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The Sound of Silence: What Do We Know When Insiders Do Not Trade?

George P. Gao Ph.D.
Cornell University

Qingzhong Ma Ph.D.
Cornell University, qm26@cornell.edu

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The Sound of Silence: What Do We Know When Insiders Do Not Trade?

Abstract

We examine the phenomenon of insider silence, periods when corporate insiders do not trade. Our evidence strongly supports the jeopardy hypothesis that regulations inhibit insiders from trading on extreme information, implying a relation between insider silence and extreme future returns. First, insiders of merger targets refrain from buying in the months before the merger announcement, and insiders of bankruptcy firms refrain from selling before the bankruptcy filing. Second, among firms that are likely to have bad news, insider silence predicts significant negative future returns, which are even lower than when insiders net sell. Further, the negative information in insider silence is gradually incorporated into stock prices, and a significant portion of it is released around quarterly earnings announcements. Finally, the price inefficiency due to insider silence is pervasive, and market frictions make it worse.

Keywords

Cornell, insider trading, insider silence, short interest, price efficiency, limits to arbitrage, regulation

Disciplines

Finance and Financial Management | Real Estate

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**The Sound of Silence:
What Do We Know When Insiders Do Not Trade?***

George P. Gao and Qingzhong Ma
Cornell University

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* Gao: 314 Sage Hall, Samuel Curtis Johnson Graduate School of Management, Cornell University, Ithaca, New York, 14853. Email: pg297@cornell.edu, phone: (607) 255-8729. Ma (corresponding author): 435 B Statler Hall, School of Hotel Administration, Cornell University, Ithaca, New York, 14853. Email: qm26@cornell.edu, phone: (607) 255-8140. We are grateful to Warren Bailey, Sanjeev Bhojraj, Walter Boudry, Zhi Da, Vyacheslav Fos (NFA discussant), Pengjie Gao, Andrew Karolyi, Hyunseob Kim, Bob Libby, Edith Liu, Peng Liu, Ken Merkley, Roni Michaely, Pam Moulton, David Ng, Gideon Saar, Rick Sias, Andrey Ukhov, Eric Yeung, Wei Zhang, and seminar participants at Cornell University (Johnson accounting), Cornell finance brownbag, and the 2012 Northern Finance Association conference for helpful suggestions, Yaxuan Qi for providing the bankruptcy sample, Irene Kim for help with constructing the litigation risk data, and Bobbie Goettler for editing assistance. All errors are our own.

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Abstract

We examine the phenomenon of insider silence, periods when corporate insiders do not trade. Our evidence strongly supports the jeopardy hypothesis that regulations inhibit insiders from trading on extreme information, implying a relation between insider silence and extreme future returns. First, insiders of merger targets refrain from buying in the months before the merger announcement, and insiders of bankruptcy firms refrain from selling before the bankruptcy filing. Second, among firms that are likely to have bad news, insider silence predicts significant negative future returns, which are even lower than when insiders net sell. Further, the negative information in insider silence is gradually incorporated into stock prices, and a significant portion of it is released around quarterly earnings announcements. Finally, the price inefficiency due to insider silence is pervasive, and market frictions make it worse.

Keywords: Insider trading; Insider silence; Short interest; Price efficiency; Limits to arbitrage; Regulation

JEL classifications: G12, G14, G18

1. Introduction

Previous work demonstrates that corporate insider trading appears to be informative—the stocks insiders buy tend to subsequently outperform those insiders sell.¹ Corporate insiders such as officers and directors, however, do not trade frequently. For example, in 33% of the U.S. firms insiders do not trade over a half-year horizon (see Panel A of Figure 1 in detail). There are at least two possible reasons for this phenomenon of insider silence (no trading). Obviously, insiders do not trade when they have no information to trade on (see Grossman and Stiglitz, 1980; Kyle, 1985). Somehow counterintuitive, however, insiders may choose not to trade when they have extreme information. This is because insider trading is regulated and in general trading on material, nonpublic information is illegal.² Therefore, insiders avoid trading when the information asymmetry is large. In the former case, insider silence means no information. In the latter case, however, insider silence can be associated with extreme information.³

In this paper, we propose and test a jeopardy hypothesis, which posits that due to regulations, insiders refrain from trading their own company stocks while possessing extreme information, implying a relation between insider silence and extreme future stock returns, either positive or negative. The hypothesis can also be viewed as a direct implication of DeMarzo, Fishman, and Hagerty (1998), who theorize that the optimal enforcement of insider trading regulations follows large trading volumes or large price movements or both. Insiders caught trading large volumes are assessed the maximum penalty while small trades are not penalized. Under such an enforcement policy, insiders do not trade on extreme information.

Since the jeopardy hypothesis relates insider silence to both extremely positive and extremely negative future returns, testing the hypothesis on a pooled sample is ineffective. This is because a combination of extremely positive returns and extremely negative returns in a pooled sample is attenuated toward zero. We adopt two approaches in our empirical design. The

¹ See, for example, Seyhun, 1986, 1998; Lakonishok and Lee, 2001; Piotroski and Roulstone, 2005; Marin and Olivier, 2008; Sias and Whidbee, 2010; Purnanandam and Seyhun, 2011; Cohen, Malloy, and Pomorski, 2012.

² For a recent example on the costs of trading on inside information, see the following news from Bloomberg. <http://www.bloomberg.com/news/2012-06-01/ex-consol-energy-executives-sued-by-sec-over-insider-trading.html>.

³ It is worth noting that this phenomenon of insider silence differs from the no-trade outcome as in Milgrom and Stokey (1982), who theorize that in a noiseless rational market under the assumption of common knowledge, investors do not trade even when they have information. This no-trade-theorem refers to a phenomenon of no trading by anyone in a noiseless rational world. In the insider silence phenomenon we examine only insiders as a group do not trade for a period of time, but the total trading volume in the market is not necessarily zero. The no-trade-theorem does not hold when the assumptions are relaxed. For example, when liquidity (or noise) traders are allowed, trade occurs (Kyle, 1985; Glosten and Milgrom, 1984; De Long, Shleifer, Summers, and Waldman, 1990).

first approach relies on ex-post corporate events that are unequivocally pertaining to extreme information. We choose two extreme events: merger offers and bankruptcy filing. Merger offers represent a clean signal of extremely positive information while bankruptcy filing is the opposite. For the sample of merger offers, the jeopardy hypothesis implies that insiders of merger targets refrain from buying their own company shares in the months leading to the public announcement of the merger deal. Further, this pattern of no buying prior to a merger offer should be more pronounced for targets in friendly deals than in hostile deals. This is because insiders of targets in friendly deals have been involved in the private negotiation process and have been aware of the upcoming deal announcement. By contrast, it is less likely that insiders of targets in hostile deals have foreknowledge of an upcoming takeover offer. For the sample of bankruptcy firms, the jeopardy hypothesis predicts that insiders refrain from selling their own company shares before the bankruptcy filing.

For a large sample of mergers announced between 1992 and 2010, we find strong evidence supporting the jeopardy hypothesis. Specifically, the proportion of targets whose insiders net buy their own company shares is around 8%-10% during the time period at least six months before the announcement month. This proportion then decreases to only about 3% in the announcement month. Further, this pattern of decreased proportion of targets whose insiders net buy exists only in the subsample of friendly deals. Likewise, for a sample of firms that filed bankruptcy during 1992-2010, we find that the proportion of bankruptcy firms whose insiders net sell starts to drop from about 10% in the 30th month to about 5% right before the filing month.

Our second approach relies on an ex-ante signal, specifically short interest, to separate firms with extremely positive information from firms with extremely negative information. The recent growing literature on short selling provides overwhelmingly convincing evidence that short investors are informed about firm-specific information, especially negative information, and that short selling flows and short interest predict future stock returns (see Section 2 for detailed discussion). Thus, firms that are heavily shorted are more likely to have negative information and firms that are lightly shorted are more likely to have positive information.

This empirical setting allows us to entertain three testable implications of the jeopardy hypothesis. First, among firms whose insiders have negative information, insider silence predicts negative future returns, which are even lower than when insiders are net sellers. Second, among firms whose insiders have positive information, insider silence predicts positive future returns,

which are even higher than when insiders are net buyers. Third, if keeping silent protects insiders from regulatory and legal action against them, insiders should have abstained from trading for a longer time period if the information is more extreme. Thus, a longer period of insider silence is associated with even more extreme returns.

Using short interest to separate firms with positive information from firms with negative information, we find strong evidence supporting the jeopardy hypothesis, particularly among firms with negative information. Specifically, we first rank stocks into quintiles based on their short interest. Among the stocks in the top quintile (firms with negative information), we establish the following four results.⁴ First, a “silence” portfolio that consists of stocks whose insiders have not traded within the past six months experiences subsequent negative abnormal returns. This return predictability persists up to 24 months. For example, the average one-year buy-and-hold abnormal return (BHAR) of the “silence” portfolio is a significant -7.3% . By contrast, a “sell” portfolio that consists of stocks whose insiders have net sold within the past six months only experiences moderate, short-lived negative returns in the future. The return difference between the “silence” and “sell” portfolios is significantly negative and its magnitude grows with the holding period.

Second, among firms in the top short interest quintile, a longer period of silence is associated with even lower abnormal returns. To illustrate, when insiders have been silent for one month (that is, insiders have not traded over the previous month but have traded prior to that), the one-year BHAR is an insignificant -0.79% . By contrast, when insiders have been silent for 12 months or longer, the one-year BHAR is a significant -9.95% .

Third, insider silence information is only gradually incorporated into stock prices. We show this point through monthly Fama-French-Carhart four-factor alphas and monthly average returns surrounding earnings announcements. The monthly four-factor alphas of an equal-weight “silence” portfolio gradually decay over a 12-month holding period. The alphas of a value-weight “silence” portfolio exhibit a similar pattern. The abnormal returns surrounding the earnings announcements in the months following portfolio formation are significantly negative for the “silence” portfolio, and are significantly lower than those of the “sell” portfolio. In

⁴ There is no evidence supporting the jeopardy hypothesis among firms in the bottom short interest quintile (firms with positive information). This is probably because the good news contained in low short interest is not extreme enough to trigger insiders’ concern about legal jeopardy. Our evidence on merger offers suggests that when the private information is sufficiently extreme insiders refrain from trading to avoid regulatory and legal action.

addition, these negative earnings announcement returns of the “silence” portfolio account for a large portion of the monthly alphas, indicating that earnings announcements are an important channel through which information in insider silence is incorporated into stock prices. Consistent with the “bad news travels slowly” story in Hong and Stein (1999), our evidence indicates that investors underreact to insider silence information and are systematically surprised when firm-specific (negative) news is released through earnings announcements.

Finally, the price inefficiency due to insider silence is pervasive, and market frictions such as limits to arbitrage and information uncertainty make it even worse. We use ten proxies for limits to arbitrage or information uncertainty to examine this issue. Using firm size as the proxy, for instance, the one-year BHARs of the “silence” portfolios for small and large firms are -9.25% and -3.64% , and the “silence” portfolios underperform their corresponding “sell” portfolios by 5.42% and 3.91% , respectively (all these numbers are highly significant).

Taken in its entirety, our evidence strongly supports the jeopardy hypothesis based on the work of DeMarzo, Fishman, and Hagerty (1998). The evidence is also consistent with the desire for firms to impose blackout period policy during the time that information asymmetry is high. Bettis, Coles, and Lemmon (2000) find that blackout period policy is quite common in the United States. Our paper also complements prior studies on strategic behavior in insider trading due to concerns about legal jeopardy (Ke, Huddart, and Petroni, 2003; Huddart, Ke, and Shi, 2007).

We consider two alternative hypotheses. One is litigation risk. Because insider trading is related to shareholder litigation (e.g., Johnson, Kasznik, and Nelson, 2000; Kim and Skinner, 2012), litigation risk can be viewed as an alternative mechanism that monitors opportunistic insider trading. Insiders of firms that are subject to high litigation risk may refrain from trading even when their information is not as extreme. Consistent with this interpretation, our analysis shows that insider silence is associated with weaker negative future returns for firms with higher litigation risk. However, these negative future returns remain significant, suggesting that litigation risk does not explain our main results. This conclusion is reconfirmed in our Fama-MacMeth (1973) cross-sectional regressions, in which many other potential confounding factors are controlled for. Among the factors we consider, we particularly control for short interest, the variable we use to separate firms with positive information from those with negative information. Consistent with the short selling literature, we find that higher short interest predicts lower future

returns. The coefficients on insider silence, however, remain significant in all regression models we estimate.

The other alternative hypothesis is that insiders' portfolio constraints, as analyzed in Marin and Olivier (2008), drive our main result. The key insight of their model is that insiders face some portfolio constraints. For example, insiders cannot short sell; insiders hold the shares to maintain control; the shares insiders hold are restricted and not available for sale. A period of heavy insider selling followed by a period of relatively low trading activity signals to the market that insiders possess bad information. When uninformed investors update their beliefs on expected payoffs and risk, a price crash occurs. Our analysis confirms that insider silence following a period of heavy selling predicts significant negative returns. After excluding these heavy-selling stocks, however, the remaining stocks still experience significant negative returns. Therefore, it is unlikely that portfolio constraints drive our result.

Our paper is closely related Marin and Olivier (2008) but differs from theirs in at least two important aspects. First, the phenomenon of "insider silence" is totally independent from the phenomenon of "the dog that did not bark" examined in their paper. Simply put in the language of "the dog that did not bark," Marin and Olivier (2008) analyze the situation in which the dog has lowered its barking for a short recent period after having barked hard for a long time, whereas our paper investigates the situation in which the dog has not barked for a long period of time. This point is clearly reflected in our empirical work. To illustrate, firm/month observations that have no insider trading in the past year will be filtered out in the baseline analysis of Marin and Olivier (2008), whereas such observations occupy the center stage in our analysis. That is, these firms, if among the top short interest quintile, experience significant negative returns in the future, which are even lower than when insiders net sell in the past. Second, the implications on price efficiency are exactly opposite. The "insider silence" phenomenon is associated with price inefficiency. That is, it takes long time for the market to fully incorporate the "insider silence" information into stock prices and a significant portion of it is released through earnings announcements. By contrast, the stock price crash in the phenomenon of "the dog that did not bark" is consistent with investor rationality and market efficiency. With these significant differences, our work complements Marin and Olivier (2008). They show the information content of insider selling, and we are, to the best of our knowledge, the first to systematically examine the frequent phenomenon of "insider silence," namely, when insiders do not trade. Our

evidence that insider silence is informative complements the extensive literature on insider trading, which focuses almost exclusively on insider buying and selling transactions. Broadly speaking, the finding that insider silence contains information also provides direct evidence supporting theoretical models on information and the lack of trading (e.g., Diamond and Verrecchia, 1987; Easley and O'Hara, 1992).

The finding that the negative information contained in insider silence is gradually incorporated into stock prices and that the information is released mainly through quarterly earnings announcements adds new empirical evidence to the growing literature on investor underreaction and return predictability (see a survey in Barberis and Thaler, 2003). Our evidence suggests that investors systematically underreact to insider silence and are surprised when firm-specific information is released in earnings announcements.

Last but not least, our study has implications for the link between insider trading regulation and price efficiency. One of the most prominent reasons for deregulating insider trading is that insider trading improves price efficiency (Manne, 1966). The evidence that supports this argument comes primarily from the informativeness of insider trading (see Meulbroek, 1992; Manne, 2005 and references therein). Little is known what happens to information when regulation does not allow insider trading, and how the suppressed information eventually gets into stock prices? Our paper provides evidence that regulations reduce price efficiency by suppressing insider trading and distorting the flow of insider information into a “silent” form, which is only gradually incorporated into stock prices, mainly through earnings announcements. While by no means do we take a stance on whether insider trading should be further regulated or deregulated, our evidence sheds light on the mechanism through which regulations affect the flow of information, which in turn affects price efficiency.⁵

The remainder of the paper is organized as follows. In section 2, we develop the hypothesis and empirical strategies. Section 3 describes the data and samples. Section 4 presents results based on a sample of merger targets and a sample of bankruptcy firms. In section 5 we use short interest as an ex-ante signal to classify firms with positive and negative information and present evidence on the information content of insider silence, how the information is incorporated into stock prices, and how market frictions affect the price inefficiency due to

⁵ Fishman and Hagerty (1992) argue that insider trading could reduce price efficiency due to two adverse effects on the competitiveness of the market. That is, insider trading deters other traders from acquiring information, and it skews the distribution of information held by traders toward just one trader.

insider silence. We discuss alternative hypotheses and robustness checks in Section 6 and conclude in section 7.

2. Hypothesis development and empirical strategy

2.1. Hypothesis

Insider trading is regulated in the United States, and trading on insider information is generally illegal.⁶ Firms respond to the regulations by imposing blackout period policies during the time of high information asymmetry (Bettis, Coles, and Lemmon, 2000). Both government and firm-level regulations affect insider trading decisions. The most relevant component of Federal regulation is known as the “disclose or abstain” rule, which requires insiders to disclose the private information before trading, or to abstain from trading until the information has been disclosed. The theoretical work of DeMarzo, Fishman, and Hagerty (1998) on the optimal enforcement of insider trading regulations suggests that insiders keep silent on moderate or extreme news, but trade aggressively on news with intermediate price impact.⁷ In addition, empirical studies on insider trading behaviors suggest that insiders strategically arrange their trading when they possess private information. Ke, Huddart, and Petroni (2003), for example, find that insiders increase selling shares three to nine quarters prior to a break in a string of consecutive increases in quarterly earnings. Huddart, Ke, and Shi (2007) study the timing of insider trading around SEC 10-K and 10-Q filings and report that insiders avoid profitable trades when the legal jeopardy associated with such trades is high, such as trades immediately prior to earnings announcements.

Based on these prior studies, we propose a jeopardy hypothesis, which posits that to avoid legal jeopardy, insiders do not trade when they possess extreme information, and they trade (either buy or sell) while possessing intermediate information. Thus the jeopardy hypothesis implies that insider silence is associated with extreme future returns, whereas insider buying or selling is associated with intermediate future returns.

2.2. Empirical strategy and testable implications

⁶ See Seyhun (1992), Meulbroek (1992), and Bainbridge (1999, 2007) for a complete discussion of the legal rules and institutions related to insider trading.

⁷ The model of DeMarzo, Fishman, and Hagerty (1998) applies to informed investors in general who are not necessarily employees of the company and thus are not necessarily required to report their trades to the SEC. For insider trades that we examine, insiders are required to report their trades to the SEC, a requirement that makes the implication on the relation between extreme information and silence even more straightforward. With ex-post verifiable trades on SEC record, insiders dare not trade before large price movements.

Because insider silence can be associated with either positive or negative extreme news, a sound empirical strategy for testing the hypothesis requires separating firms whose insiders have positive information from those whose insiders have negative information. In other words, we need test this hypothesis conditional on insider information. A simple example illustrates this point. Suppose firms GG, BB, G, B, and N have extremely good, extremely bad, good, bad, and no information, respectively. If the jeopardy hypothesis is at work, the researcher observes insider silence from firms GG, BB, and N, insider buying in firm G, and selling in firm B. For a sample in which firms GG, BB, and N are pooled together, the detected future return would be an average of very high returns from firm GG, very low returns from firm BB, and zero returns from firm N. Thus the average future return of the silence group as a whole is attenuated toward zero. As a result, analyses of a pooled sample are less effective in testing the jeopardy hypothesis. A more powerful empirical design should first separate GG firms from BB firms.

We consider two distinct and complementary approaches. The first is based on ex-post corporate events that unequivocally pertain to extremely good or bad information. Ke, Huddart, and Petroni (2003), for example, adopt this approach and identify their sample firms that experience a break in a string of earnings increases, a clear scenario of extremely negatively information. We choose two special events: corporate merger offers and bankruptcy filing. It is well documented in the literature that a company receiving a merger offer experiences significant share price increase at the announcement (e.g., Jensen and Ruback, 1983). Recent studies on mergers document that a long private negotiation process exists before the public announcement (Boone and Mulherin, 2007), suggesting that insiders of merger targets are aware of the deal prior to the public announcement. Thus, merger targets provide a clean testing ground for the jeopardy hypothesis, which implies in this situation that insiders of merger targets stop buying their own company shares in the months leading to the deal announcement. Further, this phenomenon should be more pronounced for targets in friendly deals, in which insiders of the targets have been involved in and thus have foreknowledge of the upcoming announcement. By contrast, insiders of targets receiving hostile or unsolicited merger offers are less likely to stop buying their own company shares. Similarly, firms that filed bankruptcy provide another clean testing ground for the case of extremely negative information. The jeopardy hypothesis implies that insiders refrain from selling before the bankruptcy filing.

Although the approach based on ex-post events has the benefit of cleanness from hindsight, it has limitations. First of all, such special events are relatively rare. Second, the case of merger offers makes it trivial to investigate how the information is incorporated into stock prices – the target stock price immediately increases at the announcement and on average stays flat thereafter. This result is well documented in the literature (and we also confirm it in our analysis). Further, in both cases ex-post information is not tradable.

Our second approach complements the first by relying on an ex-ante signal to distinguish firms with negative information from those with positive information. At the first glance such an ex-ante signal seems impossible as it would imply profitable arbitrage opportunities and thus a direct violation of market efficiency. With limited arbitrage in real life (De Long, Shleifer, Summers, and Walkman, 1990; Shleifer and Vishny, 1997), however, such a signal may exist. The recent growing literature on short selling provides overwhelming evidence that short interest might be a viable candidate. For example, short sellers use fundamental information in their trades (Dechow, Hutton, Meulbroek, and Sloan, 2001; Drake, Rees, and Swanson, 2011); they become informed by better interpreting firm-specific public news (Engelberg, Reed, and Ringgenberg, 2012); armed with information advantage, short sellers exploit profitable opportunities prior to earnings announcements, analyst downgrade, and earnings restatement (Christophe, Ferri, and Angel, 2004; Desai, Krishnamurthy, and Venkataraman, 2006; Christophe, Ferri, Hsieh, 2010; Boehmer, Jones, and Zhang, 2012); they are even able to identify financial misconduct (Karpoff and Lou, 2010). With these information advantages, it is not surprising that short selling flows and short interest predict future stock returns (Jones and Lamont, 2002; Asquith, Pathak, and Ritter, 2005; Boehmer, Jones, and Zhang, 2008; Diether, Lee, and Werner, 2009; Boehmer, Huszar, and Jordan, 2010; Purnanandam and Seyhun, 2011). In addition, short interest information is at least monthly updated and easily available for most, if not all, stocks.

We thus use short interest to classify firms, ex ante, into those with positive information (lightly shorted stocks) and those with negative information (heavily shorted stocks). This setting allows testing the following two implications of the jeopardy hypothesis.

- (a) Among firms with positive information, firms whose insiders do not trade in the past earn positive future returns, which are higher than do firms whose insiders net buy.

(b) Among firms with negative information, firms whose insiders do not trade in the past earn negative future returns, which are lower than do firms whose insiders net sell.

Further, to the extent that having abstained from trading for a longer time period before the information is released better shields insiders from legal jeopardy, insiders who possess more extreme information should have remained silent for a longer period. The point is clear when one compares the extreme case of bankruptcy (see Section 4.2) with the relatively mild case analyzed in Ke, Huddart, and Petroni (2003), in which the firms experience a break in a string of earnings increases. As we show later in the paper insiders of the firms that file bankruptcy start to refrain from selling almost three years before the filing. By contrast, Ke, Huddart, and Petroni (2003) report evidence that insiders increase selling shares about nine to three quarters before the break in the string of earnings increases. We thus have the last implication of the jeopardy hypothesis.

(c) The longer is the silence period, the more extreme are the future returns.

3. Data and samples

3.1. Data

We obtain insider trading data from Thomson Reuters Insider Filing Data Feed. The Securities and Exchange Commission (SEC) mandates that officers and directors, large shareholders (those who own 10% or more of the outstanding shares), and affiliated shareholders report their transactions to the SEC by the 10th of the month following the transactions (prior to August 2002) or within two days following the transactions (since August 2002). Following previous studies (e.g., Rozeff and Zaman, 1998; Piotroski and Roulstone, 2005; Sias and Whidbee, 2010), we limit our analysis to officers and directors because previous research shows the information content of insider trading is mainly limited to trades by directors and officers.⁸ We define net insider demand (NID) for period t in equation (1). Our main analyses focus on NID measured over the past six months, but the results are robust to NID measured over different horizons, such as the past three months or 12 months.⁹

$$NID_{j,t} = \frac{\# \text{ shares insiders buy}_{j,t} - \# \text{ shares insiders sell}_{j,t}}{\# \text{ shares outstanding}_{j,t}} \quad (1)$$

⁸ We follow the literature (e.g., Lakonishok and Lee 2001; Sias and Whidbee 2010) to “clean” the insider trading data. Specifically, we use the following filters. We delete duplicate and amended records and records with cleanse code of “S” or “A” are deleted. Transaction price must be available, and we delete records if the number of shares in a transaction is below 100. The transaction code is either “P” or “S” for stock transactions and “M” for options exercised. We delete transactions that involve more than 20% of total shares outstanding, and delete records if the transaction price is outside the 80%–120% range of the CRSP end-of-day stock price.

⁹ We use the insider trades that are reported to the Securities and Exchange Commission (SEC) during the past six months. Our results are robust to using trades that occur during the time period.

We define a firm j over time period t as insider net buying if $NID_{j,t} > 0$, net selling if $NID_{j,t} \leq 0$, and silence if no insider trading activity is reported to the SEC.

For the period between January 1992 and December 2002, we obtain monthly short interest data from the exchanges, and for the period between January 2003 and December 2010 we extract the data from Standard and Poor's Compustat. Following the literature, we scale short interest by the number of shares outstanding at the end of each month to obtain the short interest ratio, shown in equation (2):

$$SI_{j,t} = \frac{SHORTINT_{j,t}}{SHROUT_{j,t}} \quad (2)$$

where $SHORTINT_{j,t}$ is the number of shares of short interest for stock j at the end of month t , and $SHROUT_{j,t}$ is the total number of shares outstanding for stock j of month t . To minimize data error we exclude stock month observations if there is a stock split in the month or the short interest exceeds 50%.

We obtain stock return data from CRSP and accounting data from Compustat. Appendix A provides definitions of the complete list of variables. We follow the literature to construct the buy-and-hold abnormal returns after portfolio formation (Laknoishock and Lee, 2001; Sias and Whidbee, 2010). Appendix B describes the procedure in detail.

3.2. Samples

We construct three samples. One is a sample of merger targets. From the Securities Data Corporation (SDC) database, we construct a sample of firms receiving merger offers during 1992–2010. We restrict the deal size to be at least US\$50 million; the target firm is publicly traded; the transaction form is merger or acquisition. For a target receiving multiple offers, we keep the first announcement only. The final sample has 4,267 targets. From SDC we also construct a sample of firms that filed bankruptcy during 1992–2010. We focus on the 524 firms that have stock price and return data in the month of filing, although the main message remains the same without this restriction.

The sample for the ex-ante signal approach is based on all common stocks (share code 10 or 11) covered in CRSP/Compustat merged database. We exclude stocks whose stock price at the end of the previous December is lower than \$2 and firms younger than a year (from the first month on CRSP file with valid price and return data). After merging these databases, our final dataset covers insider trading and short interest data from January 1992 to December 2010 and

stock-return data up to December 2011. Our return data covers 227 cross-sections (February 1992 to December 2010) with an average cross-section size of 3,895.

3.3. Summary statistics

Table 1 shows the percentage of firms whose insiders keep silent, net buy, and net sell, as well as the distribution of non-missing net insider demand (NID), as defined in equation (1). Based on a six-month interval, in 33% of the firms insiders do not trade; insider net buying consists of 20.5% of the sample, and insider net selling consists of the remaining 46.6%. The percentage of insider silence is 74.1%, 49.4%, and 19.5% when NID is measured over the past one, three, and 12 months, respectively. Sias and Whidbee (2010), one of the recent studies covering a similar time period, imply the percentage of no insider trading over a quarter is 49.8% (see their first two rows of Table 9 on page 1578). These numbers suggest insider silence is a frequent phenomenon. In addition, the distribution of our quarterly NID is very similar to that reported in Sias and Whidbee (2010, Table 1).

To see how insider silence fluctuates over time, Panel A of Figure 1 plots the month-by-month proportions of firms whose insiders net buy, net sell, or keep silent over the trailing six months. The percentage of insider silence exhibits a decreasing trend, especially at the time point when the Sarbanes–Oxley Act (SOX) took effect (August 2002), indicating that the recent regulation on insider trading has an impact on insider trading activities. Insider selling increased from the early 2000s to mid-2007, when the recent financial crisis occurred. On the other hand, the percentage of firms with net insider buying increased following the start of the recent crisis but decreased after early 2009.

To see how insider trading is correlated with short interest, we sort firms into short interest deciles and calculate the fractions of firms with insider silence, net buying, and net selling within each decile. Panel B of Figure 1 shows that the percentage of firms with net insider selling increases when short interest piles up. Overall, the strong correlation between NID and short interest is consistent with short sellers being informed (as discussed in Section 2) and suggests that it is reasonable to use short interest to distinguish firms with positive information from those with negative information.

[Insert Table 1 & Figure 1 about here]

4. Evidence based on ex-post corporate events

In this section we examine the samples of merger targets and bankruptcy firms, respectively. The jeopardy hypothesis implies that insiders of a merger target refrain from buying in the months leading to the public announcement of the merger deal. For the bankruptcy firms, insiders refrain from selling in the months prior to the bankruptcy filing.

4.1. The sample of merger offers

Table 2 presents the average monthly abnormal return (using a benchmark as described in Appendix B), p-value of the abnormal return, cumulative abnormal return, percent of target firms whose insiders net buy, and percent of firms whose insiders net sell for the 24 months before and 12 months after the announcement. Figure 2 plots the cumulative abnormal returns and the proportion of firms whose insiders net buy. Consistent with the prior literature (e.g., Jensen and Ruback, 1983; Jarrell, Brickley, and Netter, 1988; Andrade, Mitchell, and Stafford, 2001), the abnormal return of target firms is large in the announcement month (25.2%) and is statistically significant at the 1% level. Also consistent with the literature (e.g., Schwert, 1996), there is evidence of price run-up in the months immediately leading to the announcement, and the target stock price stays flat on average after the announcement.

During the months long before the public announcement, the proportion of targets whose insiders net buy is around 8-10%, which is slightly higher than but generally in line with the grand sample average of 7.6% (see Table 1). This percentage starts to drop when it approaches the announcement month and reaches 2.9% during the announcement month. Unreported χ^2 tests show that the proportion of firms with insider net buying during any of the three months right before the announcement is statistically different (at the 1% level) from that during any of the months from the 24th to the sixth months before the announcement.¹⁰

In unsolicited or hostile deals, insiders of targets are less likely to be aware of the upcoming takeover offer and are less likely to have abstained from buying shares of their own companies, as compared to friendly deals in which target insiders have been involved in the private deal process. In an unreported analysis, we conduct the same investigation as in Table 2 and Figure 2 for the subsample of 275 hostile (or unsolicited) deals and find no significant

¹⁰ Note that an interesting pattern also exists in the proportion of targets with insider net selling. During the period before the public announcement, the proportion of net selling is between 18% and 20%, which is in line with the grand sample average of 18.3% (see Table 1). This proportion reduces to 10.4% in the month before the announcement. Thus, insiders delay selling, with the knowledge of the upcoming price appreciation upon the announcement. This delayed selling is consistent with the passive buying behavior analyzed in Agrawal and Nasser (2012).

evidence of decreasing proportion of targets with net insider buying during the months prior to the announcement. On the other hand, the subsample of 3,992 friendly deals exhibits the exact pattern as shown in Table 2 and Figure 2.

[Insert Table 2 & Figure 2 about here]

4.2. The sample of bankruptcy firms

For the sample of bankruptcy firms, Figure 3 plots the cumulative abnormal returns from 60 months before to 12 months after the bankruptcy filing month. It shows that the stock price starts to decline from 30 months before the filing. To see how insiders respond to the negative information, we draw, month by month, the proportion of these firms whose insiders net sell. We also draw its six-month moving average. The figure clearly exhibits a declining trend on the proportion of firms with insider net selling from 30 months before the filing (about 10%) to the month of the filing (about 5%). This evidence is consistent with the jeopardy hypothesis that insiders abstain from selling while anticipating big negative news. What appears striking, insiders start to abstain from selling as early as almost two and half years before the bankruptcy filing. This pattern indicates that insiders choose to abstain from trading well in advance when the consequence of the private information is extreme.¹¹ We revisit the length of insider silence when testing the jeopardy hypothesis based on an ex-ante signal (see Section 5.2).

[Insert Figure 3 about here]

Overall, our results based on ex-post corporate events strongly support the jeopardy hypothesis. That is, insiders of a target who are aware of the forthcoming public announcement of the merger offer abstain from trading (more explicitly, buying) to avoid legal jeopardy. Likewise, insiders of a bankruptcy firm who have private information about the upcoming extremely bad news refrain from selling long before the filing.

5. Evidence based on an ex-ante signal

¹¹ The insider trading pattern in our sample differs from that reported in Seyhun and Bradley (1997), who analyze a sample of bankruptcy firms during 1975-1992 and find that insiders on average increase selling shares when it approaches the bankruptcy filing date. This pattern is in stark contrast to the concern of legal jeopardy. The difference between these two samples is probably due to the enforcement of insider trading becoming stricter over time so that insiders in bankruptcy cases have learned to be more sensitive to legal jeopardy. There is indication, however, that even in the early years some executives have shown concerns of legal jeopardy. Specifically, Seyhun and Bradley (1997, p. 200) find that about 40% of their sample firms report no trades by top executives over a 7-year horizon (five before and two after the filing). Seyhun and Bradley (1997, p.200) allude to illegal insider trading not reported to the SEC. This interpretation is consistent with our jeopardy hypothesis.

We examine in this section the link between insider silence and future stock returns, using short interest as an ex-ante signal to distinguish between firms with positive and negative information.

5.1. Insider silence and future returns

We first monthly rank stocks into quintiles based on their short interest measured as of the previous month. Among the sample of stocks, we then monthly form three portfolios based on their insider trading activity over the past six months. The “silence,” “buy,” and “sell” portfolios consist of stocks whose insiders have not traded, bought in net, and sold in net, respectively, within the past six months. For each of the portfolios we then calculate the equal-weight buy-and-hold abnormal returns (BHAR) over the subsequent holding period of one, three, six, 12, and 24 months.¹² We consider the impact of firm size in Sections 5.3 and 5.5. Table 3 presents the time-series average of the portfolio BHARs with their t-statistics based on Newey-West (1987) standard errors shown in brackets. Panel A uses the whole sample; Panels B and C use the sample of stocks in the top and bottom short interest quintiles, respectively.

Panel A shows that insider silence in general predicts negative future stock returns. The “silence” portfolio, for example, on average has a 12-month BHAR of -2.3%, which is significant at the 1% level. In addition, this negative return pattern is not reversed at least up to two years after portfolio formation. As discussed in Section 2, insider silence can be associated with both negative and positive extreme information. Thus a significant negative return associated with insider silence in a pooled sample indicates that the impact of extremely negative information outweighs that of extremely positive information.

Consistent with the prior literature on insider trading (e.g., Seyhun, 1986, 1998; Lakonishok and Lee, 2001; Sias and Whidbee, 2010), there is a significant return spread between the “buy” and “sell” portfolios over a holding period of up to three months. The last two rows of Panel A show that the return difference in 12-month BHAR between the “silence” and “sell” portfolios is a significant -1.98%. In unreported tests, the spread between the “silence” and “buy” portfolios are also significant.

Panel B reports portfolio returns for the sample of stocks with high short interest (top quintile). Insider silence predicts significant future negative returns up to two years: the 12- and

¹² For holding periods up to 12 months, our return data cover January 1992 to December 2010; for the 24-month holding period, our return data cover January 1992 to December 2009.

24-month BHARs of “silence” portfolios are -7.3% and -10.9% , respectively, both highly significant. By contrast, the “sell” portfolio experiences only small negative future returns, which last for only a short horizon (up to six months). Indeed, the 12-month BHAR of the “sell” portfolio is only -1.43% , which is not statistically different from zero. The difference between the “silence” and “sell” portfolios for any holding period is significant, and its magnitude grows with the holding period. Figure 4 plots the average BHARs of these portfolios over the one- to 12-month holding periods. The “silence” portfolio shows a striking negative drift, whereas the “buy” and “sell” portfolios have rather flat abnormal returns. Overall, these results strongly support the jeopardy hypothesis that insiders abstain from trading when they possess extremely negative information.¹³

Panel C reports portfolio returns for the sample of stocks with low short interest (the bottom quintile). There is no evidence consistent with the jeopardy hypothesis regarding extremely positive information. Over any holding period, no significant positive BHARs of the “silence” portfolios are present, and the “silence” portfolio does not outperform the “buy” portfolio. One possible explanation for the lack of significant positive returns associated with insider silence in Panel C is that low short interest on average is not “extreme” enough to trigger concerns about legal jeopardy. The point is clear if one compares the evidence in Panel C of Table 3 to that of Table 2 and Figure 2. When insiders possess extremely positive information such as that of a merger offer, insiders refrain from trading to avoid legal jeopardy.

[Insert Table 3 & Figure 4 about here]

In subsequent analyses we focus on the subsample of firms with negative information (firms in the top short interest quintile). As discussed earlier, this setting affords us the opportunity to examine how information in insider silence is incorporated into stock prices.

5.2. Length of the silence period

The jeopardy hypothesis implies a relation between the length of insider silence and the magnitude of future abnormal returns. Insiders of firms with more negative information are more likely to abstain from trading long before the start of stock price decline. As a result, among

¹³ In unreported analysis we find that “silence” portfolio membership is somewhat sticky. The average probability for a stock in the “silence” portfolio (within the top short interest quintile) to join the “silence,” “buy,” and “sell” portfolios (still in the top short interest quintile) six months later is 34%, 10%, and 21%, respectively. For the rest of the stocks, 24% remain in the sample but out of the top short interest quintile, and 11% of them drop out of the grand sample.

firms with negative information, a longer period of insider silence is associated with even lower future returns.

For stocks in the top short interest quintile, we further form four mutually exclusive portfolios based on the length of insider silence. Firms whose insiders do not trade over the recent month but have traded prior to that month form the portfolio “Silence for 1 month.” Firms whose insiders do not trade over the recent three months but have traded prior to that period form the portfolio “Silence for 3 months.” Firms whose insiders do not trade over the recent six months but have traded prior to that period form the portfolio “Silence for 6 months.” Firms whose insiders do not trade over the recent 12 months form the portfolio “Silence for 12 months.” Because we need at least 12-month history of insider trading, we restrict firms in this exercise to be at least 18 months old.

Figure 5 plots the average BHARs of these silence portfolios over a one-year holding horizon. The figure clearly shows that a longer period of insider silence is associated with lower (more negative) future returns. Table 4 presents those BHARs and their Newey-West t-statistics for the holding horizons of one, three, six, 12, and 24 months. For holding periods longer than six months, the abnormal returns decrease with the length of silence period. The BHAR differences between the two extreme portfolios are statistically significant and economically large, with the magnitude ranging from 0.71% for a one-month holding period to 15.29% for a two-year holding period. In sum, these results are strongly consistent with the implication of the jeopardy hypothesis.

[Insert Table 4 & Figure 5 about here]

5.3. Month-by-month abnormal returns following insider silence

Our previous results in Figure 4 and Table 3 indicate that the market underreacts to the negative information in insider silence so that the information is only gradually incorporated into stock prices. We provide more detailed, formal results in this section.

For the three insider trading portfolios formed among stocks with high short interest (see descriptions for Panel B of Table 3), we estimate their monthly abnormal returns (alphas) based on the Fama-French-Carhart four-factor model (Fama and French, 1993; Carhart, 1997) and report results in Table 5. In particular, we monthly form “silence,” “buy,” and “sell” portfolios, and calculate both equal-weight (Panel A) and value-weight (Panel B) monthly alphas for each month during the one-year holding period after portfolio formation. On an equal-weight basis,

we find significant negative alphas for the “silence” portfolio over a long period of time. For example, the first and ninth monthly alphas are -0.96% and -0.43% , respectively. The market seems to take at least nine months to fully incorporate the negative information of insider silence. The general pattern remains in the value-weight alphas although the magnitude is smaller. These results, also shown in Figure 6, clearly suggest that the negative information in insider silence is gradually incorporated into stock prices.

[Insert Table 5 & Figure 6 about here]

5.4. Earnings announcement returns following insider silence

To further investigate whether investors underreact to the negative information associated with insider silence and whether they are systematically surprised when firm-specific news is disclosed to the market, we extract quarterly earnings announcement dates from Compustat and calculate three-day announcement period abnormal returns adjusted by CRSP equal-weight daily market returns (i.e., an event window $[-1, +1]$ covering one trading day before and one day after the earnings announcement date). Specifically, within an insider trading portfolio, we calculate the three-day abnormal returns of its earnings-announcement firms for every month during the 12 months following portfolio formation. Table 6 presents the time-series average of the abnormal returns for each of the three portfolios (“silence,” “buy,” and “sell”).¹⁴ For convenience the results are also illustrated in Figure 7.

The results appear striking. First, the “silence” portfolio has incurred negative abnormal returns during its firms’ earnings announcement period (all 12 post-portfolio formation months have negative returns and eight of them are statistically significant). In contrast, the “sell” portfolio has experienced no significant return at all. Second, the economic magnitude is significant relative to the monthly alphas. Panel B presents, month by month, the ratio of the earnings announcement returns to the same-month equal-weight alpha for the “silence” portfolio. For example, in the first month after portfolio formation, the three-day abnormal return accounts for 32% of the same-month alpha; in the fourth month, the three-day abnormal return accounts for 93% of the same-month alpha.

Overall, among the sample of stocks with high short interest, our analyses in this section suggest (1) the market underreacts to the negative information of insider silence, and the return

¹⁴ We follow the methodology developed in Chopra, Lakonishok, and Ritter (1992), which is used in Jegadeesh and Titman (1993), La Porta, Lakonishok, Shleifer, and Vishny (1997), and Titman, Wei, and Xie (2004), among others.

predictability of insider silence lasts for at least nine months in the future; and (2) investors of the firms whose insiders keep silent are systematically surprised during earnings announcements, in which the negative firm-specific information is disclosed to the market.

[Insert Table 6 and Figure 7 about here]

5.5. Insider silence and market frictions

In the previous section, we establish that insider silence coupled with high short interest predicts significant negative future returns, indicating these stocks are overpriced and investors underreact to insider silence. This pattern is inconsistent with an efficient market that allows perfect arbitrage. Stock markets in reality, however, have frictions. As Shleifer and Vishny (1997) analyze, real-life arbitrageurs are professionals and their arbitrage strategy can be risky and far from perfect. In addition, information uncertainty plays a role in return predictability (e.g., Zhang, 2006). In this section we examine how these market frictions (limits to arbitrage or information uncertainty) affect the information in insider silence. Our prior is that insider silence predicts even more negative returns for stocks that are more difficult to arbitrage or that have higher information uncertainty.

To see how limits to arbitrage or information uncertainty (LTA/IU) affects the information in insider silence, we follow Choi and Sias (2012) and construct the following 10 proxies for LTA/IU: (1) firm size, (2) institutional ownership, (3) number of institutional owners, (4) number of analysts following, (5) firm age, (6) idiosyncratic volatility, (7) total volatility, (8) Amihud (2002) illiquidity, (9) Amihud modified illiquidity, (10) dollar trading volume.¹⁵ These variables are defined in Appendix A.

Every month we split stocks in the top short interest quintile into two equal groups based on one of the 10 LTA/IU variables. Within each group, we form two portfolios, “silence” and “sell,” in the same way we do in Panel B of Table 3. Since we only compare between insider silence and insider net selling, firms whose insiders net buy are excluded in this analysis. We report the average BHARs of these portfolios (and their return differences) over the subsequent one-, three-, six-, and 12-month holding periods. We also report t-statistics for the difference in the two “silence” portfolios between the high and low LTA/IU firms.

¹⁵ These proxies are also discussed in Ali, Hwang, and Trombley (2003), Baker and Wurgler (2006), Brav, Heaton, and Li (2010), and Lam and Wei (2011).

Table 7 establishes the following three results. First, for the group of stocks with low LTA/IU, there is strong evidence that supports the jeopardy hypothesis. For each LTA/IU proxy, the “silence” portfolio has significantly negative BHARs over each of the four holding horizons. For example, the least negative one-year BHAR of the “silence” portfolio is -3.17% using stocks with many institutions (Panel C), and the most negative one is -5.19% using stocks with high dollar trading volumes (Panel J). By contrast, the “sell” portfolio generally has BHARs that are not statistically different from zero, especially for holding periods beyond three months. As a result, the BHAR differences between the “silence” and “sell” portfolios are highly significant across various proxies for firms with low LTA/IU. For example, in the case of three-month BHAR, seven out of 10 return differences are significant, and in the case of one-year BHAR, all 10 return differences are significant. This evidence indicates that insider silence contains information even for stocks facing relatively weak frictions.

Second, for the group of stocks with high LTA/IU, we also find strong negative BHARs associated with insider silence. Interestingly, the “sell” portfolio has significantly negative BHARs across the LTA/IU proxies and over various holding periods. However, the BHAR differences between the “silence” and “sell” portfolios remain highly significant across various specifications: 39 out of 40 return differences are statistically significant. In addition, these return differences are also economically large. The one-year BHAR difference, for example, ranges from -4.82% based on stocks with few institutions (Panel C) to -7.60% based on stocks with high total volatility (Panel G). These results further support the jeopardy hypothesis for the group of stocks with high LTA/IU.

Last, insider silence is associated with even lower future returns for stocks that are more difficult to arbitrage or that have higher information uncertainty. In the last column, we report the t-statistics testing the differences between the two “silence” portfolios. All are significant.

The overall evidence in Table 7 suggests that the price inefficiency in insider silence is pervasive and that market frictions such as limits to arbitrage and information uncertainty make it even worse.¹⁶

¹⁶ Because stocks with high short interest are on average small (Boehmer, Huszar, and Jordan, 2010), one may argue that these firms are all subject to strong limits to arbitrage or have high information uncertainty. In an unreported analysis, we find it is not the case. Specifically, we split the sample according to NYSE size breakpoints. For firms within the top three NYSE size deciles that are also within the top short interest quintile, we find strong negative return for the “silence” portfolio over the subsequent 12 months (-4.77%), which is significantly lower than the “sell” portfolio as the spread is a significant -5.08% . Unreported for brevity, these results are available upon request.

[Insert Table 7 about here]

6. Alternative hypotheses and robustness

In this section we examine alternative hypotheses and discuss robustness checks for the main result presented in Panel B of Table 3.

6.1. The role of litigation risk

In addition to government and firm-level regulations on insider trading, shareholder litigation provides another mechanism that monitors opportunistic insider trading. Insiders of firms with higher litigation risk are less likely to trade opportunistically. Thus, our main results in Panel B of Table 3 might be driven by firms with high litigation risk. To examine this possibility we split firms in the top short interest quintile into two groups based on a proxy for litigation risk and further form insider trading portfolios within each group. We use two proxies for litigation risk. The first proxy (FPS) is based on membership in the biotechnology, computers, electronics, and retail industries (Francis, Philbrick, and Schipper, 1994a, 1994b). The second proxy (KS) is based on a regression model of litigation on accounting and stock characteristics, recently developed by Kim and Skinner (2012). The details are described in Appendix C.

We then repeat the exercise in Table 7 by using these two litigation risk proxies to form subgroups. Shown in Table 8, the results are as expected. Firms with low litigation risk experience lower returns following insider silence or insider net selling. In the subsample of firms with high litigation risk, the future returns are less negative. In both subsamples the difference between the “silence” and “sell” portfolios is significant, suggesting that litigation risk does not subsume the impact of insider silence on price inefficiency.

[Insert Table 8 about here]

6.2. Fama-MacBeth cross-sectional regressions

So far our analyses are based on portfolio sorting. This methodology produces portfolio results that are easy to interpret, but it has limitations, because the other potentially relevant factors are excluded from the analysis. For example, while we use short interest to distinguish between firms with positive information and firms with negative information, all firms within the top short interest quintile do not have the same short interest. If short interest and insider silence are correlated, it is possible that the significant negative return associated with insider silence is driven by short interest.

For a select list of firm characteristics, Panel A of Table 9 presents the time-series averages of the portfolio-level averages of the characteristics for the three insider trading portfolios. The panel also shows the differences between these portfolios. The sample includes stocks in the top short interest quintile. It appears that indeed the three portfolios differ significantly in these characteristics. For example, compared to the “sell” portfolio, firms in the “silence” portfolio have higher short interest, smaller size, higher B/M ratio, lower return momentum, lower institutional ownership, and fewer analysts following. They are, however, not necessarily younger and their litigation risk is relatively lower, probably due to smaller size.

To account for the impact of such factors on future returns, we run Fama-MacBeth (1973) cross-sectional regressions. Specifically, every month we regress the 12-month BHARs on silence, buy, and other control variables. The variable “silence” is equal to one if insiders of the firm have kept silent for the past six months, and zero otherwise. The variable “buy” is similarly defined. Panel B of Table 9 reports the time-series averages of the cross-sectional regression coefficients, together with their Newey-West t-statistics.

In Model 1, BHAR is regressed on silence and buy only. The regression coefficients and their t-statistics are equivalent to the portfolio results, as reported in Panel B of Table 3. In Model 2 we add short interest, which carries a significant negative coefficient, consistent with the prior literature (e.g., Boehmer, Huszar, and Jordan, 2010). After controlling for short interest, however, the coefficient on silence is still highly significant, both statistically and economically. This result suggests that the negative return associated with insider silence is not driven by short interest. The coefficient on silence remains significant in Models 3 and 4, where we control for firm size, B/M ratio, and return momentum. Firm size has a positive coefficient, consistent with the earlier result in Table 7 that larger firms experience less negative returns. To see the impact of market frictions, we first add those LTA/IU variables one by one in the list of control variables and then add them all (after excluding the obviously highly correlated ones) in the list. The coefficients on silence are remarkably robust. For brevity we only present the one with all variables included in the regression, shown in Model 5 of Panel B in Table 9. The coefficients on the LTA/IU variables are largely as expected. For example, firms with more analysts and higher institutional ownership are associated with higher (less negative) future returns.

Unreported for brevity, we conduct additional robustness checks. We vary the BHAR holding period. In general, when the BHAR is measured over a shorter holding period the

coefficients on silence are smaller in magnitude. For instance, with a 3-month holding period, the coefficient on silence from Model 5 is -0.477% (Newey-West t-stat -1.63); with a 6-month holding period, the coefficient on silence is -1.541% (Newey-West t-stat -2.79). This result further confirms our earlier finding that information in insider silence is gradually incorporated into stock prices. These unreported results are available from the authors upon request.

[Insert Table 9 about here]

6.3. The role of portfolio constraints: The Marin and Olivier (2008) model

In Panel B of Table 3 we test the jeopardy hypothesis based on the assumption that insiders have shares available to sell but, due to concerns about legal jeopardy, choose not to. It is possible, however, that the outcome of “no trading” is due to portfolio constraints as studied in Marin and Olivier (2008). That is, insiders cannot short sell their own company shares, insiders have concerns about corporate control, or the shares insiders hold are restricted and not available for sale. In the framework of Marin and Olivier (2008), uninformed investors might infer that insiders possess bad news and update their beliefs on expected payoffs and risk, leading to a price crash, an extreme type of negative returns. Under the Marin and Olivier (2008) framework, this alternative hypothesis could be consistent with our main finding in Panel B of Table 3 if the silence period is preceded by a period of heavy insider selling.

To see whether indeed the performance of the “silence” portfolio in Panel B of Table 3 is driven by the subsample of firms whose insiders have heavily sold in the past before the silence period, we further sort firms in the “silence” portfolio into two portfolios based on their insider trading activity before the silence period. We start with the average 207 stocks in the “silence” portfolio (see Panel B of Table 3) and restrict to firms at least 18-month old (so that insiders of new firms have at least 12 months of trading history). This restriction reduces the average number of stocks in the “silence” portfolio to 197. We then examine their insider trading activity over the preceding six months period (from months -12 to -7) and form two portfolios: “Heavy sell” and “Others.” The “Heavy sell” portfolio consists of firms whose insiders have sold in net during months -12 to -7 and that the net insider demand is below the sample median. The remaining stocks form the “Others” portfolio. For each portfolio, we calculate their buy-and-hold abnormal return (BHAR, in %) over the subsequent 1, 3, 6, 12, and 24 months. For the 24-month holding period, we use the sample ending in December 2009. Results are shown in Table 10.

For a 12-month holding period, the “Heavy sell” portfolio experiences a significant abnormal return of -7.42% , the “Others” portfolio experiences a significant return of -6.72% , and the difference between the two is not significant. The evidence suggests that it is unlikely that portfolio constraints drive our result.

[Insert Table 10 about here]

6.4. The impact of the Sarbanes–Oxley Act (SOX)

Before the Sarbanes–Oxley Act (SOX) insiders are required to report their trades by the 10th of the month following the transactions; since SOX (after August 2002) insiders are required to report their transactions to the SEC within two business days. Would more prompt disclosure of insider trades affect the information content of insider silence? Because the new disclosure requirement applies only when insiders buy or sell, one would expect SOX not to have any impact on the information content of insider silence. When insiders possess extreme information, they would choose not to trade regardless of the requirement of more prompt reporting. To the extent that the requirement of more prompt reporting deters informed trades (Brochet, 2010), insiders in the new regime might choose not to trade in some situations in which they would have traded before SOX. This change would contaminate the “silence” portfolio and make it less informative.

Without a comprehensive theory of the impact of SOX on insider silence, our analysis on this issue inevitably becomes exploratory. Further, many other important events took place following SOX (e.g., regulation Fair Disclosure, the financial crisis, RegSHO, short-selling ban, etc.), making a simple comparison between the before- and after-SOX periods even more difficult to interpret. In addition, the SEC enacted rule 10b5-1 in 2000, which effectively allowed insiders to strategically sell ahead of negative information (Jagolinzer, 2009). Bearing in mind these complexities, our goal in this exercise is modest. Instead of conducting a full-blown analysis, we examine whether the jeopardy hypothesis holds both before and after SOX.

To do so, we split the sample into two subsamples, using August 2002 as the cutoff point. For firms within the top short interest quintile, we form insider trading portfolios (“buy,” “sell,” “silence”) and examine their future returns for the two subsamples. Table 11 presents the time-series average abnormal returns for the insider portfolios over the holding periods of one, three, six, 12, and 24 months for the before- (Panel A) and after-SOX (Panel B) subsamples, respectively. The table structure is the same as in Table 3. In both subsamples, insider silence is

associated with significant negative future returns, which are significantly worse than when insiders net sell.¹⁷ Thus these results support the jeopardy hypothesis both before and after SOX.

[Insert Table 11 about here]

6.5. Database quality

In our analysis we define “insider silence” if we do not observe any insider trading activity as recorded in the database. The validity of this definition depends on the quality of the database, Thomson Reuters. At least two other possibilities can lead to observing no insider trading. First, insiders have traded but failed to report to the SEC or the SEC’s record of insider trades is incomplete.¹⁸ Thus, a researcher could mistakenly allocate some cases to the “silence” portfolio while they actually belong to the “buy” or “sell” portfolio. If these unfiled or unrecorded trades are not driven by private information, the incompleteness of the database simply adds random noise to the data and works against hypothesis testing.

Second, insiders have traded on private information but decided not to report to the SEC due to fear of regulatory and legal action. Seyhun and Bradley (1997, p. 200) discuss this possibility on a sample of firms that filed bankruptcy. Meulbroek (1992) examines episodes of illegal insider trading. Without a full list of such illegal insider trading we cannot distinguish whether our “insider silence” cases are due to insiders having not traded on information or insiders having traded on information but having hidden the trades from regulators. Either way, however, the observed insider silence is consistent with our jeopardy hypothesis that insiders do not want regulators to know that they have traded on material, nonpublic information.

Third, insiders might have never owned any shares. Thus, these firms are always classified into our “silence” portfolio. If these cases are just random noise they would only work against our hypothesis testing. These cases, however, can be endogenously related to extremely negative future performance. For firms that have extremely negative prospect, using equity as part of the executive compensation probably will not provide effective incentives. One simple

¹⁷ Nuances exist between the two subsamples. The “silence” portfolio for the after-SOX subsample experiences less extreme negative returns than for the before-SOX subsample. Conversely, the “sell” portfolio for the after-SOX subsample is associated with statistically significant future returns (about 3% over a year), whereas this pattern is much weaker before SOX. The result appears to be consistent with Jagolinzer (2009) that insiders strategically sell before negative news under SEC’s rule 10b5-1. In addition, we estimate a regression as in Model 5 in Table 9 on the subsamples before and after SOX and find that the coefficients on silence are significant in both subsamples.

¹⁸ Our insider trading data is made available through Wharton Research Data Services (WRDS). The WRDS web (See <http://wrds-web.wharton.upenn.edu/wrds/ds/tfn/index.cfm>) has the following description of the database: “The Insider Filing Data Feed (IFDF) is designed to capture all U.S. insider activity as reported on Forms 3, 4, 5, and 144 in line-by-line detail.”

example makes the point clear. Consider a manager awarded equity as part of the compensation and she knows that the stock price will significantly drop in the future. Assume no other restrictions on these shares. Would she sell? Bearing in mind the negative private information and the concern about legal jeopardy, she would not. Thus, the ex-ante value of equity compensation in such firms is essentially zero.

The above discussion has implications for a very special subset of our sample. For about 2.4% of our sample firm/months, the Thomson Reuters insider trading database covers no single record over the entire period of 1986-2011. Among the average 207 stocks in the “silence” portfolio we examine in Panel B of Table 3, on average 24 stocks belong to this special group. Unreported analysis indicates that our main conclusion still holds after excluding these 24 stocks. For example, the one-year BHAR of the “silence” portfolio (now average portfolio size of 183) is a significant -5.50%, and it is significantly lower than that of the “sell” portfolio. Thus these special cases do not drive our main result. The average 24 stocks are not random noise though, as the portfolio of these stocks experiences a significant one-year BHAR of -30.15%. These special cases are best interpreted in light of endogenous compensation.

6.6. Other robustness

We conduct numerous robustness checks on the main result in Panel B of Table 3. We vary the time window over which we measure insider trading activity (from 3, 6, to 12 months); we measure insider activity based on the transaction dates instead of reporting dates; we use a simple measure of cumulative abnormal returns instead of BHAR. In general, our main result is remarkably robust. The main result also holds when we use the top decile or the top three deciles of short interest to form the sample. Further, splitting the “sell” portfolio into “heavy sell” and “light sell” portfolios does not yield any new insight: both portfolios experience mild negative returns, both outperform the “silence” portfolio, and the difference between the two is not economically significant.

7. Conclusion

In this paper we examine the frequent phenomenon of insider silence. That is, when corporate insiders do not trade. We propose a jeopardy hypothesis, which posits that corporate insiders, due to fear of regulatory and legal action abstain from trading on extreme information, implying that insider silence can be associated with extreme future returns.

We find strong evidence supporting the jeopardy hypothesis. First, for a sample of merger targets, we find that insiders refrain from buying in the months before the announcement of the merger offer. For a sample of bankruptcy firms, insiders start to refrain from selling long before the month of bankruptcy filing. Second, using short interest to distinguish firms with positive information from those with negative information, we find more results that relate insider silence to future extreme returns, particularly when the information is negative. Specifically, among the heavily shorted stocks, insider silence predicts significant negative returns, which are even lower than when insiders net sell. The negative information is only gradually incorporated into stock prices and a significant portion of it is released surrounding the earnings announcements. The evidence suggests that insider silence is associated with price inefficiency. Using a list of proxies for limits to arbitrage and information uncertainty, we find that the price inefficiency of insider silence is pervasive and market frictions make it even worse.

The paper sheds light on how insider trading regulations are related to price efficiency. Our evidence indicates that regulations distort the flow of insider information, which in turn reduces price efficiency.

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Table 1: Summary statistics

NID	Silence	Buy	Sell	Mean	Std. Dev.	P5	P25	P50	P75	P95
1 m	74.1%	7.6%	18.4%	-0.093	0.260	-0.548	-0.099	-0.018	0.002	0.099
3 m	49.4%	15.5%	35.1%	-0.150	0.403	-0.906	-0.166	-0.027	0.004	0.157
6 m	32.9%	20.5%	46.6%	-0.241	0.624	-1.391	-0.279	-0.046	0.007	0.237
12 m	19.5%	23.8%	56.7%	-0.440	1.078	-2.445	-0.531	-0.095	0.010	0.406

For each firm, net insider demand (NID) of time t is defined as the number of shares that insiders buy minus the number of shares that insiders sell, normalized by the total number of shares outstanding at the end of time t . Each row in the table presents summary statistics of NID measured over the past 1, 3, 6, or 12 months, respectively. Silence, buy, and sell are the percentage of firms whose insiders keep silent, net buy, and net sell, respectively, over the past time period listed in the first column. The summary statistics are calculated using a pooled sample over the period from 227 cross-sections (February 1992 to December 2010) with an average cross-section size of 3,895.

Table 2: Cumulative abnormal returns, insider buying and selling in merger targets

Months	AR	p-value	CAR	Buy	Sell
-24	0.3%	0.197	0.3%	9.6%	19.7%
-23	0.5%	0.041	0.8%	9.8%	19.7%
-22	0.4%	0.128	1.2%	10.0%	18.8%
-21	0.2%	0.385	1.4%	8.9%	19.0%
-20	0.3%	0.137	1.8%	9.5%	20.1%
-19	0.4%	0.118	2.2%	9.7%	19.0%
-18	0.6%	0.008	2.8%	9.5%	19.8%
-17	0.0%	0.938	2.8%	9.4%	19.7%
-16	0.0%	0.886	2.8%	9.0%	19.8%
-15	0.5%	0.042	3.3%	8.4%	20.1%
-14	0.1%	0.555	3.5%	8.8%	19.9%
-13	-0.2%	0.399	3.3%	9.0%	18.7%
-12	0.5%	0.245	3.7%	8.7%	19.7%
-11	-0.1%	0.618	3.6%	9.0%	19.1%
-10	-0.2%	0.375	3.4%	8.4%	18.4%
-9	-0.1%	0.721	3.3%	8.5%	18.8%
-8	0.1%	0.638	3.5%	8.9%	19.5%
-7	-0.2%	0.488	3.3%	8.4%	18.4%
-6	-0.7%	0.002	2.6%	8.6%	18.3%
-5	-0.6%	0.007	1.9%	7.7%	18.5%
-4	0.1%	0.586	2.1%	6.1%	16.7%
-3	0.5%	0.055	2.5%	6.2%	15.4%
-2	0.6%	0.014	3.1%	5.5%	14.1%
-1	2.9%	0.000	6.0%	3.5%	10.4%
0	25.2%	0.000	31.2%	2.9%	11.4%
1	0.3%	0.196	31.5%	2.0%	11.8%
2	0.1%	0.768	31.5%	2.1%	11.8%
3	0.0%	0.968	31.5%	2.3%	12.1%
4	0.6%	0.020	32.1%	2.7%	13.3%
5	-0.2%	0.410	31.8%	3.2%	13.5%
6	-0.5%	0.184	31.4%	4.4%	11.9%
7	-0.2%	0.591	31.2%	5.1%	12.9%
8	0.3%	0.525	31.5%	5.4%	14.1%
9	0.0%	0.981	31.5%	8.0%	14.4%
10	1.0%	0.110	32.5%	7.4%	14.7%
11	0.6%	0.327	33.1%	6.0%	14.6%
12	-1.2%	0.046	31.8%	7.5%	12.2%

The sample includes 4,267 targets involved in merger deals announced during 1992–2010. The first column represents the months relative to the announcement month, which is set to month 0. Column “AR” is the average abnormal return for the month; “p-value” is the p-value testing the statistical significance of the average abnormal return based on two-tailed t-tests; “CAR” is the cumulative abnormal return; the “Buy” (“Sell”) column is the proportion of targets whose insiders net buy (sell) during the month.

Table 3: Insider silence and future returns

Portfolios	Average portfolio N	Holding period				
		1 m	3 m	6 m	12 m	24 m
Panel A: BHAR (in %) for whole sample						
Silence	1253	-0.35 ^a	-0.94 ^a	-1.71 ^a	-2.29 ^a	-3.69 ^b
Buy	823	0.22 ^a	0.28	0.32	1.23	1.45
Sell	1819	-0.10	-0.30	-0.46	-0.31	0.11
Buy–Sell		0.33 ^a	0.58 ^b	0.77	1.54	1.34
		[3.01]	[2.18]	[1.51]	[1.63]	[1.02]
Silence–Sell		-0.24 ^a	-0.64 ^a	-1.25 ^a	-1.98 ^b	-3.80 ^b
		[-3.55]	[-3.60]	[-3.48]	[-2.40]	[-2.14]
Panel B: BHAR (in %) for high SI						
Silence	207	-0.85 ^a	-2.46 ^a	-4.60 ^a	-7.30 ^a	-10.90 ^a
Buy	132	-0.03	-0.41	-0.87	0.30	1.55
Sell	440	-0.42 ^a	-0.97 ^a	-1.35 ^b	-1.43	-0.55
Buy–Sell		0.39 ^b	0.56	0.48	1.74	2.10
		[2.12]	[1.27]	[0.55]	[1.17]	[1.14]
Silence–Sell		-0.43 ^a	-1.48 ^a	-3.26 ^a	-5.87 ^a	-10.35 ^a
		[-3.01]	[-4.31]	[-4.96]	[-4.68]	[-4.64]
Panel C: BHAR (in %) for low SI						
Silence	350	-0.22	-0.46	-0.87	-0.71	-0.41
Buy	225	0.02	-0.22	-0.50	-0.44	-1.68
Sell	204	-0.13	-0.64	-0.98	-1.58	-2.40
Buy–Sell		0.15	0.41	0.48	1.14	0.72
		[1.37]	[1.53]	[1.00]	[1.25]	[0.47]
Silence–Buy		-0.24 ^b	-0.24	-0.38	-0.27	1.27
		[-2.43]	[-0.95]	[-0.77]	[-0.23]	[0.46]

Every month from January 1992 to December 2010, we sort firms into short interest quintiles. Panel A uses all the firms, whereas panels B and C only use the top and bottom quintiles, respectively. Within the chosen subsample, we form portfolios based on insider trading activity over the prior six months: the “silence” portfolio contains firms with no insider trading; “buy” represents firms whose insiders net buy; “sell” represents firms whose insiders net sell. For each portfolio, we calculate its buy–and–hold abnormal return (BHAR, in %) over the subsequent 1, 3, 6, 12, and 24 months. For the 24–month case, we use the sample from January 1992 to December 2009. The construction of BHAR is described in Appendix B. Each panel presents the time–series average BHAR for each portfolio and the spread between the portfolios. Tests of average BHARs and their spreads are based on Newey–West standard errors. Newey–West adjusted t–statistics for the spreads are reported in brackets. The second column reports average portfolio sizes. ^a, ^b, and ^c denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 4: The length of insider silence and future returns

Portfolios	Average portfolio N	Holding period				
		1 m	3 m	6 m	12 m	24 m
Silence for 1 month	200	-0.45 ^a	-0.92 ^a	-1.12 ^b	-0.79	-0.01
Silence for 3 months	127	-0.25	-0.63 ^c	-1.64 ^a	-1.72	-2.29
Silence for 6 months	91	-0.38 ^b	-1.24 ^a	-2.53 ^a	-3.52 ^a	-4.73 ^c
Silence for 12 months	106	-1.16 ^a	-3.18 ^a	-5.98 ^a	-9.95 ^a	-15.30 ^a
12m – 1m		-0.71 ^a [-3.37]	-2.26 ^a [-4.31]	-4.86 ^a [-5.01]	-9.16 ^a [-5.45]	-15.29 ^a [-4.03]

Every month from January 1992 to December 2010, we sort firms into short interest quintiles. Among firms within the top short interest quintile, we form portfolios based on the length of time that insiders do not trade over the prior year. Firms whose insiders do not trade over the recent month but have traded prior to that month form the portfolio “Silence for 1 month.” Firms whose insiders do not trade over the previous three months but have traded prior to that time form the portfolio “Silence for 3 months.” Firms whose insiders do not trade over the recent six months but have traded prior to that time form the portfolio “Silence for 6 months.” Firms whose insiders do not trade over the recent 12 months form the portfolio “Silence for 12 months.” Each row shows the time-series average buy-and-hold abnormal return (BHAR, in %) over the subsequent 1, 3, 6, 12, and 24 months following portfolio formation. For the 24-month case, we use the sample from January 1992 to December 2009. The construction of BHAR is described in Appendix B. The last two rows report the return difference between the two extreme portfolios and the t-statistics associated with that difference. Tests of average BHARs and their differences are based on Newey–West standard errors. The second column reports average portfolio sizes. ^a, ^b, and ^c denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 5: Monthly Fama–French–Carhart alpha

Portfolios	Month following portfolio formation											
	1	2	3	4	5	6	7	8	9	10	11	12
Panel A: Equal–weight portfolio alpha (%)												
Silence	−0.96 ^a	−0.78 ^a	−0.67 ^a	−0.63 ^a	−0.64 ^a	−0.64 ^a	−0.56 ^a	−0.53 ^a	−0.43 ^b	−0.31	−0.21	−0.27
Buy	0.01	0.11	−0.03	0.12	0.07	0.13	0.10	0.12	0.14	0.04	0.02	0.02
Sell	−0.45 ^a	−0.27 ^b	−0.21 ^c	−0.08	0.04	0.09	0.07	0.11	0.12	0.18	0.18	0.13
Buy–Sell	0.47 ^a	0.38 ^b	0.18	0.20	0.03	0.04	0.03	0.01	0.02	−0.14	−0.16	−0.11
Silence–Sell	−0.51 ^a	−0.50 ^a	−0.46 ^a	−0.55 ^a	−0.68 ^a	−0.73 ^a	−0.63 ^a	−0.64 ^a	−0.55 ^a	−0.48 ^a	−0.39 ^b	−0.40 ^b
Panel B: Value–weight portfolio alpha (%)												
Silence	−0.52 ^a	−0.32 ^c	−0.21	−0.39 ^b	−0.49 ^a	−0.42 ^b	−0.36 ^b	−0.39 ^b	−0.30 ^c	−0.43 ^b	−0.32 ^c	−0.19
Buy	−0.21	−0.07	0.08	−0.11	−0.21	−0.23	0.06	0.21	0.10	−0.02	0.18	0.18
Sell	−0.31 ^b	−0.17	−0.19	−0.05	0.12	0.14	0.11	0.08	0.16	0.09	0.15	0.10
Buy–Sell	0.11	0.10	0.27	−0.05	−0.33 ^c	−0.37 ^c	−0.06	0.13	−0.06	−0.11	0.03	0.08
Silence–Sell	−0.21	−0.14	−0.01	−0.33 ^c	−0.61 ^a	−0.57 ^a	−0.48 ^a	−0.47 ^a	−0.46 ^b	−0.53 ^a	−0.47 ^b	−0.29

Every month from January 1992 to December 2010, we sort firms into short interest quintiles. Firms within the top short interest quintile are formed into “silence,” “buy,” and “sell” portfolios according to their net insider demand over the past six months. Firms that have positive (negative; missing) net insider demand form the “buy” (“sell;” “silence”) portfolio. We calculate both equal–weight (panel A) and value–weight (Panel B) monthly returns for every month during the 12 months following the formation of these insider trading portfolios, and then regress portfolio excess returns on the Fama and French (1993) and Carhart (1997) four factors. The panels present the portfolio alphas (in %) and the spread in alphas between the portfolios. ^a, ^b, and ^c denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 6: Earnings announcement returns following portfolio formation

Panel A: Earnings announcement returns

Portfolios	1	2	3	4	5	6	7	8	9	10	11	12
Silence	-0.31 ^b	-0.34 ^b	-0.46 ^a	-0.59 ^a	-0.52 ^a	-0.43 ^a	-0.40 ^a	-0.32 ^b	-0.17	-0.14	-0.10	-0.17
Buy	-0.25	-0.22	-0.22	-0.14	-0.01	-0.02	-0.14	-0.24	-0.08	0.02	-0.12	-0.30 ^c
Sell	-0.12	-0.06	-0.05	0.00	0.02	-0.04	-0.07	-0.06	-0.09	-0.09	0.04	0.03
Buy–Sell	-0.13	-0.17	-0.17	-0.14	-0.03	0.02	-0.07	-0.17	0.01	0.11	-0.16	-0.34 ^c
	[-0.67]	[-0.70]	[-0.84]	[-0.69]	[-0.15]	[0.10]	[-0.38]	[-0.99]	[0.07]	[0.68]	[-0.99]	[-1.84]
Silence–Buy	-0.04	-0.11	-0.24	-0.45 ^c	-0.51 ^b	-0.41 ^c	-0.27	-0.12	-0.09	-0.16	0.02	0.13
	[-0.18]	[-0.43]	[-1.02]	[-1.92]	[-2.36]	[-1.79]	[-1.25]	[-0.58]	[-0.43]	[-0.85]	[0.12]	[0.54]
Silence–Sell	-0.18	-0.28 ^b	-0.41 ^a	-0.59 ^a	-0.54 ^a	-0.39 ^b	-0.34 ^b	-0.25 ^c	-0.08	-0.05	-0.14	-0.21
	[-1.30]	[-2.15]	[-2.97]	[-4.06]	[-3.65]	[-2.55]	[-2.30]	[-1.77]	[-0.53]	[-0.36]	[-1.00]	[-1.33]

Panel B: The ratio of earnings announcement returns to monthly alphas for the “silence” portfolio

Month	1	2	3	4	5	6	7	8	9	10	11	12
Ratio (%)	32	43	68	93	80	68	72	60	40	44	47	64

In Panel A, every month from January 1992 to December 2010 we sort firms into short interest quintiles. Firms within the top short interest quintile are formed into “silence,” “buy,” and “sell” portfolios according to their net insider demand over the past six months. Firms that have positive (negative; missing) net insider demand form the “buy” (“sell;” “silence”) portfolio. Following portfolio formation, we collect the firms’ earnings announcement dates from the Compustat quarterly file and calculate their three-day $[-1, +1]$ abnormal returns adjusted by CRSP equal-weight market returns. The table presents, for each of the three portfolios, the equal-weight average of the earnings-announcement period abnormal returns (in %) in every month of the 12 months following portfolio formation. The table also presents the average return spread between the portfolios with their t -statistics shown in square brackets. ^a, ^b, and ^c denote statistical significance at the 1%, 5%, and 10% levels, respectively. Panel B shows, for the “silence” portfolio only, the ratio of the earnings announcement returns to the monthly alphas (see Table 5 Panel A) for each of the 12 months following portfolio formation.

Table 7: Insider silence and market frictions

	Silence [1]	Sell [2]	D1 = [1] - [2]	Silence [4]	Sell [5]	D2 = [4] - [5]	T ([1] - [4])
Panel A: Firm size							
	Small			Large			
1	-1.00 ^a	-0.61 ^a	(-0.39) ^b	-0.55 ^a	-0.29 ^b	(-0.27) ^c	[-2.45] ^b
3	-3.14 ^a	-1.61 ^a	(-1.53) ^a	-1.17 ^a	-0.54	(-0.63) ^c	[-4.75] ^a
6	-5.91 ^a	-2.69 ^a	(-3.21) ^a	-2.12 ^a	-0.41	(-1.71) ^b	[-5.31] ^a
12	-9.25 ^a	-3.83 ^a	(-5.42) ^a	-3.64 ^a	0.27	(-3.91) ^a	[-5.00] ^a
Panel B: Institutional ownership							
	Low			High			
1	-1.13 ^a	-0.71 ^a	(-0.42) ^b	-0.42 ^b	-0.20	(-0.22)	[-3.71] ^a
3	-3.47 ^a	-1.86 ^a	(-1.61) ^a	-0.93 ^a	-0.27	(-0.65) ^c	[-6.80] ^a
6	-6.41 ^a	-2.99 ^a	(-3.41) ^a	-1.97 ^a	-0.00	(-1.96) ^a	[-6.64] ^a
12	-9.86 ^a	-3.88 ^b	(-5.98) ^a	-3.53 ^a	0.57	(-4.10) ^a	[-5.36] ^a
Panel C: Number of institutions							
	Few			Many			
1	-1.11 ^a	-0.72 ^a	(-0.39) ^b	-0.37 ^b	-0.21 ^c	(-0.16)	[-4.02] ^a
3	-3.36 ^a	-1.85 ^a	(-1.51) ^a	-0.82 ^b	-0.35	(-0.47)	[-6.74] ^a
6	-6.05 ^a	-3.22 ^a	(-2.83) ^a	-1.97 ^b	0.00	(-1.97) ^a	[-5.06] ^a
12	-9.60 ^a	-4.78 ^a	(-4.82) ^a	-3.17 ^b	0.99	(-4.16) ^a	[-4.77] ^a
Panel D: Number of analysts							
	Few			Many			
1	-1.11 ^a	-0.69 ^a	(-0.43) ^b	-0.37 ^c	-0.18	(-0.20)	[-3.77] ^a
3	-3.19 ^a	-1.59 ^a	(-1.60) ^a	-1.26 ^a	-0.42	(-0.84) ^b	[-4.57] ^a
6	-5.73 ^a	-2.43 ^a	(-3.30) ^a	-2.79 ^a	-0.42	(-2.37) ^a	[-4.04] ^a
12	-9.58 ^a	-3.69 ^a	(-5.89) ^a	-3.68 ^a	0.37	(-4.06) ^a	[-4.25] ^a
Panel E: Firm age							
	Young			Old			
1	-1.15 ^a	-0.67 ^a	(-0.47) ^b	-0.54 ^a	-0.17	(-0.37) ^b	[-2.85] ^a
3	-3.45 ^a	-1.69 ^a	(-1.76) ^a	-1.41 ^a	-0.27	(-1.14) ^a	[-3.92] ^a
6	-6.37 ^a	-2.60 ^a	(-3.76) ^a	-2.71 ^a	-0.11	(-2.61) ^a	[-3.99] ^a
12	-9.96 ^a	-3.35 ^b	(-6.61) ^a	-4.42 ^a	0.45	(-4.88) ^a	[-4.08] ^a
Panel F: Idiosyncratic volatility							
	High			Low			
1	-1.03 ^a	-0.73 ^a	(-0.29)	-0.29 ^a	-0.13	(-0.17)	[-2.48] ^b
3	-3.52 ^a	-1.71 ^a	(-1.81) ^a	-0.74 ^a	-0.27	(-0.46)	[-4.24] ^a
6	-6.42 ^a	-2.43 ^b	(-3.98) ^a	-1.98 ^a	-0.29	(-1.69) ^a	[-3.76] ^a
12	-9.95 ^a	-2.62	(-7.33) ^a	-3.81 ^a	-0.19	(-3.62) ^a	[-2.77] ^a
Panel G: Total volatility							
	High			Low			
1	-1.24 ^a	-0.66 ^b	(-0.58) ^a	-0.35 ^a	-0.20 ^c	(-0.15)	[-2.94] ^a
3	-3.63 ^a	-1.31 ^b	(-2.32) ^a	-0.91 ^a	-0.60 ^c	(-0.32)	[-3.76] ^a

6	-6.48 ^a	-1.80	(-4.68) ^a	-2.13 ^a	-0.81	(-1.31) ^b	[-3.34] ^a
12	-9.73 ^a	-2.13	(-7.60) ^a	-4.20 ^a	-0.63	(-3.56) ^a	[-2.48] ^b

Panel H: Amihud illiquidity

	Low			High			
1	-0.99 ^a	-0.62 ^a	(-0.37) ^b	-0.55 ^a	-0.29 ^b	(-0.26)	[-2.37] ^b
3	-3.06 ^a	-1.56 ^a	(-1.50) ^a	-1.22 ^a	-0.59	(-0.63) ^c	[-4.21] ^a
6	-5.64 ^a	-2.60 ^a	(-3.04) ^a	-2.51 ^a	-0.50	(-2.01) ^a	[-3.96] ^a
12	-8.91 ^a	-3.85 ^a	(-5.05) ^a	-4.19 ^a	0.25	(-4.44) ^a	[-4.03] ^a

Panel I: Amihud modified illiquidity

	Low			High			
1	-1.04 ^a	-0.58 ^a	(-0.46) ^a	-0.60 ^b	-0.31 ^b	(-0.29)	[-1.91] ^c
3	-3.12 ^a	-1.48 ^a	(-1.64) ^a	-1.56 ^a	-0.61	(-0.94) ^b	[-2.79] ^a
6	-5.80 ^a	-2.50 ^a	(-3.30) ^a	-2.94 ^a	-0.49	(-2.45) ^a	[-2.55] ^b
12	-9.18 ^a	-3.34 ^b	(-5.83) ^a	-4.64 ^b	0.04	(-4.69) ^a	[-2.05] ^b

Panel J: Dollar volume

	Low			High			
1	-1.00 ^a	-0.50 ^a	(-0.51) ^a	-0.58 ^b	-0.38 ^b	(-0.20)	[-1.82] ^c
3	-3.02 ^a	-1.33 ^a	(-1.69) ^a	-1.48 ^a	-0.75 ^c	(-0.73) ^c	[-2.86] ^a
6	-5.53 ^a	-2.25 ^a	(-3.29) ^a	-2.97 ^a	-0.74	(-2.23) ^a	[-2.47] ^b
12	-8.57 ^a	-3.33 ^b	(-5.23) ^a	-5.19 ^a	-0.10	(-5.09) ^a	[-1.99] ^b

Every month from January 1992 to December 2010, we sort firms into short interest quintiles. Within firms in the top quintile, we sort firms into two equal groups according to one of the 10 proxies for limits to arbitrage or information uncertainty (LTA/IU), as denoted in the title of each panel. Within each group, we form portfolios based on insider trading activity over the prior six months: the “silence” portfolio contains firms with no insider trading, and “sell” represents firms whose insiders net sell. For each portfolio, we calculate the buy-and-hold abnormal return (BHAR, in %) over the subsequent 1, 3, 6, and 12 months. Columns [1] and [2] and columns [4] and [5] present the time-series average BHAR for each portfolio; columns D1 and D2 report the spreads [1] – [2] and [4] – [6], respectively. The last column reports the t-statistics testing [1] – [4]. All tests are based on Newey–West standard errors. The LTA/IU variables are defined in Appendix A. ^a, ^b, and ^c denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 8: Insider silence, litigation risk, and future returns

	Silence [1]	Sell [2]	D1 = [1] – [2]	Silence [4]	Sell [5]	D2 = [4] – [5]	T ([1] – [4])
Panel A: Litigation risk proxy is FPS							
	Low			High			
1	–0.95 ^a	–0.57 ^a	(–0.38) ^b	–0.47 ^c	–0.16	(–0.31)	[–1.82] ^c
3	–2.78 ^a	–1.50 ^a	(–1.28) ^a	–1.35 ^c	–0.16	(–1.19) ^b	[–1.84] ^c
6	–5.20 ^a	–2.30 ^a	(–2.91) ^a	–2.51 ^c	0.04	(–2.55) ^a	[–1.74] ^c
12	–8.29 ^a	–3.65 ^a	(–4.64) ^a	–3.71	1.66	(–5.37) ^a	[–1.59]
Panel B: Litigation risk proxy is KS							
	Low			High			
1	–0.87 ^a	–0.64 ^a	(–0.23)	–0.75 ^a	–0.36 ^a	(–0.39) ^b	[–0.43]
3	–3.07 ^a	–2.07 ^a	(–0.99)	–2.03 ^a	–0.77 ^b	(–1.26) ^a	[–1.86] ^c
6	–6.01 ^a	–3.84 ^a	(–2.17) ^c	–3.73 ^a	–0.91 ^c	(–2.82) ^a	[–2.10] ^b
12	–11.06 ^a	–6.63 ^a	(–4.42) ^b	–5.43 ^a	–0.51	(–4.92) ^a	[–2.77] ^a

Every month from January 1992 to December 2010, we sort firms into short interest quintiles. Within firms in the top quintile, we sort firms into two groups according to one of the two proxies for litigation risk, FPS and KS, which are defined in Appendix C. Within each group, we form portfolios based on insider trading activity over the prior six months: the “silence” portfolio contains firms with no insider trading, and “sell” represents firms whose insiders net sell. For each portfolio, we calculate the buy-and-hold abnormal return (BHAR, in %) over the subsequent 1, 3, 6, and 12 months. Columns [1] and [2] and columns [4] and [5] present the time-series average BHAR for each portfolio; columns D1 and D2 report the spreads [1] – [2] and [4] – [5], respectively. The last column reports the t-statistics testing [1] – [4]. All tests are based on Newey–West standard errors. ^a, ^b, and ^c denote statistical significance at the 1%, 5%, and 10% confidence levels, respectively.

Table 9: BHAR, silence, other characteristics, and regressions
 Panel A: Summary statistics

	Silence	Buy	Sell	Silence – Sell	Buy – Sell
Short interest (%)	9.030	8.865	8.710	[0.320] ^a	[0.155] ^a
Firm size	5.850	6.000	6.662	[−0.812] ^a	[−0.661] ^a
Book-to-market	−0.828	−0.663	−1.120	[0.292] ^a	[0.458] ^a
Return momentum	0.045	−0.054	0.232	[−0.187] ^a	[−0.286] ^a
Institutional ownership (%)	44.908	48.246	53.701	[−8.792] ^a	[−5.454] ^a
Number of analysts	3.489	4.108	5.250	[−1.761] ^a	[−1.143] ^a
Age (yr)	14.821	15.716	13.856	[0.964] ^a	[1.860] ^a
Lit. risk (FPS)	0.371	0.322	0.422	[−0.052] ^a	[−0.100] ^a
Lit. risk (KS)	0.743	0.759	0.868	[−0.124] ^a	[−0.108] ^a
New firm	0.156	0.145	0.149	[0.007] ^a	[−0.004]

Panel B: Fama–MacBeth regressions

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Silence	−5.866 (−4.68) ^a	−5.641 (−4.74) ^a	−4.416 (−3.45) ^a	−4.287 (−3.52) ^a	−3.539 (−3.16) ^a
Buy	1.737 (1.17)	1.851 (1.24)	2.707 (2.35) ^b	2.764 (2.40) ^b	2.535 (2.66) ^a
Short interest		−0.489 (−3.74) ^a		−0.415 (−2.73) ^a	−0.435 (−2.71) ^a
Firm size			1.600 (3.59) ^a	1.405 (2.97) ^a	−0.720 (−0.85)
Book-to-market			−0.494 (−0.48)	−0.715 (−0.68)	−1.845 (−1.86) ^c
Return momentum			0.397 (0.14)	0.292 (0.10)	1.513 (0.63)
Institutional ownership					0.049 (2.43) ^b
Number of analysts					0.309 (2.41) ^b
Idiosyncratic volatility					−97.275 (−1.12)
Firm age					−0.059 (−1.76) ^c
Amihud illiquidity					−1.609 (−2.59) ^b
Dollar volume					0.023 (0.67)
Lit. risk (KS)					2.142 (1.23)
New firm					−4.470 (−2.56) ^b
Intercept	−1.434 (−1.08)	2.362 (1.16)	−14.392 (−3.94) ^a	−10.324 (−2.30) ^b	1.114 (0.20)

Avg. N	779	779	742	742	705
Avg. adj. R2	0.005	0.007	0.021	0.023	0.045

Every month from January 1992 to December 2010 we sort firms into short interest quintiles. Firms within the top short interest quintile are formed into “silence,” “buy,” and “sell” portfolios according to their net insider demand over the past six months. Firms that have positive (negative; missing) net insider demand form the “buy” (“sell;” “silence”) portfolio. Panel A presents the mean values of firm characteristics for the “silence,” “buy,” and “sell” portfolios and the differences among them. Panel B present the Fama–MacBeth cross–sectional regression results. Every month we regress buy–and–hold abnormal returns (defined in Appendix B) over the subsequent 12 months on insider silence, buy, and other control variables. *Silence* is a dummy variable equal to 1 if insiders of the firm do not trade over the past six months; *buy* is a dummy variable equal to 1 if insiders of the firm buy in net over the past six months; *book–to–market* ratio is the natural logarithm of the ratio of book value of equity (CEQQ), and market value of equity (PRCCQ *CSHOQ); *return momentum* is the cumulated return over the past year excluding the most recent month; *lit. risk (KS)* is a dummy variable equal to 1 if the KS measure (in Appendix C) is above sample median; *new firm* is equal to one if the firm is younger than three years. All other variables are defined in Appendix A. Each column reports the time–series average of the cross–sectional regression coefficients. T–statistics are based on Newey–West standard errors. ^a, ^b, and ^c denote statistical significance at the 1%, 5%, and 10% confidence levels, respectively.

Table 10: Insider heavy selling preceding a period of silence

Portfolios	Average portfolio N	Holding period				
		1 m	3 m	6 m	12 m	24 m
Heavy sell	33	-0.71 ^a	-2.17 ^a	-4.65 ^a	-7.42 ^a	-10.21 ^a
Others	164	-0.79 ^a	-2.32 ^a	-4.30 ^a	-6.72 ^a	-10.27 ^a
Others – Heavy sell		-0.08 [-0.31]	-0.14 [-0.29]	0.34 [0.40]	0.70 [0.46]	-0.06 [-0.03]

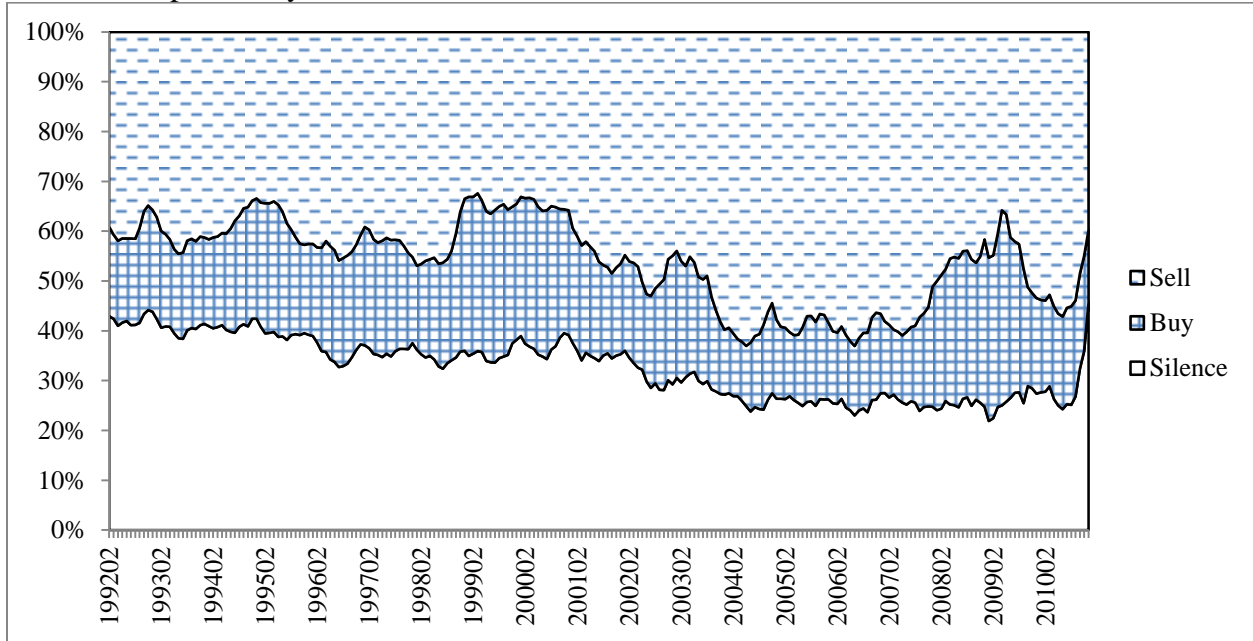
Every month from January 1992 to December 2010, we form sample firms in the top short interest quintile whose insiders have not traded during the past six months (from months -6 to -1 relative to the month to form portfolios). We then examine their insider trading activity over the preceding six months period (from months -12 to -7) and form two portfolios: “Heavy sell” and “Others.” The portfolio “Heavy sell” consists of the lower half of those whose insiders net sell during months -12 to -7 . The remaining stocks form the portfolio “Others.” For each portfolio, we calculate their buy-and-hold abnormal return (BHAR, in %) over the subsequent 1, 3, 6, 12, and 24 months. For the 24-month holding period, we use the sample ending in December 2009. The construction of BHAR is described in Appendix B. The table presents the time-series average BHARs for each of the portfolios and the spread between the two. Tests of average BHARs and the spread between the two portfolios are based on Newey–West standard errors. ^a, ^b, and ^c denote statistical significance at the 1%, 5%, and 10% confidence levels, respectively.

Table 11: Insider silence before and after the Sarbanes–Oxley Act

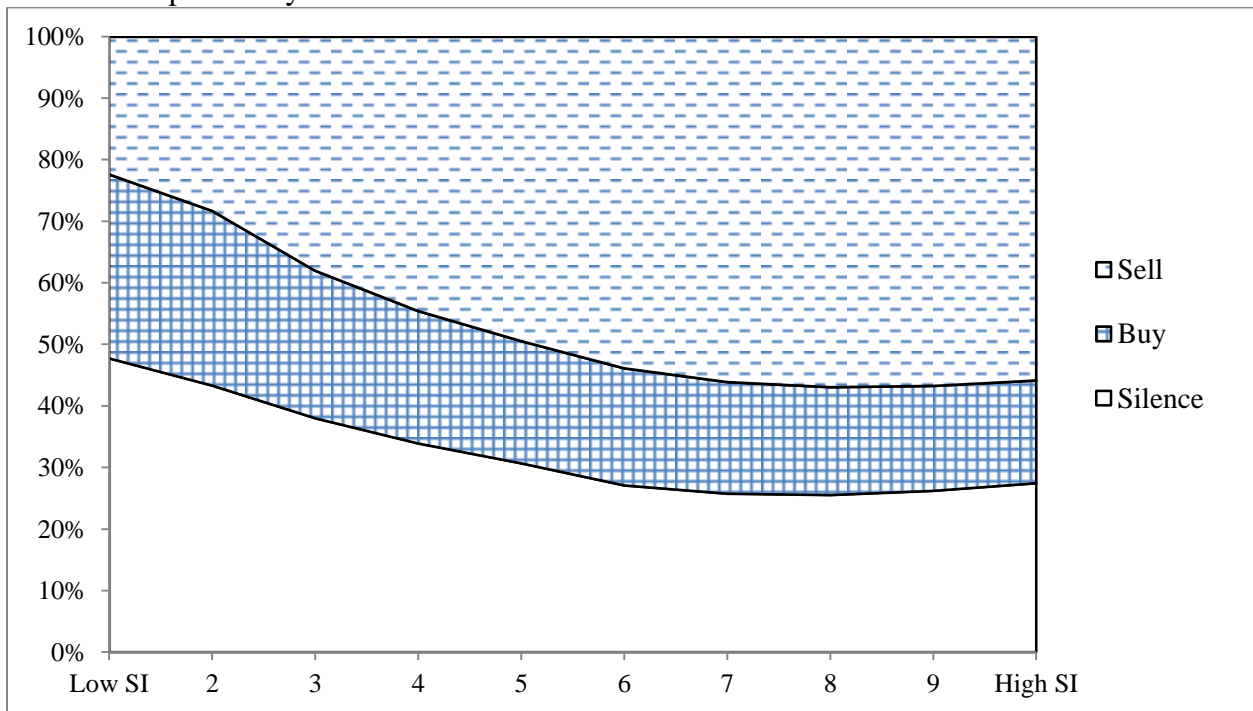
Portfolios	Average portfolio N	Holding period				
		1 m	3 m	6 m	12 m	24 m
Panel A: Before SOX						
Silence	255	-1.11 ^a	-3.11 ^a	-5.30 ^a	-8.05 ^a	-12.10 ^a
Buy	146	-0.11	-0.57	-1.12	0.94	2.56
Sell	429	-0.40 ^b	-0.85 ^c	-0.89	-0.26	1.73
Buy–Sell		0.29 [1.43]	0.28 [0.51]	-0.23 [-0.21]	1.20 [0.70]	0.84 [0.42]
Silence–Sell		-0.70 ^a [-4.26]	-2.27 ^a [-5.49]	-4.41 ^a [-5.21]	-7.80 ^a [-4.47]	-13.83 ^a [-5.14]
Panel B: After SOX						
Silence	146	-0.51 ^b	-1.63 ^a	-3.72 ^a	-6.34 ^a	-9.18 ^a
Buy	115	0.08	-0.22	-0.55	-0.51	0.11
Sell	455	-0.44 ^a	-1.14 ^a	-1.93 ^a	-2.93 ^a	-3.80 ^c
Buy–Sell		0.52 [1.58]	0.92 [1.26]	1.38 [0.99]	2.42 [0.95]	3.91 [1.26]
Silence–Sell		-0.07 [-0.30]	-0.49 [-0.92]	-1.79 ^b [-1.99]	-3.41 ^a [-2.63]	-5.38 ^a [-3.77]

Every month from January 1992 to December 2010, we sort firms into short interest quintiles and keep only the stocks in the top quintile. Panel A is based on the sample from January 1992 to August 2002 and Panel B is based on the sample from September 2002 to December 2010. For firms in the top short interest quintile, we form portfolios based on insider trading activity over the prior six months: the “silence” portfolio contains firms with no insider trading; “buy” represents firms whose insiders net buy; “sell” represents firms whose insiders net sell. For each portfolio, we calculate their buy–and–hold abnormal return (BHAR, in %) over the subsequent 1, 3, 6, 12, and 24 months. For the 24–month case, we use the sample ending in December 2009. The construction of BHAR is described in Appendix B. Each panel presents the time–series average BHAR for each portfolio and the spreads between the portfolios. Tests of average BHARs and their spreads are based on Newey–West standard errors. Newey–West adjusted t –statistics for the spreads are reported in brackets. The second column reports average portfolio sizes. ^a, ^b, and ^c denote statistical significance at the 1%, 5%, and 10% confidence levels, respectively.

Figure 1: Proportion of firms whose insiders net sell, net buy, and keep silence
 Panel A: Proportion by month

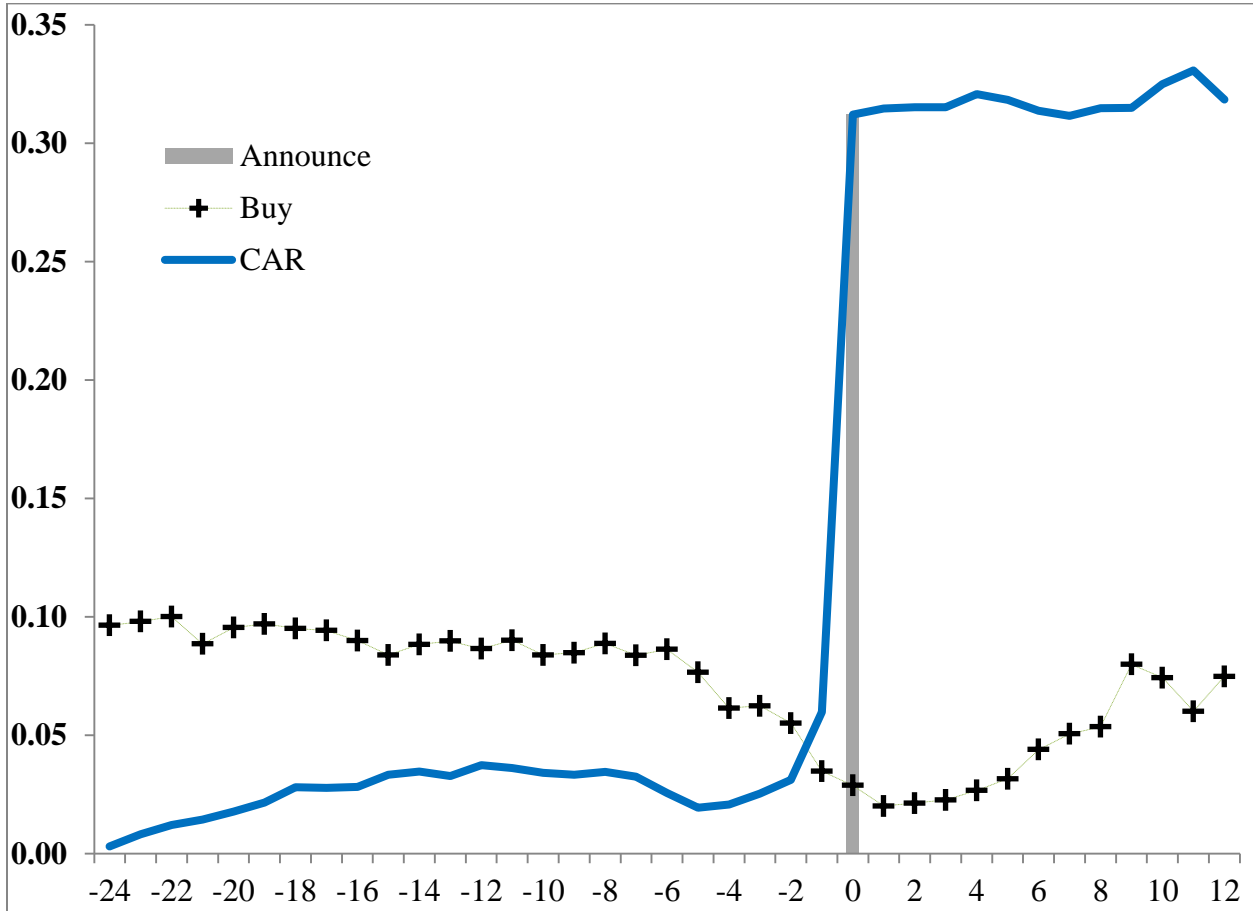


Panel B: Proportion by short interest deciles



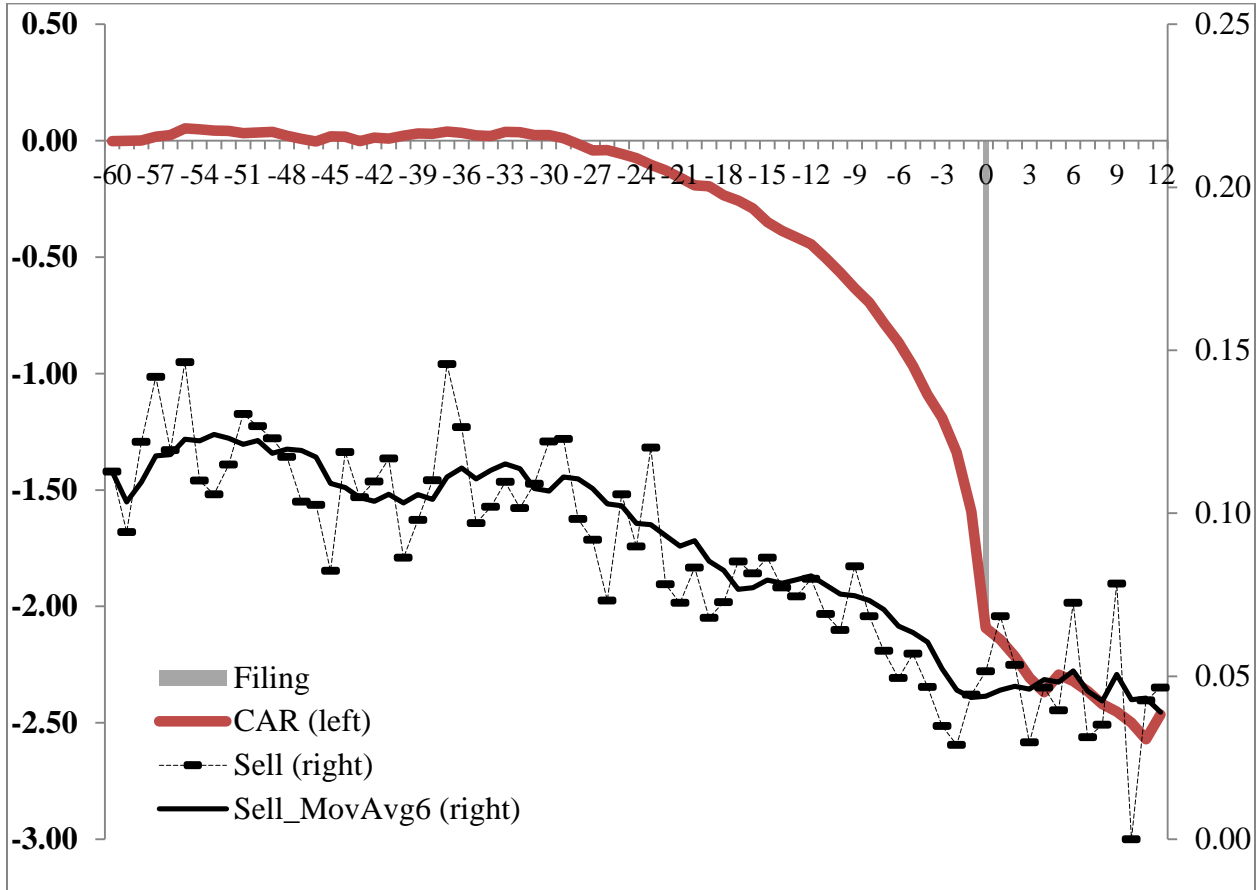
For every month from February 1992 to December 2010, Panel A presents the proportion of firms whose insiders net buy (“Buy”), net sell (“Sell”), or keep silent (“Silence”) over the trailing six months. Panel B presents the time-series average of the proportions by short interest deciles.

Figure 2:
Cumulative abnormal returns and insider net buying in merger targets



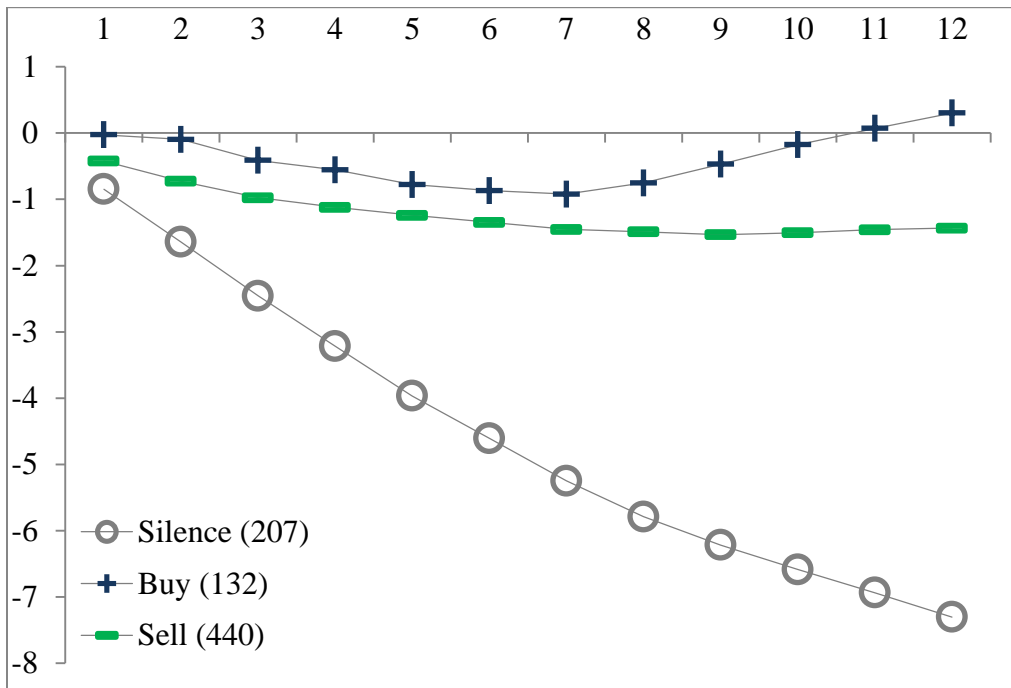
The sample includes 4,267 targets involved in merger deals announced during 1992–2010. Month 0 is the announcement month. The graph shows the proportions of targets whose insiders buy in net (Buy) from 24 months before to 12 months after the announcement. The thick solid line draws the cumulative abnormal returns.

Figure 3:
Cumulative abnormal returns and insider net selling in bankruptcy firms



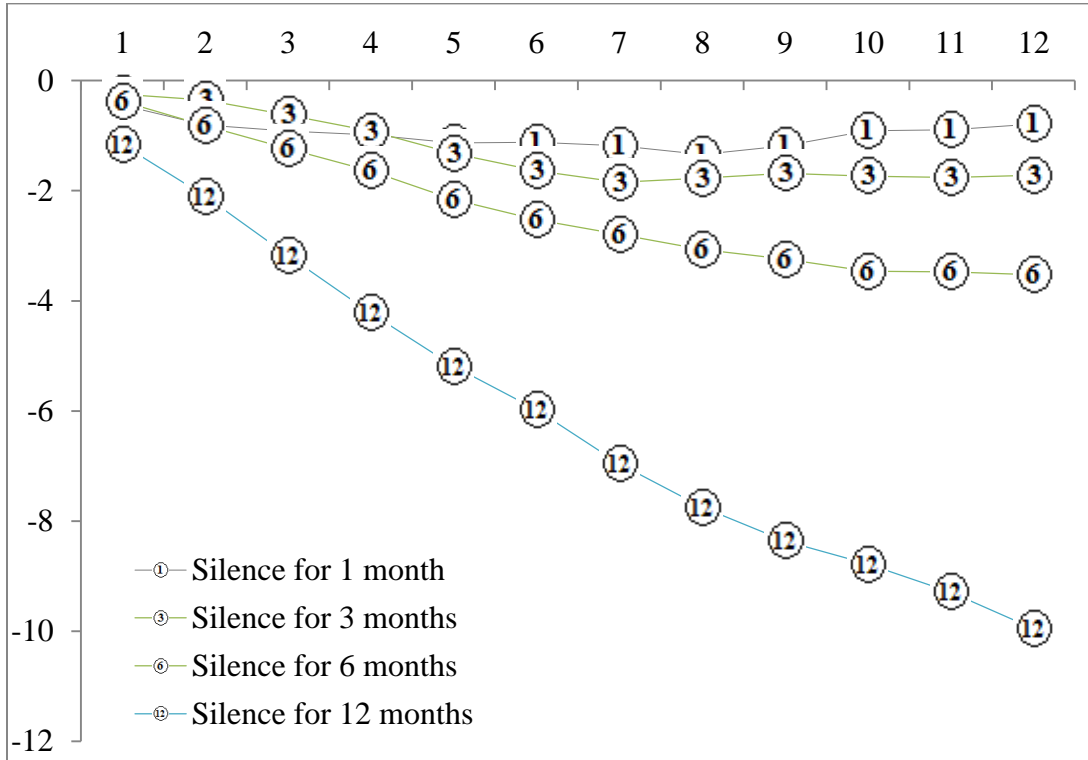
The sample consists of 524 firms that filed bankruptcy during 1992–2010. Month 0 is the filing month. The dashed line shows the proportions of bankruptcy firms whose insiders sell in net (Sell) from 60 months before to 12 months after the announcement; the thin solid line draws the 6–month moving average of this proportion (Sell_MovAvg6); the thick solid line draws the cumulative abnormal returns (CAR). The “CAR” series use the left scale, and the “Sell” and “Sell_MovAvg6” series use the right scale.

Figure 4:
Insider buying, selling, silence, and future returns when insiders possess negative information



Every month from January 1992 to December 2010, we sort firms into short interest quintiles. Within the top quintile, we form portfolios based on insider trading activity over the prior six months: the “silence” portfolio contains firms with no insider trading; “buy” represents firms whose insiders net buy; “sell” represents firms whose insiders net sell. For each portfolio, we calculate the buy-and-hold abnormal return (BHAR, in %) over the subsequent one to 12 months. The construction of BHAR is described in Appendix B. The graph plots the time-series average BHAR for each portfolio. The average portfolio size is shown in parentheses.

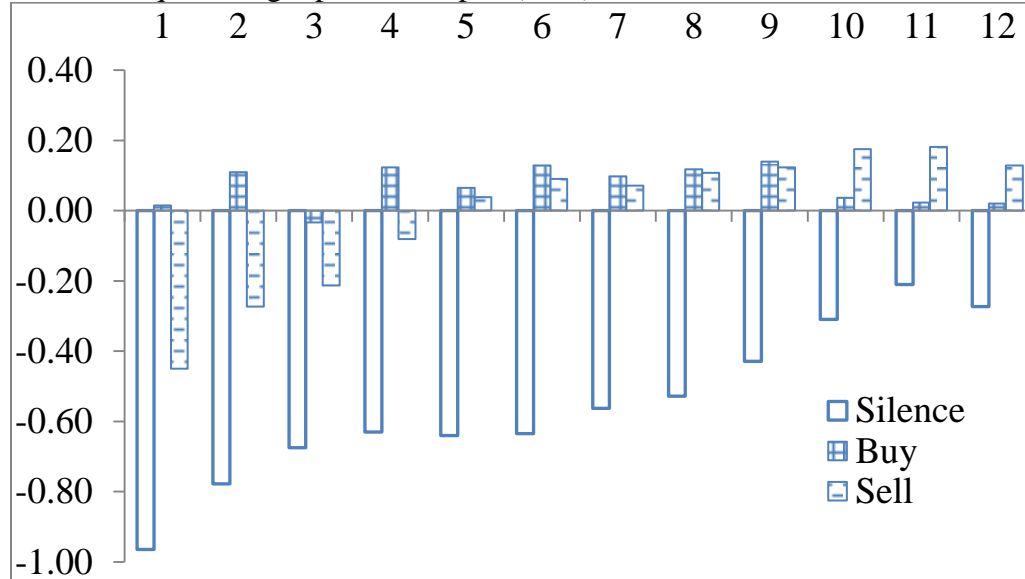
Figure 5:
Length of silence and future returns



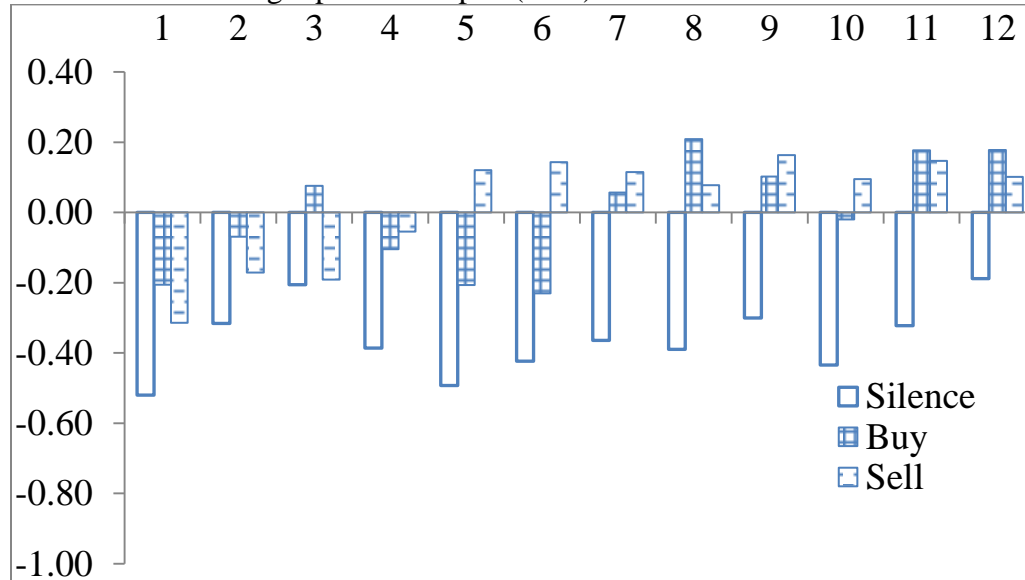
Every month from January 1992 to December 2010, we sort firms into short interest quintiles. Among firms within the top short interest quintile, we form portfolios based on the length of time insiders do not trade over the prior year. Firms whose insiders do not trade over the recent month but have traded prior to that month form the portfolio “Silence for 1 month.” Firms whose insiders do not trade over the recent three months but have traded prior to that period form the portfolio “Silence for 3 months.” Firms whose insiders do not trade over the recent six months but have traded prior to that period form the portfolio “Silence for 6 months.” Firms whose insiders do not trade over the recent 12 months form the portfolio “Silence for 12 months.” The lines plot the time-series average buy-and-hold abnormal returns (BHAR, in %) over the subsequent one to 12 months following portfolio formation. The construction of BHAR is described in Appendix B.

Figure 6: Monthly Fama–French–Carhart alphas

Panel A: Equal-weight portfolio alpha (in %)

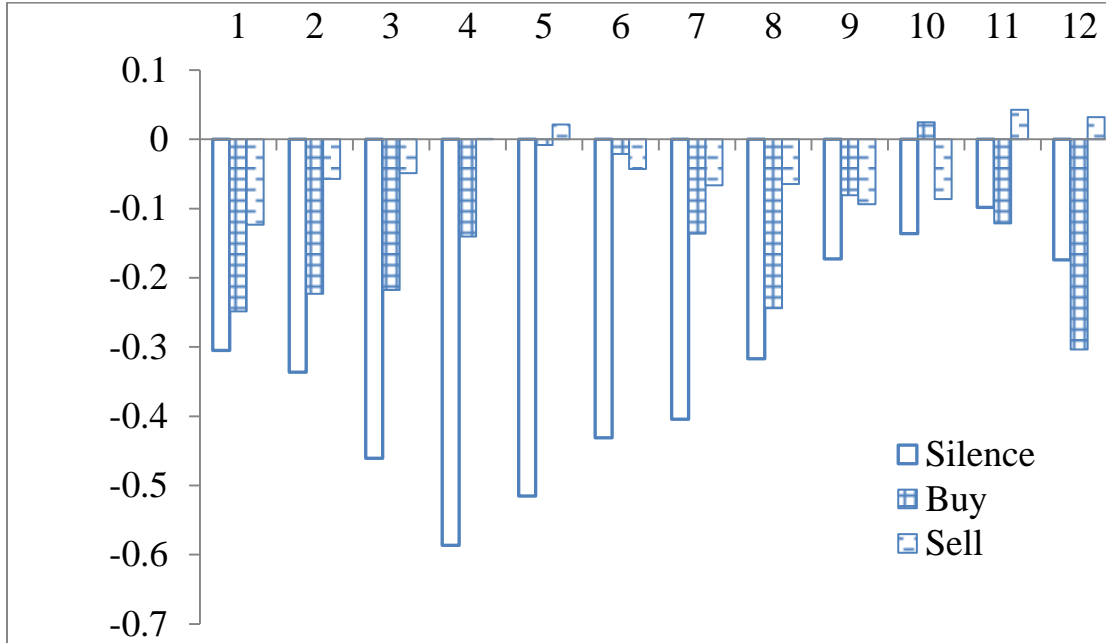


Panel B: Value-weight portfolio alpha (in %)



Every month from January 1992 to December 2010, we sort firms into short interest quintiles. Firms within the top quintile are sorted into portfolios based on their net insider demand over the past six months. Firms that have positive (negative; missing) net insider demand form the “buy” (“sell;” “silence”) portfolio. We then form equal- (panel A) and value-weight (Panel B) monthly return portfolios for every month during the 12 months following portfolio formation and regress the portfolio excess return on the Fama and French (1993) and Carhart (1997) four-factors.

Figure 7: Earnings announcement returns (%)



Every month from January 1992 to December 2010, we sort firms into short interest quintiles. Firms within the top quintile are formed into “silence,” “buy,” and “sell” portfolios according to their net insider demand over the past six months. Firms with positive (negative; missing) net insider demand form the “buy” (“sell,” “silence”) portfolio. Following portfolio formation, we collect the earnings announcement dates from the Compustat quarterly file and calculate their three-day $[-1, +1]$ abnormal returns adjusted by CRSP equal-weight market returns. The figure plots, for each of the three portfolios, the equal-weight average earnings announcement abnormal returns (in %) in each of the 12 months following portfolio formation.

Appendix A: Variable definitions

<u>Main variables</u>	
<i>Net insider demand</i>	Net insider demand of time t is defined as the number of shares that insiders buy minus the number of shares that insiders sell, normalized by the total number of shares outstanding at the end of time t .
<i>Short interest</i>	Short interest in shares divided by the number of shares outstanding, measured at the prior month end.

<u>LTA/IU variables</u>	
<i>Amihud illiquidity</i>	Ratio of absolute daily return to daily dollar volume averaged over the past three months.
<i>Amihud modified illiquidity</i>	Ratio of difference between daily high and low price to daily dollar volume averaged over the past three months.
<i>Dollar trading volume</i>	Average daily dollar volume over the past three months.
<i>Firm age</i>	Number of months since first appearing on CRSP.
<i>Firm size</i>	The market capitalization measured at the prior month end in \$million, then take natural logarithm.
<i>Idiosyncratic volatility</i>	Weekly return standard deviation over the past 52 weeks.
<i>Institutional ownership</i>	The percentage owned by institutional shareholders as of the most recent quarter end. Data from Thomson Financial 13f.
<i>Number of analysts</i>	Number of analysts following the stock as of the most recent month end. Data from I/B/E/S. Missing value is set to zero.
<i>Number of institutional owners</i>	The number of institutional shareholders as of the most recent quarter end. Data from Thomson Financial 13f.
<i>Total volatility</i>	Standard deviation of residuals from regression of weekly stock return on weekly market return over the past 52 weeks.

Appendix B: Construction of buy-and-hold abnormal return (BHAR)

We construct buy-and-hold abnormal return (BHAR) in a way similar to the recent literature (e.g., Lakonishok and Lee 2001; Sias and Whidbee, 2010). Specifically, at the end of June of year t , we independently form NYSE size and book-to-market (B/M) quintiles to extract the breakpoint values, and assign AMEX and NASDAQ stocks to the 5 x 5 portfolios according to their size and B/M values. The equal-weight portfolio return serves as the benchmark return for the stock in the same size and B/M portfolio for the months starting from July of year t to June of year $t+1$. Portfolio assignment is rebalanced every year. BHAR for stock j is defined as the buy-and-hold raw return of stock j minus the buy-and-hold benchmark portfolio return. If a stock is delisted before the holding period, returns of the months after delisting are replaced with the benchmark portfolio returns. The delisting return is used for the delisting month. We calculate BHAR for all stocks/months over the holding period of one to 24 months.

Appendix C: Proxies for litigation risk

Two proxies, FPS and KS, are defined here.

The first proxy is FPS, which is defined as equal to 1 if the firm is in the biotech (SIC codes 2833–2836 and 8731–8734), computer (3570–3577 and 7370–7374), electronics (3600–3674), or retail (5200–5961) industry, and 0 otherwise.

The second proxy KS is based on Model 3 in Table 7 of Kim and Skinner (2012, page 302).

$$\begin{aligned} \text{KS} = & \\ & \text{FPS} * 0.566 \\ & + \text{LNASSETS} * 0.518 \\ & + \text{SALES_GROWTH} * 0.982 \\ & + \text{RETURN} * 0.379 \\ & + \text{RETURN_SKEWNESS} * (-0.108) \\ & + \text{RETURN_STDDEV} * 25.635 \\ & + \text{TURNOVER} * 0.00007 / 1000, \end{aligned}$$

where the right-hand-side variables are defined below.

FPS: Defined above;

LNASSETS: Natural log of total assets at the end of year t–1;

SALES_GROWTH: Year t–1 sales less year t–2 sales scaled by beginning of year t–1 total assets;

RETURN: Market-adjusted 12-month stock return. The accumulation period ends with year t–1 fiscal year-end month;

RETURN_SKEWNESS: Skewness of the firm's 12-month return for year t–1;

RETURN_STDDEV: Standard deviation of the firm's 12-month returns for year t–1;

TURNOVER: Trading volume accumulated over the 12-month period ending with the fiscal year-end before year t–1 fiscal year-end month scaled by beginning of year t–1 shares outstanding.