t* else it is equal to zero. $GoodRet_{(t+1)}$ is an indicator variable equal to 1 if the stock's next year's market adjusted return is greater than zero else equal to zero. $GoodRoA_{(t+1)}$ is an indicator variable equal to one if next year's change in ROA is greater than zero else equals to zero. $GoodRoA_t$ is an indicator variable equal to one if the current year's change in ROA is greater than zero else equals to zero. $BM1_t$ *to* $BM4_t$ is an indicator variable equal to 1 if the book-to-market ratio is in the *i'th* quintile of year *t's* book-to-market distribution. $HRet_t$ and $Mret_t$ is an indicator variable equal to 1 if the market adjusted stock return is in the high trecile and middle trecile respectively of year *t's* distribution of realized market adjusted returns. $InsiderRet_t$ is the Modified Dietz return on the portfolio of the firm's shares held by all insiders (director and officers) computed over year *t*; it is our measure of insider trading returns. $LossDummy_t$ is an indicator which equals one if $InsiderRet_t$ is negative and zero if positive. $(InsiderRet\ X\ Loss)_t$ is an interaction variable between $InsiderRet_t$ and $LossDummy_t$. The sample period is 1986-2012 and the insider trading returns variable, $InsiderRet_t$ is winsorized at 1% on each tail. ***, ** and * denote statistical significance at 1%, 5% and 10% respectively.

Hypotheses	Variables	Dependent Variable = $Purchase_{i,t}$		
		[1]	[2]	[3]
Superior Information	$GoodRet_{(t+1)}$ *(+)*	0.1338***	0.1349***	0.1335***
	$GoodRoA_{(t+1)}$ *(+)*	0.1666***	0.1651***	0.1670***
	$GoodRoA_t$ *(+)*	0.0158	0.0154	0.0156
Undervaluation	$BM1_t$ *(-)*	-0.8829***	-0.8807***	-0.8796***
	$BM2_t$ *(-)*	-0.7520***	-0.7485***	-0.7478***
	$BM3_t$ *(-)*	-0.5167***	-0.5214***	-0.5208***
	BM4t (-)	-0.2689***	-0.2712***	-0.2699***
	$HRet_t$ *(-)*	-0.3819***	-0.3838***	-0.3937***
	$MRet_t$ *(-)*	-0.2529***	-0.2561***	-0.2633***

	$InsiderRet_t$		0.00533***	0.00268***
	LossDummy			-0.0825***
Loss Aversion	$(InsiderRet\ X\ Loss)_t$			0.00469***
Firm effects		Included	Included	Included
Year effects		Included	Included	Included

Table 7
Economic Impact of Loss Aversion - Being Loss Averse and Acting upon it versus Being Loss Averse and ignoring it

This table examines the economic impact of loss aversion on the wealth of insiders by identifying a subsample of insiders who have losses and are predicted not to purchase due to loss aversion. Then splitting this subsample into a group that acts upon their loss aversion by not purchasing and a second group that are supposedly loss averse but decide to ignore their loss aversion by purchasing and comparing their returns. $InsiderRet_t$ is the Modified Dietz return on the portfolio of the firm's shares held by all insiders (director and officers) computed over year *t*; it is our measure of insider trading returns. $MarketAdjStockRet_{(t+1)}$ is next year's market-adjusted stock return measured as the firm's 12-month cumulative return in year *t+1* minus the corresponding12-month return on the valued weighted index; it is a measure of the firm's future performance and measures insiders' potential gain from trading the firm's stock as opposed to the market portfolio.

	Mean Value		T-test for differences of means (p-value)
Variable	Group 1: No Insider Purchase	Group2:Insider Purchase	
$InsiderRet_t$	-10.0501	-6.7995	0.0313
$MarketAdjStockRet_{(t+1)}$	-0.0570	0.0814	0.0526

Table 8

Economic Impact of Loss Aversion - Firm Specific Loss Aversion Coefficients and Insider Market Timing Ability

This table examines the economic impact of loss aversion on the wealth of insiders by using a mixed logistic model to get firm specific loss aversion coefficients and forming quartiles based on these coefficients to test insider market timing ability across loss sensitivity quartiles. The first quartile has the least loss averse insiders and the fourth quartile has the most lost averse insiders. $InsiderRet_t$ is the Modified Dietz return on the portfolio of the firm's shares held by all insiders (director and officers) computed over year *t*; and approximates the dollar weighted return.. $AnnualRet_t$ year t's stock return measured as the firm's 12-month cumulative return in year *t*; it measures the time weighted return.

Quartiles	Mean value *of* $InsiderRet_t$ minus $AnnualRet_t$
1	1.99%
2	3.75%
3	4.63%
4	-0.82%