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Divergence Of Opinion And Share Repurchase

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DIVERGENCE OF OPINION AND SHARE REPURCHASE:

THEORY AND EMPIRICAL EVIDENCE

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ABSTRACT

We develop and test a new theory of share repurchases that emphasizes the importance of investors' heterogeneous expectations as a determinant of share repurchases. Optimistic shareholders (i.e. shareholders with higher expectations about future payoffs) want to pay cash to pessimistic shareholders, in exchange for the latter investors' shares. After tendering their shares, the pessimistic shareholders' opinions will not be reflected in the stock price due to short sale constraints, and thus, the stock price should increase following actual share repurchases. The theory predicts that a firm is more likely to announce and actually repurchase shares, when the divergence of investor opinion is high. The theory also predicts that managers intend to announce a larger fraction of target shares, when divergence of opinion is high. Finally, the stock returns should be related positively to not only the actual shares repurchased, but also the divergence of investor opinion. In Essay I, We survey the literature of investor heterogeneity, specifically, investor divergence of opinion and build up the models in the framework of game theory; In Essay II, we provide evidence that investors' divergence of opinion is a determinant of share repurchase; In Essay III, we test the model with actual share repurchase data. Our empirical evidence supports the divergence of opinion theory and suggests that the divergence of opinion hypothesis has incremental explanatory power even after controlling for other repurchase hypotheses, such as the undervaluation-signaling hypothesis.

DEDICATION

This dissertation is dedicated to my wife, Lie Li, and my family back in China.

LIST OF ABBREVIATIONS

Ln(MV)	Nature log of the market capitalization
AT	Total asset
Bmratio	Fama and French (1993) book-to-market ratio
Debtratio	A ratio of long-term debt to total asset
FixedAsset	A ratio of fixed asset to total asset
IntanAsset	A ratio of intangible asset to total asset
Psi	The residual of weekly return regressed on market and industry return
Cash	Cash and cash equivalent
FCF	Free cash flow
OXD	Operation cost divided by sales
R&D	Research & Development cost divided by sales
PM	Profit margin (net income divided by sales)
Return	Cumulative annual stock return
Dividend	Total dividends pay per share
Abto_mean	The mean of abnormal turnover
Abto_median	The median of abnormal turnover
SUV_mean	The mean of standardized unexplained volume
SUV_median	The median of standardized unexplained volume

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INVESTOR HETEROGENEITY IN BELIEFS AND ITS IMPACTS ON SHARE REPURCHASE: A SURVEY

Introduction

In this essay, we survey the literature about investors having divergence of opinion on a stock's value, and motivate the hypotheses that we will develop and test in essays 2 and 3 of the dissertation. We review not only the major theoretical papers, but also the main lines of empirical research. The review includes a discussion of the measures of divergence of opinion used by previous research, and the rationale for each measure. Finally, we examine how divergence of opinion can affect a manager's decision to repurchase shares. Specifically, we examine the impact of *actual* share repurchases on the long-term stock price performance in the framework of investor divergence of opinion.

Previous researchers studying share repurchases generally assume homogeneous expectations. Theoretical models have been built on signaling theory, agency theory, optimal capital structure theory, and so forth. However, the tender offer premium puzzle and the long-term stock price anomaly are left unexplained by existing models.[1] Furthermore, the majority of existing empirical tests on these models focus on announcements of share repurchase, rather than *actual* share repurchases.

[1] With the tender offer premium puzzle, managers offer a tender price that is higher than the equilibrium stock price, defined as the stock price five days after a tender offer announcement. The long-term price anomaly refers to the long-term stock price performance following repurchase announcement. Empirical studies show that stock prices drift upwards, associated with persistent long-term abnormal returns, for about three years after open market share repurchase announcements.

In this dissertation, we initiate a model with investor heterogeneous expectations to explain the open market repurchases (repurchases, hereafter). We develop testable hypotheses, not only around announcements of share repurchase, but also on a manager's *actual* share repurchase activity. The results from essays 2 and 3 suggest that investors' divergence of opinion on the firm value matters in a manager's share repurchase decision. The larger the divergence of opinion, the more likely a manager announces share repurchases and the more shares he *actually* repurchases. The long-term stock price performance is consistent with the model predictions.

The implication of the marginal-investor-theory with divergence of opinion, and the use of investors' belief dispersion measures have been adopted by previous researchers examining share repurchases. Bagwell (1991a), Bagwell (1991b), and Bagwell (1992) examine a unique dataset from Dutch Auction share repurchase, and find that shareholders are willing to sell their shares at dramatically different prices, implying an upward-sloping supply curve for equities. Persons (1997) suggests managers use tender offer repurchases to transfer wealth from shareholders who do not tender, to those who do. This transfer realizes a direct loss of firm capital, and is used as the cost of managers' signal that the firm is undervalued.

Recently, the idea of divergence of opinion is introduced to explain open market share repurchases. Fried (2001) argues that the signaling theory in open market share repurchases is problematic, and managers announce open market repurchases because of opportunism. Managers take different actions after an announcement, depending on whether the stock is truly undervalued. Huang and Thakor (2010) build a simple model, where investors disagree with the managers about the firm's investment projects. Managers choose to repurchase shares in order to

change the investor base when the divergence of opinion between investors and managers is high. Conlon, Fuller and Wang (2011) and Blau *et al.* (2011) propose a model where investors disagree with one another. Managers repurchase shares from pessimistic shareholders and transfer wealth from those shareholders to optimistic shareholders, who are willing to stay in the firm and continue to provide their capital. They provide an explanation of long-term abnormal returns, following open market share repurchases.

The rest of the paper is organized as follows. Section II discusses the origins of divergence of opinion and its impact on equilibrium asset price, including the theoretical works and empirical studies. Section III surveys the literature on the measures of divergence of opinion and their rationales. Section IV discusses the implementation of the divergence of opinion in share repurchases. We also initiate several quantitative models in this section. Section V concludes the paper.

II. Divergence of Opinion and Asset Equilibrium Price

2.1 Definition of Divergence of Opinion

Ever since Keynes (1937) and Williams (1956), economists have recognized the differences in investors' preferences and proposed the marginal-investor theory which emphasizes the importance of divergence of opinion in the functioning of capital markets. Divergence of opinion is often defined as a type of investor heterogeneity in financial economics, in which, investors' valuation of a signal asset diverge from each other because they hold different prior beliefs, or have different information process models.

People often share common information yet disagree as to the meaning of this information, not only in the evaluation of risky assets but also in the evaluation of economic policies, political candidates, and the result of tossing a dice. Another example is the differences among financial analysts' forecasts in response to a firm's earnings announcement. Investor heterogeneity can come from tax preference, risk tolerance, liquidity requirement, and private information. This branch of the literature concerns rational expectations asset pricing models. In this article, we focus on the heterogeneity originated from two other sources: the investors' prior beliefs and the model (often the likelihood function) that investors choose to process the public information. The asset pricing models in this second branch of the literature are usually referred to as irrational expectations models.

2.2 Investor Homogeneity vs. Heterogeneity

Despite these differences and despite strong and persuasive arguments put forward for including heterogeneity in finance and economics, the homogeneous representative agent paradigm is still the leading structural approach to asset pricing.[2] Anderson, Ghysels and Juergens (2005) suggest that this happens for various reasons. First, in many contexts it is difficult to derive testable predictions in asset pricing models with heterogeneous agents. Second, even though some researchers have made progress recently (e.g. Constantinides and Duffie (1996), Heaton and Lucas (1996), Shefrin (2001), and Curcuru *et al.* (2004)), there is a lack of

[2] The same argument is presented in Browning, Hansen and Heckman (1999) and Anderson, Ghysels and Juergens (2005).

tangible data that represents heterogeneity. Third, and maybe most important, many of these formulations of heterogeneous agent models are observationally equivalent to representative agent models, as argued by Gorman (1953), Sharpe (1964), and Lintner (1965). Therefore, there is often no need to explicitly consider heterogeneous agents because there exists a representative agent, with a utility function of the same form as the agents.[3]

Some researchers disagree with Lintner (1965)'s conclusions. Mayshar (1983) points out that the divergence of opinion not only exists, but is essential in determining asset prices. It is essential because of its association with endogenous limitations on the number of active market participants. The traditional models fail to recognize the fact that investors choose not only the size of their holdings in each asset, but also in which asset to invest. However, the models do agree that when short sale constraints are present, an asset pricing model with divergent opinions may differ from a model without divergent opinions. However, Mayshar (1983) continues to argue that, even without short sale constraints, investors endogenously choose to hold or not to hold an asset, which in fact constructs an uncompleted sub-market as if the short sale constraints exist.

2.3 Rational v.s. Irrational Models

[3] For example, Lintner (1969) states that "Any carryover of … Ricardian notations of 'marginal' buyers setting prices in purely competitive markets is utterly unjustified and misleading when dealing with security markets under uncertainty. Every investors is a marginal holder with respect to his last share … of each security he holds". Sharpe and Sharpe (1970) state that "in a somewhat superficial sense the equilibrium relationships derived for a world of complete agreement can be said to apply to a world in which there is disagreement, if certain values are considered to be averages".

There are two major differences between the irrational asset pricing models and the rational ones. First, in the rational expectation models, trade is not generated by pubic information signals. Since all the investors share one utility function with the representative agent, all investors derive the same reservation value based on the public information. No trade is needed as the investors' portfolio is updated together with the market movements. In the irrational models of Kim and Verrecchia (1991) and Grundy and McNichols (1989), trades are generated by the public information because traders disagree on its interpretation due to prior private information. We argue that the divergence of opinion is generated from different prior beliefs.

Second, in the rational expectations models, disagreement is the result of private information. Investors who receive private information adjust their reservation value of an asset, and thus, adjust their portfolio holdings by buying or selling a certain amount of such assets. However, Milgrom and Stokey (1982) and Varian (1989) show that speculative trades based purely on differences in private information cannot occur among risk-averse traders in the absence of noise traders. No trade happens because uninformed traders observe the updated ask or bid price submitted by other traders and infer that the orders are submitted by informed traders, therefore, there is information risk to trade with them. With only risk averse investors present in the market, no one wants to trade with the other. Thus, rational expectation models usually rely on noise traders to generate the trades. When noise traders are present, uninformed traders are not able to distinguish whether the changes of asset price are due to private information, or noise orders.

2.4 Asset Pricing Models with Divergence of Opinion

Models with agents who have heterogeneous beliefs have been studied by Miller (1977), Harrison and Kreps (1978), Jarrow (1980), Mayshar (1983), Harris and Raviv (1993), Kandel and Pearson (1995), Van den Steen (2004), Anderson, Ghysels and Juergens (2005), Hong and Stein (2007), and Fama and French (2007). These models can be categorized into three groups: first, investors simply hold heterogeneous beliefs; second, investors generate heterogeneous beliefs on the same public information due to their different prior beliefs; and third, investors have different opinions about the same information because they interpret the information differently.

Early works, including Miller (1977), belong to the first category. Miller (1977) suggests a simple framework to analyze the asset prices with the investors' divergence of opinion. There are only two securities, one is the risk-free bond and the other is a risky stock. Miller (1977) shows that with the short sale constraints, asset prices tend to be higher than the average reservation value across all investors' expectation because pessimistic investors' opinions are not incorporated into security prices.

Jarrow (1980) and Mayshar (1983) extend Miller (1977)'s model from one risky security into portfolio rebalancing with multiple risky assets. Jarrow (1980) suggests that stock prices will be overvalued when a short sale is not allowed, and investors hold homogeneous beliefs on the asset returns, but homogeneity of beliefs for the variance-covariance matrix of future asset returns. With the same assumption, Mayshar (1983) find the same results. Furthermore,

Mayshar (1983) shows that investors endogenously choose to buy an asset and become active in a portion of the security market. With the heterogeneity of beliefs, the idiosyncratic risks are priced in equilibrium.

Harrison and Kreps (1978) and Van den Steen (2004) push this argument even further. Harrison and Kreps (1978) suggest that with the heterogeneity of beliefs, equilibrium asset prices could be even higher than the reservation value of the most optimistic investors. Speculative investors hold assets and expect to re-sell them to other investors in the future. Knowing that each investor may have a different reservation value, but not knowing the magnitude of the other investors' reservation value, speculative investors could offer to buy an asset at a price higher than their own reservation value. Van den Steen (2004) further shows that the over-optimism of those speculative investors is due to the biased self-attribution. Particularly, an agent tends to choose the action that she overestimates and then attributes the failure to exogenous factors.

Kandel and Pearson (1995)'s model belongs to the second category, where investors' heterogeneity comes from different prior beliefs. They argue that the predictions from their model are consistent with the empirical findings about the patterns of trading volume. As in the models of Kim and Verrecchia (1991) and Grundy and McNichols (1989), investors draw different conclusions from the same public information. More importantly, investors agree to disagree in equilibrium.

Harris and Raviv (1993) and Anderson, Ghysels and Juergens (2005) model the heterogeneity in the way that investors share common prior beliefs and receive common information but differ in the way in which they interpret this information. In Harris and Raviv

(1993), each investor updates their beliefs about the future returns using her own model of the relationship between the news and the asset's returns. The Anderson, Ghysels and Juergens (2005) model assumes that investors have the correct beliefs about the expected consumption growth, but incorrect beliefs about the higher moments of consumption growth. Therefore, when the mean beliefs differ from the true beliefs, the heterogeneity/bias matters. These two papers find that their models with heterogeneity are better in explaining trading volume – asset price changes relationship and in predicting return – volatility relationship, respectively.

Recently, Hong and Stein (2007) and Fama and French (2007) review the literature of investor heterogeneity in the way of divergence of opinion. Both studies emphasized the importance of the divergence of opinion in improve the traditional asset pricing models built on the assumption of investor homogeneity. Hong and Stein (2007) extend the short sale constraints into the 'limits of arbitrage' and make the heterogeneous models a broader usage. They also argue that the limits of attention could also be a source of divergence of opinion. Fama and French (2007) argue that the assumptions for traditional asset pricing models, (i) there is complete agreement among investors about probability distributions of future payoffs on assets, and (ii) investors choose asset holdings based solely on anticipated payoffs, are unrealistic. Fama and French (2007) point out that the investors could disagree with each other due to their different tastes for assets as for consumption goods. They also suggest that with divergence of opinion, the uninformed investors hold the sub-optimal portfolio due the 'limits of arbitrage' suggested by Shleifer and Vishny (1997), in which the arbitrage is risky and risk averse informed investors do not fully offset the price effects of the misinformed.

Overall, the theoretical works suggest that (i) the market equilibrium version of the divergence of opinion exists; (ii) the equilibrium asset prices in the market with heterogeneous investors differ from the ones in the market where investors are homogeneous; (iii) the predictions from asset pricing models with investor heterogeneity fit the pattern of trading volume, price changes, and return volatility better.

2.5 Empirical Findings around Divergence of Opinion

In addition to the theoretical work, empirical evidences also support the existence of divergence of opinion and its impact on asset prices. The evidence comes from 1) event studies, such as corporate public announcements, analyst earnings forecasts, stock Initial Public Offerings (IPOs), and share repurchases; 2) cross-sectional studies on equilibrium asset returns; and 3) the relationship among trading volume, price changes, and return volatilities.

Researchers have long noticed that investors respond differently to corporate public announcements, and that disagreement exists in analysts' earnings forecasts.[4] Abarbanell, Lanen and Verrecchia (1995) suggest a relationship between analyst earnings forecast dispersions and the divergence of opinion among investors. They find that as a proxy of divergence of opinion, the dispersion of analyst forecasts can explain the volume reactions to earnings surprises. Anderson, Ghysels and Juergens (2005) confirm this relationship between the divergence of

[4] For example, the works include Ajinkya, Atiase and Gift (1991), Abarbanell, Lanen and Verrecchia (1995), Diether, Malloy and Scherbina (2002), Doukas, Kim and Pantzalis (2006), Zhang (2006b), Zhang (2006a), Lerman, Livnat and Mendenhall (2007), Alexandridis, Antoniou and Petmezas (2007), Sadka and Scherbina (2007), and Barron, Stanford and Yu (2009).

opinion and the dispersion of analyst forecasts by examining the cross-sectional stock returns. They find that the dispersion of analyst forecasts is a priced factor in asset pricing models and has prediction power on the return volatility.

Diether, Malloy and Scherbina (2002) test whether the dispersion of analyst forecasts is a proxy for divergence of opinion or risk. They find that their result is consistent with the argument that dispersion is a proxy for divergence of opinion rather than risk. Boehme, Danielsen and Sorescu (2006) use this proxy to test the Miller (1977)'s hypothesis and find that with the presence of short sale constraints and divergence of opinion, stocks tend to be overvalued.

Ekholm (2006) examines how different types of investors react to new earnings information. With extremely detailed data from Finland market, he finds that large investors' trading behaviors differ from the majority of investors and tend to be the other side of trades in response to an earnings surprise. They argue that differences in trading behaviors are due to investors' overconfidence. Coval and Thakor (2005) suggest that the financial intermediaries work as a 'beliefs-bridge' between optimists and pessimists.

The empirical evidence of the existence of short sale constraints and the effects of divergence of opinion on asset equilibrium price has been documented. D'avolio (2002), Duffie, Garleanu and Pedersen (2002), and Geczy, Musto and Reed (2002) study the security borrowing market and estimate the direct costs of borrowing securities for short sales. Margrabe (1978), Figlewski and Webb (1993), Ofek, Richardson and Whitelaw (2004), Evans *et al.* (2008), and Danielsen and Sorescu (2009) suggest that option market can be an substitution for mitigating

short sale constraints in completing a market. Jones and Lamont (2002), Chen and Singal (2003), Hong and Stein (2003), Nagel (2005), Haruvy and Noussair (2006), Danielsen and Sorescu (2009) examine the effects of divergence of opinion on asset prices with the presents of short sale constraints. Specifically, Boehme, Danielsen and Sorescu (2006) directly test Miller (1977)'s predictions and find that with present of short sale constraints and divergence of opinion simultaneously, the stock tend to be overvalued, as the price reflects the beliefs from the optimistic investors only.

Recently, heterogeneous beliefs are also been adopt to explain the abnormal returns following the IPOs and the share repurchases. The studies include Chemmanur, Krishnan and Nandy (2009), Huang and Thakor (2010), and Blau *et al.* (2011). The authors argue that in the events of IPOs and share repurchases, the underwriters and managers try to attract the capital from the optimistic investors and therefore result in a higher price of firms' stocks. The direct evidence of investors' heterogeneity in their reservation value of an asset is also found by Bagwell (1992) from Dutch auction share repurchases.

III. Measurement of Divergence of Opinion

A direct measure of investors' beliefs is usually un-observable and the estimates are often difficult. Researchers in finance, accounting, and economics have to rely on certain observable proxies. The theoretical framework and the empirical implications in finding proper proxies for investors' beliefs have been developed from various research lines, including methodologies based on abnormal stock trading volume, analyst earnings forecast dispersion, stock bid-ask

spreads, and rating agency splits. We survey the methodology and the rationale of each of the measure in this section.

3.1 Unexplained Volume based Proxies

Prior research suggests that a component of trading volume may be attributed to opinion divergence. The rationale is that investors trade with each other when they interpret the public information differently, either because they have different prior beliefs or because they use different models to interpret the public information.

Harrison and Kreps (1978) suggest that abnormal trading volume around corporate public announcements could be explained by the divergence of opinion among traders. Varian (1985) and Varian (1989) focus on the differences in prior beliefs as opposed to differences in models. Harris and Raviv (1993) show similar results when investors share the common public information and prior beliefs, but differ from each other in their information process models.

Kandel and Pearson (1995) predict that volume will be increasing in the diversity of investor opinions around earnings events. They document that volume is higher around earnings events than during control periods with similar returns and no earnings news. They propose a theory to explain this finding, even in those cases in which earnings events elicit little or no price reaction. Their theory assumes that investors possess different likelihood functions and this causes them to interpret earnings news differently, consistent with Harris and Raviv (1993)'s predictions.

Similar to Kandel and Pearson (1995), Kim and Verrecchia (1991) construct a model in which earnings announcements may increase information asymmetries because some market

participants process the announcement into private or informed judgments. In the context of their model, the authors show that greater diversity of opinions, caused by the differential processing of the information, leads to an increase in trading volume.

These models differ in the way that the origins of the divergence of opinion, either from the different prior beliefs, or from different information process models, or both. Nevertheless, the conclusions are comparable—greater opinion divergence across investors is associated with more trading volume.

Empirically, there is also support for using volume to proxy for differential opinions by traders. Studies analyzing total trading volume around earnings announcements include those of Bamber (1987), De Long et al. (1990), Ajinkya, Atiase and Gift (1991), and Ajinkya et al. (2004). Generally, these studies find that volume is higher around earnings events that are more likely associated with more divergent investor opinions. Garfinkel and Sokobin (2006) look at the relationship between the divergence of opinion and trading volume after earnings announcement. They argue that the post-earnings announcement drift could be explained by the divergence of opinion among investors and the correlated price changes.

Consistent evidence is also found from investors who trade on macroeconomic information releases. Fleming and Remolona (1999) find that trading volume increases significantly, while price volatility and spreads remain wide, as investors in Treasury securities trade to reconcile differential interpretations of macroeconomic information releases.

Direct evidence is also recorded in the experimental literature, Smith, Suchanek and Williams (1988) show that even when traders observe identical probabilistic dividend

distributions, then trade occurs, sometimes in large volume. They conclude that there is diversity in opinions.

The large trading volume could also be due to the different private information access across different types of investors. In the homogeneous expectation models, with the presence of noise traders, uninformed traders are unable to distinguish the trades from informed traders. Therefore, private information can also cause large trading volume. However, Brockman and Chung (2001) find that volume is increasing in the heterogeneity parameter on information event days, after controlling for the information effects of the announcements.

Finally, we recommend a measure suggested by Hong and Stein (2007) and Garfinkel (2009). We measure the divergence of opinion among investors with the abnormal market adjusted turnover, $Abto_{i,t}$. To avoid the less-trading-frequency problem, we improve their method by using weekly cumulative trading volume rather than daily trading volume.[5] The weekly market adjusted turnover, $Abto_{i,t}$, is the firm's weekly trading volume divided by its shares outstanding minus the ratio of market total trading volume, $Vol_{m,t}$, scaled by market total shares outstanding, $Shrs_{m,t}$, as in equation 3.1, where subscription i and m stands for the identification for each stock and the whole market.. We then measure the degree of divergence of opinion with the mean and median value of the weekly market adjusted turnover for each firm year.

[5] Some very illiquid stocks could have very small trading volume during some days in a year. The estimation from those extreme values can cause bias on our estimates of divergence of opinion.

$$Abto_{i,t} = \frac{Vol_{i,t}}{Shrs_{i,t}} - \frac{Vol_{m,t}}{Shrs_{m,t}}, where$$
$$Vol_{m,t} = \sum_{i=1}^{m} Vol_{i,t} \text{ and } Shrs_{m,t} = \sum_{i=1}^{m} Shrs_{i,t} \quad (3.1)$$

A large proportion of this literature is focus on the relationship between trading volume and the absolute price changes, such as Harrison and Kreps (1978), Varian (1985), Varian (1989), De Long et al. (1990), and Kandel and Pearson (1995) among others. The results suggest that absolute price changes and volume are positively correlated, consecutive price changes exhibit negative serial correlation, and volume is positively auto-correlated.

We thus recommend the standardized unexplained stock trading volume, $SUV_{i,t}$ (Garfinkel and Sokobin (2006) and Garfinkel (2009)) as an alternative measure of divergence of opinion. Standardized unexplained stock trading volume measures the unexpected trading volume from the effect of both liquidity and information. Unexpected trading volume is the residual volume ($\varepsilon_{i,t}$) from a regression of the firm's weekly trading volume on weekly signed absolutely returns:

$$Volume_{i,t} = \alpha_i + \beta_i \left|Ret_{i,t}\right|^{+} + \gamma_i \left|Ret_{i,t}\right|^{-} + \varepsilon_{i,t}, \quad (3.2)$$

The plus and minus superscripts on the absolute valued returns indicate the sign of weekly returns. The standardized unexplained trading volume is the yearly average of such residuals scaled by the standard deviation of residual, as:

$$SUV_{i,t} = \frac{\sum_{1}^{52} \varepsilon_{i,t} \Big/ 52}{\sigma_{\varepsilon_{i,t}}} \quad (3.3)$$

3.2 Analyst forecast based proxies

Unlike trading volume proxy for divergence of opinion, which is initiated by theoretical works and then supported by empirical evidences, analyst earnings forecasts dispersion proxy is concluded from empirical findings. The dispersion among analyst earnings forecasts can be looked as a natural experiment of the test on investor heterogeneity. Analysts respond to the same corporate earnings announcement and make forecasts on the future earnings by each of them. Analysts often make different forecasts on future earnings.

Another difference between analyst forecasts dispersion proxy and trading volume proxy is that researchers usually do not distinguish whether the divergence of opinion among analysts is due to the different prior beliefs or different information process models. Lack of theoretical framework and testable data, it is difficult to distinguish the original sources of the divergence of opinion.

Supportive evidence from empirical findings is numerous. Ajinkya, Atiase and Gift (1991) formally test the link between the dispersion in financial analysts' earnings forecasts and the abnormal trading volume as a proxy of divergence of opinion, predicted by Varian (1985) and Karpoff (1986). Ajinkya, Atiase and Gift (1991) show that the dispersion in analysts' earnings forecasts is positively related with the abnormal trading volume following the annual earnings announcements and is a proper proxy for agents' differing beliefs about the firm's prospects.

Abarbanell, Lanen and Verrecchia (1995) improve Ajinkya, Atiase and Gift (1991)'s measures by showing that, in a model of rational trade that incorporated earnings forecasts,

forecast dispersion along is insufficient to proxy for investor uncertainty. Other forecast properties, including the number of forecasts, the periods of the forecasts, and so forth also affect forecast dispersion. They describe an empirical methodology and show that with their method the dispersion-volume response coefficient is monotonically increasing after controlling for other effect, e.g. price changes.

Several researchers have adopted the dispersion in analyst earnings forecasts as a proxy for investors' divergence of opinion. For example, Diether, Malloy and Scherbina (2002) and Doukas, Kim and Pantzalis (2006) use dispersion in analyst earnings forecasts as a proxy to test Miller (1977)'s hypothesis; Zhang (2006a) and Zhang (2006b) examine how dispersion in analyst forecasts represents the information uncertainty and the cross-sectional relationship between forecast dispersion and the asset returns.

Lerman, Livnat and Mendenhall (2007) and Alexandridis, Antoniou and Petmezas (2007) also adopt this methodology to examine the asset pricing anomalies. While Lerman, Livnat and Mendenhall (2007) focus on post-earnings announcement drift and Alexandridis, Antoniou and Petmezas (2007) highlight the importance of divergence of opinion in explaining the post-acquisition performance, both studies suggest dispersion in analyst forecasts is a good proxy for investors' divergence of opinion. Recently, Sadka and Scherbina (2007) and Barron, Stanford and Yu (2009) also choose this proxy to test the relationship between divergence of opinion, asset liquidity, and asset prices.

We recommend the two measures suggested by Diether, Malloy and Scherbina (2002). The first proxy is the standard deviation of analyst earnings forecasts divided by the mean of the

analysts' forecasts, $Disp\_mean_{i,t}$, (see Diether, Malloy and Scherbina (2002)). For each month, we compute the monthly divergence of opinion for a firm by using the annual fiscal year earnings estimate for that month. We then estimate the average yearly divergence of opinion ($Disp\_mean_{i,t}$) as the mean of the monthly divergence of opinion in any given year.

$$Disp\_mean_{i,t} = \frac{Std(forecast)_{i,t}}{Mean(forecast)_{i,t}}; \tag{3.4}$$

Since the mean of analyst earnings forecast could be zero, and infinite analyst dispersion could be problematic, we choose an alternative measure $Disp\_price_{i,t}$, which we define as the standard deviation of analyst earnings forecasts scaled by stock price. Our model suggests that it is the difference in valuations between optimistic and pessimistic investors that matter. Thus, our second proxy for the divergence of opinion is the difference between the highest earnings forecast and the lowest one, scaled by the absolute value of the mean earnings forecast.

$$Disp\_price_{i,t} = \frac{Std(forecast)_{i,t}}{Stock\_Price_{i,t}}; \tag{3.5}$$

3.3 Bid-ask Spreads

In the literature of market microstructure, bid-ask spread has been suggested as a proxy for divergence of opinion. For example, Houge et al. (2001) use the opening bid-ask spread as a proxy of divergence of opinion of investors to test Miller (1977)'s hypothesis on IPOs. The authors argue that the bid-ask spread can be decomposed into three components, the order processing, adverse selection, and inventory costs. Among them, adverse selection components

reflect the dispersion between investors' opinions. The same methodology has also been adopted by Handa, Schwartz and Tiwari (2003).

However, the adverse selection component proposed by Amihud and Mendelson (1980) and Ho and Stoll (1983) represent the different evaluation caused by different private information. Uninformed market makers face adverse selection costs when they trade with informed traders. This type of divergence of opinion is not belongs to the scope of our definition of divergence of opinion. We therefore do not recommend use the adverse selection components of bid-ask spread as a proxy for divergence of opinion.

3.4 Agency Rating Splits

Morgan (2002) use the splits among agency ratings as a measure of dispersion of valuations among rating agencies. However, he does not model and test whether the splits among agencies are due to the different private information or due to the divergence of opinion defined in this essay. The purpose of his study is to test whether the splits of agency ratings represent the difficulty level for outside investors to understand and predict the firm's prospects. Flannery, Kwan and Nimalendran (2004) re-examine this issue with a more widely accepted proxy of divergence of opinion, the dispersion in analyst earnings forecasts, and find the contradict result. Furthermore, the agency rating data is often not publicly available. Morgan (2002) collects the data by hand. We do not use this measure in our study due to the contradictory results obtained by previous researches and the difficulty of collecting the data.

IV. Investor Heterogeneity and Share Repurchase

4.1 The Existing Literature of investor heterogeneity and share repurchases

Bagwell (1991a) first initiates the argument of the implementation of investor heterogeneity in the context of tender offer share repurchase. However, Bagwell (1991a) shows that managers can use share repurchase as a takeover deterrent when the supply curve for shares is upward-sloping. The upward-sloping supply curve represents the divergence of opinion among shareholders in evaluation the firm's value. Managers can push up stock price with share repurchases, because shareholders willing to tender in the repurchases are systematically those with the lowest valuations. The repurchases skew the distribution of remaining shareholders toward a more expensive pool. The result holds even the capital gains taxation is considered.

Bagwell (1991b) and Bagwell (1992) provide supportive evidence of investor's heterogeneity in stock valuation to his upward-sloping supply curve argument. By examining Dutch auction share repurchases, Bagwell documents that the supply curves of shares are clearly upward-sloping. The shareholders' valuations on the firm differ dramatically. He argues that the "the hypothesis of common valuations indeed is not always a good approximation".[6]

Although Bagwell does not examine why shareholders are heterogeneous in their valuations, his evidence does support the hypothesis that shareholders respond differently to a single corporate announcement.

Persons (1997) builds a model with investor heterogeneity to explain the tender offer premium puzzle. He also argues that managers transfer wealth from shareholders who do NOT tender to who do. Such wealth transferring is costly for the managers, and therefore, prevents the

[6] Bagwell (1991b), "Shareholder Heterogeneity: Evidence and Implications," *American Economic Review*, Vol 81, pp218.

low-performance firms from mimicking their signals. However, in his model, the investor heterogeneity comes from information asymmetry, rather than different prior beliefs or information process models as defined in this essay.

Huang and Thakor (2010) inherent the idea from Dittmar and Thakor (2007) but use it inversely in share repurchase rather than issuance. Huang and Thakor (2010) look at the open market repurchases. They argue that managers could have different evaluations on their firm's value from outside investors. More importantly, they point out that such differences could come from divergence of opinion rather than information asymmetry. The divergence of opinion could due to the fact that different generations have heterogeneous prior beliefs about the probability of the firm's future investment opportunities. Although they do not specifically model the differences in prior beliefs, they provide empirical evidence suggesting that divergence of opinion, proxied by dispersion in analyst forecasts and the structure of institutional holdings is an important factor which affects the managers' share repurchasing decisions.

V. Divergence of opinion and Actual Share Repurchase

5.1 A simple introduction of the idea

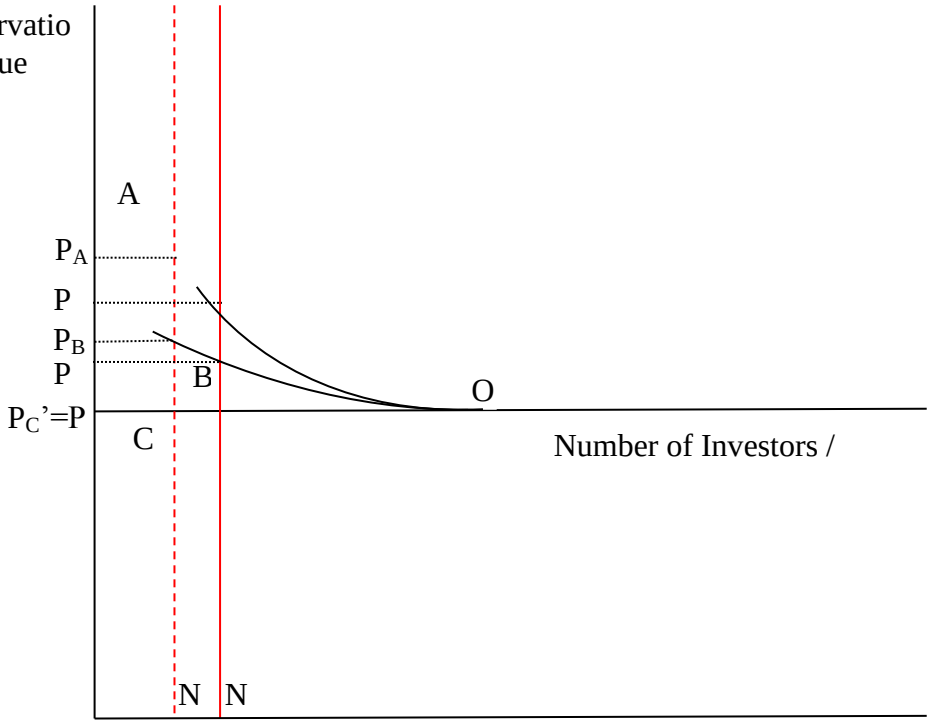
We introduce share repurchases when investors have divergent opinions by considering a simple model. The purpose of the model is to show that stock price will increase following managers' actual share repurchases.

The model is built on the framework of Miller (1977). Figure 1 shows the demand curves of shares when investors have divergent opinions on the firm's value. The curve AO, BO, and

CO are three different demand curves (similar to the upward sloping 'supply' curve in Bagwell (1991b)). The curve AO represents a demand curve of shares in a firm with the highest investor divergence of opinion on the firm value and CO represents a demand curve without the investor divergence of opinion. N is the number of shares outstanding. It also represents the supply curve of shares. The model includes short sale constraints.

In equilibrium, the stock prices will be at P_A, P_B, and P_C, for each demand curve, respectively. Consistent with Miller (1977), $P_A > P_B > P_C$ suggests that firms with high divergence of opinion among investors are likely to be overvalued.

Figure 1 Divergence of opinion and share repurchase



When managers repurchase shares, the supply curve shifts to the left from N to N'. One can see that the equilibrium prices move up to P_A', P_B ', and P_C', respectively. From the graph, one can directly observe that, P_A'-P_A > P_B '-P_B > P_C'-P_C=0. We conclude that: (i) without divergence of opinion, the stock price will not change when managers repurchase shares; and (ii) the larger the divergence of opinion, the more the stock price will increase when managers repurchase the same amount of shares. We derive testable hypotheses in essay 2 and 3 based on these two conclusions.

5.2 Key assumptions of the model

Assumption 1: Investors are heterogeneous either in their prior beliefs, or in their information processing models (the likelihood models).

This assumption allows investors to respond differently to a public announcement made by the firm's managers. However, the assumption does not require that investors hold different private information. Investors know that they are heterogeneous in their opinions about the firm's value, but they agree to disagree with each other. The objective function for each investor is to maximize the payoff. They make decisions on their own beliefs.

Assumption 2: Short sales are allowed but constraints exist.

This assumption suggests that shareholders, who tender their shares, as a whole, are not able to short sale all their previous portfolios after tendering. The short sale constraints could be the result of the high stock-borrowing costs, the trading policy constraints, or the 'limits-of-

arbitrage' due to risks in arbitraging for risk-averse investors. Similar to the divergence of opinion, short sale constraints are also the common knowledge for all investors and the manager. Assumption 3: the share repurchases do not distort the firm's investment portfolio.

With this assumption, the *true* future value of the firm does not change due to share repurchases. This assumption also implies that share repurchases do not contain information about future earnings.

5.3 A simple numerical example with 'stupid-investors'

We first provide a simple model where investors have different beliefs on a firm's value, but they do NOT update their beliefs even they observe the manager's repurchase announcement and the changes in price after the announcement.

For simplicity, we assume there are three shareholders and one manager in the firm. Each of them holds one share. Let the 'true' value of the firm at liquidation be \$48. If all shareholders keep their shares to the last period of liquidation, each of them will equally acquire one-fourth of the firm's wealth, \$12.

With the divergent opinions, each of investor (including shareholders and the manager) has his own expectation on the firm's future value. Shareholder 1 (SH1) believes each share will be worth \$10, \$11 for shareholder 2 (SH2), and \$13 for shareholder 3 (SH3). The manager, by chance, holds the belief of \$12 each share.

With short sale constraints, the stock is traded at \$10 per share, which is determined by the most pessimistic shareholder's opinion, according to the marginal-investor-theory. From the

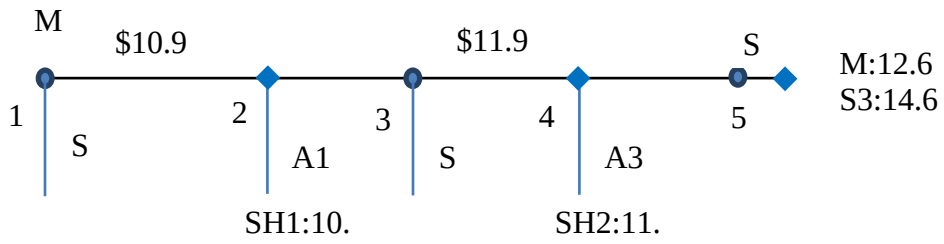
point of the manager's view, the stock is undervalued, since the manager believes that the stock is worth $12. If all shareholders and the manager choose to hold the shares until the last period, the expected payoffs for each of them are: SH1:10, SH2:11, M:12, and SH3:13.

We will show that the manager can increase his payoff by repurchasing shares. The manager will continue to repurchase shares until the stock price equals his valuation. Shareholders choose to accept or reject the manager's repurchasing offers by comparing the offering prices and the belief of each of them.

The game tree is presented in figure 2. There are 5 nodes in the game. At each node, the round circle represents the manager's decision, while the square circle represents the shareholders' choice. M, SH1, SH2, and SH3 stand for the manager, and other three shareholders. The final payoffs for each of them are also labeled in the game for each investor. The manager's strategy set is {stop, offer}. S0, S2, and S4 are the manager's strategy at node 0, 2, and 4 to stop repurchase shares. $10.9 and $11.9 are the tendering prices if the manager chooses the offer strategy at node 0 and node 2. Shareholders' strategy set is {accept, reject}. A1 and A2 represent that the shareholder accept the manager's offer at node 1 and node 3, respectively.[7]

Figure 2 'Stupid' investors' strategies in share repurchase

[7] We do not label the shareholders' reject strategy in the game. If a shareholder does not accept the manager's offer, he automatically chooses the reject strategy.



At node 1, the initial point, the manager has two strategies: (1) to repurchase at least one share or (2) not to repurchase any share. If the manager chooses not to repurchase any share, the game is over and the expected payoffs for each of investors do not change. If the manager chooses to repurchase at least one share, he offers a tender price, $10.9, which is slightly higher than current stock price, to buy shares from other shareholders.

At node 2, all shareholders observe the tender price and choose their own strategy, to accept the offer or reject the offer, by comparing the expected payoff from each of these two strategies. With a $10.9 offering price, only shareholder 1 is willing to tender his share, since his payoff from tendering, 10.9, is higher than his expected payoff, 10, from holding his share. Other shareholders choose to reject the offer, since tendering shares will reduce their payoffs.

After shareholder 1 tendering his share, the manager re-calculates the value (his expected payoffs) for each of the remaining shares, (12*4-10.9)/3=12.37. The shareholder 2 and 3 re-calculate the expected payoffs too, based on their own evaluation on the firm value. After shareholder 1 tendering, the expected payoffs for each of the investors are: S1:10.9, S2:11.03, M:12.37, and S3:13.7. The stock price is updated to $10.9-11.03, determined by the manager's

repurchasing price (bid price) and the opinion of shareholder 2 (ask price), who is not the most pessimistic shareholder.

At node 3, the manager again has two strategies: to repurchase more shares or to stop repurchase. He compares the current stock price with his own evaluation, and concludes that the stock is still undervalued. The manager thus chooses to repurchase more shares and offer $11.9, a price slightly higher than current stock price.

At node 4, remaining shareholders observe the manager's second offer, and choose to reject this offer or to accept it. Only shareholder 2 chooses to accept this offer and tender his share, since his expected payoff from tendering 11.9 is higher than 11 from holding his share. Shareholder 3 chooses to reject this offer. Aft shareholder 2 tenders his share, the manager re-calculates his expected payoff again, and the value is 12.6.

At node 5, the manager still has two strategies to choose: to repurchase or to stop. Since the stock price is now $11.9, which (almost) equals to the opinion of the manager himself. The manager will not repurchase any more shares and choose to stop. Without any more repurchases, the payoff for the manager and the shareholder 3's payoff are: M:12.6 and S3:14.6. The game is over.

The equilibrium of this game is: the manager will offer twice and repurchase two shares from shareholder 1 and shareholder 2, respectively. The manager first offers $10.9, and shareholder 1 accepts the offer. The manager then offers $11.9 and shareholder 2 accepts the offer. The manager then chooses to stop and the game is over. The payoffs for each of them are: S1:10.9, S2:11.9, M:12.6, and S3:14.6.

At each period of this game, trade occurs as it increases the payoff for each player. Stock price goes up following the investors' expectation schedule, when the manager repurchases shares. The manager stops repurchase, when the stock price equals to his belief and he cannot increase his payoff through repurchases.

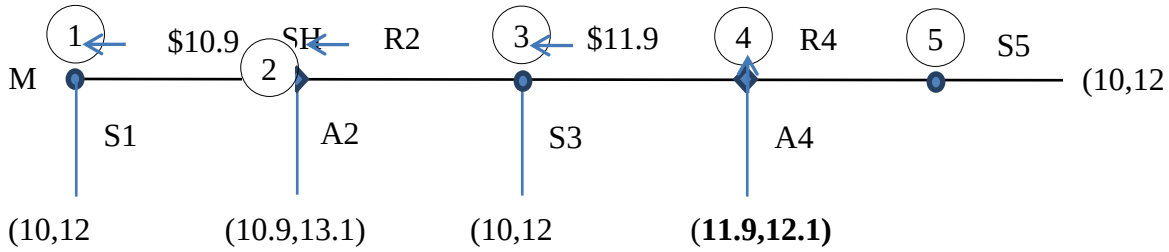
5.4 A 'smart' investor with complete information

In the above 'stupid-investors' model, investors do not respond to the information in the manager's repurchasing announcement. They choose their strategy, at each step, based upon only the *current* repurchasing information (offering price) and their own evaluation.

We now analyze a model where investors choose their strategy based upon the information from the whole game. We further assume that all investors share the full information of the game. Both shareholders and the manager know the whole structure of the game, namely the prices that the manager will offer at each step and the step where the manager will stop offer further repurchases.

To simplify the discussion, we consider the game where only one shareholder and the manager hold one share of the firm asset for each of them. The shareholder believes the firm is worth $10 per share and the manager's belief is $12 per share. The game is played as below in figure 3.

Figure 3 Smart Investor with completed information



This game tree has 5 nodes. At each node, the round circle represents the manager's decision and the square circle represents the shareholders' choice. M stands for the manager, while SH stands for the shareholder. $10.9 and $11.9 are the manager's offering prices. S1, S3, and S5 represent that the manager choose to stop repurchase at each node, respectively. A2, A4, R2, and R4 represent the shareholder's strategy at each node, to accept the offer or to reject the offer. The payoffs for the shareholder and the manager at each step are labeled in the figure.

We solve this game with backward induction. At the last period, node 5, the manager has two strategies to choose: (1) continue to offering at a price higher than 12, or (2) stop the offering. If the manager choose to offer at a higher price, for example 12.1, his pay off will be 11.9. This payoff is lower than 12, the one he can get from stopping the offering. Therefore, the best strategy for the manager is to stop the offering and accept the expected payoff 12. With this 'stop' strategy, the expected pay offs for the shareholder and the manager are (10, 12).

At the node 4, the shareholder's strategy set is (1) to accept the manager's offer at $11.9, or (2) to reject this offer. With the complete information, the shareholder knows that if he rejects

this offer, his expected payoff will be 10, since he knows that the manager will stop offer at next step. Therefore, the shareholder will choose to accept the manager's offer, 11.9, at this step.

At the node 3, the manager knows that if the manager extends the offer at $11.9, the shareholder will choose to accept the offer at his turn rather than reject it. The manager also knows that when the shareholder accepts the offer, his expected payoff will be 12.1. At the node 3, the other strategy that the manager can choose is to stop offering. If the manager choose to stop offering, he know that his expected payoff will be 12, which is less than the payoff he can get if he offer to repurchase at $11.9. Therefore, manager will choose to offer at the price $11.9 at node 3.

Back to node 2, the shareholder has choices between reject the offer at $10.9 or accept this offer. Since the shareholder knows the whole structure of the game, he knows that manager will offer at $11.9, if he rejects this offer of $10.9. He also knows that he can accept the offer at next step with a payoff 11.9, which is higher than the payoff 10.9 from accept the current offer. He thus chooses to reject the offer at $10.9 and expects the manager to offer at $11.9.

Back to the node 1, the original node, the manager knows the shareholder will reject his offer at $10.9 and wait for the offer at $11.9. However, if the manager chooses not to offer at very beginning, his expected payoff is only 12. Comparing the payoff he can get from offering to the last step, 12.1, the manager will choose to offer to repurchase shares. The game is solved.

There exists an equilibrium, in which the payoffs for the shareholder and the manager are (11.9, 12.1). The shareholder will reject all the manager's offers but the last one. The manager

will choose to repurchase shares with a higher offering price until the last step, where the offering price (almost) equals to the manager's evaluation.

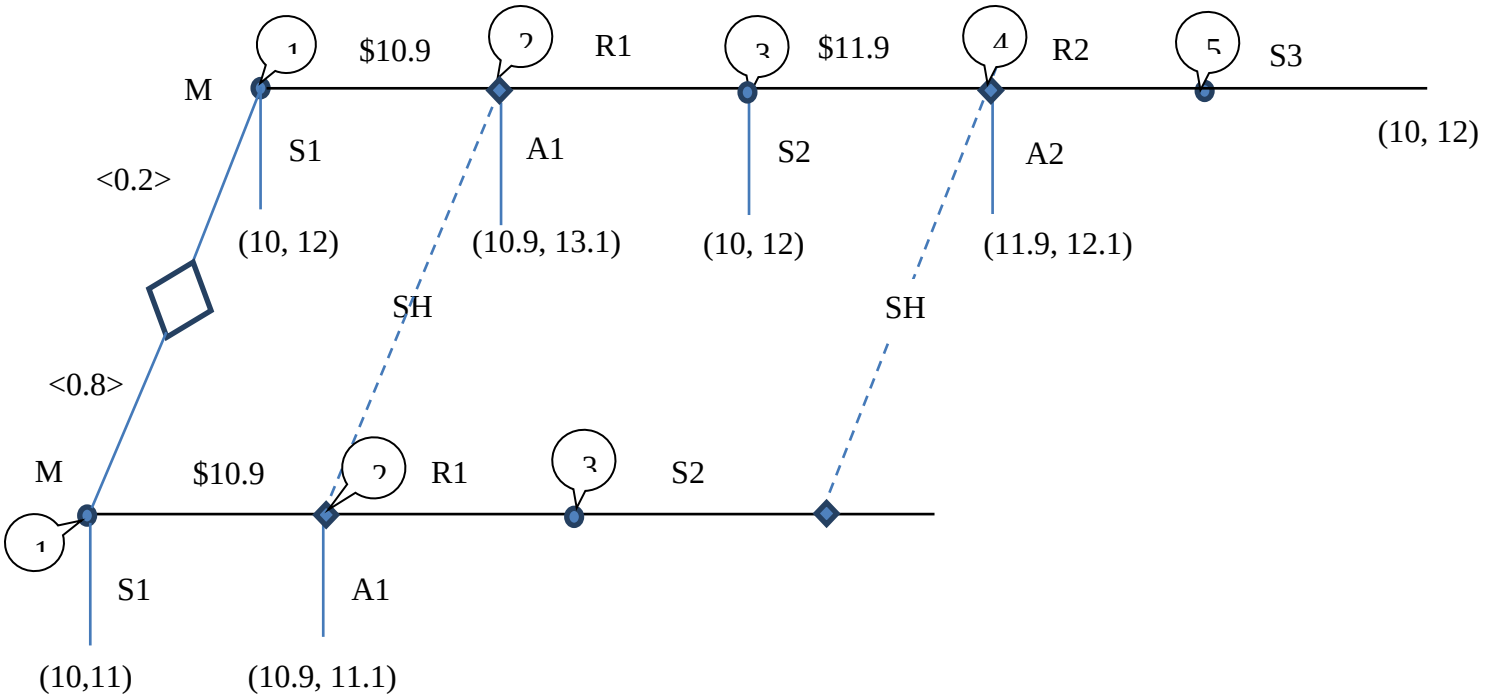
In this 'smart-investor', complete information game, shareholders will choose to hold their shares right before the manager stop offering, regardless of their own expectation. The trade will not occur until the manager's last offer. All shareholders, whose evaluations are lower than the manager's, will accept the manager's last offer. Other shareholders, whose evaluations are higher than (or equal to) the manager's, will reject all the manager's offerings. The payoffs for all shareholders and the manager increase when trade occurs.

5.5 A pessimistic 'smart' investor with in-complete information

At the initial state of the nature, a manager and a shareholder hold each share of a company. There are two states in the game, where the nature decides which state applies. In the state with good economy, the shareholder and the manager hold beliefs, $10 and $12, for value of each share. In the state with bad economy, the shareholder and the manager hold beliefs, $10 and $11, for value of each share. The possibility of the good economy is 0.2, and 0.8 for the bad economy.

Both the manager and the shareholder do not have the knowledge that which state of nature applies. The shareholder neither has the knowledge of the manager's belief, but he can observe the current offering price. The game tree is presented in Figure 4 and all symbols are same as the ones in Figure 3.

Figure 4 Smart pessimistic investors with in-complete information



At node 1, if the manager does not offer to repurchase, the game is over. However, whatever the nature is, the manager has potential gain from the trade, as 11.1>11 in the bad economy, and 13.1>12 in the good economy. The manager is thus willing to offer a repurchase. His first offer is $10.9.

At node 2, observing the manager's offer price $10.9, the shareholder makes the choice between accept the offer or reject it.

If the shareholder believes that the current state is in the good economy and the manager's reservation value is $12, he will choose to reject the offer at node 2, since the payoff

from the next offer, 11.9, will be higher than the one from the current offer 10.9. After the shareholder rejects the manager's first offer at node 2, he expects the manager's second offer.

At node 3, the manager chooses to continue to offer repurchase, since the payoff from repurchase 12.1 is higher than 12 from stop repurchase.

At node 4, the shareholder will accept the manager's offer at $11.9, and his gain will be 1.9 (11.9-10). With the probability of 0.2 of the good economy, his expected gain is 1.9*0.2=0.38.

Back to node 2, if the shareholder believes that the current state is in the bad economy and the manager's reservation value is $11, he chooses to accept the offer and tender his share at node 2 with price $10.9, because he believes there is no further offer. With the probability of 0.8 of the bad economy, his expected gain is 0.72=0.9*0.8=(10.9-10)*0.8 .

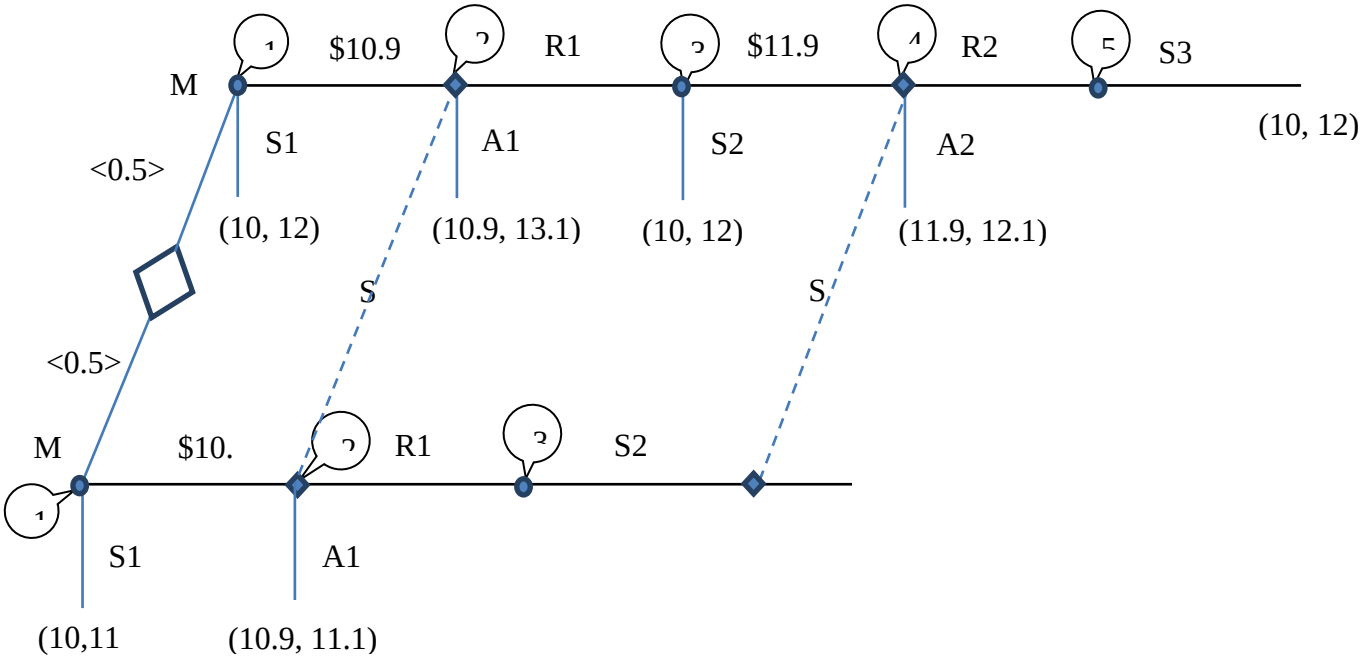
If the shareholder misunderstands the economy and accepts the first offer 10.9 in a good economy, he still has expected gain 0.18=0.9*0.2=(10.9-10)*0.2. Therefore, his total expected gain from accepting the first offer 10.9 is 0.9=0.72+0.18.

In equilibrium, with the belief structure of the investor on the manager's reservation value, (11:0.8, 12:0.2), the shareholder will always choose to accept the manager's first offer, since the expected payoff 0.9 is higher than 0.38 from other strategy. The payoffs for the shareholder and the manager are (10.9, 13.1).

5.6 An optimistic 'smart' investor with in-complete information

Now, let us consider another situation, where another shareholder holds the same prior belief about the company, but she react differently to the manager's repurchase offering. Assume the second shareholder is more optimistic and her belief structure on the manager's reservation value is (11:0.5, 12:0.5). The game has no changes, but the shareholder's expected gains change.

Figure 5 Smart optimistic investors with in-complete information



If the second shareholder accepts the offer at node 2, her total expected gain is 0.9. If she rejects the manager's offer at node 2, and is be able to get the offer at node 4 in the good economy, her expected gain is 1.9*0.5=0.95. Obviously, as an optimistic shareholder, the second shareholder will choose to reject the first offer and to wait the manager's second offer.

The manager, after seeing the shareholder rejects his $10.9 offer, has two strategies: one, to continue the second offer at $11.9, or two, to stop offering. The manager knows that, if he offers at $11.9 and the shareholder accepts the offer, his payoff will be 12.1. If the manager stop offering, his payoff is 12. The manager thus chooses to offer at $11.9. The payoffs for this shareholder and the manager are (11.9, 12.1), when the manager offers the second repurchase.

In equilibrium, with the belief structure of the investor on the manager's reservation value, (11:0.5, 12:0.5), the shareholder will always choose to reject the manager's first offer and accept the manager's second offer. The manager will also continue to offer until the offering price (almost) equals his reservation value. The payoffs for the shareholder and the manager are (11.9, 12.1).

VI Conclusion

In this paper, we briefly survey the literature of the investor heterogeneity, specifically, investor divergence of opinion. The purpose of this survey is to build a deep and broad understanding of investor divergence of opinion. We then initiate a model based on investor divergence of opinion in order to explain managers' motivation of share repurchase and related asset pricing anomalies.

We review the theories on investor divergence of opinion. Investors can have differing opinions of a single firm, even without information asymmetry. Most theoretical studies suggest that investors draw different opinions due to two reasons: first, investors have different prior beliefs and second, investors have the same prior beliefs, but different information process models. Recently, Fama and French (2007) argue that investors can have different taste on one asset, and therefore, have different utility functions on the same payoff.

Empirical evidence generally supports the existence of investor divergence of opinion and its impact on asset prices. Bagwell (1991b) and Bagwell (1992) document direct evidence of investor heterogeneity from Dutch Auction repurchases. The evidence of Miller (1977)'s over-valuation hypothesis has also been found, suggesting that investor divergence of opinion has an impact on equilibrium asset prices.

We apply Miller (1977)'s theory, and initiate a model of open share repurchases. Our model suggests that managers repurchase shares due to divergence of opinion. Managers believe pessimistic shareholders undervalue the stock, and thus repurchase shares from them. Stock prices increase as managers repurchase shares. Wealth is transferred from tendering shareholders to non-tendering shareholders when manager repurchase shares, only if those managers are not too optimistic and purchase shares at a price higher than the intrinsic value.

CHAPTER TWO:
INVESTOR HETEROGENEITY IN BELIEFS AND ITS IMPACTS ON SHARE REPURCHASE: A SURVEY

Recently, the popularity of share repurchases by firms has drawn a lot attention and raises an important question: Why do firms repurchase shares?[8] Although researchers have proposed several hypotheses, there are discrepancies between the theoretical work and the empirical findings. The goal of our paper is to develop a new theory of share repurchase, which is consistent with the results of previous empirical studies, and to test the importance of investors' expectation in the manager's decision to repurchase shares.

This paper provides an alternative theory of share repurchases that is consistent with the results of previous empirical studies. The theory builds on the idea that managers' share repurchase decision depends on their valuations, and the investors' valuations of the firm. With different priors, investors could have separate expectations on the firm's future cash flows, although they share the common information about the firm's investment portfolio. Optimistic shareholders, who have higher expectation on future cash flows and believe that current stock price is undervalued, would rather pay a premium to pessimistic shareholders for their shares and acquire more rights on future cash flows. Pessimistic shareholders are willing to tender their shares, if the repurchasing price is higher than their valuations. With short sales constraints, those pessimistic shareholders will not be able to build up short positions after tendering. As suggested by Miller (1977), stock price stays high when those pessimistic opinions are not

[8] Although U.S. corporations chose to pay out cash in the form of dividends rather than share repurchases in the past decades, Grullon and Michaely (2002) report that the expenditure on share repurchases relative to earnings expanded almost 10 times through 1980 to 2000.

reflected in the price.[9] The magnitude of the price increase is dependent upon both the degree of divergence of opinion and the quantity of shares actually repurchased. The larger the divergence of opinion, managers will repurchase more shares and the stock prices increase following those actual repurchases. From the optimistic investors' point of view, the stock was indeed undervalued. However, such undervaluation is not necessarily due to the information asymmetry, but simply the different opinions. It is the heterogeneous expectation that generates 'undervaluation'.

Managers could choose share repurchase regardless of the presence of agency problem, if only the divergence of opinion is large. If managers work for the best interests of shareholders, they could repurchase shares as long as the expenditure on share repurchase does not affect the real investment decision. Share repurchases increase the utility for both pessimistic and optimistic shareholders. When agency problem emerge, managers might over-repurchase shares and push up stock price in short run. As in Jensen (1986), they would have to skip good investment opportunities due to the lack of cash in the future. In both cases however, managers benefit from the increases in stock price through options and stock compensation.[10]

It seems that managers can always artificially push up the price through share repurchases, but there are constraints that limit managers. First, managers must have 'excess free cash' in hand in order to keep the repurchasing cost at a minimum. Without good investment opportunities, holding excess cash earns only returns at risk free rates, while the cost of

[9] The evidence of Miller (1977) theory has been documented by Diether, Malloy and Scherbina (2002), Chen, Hong and Stein (2002), Chang, Cheng and Yu (2007), and Boehme, Danielsen and Sorescu (2009).

[10] See Vermaelen (1984), Lambert, Lanen and Larcker (1989) and Fenn and Liang (2001) for more comprehensive discussion on the management incentive to share repurchases.

borrowed cash could be too high to finance a repurchasing program. Second, managers will have to pay the optimistic shareholders higher returns for the additional idiosyncratic risks from extra stake holdings. With heterogeneous expectations and short sale constraints, idiosyncratic risks cannot be fully diversified, and thus, are priced.[11] Empirically, Babenko (2009) finds that managers and employees are forced to bear more firm-specific risk after share repurchases. These two constraints predict that large, low growth firms, which usually have more excess cash and lower idiosyncratic risks, are more likely to repurchase shares. This prediction is consistent with the empirical evidence that abnormal returns are concentrated in 'value' rather than 'glamour' stocks.

We find empirical evidence that supports the investor heterogeneous expectation model. The higher the divergence of opinion among investors, the more likely a firm is to repurchase its shares, announce larger target shares, and actually repurchase more shares. Such results hold, even after controlling other factors, such as the signaling and agency hypotheses. Finally, we find that firms earn long-term excess returns only when they actually repurchase shares. A portfolio that consists of no-actual-repurchasing firms earns no abnormal returns following repurchase announcements. Overall, our empirical evidence supports the divergence of opinion hypothesis as an alternative explanation for share repurchases, even after controlling for other hypotheses such as the undervaluation-signaling hypothesis.

[11] Theoretical works can be found in Mayshar (1983), Constantinides and Duffie (1996), and Fama and French (2007); while empirical evidence are documented by Goyal and Santa-Clara (2003) and Storesletten, Telmer and Yaron (2007).

Our paper is closely related to Dittmar and Thakor (2007), who build a heterogeneous expectation model to explain the management choice between issuing debt or equity when financing an investment. They find that managers issue debt rather than equity when the markets disagree with them. Our results are also consistent with Bagwell (1991) and Bagwell (1992), who find evidence that shareholders have heterogeneous expectations about firm value.[12]

The rest of our paper is organized as follows: Section II review the literature. Section III proposes the heterogeneous expectation model in the context of share repurchases.[13] Section IV provides several testable predictions and discusses testing methodology. Sample statistics and empirical results are presented in Section V. Section VI tests the prediction on stock price following actual share repurchases and Section VII presents our conclusion.

II. Review of the existing hypotheses and the puzzling empirical findings

The undervaluation signaling hypothesis, one of the most popular arguments, is built upon information asymmetry theory.[14] This hypothesis suggests that repurchased stocks are undervalued by investors due to information asymmetry. Announcements of share repurchases are signals from managers to dissipate information asymmetry. Extraordinary growth in share repurchases could be the evidence that repurchases are an efficient signaling tool to correct

[12] Huang and Thakor (2010) also propose an investor-management agreement explanation on share repurchases. However, their paper focuses on the changes of agreement parameter around repurchases, rather than the changes of stock prices following actual share repurchases.

[13] In a separate paper, we build a formal model based on Mayshar (1983), who provides the form of asset price at equilibrium with the heterogeneous investors and the presence of short sale constraints.

[14] Theoretical works include Vermaelen (1984), Ofer and Thakor (1987), and Constantinides and Grundy (1989), among others. Empirical evidence has been suggested by Vermaelen (1981), Dann, Masulis and Mayers (1991), Comment and Jarrell (1991), D'Mello and Shroff (2000), Grullon and Michaely (2004), Louis and White (2007), and Massa, Rehman and Vermaelen (2007).

mispricing.[15] However, recent empirical evidences from markets around the world impose doubts on this hypothesis. Ikenberry, Lakonishok and Vermaelen (1995) find a buy-and-hold portfolio, built after announcements, earns significant positive abnormal returns and suggest markets under-react to announcements. Such abnormal returns have also been documented in Canada (Ikenberry, Lakonishok and Vermaelen (2000)), UK (Rau and Vermaelen (2002)), and Japan (Zhang (2002)), etc. Peyer and Vermaelen (2009) confirm the persistency of such abnormal returns, and conclude that 'Without under-reaction, such a strategy cannot be successful'.[16] The persistent market under-reaction is *inconsistent* with the hypothesis that repurchase announcements are an efficient signaling tool.

Another puzzling fact is that the post-announcement abnormal returns are driven by high book-to-market ratio firms. Ikenberry, Lakonishok and Vermaelen (1995) find that the abnormal returns are concentrated in 'value' stocks rather than 'glamour' stocks. Ikenberry, Lakonishok and Vermaelen (2000), Zhang (2002), and Von Eije and Megginson (2008) confirm this pattern with data from Canada, Japan, and Europe.[17] High book-to-market ratio firms are usually value firms with less growth opportunity. Their values are determined mainly by assets in place, rather than uncertain growth in the future. One would expect that high book-to-market ratio firms

[15]Wansley, Lane and Sarkar (1989) and Graham and Harvey (2001) survey the CFOs for the reasons for share repurchases and managers response undervaluation is their first motivation among others.

[16] Peyer and Vermaelen (2009), "The nature and persistence of buyback anomalies," Review of Financial Studies, 22-4, page 1745.

[17] Von Eije and Megginson (2008), however, provide a different explanation and focus on the substitution effect between dividends and share repurchases.

should have less information asymmetry problem.[18] However, why do these less information-asymmetric firms gain more from information signaling? Moreover, Barth and Kasznik (1999) examine 3,661 open market repurchase announcements and find that general information asymmetry is negatively related to the likelihood of repurchase announcements. We generalize the empirical findings and the theoretical predictions in figure 1.

Figure 1 Hypotheses and empirical findings
This table generalizes the empirical findings and the theoretical predications of the price/return behavior and the likelihood of share repurchases. + (-) refers to a positive (negative) reaction or relationship correspond to an event. O refers to the theory predicts no reaction to an event.

		Empirical evidence	Heterogeneous expectation hypothesis	Undervaluation-Signaling hypothesis
1.	Announcement effect of share repurchase	+	+	+
2.	Post-announcement return	+	+	O
3.	Post-announcement drift in value firms	+	+	O
4.	Likelihood of share repurchase	+(divergence of opinion) - (information asymmetry)	+	+

Other proposed hypotheses may be used in explaining the motivation for share repurchases. These hypotheses include the excess capital distribution hypothesis which is based on agency theory, leverage hypothesis which is based on capital structure theory, anti-takeover hypothesis which is based on corporate governance literature, and etc. Dittmar (2000) examines those hypotheses simultaneously from 1977 to 1996, and concludes that most hypotheses are

[18] This argument borrows the same idea as in Myers (1977) that a firm's value is given by current assets and the value of real options from discretionary future investment opportunities.

only significant in a particular period, except for undervaluation-signaling and excess capital distribution hypotheses.[19]

III. The model

In this section, we introduce a simple model where investors have divergence of opinion on a firm value and do not update their beliefs even though they observe the manager's repurchasing signal.[20]

3.1 A Simple Model Built on Miller (1977)

We first introduce the idea developed from Miller (1977). A firm has N shares and N shareholders, with each of them holds one share. Without divergence of opinion, all shareholders agree that the value of the firm is P_c per share, the respective demand curve of shares is OC in figure 2. With divergence of opinion, optimistic shareholders hold higher reservation value of the firm and the demand curves shift upwards. According to the marginal-investor theory, the stock price is determined by the most pessimistic investor. From figure 2, one can see that the higher the divergence of opinion (AO>BO>CO), the higher the stock price ($P_A > P_B > P_C$). This is the Miller (1977)'s divergence of opinion driven 'over-valuation' hypothesis, where supply of shares or shares outstanding is fixed.

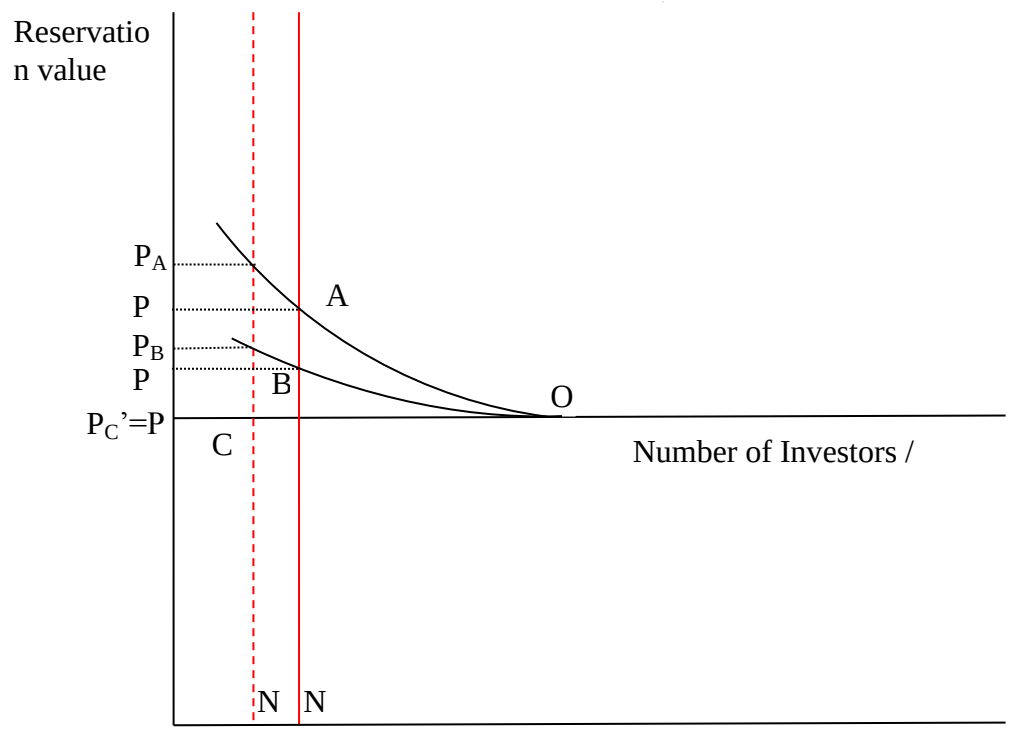
Figure 2 Share repurchase with divergence of opinion and short sale constraints

This figure is drawn as Miller (1977). X axis represents the number of shares or the number of investors, assuming one investor holds one share. Y axis represents the equilibrium stock price. Curve AO, BO, and CO are the demand curves on shares when investors hold different opinion on the firm's value. AO represents the case where investors

[19] See also Grullon and Ikenberry (2000), Allen and Michaely (2003) among others, for the review of motivation for share repurchase.

[20] Conlon, Fuller and Wang (2011) propose models of share repurchase with investor divergence of opinion. They show that in the equilibrium of this simple model is similar to a complex model where heterogeneous investors update their beliefs but do not have the full information about actual share repurchases.

have the highest divergence of opinion while CO represents the case where investors hold homogeneous expectations. N and N' are the shares outstanding (supply) before and after the actual share repurchase.



Now, let us consider a situation where the manager can endogenously determine the supply of shares through share repurchases. As long as the manager is not the most pessimistic one among all shareholders, he observes the current stock price as *undervalued*, and thus has incentive to repurchase shares. After share repurchases, the number of shares outstanding drops to N'. The equilibrium stock prices are $P_A^{'}, P_B^{'}, P_C^{'}$, respectively.

Without the divergence of opinion, the stock price moves along the demand curve CO and does not change, $P_C^{'} = P_C$. With the divergence of opinion, stock prices go up along the demand curves AO and BO and $P_A^{'} > P_A, P_B^{'} > P_B$. Therefore, the manager can push up the stock price by repurchasing

shares from pessimistic shareholders when the divergence of opinion exists. Furthermore, it is easy to show that $P_A^{'} - P_A > P_B^{'} - P_B$. The higher the divergence of opinion, the larger the price increases when the manager repurchases the same amount of shares.

3.2 The Model of Share Repurchase with 'Un-Smart' Shareholders[21]

A firm has N shares and N shareholders, with each of them hold one share.[22] At the beginning, period 0, the firm has projects with future cash flow CF, which will be realized in the future, and 'free' cash C_0 in hand.[23] Without the discount on time, the 'true' value of this firm is $V_0 = V_4 = CF + C_0$.

With divergence of opinion, the shareholders hold different prior beliefs about the firm's project future payoff.[24] The most pessimistic shareholder believe the firm is worthy of $V^1 = CF^1 + C_0$. According to the marginal-investor theory, his opinion determines the asset price, such that $P_0 = V^1$. With the wealth constraints, other optimistic shareholders are not able push up the stock price by buying his shares; with short sale constraints, the more pessimistic potential investors are not able to push down the price by short selling the stock. We outline the events of this four-period model in figure 3.

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[21] We use the 'un-smart shareholders' to refer investors who update their expectations as the stock price goes up, but they do not try to infer the manager's repurchasing decision with the observed price information.

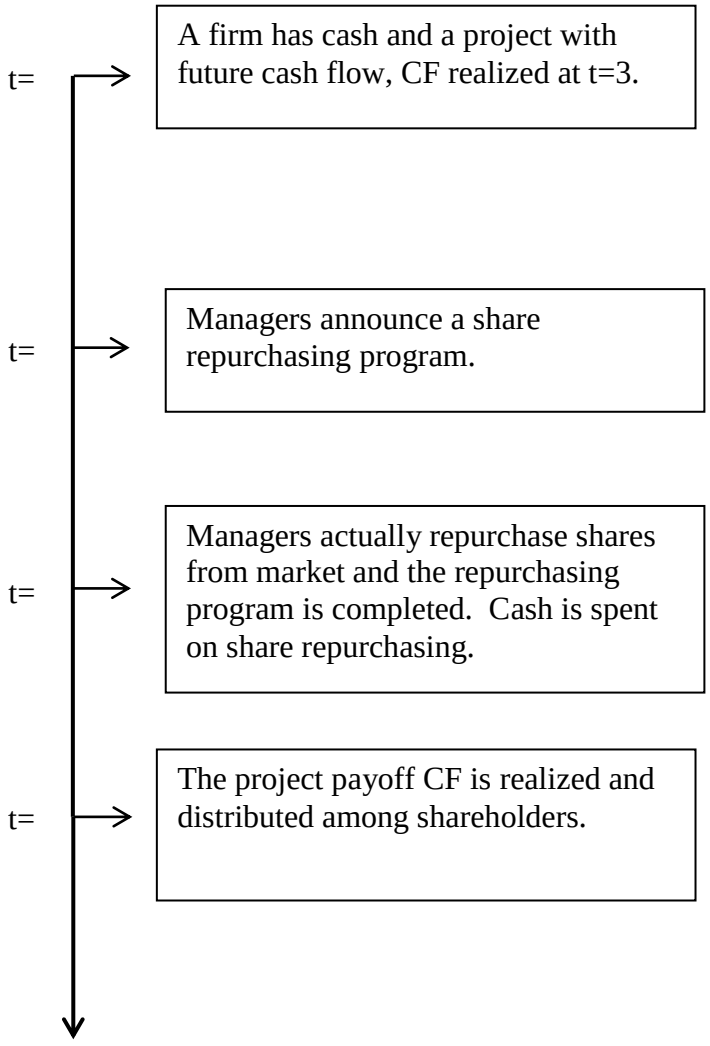
[22] We look the manager as one of the shareholder and he also holds one share.

[23] Since we do not restrict the sign of cash, one can always divide a firm's assets into a project portfolio, which includes all the investments and future investment opportunities, and cash. A positive C_0 means the firm has excess cash and no good investment opportunities; zero value of C_0 means the firm exhausts its cash and investment opportunity simultaneously; while a negative sign means the firm will have to borrow to finance some possible investments. In the later cases, managers will have to borrow to finance share repurchases.

[24] We assume no information asymmetry between the manager and shareholders, neither among shareholder themselves. The different expectation on the project payoff is due to different prior beliefs.

Figure 3 the time line of the model

This figure outlines the sequence of events. Time 0 is the initial start point, where a firm has an ongoing project and cash. In period 1, the manager announces a share repurchase program. In period 2, the manager makes the offer and actually repurchases shares from the market. In response to the manager's offer, some shareholders tender their shares. Cash is spent on share repurchases. In period 3, the payoff of the firm's project is realized and distributed among remaining shareholders.



In period 1, the manager announces an open market share repurchasing program. Shareholders keep their belief unchanged.[25] The equilibrium price is also unchanged, $P_1 = P_0$.

In period 2, the manager actually repurchases shares from the market, with an offering price $P_2 > P_1$. In response to this offer, shareholders tender their shares. However, with different evaluation on the firm, not every shareholder tenders his share, but only the ones whose reservation values are lower than P_2. The new marginal investor holds a reservation value equal to P_2 and has no difference between tendering and holding his share. Thus, P_2 is the new equilibrium stock price and is greater than $P_1 = P_0$. The stock prices keep increases as long as the manager repurchases shares from the market.

During the period 2, cash C_0 is spent on repurchasing shares.[26] The firm's project payoff CF is unaffected by repurchases. Each of remaining shareholders updates their beliefs about the firm value by a deduction of C_0, respectively.

In period 3, the project payoff CF is realized and distributed evenly among remaining shareholders.

3.3 The Numerical Example for Price Drift and Long-term Abnormal Returns

[25] As we assume no information asymmetry between the manager and investors, there is no information released from repurchasing announcement. Shareholders, thus, do not update their beliefs in response to the announcement. However, as we assume investor heterogeneity, shareholders could have different opinion because they have different information process models, as suggested by Harris and Raviv (1993) and Anderson, Ghysels and Juergens (2005). In this framework, shareholders react differently to the common repurchasing announcement and their reservation values may divergent further.

[26] One should notice that C_0 is an arbitrage number. C_0 at the beginning status can be set as any number and equal to the amount spent on actual repurchases. Extra cash can be integrated as part of the project.

We use a simple numerical example to illustrate the increases in a stock price following share repurchases. We also decompose the increases in stock price to analyze the price upward drift and the long-term abnormal returns.

For simplicity, we assume there are three shareholders and one manager in the firm. Each of them holds one share. Let the 'true' value of the firm at liquidation be $48. If all shareholders keep their shares to the last period, each of them will equally acquire one-fourth of the firm's wealth, $12.

With the divergent opinions, each of investor (including shareholders and the manager) has his own expectation on the firm's future value. Shareholder 1 (SH1) believes each share will be worth $10, $11 for shareholder 2 (SH2), and $13 for shareholder 3 (SH3). The manager, by chance, holds the belief of $12 each share.

With short sale constraints, the stock price is traded at $10 per share, which represents the most pessimistic shareholder's opinion as suggested by marginal-investor-theory. From the point of the manager's view, the stock is undervalued. Without share repurchase, the expected payoffs for each of the investors are: SH1: 10, SH2: 11, M: 12, and SH3: 13.

The manager first offers $11 to repurchase shares. Only shareholder 1 is willing to tender his share. After tendering, the stock price goes up to $11. The remaining shareholders and the manager update their expected payoffs as: SH2: 11, M: 12.3, and SH3: 13.6.

As the stock price $11 is still below the manager's belief, he offers to repurchase again at $12. This time, only shareholder 2 tenders his share. After tendering, the stock price goes up to

$12. The manager and the shareholder 3 update their expected payoffs as: M: 12.5, and SH3: 14.5. As the stock price is close to the manager's belief, he stops to repurchase any more shares.

One can directly observe that the stock price goes up along the shareholders' reservation value schedule when the manager repurchases shares. This price rising is consistent with the stock price upward drift after the announcements of open market repurchase, as managers usually repurchase shares for a number of years after their announcements.

The manager, by chance, holds an expectation about the firm's value equal to $15/share.27 Thus, the firm is undervalued from the managers' point of view (i.e. $P_0 < \$15$). The manager would be willing to offer $12/share to repurchase the 20 shares hold by those pessimistic shareholders.

Furthermore, one can see that not only the stock price increase, but also the remaining shareholders' expected payoffs increase. As long as the manager is not over-optimistic, or the manager does not repurchase the shares at the price higher than the 'true' value of each share, the remaining shareholders always gains from the share repurchases. The gains come from the wealth transfer from tendering shareholders to non-tendering shareholders.

For example, at the first repurchase, the manager buys a piece of asset worth $12 at the cost of $11. There is $1 wealth transferred from shareholder 1 to other shareholders. We argue that the long-term abnormal returns come from the wealth transfer effect from actual share repurchases.

There is no arbitrage opportunity for outside investors. An arbitrager, who observes the manager's announcement and wants to takes advantages of future price drift and abnormal returns, has to buy shares from existing pessimistic shareholders. The purchases from the arbitrager will simply push up the stock price. As the price goes up the level of the manager's belief, the manager will not repurchase any shares. The arbitrager thus become a shareholder and cannot load off his shares unless he sells at lower price.

There are limits of benefits from share repurchase too. First, the manager has to use free cash or low-cost debt to finance share repurchases. When considering the time value of the money, the cumulated interests could be too high between the time of repurchases and the time of future project payoff, the benefits from wealth transfer is limited. Second, the manager and remaining shareholders bear more idiosyncratic risk as some shareholders tender their shares. As suggested by Mayshar (1983) and Fama and French (2007), with divergence of opinion, the idiosyncratic risk is not fully diversifiable. Remaining shareholders ask for higher returns for bearing more idiosyncratic risk and push down the stock price.

IV. Testable Predictions and Testing Methodology

4.1 testable predictions

A key aspect of our study is to differentiate between the investor's heterogeneous expectations and signaling hypothesis. Since the information asymmetry is not the main force generating different valuations in our model, including the information asymmetry variables should not affect the statistical significance of the coefficients on our proxy variables that

measure the divergence-of-opinion among investors. Our tests examine whether including the divergence-of-opinion proxies affects the statistical significance of variables that control for information asymmetry. Thus:

H1: Firms with a higher divergence of investors' opinion are more likely to repurchase shares.

As the difference in valuations between optimistic investors and pessimistic investors gets larger (i.e. divergence of opinion increases), the more shares managers will be willing to repurchase. Thus:

H2: The higher the divergence of opinion, the larger the targeted fraction of shares in repurchasing announcements.

The model suggests stock price increases following actual share repurchases, as pessimistic shareholders leave the market after tendering their shares. Since a repurchase program is usually completed across years, a long-term abnormal return could be the result of long-term repurchase program. Thus, in long-run, stock price should not increase if managers only announce but do not actually repurchase shares.

H3: A firm does not earn long-term abnormal return following repurchase announcements, if managers do not actually repurchase shares.

Information asymmetry hypothesis argues that stock price will increase following repurchase announcements, because announcements signal a better future. Without the disclosure of actual share repurchases after announcements, investors have no reason to postpone their actions. Testing the prediction 3 would help to separate this model from signaling hypothesis.

Rather than attributing to investors' under reaction, our model suggests that the 'long-term price drift' is because managers repurchase shares across a long period. [28]

4.2 testing methodology

To examine the likelihood that a firm repurchases shares, we construct a sample of repurchasing and a matching sample of non-repurchasing firms. We then pool the repurchasing sample and non-repurchasing control sample as our full sample. The variable $REPUR_{i,t}$ is set to one if a firm announces at least once open market repurchase in that year, and is equal to zero otherwise. Logistic regressions are run to test the likelihood ratio after including proxies control for different hypotheses.

We choose four proxies to measure the divergence of opinion. The first proxy is the standard deviation of analyst earnings forecasts divided by the mean of the analysts' forecasts, $Disp1_{i,t}$, (see Diether, Malloy and Scherbina (2002)). For each month, we compute the monthly divergence of opinion for a firm by using the annual fiscal year earnings estimate for that month. We then estimate the average yearly divergence of opinion ($Disp1_{i,t}$) as the mean of the monthly divergence of opinion in any given year. Since the mean of analyst earnings forecast could be zero, and infinite analyst dispersion could be problematic, we choose an alternative measure $Disp3_{i,t}$, which we define as the standard deviation of analyst earnings forecasts scaled by stock

[28] An even more direct test is to examine whether price increases right after managers repurchase shares from the market. Such a test will give us a clear episode of how actual share repurchases move the price. We are not able to test this prediction due to the limits of U.S. data in this paper. With the detailed data from Hong Kong market, we will be able to examine the price behavior around actual repurchase directly.

price.[29] Our model suggests that it is the difference in valuations between optimistic and pessimistic investors that matter. Thus, our second proxy for the divergence of opinion is the difference between the highest earnings forecast and the lowest one, scaled by the absolute value of the mean earnings forecast.

$$\begin{aligned} Disp1_{i,t} &= Std(\,forecast)_{i,t} / Mean(\,forecast)_{i,t}; \\ Disp3_{i,t} &= Std(\,forecast)_{i,t} / Stock\_\Pr ice_{i,t}; \end{aligned} \tag{4.1}$$

We use the abnormal market adjusted turnover, $Abto_{i,t}$ (Hong and Stein (2007) and Garfinkel (2009)) and standardized unexplained stock trading volume, $SUV_{i,t}$ (Garfinkel and Sokobin (2006) and Garfinkel (2009)) as our third and fourth proxies for divergence of opinion. To avoid the less-trading-frequency problem, we first compute the weekly trading volume and return for each stock. The weekly market adjusted turnover is the firm's weekly trading volume divided by its shares outstanding minus the ratio of market total trading volume scaled by market total shares outstanding. The market adjusted turnover is calculated as the yearly average of weekly turnover for each firm year. Standardized unexplained stock trading volume measures the unexpected trading volume from the effect of both liquidity and information. Unexpected trading volume is the residual volume ($\varepsilon_{i,t}$) from a regression of the firm's weekly trading volume on weekly signed absolutely returns:

$$Volume_{i,t} = \alpha_i + \beta_i \left|R_{i,t}\right|^{+} + \gamma_i \left|R_{i,t}\right|^{-} + \varepsilon_{i,t}\,, \tag{4.2}$$

[29] Since the result for $Disp1_{i,t}$ are essentially the same as for $Disp3_{i,t}$, we report the result only for $Disp1_{i,t}$.

The plus and minus superscripts on the absolute valued returns indicate the sign of weekly returns. The standardized unexplained trading volume is the yearly average of such residuals scaled by the standard deviation of residual.

Our study examines three measures of information asymmetry. First, we include a direct measure of information asymmetry by following Durnev, Morck and Yeung (2004). They suggest that greater firm-specific variation in stock price represents more information compounded into price and thus less information asymmetry. This measure is also employed by Morck, Yeung and Yu (2000), Bushman, Piotroski and Smith (2004), Dittmar and Thakor (2007), and Duarte *et al.* (2008). The firm-specific variation, $Psi_{i,t}$, is defined as a natural log transformation ($Psi = \ln(\frac{1-R^2}{R^2})$) of R-squares from the following regression:

$$Ret_{i,t} = \alpha_i + \beta_i Ret\_Industry_{i,t} + \gamma_i Ret\_market_{i,t} + \varepsilon_{i,t}, \quad (4.3)$$

The dependent variable ($Ret_{i,t}$) is equal to the stock's weekly raw return, and the independent variables are industry- (defined as two-digital SIC code) and market-wide value-weighted weekly returns. Industry- and market-wide weekly return is calculated from the daily stock return collected from the Center for Research in Security Prices (CRSP). *Psi* is an inverse measure of information asymmetry: a larger *Psi* reflects lower information asymmetry.

Second, researchers generally believe that analysts' forecasts improve a firm's information environment. For example, Diether, Malloy and Scherbina (2002) suggest a measure for potential information asymmetry, $R\cov$, the residual of analyst coverage. $R\cov$ is equal to the residual, $\eta_{i,t}$, from yearly regressions of ln(1 + analyst coverage) on ln(MK) and ln(B/M) as

equation (4.4). A large residual implies a potential lack of analyst forecasts, and thus, the firm may suffer from information asymmetry.

$$\log(1+number\_analysts)_{i,t} = \lambda_{0i} + \lambda_{1i}\ln(MK)_{i,t} + \lambda_{0i}\ln(BK/MK)_{i,t} + \eta_{i,t} \quad (4.4)$$

Similar to high book-to-market ratio firms, firms with a higher proportion of fixed assets should be more transparent, since the uncertainty about the value of intangible assets and growth opportunities is small. As our third measure of information asymmetry, we compute the ratio of fixed assets to total assets (Dittmar and Thakor (2007)). The book-to-market ratio and the percentage of fixed assets also can be explained as proxies for growth opportunities.

To test the agency theory based excess-capital-distribution hypothesis, we include *Cash* and *FCFs* following Dittmar (2000). *Cash* is defined as cash and equivalents scaled by total assets, while *FCFs*, free cash flows, is the ratio of net income before taxes plus depreciation and changes in deferred taxes and other deferred charges divided by total assets. As our third proxy for agency problems, we include *OXD*, the operating expenditure, defined as operating costs divided by total assets.

Although our model suggests that managers are more willing to repurchase shares when they can finance a share repurchase with excess cash flows, they will not do so if the cash flows can be used to finance good investment opportunities. Thus, managers in a firm with growth opportunity are less likely to repurchase, however, they will be forced to do so if investors worry the cash flows will not be spent on investment but consumed by managers. Following Barth and Kasznik (1999), we construct an index to capture excess cash and limited investment opportunities, *CASHIND*. *CASHIND* is equal to cash from operations plus cash from investing

activities minus cash from financing activities other than that related to repurchases and cash dividends, divided by sales. As suggested by Barth and Kasznik (1999), using this proxy presumes firms do not issue debt to finance share repurchases other than to finance needs from operations or positive net present value projects.[30]

Recent literature suggests managers use share repurchases as an earnings management tool (Hribar, Jenkins and Johnson (2006), Roychowdhury (2006), and Gong, Louis and Sun (2008)). We include profit margin, PM , to capture the managers' earnings management incentive in share repurchases. Profit margin is defined as net income divided by sales.

We control other firm characteristics which have been suggested to affect the decision to repurchase shares. We choose firm size, $\ln mk$, measured as natural log of the firm's market value, which is equal to the average monthly stock price times shares outstanding; and the firm's book-to-market ratio, $bmratio$ (see Fama and French (1993));[31] and the past year average monthly return to capture the momentum effect.

We use a horse racing logistic regression (see Dittmar (2000)) to test the likelihood of share repurchases:

$$\begin{aligned} Repur_{i,t} = {} & \beta_0 + \beta_1 \ln mk_{i,t-1} + \beta_2 bmratio_{i,t-1} + \beta_3 return_{i,t-1} \\ & + \beta_4 InfAsy_{i,t-1} + \beta_5 Agency_{i,t-1} + \beta_6 DO_{i,t-1} + \beta_7 Earnings_{i,t-1} + \xi_{i,t} \end{aligned}, \qquad (4.5)$$

Where, $InfAsy$, $Agency$, DO , and $Earnings$ represent a group of proxies for information asymmetry, agency problem, divergence of opinion, and earnings management as discussed

[30] Due to the lack of data, the variable $CASHIND$, as well as $InTrading$ and $InOwner$, have not been applied to this version of the paper yet.

[31] Please see Fama and French (1993) for the details for this measurement.

above. All independent variables are measured one year prior to the announcements of open market share repurchases.

To test hypotheses H1 and H2, we use only the share repurchase sample. We use both portfolio approach and regression approach to examine the relationship between the fraction of target shares and the determinants of share repurchases. We first sort the repurchasing sample by book-to-market ratio into quartiles, and then sort each quartile by proxies of share repurchase determinants into sub-quartiles. A positive difference in the fraction of target shares between the highest and the lowest repurchase determinant sub-quartile would suggest a positive effect of such determinant on share repurchases.

We then again run the horse race regression to examine the explanatory power of each repurchase determinant. We finally test the relative explanation power of each repurchase determinant by a pooled multi-factor regression.

The tests on hypothesis H3 requires different data and methodology, we will explain them in section V, together with a brief literature review.

V. Sample Statistics and Empirical Results

5.1 Sample selection and sample statistics

We collect open market share repurchase data from the Securities Data Company (SDC) platinum. Our open market repurchase sample spans the period 1994 to 2003 and the selection

criteria is following Peyer and Vermaelen (2009).[32] Specifically, we exclude repurchases driven by anti-takeover or going to private considerations. The shares repurchased must be common stock. We also require that sample firms are U.S. firms listed on the NYSE, Amex or NASDAQ, have available CRSP and Compustat data, and one week prior to announcement a stock price greater than $3/share. In addition, we require the announced repurchase programs have the 'Completed' or 'Intended to Completed' status in SDC till the end of 2009. Stephens and Weisbach (1998) find that not all firms finish their announced repurchasing programs. The managers' motivation for a repurchase may be unclear if they do not intend to finish the repurchasing program.

We collect our matching sample from the population of non-repurchasing firms. In a given year, we build non-repurchasing population including firms that do not announce any type of share repurchases in three years around that year.[33] We select matching sample following Grullon and Michaely (2004). We match the non-repurchasing firm with share repurchase sample by two-digital standard industry Classifications code first, and then matched by the market value and the book-to-market ratio of the firm.[34] The matching score is given by:

$$MC = \left(\frac{market\_value_s - market\_value_m}{market\_value_s + market\_value_m}\right)^2 + \left(\frac{Book/Market_s - Book/Market_m}{Book/Market_s + Book/Market_m}\right)^2 \qquad (5.1)$$

[32] From 2004, the Securities and Exchange Commission (SEC) changes the disclosure policy and requires the firms to report their actual share repurchase activities at monthly basis.

[33] Stephens and Weisbach (1998), Brockman and Chung (2001), Zhang (2005), and Ginglinger and Hamon (2007) report that open market share repurchases usually take years for execution. One year lag after announcement limits the side effect from actual share repurchases.

[34] If matching firm with two digital SIC code is not available, WE use firms matched with one digital SIC code instead.

The matching sample is built up year by year and selected from firms with lowest matching score without duplication.

Analyst earnings forecasts data is collected from the First Call Historical Database (FCHD). FCHD contains consensus estimates of analyst earnings forecasts from 1990. Diether, Malloy and Scherbina (2002) examine the differential between the Detail History file and the Summary History file in I/B/E/S database and find that the results are very similar. We collect the estimate consensus, including mean, standard deviation, and number of analyst forecast, from FCHD directly. Ljungqvist, Malloy and Marston (2008) find a potential sampling problem due to the widespread *ex post* changes to the historical contents of the I/B/E/S database. As they suggest, we avoid such sampling problem by downloading the data after 2006.

We collect firm characteristics: total assets, book value of asset, fixed assets, cash and cash equivalent, sales, net income, operation costs, research & development expense, and tax and other deferred items from Compustat quarterly and annual data. The stock price, return, trading volume, and shares outstanding data are from the Center for Research in Securities Prices (CRSP) daily database. The firm's SIC code, and share code and listing information are from Compustat and CRSP, respectively.

Table 1 reports sample summary statistics. Panel A summarizes the full sample and suggests that the market values of the repurchasing and matching sample are similar. However, when compared to the matching firms, the repurchasing firms have a higher book-to-market ratio. This result casts first doubt on the argument that the book-to-market ratio solely drives the

share repurchases. Repurchase firms also have more cash and free cash flows than controlling sample, consistent with agency hypothesis and our model.

Tabel1 Summary statistics of control variables for various subsamples

Table1 provides medians for control variables for the full sample and several sub-samples. The variables details are: ln(mk), the natural log of market value; bmratio, the Fama and French (1993) Book-to-Market ratio; ln(AT), the natural log of total assets; Cash, the ratio of cash and cash equivalents to total assets, as in Dittmar (2000); CF, cash flow, the sum of net income before taxes plus depreciation and changes in deferred taxes and other deferred charges divided by total assets, as in Dittmar (2000); PM, profit margin, net income divided by sales; XRD, the expenditure on R&D divided by sales; OXD, the operating costs, the total operation costs divided by sales; price, average stock price; stdprc, the standard deviation of monthly stock price; returns, the average monthly returns over 12-month period before repurchase announcement. All variables are observed at one fiscal year prior to the announcement of share repurchase. Non-repurchase sample is constructed as matching sample following Grullon and Michaely (2004). For each firm who announces open market repurchase in a year, we select the matching firm following rules: first, we require the matching population firms do not announce any type of repurchases in three years, one year before and one year after; second, we require the matching firm has the same two-digit SIC code as the announcing firm. If firm with same two-digit SIC code is not available, we use one digit SIC instead; third, we select the matching firm by picking up the smallest matching score without duplication. The matching score is computed as $MC = (\frac{market\_value_s - market\_value_m}{market\_value_s + market\_value_m})^2 + (\frac{Book/Market_s - Book/Market_m}{Book/Market_s + Book/Market_m})^2$. The subscripts s and m refer to sample and matching firms, respectively. All variables are measured in the fiscal year prior to the repurchase announcement. Panel A details the full sample. Panel B details firms in the higher and lower Book-to-market ratio quartile. Panel C details firms in the upper (high disagreement) and lower (low disagreement) quartile of the disagreement parameter, Disp1, the mean of the analyst forecast dispersion, which equals the mean of the standard deviation of analyst EPS forecasts divided by the mean of forecasts, as in Diether, Malloy, and Scherbina (2002) in the year prior to the repurchase announcement. Panel D details firms in the upper and lower quartile of the disagreement parameter, Disp1m, the median of the analyst forecast dispersion. P-values indicate if the Non-repurchase and repurchase samples are significantly different from each other with respect to the sample median and spreads, using a nonparametric Kolmogorov-Smirnov test. ** and * represent statistical significance at 1% and 5% level, respectively.

	Non-repurchase	Repurchase	p-Value of median	p-Value of spreads
Panel A: Full Sample				
Ln(mk)	13.47	13.54	0.49	0.37
bmratio	0.5283	0.5197**	0.00	0.00
Ln(AT)	6.85	7.11**	0.00	0.00
Cash	0.0424	0.0492**	0.00	0.00
CF	0.0351	0.0413**	0.00	0.00
PM	0.0522	0.073**	0.00	0.00
XRD	0.0578	0.0616	0.77	0.51
OXD	0.8557	0.8278**	0.00	0.00
price	24.41	26.38**	0.00	0.00
stdprc	2.97	2.84	0.29	0.49

returns	0.0132	0.0148**	0.01	0.00
# of obs.	2711[35]	1388		

	Non-repurchase	Repurchase	p-Value of median	p-Value of spreads
Panel B: high&low Book-to-Market ratio				
High Book-to-Market ratio				
Ln(mk)	12.96	12.55**	0.00	0.01
bmratio	0.9589	0.9454	0.14	0.56
Ln(AT)	7.02	7.05	0.95	0.92
Cash	0.0242	0.0329**	0.00	0.00
CF	0.0226	0.0301**	0.00	0.02
PM	0.033	0.0607**	0.00	0.00
XRD	0.0249	0.0357	0.65	0.32
OXD	0.8736	0.8254**	0.00	0.00
price	18.43	19.56	0.28	0.74
stdprc	2.05	2.01	0.35	0.48
returns	0.0083	0.0171**	0.00	0.00
# of obs.	741	284		
Low Book-to-Market ratio				
Ln(mk)	14.42	14.53	0.68	0.39
bmratio	0.2146	0.2495**	0.00	0.00
Ln(AT)	6.76	6.84	0.07	0.10
Cash	0.0866	0.0891*	0.04	0.15
CF	0.0514	0.0532	0.62	0.69
PM	0.0794	0.0793	0.16	0.06
XRD	0.0823	0.0733	0.19	0.06
OXD	0.8263	0.8228	0.53	0.57
price	34.08	33.44	0.18	0.08
stdprc	4.67	4.19	0.09	0.07
returns	0.0186	0.0192*	0.04	0.00
# of obs.	707	318		
Panel C: high&low agreement by Dispersion1_mean				
High Disagreement				
Ln(mk)	13.03	12.84	0.18	0.36
bmratio	0.5896	0.5738	0.47	0.12
Ln(AT)	6.35	6.26	0.36	0.38
Cash	0.0492	0.0776**	0.00	0.00
CF	0.0256	0.0289	0.67	0.86
PM	0.0274	0.0393**	0.00	0.02
XRD	0.0726	0.0836	0.21	0.08
OXD	0.8883	0.8775	0.07	0.33

[35] The number of matching firms is different with the number of repurchasing sample is because some firms announce repurchases more than once in our full sample period. The matching firm could be different for the same repurchasing firm in the different announcement years.

price	18.03	18.59	0.42	0.47
stdprc	2.84	2.46*	0.03	0.02
returns	0.0089	0.0096	0.41	0.18
# of obs.	744	381		
Low Disagreement				
Ln(mk)	13.94	13.96	0.59	0.29
bmratio	0.4468	0.4915**	0.01	0.00
Ln(AT)	7.32	7.87**	0.00	0.00
Cash	0.0394	0.04393	0.33	0.44
CF	0.04368	0.0466	0.27	0.21
PM	0.0891	0.1085**	0.00	0.00
XRD	0.0481	0.0428	0.93	0.90
OXD	0.8021	0.7555**	0.00	0.00
	Non-repurchase	Repurchase	p-Value of median	p-Value of spreads
price	30.87	31.18	0.72	0.36
stdprc	3.27	3.12	0.68	0.86
returns	0.0166	0.0159	0.96	0.86
# of obs.	620	407		

Panel D: high&low agreement by Dispersion1_median

High Disagreement				
Ln(mk)	13.38	13.39	0.73	0.81
bmratio	0.5576	0.5328**	0.00	0.00
Ln(AT)	6.72	6.84	0.11	0.38
Cash	0.0445	0.0507*	0.05	0.06
CF	0.0328	0.0396**	0.00	0.00
PM	0.0451	0.0642**	0.00	0.00
XRD	0.0594	0.0642	0.52	0.21
OXD	0.8669	0.8436**	0.00	0.00
price	22.52	24.32**	0.01	0.04
stdprc	2.95	2.73*	0.05	0.11
returns	0.0122	0.0142	0.06	0.00
# of obs.	2078	995		
Low Disagreement				
Ln(mk)	13.65	13.66	0.72	0.37
bmratio	0.5162	0.5068**	0.00	0.00
Ln(AT)	6.99	7.25**	0.00	0.00
Cash	0.0393	0.045*	0.02	0.03
CF	0.0389	0.0441**	0.00	0.00
PM	0.0629	0.0794**	0.00	0.00
XRD	0.0514	0.054	0.77	0.98
OXD	0.842	0.8157**	0.00	0.00
price	26.33	28.21**	0.01	0.02
stdprc	3.01	2.91	0.78	0.94
returns	0.0148	0.0159	0.20	0.04
# of obs.	1596	1118		

In panel B, we compare the repurchase sample with matching sample in the highest and lowest book-to-market ratio quartiles. The difference between the repurchasing firms and the matching sample changes as the book-to-market ratio changes. Significant differences exist in high book-to-market ratio firms, but, not in the low book-to-market ratio pairs. This result is consistent with the literature that book-to-market ratio is a key factor that affects share repurchases.

Panel C shows the results sorted by our key divergence of opinion variable, the dispersion of analyst earnings forecasts. Since the model predicts that it is the high divergence of opinion drives share repurchases, we expect the effect of book-to-market ratio and other variables are absorbed by the variable of divergence of opinion, especially in the highest divergence of opinion quartile. The results in panel C and D are exactly what we expect: the differences in book-to-market ratios, firm sizes, and free cash flows between the two samples become insignificant in the highest divergence of opinion quartile. In the lowest divergence of opinion quartile, the repurchase sample has a higher book-to-market ratio.

5.2 The likelihood of share repurchases

To examine the explanatory power of the book-to-market ratio, divergence of opinion, and other proxies suggested by the signaling and agency hypotheses, we run a horse racing regression. First, we run logistic regressions on variables from existing hypotheses. The results are presented in Table 2, Panel A.

Table 2 Horse races of logistic regression on share repurchase determinants

This table reports the horse race logistic regression among several hypothesized motivations. The dependent variable equals one if a firm announces at least once open market share repurchase in that year, or else equals zero. Psi, another measure of information asymmetry, is defined as $Psi = \ln\left[(1-R_i^2)/R_i^2\right]$ as in Dittmar and Thakor (2007), where R_i^2 is industry i's average R^2 from a regression of firm-specific weekly returns on value-weighted market and value-weighted industry indices. The industry is defined at the two-digital SIC code. Rcov, the residual of analyst coverage, is another measure of information asymmetry, defined as the residual from yearly regressions of ln(1 + analyst coverage) on ln(MV) and ln(B/M), as in Diether, Malloy and Scherbina (2002). We select, FA, the ratio of fixed assets to total assets as the third measure of information asymmetry, computed as in Dittmar and Thakor (2007). Disp1, the standard deviation of analyst annual EPS forecasts divided by the mean of forecasts as in Diether, Malloy and Scherbina (2002); Disp3, the standard deviation of analyst annual EPS forecasts divided by the stock price as in Garfinkel (2009); AbTO, the abnormal market adjusted turnover as in Hong and Stein (2007) and Garfinkel (2009), SUV, the standardized unexplained trading volume as in Garfinkel (2009), into quartiles. Other independent variables are defined as in table 1. We run general linear regression for every proxy for each hypothesis. We then select the best proxy for each hypothesis and run the pooled the multi-factor regression. The p-values are reported and the bold font represents significant at or less than 5% level.

Panel A: logistic regression on information asymmetry and agency proxies

Wald-score	50.57	50.38	21.71	52.68	46.58	45.80	67.59
	logitO1	*logitA1*	*logitA2*	*logitA3*	*logitI1*	*logitI2*	*logitI3*
intercept	0.317	0.288	0.714	-0.031	0.106	0.399	0.352
	0.31	0.37	0.06	0.94	0.76	0.21	0.27
bmratio	**0.192**	**0.204**	**0.367**	**0.206**	**0.212**	0.174	0.146
	0.04	0.04	0.00	0.03	0.03	0.07	0.12
Ln(mk)	0.028	0.029	-0.001	0.032	0.034	0.023	0.014
	0.18	0.17	0.97	0.13	0.13	0.28	0.55
PM	**-2.294**	**-2.303**	**-0.889**	**-1.987**	**-2.060**	**-2.126**	**-1.936**
	0.00	0.00	0.02	0.00	0.00	0.00	0.00
return	-0.010	-0.026	-0.601	-0.029	-0.459	-0.418	-0.213
	0.97	0.97	0.61	0.97	0.66	0.68	0.83
Cash		0.100					
		0.71					
CF			-0.331				
			0.74				
OXD				0.326			
				0.16			
Psi					**-0.063**		
					0.07		
Rcov						-0.235	
						0.23	
Fix Assets							**0.694**
							0.00

Penal B: logistic regression on divergence of opinion proxies and pooled multi-factor regression

Wald-score	61.63	59.50	214.31	64.60	56.01	53.79	77.65	74.02
	logitD1	logitD2	logitD3	logitD4	logitP1	logitP2	logitP3	logitP4
intercept	0.152	0.243	1.237	0.923	0.057	0.109	-0.088	-0.003
	0.64	0.44	0.00	0.01	0.87	0.76	0.83	0.99
bmratio	0.186	0.173	0.101	**0.196**	0.189	0.184	0.154	0.146
	0.05	0.07	0.29	0.04	0.06	0.07	0.11	0.13
Ln(mk)	0.034	0.028	0.013	0.004	0.035	0.031	0.022	0.017
	0.11	0.18	0.56	0.85	0.11	0.17	0.31	0.42
PM	**-1.994**	**-2.097**	**-2.122**	**-2.289**	**-1.776**	**-1.889**	**-1.425**	**-1.538**
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
return	0.212	0.206	0.349	-0.031	-0.185	-0.029	-0.029	-0.059
	0.83	0.84	0.74	0.97	0.86	0.84	0.97	0.95
Cash					-0.113	-0.029		
					0.68	0.91		
CF								
OXD							0.271	-0.268
							0.24	0.25
Psi					-0.042	-0.044		
					0.23	0.21		
Rcov								
Fix Assets							**0.649**	**0.629**
							0.00	0.00
Disp1	**0.566**				**0.521**		**0.497**	
	0.01				0.00		0.00	
Disp3		**7.007**				**6.502**		**5.483**
		0.00				0.00		0.01
Abto_median			**-2.069**					
			0.00					
SUV_median				**1.381**				
				0.00				

We find that firms with a high book-to-market ratio are more likely to repurchase shares. The sign of the coefficient for the book-to-market ratio is positive and statistically significant for most of the regression models. Consistent with the undervaluation signaling hypothesis, we find that firms with high information asymmetry are more likely to repurchase shares, as *Psi* is negative and significant. We also find that repurchase firms have a lower profit margin after

controlling for other characteristics. The coefficient for PM is significant at the 1% level across all regressions. The fixed asset is positive and significant. Recall that the fixed assets could be proxy for both information asymmetry and growth opportunity. As a proxy for information asymmetry, the positive sign on fixed assets is inconsistent with the direct measure of information asymmetry, Psi. The positive coefficient on fixed assets may also suggest the repurchase firms have less growth opportunity. This result, combined with the negative sign on profit margin, implies that managers tend to repurchase share when the firm has lower income and less growth opportunities. This implication is consistent with the argument that repurchases are an earnings management tool.[36] However, we do not find evidence to support the agency problem hypothesis. The coefficient for $Cash$, $FCFs$, and OXD are not statistically significant.

Panel B shows the regressions results when we add our proxies for the divergence of opinion. Consistent with the prediction of the model, all proxies of divergence of opinion are positive and significant at the 1% level. Firms with higher divergence of opinion are more likely to repurchase shares. More strikingly, we find that after including the divergence of opinion variables, the effect of book-to-market ratio becomes insignificant, consistent with the results in panel C and D, table 1. Profit margin is negative and significant.

Finally, as in Dittmar (2000), we put all proxies for different hypotheses into one regression and examine which one has the most explanatory power. As the model predicts, proxies of divergence of opinion are positive and significant. The profit margin is positive and

[36] For the literature on this argument, see Roychowdhury (2006), Hribar, Jenkins and Johnson (2006), Gong, Louis and Sun (2008), among others.

significant, and the information asymmetry proxies lost their explanatory power. The positive signs on both fixed assets and divergence of opinion proxies, together with the negative sign on profit margin, indicate that when investors have different opinions about the firm's future and the firm has no better investment opportunity, the managers often repurchase shares from pessimistic shareholders.

Overall, the results in table 2 are consistent with our theoretical prediction 1 that the divergence of opinion affects the decision to repurchase share. We confirm the results of existing literature that the book-to-market ratio and information asymmetry are positively related to the likelihood of a share repurchase. However, we also show that divergence of opinion has incremental explanatory power than the book-to-market ratio and information asymmetry.

5.3 The fraction of target shares in announcements of open market repurchases

From the point of classical signaling theory, the announcements of open market share repurchases are not a convincing signal. First, open market repurchase announcements are not a commitment. There is no penalty for non-execution, and firms can stop or withdrawn from a repurchasing program at any time. Stephens and Weisbach (1998) report that approximately one-half of firms announcing a share repurchase bought their target number. More than 10 percent of repurchasing firms bought less than 5% of target shares during the three-year period following the announcement. Second, such repurchase announcements do not contain much solid information. The only numbers in the announcements are what percent of the firm's shares the managers intend to buy. An open market repurchasing program usually does not have a fixed

ending date. Third, until 2004, managers did not have to disclose the actual shares repurchased in their financial statements. To examine the strength of the motivation behind a repurchase announcement, we use the targeted fraction of shares to be repurchased.

We test our hypothesis H2 by examing the relationship between the fraction of target shares in announcements and the suggested proxies. We then run a general linear regression while controlling for various firm characteristics. As in Fama and French (1993), we double sort the share repurchasing sample by the book-to-market ratio and other hypothesized motivation proxies. The results are reported in table 3.

Table 3 percentage of shares sought and the percentage of announced program completed

Table3 provides mean (%sought_mean) and median of percentage (%sought_median) of shares sought for a repurchasing program and the percentage of completed open market repurchase program (%completed) across subsamples sorted by measures of information asymmetry and agency problems. The full sample covers all open market repurchase programs with 'Completed' and 'Intended to Completed' status in the SDC platinum through 1994 to 2003. The sample are first sorted by Fama and French (1993) Book-to-Market ratio and then proxies: Psi, another measure of information asymmetry, is defined as $Psi = \ln\left[(1-R_i^2)/R_i^2\right]$ as in Dittmar and Thakor (2007), where R_i^2 is industry i's average R^2 from a regression of firm-specific weekly returns on value-weighted market and value-weighted industry indices. The industry is defined at the two-digital SIC code. Rcov, the residual of analyst coverage, is another measure of information asymmetry, defined as the residual from yearly regressions of ln(1 + analyst coverage) on ln(MV) and ln(B/M), as in Diether, Malloy and Scherbina (2002). We select, FA, the ratio of fixed assets to total assets as the third measure of information asymmetry, computed as in Dittmar and Thakor (2007). The higher Rcov, lower Psi, and lower FA represent the higher information asymmetry. Cash and free cash flows are measures of potential agency problem motivated repurchase, as in Dittmar (2000). Cash is the sum of cash and cash equivalent divided by total assets, while CF is the cash flow, the net income before taxes plus depreciation and changes in deferred taxes and other deferred charges divided by total assets. Results are represented in panel A, B, C, D, and E, respectively. All variables are measured one year prior to the announcement of share repurchase.

Panel A: Double sort by B/M ratio and firm specific risk (Psi), high Psi, low Inf. Asy.

bmq	Psi	obs.	%sought_mean	%sought_median	%completed
lowest	lowest	110	8.45	6.15	11%
	2	80	8.28	6.10	20%
	3	89	7.49	5.60	9%
	largest	68	8.00	6.45	25%

2	lowest	104	7.65	6.40	20%
	2	88	6.46	6.05	10%
	3	67	6.05	5.00	16%
	largest	88	9.81	6.50	13%
3	lowest	86	5.88	5.00	17%
	2	88	6.71	5.20	13%
	3	94	7.32	5.45	14%
	largest	79	8.36	5.80	24%
largest	lowest	75	7.54	5.60	12%
	2	82	6.74	5.00	13%
	3	88	8.89	8.05	16%
	largest	103	9.15	7.90	20%

Panel B: Double sort by B/M ratio and residual of analyst coverage

bmq	Rcov	obs.	%sought_mean	%sought_median	%completed
lowest	lowest	101	8.42	6.20	10%
	2	71	8.19	6.10	18%
	3	80	7.54	5.60	15%
	largest	95	8.08	6.20	19%
2	lowest	95	7.07	6.20	14%
	2	79	7.08	5.70	19%
	3	90	7.94	6.00	12%
	largest	83	8.27	6.00	16%
3	lowest	88	7.82	5.15	17%
	2	93	7.02	5.40	15%
	3	83	6.06	5.00	22%
	largest	83	7.25	5.30	13%
largest	lowest	91	9.42	7.40	13%
	2	94	7.38	5.50	10%
	3	86	7.74	6.60	21%
	largest	77	8.12	6.90	21%

Panel C: Double sort by B/M ratio and Fixed Assets

bmq	FAq	obs.	%sought_mean	%sought_median	%completed
lowest	lowest	22	5.79	4.90	14%
	2	126	7.29	6.10	13%
	3	124	9.30	6.80	20%
	largest	75	8.04	5.60	12%
2	lowest	81	6.07	5.00	9%
	2	89	7.52	6.50	19%
	3	95	7.75	6.50	19%
	largest	82	8.96	5.90	12%
3	lowest	122	6.19	5.00	14%
	2	67	7.61	6.30	16%
	3	77	7.78	5.60	21%
	largest	81	7.18	5.20	17%
largest	lowest	153	6.92	5.10	19%
	2	55	9.04	7.00	9%
	3	41	8.76	7.50	27%
	largest	99	9.36	8.30	10%

Panel D: Double sort by B/M ratio and Cash

bmq	Cash	obs.	%sought_mean	%sought_median	%completed
lowest	lowest	71	9.86	6.20	18%
	2	63	7.56	5.60	17%
	3	76	8.19	6.60	12%
	largest	137	7.32	5.70	15%
2	lowest	82	8.37	6.00	13%
	2	89	6.22	5.00	12%
	3	77	6.75	6.00	14%
	largest	99	8.80	7.80	19%
3	lowest	88	7.66	5.80	19%
	2	81	6.39	5.00	12%
	3	108	6.28	5.00	16%
	largest	70	8.23	5.70	20%
largest	lowest	109	8.87	7.90	17%
	2	113	7.72	6.40	20%
	3	85	7.82	5.60	12%
	largest	41	8.27	6.30	10%

Panel E: Double sort by B/M ratio and Cash Flows

bmq	CF	obs.	%sought_mean	%sought_median	%completed
lowest	lowest	125	7.38	6.00	15%
	2	43	7.38	6.30	16%
	3	71	8.19	5.90	15%
	largest	108	9.09	5.90	15%
2	lowest	152	6.84	5.15	14%
	2	68	8.47	6.40	25%
	3	73	8.80	7.00	11%
	largest	54	6.91	6.00	11%
3	lowest	207	6.82	5.10	14%
	2	46	6.82	5.80	28%
	3	51	8.76	5.50	20%
	largest	43	6.35	5.00	12%
largest	lowest	230	7.77	6.25	16%
	2	68	8.17	7.05	19%
	3	30	10.62	6.80	10%
	largest	20	9.09	9.20	15%

To test the information asymmetry hypothesis, we double sort the repurchasing sample by book-to-market ratio and information asymmetry proxies, Psi, and $R\text{cov}$. The results are presented in table 3, panels A and B, respectively. The fraction of target shares, measured as mean and median of percentage shares sought increases with Psi, and increases only in high book-to-market ratio quartiles (quartile 3 and 4). Recall that *Psi* is an inverse measure of information asymmetry. The larger the Psi, the smaller is the information asymmetry. Thus, the increasing in the fraction of target shares along with *Psi* suggests that firms actually intend to repurchase less when information asymmetry is higher. This result implies that, if different opinion component caused by information asymmetry can be absorbed by divergence of opinion, information asymmetry may actually keep managers from repurchasing shares. We argue that the reason is because with high information asymmetry, managers face server adverse selection costs. Similar to the idea in Miller and Rock (1985), managers bear high adverse selection costs

and lose to informed traders in the markets. In the high book-to-market ratio quartiles, we also find that the less the information asymmetry, the more likely the firm will finish the repurchasing program.

The results from double-sorting on the book-to-market ratio and fixed assets are reported in panel C. Consistent with the results from direct measure of information asymmetry, the indirect measure of information asymmetry, fixed assets, also has a positive relationship with the fraction of target shares. The mean and median of percentage shares sought increase with the value of fixed assets and this pattern is consistent across all book-to-market ratio quartiles, except for the lowest one. Overall, the results suggest that if the fraction of target shares in repurchasing announcements is a signaling tool used by managers, information asymmetry actually reduces the motivation for managers to use such a tool and adds additional costs to accomplish their commitments.

We then examine the excess capital distribution hypothesis by double-sorting the sample on book-to-market ratio and Cash and Cash Flows. We do not find a significant pattern across quartile portfolios sorted by Cash, as presented in table 3, panel D. However, the fraction of target shares increases with the amount of free cash flows in the highest book-to-market ratio quartile, which is consistent with the excess capital distribution hypothesis.

We have re-examined the existing literature and the results support the undervaluation hypothesis as the significance is driven by high book-to-market ratio firms. However, rather than supporting the information asymmetry explanation, the evidence suggests that the potential adverse selection problem caused by information asymmetry might reduce the motivation for

managers to repurchase shares. Our results weakly support the excess-capital-distribution hypothesis.

We then double sort the repurchasing sample by book-to-market ratio and four divergence of opinion proxies, $Disp1$, $Disp2$, $Abto$, and SUV. Results are reported in table 4.

Table 4 percentage of shares sought and the announced program completed – divergence of opinion

Table 4 provides mean (%sought_mean) and median of percentage (%sought_median) of shares sought for a repurchasing program and the percentage of completed open market repurchase program (%completed) across subsamples sorted by measures of divergence of opinion. The full sample covers all open market repurchase programs with 'Completed' and 'Intended to Completed' status in the SDC platinum through 1994 to 2003. The sample are double sorted by Fama and French (1993) Book-to-Market ratio and disagreement measures: Disp1, the standard deviation of analyst annual EPS forecasts divided by the mean of forecasts as in Diether, Malloy and Scherbina (2002); Disp3, the standard deviation of analyst annual EPS forecasts divided by the stock price as in Garfinkel (2009); AbTO, the abnormal market adjusted turnover as in Hong and Stein (2007) and Garfinkel (2009), SUV, the standardized unexplained trading volume as in Garfinkel (2009), into quartiles. Results are represented in panel A, B, C, and D, respectively. Panel E reports the correlation coefficient among share repurchase determinants and the percentage of shares sought. All variables are measured one year prior to the announcement of share repurchase.

Panel A: Double sort by B/M ratio and Dispersion of Analyst Earnings Forecasts/Mean

bmq	Disp1q	obs.	%sought_mean	%sought_median	%completed
lowest	lowest	94	7.50	5.65	14%
	2	88	7.34	5.45	18%
	3	84	10.01	7.70	15%
	largest	81	7.53	5.80	14%
2	lowest	100	6.66	5.00	14%
	2	80	7.60	6.40	10%
	3	95	8.67	6.10	11%
	largest	72	7.41	6.40	29%
3	lowest	96	6.34	5.00	23%
	2	84	6.80	5.00	17%
	3	77	8.32	5.40	17%
	largest	90	6.85	5.95	9%
largest	lowest	57	6.14	5.00	19%
	2	94	8.29	6.50	11%
	3	92	8.40	7.05	22%
	largest	104	9.00	7.95	13%

Panel B: Double sort by B/M ratio and Dispersion of Analyst Earnings Forecasts/Price

bmq	Disp3q	obs.	%sought_mean	%sought_median	%completed
lowest	lowest	64	8.32	5.40	14%
	2	70	8.22	6.00	16%
	3	58	8.02	6.15	17%
	largest	46	8.10	6.20	20%
2	lowest	78	6.29	5.00	12%
	2	82	7.43	5.75	15%
	3	96	7.18	6.15	13%
	largest	64	9.03	6.77	23%
3	lowest	56	6.73	5.00	20%
	2	106	7.26	5.05	24%
	3	85	6.85	5.20	14%
	largest	69	6.94	5.20	10%
largest	lowest	54	7.74	5.10	24%
	2	58	7.69	6.70	19%
	3	79	7.73	5.60	14%
	largest	67	8.24	7.40	12%

Panel C: Double sort by B/M ratio and Abnormal Market Adjusted Turnover

bmq	AbTOq	obs.	%sought_mean	%sought_median	%completed
lowest	lowest	102	7.98	5.85	8%
	2	78	6.98	5.75	26%
	3	83	6.72	5.00	17%
	largest	84	10.54	7.55	13%
2	lowest	103	7.92	6.00	10%
	2	75	6.99	5.80	23%
	3	71	7.26	6.00	23%
	largest	98	7.91	6.40	9%
3	lowest	100	7.51	5.10	16%
	2	88	6.49	5.00	17%
	3	95	6.43	5.40	22%
	largest	64	8.02	5.55	9%
largest	lowest	115	7.86	6.50	15%
	2	82	7.55	6.70	20%
	3	74	8.56	5.30	11%
	largest	77	8.91	8.20	18%

Panel D: Double sort by B/M ratio and Standardized Unexplained Trading Volume

bmq	SUVq	obs.	%sought_mean	%sought_median	%completed
lowest	lowest	72	9.49	6.50	15%
	2	78	8.20	6.65	14%
	3	84	6.97	5.55	19%
	largest	113	7.91	5.60	13%
2	lowest	88	8.47	6.75	18%
	2	90	7.20	6.00	9%
	3	84	6.67	5.10	18%
	largest	85	7.98	6.30	15%
3	lowest	89	6.63	5.20	11%
	2	78	6.29	5.00	18%
	3	102	7.85	5.85	17%
	largest	78	7.23	5.20	22%
largest	lowest	117	8.66	6.90	20%
	2	95	8.14	6.60	17%
	3	71	7.56	6.20	10%
	largest	65	7.98	6.60	14%

Panel A and B report mean and median of the fraction of target shares in announcements across quartiles sorted by book-to-market ratio and divergence of opinion measured from dispersion of analyst earnings forecasts. The value of the fraction of target shares increases with the estimate of divergence of opinion in both panels A and B. Especially, in panel B, the median increases monotonically with the dispersion of analyst earnings forecasts scaled by stock price across all four book-to-market quartiles. It's the first time in this paper we observe the repurchasing motivation proxy dominates the book-to-market ratio. This result is consistent with our hypothesis H2 that firms will announce more target shares when the divergence of opinion is higher. The incremental explain power of divergence of opinion over book-to-market ratio also suggests that the divergence of opinion is a key determinant in the decision of share repurchases. Additionally, we find an interesting pattern from the repurchasing program completion rate across quartiles. The completion rate increases as the divergence of opinion increases in the low

book-to-market ratio quartiles. This is evidence that supports prediction 3 firms with higher divergence of opinion will not only announce more target shares, but also indeed repurchase more shares. However, a puzzle appears in the high book-to-market ratio quartiles: the completion rate decreases as the divergence of opinion increases. This result implies that although managers intend to announce large amount of target shares, constraint by high book-to-market ratios, they have no ability to repurchase such amount.

The portfolios built on divergence of opinion proxy, $Abto$, also suggest the fraction of target shares increases with the divergence of opinion. Although the trends through quartile 1 to quartile 4 in each book-to-market ratio subsample are not as consistent as the ones in $Disp1$ and $Disp2$ quartiles, the fraction of target shares in quartile 4 is still significantly greater than the fraction in quartile 1. The results from our forth proxy of divergence of opinion, SUV, are however, mixed and insignificant. The in-significant results from $Abto$ and SUV are expected. Remember that both abnormal turnover and standardized unexplained trading volume are computed from stock trading volume, shares outstanding, and returns. As long as firms actually repurchase shares after repurchase announcement, shares outstanding must change. Therefore, the value of $Abto$ and SUV are affected by share repurchase itself and are no longer exogenous variables. Later on, we will show that their coefficients in regression analysis are also in-significant as expected.

Overall, the results are consistent with hypothesis H2 that firms with higher divergence of opinion announce more target shares in announcements. The larger repurchasing completion

rates in the high *Disp*1 quartiles, especially in low book-to-market ratio subsample, suggest that those firms not only intend to repurchase more shares, but also actually repurchase those shares.

Before we jump into regression analysis, we examine the correlation coefficients among those variables. Since we have multiple proxies for each hypothesis, correlation coefficient will tell us where the potential multiple collinear problems could come from. We choose only one proxy for each hypothesis in the regression analysis. The correlation coefficients are reported in table 5.

Tab le 5 Correlation coefficients for repurchase sample

	bmratio	Ln(mk)	PM	Ret	Cash	CF	OEFF	Psi	Rcov	fixasset	Disp1	Disp3	Abto
bmratio	1.00												
Ln(mk)	**-0.31**	1.00											
	0.00												
PM	-0.06	**0.13**	1.00										
	0.02	0.00											
Returns	0.00	-0.01	**0.09**	1.00									
	0.99	0.68	0.00										
Cash	-0.16	-0.06	0.06	0.06	1.00								
	0.00	0.02	0.02	0.02									
CF	-0.11	0.07	0.50	0.15	**0.09**	1.00							
	0.00	0.04	0.00	0.00	0.01								
OXD	-0.05	-0.12	-0.55	-0.05	0.01	**-0.13**	1.00						
	0.05	0.00	0.00	0.07	0.72	0.00							
Psi	0.09	0.21	0.07	-0.16	-0.23	0.04	-0.09	1.00					
	0.00	0.00	0.01	0.00	0.00	0.18	0.00						
Rcov	0.02	0.01	-0.01	-0.14	-0.02	-0.03	-0.02	0.05	1.00				
	0.55	0.77	0.67	0.00	0.45	0.35	0.39	0.08					
fixasset	0.00	0.07	-0.21	-0.06	-0.16	0.07	0.11	**0.10**	-0.01	1.00			
	0.91	0.01	0.00	0.04	0.00	0.03	0.00	0.00	0.79				
Disp1	0.05	-0.12	**-0.23**	-0.12	0.07	-0.19	0.10	-0.13	0.00	0.07	1.00		
	0.04	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.94	0.01			
Disp3	0.10	-0.13	**-0.25**	-0.11	0.05	-0.16	0.13	-0.13	0.06	0.16	**0.64**	1.00	
	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.02	0.00	0.00		
Abto_median	0.03	0.01	0.04	-0.12	-0.06	0.04	-0.01	0.21	0.04	-0.02	-0.02	0.05	1.00
	0.33	0.58	0.19	0.00	0.03	0.29	0.64	0.00	0.18	0.58	0.38	0.07	
SUV_median	-0.15	**0.28**	0.06	-0.01	-0.01	0.06	-0.03	0.03	0.00	0.06	-0.04	-0.03	0.00
	0.00	0.00	0.02	0.76	0.78	0.07	0.33	0.20	0.86	0.04	0.14	0.25	0.94

We adopt three variables to proxy for agency problem: Cash, Free Cash Flows, and Operation Expenditure. Among them, Cash and Free Cash Flows are significant correlated, but the correlation coefficient is less than 0.1. Free Cash Flows and Operation Expenditure are also negatively significantly correlated with -0.13 coefficient estimates. Among three proxies for information asymmetry, Psi, and Fixed Assets are significantly correlated with coefficient 0.1. As expected, two proxies for divergence of opinion estimated from analyst earnings forecast data, $Disp1$ and $Disp3$ are positively significantly correlated with a coefficient value 0.64. We drop one of them in our regression analysis. The result form general linear regression analysis is reported in table 6.

Table 6 regression analysis on determinants of the fraction of target shares in announcements

This table reports the horse races on general linear regression among several hypothesized motivations after controlling for heterogeneous error and year-trend. The dependent variable is the fraction of target shares (parentage of shares sought). The independent variables are defined as in table 4. We run general linear regression for every proxy for each hypothesis. We then select the best proxy for each hypothesis and run the pooled the multi-factor regression. The p-values are reported and the bold font represents significant at or less than 5% level.

Fit-value	3.73	3.29	5.95	3.46	5.78	5.06	5.55	6.42	7.31	5.75	5.4	6.38
	O	A	A	A	IA	IA	IA	DO	DO	DO	DO	Pool
Inter.	11.89	12.36	8.814	11.147	11.840	10.012	10.618	10.155	10.015	10.918	10.579	9.472
	0	0	0	0	0	0	0	0	0	0	0	0
bmratio	-0.325	-0.353	-0.242	-0.226	-0.385	-0.008	-0.332	-0.37	-0.444	-0.324	-0.350	-0.418
	0.43	0.47	0.56	0.64	0.36	0.98	0.43	0.37	0.28	0.43	0.39	0.32
lnmk	**-0.277**	**-0.338**	**-0.269**	**-0.350**	**-0.330**	**-0.264**	**-0.306**	**-0.261**	**-0.261**	**-0.288**	**-0.281**	**-0.296**
	0	0	0	0	0	0	0	0	0	0	0	0
pm	**-3.657**	0.660	-2.098	0.683	**-3.805**	**-3.256**	**-3.268**	**-3.117**	-2.745	**-4.048**	**-4.142**	-0.358
	0.02	0.78	0.27	0.8	0.02	0.04	0.04	0.05	0.09	0.01	0.01	0.85
return	-6.981	-11.87	-5.657	-10.74	-4.176	-4.370	-5.516	-4.105	-3.988	-6.667	-5.695	-2.206
	0.14	0.03	0.22	0.05	0.38	0.35	0.24	0.37	0.39	0.15	0.22	0.64
cash	1.642											
	0.14											
Cash Flow		-1.755										
		0.66										
OXD			**1.833**									**1.871**
			0.05									0.04
RE				0.404								
				0.75								
Psi					**0.293**							**0.362**
					0.04							0.01
Rcov						0.569						
						0.49						
Fix Assets							1.173					
							0.08					
Disp1								**1.593**				
								0.05				
Disp3									**35.1677**			**35.287**
									0			0
Abto										-0.926		
										0.11		
SUV											-0.349	
											0.81	

The horse racing regression analysis is similar to the one in testing prediction 1 and 2. We first run a regression without controlling for any other hypothesized motivations to test the effect of firm's size, book-to-market ratio, and stock return momentum on share repurchase. We find that large firms tend to announce small fraction of target shares in repurchase announcement. This result is expected. Small firms usually have fewer shares outstanding; therefore, with same amount of shares sought in announcement, small firms have a larger fraction of target shares. The book-to-market ratio and past year returns are not significant. Interestingly, the firm's profit margin is significantly negatively related with the fraction of target shares. The negative coefficient implies that firms with trouble in increasing or keeping earnings tend to announce large number of target shares. By reducing more shares outstanding, managers can artificially increase earnings per share.

We then test the excess capital distribution hypothesis by adding proxy for agency problem. Although Cash and Free Cash Flows are not significant as predicted by agency problem based cash distribution hypothesis, we do find that firms announce larger fraction of target shares have higher operation costs, which implies potential agency problem. Together with the negative coefficient on Profit margin, the result suggests that managers spend too much in operation, however, cannot improve the earnings.

Consistent with the results from portfolio approach analysis, the information asymmetric proxy *Psi* has a significant and positive sign. Firms with less information asymmetry problem announce more target shares, although the likelihood test in table 2 suggests information asymmetry is a reason why firms announce share repurchases. This seemly contradict result is

consistent with the fact that although repurchases are not a commitment, as Stephens and Weisbach (1998)argue, firms a large proportion of announcing firms still repurchases their target shares and finish the program. We, again, tend to conclude that the potential adverse selection costs due to information asymmetry actually are resistant for managers actual share repurchases.

As the model predicted, two proxies for divergence of opinion, $Disp1$ and $Disp3$, are both positive and significant. Consistent with the results in portfolio approach, other two proxies, $Abto$ and SUV, are neither significant. We therefore will drop these two proxies. Since $Disp3$ has a higher significance level than $Disp1$, we choose $Disp3$ as our best proxy for divergence of opinion in pool horse race regression.

Before we run the horse race, the changes on the coefficient of Profit margin draw us attentions. This coefficient keeps negative and significant at 5% level through all above regressions. This seems strongly support the Roychowdhury (2006) earnings management tool hypothesis. However, after including $Disp3$, the significant level of Profit margin reduces to 10% level. We argue that the decreases in the explanation power of Profit margin are because investors have different opinions on the share repurchasing firm's profit ability, although share repurchasing firms generally have low level of profit ability. The one who accept the firm's profit ability will hold her shares, while the other who is not satisfied will tender shares.

The pooled horse race regression confirms our model prediction 3 and 4, as well as our conjectures on adverse selection costs and firms' profitability. Divergence of opinion significantly affects the fraction of targeted shares in announcements. The large the divergence of opinion, the larger is the number of targeted shares. Rather than information asymmetry

driving the share repurchases, the adverse selection costs due to information asymmetry are resistant for managers to repurchase shares. Profitability becomes insignificant as expected.

VI. Long-term price drift and actual share repurchases

Long-term abnormal returns following announcement of open market share repurchases were early documented by Ikenberry, Lakonishok and Vermaelen (1995), followed by Ikenberry, Lakonishok and Vermaelen (2000), Rau and Vermaelen (2002), Zhang (2002) and Peyer and Vermaelen (2009). The abnormal returns due to long-term price upward drift have been attributed to investors' under-reaction (Grullon and Michaely (2004)) or mistakes (Peyer and Vermaelen (2009)). However, those explanations bring out further questions: why investors keep under reacting or making mistakes in share repurchases. Our model suggests that investors neither under-react to announcements of share repurchase, nor do they continuously make mistakes. Investors choose to tender or hold their shares based on their own opinions. The long-term price drift is due to the property of the long-term open market repurchasing program.

We test hypothesis H3 by looking at actual share repurchase data. We first select firms who announce open market share repurchases from SDC platinum. We screen the sample firms with same conditions as early. Starting from 2004, the SEC requires firms to report actual share repurchase information. We collect the actual share repurchase information in firm's quarterly reports from Compustat Quarterly data. The final sample covers from 2004 to 2008 and the sample statistics are reported in table 7.

Table7 Actual share repurchase sample statistics

This table reports the sample statistics for firms announce open market share repurchase from 2004 to 2008. %sought is the percentage of shares sought (the fraction of target shares) in a repurchase announcement. Book-to-market ratio is calculated as Fama and French (1993) and Size is measured as the market value of the repurchasing firm at the end of year prior to announcement of share repurchase. CAR is the three-day cumulative market excess return around the announcement of share repurchase, as in Peyer and Vermaelen (2009). Panel A reports the statistics for firms whose repurchasing programs are labeled as 'Completed' or 'Intend to Completed' in SDC database, while panel B reports statistics for 'Completed' firm only. Panel C represents the three days cumulative market excess returns around announcements.

Panel A Firms with 'Completed' or 'Intend to completed' repurchasing program

year	# of firms	%sought	Book/market	Size
2004	7102	7.68	0.9327	6.5767
2005	6828	8.07	0.8927	6.6509
2006	6514	8.15	0.8747	6.7424
2007	6015	7.80	0.9504	6.8361
2008	5303	7.94	1.2595	7.0084

Panel B Firms with 'Completed' repurchasing program only

year	# of firms	%sought	Book/Market	size
2004	2430	10.40	1.0235	6.7754
2005	2307	6.98	0.9595	6.8269
2006	2170	8.58	0.9431	6.9479
2007	1982	6.48	1.0201	7.0399
2008	1773	8.12	1.3418	7.1871

Panel C Three-day cumulated market excess return around announcements by firms with 'Completed' or 'Intend to completed' repurchasing program

year	CAR	%sought
2004	1.64%	7.91
2005	1.28%	8.35
2006	1.55%	8.08
2007	1.07%	8.04
2008	1.46%	8.12

We first separate the full sample into two sub-samples according to their repurchasing program status. Although two sub-samples are similar in firm size, firms who have completed their program averagely have higher book-to-market ratio. This result is consistent with existing literature that book-to-market ratio is a driving force of share repurchases. The differences in the fraction of target shares are insignificant. The abnormal announcement returns are also similar to

previous findings, suggesting that the property of share repurchases after the SEC disclosure rule does not change too much.

The model predicts that the long-term price drifts are due to actual share repurchases, rather than an under-reaction to share repurchase announcements. Therefore, one should not observe the long-term abnormal returns following an announcement where no share is actually repurchased. We test this prediction by examining the abnormal return from a selected sample where firms only announce repurchases but do not actually repurchase shares. We use the calendar approach proposed by Fama (1998) to estimate the abnormal returns for one to four years around announcements of share repurchases. The results are reported in table 8. Different from existing literature, but consistent with the model prediction, there is no positive abnormal return following announcements. The returns on a long-term buy and hold portfolio are no different between the periods before announcements and the periods after.

Table 8 long-term price drift for firms do NOT actually repurchase shares

This table reports the long-term price drift for firms who announced share repurchase from 2004 to 2008, but did not repurchase any shares after the announcements. The long-term price drift is measured by market excess return. We use Fama (1998) time calendar approach to compute market excess return by subtracting market return (CRSP weighted monthly average) from stock monthly raw return.[37] Months are the number of month prior to or after a repurchasing announcement. ** represents 1% significant level.

Months	Prior	# of obs.	Post	# of obs.	Post-prior	T-value
12	-0.223%	6441	0.205%	10289	0.428%**	-2.67
24	0.108%	10975	0.167%	17584	0.059%	-0.47
36	0.240%	14057	0.129%	21462	-0.111%	0.96
48	0.248%	15777	0.153%	23511	-0.095%	0.84

[37] Schultz (2003) shows that the long-run under (over) -performance is likely to be observed *ex-post* in an efficient market. This is so called *pseudo* market timing. We follow Fama (1998) time calendar approach to avoid this problem. The market excess return at month 24 is the mean of monthly returns from month 1 to 24 before an announcement for a prior-period excess return. The respective post-period excess return is measured from month 1 to 24 after that announcement.

The result in table 8 provides indirect support for the hypothesis H3. We test the H3 directly by examining the abnormal returns and the timing of actual share repurchases. The model predicts that price stays high right after actual share repurchases, as if no information were released from actual share repurchases and investors do not update their reservation values. We estimate the monthly abnormal return with Fama (1998) approach and compute the average monthly return for the months with actual repurchases and without actual repurchases. Due to the limitation of the SEC filing requirement and the structure of Compustat data, we can only observe the frequency of actual share repurchases at quarterly level. The average monthly abnormal returns for repurchasing quarters and non-repurchasing quarters are reported in table 9, in the window from one to four years.

Table 9 abnormal return and actual share repurchase

This table reports the differences in abnormal returns between firms who announced but did not repurchase any shares and firms who announced and actually repurchased shares from 2004 to 2008. The abnormal returns are Alfas from regressing firms' monthly raw return on market return, firm size, and book-to-market ratio (Fama-French three factor model) in each period. Month is the number of months after a repurchasing announcement. ** represents 1% significant level.

Months	No_repur	Repur	No-repur - Repur	T-value
12	0.36%	-0.10%	0.46%**	2.27
24	0.39%	-0.12%	0.51%**	3.16
36	0.34%	-0.17%	0.51%**	3.55
48	0.24%	-0.15%	0.49%**	3.68

The result looks striking at first glance. The abnormal returns in non-repurchasing quarters are significantly higher than ones in repurchasing quarters, directly opposite with the model prediction. This result, however, is consistent with the price support hypothesis that managers repurchase shares when the stock price is low. The negative market excess returns

reflect managers' ability in timing the market. The quarterly actual repurchase data is not suitable to test the immediate price reaction to share repurchases. With the trading level data from Hong Kong market, Brockman and Chung (2001) are able to examine the price behavior following actual share repurchases. Although they focus on managerial timing and the liquidity effects, they document that returns in repurchase periods are significantly higher than the ones in non-repurchase periods.[38] Their results lend direct support for this heterogeneous expectation share repurchase model.

VII. Conclusion

In this paper, we investigate why firms repurchase shares. Although the undervaluation-signaling hypothesis has been popular for years, the empirical evidence often is not consistent with the signaling hypothesis. Many researchers borrow the ideas from behavioral finance, and accept the irrational explanation that investors persistently under-react to repurchase announcements and make mistakes. Such an explanation, however, challenges the principle of market efficiency. It is not clear why rational investors do not arbitrage on such long-term abnormal returns.

In our model, investors are fully rational, but different from each other in that they hold different expectations about the firm's cash flows. That is, investors can hold different opinions about firm's future cash flows even though they observe the same market information. Thus,

[38] Brockman and Chung (2001), "Managerial timing and corporate liquidity: evidence from actual share repurchases," *the Journal of Financial Economics*, 61, page 434, table 5.

they react differently to the same information conveyed in repurchase announcements. Each investor chooses the optimal trading strategy based on their reservation values, and the offered repurchasing prices. The managers' share repurchase decision maximizes each shareholder's utility in different ways. Pessimistic shareholders are able to tender their shares and gain a tender premium, while optimistic shareholders acquire more shares of future cash flows and a higher liquidation value of their share holdings. Any long-term price drift, following a share repurchase announcement, reflects the movement of the price along the investors' demand curve. Share repurchases are indeed 'best choices' when the firm has excess capital and few investment opportunities. Our model is consistent with the top two reasons that managers responded to in a real world survey by Brav *et al.* (2005).[39]

In addition to providing a theory that is consistent with documented anomalies about share repurchases, this paper also presents other supportive empirical evidence. We find the likelihood that a firm will repurchase shares increases, as the divergence of investor opinion increases. This pattern holds consistent, even after controlling for the book-to-market ratio, firm size, past returns, and information asymmetry. We also document a positive relationship between the divergence of opinion and the announced target shares. There is no long-term abnormal return, if a firm only announces a repurchasing program but does not repurchase any stock. Overall, our evidence suggests that the heterogeneous expectation theory has incremental explanation power over other existing hypotheses.

[39] In responding the question 'What factors might get your company to seriously consider repurchasing shares in the future?', managers rank (1) Market undervaluation of our stock and (2) Our company having extra cash/marketable securities the top two factors that affect the repurchasing decision. Managers also state that 'We make repurchase decisions after our investment plans are Determined'. See Brav *et al.* (2005) for details.

The model and the evidence presented in this paper mainly focus on a firm's share repurchase decision. However, like Dittmar and Thakor (2007), this paper provides an alternative explanation that can affect corporation decisions. The classic homogeneous assumption might not hold in a real managers' decision-making environment, so the heterogeneity assumption may be needed to understand manager and investor behavior.

CHAPTER THREE:

WHY DO FIRMS REPURCHASE SHARES? EVIDENCE FROM ACTUAL SHARE REPURCHASES

In this paper, we provide new evidence to explain managers' motivation to repurchase shares by looking at their actual share repurchase activity. Existing literature focuses on the announcements of open market share repurchases (hereafter, repurchases) and largely ignores the managers' actual repurchasing activity. Both theoretical works and empirical tests often assume that managers repurchase shares after announcements. However, in practice, managers neither take their announcements as a commitment, nor do they always repurchase shares after announcements.[40] We purport that in the absence of actual share repurchases, the explanatory power of previous studies may be diminished.

We contribute to the existing literature by examining managers' actual share repurchase activity. We test whether these theoretical predictions hold when examining actual share repurchases. Specifically, we test the three hypotheses simultaneously: the information asymmetry hypothesis based on signaling theory, the excess capital distribution hypothesis based on agency theory, and the investor divergence of opinion hypothesis based on marginal-investor theory. Overall, our results support the excess capital distribution and investor divergence of opinion hypotheses. We find no significance evidence to support for information asymmetry hypothesis.

[40] Bamber (1987), Stephens and Weisbach (1998), and Jagannathan, Stephens and Weisbach (2000) document that managers not all managers repurchase share right after their announcements.

Developed by Bhattacharya (1979), Vermaelen (1984), Miller and Rock (1985), and Ofer and Thakor (1987), the information asymmetry hypothesis suggests that managers in better-performing firms believe their stocks are undervalued by the market and consequently they use repurchase announcements as a signal to differentiate themselves from low-performing firms. Managers in firms with high levels of information asymmetry therefore have an incentive first to announce share repurchases, and then follow through and repurchase shares to make their announcements creditable.

Jensen (1986), develops agency theory – upon which the excess capital distribution hypothesis is based. Researchers subscribing to this view purport that share repurchases reduce excess free cash flow, and therefore mitigate the potential over-investment problem. This hypothesis implies that firms with a large amount of cash and few growth opportunities should repurchase shares, and that following share repurchases, these firms should experience a decrease in the level of cash and free cash flow.

Although empirical research provides some support for the information asymmetry and excess capital distribution hypotheses, these approaches fail to explain several anomalies, specifically, the documented long-term price drift and abnormal returns that occur subsequent to announcements of open market share repurchases. In an attempt to explain these anomalies, Huang and Thakor (2010), Blau et al. (2011), and Conlon, Fuller and Wang (2011) apply the investor heterogeneity hypothesis, where investors hold different opinions due to different prior beliefs or different information process models.

This approach suggests that investors draw different conclusions about the future, even when they have the same information (provided by managers) about the current state of world. It follows then that stock prices will be undervalued, as pessimistic investors, according to the marginal investor theory, determine stock prices, and they arrive at a lower expectation value for a firm than do optimistic investors. Within this hypothesis, the announcement of a share repurchases indicates that managers' view their stock as undervalued; it implies that the larger the divergence of investors' opinion, the more likely it is that managers not only make share repurchases but that they repurchase more shares.

Following the research of Dittmar (2000) and Grullon and Michaely (2004), and using measures of actual share repurchases, we jointly test our predictions across these three hypotheses. Rather than focusing on repurchase announcements or assuming that managers actually repurchase share in the three years following an announcement, we examine the firm following actual share repurchases. We estimate the actual share repurchases with the methodology proposed by Fama and French (2001), Skinner (2008), and Huang and Thakor (2010) - this method allows us to observe directly whether managers repurchase shares and estimate the amount of shares they repurchased in a year.

We use a direct measure of information asymmetry, Psi, and two indirect measures, the intangible asset ratio and fixed asset ratio, to estimate the level of information asymmetry in a firm. We find that the firms who repurchase shares have less information asymmetry compared to a sample of firms who do not repurchase shares. Additionally, when restricting our examination to a sample of firms that repurchase, we find that firms with less information

asymmetry repurchase more shares. We fail to detect any significant decline in information asymmetry following actual share repurchases. Although our findings are contrary to the predictions of the information asymmetry hypothesis, they are consistent with Merton and Rock (1985) who purport that managers face adverse selection problem when they repurchase shares from market and they will therefore be reluctant to repurchase shares when information asymmetry is high.

We find empirical support for an agency cost motivation for share repurchase programs – i.e. firms with large cash reserves that lack good investment opportunities. Our repurchasing sample firms have significantly higher levels of cash and free cash flow, and lower R&D expense than do non-repurchasing firms. We also find that firms with more cash and a higher level of free cash flow repurchase more shares. Our findings suggest that excess capital re-distribution could be a motivation for managers to repurchase shares, as after actual share repurchases, the cash reserve declines significantly, both in the form of cash and free cash flow.

We also find evidence consistent with the investor heterogeneity hypothesis. Following Garfinkel and Sokobin (2006), Hong and Stein (2007), and Garfinkel (2009), we use estimates from trading volume to estimate the divergence of opinion amongst a firm's investors. Our results suggest that the investors of repurchasing firms have higher divergence of opinion on their holding firm's value than the investors of non-repurchasing firms. The difference in divergence of opinion between repurchasing and non-repurchasing firms persists after controlling for firm characteristics. We also find that when a firm has higher divergence of opinion among its investors, managers tend to repurchase more shares in the following year. We

also document that the divergence of opinion is significantly higher in the year prior to actual share repurchase than the year in which a consecutive repurchasing program concludes.

This paper is closely related to a survey completed by Brav et al. (2005) on the opinion of managers regarding share repurchases. Managers state that they repurchase shares because they believe their stock is undervalued – share repurchases provide a relatively high rate of return compared to other investment opportunities. Consistent with this view, we find that repurchasing firms have lower operating and R&D expenses; firms with lower profit margin and lower past-year returns repurchase more shares. Our result suggests that managers repurchase shares when they hold more optimistic opinion on the firm value than pessimistic investors. For a mature firm with a large amount cash on hand but few growth opportunities, managers repurchase stocks from pessimistic shareholder for the best interests of optimistic, long-term shareholders. Different from 'future cash flow' signaling, we argue that the announcement of repurchase signal only the managers' opinion on their stock price. There is no additional information about future cash flows that could (should) be released to public.

The rest of our paper is organized as follows: Section II briefly introduces the three hypotheses and reviews the actual share repurchase literature. Section III describes the methodology and variables used in our empirical test. Section IV presents the sample statistics and the properties of consecutive actual share repurchasing program. In section V, we test the three proposed hypotheses and examine how firms change following actual share repurchase. Section VI concludes the paper.

II. The Motivation of Share Repurchase and the Actual Share Repurchases

2.1 The Motivation of Managers to Repurchase Shares

Share repurchases, especially open market share repurchases, have been extensively examined in academic literature. Several explanations for managerial motivation to repurchase shares have been proposed by researchers, including the information asymmetry hypothesis based on signaling theory, the excess capital redistribution hypothesis based on agency theory, as well as other hypotheses focusing on capital structure optimization, acquisition deterrence, and dividends substitution.[41]

Tests of these hypotheses focus primarily on the associated announcement effect. Dann (1981), Vermaelen (1981), and Comment and Jarrell (1991) all document significant stock price reaction to the announcement of share repurchases. More recently, Ikenberry, Lakonishok and Vermaelen (1995), Ikenberry, Lakonishok and Vermaelen (2000), and Peyer and Vermaelen (2009), find that share prices do not reach a new equilibrium immediately in response to these announcements, but tend to drift for at least three years. This long-term price drift and the related long-term abnormal returns both represent share repurchase anomalies, which serve to cast doubts on the explanatory power of traditional hypotheses.

Recently, Huang and Thakor (2010), Conlon, Fuller and Wang (2011) and Blau *et al.* (2011) apply the investor heterogeneity hypothesis to open market share repurchases in an attempt to explain long-term share repurchase anomalies. This hypothesis emphasizes the

[41] For information asymmetry hypothesis, see Bhattacharya (1979), Merton and Rock (1985), and Vermaelen (1981); for free-cash-flow hypothesis, see Morse (1980), Easterbrook (1984), and Jensen (1986). For a broad review on this literature, see also Dittmar (2000), Grullon and Ikenberry (2000), and Allen and Michaely (2003).

importance of actual share repurchases, rather than focusing on the announcements of repurchase.

The investor divergence of opinion, which was introduced early in finance literature, is built upon the investor heterogeneity or the marginal-investor theory, where asset prices are determined by the marginal investors' opinion in the incomplete market (Keynes (1937), Williams (1956), Miller (1977), and Mayshar (1983)). With divergence of opinion, both optimistic and pessimistic investors are present in the market simultaneously. When managers offer to repurchase shares, only pessimistic shareholders choose to tender their shares, while optimistic shareholders choose to hold their shares and maintain their status as shareholders. After tendering, stock price reflects the 'new' marginal shareholder's opinion. The updated stock price is higher than the price before tendering, since new marginal investors are slightly more optimistic than are tendering shareholders. The stock prices keep drifting upward as long as managers actually repurchase shares from the market. The opinion of pessimistic shareholders is not incorporated into the stock price because with short sale constraints, pessimistic shareholders who have just tendered their shares cannot short sell the stock.

The investor divergence of opinion hypothesis suggests that managers repurchase shares for the best interests of long-term shareholders, since these shareholders (and managers) believe the stock is undervalued by pessimistic investors. The larger the divergences of opinion between optimistic and pessimistic investors, the more incentive managers have to repurchase shares. The announcements of share repurchase disclose managers' opinion on current stock price. Wealth is transferred from tendering shareholders to non-tendering shareholders as long as managers are

not overly optimistic. Therefore, non-tendering shareholders earn long-term abnormal returns when managers continue to repurchase shares from the market.

2.2 The Actual Share Repurchases

Academic researchers customarily assume that managers repurchase shares after their announcement. However, speculation in the press suggests actual repurchase rates of only 30-40 percent (For example, see WSJ "Most buybacks are stated, not completed" March 7, 1995). Stephens and Weisbach (1998), and Jagannathan, Stephens and Weisbach (2000) suggest an actual repurchase rate of 70-80 percent at most. Bamber (1987) find that, immediately after the market crash in 1987, many firms announced a repurchase program, but most of them did not actually repurchase shares.

Managers' actual share repurchasing activity and their managerial performance are closely related to actual share repurchases. Stephens and Weisbach (1998) first examine the actual share repurchase with proxies for changes in shares outstanding or treasury stock and dollars spent on reacquiring shares. They find that managers' actual share repurchase behavior is heavily affected by prior stock performance. Lie (2005) document that the operating performance improvement and the positive earnings announcement returns are limited to firms who actually repurchase shares; they argue that it is the actual repurchases, not announcements, predict future firm's performance improvements. Similarly, Blau *et al.* (2011) find that there is no long-term abnormal return from firms who only announce open market repurchases but actually do not reacquire shares.

Consistent evidences is also found in the Hong Kong and French markets, where detailed actual share repurchasing data is available at daily or intraday intervals. For example, in the Hong Kong market, Brockman and Chung (2001) document a positive relationship between stock price performance and actual share repurchases, and Zhang (2005) find that repurchasing firms, not announcing firms, earn 20 percent higher abnormal return than their matched sample firm counterparts. Using data from 352 French firms, Ginglinger and Hamon (2007) document that French firms repurchase shares at a price lower than the average trading price, as shares are repurchased after an observable decline in share price. They argue that there is no evidence that managers use private information to repurchase stock before the share price rises.

III. Methodology

3.1 Actual Share Repurchase

Firms operating in the U.S. market do not disclose their actual share repurchase activity in detail (for example, on a daily basis). Neither the number of shares repurchased, nor the repurchasing price and time are made available to the public.[42] Adding to the complexity of the situation, firms may issue new stocks after managers announce a repurchasing program, or they might re-distribute the repurchased stocks as compensation to executive managers or for the execution of employee options.

[42] Beginning in 2004, the U.S. Securities and Exchange Committee (SEC) required all U.S. listed firms to report share repurchase data in their quarterly reports, including the dollar value spent on the repurchase and the average repurchasing share price.

To estimate the number of actual shares repurchased, we adopt the methodology used by Fama and French (2001), Skinner (2008), and Huang and Thakor (2010) to measure the dollar value spent on actual share repurchases. Firms can use two techniques to repurchase shares: either the treasury stock method or the retiring stock method. In the treasury stock method, firms repurchase shares from the market and hold them as treasury stock in the book. Treasury stocks can be reissued to employees, or offered back to outside investors on the market. With the retirement stock method, firms repurchase and then retire shares from the market, which results in an immediate reduction in the number of shares outstanding.

For firms using the treasury stock method, we measure for each fiscal year the dollar value spent on share repurchases for year t as the change in common treasury stock from year t-1 to year t. We then estimate the number of shares actually repurchased by dividing the dollar amount with the share price at the end of fiscal year (Equation 3.1). [43]

$$number\_repur_{i,t} = \frac{\$treasury_{i,t} - \$treasury_{i,t-1}}{Price_{i,t}}; \qquad (3.1)$$

If a firm has zero treasury stock in the current and prior year, we infer that the firm uses the retirement method to repurchase shares. We measure the dollar value spent on repurchases for year t as the difference between purchases and sales of common and preferred stock in year t. The actual number of shares repurchased in year t is calculated by dividing the dollar value spent on share repurchases with the end-of-fiscal-year stock price (Equation 3.2.).

[43] We also estimate the net changes of shares outstanding by dividing the dollar value with the middle stock price of the yearly highest and lowest during that fiscal year. We find the result is similar to the one estimated with the end of year stock price.

$$number\_repur_{i,t} = \frac{\$Purchase_{i,t} - \$Sales_{i,t}}{Price_{i,t}}; \quad (3.2)$$

We measure the actual change in shares outstanding, referred to as the actual share repurchases ratio, as the ratio of the actual shares repurchased during a year and the total shares outstanding at the beginning of that year (Equation 3.3).

$$Repur_{i,t} = \frac{number\_repur_{i,t}}{shares\_outstanding_{i,t-1}}, \quad (3.3)$$

3.2 Divergence of Opinion

Investors trade with each other when they have a different valuation of the same asset (Morse (1980), Karpoff (1986), Bamber (1987), Kandel and Pearson (1995), and Chen, Hong and Stein (2001), Fama and French (2007)). More specifically, Varian and Michigan (1985) distinguish investor opinion from information in a Bayesian framework. They argue that trading volume depends only on differences of opinion, even when investors receive different information, because the market price eventually adjusts to reveal all information in the economy and thus negates the value of unique information held by any single investor.

Following Hong and Stein (2007) and Garfinkel (2009), we use the abnormal market adjusted turnover, $Abto_{i,t}$ to measure divergence of opinion among investors. To avoid the less-trading-frequency problem, we enhance their methodology by using weekly cumulative trading

volume rather than daily trading volume.[44] The weekly market adjusted turnover, $Abto_{i,t}$, is firm *i*'s trading volume during week *t*, divided by its shares outstanding during that same week, minus the ratio of the market's total weekly trading volume, $Vol_{m,t}$, scaled by the market total shares outstanding, $Shrs_{m,t}$, (Equation 3.4). The measure the degree of divergence of opinion is determined by the mean and median value of the weekly market adjusted turnover for each firm year.

$$Abto_{i,t} = \frac{Vol_{i,t}}{Shrs_{i,t}} - \frac{Vol_{m,t}}{Shrs_{m,t}}, where$$
$$Vol_{m,t} = \sum_{i=1}^{m} Vol_{i,t} \text{ and } Shrs_{m,t} = \sum_{i=1}^{m} Shrs_{i,t} \quad (3.4)$$

We also compute the standardized unexplained stock trading volume, $SUV_{i,t}$ (Garfinkel and Sokobin (2006) and Garfinkel (2009)) as an alternative measure of divergence of opinion.[45] Standardized unexplained stock trading volume measures unexpected trading volume resulting from the impact of both liquidity demands and information. Unexpected trading volume is the residual volume ($\varepsilon_{i,t}$) from a regression of the firm's weekly trading volume on weekly signed absolutely returns (Equation 3.5):

$$Volume_{i,t} = \alpha_i + \beta_i \left|Ret_{i,t}\right|^{+} + \gamma_i \left|Ret_{i,t}\right|^{-} + \varepsilon_{i,t}, \quad (3.5)$$

[44] Il-liquid stocks could have periods of low daily trading volume. The estimation from those extreme values can cause bias in estimates of divergence of opinion.

[45] The dispersion of analyst forecasts is often used as a measure for divergence of opinion. However, under the assumption of heterogeneous expectations among investors, analysts' opinion may not provide an accurate reflection of the true investors' opinion. In addition, a lack of observations also limits the use of analyst forecast data.

The plus and minus superscripts on the absolute valued returns indicate the sign of weekly returns. The standardized unexplained trading volume is the yearly average of such residuals scaled by the standard deviation of residual (Equation 3.6), as:

$$SUV_{i,t} = \frac{\sum_{1}^{52} \varepsilon_{i,t} \Big/ 52}{\sigma_{\varepsilon_{i,t}}} \tag{3.6}$$

3.3 Information Asymmetry

Information asymmetry could cause investors to hold different valuations of a stock. We use three measures to estimate the level information asymmetry. First, we include a direct measure suggested by Durnev, Morck and Yeung (2004). They purport that greater firm-specific variation in stock price implies that more information is impounded into the price and therefore lower levels of information asymmetry exists. This measure is also employed by Morck, Yeung and Yu (2000), Bushman, Piotroski and Smith (2004), Dittmar and Thakor (2007), Duarte *et al.* (2008), and Huang and Thakor (2010).

The firm-specific variation, $Psi_{i,t}$, is defined as a natural log transformation ($Psi = \ln(\frac{1-R^2}{R^2})$) of R-squares from the following regression:

$$Ret_{i,t} = \alpha_i + \beta_i Ret\_Industry_{i,t} + \gamma_i Ret\_market_{i,t} + \varepsilon_{i,t}, \tag{3.7}$$

The dependent variable ($Ret_{i,t}$) is equal to the stock's cumulative weekly raw return, and the independent variables are industry- (defined as two-digital standard Industry Classification (SIC) code) and market-wide value-weighted weekly returns. The industry- and market-wide

weekly returns are value-weighted weekly stock return across industry and the market. *Psi* is an inverse measure of information asymmetry: a larger *Psi* reflects lower levels if information asymmetry.[46]

Two other measures of information asymmetry are used - a pair of opposite measures, the fixed asset ratio and the intangible asset ratio. Previous research suggest that firms with a higher proportion of fixed assets should be more transparent, since the uncertainty about the value of firm's assets is small and thus easy to value, while intangible assets typically are unrecognized and estimates of their fair values are not disclosed (Cañibano, Garcia-Ayuso and Sánchez (2000), Barth, Kasznik and McNichols (2001)). Relating assets and share repurchases, Barth and Kasznik (1999) find that firms with more intangible assets are more likely to announce share repurchase program and experience more positive post-announcement returns. Conversely, Rajan and Zingales (1995) and Dittmar and Thakor (2007) find that firms with high fixed asset ratio are more likely to use debt instead of equity financing. We measure the fixed asset ratio as net fixed assets divided by total assets (Dittmar and Thakor (2007)) and intangible asset ratio as the intangible assets other than goodwill scaled by total assets other than goodwill (Barth and Kasznik (1999)).

3.4 Agency Problem

[46] For example, if a firm's stock moving is perfectly correlated with the moving of market index, the R-square from equation 4.7 will be one. For such an R-square, the Psi approaches negative infinity. However, for such a firm, there is no firm-specific information incorporated into its price, as the price always moves with market index. Since no firm-specific information is revealed through its price, the firm has a high level of information asymmetry.

To evaluate the suppositions of the excess-capital-distribution hypothesis in relation to share repurchases, we capture each firms *Cash* and free cash flows, *FCFs*. Following Dittmar (2000), *Cash* is defined as cash and cash equivalents scaled by total assets, while *FCFs* is the ratio of net income before taxes plus depreciation and changes in deferred taxes and other deferred charges divided by total assets. As our third proxy for agency costs, we include, operating expenditures, *OXD*, defined as operating costs divided by total sales.

3.5 Growth, Profitability, and other variables

Ikenberry, Lakonishok and Vermaelen (1995), Ikenberry, Lakonishok and Vermaelen (2000), and Von Eije and Megginson (2008), who demonstrate that a long-term price drift follows announcements of share repurchase, focus on firms with high book-to-market ratios. High book-to-market ratio firms are usually low growth firms. We include the Fama and French (1993) book-to-market ratio, *bmratio* and the Research and Development expense, $R\&D$, defined as the R&D spending divided by sales, to capture the firms' growth and new investment opportunity. [47]

We control for other firm characteristics: to capture the firm size effect, we use *lnmk*, measured as the natural log of the firm's market value; to capture the contrarian trading effect, we include the past year's average monthly return, *Return*; and to capture the dividend substitution effect we include dividends paid per share, *Dividend*. Recent literature suggests that

[47] Refer to Fama and French (1993) for a detailed description of the bmratio measurement. The factors used to estimate the bmratio (Fama-French three-factor model) are from Kenneth R. French website, Data Library.

earnings are positively related to a firms' payout policy (Skinner (2008)), therefore we include profit margin, PM , defined as net income divided by sales, to measure the firms' profitability. Variables and their definitions are listed in table 1.

Table 1 Definition of variables
This table defines the variables used in this paper.

Variables	Definition
Ln(MV)	Nature log of the market capitalization
AT	Total asset
Bmratio	Fama and French (1993) book-to-market ratio
Debtratio	A ratio of long-term debt to total asset
FixedAsset	A ratio of fixed asset to total asset
IntanAsset	A ratio of intangible asset to total asset
Psi	The residual of weekly return regressed on market and industry return
Cash	Cash and cash equivalent
FCF	Free cash flow
OXD	Operation cost divided by sales
R&D	Research & Development cost divided by sales
PM	Profit margin (net income divided by sales)
Return	Cumulative annual stock return
Dividend	Total dividends pay per share
Abto_mean	The mean of abnormal turnover
Abto_median	The median of abnormal turnover
SUV_mean	The mean of standardized unexplained volume
SUV_median	The median of standardized unexplained volume

IV. Sample Selection and the Properties of Actual Share Repurchases

4.1 Data Sources and Sample selection

To compute the actual share repurchase, we collect yearly treasury stock, and purchases and sales of common stock from the Compustat annual database. The fiscal-year-end and the fiscal-year highest and lowest stock price are also collected from Compustat. To compute the

divergence of opinion measures *Abto* and *SUV* , we collect stock daily trading volumes and returns from the Center for Research in Security Prices (CRSP) and aggregate them into calendar weeks to obtain the cumulative weekly trading volume and return. To compute the information asymmetry measure, *Psi* , we collect daily stock price and the weighted-average Standard & Poor's 500 index from CRSP. The weekly return is the cumulative return in each calendar week. The industry average return is the cumulative return in each calendar week based on two-digit Standard Industry Classification (SIC) code. We collect each firm's other characteristics: total assets, book value of asset, long-term debt, fixed assets, intangible assets, cash and cash equivalent, sales, net income, operation costs, research & development expense, tax and other deferred items, dividends, and shares outstanding from Compustat annual data.

Our repurchase and non-repurchase pooled sample spans the period from 1991 to 2009. We require that each firm be U.S. firm listed on the NYSE, Amex or NASDAQ, have CRSP and Compustat data available, and have a fiscal-year-end stock price higher than $5. We also exclude observations with negative total assets. We delete outlier observations, specifically, firms with a book-to-market ratio less than 1 percent or greater than 99 percent percentile of the total population and firms with negative profit margins (about 2% of total population).

4.2 Actual Share Repurchase

As in Skinner (2008), a firm-year is designated as an actual share repurchasing year only if the actual share repurchase ratio is positive. The actual share repurchase ratio is estimated by dividing the dollar value spent on actual repurchases with both the fiscal-year-end stock price

and the middle of fiscal-year highest and lowest stock price. The distribution of actual share repurchases is reported in Panel A, Table 2. There are about 40% of total observations having less than 1% actual share repurchase ratio. Only around 5% actual share repurchases are greater than 10% of total shares outstanding.

In Panel B, we report the time-series trend of share repurchase from 1991 to 2009. Most firms repurchase 1% to 2% of their shares per year, with a median value of 1% and a mean value of 2.3%. The actual share repurchase ratio estimated from the fiscal-year-end stock price and the middle of fiscal-year highest and lowest price are similar.[48] In the later studies, we use the actual share repurchase ratio estimated from fiscal-year-end stock price only.

We also observe two significant peaks in the number of firms who has actively engaged in actual share repurchase during our sample period. The first peak is around 1998/1999, during the early stage of the Internet (Dot-Com) bubble. The second peak is in 2008, which marks the beginning of the recent financial crisis. Not only there are more firms repurchase shares during these two peak periods, but firms on average repurchase more shares. These findings are consistent with the result of Dittmar and Dittmar (2004) that the aggregate share repurchases are affected by the business cycle.

4.3 The consecutive actual share repurchases

[48] The net share repurchases estimated from fiscal-year end price are slightly upward biased relative to the ones estimated from middle-price. This upward bias suggests that the stock price drops in the year the firm actually repurchases shares. We run the tests based on net share repurchase estimated from midpoint price – the average price of the year highest and lowest price, the results are not significantly different.

Not all managers actively repurchase shares after their announcements of share repurchase. Lie (2005) and Blau et al. (2011) document that there are firms do not repurchase any shares after the announcements. Furthermore, Lie (2005) find that both the operating performance improvement and the positive earnings announcement returns are limited to those firms that actually repurchase shares. Blau et al. (2011) find that the long-term abnormal returns following repurchasing announcements disappear if firms do not actually repurchase shares. Lie (2005) suggest that it is the actual repurchase, not the announcement, predict future performance improvements.

Indeed, the actual share repurchase could be much smaller, even though managers actively repurchase shares after announcement. For firms using treasury stock method, managers could re-issue the treasury stock at the same year or one year later when they repurchase shares. Firms could also issue new shares on the market. The actual number of shares repurchased is offset by the new issued shares.

To examine how the actual share repurchases affect the firm's characteristics, we limit our repurchasing sample for firm-year observations with significant actual share repurchase (greater than 1 percent of shares outstanding), which covers about 60 percent of our full actual repurchasing sample. In Table 3, we report t statistics of the sample categorized by the year and the repurchasing program. In Panel A, we report how frequently a firm has significant share repurchase. About 27 percent of firms repurchase more than 1 percent of shares outstanding only once in our 19-year sample period, from 1991 to 2009. About 18 percent and 13 percent of firms

repurchase significant amount of shares twice or three times in our sample period respectively.

The low frequency of share repurchase suggests that firms repurchase shares discontinuously.

Table 2 Statistics of firms' net share repurchases

This table reports the distribution of net share repurchases, which is defined as the number of shares a firm repurchased divided by the firm's shares outstanding in a given fiscal year. We following Fama and French (2001), Skinner (2008), and Huang and Thakor (2010) to compute the net share repurchases. The net shares repurchased is estimated in the increase in common treasury stock divided by stock price, if the firm uses the treasury stock method for repurchases; otherwise the net shares repurchased is the difference between stock purchases and stock issuances divided by stock price. Since firms often continuously repurchase shares from market at market price, we estimate the average repurchasing price by two proxies, the fiscal year closing price and the midpoint of year-high and –low price.[49] The net share repurchased ratio is the number of net shares repurchased divided by shares outstanding.

Panel A the distribution of actual share repurchase by firm-year

Panel A reports distribution of the net repurchase ratio. Close and Midpoint are ratio estimated by fiscal year closing stock price and middle of year-high and –low stock price.

Percentile	1%	5%	10%	25%	50%	75%	90%	95%	99%
Close	.00157%	.0176%	.0517%	.297%	1.3%	3.6%	7.5%	10.9%	22.7%
Midpoint	.00162%	.0176%	.0505%	.282%	1.2%	3.4%	6.7%	9.4%	18.5%

Panel B actual share repurchase from 1991 to 2009

Panel B reports the trend of share repurchase from 1991 to 2009. N is the number of firms that repurchased shares in that year. We compute the repurchase ratio with average repurchasing price based on fiscal-year end price and the middle of fiscal-year high and low price. Since these two estimations are very close, in later tables we reports the results based on fiscal year closing price only.

		Estimated by fiscal-year closing price				**Estimated by fiscal-year middle price**			
Year	**N**	**mean**	**median**	**max**	**min**	**mean**	**median**	**max**	**min**
1991	635	2.12%	0.66%	71.01%	0.00%	2.07%	0.69%	67.40%	0.00%
1992	666	2.14%	0.83%	39.87%	0.00%	2.00%	0.77%	33.55%	0.00%
1993	768	1.78%	0.62%	42.91%	0.00%	1.70%	0.62%	39.78%	0.00%

[49] As managers usually repurchase shares when price is relatively low, our estimations are downward biased. The real net shares repurchased would be slightly higher.

1994	984	2.18%	0.91%	36.11%	0.00%	1.96%	0.81%	32.14%	0.00%
1995	1001	1.92%	0.89%	48.25%	0.00%	1.93%	0.91%	40.53%	0.00%
1996	1138	2.36%	1.07%	35.93%	0.00%	2.24%	1.01%	51.22%	0.00%
1997	1303	2.36%	1.07%	51.60%	0.00%	2.32%	1.12%	43.83%	0.00%
1998	1545	3.58%	1.85%	65.84%	0.00%	2.90%	1.55%	47.23%	0.00%
1999	1445	4.47%	2.29%	90.93%	0.00%	3.75%	1.99%	57.60%	0.00%
2000	1263	4.28%	2.18%	67.56%	0.00%	3.50%	1.87%	50.71%	0.00%
2001	1044	2.34%	0.98%	67.84%	0.00%	2.09%	0.92%	62.84%	0.00%
2002	1003	2.81%	1.26%	77.28%	0.00%	2.32%	1.08%	76.46%	0.00%
2003	918	1.92%	0.96%	33.18%	0.00%	2.13%	1.13%	29.30%	0.00%
2004	874	2.23%	1.14%	24.74%	0.00%	2.28%	1.18%	25.60%	0.00%
2005	976	2.85%	1.69%	37.83%	0.00%	2.84%	1.71%	29.39%	0.00%
2006	1038	2.79%	1.71%	38.82%	0.00%	2.77%	1.67%	36.86%	0.00%
2007	1093	3.86%	2.05%	86.13%	0.00%	3.33%	1.91%	75.38%	0.00%
2008	1195	5.55%	3.07%	91.98%	0.00%	3.64%	2.29%	51.87%	0.00%
2009	730	1.86%	0.66%	25.71%	0.00%	2.00%	0.81%	23.02%	0.00%

We categorize the discontinuous actual share repurchase activities into different repurchasing programs according to the consecutive repurchasing years. We define the number of consecutive repurchasing year as following: the number of years a firm continuously repurchases shares more than 1 percent per year without interruption. For example, if a firm repurchases 1 percent of shares from 2002 to 2004 each year and does not have significant share repurchase in 2005, the number of consecutive repurchasing years of this program is three. With this definition, a firm could have multiple repurchasing programs in our sample period, and each program could have different consecutive repurchasing years.

It is important to note that this definition does not guarantee that the first year of a consecutive repurchasing program is the year of or the year following a repurchasing announcement. In practice, managers do not commit to repurchase shares immediately following

an announcement – they have the option to postpone or cancel the actual repurchase plan. However, this definition has a distinct advantage in that it allows us to examine the effects of a series of actual share repurchases on a firm following a significant level of share repurchases.

In our sample, 49 percent of consecutive repurchasing program observations continue for only one year, 22 percent of significant repurchasing years belong to a two-year program, and 11 percent are part of a three-year program. As the number of consecutive years increases, the number of observations drops quickly. Only few firms (less than .5 percent) continuously repurchase shares for more than 10 years. Although the repurchasing programs are different in their consecutive year, the average shares repurchased per year are very similar across different programs, with the mean of share repurchase per year at 3 percent with a median of 2.5 percent. Detailed results are reported in Table 3, Panel B.

Table 3 repurchase frequencies and consecutively repurchases
This table reports the behavior of firms share repurchases. Showup is the number a firm being observed in our net repurchasing sample. Firm often repurchase shares consecutively. We categorize the consecutively repurchase by the number of uninterrupted repurchasing years. The mean and median of repurchase per firm-year and the sum of total repurchase during the uninterrupted sequence are reported.

Panel A			Panel B				
Frequency			Percentage Shares Repurchased				
Occurrence	N (firms)	% of total	Consecutive Years	obs.	%	mean	median
1	1399	27.60%	1	4147	48.91%	3.02%	3.02%
2	939	18.53%	2	1893	22.33%	2.97%	2.97%
3	675	13.32%	3	967	11.41%	3.03%	2.32%
4	512	10.10%	4	543	6.40%	2.91%	2.29%
5	368	7.26%	5	350	4.13%	3.09%	2.38%
6	245	4.83%	6	161	1.90%	3.32%	2.50%

7	250	4.93%	7	119	1.40%	3.58%	2.66%
8	141	2.78%	8	88	1.04%	2.66%	1.94%
9	136	2.68%	9	60	0.71%	2.58%	2.00%
10	117	2.31%	10	45	0.53%	2.93%	2.11%
11	93	1.84%	11	35	0.41%	2.65%	1.64%
12	60	1.18%	12	18	0.21%	2.60%	1.76%
13	44	0.87%	13	17	0.20%	2.43%	1.88%
14	31	0.61%	14	10	0.12%	2.50%	1.95%
15	20	0.39%	15	5	0.06%	2.15%	1.84%
16	17	0.34%	16	9	0.11%	3.00%	2.18%
17	13	0.26%	17	7	0.08%	2.56%	2.17%
18	7	0.14%	18	3	0.04%	2.82%	2.26%
19	1	0.02%	19	1	0.01%	3.16%	1.95%

V. Empirical Results

5.1 The difference between repurchasing and non-repurchasing firms

Before we investigate how firms change after actual share repurchases, we examine how repurchasing firms differ from non-repurchasing firms. We first construct two comparable samples of repurchasing and non-repurchasing firms. For each year in our sample (1993 – 2007), firms are identified as a non-repurchasing firm if they do not repurchase at least 1 percent of outstanding shares in a five-year window (two-years prior to and following the current year). Firms are designated as repurchasing firms if they repurchases more than 1 percent of shares outstanding in the current year and have positive actual repurchase (with a sum of three-year actual share repurchase greater than zero) in a three-year window (one-year before and one-year after). This classification yields 6,911 non-repurchasing firm-years and 3,356 repurchasing firm-

year. All variables are measured at the beginning of each fiscal year. We report the differences between repurchasing and non-repurchasing firms in table 4.

Table 4: Firm characteristics between repurchase firm and non-repurchase firm
This table reports the differences between repurchase and non-repurchase firms. For each year, if a firm does not repurchase any shares in a five years window (two-year before and two-year after) and have data available across the window, we identify the firm as a non-repurchasing firm. We identify a firm as repurchasing firm if it repurchases more than 1% shares outstanding in that year and has total positive net repurchases in a three-year window (one-year before and one-year after). The sample covers from 1993 to 2007, including 6911 non-repurchasing firm-year and 3356 repurchasing firm-year. All variables are measured at the beginning of each fiscal year. Student T-test is conducted to compare the means of two samples. **, * represent 1% and 5% levels of significance, respectively.

Variable N	Non-repurchase 6911	Repurchase 3356	Non-Repur - Repur
Ln(MV)	12.1917	13.2010	-30.80***
AT	1128.9	2592.1	-16.95***
Bmratio	0.6240	0.5847	5.52***
Debtratio	0.1710	0.1484	7.50***
FixedAsset	0.3026	0.2612	9.94***
IntanAsset	0.0994	0.1241	-8.26***
Psi	-2.5118	-2.0748	-19.60***
Cash	0.1441	0.1524	-3.08***
FCF	0.0746	0.1337	-25.31***
OXD	0.9328	0.8407	16.07***
R&D	0.1269	0.0574	10.14***
PM	0.0345	0.0507	-13.78***
Return	1.1963	1.1363	6.32***
Dividend	0.2096	0.2954	-8.68***
Abto_mean	0.3578	0.4055	-8.13***
Abto_median	0.3684	0.4082	-6.71***
SUV_mean	0.0009	0.0010	-1.75*
SUV_median	-0.2236	-0.2063	-9.59***

Consistent with the findings in Barth and Kasznik (1999), Rajan and Zingales (1995), and Dittmar and Thakor (2007), we find significance differences between the repurchasing firms and non-repurchasing firms. Repurchasing firms are larger, have more total assets, smaller debt ratios, higher intangible asset ratios and lower fixed asset ratios.

These results are consistent with the excess cash flow hypothesis and its underlying basis in agency theory. The repurchasing firms have substantially more cash and free cash flow than non-repurchasing firms, but less operating cost and R&D expenses. The presence of large cash reserves with small operating costs in the share repurchasing sample suggests that managers in those firms do not intend to use 'free cash flows' to 'build their own empire' (Jensen (1986)), but to distribute the cash back to shareholders.

The lower R&D expense is also consistent with the response of managers in Brav *et al.* (2005)'s survey that managers, without better projects to pursue, consider a 'share repurchase as a good investment opportunity'. Conversely, repurchasing firms have a higher profit margin than non-repurchasing firms, but experience lower stock returns. This is consistent with the managerial opinion suggested by Ikenberry, Lakonishok and Vermaelen (1995), Grullon and Michaely (2004), and Peyer and Vermaelen (2009)that undervaluation is the most important motivation for them to repurchase shares.

Consistent with our heterogeneous expectation hypothesis, repurchasing firms have higher divergence of opinion, measured by four proxies from trading volume. The abnormal turnover, after controlling for market-wide and industry-wide variance, is higher for repurchasing firms at both the mean and the median. The standardized unexplained trading

volume after controlling for the effect of abnormal return is also higher for repurchasing firms at both mean and median.

However, the evidence does seem to support the information asymmetry hypothesis proposed by Vermaelen (1981). The higher intangible asset ratio but lower fixed asset ratio in share repurchasing sample, together with the higher value of *Psi* , seems to contradict the traditional argument of the signaling hypothesis. Repurchasing firms also pay, on average, more dividends per share than non-repurchasing firms, which do not support the dividends / share repurchase substitution hypothesis.

Overall, the comparison between repurchasing and non-repurchasing firms supports the heterogeneous expectation and the excess cash flow hypotheses, as its results are consistent with the managers' 'better investment opportunity' and 'undervaluation' motivation. The result, however, fail to support the information asymmetry hypothesis.

We then focus on the difference of divergence of opinion between these two samples after controlling for firms' characteristics. The results are reported in table 5. The dependent variable is abnormal turnover, while Repurchase is a dummy variable, which equals one if an observation is a repurchasing firm-year. We run four regression models while controlling for book-to-market ratio effect, information asymmetry effect, and excess cash flow effect. Overall, the results are consistent with the heterogeneous expectation hypothesis. Divergence of opinion is consistently and statistically significantly higher for the repurchasing firms.

Table 5 Difference of Divergence of opinion after controlling other factors
This table uses the sample as in table 4. The dependent variable is the Abto_mean, a proxy for divergence of opinion. Repurchase is a dummy variable which equals one if a firm repurchases shares during the fiscal year. All other independent variables are measured at the beginning of each fiscal year. **, * represent 1% and 5% levels of significance, respectively, after controlling for heteroscedasticity.

	Simple model		Info. model		Agency Model		Full-factor model	
	Co-eff	T-value	Co-eff	T-value	Co-eff	T-value	Co-eff	T-value
Repurchase	0.1179	4.10**	0.0281	3.80**	0.0258	4.14**	0.0337	3.24**
Ln(MV)	0.0198	4.39**	0.0136	4.83**	0.0212	9.32**	0.0097	2.52*
AT	0.0000	0.11	0.0000	1.14	0.0000	0.67	0.0000	2.30*
Bmratio	0.0072	0.85	0.0044	0.42	0.0150	1.71	0.0052	0.34
Debtratio	-.0356	-1.93					-.0577	-1.55
FixedAsset			-.0269	-1.54			-.0077	-0.23
IntanAsset			0.1843	7.32**			0.3184	7.86**
Psi			0.0025	0.71			0.0015	0.29
Cash					0.0408	2.30*	0.1275	3.81**
FCF					0.0334	1.12	0.1046	2.17*
OXD					0.0719	3.79**	0.1123	3.58**
PM					0.0641	3.49**	0.0621	2.20*
Dividend					-.0116	-1.97*	-.0157	-1.09
Return							-.0361	-3.95**
Intercept	0.1179	4.10**	0.1847	4.48**	0.0183	0.50	0.1208	1.74

We find that the intangible asset ratio is significantly positively related with divergence of opinion, which suggests that the intangible assets could be a potential reason why investors hold different opinions on firm value. However, the information asymmetry variable, *Psi*, is uncorrelated with divergence of opinion. This result is consistent with Varian and Michigan (1985)'s theory that the divergence of opinion measure, abnormal turnover, is unaffected with information asymmetry.

5.2 The actual shares repurchased and the divergence of opinion

We then restrict our examination to the sample with firms who actually repurchase shares. The heterogeneous expectation hypothesis suggests that managers repurchase shares because they hold higher evaluation on the firm than do pessimistic investors, the higher the divergence of opinion, the larger the firm is undervalued from the point of managers' view, and thus, the more shares managers are willing to repurchase from those pessimistic shareholders.

In this section, we examine the relationship between the actual share repurchase and the level of divergence of opinion. The sample is same as the one used in Table 4, but exclude the non-repurchasing firms. The results are reported in Table 6. The dependent variable is the actual share repurchase ratio during a fiscal year and all independent variables are measured at the beginning of each year.

The results are consistent across four models. When the divergence of opinion is higher, the managers repurchase more shares during the year. Consistent with pervious findings, the firms with higher book-to-market ratio, more cash and free cash flows, or larger negative returns, repurchase more shares. Firms that have lower profitability or already paid dividends in last year repurchase fewer amounts of shares. More strikingly, we find firms with less information asymmetry problem repurchase more shares, in both the information asymmetry model and the full-factor model. The result is again contradict with the information asymmetry hypothesis, but is consistent with the Merton and Rock (1985) that, with high information asymmetry, managers face the adverse selection problem when they repurchase shares, and thus, will be less likely to repurchase shares.

Table 6 Actual Share Repurchase and Divergence of Opinion
This table examines the relationship between the divergence of opinion and the amount of actual shares repurchased in a year. The sample is same as the one in table 4. The dependent variable is the actual net share repurchase during the fiscal year. All independent variables are measured at the beginning of repurchasing fiscal year. **, * represent 1% and 5% levels of significance, respectively.

	Simple model		Info. model		Agency Model		Overall	
	Co-eff	T-value	Co-eff	T-value	Co-eff	T-value	Co-eff	T-value
Abto_mean	0.0097	5.70**	0.0088	4.57**	0.0094	4.15**	0.0053	2.05*
Ln(MV)	0.0066	16.68**	0.0054	10.84**	0.0057	10.24**	0.0045	6.56**
AT	-.0006	-4.86**	-.0008	-5.27**	-.0004	-2.29*	-.0003	-1.46
Bmratio	0.0191	12.21**	0.0135	7.19**	0.0287	12.25**	0.0233	8.38**
Debtratio	-.0298	-8.72**					-.0068	-1.02
FixedAsset			-.0296	-9.59**			-.0093	-1.57
IntanAsset			-.0051	-1.14			0.0050	0.68
Psi			0.0053	8.36**			0.0056	5.90**
Cash					0.0304	7.14**	0.0209	3.47**
CF					0.1064	15.96**	0.1146	13.48**
OXD					-.0241	-5.05**	-.0197	-3.50**
PM					-.0281	-6.82**	-.0176	-3.49**
Dividend					-.0022	-0.97	-.0075	-2.93**
Return							-.0093	-5.68**
Intercept	-.0763	-14.33	-.0410	-5.54**	-.0679	-7.40**	-.0253	-2.04*

5.3 The change in firms after actual share repurchases

In this section, we focus on changes experienced firms subsequent to actual share repurchasing programs. To quantify changes around a repurchasing program, we first identify each of the repurchasing programs for a given firm. A consecutive repurchasing program is defined in section 4.3. We collect the repurchasing programs with one, two, and three consecutive repurchasing years, which are labeled as S1, S2, and S3 respectively. We then

compare the firms' characteristics at the beginning of a repurchasing program (pre-) and one year after the end of the repurchasing program (post-). The results are reported in table 7.

Table 7 changes of firms' characteristics pre- and post- a continuous share repurchase program
This table reports the changes of firms' characteristics at the year before and the year after an uninterrupted repurchase program. S1, S2, and S3 represent a repurchase program continues for one, two, and three years without interruption. Post is one year following the repurchase program; while pre is one year pre to the repurchase program. **, * represent 1% and 5% levels of significance, respectively, after controlling for heteroscedasticity.

	S1			S2			S3		
Variable	Post-	Pre-	T-value	Post-	Pre-	T-value	Post-	Pre-	T-value
Abto	0.4473	0.4829	-2.82**	0.4397	0.5532	-5.48**	0.4153	0.4673	-2.33*
Abto_m	0.4819	0.5181	-2.52*	0.4724	0.5842	-4.78**	0.4095	0.5071	-2.92*
Ln(MV)	12.358	12.452	-2.01*	12.594	12.698	-1.50	12.882	12.876	0.06
AT	2365.4	1958.7	1.86	2289.8	1967.0	1.46	2598.8	1875.8	1.98*
Bmratio	0.6394	0.5916	4.47**	0.6809	0.5825	6.22**	0.6961	0.5796	5.18**
Debtratio	0.1716	0.1591	2.76**	0.1786	0.1469	4.95**	0.1611	0.1476	1.52
FixedAsset	0.2801	0.2687	1.80	0.2736	0.2570	1.82	0.2692	0.2514	1.38
IntanAsset	0.1224	0.1196	0.64	0.1361	0.1255	1.58	0.1320	0.1236	0.87
Psi	-2.5315	-2.5583	0.79	-2.4277	-2.2848	-2.94**	-2.296	-2.373	1.19
Cash	0.1544	0.1783	-4.77**	0.1395	0.1745	-5.08**	0.1448	0.1682	-2.39*
FCF	0.0575	0.0822	-5.96**	0.0621	0.1071	-7.81**	0.0757	0.1152	-5.91**
OXD	0.9205	0.9215	-0.08	0.8981	0.8743	1.94	0.8876	0.8581	2.07*
R&D	0.1133	0.1385	-1.73	0.0989	0.0888	0.77	0.0855	0.0802	0.32
PM	-0.0458	-0.0427	-0.25	-0.0204	0.0125	-2.19*	-.0026	.0272	-1.87
Return	1.2089	1.1424	4.19**	1.1972	1.1916	0.25	1.2138	1.2412	-0.87
Dividend	1.2089	1.1424	4.19**	0.2539	0.2362	0.73	0.2984	0.2474	1.73

Consistent with the heterogeneous expectation hypothesis, the divergence of opinion shifts downward after an actual share repurchase program. Both the mean and the median of abnormal turnover (Abto and Abto_m) decrease. The decreases in abnormal turnover are

statistically significant and consistent across all three types of consecutive repurchasing programs. The cash and free cash flow also reduce dramatically in all three types of repurchasing programs. The decreasing in cash could be a direct result of share repurchases. Managers invest the excess cash into share repurchases as there are no other better investment opportunities (Brav *et al.* (2005)). The reduction in cash is also consistent with the excess cash distribution hypothesis.

More interestingly, we find that the book-to-market ratio increases, rather than decrease, after the actual share repurchase programs. In all three types of repurchasing programs, the firms' book-to-market ratio increases significantly in the year after the repurchasing program comparing to its value at the beginning of the program. This result suggests that the high book-to-market ratio might not be the result rather than the force that driving managers to repurchase shares. We also document a significant increase in debt ratio, which suggests that equity value decreases after significant amount of cash is paid out.[50]

This change in information asymmetry of the firm is, again, failed to support the signaling hypothesis. In in type S1 and S3 share repurchasing programs, the information asymmetry measures do not change significantly after share repurchases. More strikingly, the information asymmetry increases after the type 2 repurchasing program. The profit margin represents the same pattern as information asymmetry: insignificant changes in type 1 and 3 programs and decrease in type 2 programs, which cast doubt on the argument that share

[50] The managers can also borrow money to repurchase shares. However, this strategy brings a large agency costs between shareholders and debt holders. The debt issuers often restrict the managers' flexibility of using debt to finance the net cash payout through either dividends or share repurchases.

repurchase announcements signal better future performance. This result, however, is consistent with Grullon and Michaely (2004), who document no operating performance increase following open market repurchase announcement.

We then focus on the changes of divergence of opinion among the investors. The investor heterogeneous expectation hypothesis predicts that managers repurchase shares due to the high divergence of opinion; after share repurchases, only the optimistic shareholders hold the stocks; and thus the stock price increases as the divergence of opinion decreases. We examine the changes in divergence of opinion after controlling for other firm characteristics. The sample contains the observations from the year at the beginning of the repurchasing program and one year after the end of a program. We then run the regression where the dependent variable is the divergence of opinion (Abto_m). We set a dummy variable, Pre, which equals one if the observation is from the year at the beginning of a repurchasing program.

Table 8 changes of divergence of opinion before and after an uninterrupted repurchasing program

This table reports the changes of divergence of opinion at one year before and one year after an uninterrupted repurchasing program after controlling for firm characteristics. The dependent variable is the divergence of opinion, Abto_mean. S1, S2, and S3 represent a repurchase program continues for one, two, and three years without interruption. Pre is a dummy variable is the variable is observed one year before share repurchase, otherwise equals zero. Other variables are measured each year respectively. **, * represent 1% and 5% levels of significance, respectively, after controlling for heteroscedasticity.

	S1		S2		S3	
	Co-eff	T-value	Co-eff	T-value	Co-eff	T-value
Pre	0.0252	2.67**	0.0404	2.22*	0.0539	2.09*
Ln(MV)	0.0508	10.48	0.0620	11.67**	0.0208	2.44*
Bmratio	0.0462	2.31*	0.0647	3.07**	-.0023	-.07
IntanAsset	0.3798	7.39**	0.4036	7.75**	0.1949	2.42*

Psi	-.0287	-3.77**	-.0371	-4.78**	-.0213	-1.66
Cash	0.1243	2.70**	0.2036	4.10**	0.0878	1.13
FCF	-.0092	-.15	0.0197	0.29	0.1467	1.17
PM	0.1138	3.78**	0.1361	3.96**	0.1029	1.25
OXD	0.0994	3.20**	0.1334	3.60**	0.1018	1.22
Dividend	0.0087	1.22	0.0380	2.54*	-.0279	-.93
Return	-.0902	-6.95**	-.1359	-9.07**	-.0980	-4.27**
Intercept	-.3292	-4.03**	-.4527	-4.98**	0.1325	0.85

The result is reported in table 8. Consistent with the heterogeneous expectation hypothesis, the divergence of opinion is larger for observations from the year at the beginning of repurchasing program. As the number of consecutive year increases, the changes in divergence of opinion decrease, suggesting that the effects of actual share repurchases on the divergence of opinion decrease. Such decreasing effect is consistent with the insignificant return increases after type 2 and 3 repurchasing program in Table 7, and therefore, support the heterogeneous expectation hypothesis that stock price increases as the divergence of opinion decreases.

VI. Conclusion

In this paper, we jointly test three hypotheses in an attempt to explain the motivation of managers to initiate share repurchase programs: the information asymmetry hypothesis based on signaling theory, the excess capital distribution hypothesis based on agency theory, and the investor divergence of opinion hypothesis based on marginal-investor theory. Overall, our results support the agency and investor divergence of opinion hypotheses. We do not find significant evidence in support of the information asymmetry hypothesis.

We test these three hypotheses by looking at the firms' actual share repurchase - our research differs from past empirical works, which traditionally focuses on the announcement effect of share repurchase and assume managers will repurchase shares after their announcement. We select our repurchasing sample for firms with yearly actual share repurchase of more than 1 percent of shares outstanding. Amongst them, more than 72 percent of firms repurchase more than once from 1991 to 2009. We also find that firms choose to execute their repurchasing programs over a different number of consecutive years, and firms on average repurchase 3 percent of shares outstanding each year. Overall, approximately 50 percent of our net share repurchasing programs last for only one year and 40 percent of repurchasing programs proceed consecutively in two, three and four years.

Consistent with the investor divergence of opinion hypothesis, repurchasing firms have a higher degree of divergence of opinion compared to non-repurchasing firms. The difference in divergence of opinion remains significant after controlling for firm characteristics. The number of shares repurchased is positively correlated with the degree of divergence of opinion - firms with a higher divergence repurchase more shares during a year. The explanatory power of divergence of opinion remains significant after controlling for other explanations, including the book-to-market ratio, cash distribution, dividend substitution, and information asymmetry. Divergence of opinion drops significantly after managers actually repurchase shares. The results are consistent in repurchasing programs with one-, two- and three-consecutive years.

Our results are also consistent with the agency cost hypothesis. Repurchasing firms have higher level of cash and free cash flow, profitability and intangible asset ratio, but lower stock

returns, and fixed assets ratio. We also document significant decreases in both cash and free cash flow after actual share repurchases.

We do not find evidence to support the information asymmetry hypothesis. Our results indicate instead that firms with higher information asymmetry actually repurchase fewer shares, and we do not find a significant decrease in information asymmetry following actual share repurchase. These results are in contrast to the information hypothesis but in agreement with Miller and Rock (1985), who argue that managers are reluctant to repurchase shares when the information asymmetry is higher due to adverse selection.

Our findings suggest that investors and researchers should exercise cautions in interpreting managers' announcement, especially when the announcement is not a commitment. We also argue that it is important to recognize the impact of investor heterogeneity, as suggested by Bagwell (1991), when the homogeneous representative model does not fit into the empirical observations.

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PhD in Finance, minor in **Economics**:

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- Thesis: Heterogeneous Expectation and Share Repurchase: Theory and Empirical Evidence

MBA (**finance** focus):

- Peking University (No.1 in China), September 2003 to May 2006
- Thesis: Localized Global Business: the Marine Industry in China

Bachelor in Electrical **Engineering**, minor in **Psychology**:

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Area of Interests

Research:

Corporate Finance (IPO, SEO, payout policy, and M&A), Market Microstructure (liquidity, fraction & arbitrage, and information asymmetry), Empirical Asset Pricing, Behavioral Finance (heterogeneous expectation).

Teaching:

Business Finance, Corporate Finance, Investment, Portfolio Management, International Finance, Mathematical Finance, Economic Statistics at undergraduate and graduate level.

Research Experience

Publication

"REIT Short Sales and Return Predictability," *The Journal of Real Estate Finance and Economics*, 2011, with Benjamin Blau and Matthew Hill

Working paper

"Asset Transparency and Securities' Trading Property: Evidence from ETFs, Closed-end funds, and REITS" with Michael Goldstein, Bonnie Van Ness, and Robert Van Ness; (presented at FMA 2009, Reno);

"On the Timing of Hedge Fund Company's IPO," with Fan Chen and Li-wen, Chen;

"Divergence of Opinion and the Likelihood of Announcements of Share Repurchase," with Benjamin Blau, Kathleen Fuller, and M. Mark Walker, dissertation essay; (scheduled presentation at SWFA 2011, Houston);

"Investors' Heterogeneous Expectation, Actual Share Repurchases, and Long-term Price Drift: Theory and Empirical Evidence from Hong Kong," with John Conlon and Kathleen Fuller, dissertation essay;

"How do Firms Change Following Actual Share Repurchases: Matured or New Growth," with Kathleen Fuller and M. Mark Walker, dissertation essay;

"Share Repurchases, Insider Trading, and Corporate Governance," with Ebrahim. Alireza;

Teaching Experience

University of Mississippi

Instructor

Business Finance	Fall, 2010

Teaching Assistant

Intermediate Financial Management	Fall, 2009; Spring 2010
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Peking University

Graduate Instructor	2003 – 2006

Working Experience

Schneider Electric Investment (China) Co., Ltd. 2005 - 2007

Section Manager & Global Account Manager

Schaffner EMG. (Beijing) 2002 - 2005

Sales & Product Manager

SANTAK Electric (Shenzhen) Co., Ltd. 1999 - 2002

Research & Development Engineer

Academic Service Experience

Panel Discussion:

American Financial Association Annual Meeting, 2010, Atlanta, GA

Presentation:

Southwestern Financial Association Annual Meeting, 2011, Houston, TX

Financial Management Annual Meeting, 2009, Reno, NV

Discussion:

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Ad Hoc Referee:

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Association

- American Financial Association (AFA)
- Allied Social Science Association (ASSA)
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- Eastern Financial Association (EFA)
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Awards and Hornors

2011

- Southwestern Financial Association (SWFA) – Annual Meeting Travel Grant
- University of Mississippi, Graduate School – Dissertation Fellowship
- University of Mississippi, Graduate School – Professional Meeting Travel Grant

2010

- American Financial Association (AFA) - Annual Meeting Travel Grant

- University of Mississippi, Graduate School – Professional Meeting Travel Grant

2009

- University of Mississippi, Graduate School – Graduate Student Council Research Grant
- University of Mississippi, Graduate School – Professional Meeting Travel Grant

2007 - Present

- University of Mississippi – Graduate Student Research Assistantship

2006

- Peking University, Guanghua School of Management - Best MBA Dissertation Paper
- Schneider-Electric Investment (China) Co., Ltd. – Team of Top Sales

2004

- Schaffner EMG. (Beijing) - Star Employee

2000

- SANTAK Electric (Shenzhen) Co., Ltd. – Employee of the Year (For a new structural diagram design earned US Patent (No. 6,744,643 B2 2004))

1995 – 1999

- Zhejiang University – Second and Third Class scholarships, Student Organization Fellowship

References

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