# Share Repurchase Rumors:

# Signaling, Publication and Market Reaction

Inho Kim and Yong H. Kim†
***Carl H. Lindner College of Business***
University of Cincinnati

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†Corresponding authors: kimio@uc.edu and kimyh@uc.edu, respectively
*Carl H. Lindner College of Business*, University of Cincinnati
Cincinnati, OH 45221-0195, U.S.A. E-mail:

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Abstract

In this paper, we analyze share repurchase rumors comparing them with share repurchase announcements in the period from 1999 to 2010. We found the empirical evidence that share repurchase rumors exhibit positive signaling effect comparable to the announcement effect of share repurchases. We then extend the existing theory of rumors (information transmission) by introducing the concept of publication status. Publication of rumors changes their status from private to public information. This transition results in smaller abnormal returns and acceleration in uninformed liquidity trading. In addition, empirical evidence suggests that the stock market differentiates information from different publication sources, e.g., major news providers versus self reporting company presses.

Keywords: Rumor, Share repurchase, Signaling, Publication effect, Publication source effect

JEL Codes: G14, G35

## I. Introduction

Survey responses from chief financial officers (CFOs) and chief executive officers (CEOs) indicate that the major motivation for share repurchase is their belief that the shares are undervalued (Brav, Graham, Harvey, and Mikaely (2005)). For example, in September 2011, Warren Buffett announced share repurchase of Berkshire Hathaway citing Berkshire's undervaluation. When managers believe that their companies are undervalued because firm's expected cash flow is underestimated or firm-specific risk is overestimated, they would choose share repurchase to provide information or signal of undervaluation to the stock market. Previous studies provide empirical evidence that share repurchases alleviate undervaluation (Dann (1981), Vermaelen (1981), Ikenberry, Lakonishak, and Vermaelen (1995), and Graham, Harvey, and Rajigopal (2005)). In addition, share repurchase may increase earnings per share (EPS) after its implementation (Bens, Nargar, Sinner, and Wong (2003)), adding perhaps more weight on the signal of undervaluation even though the increase of future EPS is uncertain.

To the extent that rumor is considered to be a type of information, it is natural to ask a question whether share repurchase rumors also carry any information of undervaluation and induce market reactions similar to the announcements of share repurchase in the market. Would the rumored firms experience value changes like share repurchase announcement firms? Financial rumors are difficult to detect, collect, and confirm because of the very nature of rumor. In general, earlier studies on rumors collect and analyze published rumors from newspapers such as Heard on the Street --- *Wall Street Journal.*[1] However, recent advances in information technology have made it possible to trace most rumors, published as well as

[1] Pound and Zeckhauser (1990) and Zivney, Bertin, and Torabzadeh (1996) both collect data from Wall Street Journal.

unpublished, in the internet environment[2] but still there is some limitation of accessibility to financial rumors.

In their discussion on the theoretical underpinnings of rumor (information) and its transferring process, Crawford and Sobel (1982) develop a model in which the better-informed agent (rumormonger in Van Bommel (2003)) sends a noisy signal to the less-informed agent (follower in Van Bommel (2003)). The latter agent, after information is received, makes a decision based on rational expectation and preference to the information --- the more closely aligned (similar) to her preference, the more informative the signal.[3] Kyle (1985) derives a model of transferring private information and liquidity characteristics among three types of traders: insider (rumormonger in Van Bommel (2003)), noise traders (liquidity traders in Van Bommel (2003)) and market makers. Noise trading camouflages informed trading from the market makers while providing profits to the informed trader. Based on these two theoretical models**,** Van Bommel (2003) develops a model on rumor trading and suggests that a rumormonger can exploit two chances of profitable trading --- at the time of rumor release and price overshoot.

Rumors have been investigated in the literature with respect to share repurchase or mergers and acquisitions (M&As). Share repurchase rumors are different from M&A rumors because ,in M&A deals, acquirers and target firms are separate economic entities from each other. However, the need to recognize separate entities does not exist in share repurchases. In other words, the acquirer and the target may possess conflicting

[2] For example, Tumarkin and Whitelaw (2001) and Clarkson, Joyce, and Tutticci (2006) investigate the impact of rumors on stock market with data from internet postings and discussions.

[3] Crawford and Sobel (1982) assume 'perfect communication' between agents, but it does not exist in the real world. Therefore, they apply the receiving agent's preference match assumption, replacing the concept of perfect communication.

interests in the rumor of M&A.[4] That is not the case in share repurchase rumors. This difference is an important aspect of understanding the repurchase rumor's impact on stock market. Despite this unique difference, little has been investigated about share repurchase rumors. This is the first empirical research on share repurchase rumors.

The purpose of this paper is to empirically investigate the theories of information transmission and market responses to share repurchase rumors. First, we analyze the existence and similarity of signaling effects of rumors by measuring their market reactions relative to the announcement effects of share repurchases. Second, we specifically analyze the trading behavior (or pattern) around rumors and announcements of share repurchase. Finally, we test the publication effect of rumors, specifically differences in the market reaction dependent on the differences in information source (publication outlet). This may allow us to investigate the possibility of self manipulation.

This paper reports two major findings. First, the rumors of share repurchase have their *signaling effect* of undervaluation. Unlike M&A rumors, however, share repurchase rumors are unidirectional (in general, *upward*) information and share repurchases are, unlike M&A deals, expected to be a series of corporate events without a specified time period. We test the signaling effect of share repurchase rumors by measuring and comparing it with the share repurchase announcement effect in short-term and long-term market reactions. We find that share repurchase rumors play a positive role on short-term and long-term valuation. Rumored firms experience positive abnormal returns in short-term and positive returns in long-term. Specifically, rumored firms that are undervalued (e.g., small market-to-book ratio) show positive buy-and-hold returns in 3, 6, 9, and 12 month periods, which are comparable to

[4] For example, higher (lower) price is preferred for target firms (acquirers) in M&A deals, so that target firms have motivation to release the information.

those of share repurchase announcement firms[5]. The positive long-term performance is observed explicitly in small market-to-book ratio group. Our result provides an empirical evidence of signaling effect associated with share repurchase rumors.

Second, we extend the theory of rumor (information transmission theory) by exploring the effect of differences in publication status. Specifically, we document the empirical evidence of differences in market reactions to unpublished and published share repurchase rumors in terms of comparative cumulative average abnormal returns (CAAR) and cumulative abnormal turnover ratios (CAAT). Rumors are indistinguishable from share repurchase announcements in terms of abnormal returns (CARs) when rumors are still in unpublished status. However, published rumors lose abnormal returns after publication, while unpublished rumors maintain abnormal returns until expiration (one or two weeks). We also confirm that there are no different market responses in both unpublished and published rumors during the periods of their unpublished status. Interestingly, financial companies are less sensitive to repurchase rumors than firms in other industries probably because of relatively higher uncertainties associated with regulatory constraints on financial firms such as capital requirements.[6] In general, our findings on share repurchase rumors support the semi-strong form efficient market hypothesis (EMH)[7].

We identify three additional findings that are related to our major findings about share repurchase rumors. First, our results suggest the similarity of firm characteristics, especially profitability, between rumored firms and repurchase announcement firms. They are

[5] We follow Ikenberry et al. (1995) method on sub-grouping by market-to-book ratio.

[6] For a recent case of repurchase rumor of a financial institution under regulatory uncertainties, see J.P. Morgan Chase's repurchase rumor in Heard on the Street, *Wall Street Journal*, B18, April 14-15, 2012.

[7] Samuelson (1965) and Fama (1970).

also similar in terms of market reaction around rumors and announcements of share repurchase. This implies that repurchase rumors and the characteristics of rumored firms seem to provide credible signals to market participants that are similar to the situation and characteristics of share repurchase announcement firms. This result supports the theory of Crawford and Sobel (1982) in that more similarity between firms that have repurchase rumors and those actually implemented share repurchases leads more credibility (preference) about the repurchase rumors.

Our logistic analysis shows similarities between rumored firms and repurchasing firms in their characteristics. We also find similar changes and impacts around rumors and announcements of share repurchase in terms of alpha (intercept) in the regression model.

Second, we observe the empirical evidence of liquidity trading behavior around the publication of rumors. As suggested theoretically by Kyle (1985) and Van Bommel (2003), initial abnormal returns (profits) to a rumormonger or instant followers are followed by liquidity trading behavior of uninformed traders. Specifically, around the publication of rumors, abnormal returns seem to be replaced by abnormal turnover ratios. These replacements are likely caused by uninformed liquidity traders. Uninformed liquidity traders may consider the published rumors as private information because news providers report only the existence of rumors without confirming the content of rumors. Thanks to ever accelerating advances in information technology, information is more widely accessible to market participants in a very short time period. We conjecture that such an enhanced accessibility would encourage uninformed liquidity trading behavior.

Third, we empirically attempt to define and examine the publisher identity effect of published share repurchase rumors. Different identity of publishers, such as news providers,

Securities and Exchange Commission (SEC) or company press tends to receive different level of attention from the market. Reports from the third party news providers, e.g., Associated Press (AP), Reuters or Bloomberg, generate relatively higher market reaction, while little market responses are detected against self serving reports by company presses, which is consistent with self manipulation hypothesis.

This paper is organized as follows. Section I presents introduction and purpose of the research. Section II describes rumors and publication effect. Section III presents literature reviews and hypotheses. In Section IV, we explain data and methodology. In Section V, we report empirical findings. Section VI concludes.

## II. Rumors and the publication effects

### *A. Definition of Rumor*

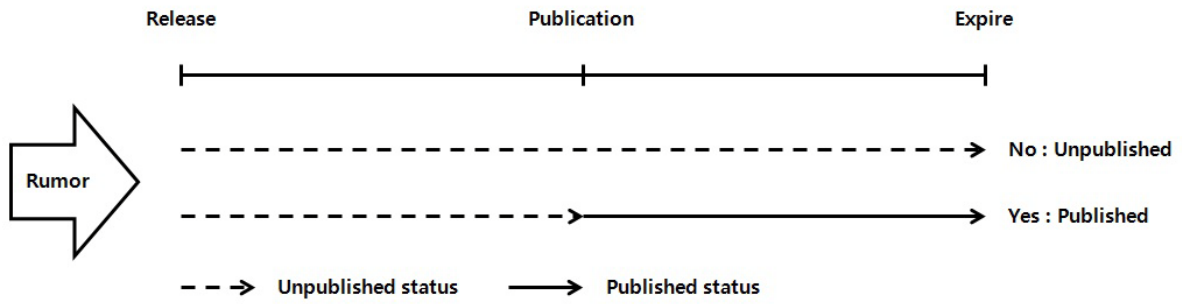
A rumor is defined in sociology as an unverified account or explanation of events circulating from person to person and pertaining to an object, event, or issue in public concern (Peterson and Gist (1951)). Similarly, a financial rumor refers to specific unconfirmed information related with financial markets, and its major buyers and sellers are financial market participants.

Prior studies on financial rumors indicate that no classification attempt has been made on rumors by the status of publication. We classify rumors into unpublished and published categories to examine market reactions on differences in publication status. Rumors are classified as unpublished if they are not picked up by mass media or do not stay on in the website posted until rumors expire, while rumors reported by mass media are

classified as published. The major reason we classify rumors into unpublished and published is that news media are involved in almost every information transmission and the publication status of rumors could possibly induce different market reactions due to the differences in market participants' perceived level of private information accessibility upon the publication of rumors.

We provide the time line of unpublished and published rumors by mass media in Figure 1. Dotted line and solid line represent unpublished and published status of rumor, respectively. At the early stage of the rumor release, both rumors are in unpublished status.[8] By the publication stage, one rumor transforms its unpublished status into published status and the other continues to be unpublished. The rumors expire in different status.

**Figure 1. Time line of unpublished and published rumors by publication**




The market impact of published rumors before their publication is assumed to be identical to that of unpublished rumors. After publication, however, a rumor turns into a publicly

[8] In our sample, the dates of rumor release for published rumors are not available, while the dates of rumor publication as well as the release date of unpublished rumors are identified.

accessible information and its market impact would be changed.

### *B. Publication effects*

To publish is to make content available to the general public.[9] Based on information transmission theories (Crawford and Sobel (1982) and Kyle (1985)) and rumor theory (Van Bommel (2003)), rumors (private information) cause price increases if they match receivers' preferences and informed trading. Therefore, we expect positive market reaction on share repurchase rumors because share repurchase generally provides favorable information (undervaluation signal) to market participants.[10]

We expand rumor mechanism by incorporating the publication status of rumors. Upon the publication of rumors, we posit that informed traders and uninformed traders may show different reactions to rumors. Better informed traders are likely to lose their interest in a published rumor as a means to send noisy signal. However, uninformed liquidity traders may be more interested in this rumor because its publication would increase the level of accessibility to the perceived private information. In other words, published rumors are no longer private information to informed traders. However, because the publication of a rumor is not confirming the truth of rumor's content, this published rumor is still attractive perceived private information to uninformed liquidity traders. Different reactions from informed and uninformed market participants due to the publication are then likely to induce changes from price increase to turnover ratio increase as the role of key market players are

[9] Definition from http://en.wikipedia.org/wiki/Publication

[10] Dann (1981), Vermaelen (1981), Wansley, Lane, and Sarkar (1989), Ikenberry et al. (1995), Tsetsekos, Kaufman, and Gitman (1998), Brav et al. (2005), and Graham et al. (2005)

transitioning from informed traders to uninformed liquidity traders. As a result, reported (published) rumors receive more attention from uninformed liquidity traders triggering frequent trades but the profitability associated with such uninformed trades would likely be insignificant.

Some rumors are picked up by news providers/media and some others are not. One of the critical reasons for the selection of publication appears to be the timing.[11] By the time financial rumors hit the market, the level of market reaction is likely to be almost at peak. If news providers/media miss this initial period of market reaction then readers (market participants) are less likely to buy the news because they already know. Based on this scenario, once news providers miss the right time to report financial rumors, they seem to just let the rumors stay unpublished given the limited perceived value of reporting them in their media.

## III. Literature review and hypothesis

### *A. Prior studies on rumor and motivation of the study*

Crawford and Sobel (1982) suggest rational behavior in information transmission between two different agents. In perfect communication environment, the existence of direct communication between two agents is one of the most critical conditions but oftentimes unrealistic, so they apply the degree of interest match to replace the need for perfect communication. In their generalized model, a better-informed agent sends a noisy signal to the other agent for the strategic communication and the action the other agent takes determine

[11] To confirm the timing assumption, we compare the market reactions of unpublished and published rumors during their unpublished period in Figure 1 and find little statistical difference between the two groups.

the profit of both agents that is based on the rational behavior of the agent's interest.

Kyle (1985) develops an insider trading model by explaining the relationship between insider, noise traders and market makers. In the model, he analyzes the information content of prices, liquidity characteristics of market and value of the private information.

Van Bommel (2003), based on the theory of Crawford and Sobel (1982) and Kyle (1985), develops a dynamic model with rational profit-maximizing traders, where rumormongers release imprecise rumor to the market. Followers will trade on the rumor, which would provide two trading opportunities first at rumor release and next at price overshoot. These two opportunities increase trading volume and the expense of uninformed liquidity traders which may turn into the profit of informed traders. In this setting, there must be some evidence of the increase in uninformed liquidity trading.

Following Van Bommel (2003), we expect that uninformed liquidity trading increases trading volume but not stock price, because a trader who buys stocks without information is likely to make an attempt to sell them to another uninformed trader after being informed about a rumor. Therefore, uninformed liquidity trading is likely to increase in trading volume. For the same reasoning, the stock price may stay at an insignificantly higher than the previous level, if not at the same level, during the period of frequent turnovers.

Most, if not all, studies on financial rumors are concerned with published rumors but not about the changes in the status of publication. Pound and Zeckhauser (1990) collect takeover rumors from Heard on the Street in *Wall Street Journal*. They investigate excessive returns after the publication of rumor in different time periods of one day (rumor publication day), 20 day, and one year holding periods, which represented 0.07%, 7.78%, and 1.77%, respectively. They conclude that published takeover rumors cannot generate excess trading

returns.

Zivney et al. (1996) investigate investment strategy and performance with rumor data from 'Heard on the Street' and 'Abreast of the Market' column. They document that buy-and-hold trading strategy using rumors generates negative returns in long-term period but, in short-term period, this trading strategy generates positive returns. They suggest that long-term (approximately 100 days after rumor publication date) short sale trades show positive returns, which are a 20 percent annual excess return with 70 percent of 486 trades. These previous empirical studies report that no excess returns are generated by published takeover rumors, which supports the efficient market hypothesis (semi-strong form).

Unlike published rumors, there are rumors that are not picked up by mass media and remain unpublished. It is likely that these two types of rumors may exhibit different as well as similar characteristics from each other. Therefore, we segment rumors into published and unpublished groups to examine whether stock market reacts differently to them and whether the firm characteristics between the two groups exhibit any similarities.

The information (publication) source on rumors could play critical roles. It identifies a rumor as published information. It also attracts a greater number of potential market participants' attention to a rumored company and tends to trigger more trades. Its spread is likely to be accelerated by internet, so more people would be exposed to the information. On the other hand, it takes more time for unpublished rumors to be spread throughout the market because they are typically transmitted from people to people without the benefit of being published by a legitimate medium. We expect that unpublished rumors would take more time to spread out, which in turn would prolong the process of price discovery, or the unpublished information would be shared only among private members or groups (Clarkson et al. (2006)

and Bettman et al. (2010)). Therefore, abnormal returns associated with unpublished rumors would last longer than the abnormal returns of published rumors. However, the magnitude of abnormal returns could be small or would not exist to any significant level because of unpublished rumors'slower diffusion process.

The asymmetry of information on rumored firms is another important issue. . Reporting how the frequency of security issuance can be affected by analyst coverage, Chang, Dasgupta, and Hilary (2006) argue that less analyst coverage causes less frequent issuance of equity, which is in turn a measure of information asymmetry associated with a firm. In a similar vein, Bowen, Chen, and Cheng (2008) suggest that underpricing of seasoned equity offering (SEO) is decreased with higher analyst coverage. In addition, Givoly and Lakonishok (1979) show that stock prices are affected by analyst reports and recommendations.

***B. Prior studies on share repurchase***

It is important to understand the aspects of repurchase firms relative to those of the repurchase rumor firms. If there are similar characteristics between them, it is conceivable that their similarities may cause the generation of repurchase rumor. If they are not similar, unless any systematic relationship is identified between the two groups, we could argue that rumors are just noise.

Prior studies have established that repurchase announcements are positively related to the probability of stock price increases because it is considered to be a signal that a firm has enough cash or cash flows or better prospects. In turn, agency problems associated with excess capital/cash can be reduced via share repurchase as an alternative dividend payout

method.[12] In addition, undervaluation problems caused by information asymmetry can be resolved by announcing share repurchase.[13] Lie (2005) documents that operating performance improves after repurchase announcement. Operating performance improvements with positive earnings are reported in the same fiscal quarter of share repurchase. In contrast, Grullon and Michaely (2000) report a decline in return on assets (ROA), capital expenditures and cash reserves after repurchase announcement, while firm risk measured by cost of capital decreases.

Jagannathan, Stephens, and Weisbach (1999) and Guay and Harford (2000) report that aspects of cash flow would affect firm's payout policy. Firms with constant operating profits tend to pay dividend, while firms with temporary non-operating profits tend to repurchase. In addition, Dittmar (2000) documents that firms control leverage ratios by repurchasing stocks. Higher level of debt decreases free cash flow that could be used for stock repurchase or it is also possible that leverage ratio can be controlled to influence shareholders' wealth.

Based on the optimal (or target) leverage hypothesis, firms may use share repurchase to achieve the optimal (or target) capital structure (Bagwell and Shoven (1989) and Hovakimian, Opler, and Titman (2001)). Nohel and Tarhan (1998) examine operating performance changes before and after repurchases. They report that operating performance after repurchase improves only in low growth firms, which is based on efficient utilization rather than growth opportunities. It is clear that these studies suggest changes in firms' characteristics in terms of profitability, capital structure, volatility, transparency around

[12] Jensen and Meckling (1976), Myers and Majluf (1984), and Jensen (1986)

[13] Vermaelen (1981), Asquish and Mullins (1986), Comment and Jarrell (1991), Dann, Masulis, and Mayers (1991), Hertzel and Jain (1991), Ikenberry et al. (1995), and Graham et al. (2005)

announcement of repurchases. We therefore test changes in repurchasing firms and in rumored firms focusing in these characteristics. We also follow Ikenberry et al. (1995 and 2000) and Chan, Ikenberry, and Lee (2004) to investigate long-term performance of share repurchasing firms and rumored firms by examining buy-and-hold abnormal returns and excess returns of CAPM factor models.

Babenko, Tserlukevich, and Vedrashiko (2013) reports that open market share repurchase announcements with more prior insider trading provide stronger signals of undervaluation and also more likely to complete share repurchase programs.

### *C. Hypotheses*

*H1: Alternative signaling effect hypothesis*

According to the signaling theory (Bhattacharya (1979) and Miller and Rock (1985)), announcements of share repurchase provide a signal of undervaluation to the market (Vermaelen (1981), Ikenberry et al. (1995), and Graham et al. (2005)). Share repurchase rumors may produce similar signals to the market and, if so, we may expect that rumored firms and repurchase announcement firms would both perform in positive direction (Ikenberry et al. (1995) and (2000) and Chan et al. (2000)). According to Chan et al. (2010), share repurchase contains the flexibility of completion in the case of open market share repurchase. This flexibility of completion may provide more similarity to share repurchase rumors.

Several studies have identified characteristics and changes that are relevant to stock

repurchasing firms.[14] Rumored firms may be similar to share repurchase firms in their characteristics, in terms of replicating the association between share repurchase announcement and its credibility of undervaluation signal to market participants. If so, we expect that the impact of share repurchase rumors, the firm characteristics and their changes after events would be similar to those of share repurchase announcements.

*H2: Publication effect hypothesis*

We know from the efficient market theory that it is difficult to generate abnormal returns with published rumors (publicly accessible information). In contrast, unpublished rumors (private information) may produce abnormal returns to the market participants. Therefore, we categorize rumors into published and unpublished rumors. A rumor is published when it is reported by mass media and an unpublished rumor is when it is not reported by the media. Then we expect that published rumors generate little or less abnormal returns than unpublished rumors during the same event window periods. Little abnormal returns after publication of rumors can be a supporting empirical evidence for semi-strong EMH.

Due to differences in diffusion channels and speeds between published and unpublished rumors, we expect differences in market reactions to them.

*H2a: Publisher identity hypothesis*

Unlike announcements, rumors can be distributed in many ways. Different types of information sources may induce different degrees of market reactions because of their

[14] Nohel and Tarhan (1998), Dittmar (2000), Guay and Harford (2000), and Jagannathan et al. (2001)

reputation and credibility. For instance, both Zeckhauser (1990) and Zivney et al. (1996) report short-term positive market reactions using rumor data from *Wall street Journal*. The high level of reputation enjoyed by *Wall Street Journal* is likely to provide relatively stronger impact to the market. However, rumor reports from their own company presses may deliver less credibility, even if they have high reputation, because self serving manipulation may still be the concern by most market participants.

When publication effect exists, the reputation or identities of information could induce another issue. News providers which are major information sources spread information through television, newspapers, and internet and transfer information to millions of people instantly. News providers with higher reputation would provide stronger impact to the market than news providers with lower reputation. We assume that different identities of information sources would cause different market responses. For example, major news providers would generate more impact to the market than company press.

To examine this hypothesis, we use total number of 147 cases in our sample that excluded financial industry and classify information sources into three groups. (1) Mass media [15] occupies 92 cases (62.6%), (2) company press, advisor submission and miscellaneous websites are 38 cases (25.9%), and (3) stock exchange and SEC filings are 17 cases (11.6%). We expect each group may show different characteristics reflecting different reputational levels.

*H3: Preference match hypothesis*

[15] Mass media (news providers) namely refer to Associated Press, Bloomberg, Newswire, Reuters and more.

Crawford and Sobel (1982) suggest that information receivers follow rumor more when their preference is similar to that of information provider. We apply this strategic information transmission theory to share repurchase rumors to detect information receivers' preferences. For example, higher profitability provides higher probability of actual share repurchases from rumors, but still more factors exist. The resemblance between rumored firms and repurchasing firms could be positively related to the receiving agents' preferences because it makes the rumormonger more trustable, i.e., the receiving agents are more likely to believe that the rumored firms have higher probability to repurchase. Also, some factors supporting the capability of actual share repurchase provide more credibility to information receivers. We categorize factors that would be of interest to information receivers, such as number of shares to buyback, cash holding, profitability, tendency, market-to-book ratio and capital structure.

## IV. Data and methodology

### *A. Data*

We collect our sample from ORBIS (Bureau van Dijk) which covers 60 million companies worldwide and is searchable using hundreds of criteria. In ORBIS, Zephyr contains global M&A deals from year 1999 and about 60,000 deals are added per year. Zephyr collects share repurchase rumors from different sources - stock exchange announcements and 70,000 daily global news sources. Zephyr indicates a rumor if there is no corresponding stock exchange announcement then the deal is added as a rumor with the source showing as the news source.[16] We categorize published and unpublished rumors by the existence of this news

[16] According to the Zephyr, if the news source is not permanent (temporally posted), this rumor is recorded

source.

We select share repurchase cases of US listed firms that contain rumors and share repurchase announcements during the sample period from 1999 to 2010. To build a data set, a rumor is defined that no announcement is followed within one year after rumor is detected/released.[17] For repurchase announcements, we choose all share repurchase cases from Zephyr.[18] We check deal headlines and LexisNexis and collect missing cases manually by inputting company names, information sources, full or adjusted CUSIP codes, and tickers for Center for Research in Security Prices (CRSP) and COMPUSTAT and exclude cases that have insufficient or improper information[19]. Our final data set includes 273 cases of rumors and 2510 cases of share repurchases. Rumor group is composed of published (190 cases) and unpublished (83 cases) rumors. Published rumor contains the name of publication, headline summary and date of release. To conduct event study analysis we use CRSP data of daily stock returns, trading volumes and index returns. For regression and logistic analysis we utilize financial data from COMPUSTAT. We use factor variables (monthly risk-free rate, market rate, SMB, and HML) from the Kenneth French website.[20]

We provide descriptive statistics in Table 1. Sample is divided into whole sample and financial industry excluded sample. Result is reported in categories of rumor versus

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without the news source. We define this as an unpublished rumor.

[17] There are another two types of rumor in this sample --- one is followed by no announcement and the other is followed by no announcement within one year. Most of cases belong to the former.

[18] Open market share repurchase takes major portion (94.4%) and other methods take minor portion in our sample. Open market share repurchase brings an issue about the completion of share repurchase, but it is not the issue we are investigating in this paper.

[19] We exclude the overlapped cases with rumor and repurchase in the same deal number and firms with insufficient information from CRSP (stock prices and trading volumes) and COMPUSTAT (financial statement data).

[20] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/

repurchase and unpublished versus published in each table. Deal information is collected at year (0) and financial and other variables are collected at year (-1). We also categorize variables into financial structure, profitability, volatility, valuation, transparency and payout policy dummies.[21] We find some similarity and difference between rumored firms and repurchasing firms. For example, more financial companies tend to pay dividends (rumor (54.7%) and repurchase (50.2%) in whole sample) than other companies (rumor (46.0%) and repurchase (46.9%) in financial industry excluded sample). Repurchase announcement firms (published rumor firms) have experienced more share repurchase than rumored firms (unpublished rumor firms).

[Insert Table 1 Here]

In Table 2, we indicate the regression result of post- versus pre-characteristic changes in rumor and repurchase for deeper investigation because we find little significant difference of t-test and Mann-Whitney test between year (-1) and year (0). We conduct regression analysis with post-aspects (response variable) versus pre-aspects (explanatory variable) of the firms.[22] The intercept (alpha) of this regression model indicates the impact of repurchase rumors and announcements. Rumors and repurchases generate significant positive impact in most of variables. Importantly, MKBK shows 0.308 (rumor) and 0.265 (repurchase), at the significance level of 1%. REPORT/MTH and AVE. RECOM record 0.286 and 2.074 (rumor) and 0.286 and 1.019 (repurchase) at the significant level of 1%, respectively. It can be interpreted that firms receive positive impact on valuation and get more attention after experiencing rumor and share repurchase in the same manner. Positive impact on AVE.

[21] We build the list of factors based on previous studies on repurchase --- Chang et al. (2006), Grullon and Michaely (2004), Jagannathan and Stephens (2003), Dittmar (2000), Stephens and Weisbach (1998), and Ikenberry et al. (1995).

[22] We apply Nohel and Tarhan (1998) method.

RECOM means less recommendation to buy, which is caused by positive impact on firm valuation. Positive impacts on other variables could be related with positive long-term performance of rumored and repurchasing firms. LBT/AST has insignificant negative impact on rumor, while it positively and significantly influence on share repurchase. According to optimal leverage ratio hypothesis (Hovakimian et al. (2001) and Dittmar (2000)), share repurchases announcements increase debt ratio, while rumors provide little impact on debt ratio. The significant positive alphas in profitability variables could lead positive performance in the long-term performance (EBITDA/AST and EBITDA/REV).

[Insert Table 2 Here]

***B. Methodology***

*(1) Event study*

For event study we consider two dimensions of stock market, one is abnormal return and the other is abnormal turnover ratio. We measure cumulative average abnormal return (CAAR) and cumulative average abnormal turnover ratio (CAAT) to investigate influence and relationship between return and trading volume around rumors and announcements of share repurchase. Abnormal return is measured by the market model (Brown and Warner (1985)) that utilize the -120 to -31 day estimation window (90 days) and the equally weighted market index for bench mark.[23] The market model equation is expressed as follows:[24]

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \quad , \textit{where t=-120, …, -31}$$

[23] Market model seems more suitable for estimating specific firm's abnormal return.

[24] All models are applied to different sample groups in the same manner.

$$AR_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_i R_{mt} \ , \textit{where t=-20, ..., +20}$$

$$CAR_i = \sum_{t=-20}^{+20} AR_{it} \ , \qquad CAAR = \sum_{i=1}^{n} CAR_i/n$$

where $\alpha_i$ is a intercept for the stock $i$, $\beta_i$ is the market beta of the stock $i$, $R_{mt}$ is the equally weighted market index return, and $\varepsilon_{it}$ is an error term.

Abnormal turnover ratio is measured by log turnover method. By applying logarithm on turnover ratio it is possible to reduce skewness and kurtosis.[25]

$$Log\ Turnover(T_{i,t}) = Log\left(\frac{Trading\ Volume_{i,t}}{Share\ Outstanding_{i,t}}\right)$$

$$Abnormal\ urnover(AT_{i,t}) = T_{i,t} - \bar{T}_i \quad , where\ \bar{T}_i = \frac{\sum_{t=-120}^{-31} T_{i,t}}{90}$$

*(2) Regression analysis*

To analyze the relationship between abnormal return (turnover ratio) and categorized variables, we conduct regression analysis applying cumulative abnormal return, CAR[0] (cumulative abnormal turnover ratio, CAT[0]), as a response variable and categorized variables for explanatory variables. The model equation is expressed as follows:

[25] See Ajinkya and Jain (1989) and Chae (2005).

$$CAR[0]_i(CAT[0]_i)$$

$$= \alpha_i + \beta_{i1}SHARE + \beta_{i2}LN(AST) + \beta_{i3}\,CAPX/AST\,(CAPX/EBITDA)$$
$$+ \beta_{i4}\,CHE/AST + \beta_{i5}\,EBITDA/AST\,(EBITDA/REV) + \beta_{i6}\,LBT/AST$$
$$+ \beta_{i7}NOPI/AST + \beta_{i8}STD(mRET)\,(MKBK)$$
$$+ \beta_{i9}REPORT/MTH\,(AVE.RECOM) + \beta_{i10}DV\_DUM + \beta_{i11}RPS\_DUM$$

where SHARE is the percentage of share repurchase rumored and announced. LN(AST) is natural log of total asset. CAPX/AST and CAPEX/EBITDA is capital expenditure divide by total asset and earnings before interest, tax, depreciation and amortization, respectively. CHE/AST is cash and short-term investment divided by total asset. EBITDA/AST and EBITA/REV is earnings before interest, tax, depreciation and amortization divided by total asset and total sales, respectively. LBT/AST is total liability divided by total asset. NOPI/AST is non-operating income divided by total asset. STD(mRET) is standard deviation of monthly stock return for previous one year. MKBK is market value divided by book value of firms. REPORT/MTH is total number of reports for one year divided by 12 months. AVE. RECOM is average of recommendation for one year, 1 is strong buy and 5 is strong sell. DV_DUM and RPS_DUM are dummy variables for dividend payment and repurchase execution, 1 for yes, 0 for no.

We examine the impact of rumors and announcements of share repurchase by regressing the firm characteristic variables of year after (POST) and before (PRE). We expect that this regression analysis produces the directions (positive or negative) and degree of the impact around rumors and announcements of share repurchase. We modify the methods from Nohel and Tarhan (1998). The model equation is expressed as follows:

$$POST_i = \alpha_i + \beta_i PRE_i$$

where $POST_i$ is *i* variable of firm characteristic at the end of year (0) and $PRE_i$ is *i* variable of firm characteristic at the end of year (-1).

*(3) Logistic regression analysis*

We apply logistic regression to compare differences between rumored and repurchasing firms and also published and unpublished firms using the probability of selection. For multinomial logistic regression, response variable should be defined in a dummy variable. In the first category, 1 is applied to the cases of rumors, 2 is for repurchase announcements. In the second category, 1 is for published rumors and 2 is for unpublished rumors. The model equation is expressed as follows:

$$\begin{aligned} LN\left(\frac{P}{1-P}\right) = {} & \alpha_i + \beta_{i1} LN(AST) + \beta_{i2}\, CAPX/AST\ (CAPX/EBITDA) + \beta_{i3}\, CHE/AST \\ & + \beta_{i4}\, EBITDA/AST\ (EBITDA/REV) + \beta_{i5}\, LBT/AST + \beta_{i6} NOPI/AST \\ & + \beta_{i7} MKBK + \beta_{i8} STD(mRET) + \beta_{i9} REPORT/MTH + \beta_{i10} AVE.RECOM \\ & + \beta_{i8} DV\_DUM + \beta_{i9} RPS\_DUM \end{aligned}$$

where *P* is a probability of select rumor (or published), *1-P* is a probability of select repurchase (or unpublished). Definitions of variables are same as regression model 1 and 2.

*(4) Buy-and-Hold abnormal returns (BHAR) and calendar portfolio approach*

To calculate buy-and-hold (abnormal) returns, we follow the method of Barber and Lyon (1997) and Chan et al. (2004). We measure buy-and-hold returns (BHR) and buy-and-hold abnormal returns (BHAR) of rumored and repurchasing firms. The model equations are

expressed as follows:

$$BHR_{it} = \prod_{t=1}^{n}[1 + R_{it}] \qquad and \qquad BHAR_{it} = \prod_{t=1}^{n}[1 + R_{it}] - \prod_{t=1}^{n}[1 + R_{mt}]$$

where $R_{it}$ is return of firm $i$ at time $t$ and $R_{mt}$ is return of market index at time $t$. We use value weighted market index returns and equally weighted market index returns for the market index returns. We divide our sample into two, bigger and smaller than median of market-to-book ratio (MKBK), which categorizes undervaluation level, i.e., glamour or value stock.[26] The median of MKBK for rumor is 0.85 and repurchase is 0.95.

To conduct calendar portfolio approach, we apply market model and three factor model from Fama and French (1992, 1993) and portfolio formation from Ikenberry et al. (2000). Stocks are included in the portfolios 3m (months 1 to 3), 6m (months 4 to 6), 9m (months 7 to 9), 12m (months 10 to 12), 1- 6m (months 1 to 6), and 1-12m (months 1 to 12) after rumor or announcement, respectively. The model equations are expressed as follows:

$$r_{pt} - r_{ft} = \alpha + \beta_m(r_{mt} - r_{ft}) + \epsilon_t$$

$$r_{pt} - r_{ft} = \alpha + \beta_m(r_{mt} - r_{ft}) + \beta_{smb}(r_{st} - r_{bt}) + \beta_{hml}(r_{ht} - r_{lt}) + \epsilon_t$$

where $\alpha$ is intercept of the regression model and abnormal return of portfolio. $\beta$ is slop of the regression model. $r_{pt}$ is return of portfolio at time $t$ and $r_{ft}$ is risk free rate at time $t$, which is monthly Treasury bill rate. $r_{mt}$ is market return at time $t$. $r_{st}$ and $r_{bt}$ are returns of small and big stocks at time $t$. $r_{ht}$ and $r_{lt}$ are returns of high and low book-to-market ratio stocks at time $t$.

[26] The number of rumored firms results in dividing two groups for statistical stability, which is a modification of Ikenberry et al. (1995) and Chan et al. (2004).

## V. Empirical results

To detect the signaling effect of share repurchase rumors, we analyze market responses (short-term reaction) to the rumors and announcements of share repurchases, we measure CAARs and CAATs and report them in the categories of rumor versus announcement of share repurchase and published rumor versus unpublished rumor in Table 3. We display the result of whole sample in panel A, financial industry excluded sample in panel B and MKBK median sample in panel C.[27]

Panel A and B show almost identical results. Panel A represents smaller magnitude of rumor impact from the market because of financial industry and its regulation. We interpret this market reaction result with panel B.

Rumor indicate significant positive abnormal returns in the period from [-10,0] to [0], while repurchase records significant positive abnormal returns in all periods.[28] There is no significant difference between rumor and repurchase in the first three periods, which is the partial evidence of signaling effect of rumors. Rumor is divided into unpublished and published rumors in right hand side of panel B. They represent different pattern in abnormal returns. Unpublished rumor generates significant positive returns after the release, while published rumor does before publication. In these periods, both unpublished and published rumors are in unpublished status. We find no significant difference in both unpublished status.[29] This is the empirical evidence of publication effect. Publication of rumors changes

[27] The median of MKBK for rumor is 1.090 and share repurchase is 1.139, respectively.

[28] Rumor, the combined result of unpublished and published rumors placed in left hand side of panel A, looses the statistical significance in the period [0,5] and [0,10].

[29] We compare CAARs of [0,5] and [0,10] in unpublished and CAARs of [-10,0], [-5,0] and [0] in published rumor sample, by matching and grouping.

market reaction resulted in disappearing abnormal returns. This result is consistent with semi-strong form of efficient market hypothesis.

To verify signaling effect of rumors, we measure market reaction difference between repurchase and published rumor in the periods from [-10,0] to [0] and between repurchase and unpublished rumor in the periods of [0,5] and [0,10]. We find no significant difference in all cases and it indicates that rumors generate signals (signaling effect) like share repurchases do in short-term periods.

CAARs of published rumor, in the left hand side of panel B, drop instantly right after the publication. This result empirically supports publication effect hypothesis. Publication makes rumors (private information) accessible in public and this accessibility removes excessive returns. In addition, increase of abnormal turnover ratio is detected after the publication. It is the empirical evidence of uninformed liquidity trading around rumors because increase of trading is found after price overshoots (Van Bommel (2003)). Uninformed liquidity traders are not informed about the rumors until they are involved in rumor trading because mass media only report the existence of rumors not the truth of the rumor contents.

In panel C, we divide our sample into MKBK big and small group to investigate the relationship between undervaluation and rumor signal. Rumor in MKBK small sample indicates positive abnormal returns in all periods but only statistically significant in the periods of [-10,0], [0] and [-1,1]. This result would be caused by the combination of unpublished and published rumors. The abnormal returns in rumor and repurchase are statistically indifferent in MKBK small sample, while there are some difference in MKBK big sample. This can be interpreted that share repurchase rumors can be more acceptable if

their market-to-book ratios are relatively smaller. This result is consistent with the receiver's preference match theory of Crawford and Sobel (1982).

[Insert Table 3 Here]

We report market reactions to different information sources to test publisher identity hypothesis in Table 4. In general, news providers with higher reputation, for example Reuters or Bloomberg, receive more attention and credibility than the information sources with lower reputation, such as company presses. This result provides two empirical results. First, the third party publishers with higher reputation generate bigger market impacts with rumor reports, which defined reputation effect. Second, rumor reports from company presses result in little market impacts, which called publisher identity effect and could be caused by market participants' self-serving manipulation concern.

We categorize financial industry excluded sample into mass media (92 cases), company press (38 cases), and stock exchange and SEC (17 cases). CAARs in mass media record significant positive abnormal returns in the period from [-10,0] to [0,1] and [-1,1]. Positive abnormal returns are observed in [0,2] and [0,5] but statistically insignificant. Interestingly, company press indicates negative insignificant abnormal returns. This is the empirical evidence of both reputation effect and publisher identity effect. Stock exchange and SEC contain statistically insignificant results because they contain more official and regulatory characteristics.

[Insert Table 4 Here]

Figure 2 provides graphs of CAAR[-20,20] and CAAT[-20,20] of rumors versus share repurchases and published versus unpublished rumors. In upper left figure, repurchases

represent price upgrade after announcement, while rumors do not.[30] However, rumors underperform in the prior period of rumor releases. It is not clear whether this underperformance is artificial or accidental. It makes rumor more believable and tradable to (uninformed) liquidity traders in the perspective of undervaluation. In upper right figure, both unpublished and published rumors show similar pattern with shifting published rumor to the left. It is clear that rumors in unpublished period generate higher positive abnormal returns than published status in short-term period.

In CAAT figures between rumor and repurchase, rumors and repurchases move together before the event day but after the event day rumors increase more in CAAT than that of repurchases. It is clear evidence of uninformed liquidity trading after the publication of share repurchase rumors. Both unpublished and published rumors represent analogous pattern of turnover ratio.

[Insert Figure 2 Here]

In Table 5, we report the result of regression analysis using CAR[0] as a response variable.[31] This regression is to test whether cumulative abnormal returns are rational as responses to rumors and share repurchase announcements. We provide two models for each group. In all models, SHAREs are positively related with CARs at the significance level of 1%[32]. In rumored firms, CHE/AST (0.066 and 0.067) and LBT/AST (0.035 and 0.033) in

[30] This is due to the mixture of unpublished and published effect. In upper right figure, to isolate this mixture of effect, we provide market reactions of unpublished and published rumors. This figure shows about 1% of abnormal returns around rumor periods.

[31] We select CAR[0] because only day 0 contains both unpublished and published rumor together, which allow us to compare them directly. In other periods, it is impossible to compare market reaction directly.

[32] We exclude SHARE in the model 1 and 2 of unpublished rumor category due to insufficient sample numbers and same method is applied in Table 6.

both model 1 and 2 represent positive relationship with CARs at the significance level of 5%. Higher debt ratio caused by previous share repurchase seems to add more positive market impact on rumors. In model 2, CAPX/EBITDA (-0.029) is negatively and AVE. RECOM (0.015) is positively related to market reaction. Cash holding would appeal positively to market participants and higher debt ratio seems to show higher tendency of share repurchase implementation. Less spending in capital expenditure tends to positively influence on more cash holding. Less recommendation from analysts results in market surprise.

In model 1 of repurchase, STD(mRET) (0.102) is positively related with CAR[0] at the significance of 1%. In model 2 of repurchase, LN(AST) (-0.002) and CAPX/EBITDA (-0.004), EBITDA/REV (-0.009), MKBK (-0.001) and AVE. RECOM (-0.003) are significantly related with market responses. Smaller firm size provides market surprise reaction based on information asymmetry and less capital expenditure is positively related to market reaction. The result of published rumors is identical to the result of rumors. The result of regression on short-term market reaction concludes that market participants are significantly interested in the percentage of share repurchase, profitability and cash holding for rumored firms. The regression results lead us to expect that more factors influence on the short-term market reaction in the cases of share repurchase, while rumors are less related to the factors that influence on share repurchase.

[Insert Table 5 Here]

Table 6 represents regression analysis result using CAAT[0] as a response variable. According to Table 3, CAARs and CAATs of rumors display different patterns relative to repurchases and we detect some unique aspects of rumor and repurchase firms when we regress with CARs. This regression analysis is for assessing market participants' trading

behavior and critical factors around rumors and announcements of share repurchase. The analysis is also intended to examine whether the result is consistent with that of regression with CAR.

In both rumor and repurchase, LN(AST) presents significantly negative relationship with CAT[0].[33] More information asymmetry seems to surprise market and induce people to trade more. SHARE is only positively related to CAT[0], at the significance of 1%, in repurchase, while SHARE is not significant in both model of rumor. SHARE and LN(AST) indicate the consistent relationship in the regression of CAT[0] and CAT[0]. The regression result of CAAT[0] is less clear than that of CAAR[0], which can be explained with uninformed liquidity trading (or noise trading).

[Insert Table 6 Here]

We report logistic regression result in Table 7.[34] The purpose of this analysis is to find characteristic differences between rumored firms and repurchasing firms as well as published and unpublished rumored firms. All models are suitable based on the result of Hosmer and Lemeshow Goodness-of-Fit test and predictability of models are from 75.2% to 96.4%. Rumor and repurchase represent difference in EBITDA/AST (-1.468), REPORT/MTH (0.242) and RPS_DUM (0.482). Repurchase sample are bigger in EBATDA/AST and rumor sample are bigger in REPORT/MTH and RPS_DUM. Among the firm characteristics, profitability is the only difference between rumors and share repurchases. Rumored firms tend to conduct share repurchase more than share repurchasing firms in the prior year of the event.

[33] It is significant in model 2 of both rumor and repurchase at the significance level of 5% and 1%, respectively.

[34] We exclude the variable SHARE because not all cases contain SHARE information, especially rumor sample.

In MKBK big and small models, rumored firms tend to spend less capital expenditure and make less profit than repurchasing firms. Rumored firms tend to repurchase more than repurchasing firms in the prior year of the event. According to the result of logistic regression, it is possible to conclude that both rumored firms and repurchasing firms are highly identical in firm characteristics.

[Insert Table 7 Here]

In Table 8, we report buy-and-hold return (BHR) and buy-and-hold abnormal return (BHAR) after rumors and announcements of share repurchases. The reason why we measure performance for one year is to test rumor signaling effect could affect on longer-term periods. Another reason is that we also find some positive profitability impact from rumored firm as well as repurchasing firms in Table 2. To test the signaling effect of rumor, we measure BHR and BHAR following Barber and Lyon (1997) methods from month 1 to month 3, 6, 9, and 12, respectively.

In panel A and B, BHRs in both rumor and repurchase record significant positive BHR in a year. BHRs of repurchases in 3 and 6 months are significantly bigger than those of rumors in median, but from 9 month the difference of BHR disappears. This result supports the signaling effect of rumors and its long-term effects too.

In MKBK big sample rumor represents weak performance up to 6 months, but from 9 month to 12 month rumor increase BHR significantly. We find significant BHR difference between two groups in 3 month and 6 month in MKBK big sample. Rumor in MKBK small sample shows stronger BHR than rumors in MKBK big sample. We find no difference between rumors and share repurchases in all periods. This leads us to conclude that firms with more undervaluation represent higher positive performance and insignificant difference

in value increase between rumors and announcements to share repurchase. In conclusion, undervaluation can be resolved by share repurchase rumors and loner-term signaling effect can be supported empirically.

[Insert Table 8 Here]

For robust check, we report long-term performance of rumors and repurchases using the calendar portfolio method in Table 9. We form three types of portfolios --- four portfolios every three months, one portfolio in six months, and one portfolio in twelve months within a year. We estimate abnormal performance measured by intercept of one-factor and three-factor model, respectively. We observe positive abnormal return (1.2%) at 9m of one-factor model in rumor, at the significance level of 5%. In other cases of rumor, we find insignificant positive abnormal returns. Repurchase records positive significant abnormal returns at 3m (1.1%), 1-6m (0.8%) and 1-12m (0.9%) of one-factor model. Other cases represent positive insignificant abnormal returns. In this portfolio approach, we find weak positive abnormal returns in both rumors and repurchases that are almost identical. This may be highly related on the flexibility of open market share repurchase completion (Chan et al. (2010)). Based on the result in Table 8 and 9, rumor generates positive buy-and-hold returns but returns are not stronger than market performance. Share repurchase rumor seems to contain signals of undervaluation and this signal stays not only short-term but also long-term.

[Insert Table 9 Here]

## VI. Conclusion

We document the results of first empirical investigation about open market share repurchase

rumors. Our sample period is from 1999 to 2010 and the sample is categorized by rumors and announcements of share repurchase as well as unpublished and published rumors. Our results extend rumor theory by providing empirical evidence and potential explanations for the signaling effect and publication effect of share repurchase rumors. We investigate the signaling effect of share repurchase rumors by comparing it with the effect of share repurchase announcements. Share repurchase rumors generate similar signals to the share repurchase announcements. This signaling effect indicates positive changes of valuation and other firm characteristics after the information released.

Publication effect of rumors explains the difference in informational status and publisher identities. It is corroborated by the analysis of cumulative average abnormal returns (CAAR) and cumulative average abnormal turnover ratio (CAAT), which also explains uninformed liquidity trading and semi-strong form of EMH empirically., Financial industry is less sensitive to the share repurchase rumors and our result supports this low sensitivity with the empirical evidence of short-term and long-term market reactions.

Consistent to the preference match theory, rumored firms not only exhibit similar status but also analogous changes and characteristics relative to share repurchase announcement firms. These findings support the notion that market (participants) may have reasons to trust rumors of share repurchase and consequently generate comparable short- and long-term market reactions.

We observe uninformed liquidity trading after publications of rumors, which is supported by an empirical evidence of increasing CAATs with dropping CAARs. This result seems to be caused by the contents of rumor reports that indicate rumors without confirming rumor contents.

Finally, we document different market reactions to different publication sources. Major news providers generate bigger market impacts with rumor publications, while company presses provide little market impacts. We conclude that market seems to distinguish publisher identity.

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## Table 1. Descriptive Statistic

The number of whole samples of Deal Value and Deal Share in rumors is 232 and the number of financial industry excluded samples of Deal Value and Deal Share in rumors is 169. Return at Day 0 is measured by difference between the stock price at the beginning and the ending of rumors and repurchases. LN(AST) is natural log of total asset. CAPX/AST and CAPEX/EBITDA is capital expenditure divided by total asset and earnings before interest, tax, depreciation and amortization, respectively. CHE/AST is cash and short-term investment divided by total asset. EBITDA/AST and EBITA/REV is earnings before interest, tax, depreciation and amortization divided by total asset and total sales, respectively. LBT/AST is total liability divided by total asset. NOPI/AST is non-operating income divided by total asset. STD(mRET) is standard deviation of monthly stock return of year -1. MKBK is market value divided by book value of firms. REPORT/MTH is total number of reports for one year divided by 12 months. AVE. RECOM is average of recommendation for one year, 1 is strong buy and 5 is strong sell. DV_DUM and RPS_DUM are dummy variables for dividend payment and repurchase execution in the previous year, 1 for yes, 0 for no.

| | Whole Sample | | | | Financial Industry Excluded | | | |
|---|---|---|---|---|---|---|---|---|
| | Rumor | Repurchase | Unpublished Rumor | Published Rumor | Rumor | Repurchase | Unpublished Rumor | Published Rumor |
| | N: 273 | N: 2510 | N: 83 | N: 190 | N: 230 | N: 1944 | N: 83 | N: 147 |
| Share Outstanding | 341,330 | 242,000 | 266,450 | 368,050 | 348,920 | 271,500 | 180,110 | 293,730 |
| Stock Price ($) | 28.86 | 31.505 | 25.46 | 30.07 | 27.96 | 30.078 | 23.79 | 32.07 |
| Deal Value ($mil.) | 732.42 | 732.212 | 461.74 | 828.98 | 667.59 | 756.16 | 681.87 | 872.33 |
| Deal Share (%) | 10.23 | 7.80 | 15.67 | 8.85 | 10.94 | 8.30 | 19.80 | 9.04 |
| Return at Day 0 (%) | 0.70% | 1.10% | 0.80% | 0.60% | 1.10% | 1.20% | 2.00% | 0.90% |
| LN(AST) | 7.931 | 7.381 | 7.520 | 8.075 | 7.498 | 7.162 | 7.389 | 7.432 |
| CAPX/AST | 0.033 | 0.034 | 0.030 | 0.028 | 0.039 | 0.042 | 0.038 | 0.040 |
| CAPX/EBITDA | 0.236 | 0.256 | 0.251 | 0.231 | 0.355 | 0.301 | 0.300 | 0.339 |
| CHE/AST | 0.158 | 0.156 | 0.149 | 0.162 | 0.185 | 0.176 | 0.175 | 0.200 |
| EBITDA/AST | 0.097 | 0.118 | 0.101 | 0.096 | 0.120 | 0.140 | 0.118 | 0.125 |
| EBITDA/REV | 0.158 | 0.176 | 0.157 | 0.158 | 0.133 | 0.149 | 0.114 | 0.128 |
| LBT/AST | 0.599 | 0.550 | 0.559 | 0.613 | 0.531 | 0.490 | 0.502 | 0.523 |
| NOPI_AT | 0.005 | 0.005 | 0.002 | 0.006 | 0.008 | 0.007 | 0.002 | 0.010 |
| STD(mRET) | 0.105 | 0.093 | 0.126 | 0.097 | 0.106 | 0.101 | 0.145 | 0.090 |
| MKBK | 1.208 | 1.388 | 1.191 | 1.214 | 1.487 | 1.625 | 1.336 | 1.616 |
| REPORT/MTH | 1.025 | 0.869 | 1.127 | 0.995 | 1.023 | 0.901 | 1.200 | 0.945 |
| AVE. RECOM. | 2.465 | 2.400 | 2.190 | 2.547 | 2.371 | 2.359 | 2.121 | 2.484 |
| DV_DUM | 54.7% | 50.2% | 44.3% | 58.5% | 46.0% | 46.9% | 43.8% | 43.9% |
| RPS_DUM | 49.6% | 62.4% | 42.6% | 52.1% | 53.1% | 65.4% | 45.8% | 56.1% |

## Table 2. Regression of post- versus pre-rumor and repurchase ($POST_i = \alpha_i + \beta_i PRE_i + \varepsilon_i$)

Response variables are measured by values from year -1 and explanatory variables are measured by values from year 0. LN(AST) is natural log of total asset. CAPX/AST and CAPEX/EBITDA is capital expenditure divided by total asset and earnings before interest, tax, depreciation and amortization, respectively. CHE/AST is cash and short-term investment divided by total asset. EBITDA/AST and EBITA/REV is earnings before interest, tax, depreciation and amortization divided by total asset and total sales, respectively. LBT/AST is total liability divided by total asset. NOPI/AST is non-operating income divided by total asset. STD(mRET) is standard deviation of monthly stock return of year -1. MKBK is market value divided by book value of firms. REPORT/MTH is total number of reports for one year divided by 12 months. AVE. RECOM is average of recommendation for one year, 1 is strong buy and 5 is strong sell. DV_DUM and RPS_DUM are dummy variables for dividend payment and repurchase execution in the previous year, 1 for yes, 0 for no. *p*-value is reported in parentheses. ***, **, * are significant at the 1%, 5%, and 10% levels, respectively.

| Financial | Rumor | | | | Repurchase | | | |
|---|---|---|---|---|---|---|---|---|
| Industry Excluded | Alpha | Beta | $R^2$ | F-Stat. | Alpha | Beta | $R^2$ | F-Stat. |
| LN(AST) | 0.101 | 0.996*** | 0.980 | 7959.00*** | 0.034* | 1.005*** | 0.986 | 18170.00*** |
| | (0.246) | (0.000) | | (0.000) | (0.059) | (0.000) | | (0.000) |
| CAPX/AST | 0.014*** | 0.738*** | 0.336 | 82.99*** | 0.010*** | 0.762*** | 0.638 | 4092.53*** |
| | (0.002) | (0.000) | | (0.000) | (0.000) | (0.000) | | (0.000) |
| CAPX/EBITDA | 0.809 | 0.000 | 0.000 | 0.00 | 0.245*** | 0.169*** | 0.058 | 137.46*** |
| | (0.124) | (0.988) | | (0.988) | (0.000) | (0.000) | | (0.000) |
| CHE/AST | 0.031*** | 0.776*** | 0.702 | 389.58*** | 0.012*** | 0.899*** | 0.824 | 1169.00*** |
| | (0.006) | (0.000) | | (0.000) | (0.000) | (0.000) | | (0.000) |
| EBITDA/AST | 0.021*** | 0.865*** | 0.707 | 508.40*** | 0.017*** | 0.875*** | 0.739 | 1700.00*** |
| | (0.204) | (0.000) | | (0.000) | (0.000) | (0.000) | | (0.000) |
| EBITDA/REV | 0.089*** | 0.482*** | 0.505 | 2145.00*** | -1.037*** | 6.651*** | 0.829 | 1215.99*** |
| | (0.000) | (0.000) | | (0.000) | (0.000) | (0.000) | | (0.000) |
| LBT/AST | -0.004 | 1.061*** | 0.752 | 501.45*** | 0.018*** | 0.991*** | 0.852 | 14463.06*** |
| | (0.878) | (0.000) | | (0.000) | (0.000) | (0.000) | | (0.000) |
| NOPI/AST | 0.008*** | 0.049 | 0.014 | 2.33 | 0.003*** | 0.518*** | 0.262 | 886.79*** |
| | (0.000) | (0.129) | | (0.129) | (0.000) | (0.000) | | (0.000) |
| STD(mRET) | 0.049*** | 0.475*** | 0.396 | 108.63*** | 0.048*** | 0.418*** | 0.335 | 1268.75*** |
| | (0.000) | (0.000) | | (0.000) | (0.000) | (0.000) | | (0.000) |
| MKBK | 0.308*** | 0.739*** | 0.651 | 308.27*** | 0.265*** | 0.753*** | 0.712 | 6176.00*** |
| | (0.000) | (0.000) | | (0.000) | (0.000) | (0.000) | | (0.000) |
| REPORT/MTH | 0.286*** | 0.708*** | 0.575 | 193.13*** | 0.286*** | 0.723*** | 0.499 | 576.23*** |
| | (0.000) | (0.000) | | (0.000) | (0.000) | (0.000) | | (0.000) |
| AVE. RECOM | 2.074*** | 0.169*** | 0.063 | 9.560*** | 1.019*** | 0.168*** | 0.074 | 43.64*** |
| | (0.000) | (0.002) | | (0.002) | (0.000) | (0.000) | | (0.000) |

## Table 3. Cumulative average abnormal return (CAAR) and cumulative average abnormal turnover ratio (CAAT) analysis

Panel A and B represent the result of CAARs and CAATs using whole sample and financial industry excluded sample, respectively. Panel C reports the result of CAARs and CAATs using financial industry excluded sample in big and small median of MKBK. CAAR is measured by the market model using the -120 to -31 day estimation window (90 days) and the equally weighted market index for bench mark ( $AR_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_i R_{mt}$) (Brown and Warner (1985)). CAAT is measured by log(trading volume/share outstanding) - average of log turnover ratio (Chae (2005)). [a,b,c] significant at the 1%, 5%, and 10% levels, respectively, and t-test for difference from zero. *p*-value of t-test and Mann-Whitney test is in parenthesis. [***], [**], [*] are significant at the 1%, 5%, and 10% levels, respectively, and test for difference between two groups. Day 0 is the first day of rumor released for unpublished rumors and the first day of the published for published rumors.

Panel A. Whole Sample

| | Rumor N:273 | | Repurchase N:2510 | | t-test | M-W test | Unpublished Rumor N:83 | | Published Rumor N:190 | | t-test | M-W test |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Median | Mean | Median | Sig. (2-tailed) | | Mean | Median | Mean | Median | Sig. (2-tailed) | |
| CAAR[-10,0] | 0.014[c] | 0.009 | 0.006[a] | 0.006 | (0.217) | (0.478) | 0.004 | 0.005 | 0.017[b] | 0.010 | (0.441) | (0.714) |
| CAAR[-5,0] | 0.009[c] | 0.009 | 0.008[a] | 0.007 | (0.901) | (0.614) | 0.001 | 0.009 | 0.012[b] | 0.008 | (0.367) | (0.727) |
| CAAR[0] | 0.006[c] | 0.004 | 0.011[a] | 0.005 | (0.075)[*] | (0.304) | 0.002 | 0.002 | 0.008[b] | 0.005 | (0.445) | (0.495) |
| CAAR[0,5] | 0.002 | 0.008 | 0.019[a] | 0.010 | (0.001)[***] | (0.007)[***] | 0.017[c] | 0.010 | -0.003 | 0.005 | (0.096)[*] | (0.098)[*] |
| CAAR[0,10] | 0.002 | 0.010 | 0.022[a] | 0.010 | (0.001)[***] | (0.050)[**] | 0.015 | 0.020 | -0.003 | 0.008 | (0.207) | (0.173) |
| CAAR[-1,1] | 0.005 | 0.010 | 0.016[a] | 0.010 | (0.006)[***] | (0.012)[**] | 0.008 | 0.010 | 0.004 | 0.007 | (0.727) | (0.766) |
| CAAR[-20,20] | 0.000 | -0.004 | 0.016[a] | 0.010 | (0.174) | (0.173) | -0.002 | 0.000 | 0.001 | -0.004 | (0.915) | (0.659) |
| CAAT[-10,0] | 0.810[a] | 0.595 | 0.801[a] | 0.560 | (0.948) | (0.717) | 1.178[a] | 0.810 | 0.681[a] | 0.500 | (0.101) | (0.083) |
| CAAT[-5,0] | 0.555[a] | 0.470 | 0.565[a] | 0.430 | (0.911) | (0.888) | 0.790[a] | 0.660 | 0.473[a] | 0.440 | (0.088) | (0.114) |
| CAAT[0] | 0.264[a] | 0.190 | 0.214[a] | 0.160 | (0.041)[**] | (0.046)[**] | 0.312[a] | 0.230 | 0.248[a] | 0.180 | (0.207) | (0.412) |
| CAAT[0,5] | 1.330[a] | 1.110 | 0.856[a] | 0.700 | (0.000)[***] | (0.000)[***] | 1.180[a] | 0.930 | 1.383[a] | 1.270 | (0.362) | (0.172) |
| CAAT[0,10] | 1.839[a] | 1.685 | 1.138[a] | 0.940 | (0.000)[***] | (0.000)[***] | 1.507[a] | 1.010 | 1.956[a] | 1.950 | (0.220) | (0.055) |
| CAAT[-1,1] | 0.703[a] | 0.580 | 0.523[a] | 0.440 | (0.001)[***] | (0.000)[***] | 0.764[a] | 0.550 | 0.681[a] | 0.580 | (0.471) | (0.979) |
| CAAT[-20,20] | 3.321[a] | 2.900 | 2.447[a] | 2.030 | (0.047)[**] | (0.011)[**] | 3.077[a] | 2.550 | 3.407[a] | 2.900 | (0.724) | (0.410) |

Panel B. Financial Industry Excluded

| | Rumor N:230 | | Repurchase N:1944 | | t-test | M-W test | Unpublished Rumor N:83 | | Published Rumor N:147 | | t-test | M-W test |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Median | Mean | Median | Sig. (2-tailed) | | Mean | Median | Mean | Median | Sig. (2-tailed) | |
| CAAR[-10,0] | 0.014[c] | 0.010 | 0.006[a] | 0.006 | (0.303) | (0.392) | 0.010 | 0.007 | 0.015[b] | 0.010 | (0.798) | (0.649) |
| CAAR[-5,0] | 0.015[c] | 0.012 | 0.009[a] | 0.008 | (0.739) | (0.294) | 0.009 | 0.012 | 0.018[b] | 0.011 | (0.497) | (0.665) |
| CAAR[0] | 0.012[b] | 0.005 | 0.012[a] | 0.006 | (0.807) | (0.652) | 0.006 | 0.003 | 0.015[b] | 0.006 | (0.363) | (0.403) |
| CAAR[0,5] | 0.009 | 0.010 | 0.022[a] | 0.010 | (0.012)[**] | (0.018)[**] | 0.025[b] | 0.022 | 0.002 | 0.006 | (0.102) | (0.063)[*] |
| CAAR[0,10] | 0.008 | 0.013 | 0.024[a] | 0.010 | (0.006)[***] | (0.036)[**] | 0.026[c] | 0.040 | 0.001 | 0.008 | (0.093)[*] | (0.034)[**] |
| CAAR[-1,1] | 0.013 | 0.012 | 0.018[a] | 0.010 | (0.138) | (0.064)[*] | 0.016 | 0.015 | 0.012 | 0.012 | (0.782) | (0.743) |
| CAAR[-20,20] | -0.001 | -0.009 | 0.019[a] | 0.020 | (0.167) | (0.121) | 0.009 | 0.004 | -0.004 | -0.022 | (0.636) | (0.333) |
| CAAT[-10,0] | 0.829[a] | 0.615 | 0.812[a] | 0.540 | (0.809) | (0.503) | 1.101[a] | 0.810 | 0.716[a] | 0.451 | (0.288) | (0.198) |
| CAAT[-5,0] | 0.642[a] | 0.591 | 0.581[a] | 0.450 | (0.847) | (0.436) | 0.841[a] | 0.694 | 0.559[a] | 0.482 | (0.215) | (0.184) |
| CAAT[0] | 0.297[a] | 0.218 | 0.225[a] | 0.180 | (0.047)[**] | (0.049)[**] | 0.334[a] | 0.241 | 0.282[a] | 0.207 | (0.386) | (0.505) |
| CAAT[0,5] | 1.152[a] | 0.965 | 0.881[a] | 0.720 | (0.013)[**] | (0.017)[**] | 1.136[a] | 0.820 | 1.159[a] | 1.066 | (0.927) | (0.796) |
| CAAT[0,10] | 1.540[a] | 1.353 | 1.129[a] | 0.930 | (0.011)[**] | (0.008)[***] | 1.423[a] | 1.016 | 1.589[a] | 1.468 | (0.683) | (0.390) |
| CAAT[-1,1] | 0.696[a] | 0.588 | 0.550[a] | 0.480 | (0.021)[**] | (0.024)[**] | 0.765[a] | 0.691 | 0.668[a] | 0.546 | (0.480) | (0.605) |
| CAAT[-20,20] | 2.683[a] | 2.200 | 2.379[a] | 2.010 | (0.317) | (0.113) | 2.446[a] | 2.200 | 2.781[a] | 2.178 | (0.761) | (0.694) |

Panel C. The comparison by Market-to-book ratio (Financial Industry Excluded and MKBK median for rumor is 1.090 and repurchase is 1.139)

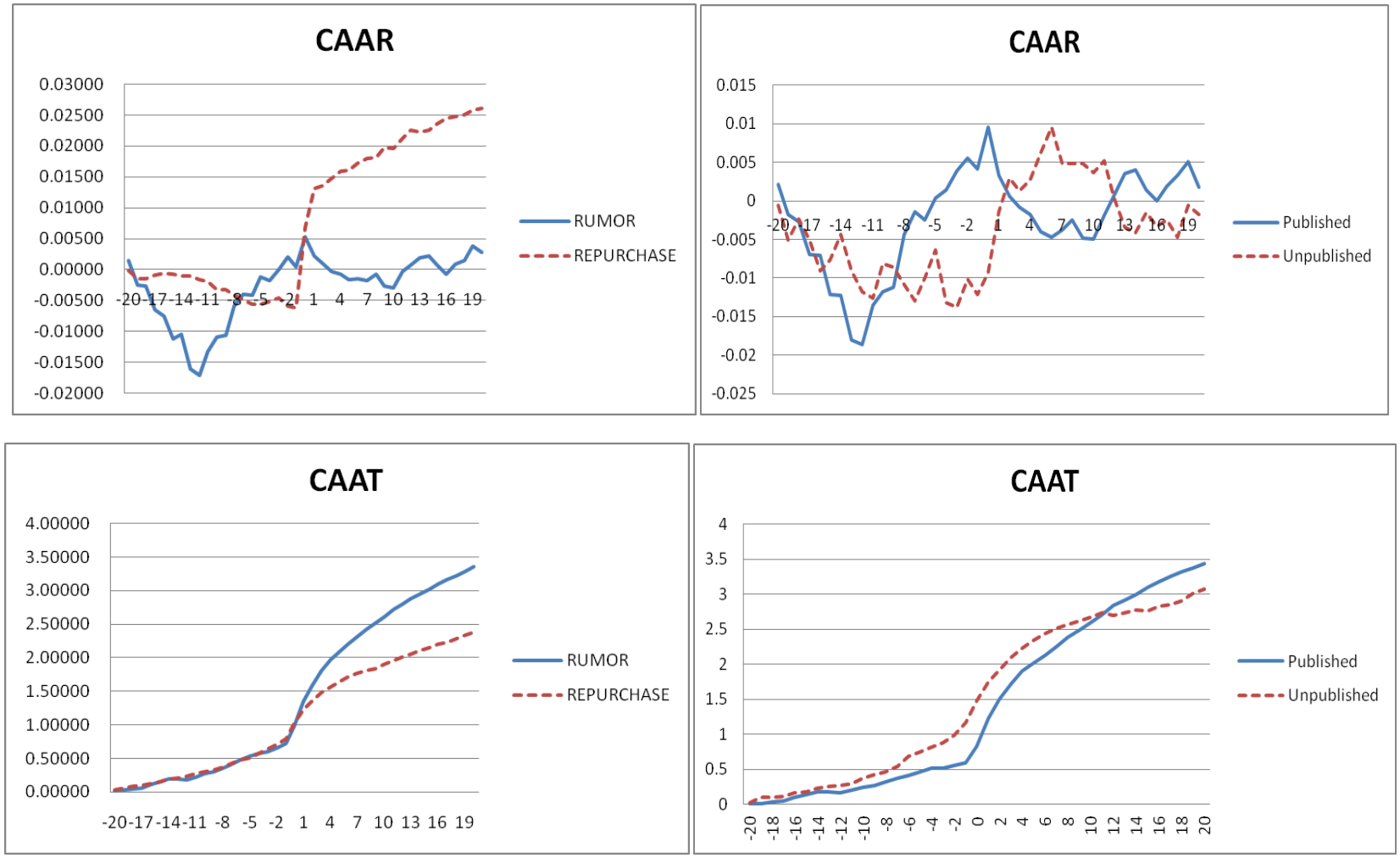
| | MKBK Big | | | | | | MKBK Small | | | | | | Big-Small | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rumor N: 116 | | Repurchase N: 981 | | Difference | | Rumor N:114 | | Repurchase N: 962 | | Difference | | Rumor | | Repurchase | |
| | Mean | Median | Mean | Median | t-test | M-W test | Mean | Median | Mean | Median | t-test | M-W test | t-test | M-W test | t-test | M-W test |
| CAAR[-10,0] | 0.005 | 0.005 | 0.003 | 0.006 | (0.782) | (0.774) | 0.032[c] | 0.010 | 0.019[a] | 0.006 | (0.452) | (0.406) | (0.183) | (0.321) | (0.059)[*] | (0.325) |
| CAAR[-5,0] | 0.009 | 0.010 | 0.008[b] | 0.008 | (0.799) | (0.550) | 0.015 | 0.010 | 0.021[a] | 0.008 | (0.666) | (0.533) | (0.698) | (0.453) | (0.032)[**] | (0.458) |
| CAAR[0] | 0.009[a] | 0.004 | 0.013[a] | 0.006 | (0.308) | (0.421) | 0.017[c] | 0.006 | 0.016[a] | 0.005 | (0.850) | (0.712) | (0.340) | (0.504) | (0.388) | (0.675) |
| CAAR[0,5] | 0.002 | 0.008 | 0.026[a] | 0.010 | (0.003)[***] | (0.010)[***] | 0.017 | 0.010 | 0.023[a] | 0.010 | (0.648) | (0.555) | (0.235) | (0.424) | (0.597) | (0.553) |
| CAAR[0,10] | -0.002 | 0.010 | 0.030[a] | 0.020 | (0.001)[***] | (0.014)[**] | 0.019 | 0.009 | 0.026[a] | 0.010 | (0.572) | (0.661) | (0.134) | (0.360) | (0.626) | (0.506) |
| CAAR[-1,1] | 0.006 | 0.010 | 0.019[a] | 0.010 | (0.041)[**] | (0.055)[*] | 0.023[c] | 0.010 | 0.023[a] | 0.010 | (0.959) | (0.988) | (0.151) | (0.172) | (0.439) | (0.752) |
| CAAR[-20,20] | -0.014 | -0.004 | 0.027[a] | 0.020 | (0.046) | (0.035)[**] | 0.021 | 0.001 | 0.035[a] | 0.020 | (0.657) | (0.760) | (0.228) | (0.158) | (0.635) | (0.714) |
| CAAT[-10,0] | 0.714[a] | 0.690 | 0.635[a] | 0.460 | (0.941) | (0.515) | 0.862[a] | 0.520 | 1.027[a] | 0.620 | (0.546) | (0.486) | (0.083)[*] | (0.238) | (0.022)[**] | (0.069)[*] |
| CAAT[-5,0] | 0.526[a] | 0.520 | 0.470[a] | 0.380 | (0.747) | (0.536) | 0.514[a] | 0.425 | 0.752[a] | 0.630 | (0.991) | (0.790) | (0.235) | (0.299) | (0.007)[***] | (0.029)[**] |
| CAAT[0] | 0.245[a] | 0.210 | 0.199[a] | 0.150 | (0.164) | (0.131) | 0.271[a] | 0.170 | 0.309[a] | 0.260 | (0.619) | (0.690) | (0.103) | (0.283) | (0.000)[***] | (0.001)[***] |
| CAAT[0,5] | 1.083[a] | 1.040 | 0.789[a] | 0.660 | (0.057)[*] | (0.052)[*] | 1.590[a] | 1.470 | 1.066[a] | 0.870 | (0.263) | (0.329) | (0.248) | (0.562) | (0.020)[**] | (0.061)[*] |
| CAAT[0,10] | 1.481[a] | 1.460 | 0.934[a] | 0.820 | (0.025)[**] | (0.017)[**] | 2.266[a] | 2.090 | 1.416[a] | 1.250 | (0.229) | (0.229) | (0.284) | (0.648) | (0.010)[***] | (0.052)[*] |
| CAAT[-1,1] | 0.650[a] | 0.570 | 0.512[a] | 0.430 | (0.082)[*] | (0.065)[*] | 0.742[a] | 0.560 | 0.674[a] | 0.550 | (0.488) | (0.420) | (0.368) | (0.537) | (0.015)[**] | (0.074)[*] |
| CAAT[-20,20] | 2.660[a] | 2.455 | 1.715[a] | 1.710 | (0.233) | (0.185) | 3.977[a] | 3.270 | 3.194[a] | 2.350 | (0.565) | (0.252) | (0.215) | (0.287) | (0.004)[***] | (0.052)[*] |

## Table 4. Cumulative average abnormal return and turnover ratio (CAAR and CAAT) analysis of information identities.

CAAR is measured by the market model using the -120 to -31 day estimation window (90 days) and the equally weighted market index for bench mark ( $AR_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_i R_{mt}$) (Brown and Warner (1985)). CAAT is measured by log(trading volume/share outstanding) - average of log turnover ratio (Chae (2005)). [a,b,c] are significant at the 1%, 5%, and 10% levels, respectively, and t-test for difference from zero. *p*-value of t-test and Mann-Whitney test is in parenthesis. [***], [**], [*] are significant at the 1%, 5%, and 10% levels, respectively, and test for difference between two groups.

| Financial Industry | Mass Media (1) | | | Company Press (2) | | | Stock Exchange & SEC (3) | | | t-test | M-W test |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Excluded | N | Mean | Median | N | Mean | Median | N | Mean | Median | (1)-(2) | (1)-(2) |
| CAAR[-10,0] | 92 | 0.028[b] | 0.016 | 38 | -0.015 | -0.026 | 17 | 0.043 | 0.059 | (0.077)[*] | (0.118) |
| CAAR[-5,0] | 92 | 0.021[b] | 0.018 | 38 | -0.007 | -0.007 | 17 | 0.027 | 0.004 | (0.084)[*] | (0.064)[*] |
| CAAR[-2,0] | 92 | 0.022[a] | 0.014 | 38 | -0.008 | -0.002 | 17 | 0.007 | 0.001 | (0.035)[**] | (0.045)[**] |
| CAAR[-1,0] | 92 | 0.022[a] | 0.009 | 38 | -0.006 | 0.000 | 17 | 0.004 | 0.004 | (0.042)[**] | (0.072)[*] |
| CAAR[0] | 92 | 0.019[a] | 0.005 | 38 | 0.002 | 0.004 | 17 | 0.003 | 0.002 | (0.171) | (0.662) |
| CAAR[0,1] | 92 | 0.016[c] | 0.008 | 38 | -0.002 | 0.008 | 17 | 0.003 | -0.005 | (0.288) | (0.923) |
| CAAR[0,2] | 92 | 0.011 | 0.014 | 38 | -0.001 | 0.018 | 17 | -0.003 | -0.001 | (0.469) | (0.830) |
| CAAR[0,5] | 92 | 0.002 | 0.006 | 38 | -0.008 | 0.009 | 17 | 0.000 | -0.001 | (0.597) | (0.857) |
| CAAR[0,10] | 92 | -0.006 | 0.006 | 38 | 0.006 | 0.017 | 17 | -0.001 | -0.010 | (0.584) | (0.327) |
| CAAR[-1,1] | 92 | 0.018[b] | 0.012 | 38 | -0.010 | -0.002 | 17 | 0.004 | -0.002 | (0.089)[*] | (0.348) |
| CAAR[-20,20] | 92 | -0.006 | -0.025 | 38 | -0.014 | -0.022 | 17 | 0.060 | 0.058 | (0.838) | (0.972) |
| CAAT[-10,0] | 92 | 0.768[a] | 0.705 | 38 | 0.352 | 0.079 | 17 | 1.049[a] | 0.939 | (0.363) | (0.171) |
| CAAT[-5,0] | 92 | 0.557[a] | 0.601 | 38 | 0.342[c] | 0.347 | 17 | 0.661[a] | 0.675 | (0.420) | (0.282) |
| CAAT[-2,0] | 92 | 0.438[a] | 0.503 | 38 | 0.340[a] | 0.332 | 17 | 0.350[b] | 0.407 | (0.497) | (0.311) |
| CAAT[-1,0] | 92 | 0.346[a] | 0.399 | 38 | 0.369[a] | 0.262 | 17 | 0.214[c] | 0.232 | (0.837) | (0.813) |
| CAAT[0] | 92 | 0.274[a] | 0.225 | 38 | 0.290[a] | 0.152 | 17 | 0.168[a] | 0.183 | (0.837) | (0.713) |
| CAAT[0,1] | 92 | 0.603[a] | 0.594 | 38 | 0.529[a] | 0.320 | 17 | 0.632[a] | 0.625 | (0.600) | (0.345) |
| CAAT[0,2] | 92 | 0.826[a] | 0.779 | 38 | 0.683[a] | 0.358 | 17 | 0.870[a] | 0.660 | (0.466) | (0.201) |
| CAAT[0,5] | 92 | 1.206[a] | 1.085 | 38 | 0.965[a] | 0.806 | 17 | 1.371[a] | 1.091 | (0.449) | (0.279) |
| CAAT[0,10] | 92 | 1.715[a] | 1.834 | 38 | 1.305[a] | 1.076 | 17 | 2.065[a] | 1.851 | (0.435) | (0.279) |
| CAAT[-1,1] | 92 | 0.675[a] | 0.589 | 38 | 0.609[a] | 0.416 | 17 | 0.678[a] | 0.588 | (0.702) | (0.420) |
| CAAT[-20,20] | 92 | 3.085[a] | 2.454 | 38 | 1.626[c] | 2.078 | 17 | 4.292[a] | 4.544 | (0.318) | (0.171) |

**Figure 2. Cumulative average abnormal return (CAAR) and cumulative average abnormal turnover ratio (CAAT) of [-20,20]**



## Table 5. Regression analysis of cumulative abnormal return (CAR[0])

Response variable is CAR[0]. CAR is measured by the market model using the -120 to -31 day estimation window (90 days) and the equally weighted market index for bench mark ( $AR_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_i R_{mt}$) (Brown and Warner (1985)). SHARE is the percentage of share repurchase rumored and announced. LN(AST) is natural log of total asset. CAPX/AST and CAPEX/EBITDA is capital expenditure divided by total asset and earnings before interest, tax, depreciation and amortization, respectively. CHE/AST is cash and short-term investment divided by total asset. EBITDA/AST and EBITA/REV is earnings before interest, tax, depreciation and amortization divided by total asset and total sales, respectively. LBT/AST is total liability divided by total asset. NOPI/AST is non-operating income divided by total asset. STD(mRET) is standard deviation of monthly stock return of year -1. MKBK is market value divided by book value of firms. REPORT/MTH is total number of reports for one year divided by 12 months. AVE. RECOM is average of recommendation for one year, 1 is strong buy and 5 is strong sell. DV_DUM and RPS_DUM are dummy variables for dividend payment and repurchase execution in the previous year, 1 for yes, 0 for no. The variable SHARE is excluded because of insufficient number of samples in unpublished rumor category. *p*-value is reported in parentheses. $^{***}$, $^{**}$, $^{*}$ are significant at the 1%, 5%, and 10% levels, respectively.

| Financial | Rumor | | Repurchase | | Published Rumor | | Unpublished Rumor | |
|---|---|---|---|---|---|---|---|---|
| Industry Excluded | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 |
| (Constant) | 0.022 | -0.026 | 0.004 | 0.033*** | 0.010 | -0.031 | 0.106 | 0.052 |
| | (0.498) | (0.367) | (0.551) | (0.000) | (0.772) | (0.335) | (0.120) | (0.318) |
| SHARE | 0.155*** | 0.155*** | 0.080*** | 0.080*** | 0.139*** | 0.145*** | | |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | - | - |
| LN(AST) | -0.006 | -0.005 | -0.001 | -0.002** | -0.004 | -0.003 | -0.003 | -0.007 |
| | (0.122) | (0.116) | (0.191) | (0.004) | (0.299) | (0.292) | (0.716) | (0.245) |
| CAPX/AST | -0.190 | | -0.008 | | -0.144 | | 0.095 | |
| | (0.236) | | (0.709) | | (0.378) | | (0.735) | |
| CAPX/EBITDA | | -0.029** | | -0.004* | | -0.030** | | 0.018 |
| | | (0.042) | | (0.078) | | (0.043) | | (0.257) |
| CHE/AST | 0.066** | 0.067** | -0.003 | 0.002 | 0.079** | 0.070** | -0.076 | -0.093 |
| | (0.041) | (0.026) | (0.677) | (0.741) | (0.024) | (0.026) | (0.255) | (0.188) |
| EBITDA/AST | 0.015 | | 0.001 | | -0.015 | | -0.159 | |
| | (0.758) | | (0.946) | | (0.788) | | (0.139) | |
| EBITDA/REV | | 0.039 | | -0.009** | | 0.010 | | 0.004 |
| | | (0.315) | | (0.045) | | (0.796) | | (0.964) |
| LBT/AST | 0.035** | 0.033** | 0.003 | 0.002 | 0.043** | 0.034*** | -0.026 | 0.034 |
| | (0.036) | (0.012) | (0.571) | (0.734) | (0.015) | (0.010) | (0.669) | (0.602) |
| NOPI/AST | 0.713* | 0.414 | 0.008 | 0.010 | 0.660 | 0.511 | 0.904* | 0.987 |
| | (0.084) | (0.274) | (0.827) | (0.786) | (0.218) | (0.282) | (0.099) | (0.155) |
| STD(mRET) | -0.097 | | 0.102*** | | -0.077 | | -0.148 | |
| | (0.354) | | (0.000) | | (0.474) | | (0.520) | |
| MKBK | | -0.002 | | -0.001* | | 0.000 | | 0.003 |
| | | (0.519) | | (0.090) | | (0.886) | | (0.703) |
| REPORT/MTH | 0.004 | | -0.002 | | 0.003 | | -0.005 | |
| | (0.516) | | (0.403) | | (0.556) | | (0.738) | |
| AVE. RECOM | | 0.015** | | -0.003* | | 0.016** | | 0.004 |
| | | (0.045) | | (0.076) | | (0.040) | | (0.766) |
| DV_DUM | 0.009 | 0.003 | 0.001 | 0.001 | 0.006 | 0.004 | -0.021 | -0.015 |
| | (0.386) | (0.735) | (0.695) | (0.935) | (0.554) | (0.689) | (0.266) | (0.425) |
| RPS_DUM | 0.000 | 0.001 | -0.002 | -0.003 | -0.003 | -0.004 | 0.004 | -0.012 |
| | (0.924) | (0.858) | (0.430) | (0.148) | (0.733) | (0.633) | (0.816) | (0.465) |
| F | 4.966*** | 6.350*** | 7.239*** | 6.321*** | 4.823*** | 6.537*** | 0.916 | 0.855 |
| sig. | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.534) | (0.584) |
| R square | 0.512 | 0.573 | 0.120 | 0.109 | 0.541 | 0.615 | 0.268 | 0.263 |

## Table 6. Regression analysis of cumulative abnormal turnover ratio (CAT[0])

Response variable is CAT[0]. CAT is measured by log(trading volume/share outstanding) - average of log turnover ratio (Chae (2005)). SHARE is the percentage of share repurchase rumored and announced. LN(AST) is natural log of total asset. CAPX/AST and CAPEX/EBITDA is capital expenditure divided by total asset and earnings before interest, tax, depreciation and amortization, respectively. CHE/AST is cash and short-term investment divided by total asset. EBITDA/AST and EBITA/REV is earnings before interest, tax, depreciation and amortization divided by total asset and total sales, respectively. LBT/AST is total liability divided by total asset. NOPI/AST is non-operating income divided by total asset. STD(mRET) is standard deviation of monthly stock return of year -1. MKBK is market value divided by book value of firms. REPORT/MTH is total number of reports for one year divided by 12 months. AVE. RECOM is average of recommendation for one year, 1 is strong buy and 5 is strong sell. DV_DUM and RPS_DUM are dummy variables for dividend payment and repurchase execution in the previous year, 1 for yes, 0 for no. The variable SHARE is excluded because of insufficient number of samples in unpublished rumor category. *p*-value is reported in parentheses. ***, **, * are significant at the 1%, 5%, and 10% levels, respectively.

| Financial | Rumor | | Repurchase | | Published Rumor | | Unpublished Rumor | |
|---|---|---|---|---|---|---|---|---|
| Industry Excluded | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 |
| (Constant) | 0.512* | 0.641** | 0.388*** | 0.425*** | 0.315 | 0.491 | 0.943 | 1.197** |
| | (0.082) | (0.021) | (0.000) | (0.001) | (0.304) | (0.121) | (0.113) | (0.016) |
| SHARE | 0.358 | 0.352 | 0.681*** | 0.702*** | 0.179 | 0.204 | | |
| | (0.178) | (0.181) | (0.000) | (0.000) | (0.510) | (0.454) | - | - |
| LN(AST) | -0.043 | -0.057** | -0.022 | -0.025*** | -0.007 | -0.026 | -0.098 | -0.116** |
| | (0.178) | (0.037) | (0.005) | (0.000) | (0.839) | (0.398) | (0.143) | (0.034) |
| CAPX/AST | 0.974 | | -0.044 | | 1.024 | | 3.453 | |
| | (0.488) | | (0.816) | | (0.468) | | (0.164) | |
| CAPX/EBITDA | | -0.155 | | -0.024 | | -0.145 | | 0.125 |
| | | (0.244) | | (0.289) | | (0.297) | | (0.379) |
| CHE/AST | -0.127 | -0.272 | -0.016 | -0.043 | 0.049 | -0.205 | -0.931 | -0.558 |
| | (0.647) | (0.326) | (0.795) | (0.509) | (0.868) | (0.483) | (0.112) | (0.372) |
| EBITDA/AST | 0.065 | | -0.150* | | 0.014 | | -0.620 | |
| | (0.883) | | (0.093) | | (0.976) | | (0.499) | |
| EBITDA/REV | | 0.333 | | -0.006 | | 0.070 | | 0.159 |
| | | (0.360) | | (0.894) | | (0.853) | | (0.825) |
| LBT/AST | 0.265* | 0.272** | 0.036 | 0.050 | 0.301** | 0.285** | 0.016 | 0.268 |
| | (0.071) | (0.029) | (0.413) | (0.245) | (0.047) | (0.021) | (0.976) | (0.647) |
| NOPI/AST | -1.513 | -2.330 | -0.394 | -0.435 | -5.343 | -4.820 | 0.130 | 0.617 |
| | (0.674) | (0.512) | (0.260) | (0.217) | (0.249) | (0.291) | (0.978) | (0.919) |
| STD(mRET) | -0.505 | | -0.045 | | -0.646 | | 1.307 | |
| | (0.584) | | (0.823) | | (0.489) | | (0.516) | |
| MKBK | | -0.009 | | 0.001 | | 0.004 | | -0.030 |
| | | (0.747) | | (0.916) | | (0.880) | | (0.693) |
| REPORT/MTH | -0.054 | | -0.026 | | -0.067 | | -0.033 | |
| | (0.301) | | (0.124) | | (0.194) | | (0.786) | |
| AVE. RECOM | | -0.023 | | -0.026 | | -0.024 | | -0.084 |
| | | (0.742) | | (0.145) | | (0.751) | | (0.528) |
| DV_DUM | -0.093 | -0.068 | 0.017 | 0.017 | -0.157 | -0.112 | -0.097 | -0.030 |
| | (0.290) | (0.424) | (0.410) | (0.409) | (0.102) | (0.228) | (0.550) | (0.862) |
| RPS_DUM | 0.053 | 0.074 | -0.056*** | -0.061 | -0.011 | 0.010 | 0.266 | 0.225 |
| | (0.527) | (0.329) | (0.008) | (0.003) | (0.900) | (0.903) | (0.112) | (0.143) |
| F | 2.290** | 2.331** | 6.594*** | 5.896*** | 2.099** | 1.920* | 1.388 | 1.197 |
| sig. | (0.023) | (0.020) | (0.000) | (0.000) | (0.040) | (0.062) | (0.242) | (0.341) |
| R square | 0.326 | 0.330 | 0.107 | 0.115 | 0.339 | 0.319 | 0.357 | 0.333 |

## Table 7. Logistic regression analysis on rumors and announcements of share repurchase

Rumor (1) and Repurchase (0) are dependent variables for logistic regression models. LN(AST) is natural log of total asset. CAPX/AST and CAPEX/EBITDA is capital expenditure divided by total asset and earnings before interest, tax, depreciation and amortization, respectively. CHE/AST is cash and short-term investment divided by total asset. EBITDA/AST and EBITA/REV is earnings before interest, tax, depreciation and amortization divided by total asset and total sales, respectively. LBT/AST is total liability divided by total asset. NOPI/AST is non-operating income divided by total asset. STD(mRET) is standard deviation of monthly stock return of year -1. MKBK is market value divided by book value of firms. REPORT/MTH is total number of reports for one year divided by 12 months. MKBK median for rumor is 1.090 and repurchase is 1.139. AVE. RECOM is average of recommendation for one year, 1 is strong buy and 5 is strong sell. DV_DUM and RPS_DUM are dummy variables for dividend payment and repurchase execution in the previous year, 1 for yes, 0 for no. In Hosmer and Lemeshow Goodness-of-Fit test of logistic regression, $H_0$ is '*model is suitable*'. If the p-value of Chi-square is insignificant, the model is suitable. *p*-value is reported in parentheses. ***, **, * are significant at the 1%, 5%, and 10% levels, respectively.

| | Financial Industry Excluded Sample | | | | MKBK big | | MKBK small | |
|---|---|---|---|---|---|---|---|---|
| | Rumor (1) vs. Rep (0) | | Pub (1) vs. UnPub (0) | | Rumor (1) vs. Rep (0) | | Rumor (1) vs. Rep (0) | |
| | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 |
| LN(AST) | 0.031 | 0.102 | -0.008 | -0.072 | -0.043 | 0.061 | 0.180 | 0.175 |
| | (0.683) | (0.100) | (0.969) | (0.648) | (0.704) | (0.465) | (0.186) | (0.125) |
| CAPX/AST | -2.033 | | 12.614 | | -2.539 | | -5.643 | |
| | (0.350) | | (0.153) | | (0.343) | | (0.383) | |
| CAPX/EBITDA | | -0.127 | | 0.205 | | 0.078 | | -0.666* |
| | | (0.536) | | (0.714) | | (0.790) | | (0.075) |
| CHE/AST | 0.129 | 0.105 | 3.772** | 1.187 | -0.343 | 0.075 | -0.182 | -1.191 |
| | (0.826) | (0.869) | (0.046) | (0.503) | (0.632) | (0.921) | (0.924) | (0.551) |
| EBITDA/AST | -1.468* | | -2.611 | | -2.533** | | 1.338 | |
| | (0.093) | | (0.347) | | (0.018) | | (0.723) | |
| EBITDA/REV | | -0.027 | | 0.266 | | 0.045 | | -0.202 |
| | | (0.912) | | (0.769) | | (0.894) | | (0.689) |
| LBT/AST | 0.388 | 0.245 | 1.146 | 0.692 | 0.890 | 0.641 | -0.288 | -0.549 |
| | (0.237) | (0.498) | (0.300) | (0.561) | (0.042) | (0.154) | (0.702) | (0.602) |
| NOPI/AST | 1.434 | 0.820 | 27.363 | 23.342 | 3.575 | 0.554 | -5.218 | -7.585 |
| | (0.726) | (0.838) | (0.184) | (0.229) | (0.571) | (0.928) | (0.790) | (0.703) |
| STD(mRET) | -0.986 | | -19.093*** | | -2.992 | | 3.154 | |
| | (0.553) | | (0.001) | | (0.311) | | (0.252) | |
| MKBK | | -0.032 | | 0.125 | | -0.145 | | 0.532 |
| | | (0.650) | | (0.536) | | (0.122) | | (0.562) |
| REPORT/MTH | 0.242* | | -0.300 | | 0.195 | | 0.123 | |
| | (0.084) | | (0.377) | | (0.329) | | (0.664) | |
| AVE. RECOM | | 0.003 | | 1.322*** | | -0.104 | | 0.251 |
| | | (0.988) | | (0.005) | | (0.696) | | (0.412) |
| DV_DUM | 0.124 | 0.206 | 0.746 | 0.403 | 0.335 | 0.466* | -0.141 | 0.056 |
| | (0.557) | (0.327) | (0.173) | (0.443) | (0.243) | (0.099) | (0.725) | (0.890) |
| RPS_DUM | 0.482** | 0.456** | -0.600 | -0.534 | 0.376 | 0.323 | 0.665* | 0.762** |
| | (0.013) | (0.018) | (0.221) | (0.257) | (0.169) | (0.224) | (0.069) | (0.040) |
| INTERCEPT | -2.994*** | -3.581*** | 1.702 | -2.445 | -1.125 | -2.016** | -3.358** | -3.536** |
| | (0.000) | (0.000) | (0.366) | (0.160) | (0.274) | (0.032) | (0.013) | (0.036) |
| Chi-square | 6.189 | 10.526 | 4.532 | 7.146 | 9.294 | 5.294 | 6.159 | 12.984 |
| | (0.626) | (0.396) | (0.806) | (0.521) | (0.318) | (0.726) | (0.629) | (0.112) |
| -2 Log likelihood | 927.081 | 904.81 | 140.023 | 127.464 | 446.314 | 436.893 | 215.759 | 212.217 |
| Cox & Snell R square | 0.012 | 0.006 | 0.132 | 0.181 | 0.036 | 0.021 | 0.042 | 0.041 |
| % Correct | 92.0% | 92.3% | 78.5% | 75.2% | 95.9% | 96.4% | 93.3% | 86.1% |

## Table 8. Buy-and-Hold returns(BHR) after rumors and announcements of repurchases

Panel A represents the result of whole sample and Panel B represents the result of financial industry excluded sample. Panel C and D report the result of MKBK big and small sample. BHRs and BHARs are measured by Barber and Lyon (1997) methods, multiplying monthly returns from month 1 to month 3, 6, 9, and 12 ($BHR = \prod(1 + mRET_{it})$). BHR is buy-and-hold return. [a,b,c] are significant at the 1%, 5%, and 10% levels, respectively, and t-test for difference from zero. *p*-value of t-test and Mann-Whitney test is in parenthesis. [***], [**], [*] are significant at the 1%, 5%, and 10% levels, respectively, and test for difference between two groups.

| Panel A. Whole Sample | | 3 month | 6 month | 9 month | 12 month |
|---|---|---|---|---|---|
| Rumor | Mean | 0.048[b] | 0.097[b] | 0.173[a] | 0.174[a] |
| (N:273) | Median | 0.020 | 0.030 | 0.080 | 0.100 |
| Repurchase | Mean | 0.075[a] | 0.117[a] | 0.163[a] | 0.189[a] |
| (N:2510) | Median | 0.050 | 0.070 | 0.080 | 0.090 |
| t-test | | (0.326) | (0.600) | (0.845) | (0.812) |
| M-W test | | (0.045)[**] | (0.023)[**] | (0.425) | (0.632) |
| Panel B. Financial Industry Excluded | | | | | |
| Rumor | Mean | 0.046[b] | 0.099[b] | 0.174[a] | 0.174[a] |
| (N:230) | Median | 0.020 | 0.040 | 0.080 | 0.120 |
| Repurchase | Mean | 0.103[a] | 0.177[a] | 0.296[a] | 0.415[a] |
| (N:1944) | Median | 0.080 | 0.095 | 0.160 | 0.205 |
| t-test | | (0.332) | (0.603) | (0.844) | (0.812) |
| M-W test | | (0.046)[**] | (0.024)[**] | (0.429) | (0.636) |
| Panel C. MKBK Big with Financial Industry Excluded | | | | | |
| Rumor | Mean | 0.019 | 0.034 | 0.107[b] | 0.105[b] |
| (N:116) | Median | -0.004 | 0.020 | 0.055 | 0.085 |
| Repurchase | Mean | 0.055[a] | 0.101[a] | 0.275[a] | 0.356[a] |
| (N:981) | Median | 0.050 | 0.040 | 0.130 | 0.180 |
| t-test | | (0.202) | (0.222) | (0.755) | (0.434) |
| M-W test | | (0.028)[**] | (0.028)[**] | (0.366) | (0.400) |
| Panel D. MKBK Small with Financial Industry Excluded | | | | | |
| Rumor | Mean | 0.106[b] | 0.218[c] | 0.295[b] | 0.295[b] |
| (N:114) | Median | 0.050 | 0.070 | 0.095 | 0.120 |
| Repurchase | Mean | 0.118[a] | 0.237[a] | 0.358[a] | 0.565[a] |
| (N:962) | Median | 0.100 | 0.115 | 0.165 | 0.235 |
| t-test | | (0.700) | (0.925) | (0.808) | (0.879) |
| M-W test | | (0.624) | (0.349) | (0.615) | (0.602) |

## Table 9. Long-term performance of rumors and repurchases using calendar portfolio

Three types of portfolios are formed by every three months, one portfolio for the first six months, and one portfolio for the first twelve months during the periods of 1999 to 2010. Abnormal returns are measured by one-factor and three-factor model (Fama and French (1993)). All regression models are statistically stable at the significant of 1%.

$$r_{pt} - r_{ft} = \alpha + \beta_m(r_{mt} - r_{ft}) + \epsilon_t$$

$$r_{pt} - r_{ft} = \alpha + \beta_m(r_{mt} - r_{ft}) + \beta_{smb}(r_{st} - r_{bt}) + \beta_{hml}(r_{ht} - r_{lt}) + \epsilon_t$$

where $\alpha$ is intercept of each regression model and abnormal return of each portfolio. $\beta$ is slop of each regression model. $r_{pt}$ is return of portfolio at time $t$ and $r_{ft}$ is risk free rate at time $t$, which is one month Treasury bill rate. $r_{mt}$ is market return at time $t$. $r_{st}$ and $r_{bt}$ are returns of small and big stocks at time $t$. $r_{ht}$ and $r_{lt}$ are returns of high and low book-to-market ratio stocks at time $t$. $^{***}$, $^{**}$, $^{*}$ are significant at the 1%, 5%, and 10% levels, respectively.

| | Rumor | | | | | | Repurchase | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3m | 6m | 9m | 12m | 1-6m | 1-12m | 3m | 6m | 9m | 12m | 1-6m | 1-12m |
| *One-factor model* | | | | | | | | | | | | |
| $\alpha$ | 0.001 | 0.003 | 0.012** | 0.011 | 0.003 | 0.006 | 0.011*** | 0.005 | 0.004 | 0.007 | 0.008*** | 0.009*** |
| | (0.932) | (0.766) | (0.029) | (0.325) | (0.604) | (0.294) | (0.007) | (0.250) | (0.207) | (0.162) | (0.006) | (0.007) |
| $\beta_m$ | 1.287*** | 1.204*** | 1.443*** | 1.257*** | 1.236*** | 1.291*** | 1.052*** | 0.991*** | 1.226*** | 1.121*** | 1.052*** | 1.134*** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| $R^2$ | 0.136 | 0.090 | 0.149 | 0.186 | 0.111 | 0.141 | 0.124 | 0.103 | 0.136 | 0.196 | 0.113 | 0.142 |
| *Three-factor model* | | | | | | | | | | | | |
| $\alpha$ | -0.002 | 0.002 | 0.008 | 0.005 | 0.001 | 0.002 | 0.007* | 0.002 | 0.008 | 0.002 | 0.005 | 0.004 |
| | (0.703) | (0.895) | (0.159) | (0.625) | (0.936) | (0.766) | (0.076) | (0.587) | (0.770) | (0.605) | (0.113) | (0.211) |
| $\beta_m$ | 1.188*** | 1.101*** | 1.373*** | 1.028*** | 1.139*** | 1.164*** | 0.998*** | 0.957*** | 1.124*** | 0.984*** | 1.013*** | 1.075*** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.001) | (0.000) | (0.000) |
| $\beta_{smb}$ | 0.807*** | 0.368 | 0.764*** | 1.0142*** | 0.622** | 0.869*** | 0.499*** | 0.422** | 0.803*** | 0.867*** | 0.468*** | 0.522*** |
| | (0.007) | (0.446) | (0.006) | (0.002) | (0.020) | (0.000) | (0.000) | (0.029) | (0.000) | (0.000) | (0.000) | (0.000) |
| $\beta_{hml}$ | 0.433 | 0.970* | 0.588* | 0.816 | 0.577** | 0.591*** | 0.497*** | 0.340* | 0.202 | 0.378 | 0.472*** | 0.492*** |
| | (0.167) | (0.088) | (0.060) | (0.132) | (0.048) | (0.015) | (0.001) | (0.064) | (0.166) | (0.006) | (0.000) | (0.001) |
| $R^2$ | 0.158 | 0.103 | 0.171 | 0.213 | 0.127 | 0.162 | 0.142 | 0.109 | 0.154 | 0.209 | 0.124 | 0.154 |