Noisy Signaling through Open Market Share Repurchase Programs and Information Production by Institutions

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Abstract

We propose a "noisy signaling" hypothesis of open market share repurchase (OMSR) programs, where the equity market equilibrium that prevails after OMSR program announcements is a partial pooling rather than a fully separating equilibrium. We argue that two complementary mechanisms, namely, actual share repurchases by firms and information production by institutions, serve to reduce the residual equity market information asymmetry facing firms subsequent to OMSR program announcements. We test the implications of our noisy signaling hypothesis using transaction-level data on trading by institutions and by a subsample of identified hedge funds, and find strong support for the above hypothesis.

1 Introduction

In recent years, the number of firms undertaking stock repurchases has increased dramatically, while the proportion of firms distributing value through cash dividends has declined (see, e.g., Fama and French (2001)). Open-market share repurchases (OMSRs) constitute around 90% of the stock repurchases consummated in recent years: see, e.g., Comment and Jarrell (1991). An interesting question in this context is regarding the precise economic mechanism through which OMSR programs maximize shareholder value. The predominant rationale for share repurchase programs provided by the existing theoretical literature is that they serve to signal firm insiders' private information about the intrinsic value of the firm to outsiders in the equity market: see, e.g., Ofer and Thakor (1987) or Constantinides and Grundy (1989). However, there are certain important modifications of the traditional signaling paradigm that need to be made if we are to apply it to the case of OMSR programs.

Signaling models of share repurchase assume that the firm commits to repurchase a certain number of shares, as is the case in practice in Dutch auction or fixed-price tender offer repurchase programs. However, there is no such commitment to buy a specified number of shares in an OMSR program: the announcement of such a program involves announcing the authorization by the firm's board to repurchase a certain number of shares, not a commitment to buy these shares. This means that an important assumption underlying theoretical models of signaling private information using stock repurchases does not hold in the case of OMSR programs, implying that stock repurchases using OMSR programs may not be able to signal insider private information fully to the equity market. In particular, since top managers' compensation is often linked to stock price, firm managers have an incentive to boost stock prices in the short run, even if they believe that their equity is correctly valued or even overvalued. Given this incentive, and if there is no cost incurred by firm managers for not repurchasing a significant fraction of the shares announced in an OMSR program, even the managers of overvalued firms have an incentive to announce an OMSR program (in order to mimic the behavior of undervalued firms) but actually repurchase only a small fraction of

the announced shares (or none at all).

The fact that OMSR programs may not be able to fully signal firm insiders' private information, however, does not necessarily imply that such programs are not able to convey any information at all to outside investors in the equity market. In this paper, we argue that as long as firm managers suffer a moderate reputational or other cost arising from the firm's actual repurchase falling short of the number of shares authorized in the OMSR program announcement, OMSR programs will be able to convey a noisy signal that the firm's equity is undervalued to outside shareholders.[1] In other words, while an OMSR announcement itself may not fully eliminate the undervaluation of the firm's equity, it is likely to reduce it, with additional information being conveyed gradually over time as the firm subsequently repurchases a larger and larger number of its shares. We further argue that, in this setting, institutional investors play an important role complementary to OMSR program announcements and actual share repurchases by firms in reducing the information asymmetry faced by firms in the equity market (and therefore their equity undervaluation): institutions are able to accomplish this by producing information about announcing firms and trading in their equity after the announcement of OMSR programs. We will refer to the above hypothesis as the "noisy signaling hypothesis" of OMSR programs. The objective of this paper is to propose the above novel hypothesis about OMSR programs and to test its implications in the unique setting of information production and trading by institutional investors, using a detailed transaction-level institutional trading database.

The economic setting we consider to develop our empirical analysis can be described as follows. Consider a situation where the insiders of a firm, having private information about its intrinsic value, are considering whether or not to undertake an OMSR program.

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[1]It is worth noting that the completion rate of actual OMSR programs announced in practice is broadly consistent with firms facing a moderate per share cost of not actually repurchasing the number of shares announced in the OMSR program (as required by our noisy signaling hypothesis). In particular, the evidence in our sample is that, on average, firms actually repurchase 80.11 percent of the shares announced in the OMSR program in the one-year period after the announcement. The evidence documented in various other papers in the existing literature point to a substantial completion rate in OMSR programs, on average: see, e.g., Stephens and Weisbach (1998), who document that firms acquire on average 74 to 82 percent of the number of shares announced within three years of the repurchase announcement.

For concreteness, consider three types of firms: those with the highest intrinsic value (type G), medium intrinsic value (type M), and the lowest intrinsic value (type B). Prior to an OMSR program announcement, all three types of firms are pooled together (priced at the average value across types), so that the type G and type M firms are undervalued while the type B firm is overvalued. This means that the higher type firms have an incentive to announce an OMSR program to reduce their undervaluation: we argue that, even if there is no commitment to buy back all the shares announced in the program, announcing an OMSR program will convey a noisy signal of higher intrinsic value as long as there is at least a moderate reputational or other cost per share to firm management of having a shortfall in the number of shares actually repurchased relative to the target number of shares announced in the OMSR program ("shortfall cost" from now on). We argue that, in this setting, the type G and type M (higher intrinsic value) firms will announce an OMSR program while the type B firms (lowest intrinsic value) firm will not. Further, there will be an announcement effect (abnormal stock return) following such an announcement. However, the undervaluation of the highest firm type will not be completely eliminated by an OMSR program, since, after the announcement, the type G and type M firm will remain pooled together. Consequently, we argue that, after the OMSR program announcement, while both types will repurchase shares, the highest intrinsic value (type G) firms will repurchase a larger number of their own shares than the medium intrinsic value (type M) firms, so that their equity undervaluation is further reduced.

We argue in Section 3.1 that the above partial pooling equilibrium is the one that is most likely to prevail in the equity market after an OMSR program announcement for a very wide range of the per share shortfall cost incurred by firm insiders.[2] Given the nature of this equilibrium, there is room for information production about intrinsic firm values

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[2]In particular, we argue in Section 3.1 that a fully pooling equilibrium is likely to prevail only if the per share shortfall cost is close to zero; similarly, a fully separating equilibrium is likely to prevail only if the per share shortfall cost is extremely high. Further, we point out that the implications of these two types of equilibria are contradicted by the empirical evidence on the announcement effects of OMSR programs and the completion rate of actual share repurchases following OMSR program announcements.

by institutional investors, who will trade on this information in the equity market. The precision of this information produced by institutions is likely to be lower than that of the private information (about their own firm's intrinsic value) held by firm insiders, so that, while information production helps institutions reduce their information disadvantage with respect to firm insiders, it does not eliminate it. Since the information produced by institutions gets reflected in firms' stock prices through their trading, institutional trading will further reduce the information asymmetry faced by the highest intrinsic value (type G) firms (and therefore the undervaluation of their equity). In summary, we hypothesize that there are three complementary mechanisms that serve to reduce the information asymmetry facing firms (and thereby the undervaluation of their equity) in OMSR programs: first, the OMSR program announcement itself; second, actual share repurchases by firms in the open market following the announcement; and third, information production and trading by institutions subsequent to the OMSR program announcement. We discuss this economic setting in more detail in Section 3.1 where we develop a theoretical framework incorporating the above ingredients, based on which we develop testable hypotheses for our empirical analysis (in Section 3.2).

We address the following four sets of research questions in the above economic setting. The first set of research questions is regarding the ability of institutions to produce valuable information about a firm prior to its announcing an OMSR program. We address this question empirically by analyzing whether institutional trading prior to an OMSR program announcement has predictive power for the announcement effect of such a program. The second set of research questions is regarding institutions' ability to produce valuable information about a firm immediately after its announcing an OMSR program. The answer to this question gives us insight into the nature of the equilibrium that prevails in the equity market after an OMSR program announcement: clearly, there is no room of information production by institutions in the event this equilibrium is fully separating, thus resolving all information asymmetry upon the announcement of the program. We address this question

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empirically, in two steps. First, by analyzing the predictive power of institutional trading immediately after an OMSR program announcement for the subsequent long-run performance of the firm's equity. Second, by analyzing whether institutions are able to make abnormal profits by trading in the announcing firm's equity after the announcement of an OMSR program. If institutions indeed have a residual information advantage over retail investors after the announcement of an OMSR program, they should be able to translate this information advantage into abnormal profits by trading in the firm's equity.

The third research question is regarding the interaction between the information production by institutions and the actual share repurchases by firms after an OMSR program announcement. If institutions are able to produce valuable information about the undervaluation of firms' equity after an OMSR program announcement (and buy more equity in more undervalued firms), while more undervalued firms repurchase a larger number of their own shares after the announcement, then institutional net buy should be positively related to the number of shares actually repurchased by announcing firms. We address this question by empirically analyzing the predictive power of institutional trading immediately after an OMSR program announcement for the actual share repurchases made by the announcing firm in the subsequent period. The fourth and final research question is how the information produced by institutions interacts with the private information held by insiders (conveyed to the equity market noisily through the OMSR program announcement and the actual share repurchases of firms) to affect the information asymmetry facing the firm. We address this question empirically by analyzing how institutional trading immediately after an OMSR program announcement affects the change in information asymmetry faced by the firm from before the announcement of an OMSR program to after.

We are able to address the above four research questions directly, given our transaction-level institutional trading data. While we conduct our empirical analysis using trading by our entire sample of institutions around OMSR programs, some of the institutions in our sample may not have the ability (or inclination) to produce information. Therefore, we

also conduct our analysis using trading by a subsample of institutions, namely, hedge funds, whose avowed objective is to produce information and to trade on this information in order to generate positive abnormal returns, and who are likely to be less constrained in their trading relative to other institutions in our overall sample.

We make use of a detailed transaction-level institutional trading database provided by Abel Noser Solutions (formerly Ancerno Ltd., or Abel/Noser Corporation) to address the above research questions. Our data includes transactional-level institutional trading data spanning twelve years from January 2003 to September 2011 originated from 868 different institutions, with an aggregate annualized trading principal of around $9 trillion on all U.S. domestic equity. For an average open-market repurchase event, our sample institutions collectively account for about 12% of the CRSP-reported trading volume within the two-year period surrounding the open-market repurchase announcement. With this dataset, we are able to track institutional trading both before and after an open-market share repurchase announcement. We are also able to compute realized institutional trading profitability net of explicit trading costs (i.e., brokerage commissions) and implicit trading costs (i.e., market impact). Throughout this paper, we use a variable we call "Net Buy" to measure institutional trading. We define Net Buy as the number of shares purchased by institutions minus the number of shares sold by institutions, normalized by the number of shares outstanding.

Our paper provides a number of new results on the effect of information production and trading by institutional investors around OMSR programs on the valuation of the equity of firms announcing such programs, thereby yielding considerable insight into the mechanism through which OMSR programs help to reduce the information asymmetry faced by announcing firms. We organize our empirical tests and results into five parts, corresponding to five different empirical analyses we undertake to address the four sets of research questions outlined above.

First, we study, for the first time in the literature, the informativeness of institutional trading before the announcement of an open-market repurchase program. We find that

institutional trading before an open-market repurchase announcement has considerable predictive power for the announcement effect of these programs.[3] This result holds for trading by the entire sample of institutions as well as for trading by hedge funds. A larger extent of net buying by institutional investors prior to OMSR program announcements is significantly associated with a smaller announcement effect. This suggests that institutional investors are indeed able to produce valuable information about the intrinsic values of firms announcing OMSR programs: since the information produced by institutions gets reflected in the equity prices of firms as a result of institutional trading, the undervaluation of firms with greater institutional net buying is reduced to a greater extent prior to the announcement, so that the stock market reaction to OMSR program announcements by such firms will be smaller.

Second, we study the predictive power of institutional trading immediately after OMSR program announcements (over the next month) for the firm's subsequent long-run (one year) performance, again for the first time in the literature. We find that hedge fund trading immediately after an open-market share repurchase announcement has considerable predictive power for the firm's subsequent long-run stock performance: a 1% increase in hedge fund net buying is associated with about 4.5% increase in the firm's abnormal stock return over the subsequent one-year period. This result is robust to controlling for various variables capturing publicly available information, as well as the extent of trading in the firm's equity by insiders.

Third, we study the realized profitability of institutional trading after OMSR program announcements, using actual transaction prices and net of brokerage commissions, for the first time in the literature. We find that institutions make positive abnormal profits by trading in the firms' equity after the announcement of OMSR programs, even after taking commissions and other trading costs into account. This is the case when the information conveyed by the announcement of an OMSR program is noisier (i.e., when the size of the

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[3]This result is robust to controlling for various variables that have been found in the prior literature to be able to predict announcement effects of open-market share repurchase programs, including prior firm performance and insider trading.

OMSR program is smaller or when the firm actually repurchases a smaller number of shares subsequent to the announcement). This result holds not only for trading by our hedge fund subsample, but also for trading by our entire sample of institutions. In terms of economic magnitude, over the one-year horizon after an OMSR program announcement, our sample institutions on average realize a risk-adjusted return of 1% when the size of the OMSR program is smaller (i.e., below the sample median), and they realize a risk-adjusted return of 0.8% when the firm actually repurchases less subsequent to the announcement (i.e., below the sample median). The profitability of trading by hedge funds in the same time horizon (one year) is even larger. These results suggest that the information produced by institutional investors (especially hedge funds) after an open-market repurchase announcement that we documented earlier translates into real trading profits when the information conveyed by the OMSR program announcement made by the firm is noisier (i.e., when the size of the OMSR program is smaller or when the firm actually repurchases less subsequent to the announcement).

The above two results, on the predictive power of institutional trading for subsequent stock returns and the realized profitability of institutional trading, respectively, together show that institutions are able to generate a residual information advantage over retail investors even after the announcement of an OMSR program. The fact that institutions are able to produce valuable information about the intrinsic value of firms announcing OMSR programs suggests that the equilibrium prevailing in the equity market after the announcement of such a program is a partial pooling (rather than a fully separating) equilibrium, since there would be no room for information production by institutions in a fully separating equilibrium (where all information asymmetry about firm value is resolved) upon the OMSR program announcement itself.

Fourth, we study the predictive power of institutional trading immediately after OMSR program announcements for the actual share repurchases made by firms in the subsequent period, again for the first time in the literature. We find that institutional trading (by

institutions in our entire sample as well as by our subsample of hedge funds) immediately after an OMSR program announcement (either over a month or one quarter horizon) has considerable predictive power for the subsequent actual share repurchases made by the firm: a 1% increase in institutional net buying over the next quarter is associated with about a 3% increase in the firm's actual repurchase over the subsequent two-quarter period.[4] The above result is consistent with the noisy signaling hypothesis that we advance in this paper. In particular, the positive relation we document between institutional trading and actual stock repurchases is consistent with both the above variables serving as complements to OMSR program announcements in reducing the information asymmetry (and therefore the equity undervaluation) of firms making OMSR program announcements.

Fifth and finally, we examine how institutional trading after OMSR program announcements affects the information asymmetry faced by announcing firms in the equity market. We find that institutional trading over the two-quarter period immediately after an open-market repurchase program announcement is associated with a significant reduction in information asymmetry faced by the firm around the OMSR program announcement (i.e., from before the announcement to after) where information asymmetry is measured using four proxies widely used in the literature, namely, analyst forecast errors, analyst forecast dispersions, coefficient of variation of analyst forecasts, and bid-ask spreads. Thus, greater net buying by institutional investors of the equity of firms announcing OMSR programs is associated with a greater reduction in analyst forecast errors; greater reduction in analyst forecast dispersions; greater reduction in the coefficient of variation of analyst forecasts; and a greater reduction in the bid-ask spreads of the announcing firms' equity. This result provides direct evidence showing that institutional trading subsequent to an OMSR program announcement serves a role complementary to the announcement itself in reducing the information asymmetry facing firms announcing OMSR programs, thus providing further support to our noisy signaling

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[4]This result is robust to controlling for various variables capturing publicly available information, as well as the extent of trading in the firm's equity by insiders. Unless otherwise mentioned, the economic magnitude refers to that of trading by our entire sample of institutions.

hypothesis.

The rest of the paper is organized as follows. Section 2 relates this paper to the existing literature and discusses its contribution relative to this literature. Section 3.1 develops a theoretical framework analyzing the complementary role of OMSR program announcements, subsequent actual share repurchases, and institutional trading after OMSR program announcements in reducing the information asymmetry faced by firms; Section 3.2 develops testable hypotheses based on the above theoretical framework. Section 4 describes the data and various variables used in our empirical analysis. Section 5 presents our empirical tests and results. Section 6 concludes.

2 Relation to the Existing Literature and Contribution

Our paper is related to two strands in the theoretical literature. The theoretical literature closest to our paper is the one modeling institutions as information producers and the implications of such information production for stock repurchases, dividends, and equity issues. Brennan and Thakor (1990) develop a theoretical model assuming that large investors such as institutions have the ability to produce information about firms in the context of their choice of distribution method between open-market repurchases, dividends, and fixed-price tender offers. They, however, do not assume that firm insiders have any private information about intrinsic firm value, and the objective of their paper is to analyze how the presence of both informed investors (such as institutions) and uninformed investors (such as retail investors) among a firm's shareholders affect its choice of payout methods between dividends, OMSR programs, and tender offer repurchases. Nevertheless, our paper may be viewed as empirically analyzing an important assumption of their model, namely, that institutional investors are able to produce information about firms undergoing OMSR programs. Allen, Bernardo, and Welch (2000) develop a theoretical model incorporating the role of institutions as information producers. In their model, institutions have the ability

to produce information about the intrinsic values of firms, and are at a greater advantage relative to retail investors in buying shares in firms paying dividends, since dividends are taxed for individuals but untaxed for institutions. In this setting, firms prefer to pay taxable dividends rather than repurchase shares in equilibrium, since paying taxable dividends allows them to reveal their true values to outside investors making use of institutions' ability to produce information about true firm value. Chemmanur and Jiao (2011) develop a model of institutional trading and information production around SEOs. We adapt their economic setting to OMSRs when developing a theoretical framework that incorporates information production by institutions after OMSR program announcements.

The theoretical signaling literature on stock repurchases is also related to our paper. This literature argues that, in an asymmetric information setting, undervalued firms are able to credibly and fully separate themselves from overvalued firms using stock repurchases: see, e.g., Ofer and Thakor (1987), Constantinides and Grundy (1989), Vermaelen (1981), or Persons (1994).[5] Oded (2005) points out that, unlike Dutch auction or fixed-price tender offers, OMSR programs do not pre-commit firms to acquire shares, and that many firms buy back only a fraction of the dollar value announced, thus calling into the question the ability of OMSR programs to signal true firm value. He, however, goes on to develop a signaling model of OMSR programs where firms face a trade-off between the long-run gains from the informed trading that the option to repurchase shares creates and the short-run costs from the market's accounting for this adverse selection.[6] Under this trade-off, only good firms announce open-market repurchase programs, so that the announcement of an OMSR program acts as a credible signal (i.e., yielding a fully separating equilibrium).[7] In

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[5]McNally (1999) develops a signaling model of OMSR programs in a setting similar to that of Leland and Pyle (1977). He assumes that entrepreneurs are risk averse and do not tender their own shares, so that a share repurchase increases entrepreneurs' proportionate equity holdings in the firm, triggering an increase in equity value due to the signaling effect of such an increase (similar to the signaling effect of entrepreneurs' equity holdings in Leland and Pyle (1977)). However, he assumes that the announcement of the target number of shares in an OMSR program is a "commitment to action," thus assuming away the difference between OMSR programs and the other two forms of repurchase (Dutch auction and fixed-price tender offers) that exists in practice.

[6]See also Ikenberry and Vermaelen (1996) for a discussion of this option under symmetric information.

[7]This result, however, holds only under the rather strong assumption that the stock value distribution

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contrast to the above literature, we argue that OMSR program announcements are not able to fully signal true firm value: i.e., the equilibrium prevailing in the equity market after an OMSR program announcement is not a fully separating equilibrium but a partial pooling equilibrium. Further, the empirical evidence we document here, that institutions are able to produce valuable information about firms announcing OMSR programs and generate abnormal profits from trading on this information, also contradicts the notion that OMSR program announcements fully convey firm insiders' private information to the equity market: there is no room for information production by institutions in a fully separating equilibrium.[8]

Our paper is also related to the large empirical literature on stock repurchases in general and OMSR programs in particular. A number of early papers show that the prices of firms that announce a stock repurchase program increase significantly in the short run (e.g., Dann (1981); Vermaelen (1981)) and in the long run (e.g., Ikenberry, Lakonishok, and Vermaelen (1995)). Comment and Jarrell (1991) study the relative signaling power of Dutch-auctions, self-tender offers and open-market repurchases, and show that, while the announcement effects of OMSR programs are positive, they provide weaker signals of stock undervaluation (weaker announcement effects) compared to the other two forms of repurchase. Comment and Jarrell (1991) also point out that larger OMSR program announcements are viewed as stronger signals. A number of papers have also studied actual share repurchases in OMSR programs and compared the number of shares actually repurchased relative to the target number announced in OMSR programs. Stephens and Weisbach (1998) document that for OMSR programs announced between 1981 to 1990, firms acquire on average 74 to 82 percent of the shares announced as repurchase targets within three years of the repurchase announcement. Ben-Rephael, Oded, and Wohl (2014) show that disclosure of firms' actual repurchase

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of a good (higher intrinsic value) firm has a higher variance than that of a bad (lower intrinsic value) firm, so that the option to repurchase the shares of a good firm is more valuable than the corresponding option of a bad firm.

[8]Bayar, Chemmanur, and Liu (2014) develop a theoretical analysis of a firm's choice between dividend payments and share repurchases to pay out cash (in a setting of heterogeneous beliefs between firm insiders and outsiders as well as among outsiders). They also develop a theoretical rationale for the positive long-run stock returns following stock repurchases that has been documented in the empirical literature. See Allen and Michaely (2003) for an extensive review on the payout policy literature.

activity following OMSR program announcements lead to a positive and significant abnormal stock return, consistent with actual share repurchases contributing to a reduction in the residual information asymmetry facing firms even after an OMSR program announcement. Busch and Obernberger (2017) find that actual share repurchases in OMSR programs increase stock price efficiency and the information content of stock prices. Despite the above large body of empirical evidence, there has been no empirical analysis of the role played by information production and trading by institutions in mitigating the residual information asymmetry faced by firms after the announcement of OMSR programs in the existing literature: this is our focus here.[9,10]

Our paper makes several important contributions to the literature at a conceptual as well as at an empirical level. First, ours is the first paper in the literature to propose a noisy signaling hypothesis of OMSR programs. Thus, we are the first to argue that, in contrast to the existing literature which has theoretically demonstrated a separating equilibrium after share repurchase programs in general, the equilibrium in the equity market after an OMSR program announcement is likely to be a partial pooling equilibrium, where (in a setting with a continuum of types or a discrete type setting with three or more types) the highest firm types pool by announcing an OMSR program while the lowest types do not announce such a program. In this context, we argue that there is room for some information transmission from firm insiders to equity market investors through an OMSR program announcement, even in the absence of a commitment by the firm to buy back the entire amount of shares announced, as long as the firm or its insiders suffer a moderate shortfall cost per share: i.e., the firm incurs such a cost if the actual number of shares repurchased falls short of the target number of shares announced. Finally, we conjecture that, in such a partial pooling equilibrium, there

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[9]Two other contemporaneous papers also study trading by institutional investors around stock repurchases. DeLisle, Morscheck, and Nofsinger (2014) document that institutional investors are net sellers during share repurchases. In a similar spirit, Huang and Zhang (2013) show that institutions sell after share repurchase announcements. Neither of these papers analyze and test hypotheses regarding the information production role of institutional investors, which is our focus here.

[10]Our paper is also distantly related to the empirical literature analyzing institutional trading around corporate events other than stock repurchases: see, e.g., Gibson, Safieddine, and Sonti (2004) and Chemmanur, He, and Hu (2009), who empirically analyze institutional trading around SEOs.

are two mechanisms that play a role complementary to OMSR program announcements in further mitigating the residual information asymmetry faced by the firm even after the OMSR program announcement. The first such mechanism is actual share repurchases by firms after OMSR program announcements: we argue that more undervalued firms repurchase a larger number of shares after OMSR program announcements, thereby conveying further information about intrinsic firm value to the equity market. The second such mechanism is information production by institutions and trading by them making use of this information after OMSR program announcements. We argue that, based on their information production, institutions buy more equity in more undervalued firms, and institutions' information getting reflected in stock prices as a result of their trading further reduces the residual information asymmetry facing firms after OMSR program announcements.

The second contribution made by our paper lies in testing the implications of the above noisy signaling hypothesis of OMSR program announcements for information production and trading by institutions. The results of our empirical analysis provide considerable support for the noisy signaling hypothesis. First, the fact that institutions are able to produce valuable information subsequent to OMSR program announcements (as evidenced by the predictive power of institutional trading and the realized profitability of such trading) provides support for the notion that the equilibrium prevailing in the equity market is a partial pooling rather than a fully separating equilibrium: there would be no room for information production by institutions in a separating equilibrium, since, in such an equilibrium, all information asymmetry is resolved upon the announcement of the OMSR program itself. Second, the positive relationship that we document between institutional net buying and actual share repurchases by firms provides further support for the noisy signaling hypothesis. This positive relationship is likely to be induced by the fact that firms that are more undervalued after OMSR program announcements repurchase more of their own shares, while institutions net buy a larger number of shares after OMSR program announcements in firms that they believe to be more undervalued. Third, we provide direct evidence supporting

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the complementary role of information production and trading by institutions in reducing the residual information asymmetry facing firms announcing OMSR programs, by showing that the reduction in information asymmetry facing firms from before an OMSR program announcement to after such an announcement is greater when net buying by institutions in the firm's equity immediately after the announcement is greater.

Our paper also makes a third contribution to the literature by documenting the predictive power of institutional trading prior to OMSR program announcements for the announcement effects of such programs. This, along with the other empirical results discussed earlier, allows us to empirically confirm a crucial assumption made by the Brennan and Thakor (1990) model: we are able to show that institutional investors are indeed able to produce credible information about the intrinsic values of firms around OMSR programs.

3 Theoretical Framework and Testable Hypotheses

3.1 Theoretical Framework

In this section we briefly develop a theoretical framework that allows us to analyze the noisy signaling role of OMSR programs, and the complementary role of information production and trading by institutions in conveying information from firm insiders to uninformed outsiders (e.g., retail investors) in the equity market. We will use this theoretical framework to develop testable hypotheses in the next section.

Consider a situation where the insiders of a firm, having private information about its intrinsic value, are deciding whether or not to undertake an OMSR program. If insiders choose to announce an OMSR program, it may convey a signal to outsiders that the firm's equity is undervalued relative to its intrinsic value as assessed by firm insiders (based on their private information): whether the signal is fully revealing or partially revealing, or whether there will be any information content to this signal at all, will depend upon the nature of the equilibrium that prevails in the equity market after the OMSR program announcement, as

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we discuss below. In other words, the announcement of an OMSR program may convey firm insiders' private information only partially to outsider shareholders, thereby reducing (but not necessarily eliminating) the undervaluation of the firm's equity relative to its intrinsic value. The fact that, even after an OMSR program announcement, there may be residual undervaluation of the firm's equity leaves room for information production by institutions about the firm's intrinsic value: i.e., information production by institutions getting reflected in the stock price may play a role (complementary to the noisy signal conveyed by the OMSR program) in reducing the undervaluation of the announcing firm's equity.

We now analyze more precisely the nature of the equilibrium that prevails in the equity market upon the announcement of an OMSR program. The setting we study is the following. There are three types of firms: Good (type G) with intrinsic value V_G; Medium (type M) with intrinsic value V_M; and Bad (type B) with intrinsic value V_B; $V_G > V_M > V_B$. While firm insiders know the true type of their own firm, outsiders know only the probability distribution across firm types: they assess that any firm in the equity market is a type G with probability γ_G, type M with probability γ_M, and type B with probability γ_B, $\gamma_G + \gamma_M + \gamma_B = 1$. Since outsiders cannot fully distinguish between the three types of firms, the share price of any firm prior to an OMSR announcement will be the pooling value across the three types of firms: i.e., it will be $\gamma_G V_G + \gamma_M V_M + \gamma_B V_B$.

The timeline of events (depicted in Figure 1) is the following. At time 0, a firm chooses whether or not to announce an OMSR program and announces it if it finds it optimal to do so. If the firm chooses to actually repurchase any of the shares authorized in the OMSR program, it does so between time 0 and time 1, with the actual repurchases completed at time 1. Investors in the equity market (both institutional and retail investors) come to know the number of shares (if any) actually repurchased by the firm at time 1.[11]

We assume that the firm and/or its top managers suffer a per share reputation cost arising from any shortfall in the number of shares actually repurchased relative to the number

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[11]Beginning from 2004, U.S. firms are required to make quarterly disclosures of actual share repurchases and average prices paid.

of shares authorized in the OMSR program announcement: the aggregate reputation cost suffered by a firm (or its top managers) is given by the product of the number of shares by which the firm's actual repurchase falls short of the number announced (authorized) in the OMSR program and the shortfall cost per share. The firm incurs this aggregate shortfall cost (if any) at time 1, soon after the actual number of shares repurchased becomes known. We do not take a position on the magnitude of this per share shortfall cost: we argue that the nature of the equilibrium in the equity market will depend upon whether this magnitude is large, moderate, or small.

In the long-run (time 2), the true value of the firm becomes revealed exogenously (i.e., the information asymmetry between firm insiders and outsiders is eliminated at time 2, as the firm's operating performance becomes known to outsiders over time). As we discuss in more detail below, institutional investors may produce information (at a cost) about the firm's intrinsic value between the announcement of an OMSR program (time 0) and the completion of actual share repurchases (if any) by the firm (and the public disclosure of the number of shares repurchased) at time 1.

Actual share repurchases by firms
Information production and trading by institutions

t = 0	t = 1	t = 2
OMSR program announcement (if any)	Actual share repurchases completed and revealed to outsiders	Exogenous revelation of true firm values
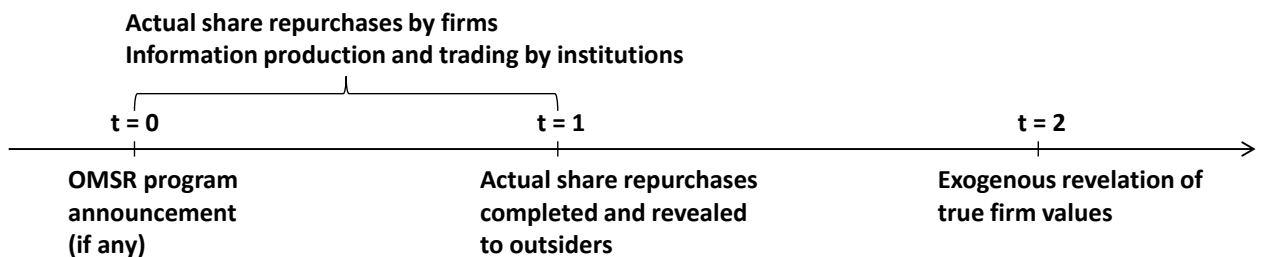
Figure 1: Timeline of Events

The objective of each firm in deciding whether or not to announce an OMSR program at time 0, and the actual number of shares to repurchase, is to maximize a weighted average of its equity values in the short run (time 0), medium run (time 1), and the long-run (time 2), net of any reputation cost incurred by the firm at time 1 due to the shortfall in shares actually repurchased. The weights placed on the valuation at each date is determined exogenously

(not alterable by firm managers).

Outsiders in the equity market consist of two types of investors.[12] The first type of investors are institutional investors, who have the ability to produce noisy information about the firm (at a cost). The precision of information produced by institutions is lower than that of the private information held by firm insiders, so that, while information production helps institutions reduce their information disadvantage with respect to firm insiders, it does not eliminate it. We assume that institutions trade on the information they produce: they buy shares that they believe to be undervalued based on the information they have produced. The second type of investors are retail investors, who do not have any ability to produce information about the intrinsic value of the firm, and are therefore at a disadvantage with respect to both institutions and insiders. Retail investors are essentially liquidity traders in the equity market in the economic setting we study here, similar to their role in market microstructure models such as Kyle (1985). The price of the firm's stock in the equity market is set by a market-maker who is uninformed to begin with, but who sets the stock price to break even (after observing the aggregate order flow of trades in the firm's equity), again similar to the price-setting rule in market microstructure models. The aggregate order flow observed by the market-maker in the equity market in our setting comes from three sources: trading by institutional investors; actual share repurchases by firms; and trading by retail investors (uninformed liquidity traders). While the market-maker cannot fully separate informed and uninformed trades, the price of the firm's equity will reflect, to some degree, the information held by institutional investors as well as that contained in the actual repurchases made by firms. The information flow between firm insiders, institutional investors, retail investors and the resulting determination of the firm's stock price (by the

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[12]We adapt the setting of Chemmanur and Jiao (2011) to analyze an equity market with information production by institutional investors around OMSR program announcements, and how this information gets reflected in stock prices. Chemmanur and Jiao (2011), however, focus on theoretically analyzing the implications of institutional trading around seasoned equity offerings. In the interest of conserving space, we choose not to develop a formal theoretical model here to analyze institutional trading around OMSR program announcements, but instead adapt the theoretical analysis of Chemmanur and Jiao (2011) to the stock repurchase setting.

market-maker) in the economic setting we postulate here is depicted in Figure 2.
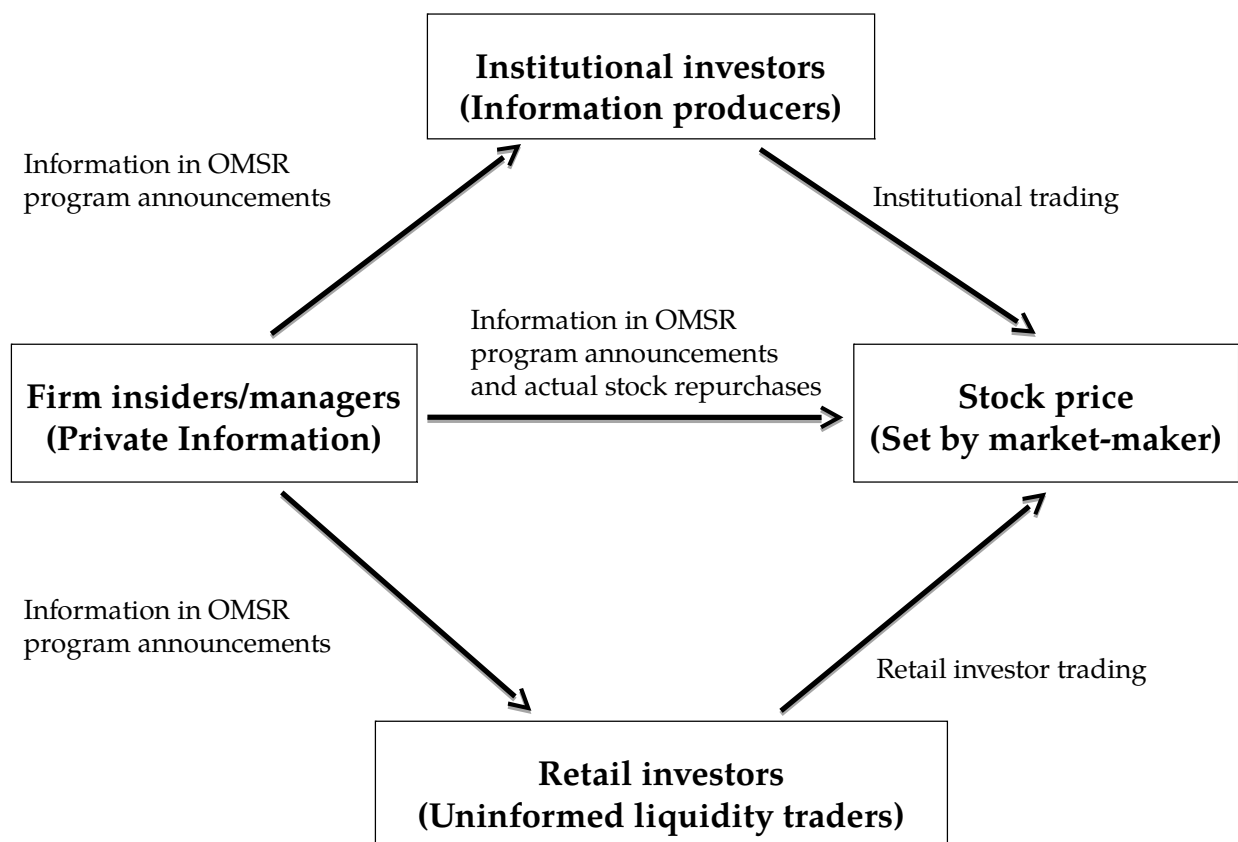
Figure 2: Information flow between firms, institutions, uninformed investors, and the stock price

We now characterize the equilibrium in the above setting as a function of the magnitude of the repurchase shortfall cost incurred by the firm. We describe three possible equilibria. We start with the equilibrium which prevails when the per share shortfall cost is moderate.

Equilibrium One (*Moderate repurchase shortfall cost per share*):

In this equilibrium, only a type G or a type M firm announces an OMSR program at time 0.[13] A type B firm will not announce such a program since its incentive compatibility (truth-telling) condition is satisfied. In other words, it is optimal for a type B firm to reveal

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[13]The number of shares authorized (and announced) in the OMSR program by the type M will be the same as that by the type G, since, otherwise it will reveal its true type. In other words, we an think of the type G as determining the number of shares to be announced in the OMSR program and the type M mimicking it by announcing the same number of shares.

its true type by refraining from making such an OMSR announcement. The trade-off faced by a type B firm is the following. On the one hand, if the type B firm makes an OMSR program announcement, it can prevent a drop in its share price from the pooled value across types to its true value. On the other hand, in this case, the type B firm will not buy back any shares between time 0 and time 1 even if it announces an OMSR program, since its shares will be overvalued relative to intrinsic value between time 0 and time 1, so that actually repurchasing shares will be prohibitively costly for the firm, resulting in the type B firm having to incur a high aggregate shortfall cost at time 1. Given that the firm's true value is revealed exogenously at time 2 (so that its equity value will equal its true value at time 2 even if it announces an OMSR program at time 0), it can be shown that the value of the type B firm's objective will be strictly lower (for moderate values of the shortfall cost) if it announces an OMSR program at time 0 compared to the case where it refrains from making any such announcement. In summary, the type B firm does not announce an OMSR program at time 0, thereby revealing its true type.[14]

Given the type B firm's behavior in the equilibrium, outside investors in the stock market recompute a firm's stock value upon an OMSR program announcement as a weighted average of the intrinsic values of the type G and the type M firms, the weights being the Bayesian updated probabilities of the firm being of type G and type M respectively (conditional on such an announcement). The announcement effect (abnormal stock return) of an OMSR program is therefore positive, since the equity value of the firm upon the announcement is strictly higher than the fully pooling value prevailing before the announcement. Subsequent to an OMSR program announcement, the type G firm continues to be undervalued, though less than before the announcement; the type M firm, however, is overvalued. Given that its shares continue to be undervalued, the type G firm repurchases the entire number of shares announced in the OMSR program between time 0 and time 1.

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[14]It is straightforward to write down the formal incentive compatibility conditions of the type B and type M firm at time 0, which are consistent with the type B choosing not to announce an OMSR program (thus separating from the other two types) while the type M chooses to announce such a program (thus pooling with the type G). We choose not to present these here due to space limits.

In contrast to the type G, the type M firm repurchases only a certain fraction of the number of shares announced in the OMSR program since its shares are overvalued, resulting in actual share repurchase being costly for that firm. The number of shares repurchased by the type M firm between time 0 and time 1 will therefore reflect the trade-off faced by that firm between buying back its overvalued shares, and incurring the repurchase shortfall cost at time 1.[15] Given that the type G and type M firms actually repurchase different numbers of shares in the open market, once the actual number of shares repurchased is revealed to outside investors at time 1, the stock prices of the two types of firms will signal their true intrinsic values (with the type G firm's stock price going up (since its true value is now fully revealed) and the type M firm's price going down). At time 2 (long-run), the information asymmetry facing all firms is resolved exogenously, so that their equity market value will be equal to their intrinsic values at this date.

The role of institutions in the above equilibrium is that of information production and trading on the information produced between time 0 and time 1. In the above equilibrium, institutions are able to produce noisy information that allow them to distinguish partially between a type M firm (overvalued) and a type G firm (undervalued). Institutions then buy equity in firms that they believe to be undervalued and sell equity in those they believe to be overvalued. Since the information contained in institutional trading gets reflected in the stock price through the inference and price-setting process of the market-maker (see Chemmanur and Jiao (2011) or Kyle (1985) for details), institutional trading between time 0 and time 1 plays a role complementary to OMSR program announcements and actual share repurchases by firms in reducing the undervaluation of the equity of a type G firm (and in reducing the overvaluation of the equity in a type M firm).[16] Further, institutional

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[15]Thus, the actual number of shares repurchased by the type M firm between time 0 and time 1 will be a function of the repurchase shortfall cost.

[16]Trading by institutions using the information they have produced and its effect on the stock price of the two firm types (type G and type M) may, in turn, affect the number of shares actually repurchased by them. However, the behavior of two firm types we specified under equilibrium remains qualitatively unchanged. Thus, as long as the undervaluation of the type G firm is not fully eliminated due to institutional trading, the firm will repurchase all the shares it has announced in the OMSR program; similarly, while the precise number of shares that the type M firm repurchases between time 0 and time 1 may change due to the

buying of shares will be correlated with actual share repurchases by firms, since institutions buy equity in undervalued (type G) firms and, as discussed above, a type G firm actually repurchases more of its own equity than a type M firm between time 0 and time 1.

Equilibrium Two (*Very low repurchase shortfall cost per share*):

In this equilibrium, all three types pool by announcing an OMSR program.[17] There is therefore no announcement effect at time 0: the stock price of any firm announcing an OMSR program remains the same as before the announcement. Between time 0 and time 1, the type B firm does not repurchase any shares, and suffers a low aggregate shortfall cost at time 1. The type B finds it optimal to announce an OMSR program at time 0 since this enables it to keep its equity value at the overvalued level at time 0 by pooling with the type G and type M, while incurring only a low aggregate shortfall cost at time 1, once it is revealed that it did not repurchase any of the shares announced in the OMSR program. Consequently, the value of the type B firm's objective is higher in this equilibrium if it announces an OMSR program but does not repurchase any shares between time 0 and time 1 (in other words, its truth-telling condition at time 0 is not satisfied when the per share shortfall cost is low). The type G firm actually repurchases all the shares it announced in the OMSR program at time 0, since its shares continue to be undervalued after the announcement (between time 0 and time 1). The type M firm may repurchase all shares announced in the OMSR program (if its shares are undervalued after the OMSR program announcement between time 0 and time 1) or only a fraction of the shares it announced (if the pooling value prevailing after the OMSR program announcement is above its intrinsic value, so that its equity is overvalued). In the latter case, its trade-off in determining the actual repurchase fraction is similar to that discussed above under equilibrium one. At time 2, true firm values are exogenously revealed, so that the equity values of all three firm types equal their intrinsic values.

Note that this equilibrium is inconsistent with the empirical evidence documented by

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reduction in overvaluation of the type M firm's equity due to institutional trading, its equilibrium behavior remains qualitatively unchanged.

[17]The type M and type B firms pool with the type G firm by announcing the same number of shares as in the type G firm's OMSR program announcement, since they will otherwise reveal their true types.

the existing literature (as well as that in this paper), since this evidence shows that OMSR programs have a positive announcement effect (see, e.g., Table 1 of this paper or previous papers such as Comment and Jarrell (1991) or Vermaelen (1981)).

Equilibrium Three (*Very high repurchase shortfall cost per share*):

In this case, the equilibrium is fully separating, so that each type of firm fully reveals its type at time 0. In this equilibrium, the type G firm announces an OMSR program at time 0 and repurchases the announced number of shares between time 0 and time 1. The type M firm also announces an OMSR program at time 0, but for a smaller number of shares; it repurchases this smaller announced number of shares between time 0 and time 1, and therefore avoids incurring any repurchase shortfall cost. The type B firm does not announce any OMSR program at time 0, since, given the large per share shortfall cost assumed here, any valuation benefit arising from pooling with the type M or the type G at time 0 is overcame by its cost of buying back its own overvalued shares (if it chooses to actually repurchase some shares between time 0 and time 1) or its aggregate shortfall cost it incurs at time 1 (if it choose not to actually repurchase the number of shares announced at time 0). In other words, the value of the type B's objective if it reveals its true type at time 0 itself is greater than if it attempts to pool with the type M or type G. The announcement effect of an OMSR program is positive for both the type G and type M firm (and therefore positive on average for all firms announcing OMSR programs).[18]

Further, since this equilibrium is fully separating at time 0 (i.e., all information asymmetry is resolved upon announcement), the magnitude of the announcement effect in an OMSR program will be as high as in other types of repurchases, such as fixed-price tender offers. This prediction is clearly inconsistent with the existing empirical literature: see, e.g., Comment and Jarrell (1991) and Vermaelen (1981), who compare the signalling power of fixed-price tender offers, Dutch auctions, and OMSRs, and conclude that OMSRs have the smallest announcement effect. Further, this equilibrium does not allow any room for

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[18]Here we are assuming that V_B is sufficiently smaller than V_M, and γ_G, γ_M, and γ_B are such that the type M firm is undervalued at the pooling price prevailing before the OMSR program announcement.

costly information production by institutions after an OMSR program announcement, since the equilibrium is fully separating, so that all information asymmetry is resolved upon the OMSR program. This, in turn, implies that, if this equilibrium prevails, institutions are unlikely to have an information advantage over retail investors in the equity market after an OMSR program announcement, so that there will be no meaningful reward to institutions engaging in costly information production.

3.2   Testable Hypotheses

In this section, we use the theoretical framework developed in Section 3.1 to develop testable hypotheses to analyze the predictive power of institutional trading around open-market stock repurchases for the announcement effect of stock repurchases; actual shares repurchased (as against the authorized repurchase in the OMSR program announced); the long-run stock return performance of the firm's equity subsequent to the announcement of an open-market repurchase; and finally, the abnormal profits realized by institutional investors (net of all transaction costs) by trading in the equity of firms subsequent to their announcement of the OMSR program. We also develop testable hypotheses for the relationship between institutional trading immediately after an OMSR program announcement and the change in the information asymmetry faced by the firm from before the announcement of the OMSR program to after.

We rely on equilibrium one discussed in Section 3.1 to develop our testable hypotheses. This is because we view this equilibrium as the most plausible one in practice, since, as we discussed in the previous section, the other two equilibria are inconsistent with the empirical evidence on the announcement effect of OMSR programs. Since the real world is continuous in terms of intrinsic firm values, we use a continuous analog of the three type model characterized in Section 3 to develop testable hypotheses: in other words, we can think of type G, type M, and type B firms that we discussed in Section 3.1 as intervals of continuous firm types behaving differently at different points in time, as discussed in equilibrium one in

Section 3.1. Finally, equilibrium one is even more likely to prevail in this continuous type version of our theoretical framework than in the discrete type framework, since, even if the per share repurchase shortfall cost that we assume in Section 3.1 is rather small in practice, there will always be a set of firm types that can be identified as behaving similar to the type B firm in equilibrium one (partial pooling equilibrium) that we discussed in section 3.1.[19]

Our first hypothesis deals with the relationship between institutional trading prior to an OMSR program announcement and the announcement effect of such a program. Before the announcement of an OMSR program, the equity of all firms will be priced at the pooling value across firm types (as we discussed in Section 3.1). Consider now the scenario where institutional investors produce information about intrinsic firm values and trade in the firm's equity prior to the OMSR program announcement. The stock price will reflect the additional information contained in trading by institutions, with the price of the firm's equity falling lower if the net buy by institutions (number of shares bought minus number of shares sold) is negative, while it will rise higher if their net buy is positive. In other words, effect of the information produced pre-OMSR program announcement by institutions getting reflected in stock prices is to reduce the extent of pooling across firm types, reducing the undervaluation of higher type firms while reducing the overvaluation of lower type firms.[20] At this point, if

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[19]It is also worth noting that the completion rate of actual OMSR programs announced in practice is broadly consistent with firms facing a moderate per share cost of not actually repurchasing the number of shares announced in the OMSR program (as in our equilibrium one). In particular, the evidence in our sample is that, on average, firms actually repurchase 80.11 percent of the shares announced in the OMSR program in the one-year period after the announcement (the evidence documented in various other papers in the existing literature is broadly similar). This is inconsistent with firms behaving as if there is no repurchase shortfall cost (as in equilibrium two) or a very high shortfall cost (as in equilibrium three). In the former scenario, we would expect the number of shares actually repurchased as a fraction of shares announced in the OMSR program to be much smaller; in latter scenario, we would expect almost all firms announcing OMSR programs to repurchase one hundred percent of the shares announced in the program. We do not observe either of the above scenarios in practice.

[20]We do not incorporate information production and trading by institutions prior to the announcement of an OMSR program in the theoretical framework developed in Section 3.1. However, it is easy to incorporate the effect of this information production and trading into our theoretical framework by introducing an additional date prior to the announcement of an OMSR program, namely, date -1, with pre-OMSR program institutional information production and trading occurring between time -1 and time 0. As we discuss in the main text, the effect of pre-announcement information production and trading by institutions is to reduce the extent of pooling across types that prevails at time 0, so that the pooling across types prevailing at time 0 (the date of the OMSR program announcement) would be lower than it would otherwise be in the absence of such information production and trading by institutions. In other words, while at time 0 three types: type

the firm announces an OMSR program, stock market investors will further positively update the value of the firm's equity, knowing that higher intrinsic value firms are more likely to announce an OMSR program than lower intrinsic value firms, and that the decision to repurchase (or not) is made by firm insiders who have private information about intrinsic firm value. This means that the magnitude of the announcement effect, which will reflect the difference in the firm's stock price from immediately before the repurchase announcement to immediately after, will be negatively related to net buying by institutional investors. The intuition here is that if the institutional net buying prior to the OMSR program announcement is larger, the reduction in the undervaluation of higher types that has already occurred prior to the OMSR program announcement is more, so that the stock market reaction to the OMSR program announcement itself will be smaller. This will be the first hypothesis that we test here (**H1**).

We now turn to trading by institutions subsequent to the announcement of an open-market repurchase program. If the announcement of an OMSR program conveys firm insiders' private information to the equity market, the price of the firm's stock immediately after the repurchase announcement will reflect this information. However, as we discussed under equilibrium one in Section 3.1, the OMSR program announcement may only be a noisy signal of firm insiders' private information. If this is indeed the case, there is room for further information production by institutions about intrinsic firm value even after an OMSR program announcement, giving institutional investors a residual information advantage over retail investors even after the announcement of an OMSR program. In this case, trading by institutions after an OMSR announcement will have predictive power for the firm's future stock returns. This is the second hypothesis that we test here (**H2**).

If (as we postulated under **H2**) institutions indeed have an information advantage over retail investors when they trade in a firm's equity subsequent to its OMSR program an-

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G, M, and B pool in our theoretical framework (discussed in Section 3.1), at time -1 even lower intrinsic value firm types than the type B may be pooling with higher type firms, so that the extent of undervaluation of higher type firms may be even more severe at time -1 than at time 0.

nouncement, we would expect this information advantage to translate into abnormal profits realized by institutions. This is therefore the next hypothesis that we test here (**H3**). The residual information advantage of institutional investors over retail investors will be greater as the information conveyed by the repurchase announcement itself is weaker or more noisy: i.e., if the repurchase program announced is smaller (as a fraction of total shares outstanding) or if the number of shares actually repurchased is smaller.[21] This, in turn, implies that the abnormal profits made by institutions from trading in the firms' equity after an OMSR program announcement will also be greater for smaller repurchase programs. This is the next hypothesis that we test here (**H4**).

We now turn to developing a testable hypothesis regarding the relation between institutional trading after an OMSR program announcement and the number of shares actually repurchased by the firm. To develop this hypothesis, recall first from our discussion of equilibrium one in Section 3.1 that higher intrinsic value firms will actually repurchase a larger number of shares (out of the total number announced in the OMSR program). If, in the above setting, institutions are able to produce information about the extent of undervaluation of firms' equity (i.e., about intrinsic firm value), and buy more of the equity in firms where the extent of the undervaluation is greater (i.e., in higher type firms), then the extent of institutional net buying immediately after an OMSR announcement will be positively related to the amount of shares actually repurchased by the firm. Thus, a greater net buy of the firms' equity by institutions after an OMSR program announcement will be positively related to the actual repurchases made by the firm in the subsequent period (**H5**).

Finally, we examine how institutional trading after an OMSR program announcement affects the information asymmetry faced by a firm. Clearly, if OMSR program announcements serve as noisy signals of firm insiders' private information to outsiders in the equity market, then the information asymmetry faced by the firm will be reduced: i.e, the extent of information asymmetry faced by the firm in the equity market subsequent to an OMSR

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[21]Comment and Jarrell (1991) point out that larger OMSR program announcements act as stronger signals, based on their announcement effects.

announcement will be lower than that before the repurchase announcement. The question we examine here, however, is the effect of the interaction between the signal conveyed by the OMSR program announcement and the information conveyed by institutional trading immediately after the announcement of the repurchase program on the change in information asymmetry facing the firm. In particular, the reduction in the information asymmetry facing the firm will be greater when the noisy signal conveyed by the repurchase announcement and the information conveyed to the equity market by institutional trading reinforce each other (which will be the case when the institutional net buy immediately after the repurchase announcement is positive). On the other hand, the reduction in information asymmetry facing the firm will be smaller when the noisy signal conveyed by the repurchase announcement and the information conveyed to the equity market by institutional trading oppose each other (which will be the case when the institutional net buy immediately after the repurchase announcement is negative). In summary, the reduction in information asymmetry facing the firm following the announcement of an OMSR program will be positively related to the institutional net buy immediately after the repurchase program announcement (**H6**).

4 Data and Summary Statistics

4.1 OMSR Program Data

The data on OMSR programs in this study comes from several sources. Our initial sample of OMSR program announcements from January 2004 to December 2010 comes from the SDC Platinum Database of Mergers and Acquisitions. We then exclude announcements such that the repurchase may be executed through tender offer, private negotiation, or Dutch auction.[22] If a firm makes multiple OMSR program announcements in the same calendar year, we only keep the first announcement. We also require that accounting information

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[22]The purpose is to eliminate repurchase programs that may be executed through a combination of methods (e.g., open-market and private negotiation).

from Compustat and stock return information from CRSP are available for the firms in our OMSR data.

Our data on U.S. firms' actual share repurchases comes from Quarterly Compustat, which is made available by the regulatory changes to Rule 10b-18 of the Securities Exchange Act of 1934 in 2003.[23] Beginning from 2004, U.S. firms are required to make quarterly disclosures of actual share repurchases and average prices paid. We then match this actual repurchase data from Quarterly Compustat with the data on OMSR announcements we obtained from SDC.

Table 1 reports summary statistics of our OMSR data. We have about 3,000 open-market repurchase programs announced from January 2004 to December 2010. The average OMSR program size, defined as the dollar amount value of the OMSR program normalized by the market capitalization of the firm, is 7.94%, consistent with prior studies in the literature (e.g., Peyer and Vermaelen (2009)). We find a significant 1.74% average abnormal return in the 3-day window around an OMSR announcement, which is also consistent with the empirical findings in the literature (e.g., Babenko, Tserlukevich, and Vedrashko (2012)). Over one-year period following an OMSR announcement, our sample firms' actual repurchases on average account for about 80.11% of the OMSR program size announced. This is largely consistent with prior findings that firms complete a significant portion of the repurchase programs within the one-year period after the announcement (e.g., Stephens and Weisbach (1998)).

4.2   Institutional Trading Data

We obtain transaction-level institutional trading data from Abel Noser Solutions, a leading execution quality measurement service provider for institutional investors. The data are similar to those used by several microstructure studies on institutional trading costs, for example, Keim and Madhavan (1995), Conrad, Johnson, and Wahal (2001), and Jones

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[23]Earlier studies (e.g., Stephens and Weisbach (1998), Fama and French (2001), and Grullon and Michaely (2002)) have used a variety of other CRSP- and Compustat-based measures to estimate actual share repurchases by U.S. firms. These estimations invariably suffer from different measurement biases. For a detailed discussion of these measures, see Banyi, Dyl, and Kahle (2008).

and Lipson (2001). To the best of our knowledge, this is the first paper to use institutional trading data to study institutional investors' trading behavior around OMSR programs.

The data cover equity trading transactions by a large sample of institutions from January 2003 to September 2011. For each transaction, the data include the date of the transaction, the stock traded, the number of shares traded, the dollar principal traded, commissions paid by the institution, and whether it is a buy or sell by the institution. The data are provided to us under the condition that the names of all institutions are removed from the data. However, identification codes are provided enabling us to separately identify all institutions. Sample institutions are either investment managers or plan sponsors. Within investment managers, hedge funds are identified by merging management companies in Abel Noser with a list of hedge funds provided by Thomson Reuters. Please see the Appendix for details of this matching algorithm.

Table 2 reports summary statistics of our institutional trading data. We have 868 institutions in our sample, with 372 of them being investment managers and 496 of them being plan sponsors. Within the group of investment managers, 162 of them are identified as hedge fund companies (including institutions that have both hedge funds and non-hedge fund businesses). In aggregate, these institutions have an annualized trading volume of around 304 billion shares and an annualized trading principal of around $9 trillion. In association with these trading activities, our sample institutions in aggregate incur an annualized commission expense of about $7.5 billion. If we consider a two-year trading horizon surrounding the OMSR announcement dates in our OMSR data, on average (for each OMSR event), our sample institutions in aggregate execute about 24,510 transactions, with a trading principal of about $3.5 billion, and account for about 12% of the trading volume reported by CRSP.

5 Empirical Tests and Results

5.1 The Relation between Pre-Announcement Institutional Trading and OMSR Program Announcement Effects

Hypothesis **H1** predicts that net buying from institutions prior to OMSR program announcements will be negatively related to OMSR program announcement effects. In this subsection, we make use of institutional trading data and examine the relationship between institutional trading before OMSR program announcements and the announcement effects of OMSR programs.

Table 3 presents the results of our OLS analysis. The dependent variable is the cumulative abnormal return over a 3-day period around OMSR announcements (i.e., the announcement return described in Table 1). Following the literature on open-market share repurchases, we calculate the announcement effects based on a market model, where the market beta is estimated with daily returns over the 6-month period ending one trading day before OMSR program announcements. The variable of interest is *Net Buy* from institutions. For ease of interpretation, from this subsection onwards, *Net Buy* is expressed in percentage rather than in basis points. In Panel A, *Net Buy* is aggregated over all sample institutions over the 12-month period before OMSR program announcements, whereas in Panel B, *Net Buy* is aggregated over all hedge funds over the 12-month period before OMSR program announcements.

From Model (1) of Panel A, we can see that the coefficient on *Net Buy* is negative and statistically significant. This is consistent with **H1**, suggesting that institutional trading prior to announcements of OMSR programs leads to the information produced by institutions about the intrinsic values of firms getting reflected in the announcing firms' stock prices before the announcement itself, so that the actual announcement effect of the OMSR program is smaller. We control for the variables that have been found in the literature to be able to explain OMSR program announcement effects, such as the size of the OMSR programs and

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the past stock return of the firm. In a recent paper, Babenko, Tserlukevich, and Vedrashko (2012) find that insider trading and insider holdings provide additional explanatory power regarding OMSR program announcement returns. In Models (2) and (3) of Panel A, we incrementally control for these variables and the coefficients on *Net Buy* remain negative and statistically significant.

In Panel B, we aggregate net buying by hedge funds, a subsample of all institutions, over the 12-month period before OMSR program announcements and perform a similar multivariate analysis as in Panel A. The coefficients on *Net Buy* remain negative and statistically significant, and the economic magnitude here is larger than that in Panel A, where *Net Buy* is calculated using trading by all sample institutions.

To summarize, we find evidence in this subsection that is consistent with hypothesis **H1**. Institutional trading before OMSR program announcements has predictive power for the announcement effect of such programs, in the sense that an algebraically lower institutional net buying before an OMSR program announcement is associated with a larger announcement effect. This result holds even after we control for variables capturing publicly available information such as the size of the OMSR program, prior firm performance, and insider trading. This evidence suggests that institutional trading prior to an OMSR program announcement indeed reflects the information produced by institutional investors about the intrinsic value of the firm. Additionally, we find evidence suggesting that hedge funds, as a subgroup of institutional investors, possess somewhat more accurate information regarding the intrinsic values of firms compared to the average for institutional investors in our overall sample. Overall, our empirical results in this section suggest that institutions are able to produce valuable information about the intrinsic values of firms announcing OMSR programs, consistent with a crucial assumption of the model of Brennan and Thakor (1990).

5.2 The Relation between Institutional Trading after OMSR Program Announcements and Subsequent Stock Returns

In the previous subsection, we examined the relationship between institutional trading before OMSR program announcements and the announcement effect of such programs. From this subsection onwards, we focus on institutional trading immediately after OMSR program announcements and examine the informativeness of such trading. We first investigate whether institutional trading immediately after OMSR program announcements predicts the subsequent stock return performance of firms (**H2**).

Table 4 reports the results of our multivariate analysis. The variable of interest is institutional trading, measured by *Net Buy*, after OMSR program announcements. We focus on institutional trading over the one month period after an OMSR program announcement. The dependent variable is the buy-and-hold abnormal return over the 12-month period in percentage points subsequent to the measurement period of *Net Buy*. Buy-and-hold abnormal return is the buy-and-hold raw return minus the buy-and-hold return of the Fama-French 25 portfolio matched on size and book-to-market. In Panel A, *Net Buy* is aggregated over all sample institutions over the one month period after OMSR program announcements, whereas in Panel B, *Net Buy* is aggregated over all hedge funds over the one month period after such announcements.[24]

In Model (1) of Panel A and Panel B in Table 4, we control for the size of the OMSR program, the amount of shares actually repurchased by the firm during the two fiscal quarters after the announcement, and various variables capturing different aspects of the firm's characteristics. The coefficient on *Net Buy* in Model (1) of Panel A is not statistically significant, suggesting that we do not find evidence that trading by institutions in our overall sample has predictive power about the future stock returns of repurchasing firms. Meanwhile,

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[24]We focus only on hedge funds that participate in trading on the stocks of OMSR announcing firms on the announcement day. This group of hedge funds, that timely respond to OMSR announcement news, are presumably more informed about the announcing firm than other hedge funds that do not trade on the announcement day.

the coefficient on *Net Buy* in Model (1) of Panel B is positive and statistically significant, suggesting that trading by hedge funds as a group has strong predictive power for future stock returns of the repurchasing firms. In Models (2) - (4) of both Panel A and Panel B, we separately control for contemporaneous insider trading, industry fixed effects, and year fixed effects, and in Model (5) of both Panel A and Panel B, we control for these variables together. We thus find that hedge funds, as a subgroup of institutional investors, have a unique information advantage in their post-OMSR program announcement trading in terms of predicting the long-run stock returns of repurchasing firms.

In summary, we find evidence that trading by a subgroup of institutional investors, namely, hedge funds, after OMSR program announcements has predictive power for the subsequent stock return performance of OMSR program announcing firms. This is consistent with hypothesis **H2**, suggesting that some institutions, notably hedge funds, possess a residual information advantage over retail investors about the firm's intrinsic value, even after the announcement of an OMSR program.[25] Overall, this evidence suggests that the equilibrium in the equity market after an OMSR program announcement is such that there is room for the production of valuable information about the intrinsic value of firms by at least one subgroup of institutions, namely, hedge funds.

5.3 Profitability of Institutional Trading after OMSR Program Announcements

In the previous subsection, we presented evidence that institutional (hedge fund) trading after OMSR program announcements has predictive power for the subsequent long-run stock return performance of firms. This result suggests that institutions are able to produce private information about the intrinsic values of firms announcing OMSR programs, even after the announcement of such programs which may partially convey firm insiders' private

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[25]The result that aggregate institutional trading does not have predictive power for future stock returns may be partially explained by the fact that some institutions may also sell shares passively to provide liquidity for firms buying back shares in the open market: see, e.g., Huang and Zhang (2013).

information as well. In this subsection, we investigate hypotheses **H3** and **H4** by analyzing whether institutions are able to use the information they have produced to realize abnormal trading profits after OMSR program announcements. Further, we analyze whether institutional investors make larger abnormal profits when the information conveyed by an OMSR program is more noisy (i.e., when the size of the OMSR program is smaller or when the firm repurchases a smaller number of shares).

We make use of our transaction-level institutional trading data to calculate trading profits, capital committed, and investment returns earned by sample institutions. Following Chemmanur, He, and Hu (2009), we consider a "raw" measure as well as a risk-adjusted measure, where we use the cumulative returns from the corresponding Fama-French 25 portfolio matched on size and book-to-market to discount profits and capital committed back to the first day of the trading horizon. We focus on institutional trading over the four quarters immediately after OMSR program announcements.

Table 5 presents the results of our analysis. In Panel A, we include trading for all institutions, and in Panel B, we include trading only for our identified hedge fund subsample. Further, we split our data by the noisiness of the signal conveyed by the OMSR program announcement: i.e., smaller versus larger OMSR programs; and by the subsequent actual share repurchase: i.e., smaller versus larger number of shares actually repurchased. In Panel A1 and B1, we split by the OMSR program size. We expect that a larger OMSR program size sends a stronger signal to the market, which leaves less room for information production by market participants (both institutional and retail investors) after such an OMSR program announcement. Therefore, we expect that institutional investors have less informational advantage compared to retail investors (and hence make smaller abnormal trading profits) when the OMSR program size is larger. In Panel A2 and B2, we split by the cumulative actual share repurchases made by the firm during the first two fiscal quarters after the OMSR program announcement. If a firm actually repurchases more, we expect that more information about firm value is already impounded into stock prices. Therefore, we expect

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institutional investors to have less of an informational advantage compared to retail investors (and hence make smaller abnormal trading profits) when the firm actually repurchases more shares.

We examine the realized investment return by institutions after OMSR program announcements in Table 5. We calculate two return measures, i.e., *return on buy principal* and *return on maximum investment.* For each return measure, we calculate a raw return measure without risk adjustment and a risk-adjusted return measure by discounting using benchmark returns of the corresponding Fama-French 25 portfolio matched on size and book-to-market. For example, *raw return on buy principal* is defined as raw profit divided by buy principal and *risk-adjusted return on maximum investment* is defined as risk-adjusted profit divided by risk-adjusted maximum investment. As we can see in Table 5 Panel A1, when the OMSR program size is smaller, institutions earn positive and statistically significant investment returns. Specifically, institutions on average realize a *risk-adjusted return on maximum investment* of 0.77% when the OMSR program size is below the sample median. On the other hand, when the OMSR program size is larger (above the sample median), institutions make zero and sometimes negative investment returns. The difference in investment returns realized by institutions between small and large OMSR programs is statistically significant. In Panel A2, we split our sample by the actual shares repurchased by the firm during the first two fiscal quarters after the OMSR program announcement, and show that, when firms actually repurchase less (below the median), institutions earn positive and statistically significant investment returns. Specifically, institutions on average realize a *risk-adjusted return on maximum investment* of 1.03% when the actual repurchase is below the sample median. On the other hand, when firms actually repurchase more (above the sample median), institutions make zero and sometimes negative investment returns. The difference in investment returns realized by institutions between small and large actual share repurchases is also statistically significant.

We also examine the realized investment returns by hedge funds after OMSR program

announcements using similar return measures, and the results are presented in Panel B of Table 5. Consistent with our findings for all institutions, we find that hedge funds earn positive and statistically significant investment returns when the OMSR program size is smaller (Panel B1), or when the firm's actual repurchase is smaller (Panel B2). In comparison to the results reported in Panel A, hedges funds realize even higher investment returns than that realized by the average institution in our overall sample. When the OMSR program size is below the sample median, we find hedged funds on average realize 1.17% *risk-adjusted return on maximum investment* (versus 0.77% realized by average institutions); when the firm's actual share repurchase is below the sample median, we find that hedge funds on average realize 2.11% *risk-adjusted return on maximum investment* (versus 1.03% realized by the average institution in our overall sample).

In summary, we find that institutional investors realize abnormal investment returns in trading the stock of OMSR program announcing firms when the size of the OMSR program is smaller and when the firm makes smaller actual share repurchases subsequent to the OMSR program announcement (**H3** and **H4**). This suggests that institutional investors are able to produce valuable information about the intrinsic values of firms announcing OMSR programs, and are able to translate this information advantage into realized trading profits, when the information conveyed by an OMSR program announcement itself is more noisy, or when the number of shares actually repurchased after the OMSR program announcement is smaller. We also find that hedge funds, who are more specialized information producers compared to institutions as a whole, hold even more of an information advantage and realize greater investment profits. Overall, our empirical results in this subsection, together with our results presented in Section 5.2, suggest that the equilibrium in the equity market after an OMSR program announcement is a partial pooling equilibrium, which leaves room for the production of valuable information by institutions. Further, our results suggest that the precision of the information produced by institutions depends upon the noisiness of the signal conveyed by the OMSR program announcement and the information conveyed by the

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number of shares actually repurchased. Thus, our results presented in the subsection provide considerable support for the noisy signaling hypothesis of OMSR programs.

5.4 Institutional Trading after OMSR Program Announcements and Actual Share Repurchases

In this subsection, we investigate the relationship between institutional trading after OMSR program announcements and the firm's actual share repurchase activities. Specifically, we test hypothesis **H5** by examining whether institutional net buying after OMSR program announcements is positively related to the actual share repurchases made by firms subsequent to these announcements.

Table 6 presents the results of our multivariate analysis. In Panel A, we aggregate institutional trading (*Net Buy*) over the first month and the first quarter after an OMSR program announcement. The dependent variable is the firm's actual share repurchases during the two fiscal quarters after the measurement period of institutional net buying, and is defined as the number of shares repurchased by the firm normalized by the number of shares outstanding. In Panel A, the coefficient on *Net Buy* is positive and statistically significant for the one quarter horizon (it is positive but insignificant for the one month horizon). This suggests that aggregate trading by all institutions during the quarter after OMSR program announcements is positively related to the future actual share repurchases by firms.

We control for variables capturing different firm characteristics. In particular, we control for several variables that affect the firm's financial ability to repurchase. Specifically, we control for the firms' cash holdings, capital expenditures, R&D expenses, and whether these firms are paying dividends. All of the coefficients on these variables have the expected signs and are statistically significant in most cases. In Models (2)-(5) and (7)-(10), we additionally control for different combinations of insider trading, insider holdings, industry fixed effects, and year fixed effects. The coefficients on *Net Buy* remain positive and statistically significant. In fact, the magnitude and statistical significance of the coefficients on

Net Buy remain similar across all the models we consider here, suggesting that institutional trading possesses additional predictive power that is not captured by these control variables regarding the firm's subsequent actual share repurchases.

We also examine the relationship between net buying by hedge funds after OMSR program announcements and firms' subsequent actual shares repurchases: the results are presented in Panel B of Table 6. We find that the coefficient on *Net Buy* (aggregated trading by hedge funds) is positive and statistically significant for the one month horizon (it is positive but insignificant for the one quarter horizon). This suggests that aggregate trading by all hedge funds during the first month after OMSR announcements is positively related to the future actual share repurchases by firms.

In summary, in this subsection we present evidence that institutional trading after an OMSR program announcement has predictive power for the subsequent actual share repurchases made by the firm, in the sense that greater net buying by institutional investors after an OMSR announcement is associated with greater actual share repurchases by the firm in the subsequent period. This is consistent with hypothesis **H5**, suggesting that the information produced by institutional investors after an OMSR program announcement is correlated with the residual undervaluation of firms announcing such programs. Since firms that are more undervalued after an OMSR program announcement are likely to undertake larger actual share repurchases according to the noisy signaling hypothesis, this induces a positive relationship between institutional net buying after OMSR program announcements and actual share repurchases. Overall, our results presented in this subsection provide further support for the noisy signaling hypothesis.

5.5 Institutional Trading and the Change in Equity Market Information Asymmetry around OMSR Program Announcements

In this subsection, we empirically examine the relationship between institutional trading after OMSR program announcements and the change in the information asymmetry facing

firms from before an OMSR program announcement to after. Specifically, we test hypothesis **H6** by examining whether institutional net buying after an OMSR program announcement is associated with a larger decrease in the extent of information asymmetry facing firms in the equity market.

Table 7 presents the results of our multivariate analysis. Our main variable of interest is *Net Buy*, measured as the aggregate institutional net buying during the first two quarters after an OMSR program announcement. The dependent variable is the difference in the measures of firms' information asymmetry from before OMSR program announcements to after. In Panel A, B, and C, we use three different measures of information asymmetry based on I/B/E/S analyst earnings forecasts; in Panel D, we use a fourth measure of information asymmetry, namely, the bid-ask spread. For each firm announcing an OMSR program, we retrieve analyst earnings forecasts for the fiscal year end before the OMSR program announcement date (at least one year before the announcement date), and after the OMSR program announcement date (at least one year after the announcement date). In Panel A, the information asymmetry measure is the mean-squared error of analysts forecasts (*MSE*). We measure forecast error as the absolute difference between the average forecasted earnings and the actual earnings per share divided by the price per share at the time of the forecast. In Panel B, the information asymmetry measure is the standard deviation of analyst forecasts (*Dispersion*). In Panel C, the information asymmetry measure is the coefficient of variation of analyst forecasts (*COV*), which is defined as the ratio of standard deviation in analyst forecasts to the absolute value of the average of analyst forecasts. In Panel D, we use the bid-ask spread (*BidAskSpread*) as a measure of information asymmetry. We first calculate the daily bid-ask spread as the average of all quoted spreads (the difference between the log ask price and log bid price) during normal trading hours on the day based on NYSE TAQ data, and average the daily bid-ask spread over the one-year horizon before the OMSR program announcement, as well as the one-year horizon following the second quarter after the OMSR program announcement.

As we can see from model (1) from Table 7 Panel A, the coefficient on *Net Buy* is negative and statistically significant, suggesting that a larger *Net Buy* is associated with a decrease in analyst forecast error from before the OMSR program announcement to after. This result is robust to controlling for firm size, book-to-market ratio, and past stock return. In model (2), we add industry and year fixed effects; in model (3) and (4), we additionally control for *Actual Repurchase* (actual shares repurchased by the firm during the first two fiscal quarters after the OMSR program announcement), *Insider Net Buy* (aggregate net purchase by top level insiders of the firm during the two fiscal quarters after the OMSR program announcement), as well as *Insider Holding* (aggregate stock holding of top level insiders of the firm at the end of the most recent fiscal year before the OMSR program announcement). The coefficients on *Net Buy* remain positive and statistically significant. Similarly, in Panel B, where we use standard deviation of analysts forecasts as the measure of information asymmetry, we find that a larger *Net Buy* is associated with a decrease in *Dispersion* from before the OMSR program announcement to after; and in Panel C, we find that a larger *Net Buy* is associated with a decrease in *COV* (coefficient of variation of analysts forecasts) from before the OMSR program announcement to after. Finally, in Panel D, we find that a larger *Net Buy* is associated with a decrease in the bid-ask spread of the firm's equity from before the OMSR program announcement to after.

In summary, in this subsection we present evidence that is consistent with hypothesis **H6**. This evidence provides direct support for the role of information production and trading by institutions in reducing the residual information asymmetry facing firms after an OMSR program announcement. In particular, we show that the reduction in information asymmetry facing firms in the equity market from before an OMSR program announcement to after such an announcement is greater when net buying by institutions in the firm's equity immediately after the announcement is greater.

6 Conclusion

In this paper, we have accomplished three objectives.

First, we have proposed a noisy signaling hypothesis of OMSR programs. Thus, in contrast to the existing literature which has theoretically demonstrated a separating equilibrium after share repurchase programs in general, we argued that the equilibrium in the equity market after an OMSR program announcement is likely to be a partial pooling equilibrium, where (in a setting with a continuum of types or a discrete type setting with three or more types) the highest firm types pool by announcing an OMSR program while the lowest types do not announce such a program. In this context, we argued that there is room for some information transmission from firm insiders to equity market investors through an OMSR program announcement, even in the absence of a commitment by the firm to buy back the entire amount of shares announced, as long as the firm or its insiders suffer a moderate shortfall cost per share: i.e., they suffer such a cost if the actual number of shares repurchased falls short of the target number of shares announced. Finally, we conjectured that, in such a partial pooling equilibrium, there are two mechanisms that play a role complementary to OMSR program announcements in further reducing the information asymmetry faced by the firm even after such announcements. The first such mechanism is actual share repurchases made by firms after OMSR program announcements: we argued that more undervalued firms repurchase a larger number of shares after OMSR program announcements, thereby conveying further information about intrinsic firm value to the equity market. The second such mechanism is information production by institutions and trading by them making use of this information after OMSR program announcements. We argued that, based on their information production, institutions buy more equity in more undervalued firms, and their information getting reflected in stock prices as a result of their trading further reduces the residual information asymmetry facing firms after OMSR program announcements.

Second, we tested the implications of the above noisy signaling hypothesis of OMSR program announcements for information production and trading by institutions. The results

of our empirical analysis provide considerable support for the noisy signaling hypothesis. First, the fact that institutions are able to produce valuable information subsequent to OMSR program announcements (as evidenced by the predictive power of institutional trading and the realized profitability of such trading) provides support for the notion that the equilibrium prevailing in the equity market is a partial pooling rather than a fully separating equilibrium: there would be no room for information production in a separating equilibrium, since, in such an equilibrium, all information asymmetry is resolved upon the announcement of the OMSR program itself. Second, the positive relationship that we documented between institutional net buying and actual share repurchases by firms provides further support for the noisy signaling hypothesis. This positive relationship is likely to be induced by the fact that firms that are more undervalued after OMSR program announcements repurchase more of their own shares, while institutions net buy a larger number of shares after OMSR program announcements in firms that they believe to be more undervalued. Third, we provided direct evidence supporting the complementary role of information production and trading by institutions in reducing the residual information asymmetry facing firms after OMSR program announcements, by showing that the reduction in information asymmetry facing firms from before an OMSR program announcement to after such an announcement is greater when net buying by institutions in the firm's equity immediately after the announcement is greater.

Finally, our paper documented the predictive power of institutional trading prior to an OMSR program announcement for the announcement effect of such a program. This, along with the other empirical results discussed earlier, allows us to empirically confirm a crucial assumption made by the Brennan and Thakor (1990) model by showing that institutional investors are indeed able to produce valuable information about the intrinsic values of firms around OMSR programs.

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Appendix: Identifying hedge funds within the Abel Noser sample

We identify hedge funds in the Abel Noser sample by merging management companies in Abel Noser with a list of hedge funds provided by Thomson Reuters. The client manager code along with the institutional manager code allows for the identification of a particular institutional investor.

The second dataset we use is the list of hedge funds provided by Thomson Reuters. This list is comprehensive as it classifies all 13F filers. We verify the quality of Thomson Reuters hedge fund classification by checking Form ADV filed by institutions. In particular, following Brunnermeier and Nagel (2004) and Griffin and Xu (2009), we classify an institution as a hedge fund if more than half of its investors are categorized as high net worth individuals or pooled investment vehicles in item 5.D. In addition, we require that the manager charge a performance-based fee (item 5.E).

To merge management companies in the Abel Noser sample with hedge funds in Thomson Reuters, we compute each institution's quarterly change in stock ownership (in number of shares) for each stock, denoted by ΔIO. For each pair of a Thomson Reuters hedge fund and an Abel Noser management company, we calculate the difference of ΔIO by two institutions and map the Thomson Reuters hedge fund to the Abel Noser management company with the closest ΔIO. Finally, we manually verify the matches identified above, using fund names from the Thomson Reuters and a manager name list disclosed by Abel Noser in 2011.

Our classification identifies 162 hedge funds in the whole sample. Since our identification is based on management companies, it is likely that our hedge fund sample includes some institutions that have both hedge funds and non-hedge funds business. Therefore, it is more appropriate to refer to hedge funds in our sample as hedge fund management companies: however, for brevity of presentation, we call them hedge funds in our analyses.

References

Allen, Franklin, Antonio E. Bernardo, and Ivo Welch, 2000, A theory of dividends based on tax clienteles, *The Journal of Finance* 55, 2499–2536.

Allen, Franklin, and Roni Michaely, 2003, Chapter 7 - payout policy, *Handbook of the Economics of Finance*.

Babenko, Ilona, Yuri Tserlukevich, and Alexander Vedrashko, 2012, The credibility of open market share repurchase signaling, *Journal of Financial and Quantitative Analysis* 47 (5), 1059–1088.

Banyi, Monica L., Edward A. Dyl, and Kathleen M. Kahle, 2008, Errors in estimating share repurchases, *Journal of Corporate Finance* 14 (4), 460–474.

Bayar, Onur, Thomas J. Chemmanur, and Mark H. Liu, 2014, Dividends versus stock repurchases and long-run stock returns under heterogeneous beliefs, *Working Paper*.

Ben-Rephael, Azi, Jacob Oded, and Avi Wohl, 2014, Do Firms Buy Their Stock at Bargain Prices? Evidence from Actual Stock Repurchase Disclosures, *Review of Finance* 18, 1299–1340.

Brennan, Michael J., and Anjan V. Thakor, 1990, Shareholder preferences and dividend policy, *Journal of Finance* 45 (4), 993–1018.

Brunnermeier, Markus, and Stefan Nagel, 2004, Hedge Funds and the Technology Bubble, *The Journal of Finance* 59, 2013–2040.

Busch, Pascal, and Stefan Obernberger, 2017, Actual Share Repurchases, Price Efficiency, and the Information Content of Stock Prices, *The Review of Financial Studies* 30, 324–362.

Chemmanur, Thomas J., Shan He, and Gang Hu, 2009, The role of institutional investors in seasoned equity offerings, *Journal of Financial Economics* 94 (3), 384–411.

Chemmanur, Thomas J., and Yawen Jiao, 2011, Institutional trading, information production, and the SEO discount: A model of seasoned equity offerings, *Journal of Economics and Management Strategy* 20 (1), 299–338.

Comment, Robert, and Gregg A. Jarrell, 1991, The relative signalling power of dutch-auction and fixed-price self-tender offers and open-market share repurchases, *Journal of Finance* 46 (4), 1243–1271.

Conrad, Jennifer S., Kevin M. Johnson, and Sunil Wahal, 2001, Institutional trading and soft dollars, *Journal of Finance* 56 (1), 397–416.

Constantinides, George M., and Bruce D. Grundy, 1989, Optimal investment with stock repurchase and financing as signals, *Review of Financial Studies* 2 (4), 445–465.

Dann, Larry Y., 1981, Common stock repurchases: An analysis of returns to bondholders and stockholders, *Journal of Financial Economics* 9 (2), 113–138.

DeLisle, R. Jared, J.D. Morscheck, and John R. Nofsinger, 2014, Share repurchases and institutional supply, *Journal of Corporate Finance* 27, 216 – 230.

Fama, Eugene F., and Kenneth R. French, 2001, Disappearing dividends: changing firm characteristics or lower propensity to pay?, *Journal of Financial Economics* 60 (1), 3–43.

Gibson, Scott, Assem Safieddine, and Ramana Sonti, 2004, Smart investments by smart money: Evidence from seasoned equity offerings, *Journal of Financial Economics* 72 (3), 581–604.

Griffin, John M., and Jin Xu, 2009, How Smart Are the Smart Guys? A Unique View from Hedge Fund Stock Holdings, *Review of Financial Studies* 22, 2531–2570.

Grullon, Gustavo, and Roni Michaely, 2002, Dividends, share repurchases, and the substitution hypothesis, *Journal of Finance* 57 (4), 1649–1684.

Huang, Sheng, and Joe Zhang, 2013, How do institutional investors trade when firms are buying back shares?, *Working Paper.*

Ikenberry, David, Josef Lakonishok, and Theo Vermaelen, 1995, Market underreaction to open market share repurchases, *Journal of Financial Economics* 39 (2-3), 181–208.

Ikenberry, David L., and Theo Vermaelen, 1996, The option to repurchase stock, *Financial Management* 25, 9–24.

Jones, Charles M, and Marc L Lipson, 2001, Sixteenths: direct evidence on institutional execution costs, *Journal of Financial Economics* 59 (2), 253–278.

Keim, Donald B., and Ananth Madhavan, 1995, Anatomy of the trading process empirical evidence on the behavior of institutional traders, *Journal of Financial Economics* 37 (3), 371–398.

Kyle, Albert S., 1985, Continuous auctions and insider trading, *Econometrica* 53 (6), 1315–1335.

Leland, Hayne E., and David H. Pyle, 1977, Informational asymmetries, financial structure, and financial intermediation, *The Journal of Finance* 32, 371–387.

McNally, William J., 1999, Open market stock repurchase signaling, *Financial Management* 28, 55–67.

Oded, Jacob, 2005, Why do firms announce open-market repurchase programs?, *Review of Financial Studies* 18 (1), 271–300.

Ofer, Aharon R., and Anjan V. Thakor, 1987, A theory of stock price responses to alternative corporate cash disbursement methods: Stock repurchases and dividends, *Journal of Finance* 42 (2), 365–394.

Persons, Jonh C., 1994, Signaling and takeover deterrence with stock repurchases: Dutch auctions versus fixed price tender offers, *The Journal of Finance* 49, 1373–1402.

Peyer, Urs, and Theo Vermaelen, 2009, The nature and persistence of buyback anomalies, *Review of Financial Studies* 22 (4), 1693–1745.

Stephens, Clifford P., and Michael S. Weisbach, 1998, Actual share reacquisitions in open-market repurchase programs, *Journal of Finance* 53 (1), 313–333.

Vermaelen, Theo, 1981, Common stock repurchases and market signalling: An empirical study, *Journal of Financial Economics* 9 (2), 139–183.

Table 1: Summary Statistics of Open-Market Share Repurchases.
This table presents summary statistics of the open-market share repurchase programs (OMSRs) data from January 2004 to December 2010. *OMSR Program Size* is the value of the OMR program (in dollar amount), normalized by the market capitalization of the firm as of the most recent month-end before the announcement date. *Announcement Effect* is measured as the three-day ([0,2]) abnormal return, where date 0 is the announcement date. Abnormal returns are calculated based on a market model, where the market beta is estimated using returns over 126 trading days ending one trading day before the announcement (that is, [-126, -1]). *Actual Completion* is the actual repurchase by the firm during one-year period after the OMSR program announcement date as a percentage of OMSR Program Size. *Log Total Assets* is the natural logarithm of total assets at the most recent fiscal year end before the announcement; similarly, *Log B/M* is the natural logarithm of Book-to-Market ratio; *Cash Holdings* is the firms cash holdings normalized by total assets; *R&D Expenses* is the firms R&D expenses normalized by total assets; *Dividend Paying Dummy* is a dummy variable which equals one if the firm pays out dividends and zero otherwise. *Prior Quarter Market-adj Return* is the market adjusted stock return during the one-quarter period before the announcement. *Prior Year Market-adj Return* is the market adjusted stock return during the one-year period before the announcement.

Variable	N	Mean	Median	Std. Err.
OMSR Program Size	2988	7.94%	6.19%	0.12%
Announcement Effect [0, 2]	2988	1.74%	1.39%	0.18%
Actual Completion	2988	80.11%	67.71%	67.25%
Log Total Assets	2988	7.15	7.05	0.04
Log B/M	2988	-0.87	-0.81	0.01
Cash Holdings	2988	0.18	0.10	0.00
R&D Expenses	2988	0.03	0.00	0.00
Dividend Paying Dummy	2988	0.52	1.00	0.01
Prior Quarter Market-adj. Return	2988	-6.18%	-5.49%	0.31%
Prior Year Market-adj. Return	2988	-2.58%	-7.58%	0.73%

Table 2: Summary Statistics of Institutional and Hedge Fund Trading Data around OMSR Programs.

This table presents summary statistics of the institutional trading sample from January 2003 to September 2011. Annualized number of transactions, annualized trading volume, annualized principal traded, and annualized commission expense are computed based on all U.S. domestic equity traded by sample institutions from January 2003 to September 2011. Sample mean, median, and total are presented. Trading around OMSRs is the aggregated trading by sample institutions during the two-year period surrounding OMSR announcement dates in our OMSR data. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	All Institutions	Investment Managers	Plan Sponsors	Hedge Funds
Number of Institutions	868	372	496	162
Annualized Number of Transactions (thousands)				
Mean	75.42	134.64	31.01	26.87
Median	7.59	26.73	4.77	1.10
Total	65,464.75	50,085.37	15,379.38	4,353.14
Annualized Trading Volume (millions)				
Mean	350.69	600.57	163.29	170.18
Median	37.75	133.74	12.96	10.80
Total	304,402.64	223,412.34	80,990.29	27,569.45
Annualized Principal Traded ($ millions)				
Mean	10,318.32	17,910.06	4,624.51	5,085.31
Median	1,060.36	3,614.01	374.07	272.43
Total	8,956,297.68	6,662,542.45	2,293,755.23	823,819.42
Annualized Commission Expense ($ millions)				
Mean	8.65	15.55	3.47	4.86
Median	0.87	3.67	0.40	0.24
Total	7,506.46	5,786.06	1,720.40	788.02
Trading around OMRs ([-4Q, 4Q])				
Number of Institutions trading around OMRs	849	360	489	157
Number of Transactions per OMR (thousands)	24.51	21.49	3.02	4.95
Trading Volume per OMR (millions)	100.02	86.01	14.61	25.06
Principal Traded per OMR ($ millions)	3,501.76	3,000.47	522.43	909.38
Commission Expense per OMR ($ millions)	2.58	2.26	0.33	0.72

Table 3: The Predictive Power of Pre-Announcement Institutional Trading for OMSR Program Announcement Returns.

This table presents OLS regression analysis of the predictive power of trading by all institutions (and a subsample of hedge funds) for the OMSR program announcement returns between 2004 and 2010. Panel A (B) presents the results using trading by all institutions (hedge funds). The dependent variable is OMSR program announcement returns, measured as the three-day ([0,2]) abnormal return, where date 0 is the announcement date. Abnormal returns are calculated based on a market model, where the market beta is estimated using daily returns over 6-month period ending one trading day before the announcement. In Panel A, *Net Buy* is the aggregate net buying, scaled by number of shares outstanding of the firm, by our institutions sample during the one-year periods before the OMSR program announcement; in Panel B, *Net Buy* is the aggregate net buying, scaled by number of shares outstanding of the firm, by our hedge funds sample during the one-year periods before the OMSR program announcement. *OMSR Program Size* is the value of the OMR program (in dollar amount), normalized by the market capitalization of the firm as of the most recent month-end before the announcement date; *Log Total Assets* is the natural logarithm of total assets of firm at the most recent fiscal year end before the announcement; *Log B/M* is the natural logarithm of Book-to-Market ratio of firm at the most recent fiscal year end before the announcement; *Industry Adj. ROA* is firm's EBIT/Total Asset minus two-digit SIC industry's median EBIT/Total Asset, at the most recent fiscal year end before the announcement; *Cash Holdings* is firm's cash holdings normalized by total assets, at the most recent fiscal year end before the announcement; *Past Stock Return* is the market adjusted stock return during the one-year period before the announcement; *Leverage* is firm's total liabilities normalized by total assets, at the most recent fiscal year end before the announcement; *Dividend Paying Dummy* is a dummy variable which equals one if firm pays out dividends during the most recent fiscal year before the announcement, and equals zero otherwise; *Insider Net Buy* is the aggregate net buy from top level insiders of firm during the one-year period before the announcement; *Insider Holding* is the aggregate stock holding of top level insiders of firm at the beginning of the one-year period before the announcement. Industry (two-digit SIC code) and year fixed effects are included. t-statistics are in parentheses. ***, **, and * represent statistical significance at the 1, 5, and 10 percent levels.

Panel A: Trading by all institutional investors

	Dep. Var.: OMSR Announcement Returns		
	(1)	(2)	(3)
Net Buy	-0.0005**	-0.0005**	-0.0005**
	(-2.06)	(-2.03)	(-2.03)
OMSR Program Size	0.0005***	0.0005***	0.0005***
	(3.41)	(3.42)	(3.42)
Log Total Asset	-0.0021***	-0.0021***	-0.0020***
	(-3.68)	(-3.70)	(-3.53)
Log B/M	0.0025	0.0024	0.0024
	(1.33)	(1.29)	(1.28)
Industry Adj. ROA	-0.0114	-0.0106	-0.0107

	(-0.87)	(-0.81)	(-0.81)
Cash	0.0004	0.0006	0.0006
	(0.06)	(0.09)	(0.08)
Past Stock Return	0.0068**	0.0068**	0.0068**
	(2.05)	(2.04)	(2.04)
Leverage	0.0069	0.0068	0.0068
	(1.07)	(1.05)	(1.05)
Dividend Dummy	0.0003	0.0003	0.0002
	(0.17)	(0.13)	(0.11)
Insider Net Buy		0.0006	0.0006
		(0.74)	(0.74)
Insider Holding			0.0000
			(0.17)
Industry Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Observations	2,853	2,853	2,853
R-squared	0.05	0.05	0.05

Panel B: Trading by hedge funds

	Dep. Var.: OMSR Announcement Returns		
	(1)	(2)	(3)
Net Buy	-0.0013**	-0.0013**	-0.0013**
	(-2.53)	(-2.51)	(-2.51)
OMSR Program Size	0.0005***	0.0005***	0.0005***
	(3.44)	(3.45)	(3.46)
Log Total Asset	-0.0020***	-0.0021***	-0.0020***
	(-3.65)	(-3.67)	(-3.50)
Log B/M	0.0025	0.0025	0.0024
	(1.33)	(1.29)	(1.28)
Industry Adj. ROA	-0.0119	-0.0112	-0.0112
	(-0.91)	(-0.85)	(-0.85)
Cash	0.0005	0.0008	0.0007
	(0.07)	(0.11)	(0.09)

Past Stock Return	0.0070**	0.0070**	0.0070**
	(2.10)	(2.09)	(2.09)
Leverage	0.0068	0.0067	0.0066
	(1.05)	(1.03)	(1.02)
Dividend Dummy	0.0005	0.0004	0.0004
	(0.25)	(0.21)	(0.19)
Insider Net Buy		0.0006	0.0006
		(0.76)	(0.77)
Insider Holding			0.0000
			(0.19)
Industry Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Observations	2,853	2,853	2,853
R-squared	0.05	0.05	0.05

Table 4: The Predictive Power of Institutional Trading after OMSR Program Announcements for Subsequent Long-run Stock Returns.

This table presents OLS regression analysis of the predictive power of institutional trading after an OMSR program announcement for the subsequent one-year stock return performance of a firm. *Net Buy* is the aggregate net buying from all institutions (hedge funds) during the first month after the OMSR program announcement in panel A (B). The dependent variable is cumulative stock return measured in percentage points over the one-year period subsequent to the measurement period of *Net Buy*, adjusted by the return of matched Fama-French 5×5 size and book-to-market portfolio return. *OMSR Program Size* is the value of the OMSR program (in dollar amount), normalized by the market capitalization of the firm as of the most recent month-end before the announcement date; *Past Stock Return* is the market adjusted stock return during the one-year period before the announcement; *Log Total Assets* is the natural logarithm of total assets of firm at the most recent fiscal year end before the announcement; *Industry Adj. ROA* is firm's EBIT/Total Asset minus 2-digit SIC industry's median EBIT/Total Asset, at the most recent fiscal year end before the announcement; *Cash* is firm's cash holdings normalized by total assets, at the most recent fiscal year end before the announcement; *Cash Flow* is firm's cash flow normalized by total assets; *S&P 500 Dummy* is an indicator variable that equals one for firms in the S&P 500 Index and zero otherwise; *Log B/M* is the natural logarithm of Book-to-Market ratio of firm at the most recent fiscal year end before the announcement; *Insider Net Buy* is the aggregate net buy from top level insiders of firm during the one-year period before the announcement; *Insider Holding* is the aggregate stock holding of top level insiders of firm at the beginning of the one-year period before the announcement. Industry (two-digit SIC code) and year fixed effects are included. t-statistics are in parentheses. ***, **, and * represent statistical significance at the 1, 5, and 10 percent levels.

Panel A: Trading by all institutional investors

	Dependent Variable: Size and book-to-Market adjusted buy-and-Hold return over 12 months after the measurement period of *Net Buy*				
	(1)	(2)	(3)	(4)	(5)
Net Buy	-0.0000	-0.0000	0.0000	0.0000	0.0000
	(-0.31)	(-0.08)	(0.03)	(0.03)	(0.03)
OMSR Program Size	-0.0026***	-0.0023**	-0.0025***	-0.0025***	-0.0025***
	(-2.97)	(-2.54)	(-2.67)	(-2.67)	(-2.67)
Past Stock Return	0.5143***	0.5711***	0.5680***	0.5680***	0.5680***
	(12.22)	(10.39)	(10.35)	(10.33)	(10.33)
Log Total Asset	-0.0069	-0.0047	-0.0048	-0.0048	-0.0047
	(-1.43)	(-0.98)	(-0.92)	(-0.92)	(-0.90)
Industry Adj. ROA	-0.2341*	-0.2353*	-0.2484*	-0.2485*	-0.2483*
	(-1.83)	(-1.91)	(-1.88)	(-1.88)	(-1.88)
Cash	0.0760**	0.0614*	0.0578	0.0578	0.0576
	(2.06)	(1.69)	(1.37)	(1.37)	(1.36)
Cash Flow	0.3502***	0.3363***	0.3122***	0.3123***	0.3123***
	(2.86)	(2.89)	(2.67)	(2.67)	(2.67)

	(1)	(2)	(3)	(4)	(5)
S&P 500 Dummy	0.0385**	0.0366**	0.0369*	0.0369*	0.0368*
	(2.10)	(2.01)	(1.92)	(1.91)	(1.91)
Log B/M	-0.0082	-0.0204*	-0.0212*	-0.0212*	-0.0212*
	(-0.71)	(-1.80)	(-1.82)	(-1.82)	(-1.82)
Insider Net Buy				-0.0012	-0.0010
				(-0.04)	(-0.04)
Insider Holding					0.0001
					(0.12)
Industry Fixed Effects	No	No	Yes	Yes	Yes
Year Fixed Effects	No	Yes	Yes	Yes	Yes
Observations	2,789	2,789	2,789	2,789	2,789
R-squared	0.27	0.31	0.32	0.32	0.32

Panel B: Trading by hedge funds

	Dependent Variable: Size and book-to-Market adjusted buy-and-Hold return over 12 months after the measurement period of *Net Buy*				
	(1)	(2)	(3)	(4)	(5)
Net Buy	0.0005**	0.0005**	0.0005**	0.0005**	0.0005**
	(2.15)	(2.35)	(2.25)	(2.25)	(2.25)
OMSR Program Size	-0.0026***	-0.0022**	-0.0024***	-0.0024***	-0.0024***
	(-2.91)	(-2.48)	(-2.63)	(-2.63)	(-2.63)
Past Stock Return	0.5146***	0.5715***	0.5681***	0.5681***	0.5681***
	(12.26)	(10.43)	(10.39)	(10.37)	(10.37)
Log Total Asset	-0.0068	-0.0047	-0.0046	-0.0046	-0.0045
	(-1.42)	(-0.97)	(-0.89)	(-0.89)	(-0.86)
Industry Adj. ROA	-0.2354*	-0.2367*	-0.2520*	-0.2521*	-0.2519*
	(-1.84)	(-1.93)	(-1.91)	(-1.91)	(-1.90)
Cash	0.0745**	0.0595	0.0569	0.0568	0.0567
	(2.02)	(1.63)	(1.35)	(1.35)	(1.34)
Cash Flow	0.3500***	0.3353***	0.3118***	0.3118***	0.3119***
	(2.86)	(2.88)	(2.66)	(2.66)	(2.66)
S&P 500 Dummy	0.0379**	0.0359**	0.0357*	0.0358*	0.0356*
	(2.07)	(1.98)	(1.86)	(1.85)	(1.85)
Log B/M	-0.0087	-0.0211*	-0.0218*	-0.0218*	-0.0218*

	(-0.75)	(-1.86)	(-1.87)	(-1.87)	(-1.87)
Insider Net Buy				-0.0012 (-0.04)	-0.0010 (-0.04)
Insider Holding					0.0001 (0.12)
Industry Fixed Effects	No	No	Yes	Yes	Yes
Year Fixed Effects	No	Yes	Yes	Yes	Yes
Observations	2,789	2,789	2,789	2,789	2,789
R-squared	0.27	0.31	0.32	0.32	0.32

Table 5: Profitability of Institutional Trading after OMSR Program Announcements.

This table reports univariate results of the profitability of institutional trading around open-market share repurchase programs (OMSRs). We consider the trading horizon starting from the first fiscal quarter after the OMSR announcement and ending at the fourth fiscal quarter after the OMSR announcement. Panel A (B) reports the profitability of trading by all institutions (hedge funds). Panel A1 (B1) reports the result where we split the sample by the cumulative actual repurchase by the firm during the first two fiscal quarters after the OMSR announcement. Panel A2 (B2) reports the result where split the sample by the OMSR program size, defined as the dollar amount value of the OMSR program, normalized by the market capitalization of the firm as of the most recent month-end before the announcement date. *Raw Profit* is the total raw profit earned by institutions using actual transaction prices net of commissions, with the net position marked to market at the end of the trading horizon. *Buy Principal* is the sum of the actual dollar amount of all the buy transactions including commissions spent by sample institutions during the trading horizon. *Maximum Investment* is the maximum dollar amount committed to trading the sample firms shares during the trading horizon by the institutions. *Raw Return on Buy Principal* is defined as the ratio of *Raw Profit* to *Buy Principal*. *Raw Return on Maximum Investment* is defined as the ratio of *Raw Profit* to *Maximum Investment*. We also discount profit and investment amount back to the first day of the trading horizon using the buy-and-hold value-weighted return from the Fama and French 25 portfolios matched on size and book-to-market. For example, *Risk-adjusted Profit* is computed by discounting the raw profit back to the first day of the trading horizon using the benchmark return from the matched Fama-French 25 portfolios; and *Risk-adjusted Return on Buy Principal* equals *Risk-adjusted Profit* divided by *Risk-adjusted Buy Principal*. T-tests are performed on the profits and the returns, respectively. T-tests are also performed on the difference in the profits, the difference in the investment amount, and the difference in the returns. Statistical significance is indicated by *** for 1% level, ** for 5% level, and * for 10% level.

Panel A: Trading by all institutional investors

	Institutional trading over $[FQ1, FQ4]$					
	Panel A1: Split by OMSR Program Size			Panel A2: Split by Actual Repurchase		
	Below Median	Above Median	Diff (B-A)	Below Median	Above Median	Diff (B-A)
Number of Observations (Events)	1392	1392		1392	1392	
Raw Profit ($ thousands)	4488.44	-3085.63	7574.08	3590.33	-2187.52	5777.86
Risk-adjusted Raw Profit ($ thousands)	4479.27	-2838.73	7317.99	4901.88	-3261.33	8163.21*
Buy Principal ($ millions)	837.72	865.93	-28.21	674.67	1028.45	-353.78***
Risk-adjusted Buy Principal ($ millions)	840.05	880.86	-40.80	691.9	1028.56	-336.65***
Maximum Investment ($ millions)	582.48	601.87	-19.39	468.23	716.12	-247.89***
Risk-adjusted Maximum Investment ($ millions)	580.83	607.12	-26.29	474.75	713.21	-238.46***

Raw Return on Buy Principal (%)	0.54**	-0.36	0.90**	0.54*	-0.21	0.75**
Risk-adjusted Return on Buy Principal (%)	0.54**	-0.32*	0.86***	0.72***	-0.32*	1.03***
Raw Return on Maximum Investment (%)	0.77***	-0.51*	1.28***	0.77**	-0.31	1.07***
Risk-adjusted Return on Maximum Investment (%)	0.77***	-0.47*	1.24***	1.03***	-0.46**	1.49***

Panel B: Trading by hedge funds

	Hedge fund trading over $[FQ1, FQ4]$					
	Panel B1: Split by OMSR Program Size			Panel B2: Split by Actual Repurchase		
Number of Observations(Events)	1392	1392		1392	1392	
Raw Profit ($ thousands)	2626.12	595.81	2030.32	2154.55*	1068.61	1085.94
Risk-adjusted Raw Profit ($ thousands)	3588.88***	184.54	3404.33**	2738.66***	1036.68	1701.98
Buy Principal ($millions)	468.87	29.37	439.5***	193.67	304.26	-110.59***
Risk-adjusted Buy Principal ($millions)	472.63	28.96	443.66***	200.29	301	-100.71***
Maximum Investment ($millions)	306.01	23.61	282.41***	126.28	203.14	-76.87***
Risk-adjusted Maximum Investment ($millions)	307.89	23.23	284.66***	129.91	201.01	-71.11***
Raw Return on Buy Principal (%)	0.55*	1.90**	-1.35	1.10**	0.33	0.77
Risk-adjusted Return on Buy Principal (%)	0.75***	0.6	0.15	1.37***	0.33	1.04**
Raw Return on Maximum Investment (%)	0.90*	1.77*	-0.88	1.68***	0.51	1.17
Risk-adjusted Return on Maximum Investment (%)	1.17***	0.54	0.63	2.11***	0.49	1.63***

Table 6: The Relation between Institutional Trading after OMSR Program Announcements and Actual Share Repurchases.

This table presents OLS regression analysis of the relationship between institutional trading after an OMSR announcement and the subsequent actual share repurchases by the firm. *Actual Share Repurchase*, the dependent variable, is the actual shares repurchased by the firm (normalized by the number of shares outstanding) during the second and third fiscal quarter after the OMSR program announcement (two fiscal quarters after the measurement period of *Net Buy*). In Models (1)-(5), *Net Buy* is aggregated net buying by all institutions (hedge funds) during the first month after the OMSR announcement in panel A (B); In Models (6)-(10), *Net Buy* is aggregated net buying by all institutions (hedge funds) during the first quarter after the OMSR announcement in panel A (B). *Log Total Assets* is the natural logarithm of total assets of firm at the most recent fiscal year end before the announcement; *Log B/M* is the natural logarithm of Book-to-Market ratio of firm at the most recent fiscal year end before the announcement; *Past Stock Return* is the market adjusted stock return during the one-year period before the announcement; *Cash* is firm's cash holdings normalized by total assets, at the most recent fiscal year end before the announcement; *CapEx* is firm's capital expenditure normalized by total assets; *R&D* is firm's R&D expenditure normalized by total assets; *Dividend Paying Dummy* is a dummy variable which equals one if firm pays out dividends during the most recent fiscal year before the announcement, and equals zero otherwise; *OMSR Program Size* is the value of the OMSR program (in dollar amount), normalized by the market capitalization of the firm as of the most recent month-end before the announcement date; *Actual Share Repurchase FQ1* is the actual share repurchased by the firm (normalized by the number of shares outstanding) during the first fiscal quarter after the OMSR program announcement; *Insider Net Buy* is the aggregate net buying from top level insiders of firm during the one-year period before the announcement; *Insider Holding* is the aggregate stock holding of top level insiders of firm at the beginning of the one-year period before the announcement. Industry (two-digit SIC code) and year fixed effects are included. t-statistics are in parentheses. ***, **, and * represent statistical significance at the 1, 5, and 10 percent levels.

Panel A: Trading by all institutional investors

	Net Buy (one month after OMSR program announcement)					Net Buy (one quarter after OMSR program announcement)				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Net Buy	0.0126	0.0074	0.0219	0.0162	0.0164	0.0309**	0.0290**	0.0369***	0.0346**	0.0346**
	(0.32)	(0.19)	(0.56)	(0.41)	(0.42)	(2.25)	(2.12)	(2.67)	(2.51)	(2.51)
Log Total Asset	0.1683***	0.1548***	0.1782***	0.1654***	0.1576***	0.1699***	0.1565***	0.1793***	0.1667***	0.1589***
	(4.98)	(4.57)	(5.00)	(4.64)	(4.29)	(5.03)	(4.62)	(5.04)	(4.68)	(4.33)
Log B/M	-0.2751***	-0.2020**	-0.2003**	-0.1148	-0.1150	-0.2715***	-0.1997**	-0.1958**	-0.1119	-0.1121
	(-3.48)	(-2.49)	(-2.41)	(-1.34)	(-1.34)	(-3.44)	(-2.47)	(-2.35)	(-1.31)	(-1.31)
Past Stock Return	-0.2189	-0.3660**	-0.2566	-0.4176**	-0.4168**	-0.2344	-0.3819**	-0.2785*	-0.4391**	-0.4384**
	(-1.31)	(-2.09)	(-1.55)	(-2.40)	(-2.39)	(-1.41)	(-2.18)	(-1.68)	(-2.52)	(-2.52)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Cash	0.3490	0.4052	0.0700	0.1147	0.1333	0.3624	0.4179	0.0782	0.1230	0.1416
	(0.90)	(1.04)	(0.17)	(0.28)	(0.32)	(0.93)	(1.08)	(0.19)	(0.30)	(0.34)
CapEx	-1.4664	-1.1464	-2.8027*	-2.3719	-2.3167	-1.5085	-1.1915	-2.8765*	-2.4452*	-2.3894
	(-1.26)	(-0.98)	(-1.89)	(-1.60)	(-1.57)	(-1.29)	(-1.02)	(-1.95)	(-1.66)	(-1.62)
R&D	-3.4815***	-3.0161**	-2.3372	-1.9301	-1.9621	-3.4672***	-3.0134**	-2.3180	-1.9259	-1.9581
	(-2.67)	(-2.31)	(-1.59)	(-1.31)	(-1.33)	(-2.66)	(-2.31)	(-1.58)	(-1.31)	(-1.33)
Dividend Paying Dummy	-0.5925***	-0.5934***	-0.3667***	-0.3566**	-0.3492**	-0.5896***	-0.5901***	-0.3604**	-0.3506**	-0.3431**
	(-4.45)	(-4.45)	(-2.62)	(-2.55)	(-2.49)	(-4.43)	(-4.43)	(-2.57)	(-2.51)	(-2.45)
OMSR Program Size	0.0782***	0.0771***	0.0694***	0.0679***	0.0678***	0.0781***	0.0770***	0.0692***	0.0677***	0.0675***
	(8.56)	(8.45)	(7.50)	(7.35)	(7.33)	(8.56)	(8.44)	(7.49)	(7.33)	(7.31)
Actual Repurchase FQ1	0.1896***	0.1861***	0.1675***	0.1633***	0.1627***	0.1940***	0.1906***	0.1719***	0.1678***	0.1672***
	(6.94)	(6.77)	(6.14)	(5.95)	(5.92)	(7.09)	(6.92)	(6.30)	(6.10)	(6.08)
Insider Net Buy				0.1309	0.1167				0.1121	0.0978
				(0.37)	(0.33)				(0.31)	(0.27)
Insider Holding					-0.0071					-0.0072
					(-0.87)					(-0.88)
Industry Fixed Effects	No	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Year Fixed Effects	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Observations	2,857	2,857	2,857	2,857	2,857	2,857	2,857	2,857	2,857	2,857
R-squared	0.07	0.08	0.12	0.13	0.13	0.07	0.08	0.12	0.13	0.13

Panel B: Trading by hedge funds

	Net Buy (one month after OMSR program announcement)					*Net Buy* (one quarter after OMSR program announcement)				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Net Buy	0.0034**	0.0033**	0.0034**	0.0033**	0.0033**	0.0003	0.0003	0.0002	0.0002	0.0002
	(2.20)	(2.16)	(2.20)	(2.15)	(2.15)	(0.43)	(0.43)	(0.31)	(0.32)	(0.32)
Log Total Asset	0.1686***	0.1552***	0.1790***	0.1662***	0.1585***	0.1683***	0.1549***	0.1780***	0.1653***	0.1575***

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	(4.99)	(4.58)	(5.03)	(4.66)	(4.32)	(4.98)	(4.57)	(5.00)	(4.64)	(4.29)
Log B/M	-0.2727***	-0.1998**	-0.1981**	-0.1129	-0.1131	-0.2752***	-0.2019**	-0.2011**	-0.1152	-0.1154
	(-3.45)	(-2.47)	(-2.38)	(-1.32)	(-1.32)	(-3.48)	(-2.49)	(-2.42)	(-1.34)	(-1.35)
Past Stock Return	-0.2152	-0.3607**	-0.2529	-0.4127**	-0.4120**	-0.2195	-0.3671**	-0.2572	-0.4191**	-0.4183**
	(-1.29)	(-2.06)	(-1.53)	(-2.37)	(-2.37)	(-1.32)	(-2.09)	(-1.55)	(-2.41)	(-2.40)
Cash	0.3383	0.3956	0.0589	0.1054	0.1237	0.3452	0.4034	0.0608	0.1082	0.1266
	(0.87)	(1.02)	(0.14)	(0.26)	(0.30)	(0.89)	(1.04)	(0.15)	(0.26)	(0.31)
CapEx	-1.5220	-1.2061	-2.8915*	-2.4676*	-2.4125	-1.4708	-1.1536	-2.7852*	-2.3606	-2.3053
	(-1.31)	(-1.04)	(-1.96)	(-1.67)	(-1.63)	(-1.26)	(-0.99)	(-1.88)	(-1.60)	(-1.56)
R&D	-3.4193***	-2.9613**	-2.2835	-1.8819	-1.9135	-3.4683***	-3.0082**	-2.3265	-1.9235	-1.9553
	(-2.62)	(-2.27)	(-1.55)	(-1.28)	(-1.30)	(-2.66)	(-2.30)	(-1.58)	(-1.31)	(-1.33)
Dividend Paying Dummy	-0.5922***	-0.5927***	-0.3646***	-0.3540**	-0.3466**	-0.5929***	-0.5937***	-0.3678***	-0.3574**	-0.3500**
	(-4.45)	(-4.45)	(-2.60)	(-2.53)	(-2.48)	(-4.45)	(-4.46)	(-2.62)	(-2.56)	(-2.50)
OMSR Program Size	0.0787***	0.0776***	0.0698***	0.0683***	0.0682***	0.0782***	0.0771***	0.0693***	0.0679***	0.0678***
	(8.62)	(8.51)	(7.55)	(7.40)	(7.38)	(8.56)	(8.45)	(7.50)	(7.35)	(7.33)
Actual Repurchase FQ1	0.1901***	0.1867***	0.1681***	0.1640***	0.1634***	0.1897***	0.1864***	0.1673***	0.1633***	0.1627***
	(6.97)	(6.80)	(6.18)	(5.98)	(5.95)	(6.95)	(6.78)	(6.14)	(5.94)	(5.92)
Insider Net Buy					0.1399	0.1258				0.1342	0.1201
					(0.39)	(0.35)				(0.38)	(0.34)
Insider Holding						-0.0070					-0.0071
						(-0.86)					(-0.87)
Industry Fixed Effects	No	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Year Fixed Effects	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Observations	2,857	2,857	2,857	2,857	2,857	2,857	2,857	2,857	2,857	2,857
R-squared	0.07	0.08	0.12	0.13	0.13	0.07	0.08	0.12	0.13	0.13

Table 7: The Relation between Institutional Trading after OMSR Program Announcements and Changes in Equity Market Information Asymmetry.

This table presents OLS regression analysis of the effect institutional trading after an OMSR announcement has on the change in the firms information asymmetry from before the OMSR announcement to after. The dependent variable is the difference in the measures of firm's information asymmetry from before the OMSR announcement to after. In Panel A, B, and C, we use three measures of information asymmetry based on I/B/E/S analyst earnings forecasts. For each firm announcing an OMSR program, we retrieve analyst earnings forecasts for the fiscal year end before the OMSR program announcement date (at least one year before the announcement date), and after the OMSR program announcement date (at least one year after the announcement date). In Panel A, the information asymmetry measure is the mean-squared error of analysts forecasts (*MSE*). We measure forecast error as the absolute difference between the average forecasted earnings and the actual earnings per share divided by the price per share at the time of the forecast. In Panel B, the information asymmetry measure is the standard deviation of analyst forecasts (*Dispersion*). In Panel C, the information asymmetry measure is the coefficient of variation of analyst forecasts (*COV*), which is defined as the ratio of standard deviation to the absolute value of the average of analyst forecasts. In Panel D, we use bid-ask spread (*BidAskSpread*) as a measure of information asymmetry. We first calculate the daily bid-ask spread as the average of all quoted spread (the difference between the log ask price and log bid price) during normal trading hours on the day based on NYSE TAQ data, and we average the daily bid-ask spread over the one-year horizon before the OMSR program announcement, as well as the one-year horizon following the second quarter after the OMSR program announcement. *Log (Market Cap)* is the natural logarithm of market capitalization of the firm at the end of OMSR program announcement; *Book-to-Market Ratio* is the book-to-market ratio based on the accounting information at the end of the most recent fiscal year before the OMSR announcement; *Actual Repurchase* is the actual repurchased shares by the firm, as a percentage of total shares outstanding at OMSR program announcement, during the first two fiscal quarters after the OMSR announcement; *Past Stock Return* is the market adjusted stock return during the one-year period before the announcement; *Insider Net Buy* is the aggregate Net Buy from top level insiders of firm during the two fiscal quarters after the OMSR announcement; *Insider Holding* is the aggregate stock holding of top level insiders of firm at the end of the most recent fiscal year before the OMSR announcement. Industry (two-digit SIC code) and year fixed effects are included. t-statistics are in parentheses. ***, **, and * represent statistical significance at the 1, 5, and 10 percent levels.

Panel A: Using change in analyst forecast error as dependent variable

| | Dependent Variable: $\Delta \log(MSE)$ | | | |
	(1)	(2)	(3)	(4)
Net Buy	-0.0571***	-0.0576***	-0.0517**	-0.0583***
	(-2.93)	(-3.07)	(-2.33)	(-2.69)
Log(Market Cap)	-0.0475	-0.0570	-0.0906*	-0.0801
	(-1.10)	(-1.30)	(-1.84)	(-1.58)
Book-to-Market Ratio	-0.0995	-0.1108	-0.1337	-0.2208
	(-0.51)	(-0.55)	(-0.59)	(-0.93)
Past Stock Return	-1.8606***	-1.5167***	-1.7081***	-1.3861***
	(-10.00)	(-7.80)	(-8.46)	(-6.56)

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	(1)	(2)	(3)	(4)
Actual Repurchase			0.0042	-0.0039
			(0.16)	(-0.15)
Insider Net Buy			0.6697***	0.1672
			(3.25)	(0.82)
Insider Holding			0.0288**	0.0278**
			(2.13)	(2.09)
Industry Fixed Effects	No	Yes	No	Yes
Year Fixed Effects	No	Yes	No	Yes
R^2	0.061	0.208	0.075	0.218
Observations	1821	1821	1394	1394

Panel B: Using change in analyst forecast dispersion as dependent variable

	Dependent Variable: $\Delta \log(Dispersion)$			
	(1)	(2)	(3)	(4)
Net Buy	-0.0106	-0.0158*	-0.0146	-0.0194**
	(-1.25)	(-1.85)	(-1.53)	(-1.99)
Log(Market Cap)	0.0036	-0.0065	0.0064	0.0044
	(0.19)	(-0.32)	(0.30)	(0.19)
Book-to-Market Ratio	-0.1344	-0.1878**	-0.2109**	-0.2731**
	(-1.57)	(-2.04)	(-2.14)	(-2.57)
Past Stock Return	-0.1818**	-0.1642*	-0.2076**	-0.1769*
	(-2.24)	(-1.86)	(-2.38)	(-1.87)
Actual Repurchase			0.0139	0.0121
			(1.21)	(1.03)
Insider Net Buy			-0.0090	-0.1396
			(-0.10)	(-1.52)
Insider Holding			0.0134**	0.0160***
			(2.21)	(2.58)
Industry Fixed Effects	No	Yes	No	Yes
Year Fixed Effects	No	Yes	No	Yes
R^2	0.005	0.091	0.014	0.100
Observations	1807	1807	1384	1384

Panel C: Using change in coefficient of variation of analyst forecasts as dependent variable

| | Dependent Variable: $\Delta \log(COV)$ | | | |
	(1)	(2)	(3)	(4)
Net Buy	-0.0231**	-0.0268**	-0.0246**	-0.0281**
	(-2.18)	(-2.57)	(-2.06)	(-2.37)
Log(Market Cap)	-0.0245	-0.0283	-0.0249	-0.0155
	(-1.04)	(-1.15)	(-0.93)	(-0.56)
Book-to-Market Ratio	-0.0473	-0.0721	-0.1125	-0.1623
	(-0.44)	(-0.64)	(-0.92)	(-1.25)
Past Stock Return	-0.9062***	-0.7998***	-0.8458***	-0.7387***
	(-8.95)	(-7.39)	(-7.79)	(-6.40)
Actual Repurchase			0.0114	0.0130
			(0.79)	(0.91)
Insider Net Buy			0.2233**	-0.0237
			(2.00)	(-0.21)
Insider Holding			0.0196**	0.0216***
			(2.49)	(2.76)
Industry Fixed Effects	No	Yes	No	Yes
Year Fixed Effects	No	Yes	No	Yes
R^2	0.049	0.160	0.061	0.180
Observations	1805	1805	1383	1383

Panel D: Using change in average bid-ask spread (%) as dependent variable

| | Dependent Variable: $\Delta BidAskSpread$ | | | |
	(1)	(2)	(3)	(4)
Net Buy	-0.0057***	-0.0037*	-0.0043**	-0.0036*
	(-2.76)	(-1.95)	(-2.11)	(-1.84)
Log(Market Cap)	-0.0594***	-0.0516***	-0.0472***	-0.0410***
	(-15.68)	(-13.65)	(-11.91)	(-10.13)
Book-to-Market Ratio	-0.0260	-0.0022	-0.0071	0.0020
	(-1.60)	(-0.14)	(-0.41)	(0.11)
Past Stock Return	-0.1248***	-0.0705***	-0.1350***	-0.0856***
	(-8.47)	(-4.87)	(-8.27)	(-5.17)

Actual Repurchase			0.0014	0.0018
			(0.59)	(0.80)
Insider Net Buy			0.0827***	0.0566***
			(6.56)	(4.61)
Insider Holding			0.0001	0.0011
			(0.07)	(1.04)
Industry Fixed Effects	No	Yes	No	Yes
Year Fixed Effects	No	Yes	No	Yes
R^2	0.125	0.297	0.147	0.291
Observations	2621	2621	1820	1820