Disclosures of Insider Purchases and the Valuation Implications of Past Earnings Signals

David Veenman
Amsterdam Business School – University of Amsterdam
d.veenman@uva.nl

Forthcoming in *The Accounting Review* (January 2012)

ABSTRACT: This study examines whether disclosures of insider equity purchases on SEC Form 4 resolve uncertainty regarding the valuation implications of reported earnings. Defining information uncertainty as ambiguity about firm value arising from low earnings precision, I predict and find that insider purchase filings trigger more positive market reactions in firms with greater information uncertainty (lower quality accruals). After controlling for future earnings changes, I further find that market reactions to purchase filings are predictably associated with prior earnings changes. The strength of this effect is increasing in the magnitude of insider purchases as well as the level of information uncertainty. Overall, these findings suggest that, in addition to signaling future earnings information, Form 4 purchase filings help investors learn about the valuation implications of past earnings signals.

Keywords: *insider trading; information uncertainty; accruals quality; earnings persistence*

Data availability: *All data are available from public sources*

This study is based on my doctoral dissertation at the University of Amsterdam and was partly conducted during my visit at the University of Wisconsin-Madison. I appreciate the helpful comments and suggestions of two anonymous reviewers, Paul Zarowin (editor), Steven Kachelmeier (senior editor), Mary Barth, Sanjay Bissessur, Qiang Cheng, Igor Goncharov, Allan Hodgson, Joost Impink, Laurence van Lent, Frank Moers, Jens Mueller, Per Olsson, Peter Pope, Bart van Praag, Bill Rees, Holly Skaife, Dan Wangerin, Terry Warfield, participants of AIS 971 at the University of Wisconsin-Madison, workshop participants at Maastricht University, University of Amsterdam, Stockholm School of Economics, Tilburg University, and participants at the 2009 EAA doctoral colloquium, 2009 EAA annual meeting, and the 2009 AAA annual meeting. Previous drafts of this study were titled "Information Uncertainty and The Relevance of Reported Insider Trades."

I. INTRODUCTION

Lack of precision in corporate disclosures induces uncertainty about firm value. As a result of this uncertainty, investors seek additional disclosure that increases the precision of their information about future cash flows. An important signal that potentially provides such information is managers' decision to trade their firm's equity on personal account. These "insider" trades are visible to investors through public disclosure on the SEC's Electronic Data Gathering, Analysis, and Retrievel (EDGAR) system.[1] Between 2003 and 2008, almost 4 million unique reports were filed on EDGAR, of which by far most were Form 4 filings of insider trades (32.7 percent).[2] In this study, I examine whether Form 4 filings resolve investor uncertainty regarding the valuation implications of reported earnings. I specifically focus on filings of insider purchases, as prior research suggests that private information is mainly reflected in insiders' purchase decisions (e.g., Lakonishok and Lee 2001).

Section 403 of the Sarbanes-Oxley Act of 2002 (SOX) requires insiders to publicly disclose their trading activity on Form 4 within two business days. Before SOX, trades could be reported by the tenth day of the next calendar month. Brochet (2010) finds that timely disclosure enhances the information content of Form 4 filings. Specifically, evidence of stronger post-SOX market reactions to insider purchase filings suggests "…that Section 403 of SOX has brought about more timeliness and transparency in the communication of managers' purchase transactions to the

[1] Section 16(a) of the Securities and Exchange Act of 1934 defines "insiders" as officers, directors, and large shareholders of more than ten percent of any equity class of securities of an issuing company. The group of large shareholders is generally ignored in the empirical literature under the presumption that their trades are less likely to reflect private information.

[2] These figures are based on a descriptive analysis of 3,980,894 unique filings identified via EDGAR's quarterly archive indices (http://www.sec.gov/cgi-bin/edgar_archive_indices). After Form 4 filings, 8-K (13.9 percent) and 6-K (3.6 percent) filings are most frequent. Only 3.2 percent of observations are 10-Q filings, while 1.3 percent are 10-K filings.

market" (Brochet 2010, 421).[3] Hence, the post-SOX regime provides a powerful setting to investigate how disclosures of insider trades affect investor decision making.

Using post-SOX (2003-2008) Form 4 filings and relying on the quality of accruals as proxy for information uncertainty (Dechow and Dichev 2002; Francis et al. 2005, 2007), I first find that market reactions to insider purchase filings are more positive for firms identified as having greater information uncertainty (lower total and innate accruals quality). This result holds after controlling for future earnings changes, other factors related to the information content of insider trades, and characteristics of a firm's information environment. The evidence is consistent with theory predicting that information events trigger greater belief revisions when prior disclosures are of lower precision (e.g., Holthausen and Verrecchia 1988).

To provide more direct evidence on whether insider purchase filings assist investors in resolving earnings information uncertainty, I build on the lagged earnings response coefficient (ERC) model of Freeman and Tse (1989). This model assumes that investors (1) are initially unable to decipher the persistence of a quarterly earnings change, (2) assign a probability estimate to the earnings change being persistent, and (3) reassess their probability estimate around a subsequent information event. The model implies that, in situations of initial uncertainty, market reactions to subsequent information events are associated with prior earnings changes when these events help investors reassess the implications of past earnings for future earnings. The sign of the association depends on whether the events increase or decrease the market's assessed probability of persistence.

[3] In addition to more timely disclosure, information on insider trades has become more easily accessible through electronic filing. While electronic filing on EDGAR was required for most SEC disclosures since 1996, insider filings were initially exempt from electronic filing requirements (SEC 2005). Consequently, many insider trades were not visible on EDGAR. As of June 30, 2003, however, SOX Section 403 requires all insider reports to be made available through the EDGAR system in Extensible Markup Language (XML) formats. Even for firms that previously voluntarily filed their insider ownership reports on EDGAR, the availability of these reports in XML formats has significantly reduced information processing costs.

Viewing insider purchases as signals that "confirm" the persistence of positive past earnings changes and "contradict" the persistence of negative earnings changes, I predict that the market reaction to insider purchase filings is positively (negatively) associated with positive (negative) prior quarterly earnings changes. Consistent with this prediction, I find that market reactions are positively associated with prior earnings changes for purchases following positive earnings changes, and negatively associated with prior earnings changes for purchases following negative earnings changes. The strength of the associations is increasing in the magnitude (relative number of shares traded) of insider purchases. These findings hold after controlling for future earnings changes and suggest that a portion of the market reaction to Form 4 filings can be viewed as a lagged response to prior earnings news.

I then predict that information uncertainty moderates the association between prior earnings changes and market reactions to insider purchase filings. In situations of greater uncertainty, rational investors are more likely to rely on additional disclosures to learn about the valuation implications of an earnings signal (e.g., Francis et al. 2007). Consistent with this prediction, I find that the positive association between prior earnings changes and market reactions to confirming purchase filings is increasing in the level of information uncertainty. Similarly, for the largest contradicting purchase filings, I find that the negative association between prior earnings changes and market reactions is moderated by information uncertainty.

Overall, the empirical results suggest that Form 4 filings of insider purchases provide important information to investors in situations of uncertainty about the valuation implications of past earnings signals. Specifically, Form 4 purchase filings appear to help investors learn about the persistence of prior earnings signals in addition to signaling new information about future earnings. Additional tests indicate that these findings are robust to using absolute abnormal accruals or earnings volatility as alternative proxies for information uncertainty.

This study makes the following contributions. First, while the literature on corporate insider trading is extensive, little evidence exists on the role of Form 4 filings in communicating management's private information to the market. Brochet (2010) is the first to document that timely disclosure of insider purchases triggers significant market reactions in the post-SOX era.[4] By showing how these market reactions vary with the noise and nature of information in prior earnings announcements, my research responds to Brochet's (2010, 445) suggestion that "…[f]uture research could investigate how more timely Form 4s influence the information content of contemporaneous financial disclosure."

Second, this study contributes to the literature by showing that insider share purchases not only signal *future* earnings information (e.g., Lustgarten and Mande 1998; Piotroski and Roulstone 2005; Roulstone 2008), but also private information regarding the valuation implications of *past* earnings news. After controlling for a positive association with future earnings changes, market reactions to Form 4 filings are predictably associated with prior earnings changes. That is, I find that market reactions to insider purchase signals are a combination of investors' anticipation of future earnings news as well as the resolution of uncertainty about the persistence and valuation implications of previously reported earnings.

Third, this study contributes to the literature on rational investor learning about the valuation implications of past earnings signals (e.g., Koch and Sun 2004; Francis et al. 2007). I show how the most frequently filed piece of information on EDGAR assists investors in revising their expectations about the implications of past earnings for future earnings and firm valuation. Lastly, the study contributes to research on the capital market consequences of information

[4] Lakonishok and Lee (2001) find little market response to either the execution or the public disclosure of insider trades in the U.S. in the pre-SOX era, when trades could be reported as late as the tenth day of the next calendar month. Fidrmuc et al. (2006), however, find economically significant market reactions to insider disclosures under a more timely disclosure regime in the U.K.

precision, which is primarily concerned with the effect of earnings precision on *expected* returns (e.g., Francis et al. 2005; Gray et al. 2009; Ogneva 2009; Kim and Qi 2010). I show how earnings precision as proxy for information uncertainty relates to *abnormal* returns around information events in post-earnings announcement periods.

This research is related to three other studies. Koch and Sun (2004) show that dividend changes alter investor perceptions about the persistence of prior earnings changes. While dividend signals are confined to the minority of dividend paying firms, insider trades occur in the majority of U.S. firms.[5] Also – analogous to share repurchases – personal insider share purchases are more flexible than dividends, given the adverse consequences of reducing or omitting a dividend (e.g., Brav et al. 2005). This study adds to Koch and Sun (2004) by focusing on a more direct and flexible signal of management's private information. I further add by documenting the effect of information uncertainty on investor learning about the persistence of past earnings.

Beneish and Vargus (2002) find, among other things, greater persistence of accruals when insiders buy relatively large amounts of shares. Their long-run abnormal return tests suggest that investors rationally price this higher persistence. By focusing on short-window returns around Form 4 filings, I provide evidence on the timing of this pricing. More importantly, while Beneish and Vargus (2002) analyze insider purchases *before* annual earnings announcements, I examine purchases filed shortly *after* quarterly earnings announcements.[6] This difference is important because their study focuses on private information about future earnings, whereas I focus on

[5] Untabulated descriptives reveal that among all companies having at least one observation in the CRSP/Compustat Fundamentals Quarterly database for fiscal 2003-2008, 70.8% have at least one Form 4 filing of officer/director trading. For the sample of companies with available data to compute quarterly earnings changes and accruals quality, this figure increases to 83.1%.

[6] Specifically, Beneish and Vargus (2002) aggregate all insider trading that occurs in firm *i* during fiscal year *t* in order to examine differences in the persistence of firm *i*'s year *t* accruals and earnings (which are publicly disclosed after the fiscal year end) into year *t+1* earnings.

insider purchases and public information about past earnings while controlling for the association with future earnings information.

Huddart and Ke (2007) analyze the relation between insider trading profitability and proxies for information asymmetry. I add to their study by showing that the precision of earnings – which can be viewed as a more primitive construct affecting the information asymmetry between insiders and outsiders (Bhattacharya et al. 2010b; Lambert et al. 2011) – relates to an important outcome of insider purchases, the relevance of its public disclosure on Form 4. While Huddart and Ke (2007) find that R&D expenditure and abnormal returns around past earnings announcements predict long-run returns after insider trades, I document an incremental effect of earnings precision and its moderating effect on lagged responses to earnings announcements around Form 4 filings.[7]

Section II presents the background literature and hypothesis development. Section III discusses the research design, Section IV presents the primary findings, and Section V presents additional tests. Section VI concludes.

II. BACKGROUND AND HYPOTHESIS DEVELOPMENT

Under the assumptions that (1) stock price equals the present value of expected future cash flows, and (2) revisions in the present value of expected future earnings proxy for revisions in the present value of expected future cash flows, one can view changes in stock price as revisions in the present value of expected future earnings (e.g., Kormendi and Lipe 1987; Collins et al. 1994). In this regard, prior research finds that ERCs are positively related to the degree of earnings

[7] In addition, the sample periods in both Beneish and Vargus (2002) and Huddart and Ke (2007) predate the more timely and transparent disclosure regime of SOX Section 403. Lev (2007, 233) comments on the sample period (1994-1997) in Huddart and Ke (2007) and notes that "…[n]ot only does the sample end 10 years ago, but the Sarbanes-Oxley Act of 2002, which had a significant impact on insider trading, its motives, and its consequences (for example, shortening significantly the reporting interval for insider trades), is not reflected in HK's analysis. This leaves open the relevance of this study to today's environment."

persistence (Collins and Kothari 1989; Easton and Zmijewski 1989). That is, greater earnings persistence is associated with a larger stock price revision following a unit of unexpected earnings.[8]

The extent to which stock prices reflect the implications of current earnings for future earnings depends on investors' ability to decipher the persistence of an earnings signal. In situations of uncertainty, rational investors are likely to utilize additional disclosures subsequent to an earnings announcement to learn about the valuation implications of the earnings signal (Francis et al. 2007). Freeman and Tse (1989) show that subsequent earnings announcements resolve part of the uncertainty about the persistence of earnings. Koch and Sun (2004) show that dividend changes help investors revising their expectations about the persistence of past earnings signals.

Following prior research, I associate information uncertainty with information precision (e.g., Ecker et al. 2006; Francis et al. 2007; Bhattacharya et al. 2010b). Specifically, I argue that the lower is the precision of information with respect to a firm's expected future cash flows, the greater is the level of uncertainty about the implications of the information for firm value. As a primary task of accounting earnings is to inform investors about expected future cash flows (Dechow et al. 1998; Barth et al. 2001), lower earnings precision arguably induces more uncertainty about a firm's future cash flows and, hence, firm value.

The precision of public information (e.g., earnings) affects the information asymmetry between insiders and outside investors. Recent theoretical and empirical research suggests that information precision can be viewed as a primitive construct affecting information asymmetry,

[8] Holding constant persistence, the assumptions also imply that ERCs are inversely related to discount rates. See Collins and Kothari (1989) and Easton and Zmijewski (1989) for empirical evidence. Other studies have shown that the ERC varies with factors such as a firm's information environment, ex-ante uncertainty, predictability, expected rates of return, and growth opportunities (Atiase 1985; Collins and Kothari 1989; Lipe 1990; Imhoff and Lobo 1992).

and that precision, not information asymmetry, affects investor risk assessments and the cost of equity capital (Bhattacharya et al. 2010b; Lambert et al. 2011). Bhattacharya et al. (2010a) further show that low earnings precision increases information asymmetry around earnings announcements, thereby increasing the value of private information held by informed investors. Baiman and Verrecchia (1996) also posit that managers' information advantage is inversely related to the precision of public information.

I examine the interaction between information uncertainty and information asymmetry, investigating whether shocks in the information asymmetry between insiders and outsiders resolve uncertainty about prior earnings signals. Specifically, I propose that the public disclosure of insider transactions is an important source of information for investors to learn about the valuation implications of prior earnings signals. Evidence in the insider trading literature suggests that insider share purchases reflect managers' private information related to future stock returns (e.g., Jaffe 1974; Finnerty 1976; Seyhun 1986, 1998) and future cash flows (Piotroski and Roulstone 2005; Roulstone 2008). Brochet (2010) finds that disclosures of insider purchase decisions on SEC Form 4 in the post-SOX era trigger economically significant belief revisions. Insider sales are generally found to be less informative and more likely driven by insiders' consumption and diversification needs (e.g., Lakonishok and Lee 2001; Jeng et al. 2003; Cheng and Lo 2006; Gu and Li 2007).

I first test the average effect of information uncertainty on investor belief revisions after insider purchase filings. Theory suggests that the magnitude of market reaction to information decreases with the noise (lack of precision) in the information and increases in prior uncertainty (e.g., Holthausen and Verrecchia 1988). Empirical studies confirm that ERCs are smaller for earnings signals of lower precision (e.g., Teoh and Wong 1993; Ecker et al. 2006). Defining information uncertainty (IU) as ambiguity about firm value arising from low earnings precision, I

predict that post-earnings announcement information events trigger stronger investor belief revisions in firms with greater IU. As low earnings precision increases information asymmetry around earnings announcements (e.g., Bhattacharya et al. 2010a), disclosures of management's private information through their trading decisions are expected to be more informative. The first hypothesis is stated as follows (in alternative form):

H1: The market reaction to insider purchase filings is increasing in the level of IU.

To more directly test whether Form 4 filings resolve investor uncertainty regarding the valuation implications of previous earnings signals, I build on the lagged ERC framework of Freeman and Tse (1989). In this regard, assume that a quarterly earnings change ($\Delta QEARN$) that is publicly disclosed is either permanent or transitory. Based on the evidence in prior research (e.g., Kormendi and Lipe 1987), we can expect the ERC for permanent earnings changes (ERC^{perm}) to be greater than the ERC for transitory changes (ERC^{trans}). Because of uncertainty about actual persistence, however, investors initially assign a probability p to the earnings change being permanent and a probability $(1–p)$ to the earnings change being transitory. Accordingly, the initial price reaction to the earnings signal is a weighted average reaction and can be depicted as (Freeman and Tse 1989; Koch and Sun 2004):

$$R_{initial} = [\, pERC^{perm} + (1-p)ERC^{trans} \,]\Delta QEARN \tag{1}$$

In the period after an earnings announcement, other information events can result in revisions in investors' initial beliefs and resolve uncertainty about the persistence of the earnings change. Specifically, if subsequent information confirms (contradicts) the persistence of the previous earnings change, investors are likely to increase (decrease) their assessed probability that the

earnings change is permanent from p to p^* (Δp). The price reaction to this subsequent information event can be formulated as (Freeman and Tse 1989; Koch and Sun 2004):

$$R_{subseq} = \Delta p[ERC^{perm} - ERC^{trans}]\Delta QEARN \quad (2)$$

Equation (2) implies that market reactions to subsequent information events (R_{subseq}) are a function of prior earnings changes ($\Delta QEARN$) in situations of initial uncertainty. The sign of the association between prior earnings changes and market reactions to these events depends on whether the events increase or decrease the market's assessed probability of persistence. Given that [$ERC^{perm} - ERC^{trans}$] is positive, market reactions to confirming (contradicting) events that increase (decrease) the market's assessed probability of persistence should be positively (negatively) associated with $\Delta QEARN$. Viewing insider purchases as good news signals that confirm the persistence of a positive earnings change, and contradict the persistence of a negative change, the second hypothesis is stated as follows (in alternative form):

H2: The market reaction to insider purchase filings is positively (negatively) associated with positive (negative) previous earnings changes.

Lastly, I combine H1 and H2 and examine the role of IU in the association between prior earnings changes and market reactions to Form 4 purchase filings. In the lagged ERC model, the extent of investor belief revision (Δp) is affected by the strength of the subsequent information signal (as shown later in the empirical tests) as well as initial uncertainty. As insider purchase filings are predicted to trigger greater belief revisions in firms characterized as having greater IU – holding constant the strength of the insider signal – lagged responses to earnings around Form 4 filings should be more pronounced for high IU firms relative to low IU firms. That is, the positive (negative) association between market reactions to insider purchase filings following positive

(negative) earnings changes will increase (become more negative) in situations of greater IU. Accordingly, the last hypothesis is stated as follows (in alternative form):

H3: The association between market reactions to confirming insider purchase filings and previous earnings changes is more positive for firms identified as having greater IU. The association between market reactions to contradicting insider purchase filings and previous earnings changes is more negative for firms identified as having greater IU.

III. RESEARCH DESIGN

Data and Sample Selection

Table 1 presents the sample selection and data filtering for Form 4 filings. I initially obtained over 1.5 million open market share trades by officers and directors, reported between 2003 and 2008, from Thomson Reuters. Consistent with prior research, I focus on open market share trades and exclude share purchases through option exercises (Cheng and Lo 2006; Huddart and Ke 2007; Huddart et al. 2007; Rogers 2008). Given that many option exercises are associated with immediate (open market) share sales, the inclusion of share purchases through option exercise would lead to double counting and the misclassification of purchases that are actually sales (Huddart and Ke 2007). In addition, because the purchase price is fixed with option exercises, purchases through exercises likely reflect different information than regular purchases (Cheng and Lo 2006; Veenman et al. 2011). I further exclude trades by non-officer insiders, such as large shareholders, that are less likely to possess private information about a firm's future cash flows (Cheng and Lo 2006; Huddart et al. 2007).

I applied several filters to ensure consistency of the data. First, I dropped all observations with Thomson cleanse code "A" ("numerous missing or invalid data elements") or "S" ("security did not meet collection requirements"). I then deleted observations with incomplete data (e.g.,

transaction price is missing). An additional 5.4 percent of observations are lost because no match was found with the CRSP database based on CUSIP identifier[9], 0.1 percent of cases are related to firms not listed on NYSE, AMEX, or NASDAQ, and another 5.2 percent are lost because no match was found with the Compustat database. This procedure results in a sample of 1,389,313 insider transactions.

- Insert Table 1 about here -

Next, observations are dropped when non-common shares underlie the transaction, when no price or return data is available on the transaction date or filing date, when the number of shares traded is greater than 25 percent of the number of shares outstanding or daily trading volume, and when the transaction price is outside of the daily price range reported on CRSP (Frankel and Li 2004). Lastly, I eliminate all trades reported with a delay of more than 50 business days (Brochet 2010) resulting in a final sample of 1,218,729 transactions.

I aggregate transactions by firm and filing date and characterize each firm-filing date as "purchase" or "sale." This procedure results in 37,828 purchase filing events and 147,219 sales filing events. The requirement of a match with a quarterly earnings announcement not earlier than 60 business days before the event reduces the number of observations to 28,618 purchase and 117,056 sales filing events. The requirement of data to compute the IU metric further reduces the number of observations to 16,951 purchase and 92,694 sales filing events.[10]

To get an understanding of the distribution of insider filing events in the 60 business day window after earnings announcements, Figure 1 shows frequencies of trading and filing activity during this window. The main insight is that, consistent with policies restricting trading around

[9] The firm identifier used in the Thomson data is CUSIP. The CRSP file "stocknames" is used to match the Thomson data with CRSP. For those companies that have a changing CUSIP over time, the historical eight-digit CUSIP identifier (NCUSIP) is used. Companies with no changes are matched by header CUSIP.

[10] Insider trades that occur less than four days before the next quarterly earnings are excluded in order to make sure that the return window (see next section) for the insider filings does not include the next earnings announcement.

earnings announcements (e.g., Roulstone 2003), transactions and filings are most frequent in the short window after the earnings announcement. This highlights the importance of examining the potential relation between information in earnings announcements and post-announcement disclosures of insider trades.

- Insert Figure 1 about here -

Lastly, I drop observations for filings that occur within four business days of 10-K filings, 10-Q filings, 8-K filings, and management earnings forecasts, resulting in samples of 12,834 purchase filing events and 70,821 sales filing events.[11] This final filter is applied to ensure that observed market reactions to Form 4 filings are not driven by managers opportunistically trading shortly before other information events. For example, Huddart et al. (2007) find that insiders profit by trading shortly before 10-K and 10-Q filings.[12]

Market Reaction to Form 4 Filings

Following Lakonishok and Lee (2001), I measure the market reaction to Form 4 filings as the cumulative abnormal return from the filing day to four days after the event: CAR[0,+4]. Daily abnormal returns are calculated by subtracting the average return of similar sized firms (using NYSE/AMEX/NASDAQ year-end cutoffs) from the cum-dividend daily return.[13] Consistent with

[11] Data on 10-K, 10-Q, and 8-K filings are obtained from EDGAR. Data on management earnings forecasts are obtained from First Call's Company Issued Guidance database. 1,803 (9,782) purchase (sales) filing events are matched with 10-K/Q filings, 2,576 (12,932) purchase (sales) filing events are matched with 8-K filings, and 78 (972) purchase (sales) filing events are matched with management forecasts. Some purchase and sales filing events are matched with multiple information events.

[12] An additional potential explanation for abnormal returns around Form 4 filings, unrelated to firm fundamentals, is that insiders "game" the market by purchasing shares, waiting for the market to (positively) respond to the trading disclosure, and immediately sell shares at an increased price. However, the "short-swing" rule under Section 16(b) of the Securities and Exchange Act of 1934 prevents short-term trading opportunities to insiders by allowing shareholders to recover any profits made by an insider when purchasing and selling (or selling and purchasing) securities within a period of six months. Hence, there is limited scope for insiders to game the market.

[13] Results are insensitive to the use of alternative measures of abnormal returns. For example, Fama and French (1993) three factor model abnormal returns, adjusted for momentum (Carhart 1997) and/or accrual quality (Ecker et al. 2006) produce qualitatively similar results.

prior literature, descriptive statistics in Panel B of Table 1 reveal that the mean (median) market reaction to insider sales filings is small in economic terms: *CAR%*=-0.11 percent (-0.22 percent). On the other hand, I find a strong market reaction around purchase filings. Mean (median) five day cumulative abnormal returns equal 2.36 percent (1.35 percent), which is economically significant and in line with Brochet (2010). Because of the limited information content of insider sales, the remainder of this study focuses on insider purchases. In supplemental tests reported later, I provide multivariate analyses of variation in market reactions to Form 4 sales filings.

Measuring Information Uncertainty

Following Francis et al. (2007), I use accruals quality as the main measure of IU, measured as the extent to which working capital accruals map into past, current, and future operating cash flows (Dechow and Dichev 2002; McNichols 2002). Under the assumption that cash flow is the valuation-relevant construct that earnings is intended to measure, variability in the (lack of) mapping of accruals into cash flows captures uncertainty about the valuation implications of accounting earnings. Lack of precision in accruals is driven by intentional as well as unintentional estimation errors (Dechow and Dichev 2002). I estimate the following equation using OLS for every year and three-digit SIC industry using all firms in the CRSP/Compustat universe:[14,15]

$$WCA_{it} = \beta_0 + \beta_1 OCF_{it-1} + \beta_2 OCF_{it} + \beta_3 OCF_{it+1} + \beta_4 \Delta SAL_{it} + \beta_5 PPE_{it} + \varepsilon_{it}, \quad (3)$$

[14] At least 20 observations are required per industry-year group. If less than 20 observations are available, I use the two-digit SIC code or one-digit SIC code.

[15] Ball and Shivakumar (2006) show that the explanatory power of equation (3) can be enhanced by controlling for the role of accruals in conditional conservatism. For the sake of comparability with prior research (e.g., Francis et al. 2007) I rely on the specification of equation (3) without controlling for this effect. Untabulated tests, however, suggest the main inferences of the paper are not affected when controlling for conditional conservatism in equation (3) using the level or change in cash from operations as proxy for economic gains and losses.

where WCA_{it} is working capital accruals for firm *i* in year *t*, computed as net income before extraordinary items (Compustat Fundamentals Annual data item IBC), plus depreciation and amortization (DPC), minus cash flow from operations (OANCF). OCF_{it} equals the cash flow from operations in year *t* for firm *i*, ΔSAL_{it} is the change in revenues (SALE) relative to year *t-1*, and PPE_{it} is gross property plant and equipment (PPEGT). All variables are deflated by average total assets (AT).[16] The residual term (ε) in equation (3) reflects unexplained accruals. Accruals quality (*AQ*) is measured as the standard deviation of residuals over the latest five firm-years, with a minimum of three years (e.g., Ashbaugh-Skaife et al. 2008).

Following prior research, I split *AQ* into its innate and discretionary components. The innate component of *AQ* can be viewed as a stable component resulting from firms' business models and operating environments, whereas the discretionary component can be viewed as a less stable component that results from management's reporting decisions (Francis et al. 2009). While discretionary accrual adjustments reflect a combination of management opportunism and signaling effects that are offsetting (e.g., Guay et al. 1996), prior research finds that innate *AQ* more strongly affects information risk than discretionary *AQ* (e.g., Francis et al. 2005; Francis et al. 2008; Gray et al. 2009; Bhattacharya et al. 2010b; Kim and Qi 2010). Similarly, I expect the effect of IU on market reactions to insider purchase filings to be driven by fundamental uncertainty about future cash flows, as captured by innate *AQ*. The discretionary component of *AQ* is less likely to drive the IU effect, as managers can use their reporting discretion to increase the precision of an earnings signal and thereby reduce uncertainty around earnings

[16] In order to mitigate the influence of extreme observations, I winsorize all variables (and all other continuous variables introduced later) at the 1st and 99th percentiles of their distributions (Kothari et al. 2005; Francis et al. 2005).

announcements. That is, discretionary reporting itself can reduce investors' needs for additional disclosure after earnings announcements.[17]

I determine the innate and discretionary components of *AQ* by estimating the following regression equation by year (Francis et al. 2005):

$$AQ_{it} = \beta_0 + \beta_1 \ln(TA)_{it} + \beta_2 \sigma(OCF)_{it} + \beta_3 \sigma(SALES)_{it} + \beta_4 \ln(CYCLE)_{it} + \beta_5 NEGEARN_{it} + \varepsilon_{it}, \quad (4)$$

where $\ln(TA)$ is the natural logarithm of total assets; $\sigma(OCF)$ is the 3-5 year standard deviation of the ratio of cash flow from operations to average total assets; $\sigma(SALES)$ is the 3-5 year standard deviation of the ratio of sales to average total assets; $\ln(CYCLE)$ is the natural logarithm of the operating cycle, measured as the sum of days receivables (ratio of average receivables to average sales per day) and days inventory (ratio of average inventory to average sales per day); and *NEGEARN* is the proportion of firm-years with negative earnings before extraordinary items in the most recent 3-5 years. Innate quality equals the fitted value from the above estimation: *AQI*. The residual portion (ε) is labeled discretionary quality: *AQD*.

Empirical Model

To test H1 and H2, I estimate the following regression equations:

$$CAR\%_{it} = \beta_0 + \beta_1 IU_{it} + \beta_2 \Delta FUTURE_{it} + \varepsilon_{it} \quad (5)$$

$$CAR\%_{it} = \beta_0 + \beta_1 \Delta QEARN_{it} + \beta_2 \Delta FUTURE_{it} + \varepsilon_{it}, \quad (6)$$

where *CAR%* is defined as before and *IU* is information uncertainty measured by accruals quality (*AQ*), innate accrual quality (*AQI*), or discretionary accruals quality (*AQD*). Following Koch and

[17] In addition, separating *AQ* into its innate and discretionary components alleviates concerns that managers opportunistically use their reporting discretion to increase the expected benefits from their trading.

Sun (2004), $\Delta QEARN$ is the seasonally differenced change in quarterly earnings, calculated as the difference between current quarter earnings before extraordinary items (Compustat Fundamentals Quarterly data item IBQ) and that of the same quarter one year earlier. $\Delta QEARN$ is deflated by lagged total assets (ATQ).[18] Further, I include $\Delta FUTURE$ to control for the potential association between insider purchases and one-year-ahead earnings changes (Piotroski and Roulstone 2005) and the potential association between IU and future profitability.[19] $\Delta FUTURE$ is the sum of the subsequent four quarterly earnings changes, scaled by lagged total assets. H1 predicts that β_1 is positive in equation (5), while H2 predicts that β_1 in equation (6) is positive for confirming insider purchases ($\Delta QEARN>0$) and negative for contradicting insider purchases ($\Delta QEARN<0$). β_2 is predicted to be positive in both (5) and (6) if insider purchases signal future earnings information.

Equation (2) suggests that the association between prior earnings changes and market reactions to subsequent information events is increasing in the magnitude of investors' belief revisions (Δp). While prior evidence in the insider trading literature suggests that larger insider purchases reflect more private information (e.g., Seyhun 1998), I expect that lagged responses to earnings around Form 4 purchase filings are stronger for larger reported trades. Therefore, following Koch and Sun (2004), who examine the effect of the size of dividend changes, I split the sample into quartiles based on the magnitude of insider trades ($INTENS\%$) and estimate the following equation:

[18] When matching AQ with quarterly earnings announcements, AQ is assumed to be available to the market three months after a firm's fiscal year end (Francis et al. 2007). Next, the quarterly earnings announcements are matched with insider filing events during the 60 trading-day window after earnings announcements. This 60 trading-day window approximately captures the number of trading days in a fiscal quarter.

[19] For example, Ogneva (2009) finds that accruals quality is inversely related to future cash flow shocks.

$$CAR\%_{it} = \beta_0 + \beta_1 \Delta QEARN_{it} * SIZE1_{it} + \beta_2 \Delta QEARN_{it} * SIZE2_{it} + \beta_3 \Delta QEARN_{it} * SIZE3_{it} + \beta_4 \Delta QEARN_{it} * SIZE4_{it} + \beta_5 \Delta FUTURE_{it} + \varepsilon_{it}, \quad (7)$$

where *SIZE#* is an indicator variable equal to 1 if the magnitude of the insider purchase falls in quartile #={1,2,3,4} of the distribution of trade magnitude, and 0 otherwise. *SIZE1* (*SIZE4*) indicates trades of the smallest (largest) magnitude. Under the assumption that larger insider purchases trigger greater belief revisions (Δp), β_4 is expected to more positive (negative) than β_1 for confirming (contradicting) insider purchase filings.[20]

Lastly, to test whether the association between earnings changes and confirming/contradicting insider purchases is moderated by IU (H3), I add an interaction term between *IU* and *ΔQEARN* to equation (6):

$$CAR\%_{it} = \beta_0 + \beta_1 \Delta QEARN_{it} + \beta_2 \Delta FUTURE_{it} + \beta_3 IU_{it} * \Delta QEARN_{it} + \varepsilon_{it}, \quad (8)$$

where β_3 is expected to be positive for purchase filings that confirm the persistence of a positive prior earnings change, and negative for purchase filings that contradict the persistence of a negative prior earnings change. If IU drives the association between past earnings changes and market reactions to insider purchase filings, I expect the main effect of *ΔQEARN* on *CAR%* to disappear when including the interaction between *IU* and *ΔQEARN*. In fact, in the extreme case of perfect information (no uncertainty), the lagged ERC model predicts a zero association between past earnings changes and market reactions to subsequent information events. Koch and Sun (2004, 2103) estimate a similar equation by including an interaction between *ΔQEARN* and

[20] Equation (7) is similar to Koch and Sun's (2004, 2103) equation (8), where they partition the quarterly earnings change based on the magnitude of dividend changes. Following their design, I do not include the main effects of size interactions in equation (7). While the main analyses include the partitioning variable *INTENS%* as a control (see next section), I find that further adding the main effects of insider purchase magnitude has no qualitative influence on the results.

an indicator variable for positive past earnings changes in their model explaining lagged earnings responses around dividend change announcements.

Control Variables[21]

I control for factors related to insider trading and firms' information environments. First, cumulative abnormal returns over the 60 days before the filing (*CARPRE%*) control for the contrarian nature of insider trades (e.g., Rozeff and Zaman 1998). Consistent with Brochet (2010), I control for the magnitude of trading by including a variable equal to the number of shares traded as a percentage of shares outstanding (*INTENS%*). Also following Brochet (2010), I control for reporting delay (*LAG*) and the likelihood of firm-level trading restrictions (*RESTRICT*) based on Roulstone (2003).

Prior research suggests that insiders of smaller firms trade more profitably than those of larger firms (e.g., Seyhun 1998). At the same time, accruals quality is lower in smaller firms (Dechow and Dichev 2002). Firm size is measured by market value at the end of the fiscal quarter (*MV*). I include the book-to-market ratio (*BTM*) to control for insiders buying relatively more shares in high book-to-market ("value") firms (Rozeff and Zaman 1998) and the effect of growth on accruals quality.

Frankel and Li (2004) show that analyst following is negatively related to the predictive ability and frequency of insider trades, as well as to the informativeness of financial statements. Analyst following (*NUMEST*) is obtained from the I/B/E/S database and is set to zero when a firm is not covered by I/B/E/S (Frankel and Li 2004, 241). I include firm age (*AGE*) to control for differences in the amount of information available about a firm (Lang 1991; Ecker et al. 2006). Following Brochet (2010), I include indicator variables for loss firms (*LOSS*) and R&D firms

[21] All variables are defined in the Appendix.

(*RND*). Previous research suggests that losses and R&D expenses complicate the use of earnings for forecasting future cash flows. Dechow and Dichev (2002) find a positive association between *AQ* and the incidence of losses, while Kim and Qi (2010) document a positive association between *AQ* and R&D. Lastly, I control for the median magnitude of market reactions to past earnings announcements (*MAG_AR%*). Huddart and Ke (2007) find that this variable (proxying for information asymmetry) is positively related to the profitability of insider trades.

IV. RESULTS

Descriptive Statistics

Table 2 presents descriptive statistics for the sample of 12,834 purchase filing observations. While not all market responses to purchase filings are positive (the Q1 value of *CAR%* equals -1.78 percent), 25 percent of filings are associated with a market reaction of at least 5.32 percent. Among the main variables, *AQ* and *AQI* have mean (median) values of 0.062 (0.044) and 0.063 (0.056), respectively. By construction, the average of *AQD* is approximately zero. *ΔQEARN* and *ΔFUTURE* are also centered around zero.

- Insert Table 2 about here -

Among the control variables, *CARPRE%* is negative, on average (-4.11 percent), consistent with insiders buying shares after stock price declines (e.g., Lakonishok and Lee 2001). The mean (median) trading intensity (*INTENS%*) as percentage of shares outstanding equals 0.037 percent (0.011 percent), comparable to the value of 0.04 percent (0.01 percent) for post-SOX purchase filings reported by Brochet (2010, Table 1). The mean (median) filing delay (*LAG*) in business days equals 1.97 (1.00), suggesting most filings occur on time. In fact, untabulated tests reveal that 90.3 percent of filings occur within the prescribed two business days. To control for the high skewness in this variable, the natural logarithm of *LAG* is included in the regressions. Further,

36.8 percent of firms are identified as having firm-level trading restrictions (*RESTRICT*), similar to Brochet (2010, Table 1), who reports 37 percent post-SOX. Because firm size (*MV*) is highly skewed, I include its natural logarithm in the analyses. The average book-to-market ratio (*BTM*) is smaller than one, and firms are followed by an average of 4.87 analysts (*NUMEST*). Following Frankel and Li (2004) and Huddart et al. (2007), I use the natural logarithm of analyst following in the regressions. The average age of firms is 17.59 years, while 36.0 percent of firms report a loss (*LOSS*) and 37.6 percent have R&D expenditures (*RND*). Lastly, the average median absolute market reaction to prior earnings announcements (*MAG_AR%*) is 4.02 percent, slightly higher than the value of 3.49 percent reported by Huddart and Ke (2007, Table 1).

- Insert Table 3 about here -

Table 3 presents pairwise and rank correlations between the variables presented in Table 2. Consistent with expectations, *CAR%* is positively correlated with *AQ*, *AQI*, *ΔFUTURE*, *INTENS%*, *BTM*, *LOSS*, and *RND*, and is negatively correlated with *CARPRE%*, *ln(MV)*, and *AGE*. Further, consistent with the inclusion of future earnings changes as a control, *ΔFUTURE* is positively related to *AQ*. Consistent with prior research, *AQ* is also negatively related to *ln(MV)*, *LOSS*, and *RND*. In addition, it is negatively correlated with *BTM*, *ln(NUMEST)*, and *AGE*. Lastly, *AQ* is positively correlated with trading intensity (*INTENS%*).

Effect of IU on Market Reaction to Form 4 filings

Table 4 presents results from testing H1. Equation (5) is estimated using OLS and significance levels are based on Rogers standard errors adjusted for heteroskedasticity and two-way clustering by firm and fiscal quarter (Petersen 2009; Gow et al. 2010). Panel A first presents results for the basic equation (5), while Panel B presents results from estimating the expanded equation (5) with the full set of control variables. Following Francis et al. (2005), I use the decile

ranks of the accruals quality variables. Further scaling the ranks between zero and one allows the regression coefficients to be interpreted as the difference in market reaction between firms in the highest and lowest IU deciles.

- Insert Table 4 about here -

For each of the models in Panel A, I find a strong positive association between future earnings changes (*ΔFUTURE*) and market reactions (*CAR%*). This finding is consistent with stock prices reflecting more information on future earnings after Form 4 filings of insider purchases. Next, in support of H1, I find significant differences of 1.57 percent and 1.98 percent in abnormal returns between firms in the lowest and highest deciles of *AQ* and *AQI* in models 1-2, respectively.

Similar to prior research analyzing the innate and discretionary components of accruals quality in the context of information risk (e.g., Kim and Qi 2010), I find no effect of *AQD* on market reactions to insider purchase filings in model 3. This finding suggests that the effect of earnings information uncertainty on investors' use of subsequent signals of private information, such as Form 4 purchase filings, is driven by fundamental uncertainty about firms' future cash flows that arises from firms' business models and operating environments, rather than management's financial reporting choices.

Although the return differentials in Panel B are lower at 0.82 percent and 0.93 percent for *AQ* and *AQI*, respectively, results are robust to controlling for other factors related to the filing and/or the firm's information environment.[22] The coefficients on the control variables suggest further that market reactions are lower in firms with higher prior returns (*CARPRE%*), increasing in

[22] Losses and R&D expenditures can be viewed as outcomes of a firm's business model and operating environment. Therefore, including *LOSS* and *RND* in the model is likely to "over-control" in the model with total (*AQ*) and innate accruals quality (*AQI*) as explanatory variables. Untabulated tests suggest that when these variables are excluded from equations (4) and (5), the coefficients on *AQ* and *AQI* increase to 1.05 and 1.28, respectively.

trading intensity (*INTENS%*), and lower in firms with trading restrictions (*RESTRICT*). Market reactions are greater in smaller (*ln(MV)*) firms and higher book-to-market (*BTM*) firms. Consistent with Aboody and Lev (2000) and Huddart and Ke (2007), market reactions are stronger for firms having R&D expenditures (*RND*). After controlling for the other factors, I find a positive association between analyst following (*ln(NUMEST)*) and the market reaction to insider purchases. Lastly, market reactions are negatively related to Huddart and Ke's (2007) earnings announcement-based information asymmetry measure (*MAG_AR%*). When the magnitude of market reactions to prior earnings announcements is viewed as a measure of prior earnings informativeness, this finding is consistent with increased investor reliance on Form 4 filings in firms where earnings are less informative.

Overall, the evidence supports H1 and suggests that Form 4 filings of insider share purchases are more useful to investors and trigger greater belief revisions when a firm's prior disclosures are more noisy and generate more uncertainty about future cash flows and the value of the firm.

Lagged Earnings Responses Around Form 4 Purchase Filings

Table 5 reports results from testing H2. Panel A presents results for the basic equations (6) and (7), while Panel B presents results for the full models with control variables. Models 1 and 3 report results from estimating equation (6) for confirming (*ΔQEARN>0*) and contradicting (*ΔQEARN<0*) purchases, respectively; models 2 and 4 report results from estimating equation (7) with trade size partitions. Similar to the testing of H1 for the information uncertainty variables, I use the decile ranks of earnings changes. Decile ranks are assigned separately for positive and negative earnings changes. Specifically, decile 10 (1) for positive (negative) earnings changes contains observations with the most positive (negative) earnings changes, while decile 1 (10) for positive (negative) earnings changes contains the least positive (negative) values. For ease of

interpretation of the regression coefficients, I scale these ranks to values between zero and one for positive earnings changes and to values between negative one and zero for negative earnings changes.[23]

- Insert Table 5 about here -

Consistent with H2, I find that market reactions to confirming insider purchases are positively associated with prior earnings changes, while reactions to contradicting purchases are negatively associated with prior earnings changes. Results from estimating equation (6) suggest a return differential between high and low positive (negative) earnings change observations of 1.48 percent (1.96 percent). When the sample is split based on trade magnitude, results from estimating equation (7) indicate that, as expected, the association between market reactions and prior earnings changes is strongest for the largest insider purchases. For the largest confirming (contradicting) purchases following positive (negative) earnings changes, the return differential between high and low positive (negative) earnings change observations of 3.65 percent (-3.85 percent). The difference between the extreme size quartiles (*ΔQEARN*SIZE4* versus *ΔQEARN*SIZE1*) is significant at the 0.01 level for both the positive and negative earnings changes samples (untabulated F-stats of 36.40 and 69.51, respectively).

Results in Table 5, Panel B suggest that the findings above hold after controlling for other factors related to insider purchases and the firm's information environment. Return differentials

[23] I scale negative earnings changes to values between negative one and zero for the following reason. When interacting *ΔQEARN* with the size indicators, *ΔQEARN* should take on negative values for observations in a specific size quartile and zero for observations not in that quartile (i.e., the comparison group). If *ΔQEARN* would be scaled to values between zero and one, *ΔQEARN* would take on values *greater* than the comparison group. For example, an observation in decile 2 (9) of negative *ΔQEARN* would take on a value of 0.11 (0.89) instead of -0.89 (-0.11) for a specific size quartile, while observations not in that size quartile take on a value of zero. Hence, scaling between zero and one would (1) flip the sign of the association and (2) affect the difference between the comparison group and the value of *ΔQEARN* for observations in a particular size quartile. While using a rank is desirable compared to the use of the raw value of negative *ΔQEARN* (because of its skewness), scaling the rank between negative one and zero better reflects the magnitude of the underlying raw negative *ΔQEARN*.

are slightly smaller, at 1.13 percent and -1.31 percent for positive and negative earnings changes, respectively. For confirming (contradicting) purchases of the largest magnitude following positive (negative) earnings changes, the return differential between high and low positive (negative) earnings change observations is 3.22 percent (-2.46 percent). The difference between the extreme size quartiles (*ΔQEARN*SIZE4* versus *ΔQEARN*SIZE1*) is significant at the 0.01 level for both the positive and negative earnings changes samples (untabulated F-stats of 15.07 and 11.37, respectively).

Looking at the control variables, future earnings changes (*ΔFUTURE*) are strongly associated with market reactions in the positive earnings changes sample, but only weakly associated with market reactions in the negative earnings changes sample. Hence, insider purchase decisions occurring after negative earnings changes are most strongly related to past, rather than future, earnings. The effects of trading restrictions (*RESTRICT*), firm size (*ln(MV)*), and analyst following (*ln(NUMEST)*) are concentrated in the negative earnings changes sample.

Overall, findings support H2 and suggest that a portion of the market reaction to Form 4 purchase filings is a lagged response to prior earnings announcements. This effect is increasing in the strength of the information signal (magnitude of the insider purchase) and implies that purchase filings not only accelerate future earnings information into price (e.g., Piotroski and Roulstone 2004; Roulstone 2008), but also accelerate past earnings information into price by resolving uncertainty.

Moderating Effect of IU

Table 6 reports results from testing H3. I estimate equation (8) to test whether IU moderates the association between prior earnings changes and market reactions to Form 4 purchase filings. Panel A presents results for the positive earnings changes (confirmation) subsample; Panel B

presents results for the negative earnings changes (contradiction) subsample. I use decile ranks for earnings changes as well as the interaction between earnings changes and IU (*ΔQEARN*IU*). Ranks are scaled to values between zero and one for positive earnings changes and to values between negative one and zero for negative earnings changes

- Insert Table 6 about here -

Consistent with H3, I find a positive effect of the interaction term on market reactions to confirming purchase filings in Panel A. Including the interaction term results in the main effect of earnings changes turning insignificant. These results hold for both *AQ* and *AQI*, but not for *AQD*.[24] For contradicting purchase filings in Panel B, coefficients on the interaction terms are negative, as predicted, but are not significantly different from zero. Although the main effect does turn insignificant for *AQ* and *AQI*, these findings suggest that IU moderates lagged earnings responses to Form 4 purchase filings only for confirming signals after positive earnings changes.

A potential explanation for the lack of significance for the effect of IU on lagged earnings responses around contradicting purchase filings is that, on average, purchases are smaller and therefore less informative for the contradiction sample. To test this reasoning, Table 7 presents results from estimating equation (8) with the *ΔQEARN*IU* interaction partitioned by trade size and using *AQ* as the proxy for IU (while including controls for the interaction between *ΔQEARN* and trade size). Consistent with results in the previous section, results of model 1 for confirming purchases are strongest for the largest purchases. Consistent with H3, market reactions to

[24] Note that equation (8) does not include a main effect of IU. This follows the design of Koch and Sun (2004, 2103) who include an interaction with a positive earnings change dummy variable in their equation (7), but do not include the dummy itself. Nevertheless, I find that adding *AQ* and *AQI* to Models 1 and 2 in Table 6, respectively, does not change inferences. Specifically, the coefficient on *ΔQEARN*IU* turns to 2.16 (p-value: 0.082) in model 1, and 4.58 (p-value: 0.006) in model 2. The coefficient on IU is insignificant in both models.

contradicting purchases of the largest magnitude have a significant negative association with *ΔQEARN*IU*.

- Insert Table 7 about here -

Overall, empirical results are in line with H3, suggesting that IU moderates the lagged response to earnings announcements around Form 4 purchase filings that provide a confirming signal. Although no average effect is found for contradicting purchases following negative earnings changes, partitioning the moderating effect of IU by trade size suggests that market reactions to the largest contradictory purchases are negatively associated with the interaction term. Based on these results, I conclude that filings of insider purchase decisions on Form 4 are more relevant and resolve more uncertainty when the information in the prior earnings signal is more ambiguous.

V. ADDITIONAL ANALYSES

Alternative Proxies for IU

Absolute Abnormal Accruals

The Dechow and Dichev (2002) measure of accruals quality is based on a 3-5 year standard deviation of the accrual model residual. Because this measure is highly autocorrelated, it is likely to be a noisy proxy for current accruals quality. Therefore, I follow Francis et al. (2005; 2007) and additionally measure IU as the absolute value of abnormal accruals (|*AAC*|) estimated using the Modified Jones (1991) model adjusted for performance (Kothari et al. 2005).[25] First, I

[25] Although abnormal accruals are commonly used as measure of discretionary reporting choices and the predicted IU effects in this paper are expected to be driven by innate accruals quality, recent research suggests that absolute abnormal accruals variables are strongly correlated with factors capturing fundamental uncertainty arising from firms' business models and operating environments (Hribar and Nichols 2007; Francis et al. 2008). Specifically, Francis et al. (2008) find that absolute abnormal accruals are more strongly correlated with innate determinants than total *AQ* measured using the Dechow and Dichev (2002) method.

calculate abnormal accruals as the residual from the following regression, estimated by year and industry group:

$$TACC_{it} = \beta_0 + \beta_1(1/AT_{it-1}) + \beta_2(\Delta SAL_{it} - \Delta REC_{it}) + \beta_3 PPE_{it} + \varepsilon_{it}, \quad (9)$$

where $TACC_{it}$ equals total accruals calculated as the difference between net income before extraordinary items and cash from operations, scaled by lagged total assets. ΔREC_{it} equals the change in receivables (RECT) relative to year *t-1*. All other variables are defined as before. Next, for each industry-year group, I partition the observations into deciles based on the lagged return on assets. Performance-adjusted abnormal accruals (*AAC*) are calculated by subtracting from firm-year *i*'s abnormal accruals the median abnormal accruals of its matched industry-year-performance group, excluding firm-year *i* (Francis et al. 2005). Compared to *AQ*, which has an autocorrelation coefficient of 0.89, |*AAC*| has an autocorrelation coefficient of 0.28. The pairwise correlation between |*AAC*| and *AQ* (*AQI*) [*AQD*] equals 0.45 (0.38) [0.27].

Earnings Volatility

Francis et al. (2004) show that earnings volatility serves as a powerful instrument for *AQ*. Accordingly, recent studies such as Bhattacharya et al. (2010b) use earnings volatility as an alternative measure of information precision. I use earnings volatility as an alternative proxy for IU and estimate earnings volatility (*EVOL*) as the standard deviation of asset-deflated annual earnings before extraordinary items over the most recent 3-5 years. The pairwise correlation between *EVOL* and *AQ* (*AQI*) [*AQD*] is 0.77 (0.73) [0.40].

Results

Table 8 reports results from testing H1 and H3 using the above two alternative proxies for IU. Models 1-3 present results for |*AAC*|; models 4-6 present results for *EVOL*. Supporting H1, I find significant differences in market reactions between firms in the highest and lowest deciles of

|*AAC*| and *EVOL* of 0.83 percent and 1.22 percent, respectively. Consistent with H3, I find that |*AAC*| and *EVOL* both moderate the positive association between market reactions to confirming purchase signals and prior earnings changes. For contradictory signals, I find no evidence of an average moderating effect for |*AAC*|. On average, however, *EVOL* does moderate the negative association between prior earnings changes and market reactions to contradicting purchase signals. Hence, I conclude that the study's main results are robust to using alternative measures of IU.

- Insert Table 8 about here -

Results for Insider Sales

Although the main focus of this study is on the valuation implications of Form 4 purchase filings, this section reports results for Form 4 sales filings for comparison purposes (untabulated). Recall from Table 1 that there are 71,094 sales filing events for 2003-2008 with sufficient data, for which the average market reaction is small (-0.11 percent). When conducting multivariate analyses of the determinants of these market reactions, I find that reporting lag and book-to-market ratios have an effect on market reactions to sales filings. Investors react more negatively to delayed sales filings and less negatively to firms with high book-to-market ratios. Further, I find a positive association between market reactions and *ΔFUTURE*, suggesting that Form 4 filings of insider sales accelerate the incorporation of future earnings information into prices. The magnitudes of the coefficients are, however, smaller than those for insider purchases. Low explanatory power for the full model with control variables (adjusted R-squared around 0.002) suggests limited information value of sales filings to the market.

If insider sales serve as a negative signal, there should be a negative effect of IU on market reactions. That is, insider sales should trigger more negative market reactions in the presence of

greater IU if sales filings are informative. Untabulated results suggest that none of the five proxies for IU used before show this negative effect of IU on market reactions. Rather, I find weak evidence of a positive effect for *AQ* and *AQI*, but the coefficients are only marginally significant and small in magnitude. One would also expect the opposite signs of associations (relative to the signs for purchases) between market reactions and prior earnings changes if Form 4 sales filings resolve earnings information uncertainty. That is, for sales that confirm (contradict) the persistence of negative (positive) prior earnings changes, one would expect a positive (negative) association between market reactions and prior earnings changes. I find no evidence of an association between market reactions to sales filings and positive or negative prior earnings changes. Further tests also show no consistent association between market reactions and prior earnings changes when interacted with trade size and/or IU measures. Overall, I conclude that Form 4 sales filings do not assist investors in resolving uncertainty about the valuation implications of reported earnings.

VI. SUMMARY AND CONCLUSIONS

Using a large sample of insider share purchases filed on SEC Form 4 during the post-SOX period (2003-2008), I examine whether Form 4 filings resolve uncertainty regarding the valuation implications of previously reported earnings. Defining information uncertainty (IU) as uncertainty about a firm's future cash flows arising from low information precision, I predict and find that market reactions to Form 4 purchase filings are stronger for firms identified as having greater IU (lower earnings precision). This finding is consistent with theory predicting that subsequent disclosures are more useful when prior disclosures, such as earnings announcements, are of lower precision.

I then show that, after controlling for a positive association with future earnings changes, market reactions to Form 4 purchase filings are positively (negatively) associated with prior earnings changes for insider purchases that follow positive (negative) quarterly earnings changes. This evidence suggests that a portion of the market reaction to Form 4 filings is a delayed reaction to prior earnings news and that investors update their initial expectations regarding the implications of earnings for future earnings. I also show that IU moderates the association between prior earnings changes and market reactions to Form 4 filings. The strength of these effects is increasing in the size of insiders' purchases, consistent with larger purchases providing more useful information to investors.

Overall, I find that Form 4 purchase filings provide more useful information for firms with greater IU, and that these filings help investors learn about the persistence of previously reported earnings. Hence, the most frequently filed piece of information on EDGAR not only signals private information about future earnings, but also signals private information about the persistence of prior earnings changes. That is, Form 4 purchase filings resolve uncertainty and help investors reassess the valuation implications of past earnings information.

These findings are subject to the following caveats. First, insiders are unlikely to have perfect information about future earnings. Although this may introduce noise in Form 4 filings, I find relatively strong evidence of investor belief revisions following insider purchase filings, with market reactions significantly associated with future earnings changes. Also, insiders' trading on forward-looking information is constrained by risk of litigation and policies that restrict the timing of trades. Nevertheless, the concentration of insider trading after earnings announcements allows me to uncover new evidence on the effect of insider trades on investors' assessments of prior earnings signals. Lastly, the measures of IU are noisy and likely capture more than IU

alone. Nevertheless, the tests suggest that findings for the effect of IU on market reactions to Form 4 filings are consistent across different proxies.

Subject to the above caveats, the research shows that Form 4 filings of insider purchases are an important source of information to the investment community. Building on this study, future research could analyze the importance of Form 4 filings as an information source relative to other sources such as management issued guidance, analyst forecast revisions, dividend announcements, or 10-K/Q filings. As well, future research could examine the extent to which relatively sophisticated users of financial information, such as financial analysts or institutional investors, rely on Form 4 filings of insider share purchases to learn about past and future earnings.

APPENDIX
Variable Definitions

CAR% = Five day cumulative size-adjusted return (in percentage) starting on the Form 4 filing date [0,+4], where daily size-adjusted returns are computed using the NYSE/AMEX/NASDAQ end-of-year market capitalization deciles;

AQ = Accruals quality, measured as the standard deviation of accrual estimation error over the most recent 3-5 years based on Dechow and Dichev (2002) and McNichols (2002), see equation (3);

AQI = Innate accruals quality based on Francis et al. (2005), see equation (4);

AQD = Discretionary accruals quality based on Francis et al. (2005), see equation (4);

ΔQEARN = Seasonally differenced change in quarterly earnings (Compustat's Fundamentals Quarterly data item IBQ) as percentage of lagged total assets (ATQ);

ΔFUTURE = Sum of next four quarterly earnings changes scaled by lagged total assets;

CARPRE% = 60 day cumulative size-adjusted returns prior to the event (in percentage);

INTENS% = Aggregate number of shares traded by all insiders in one firm on an event day as percentage of shares outstanding (CRSP daily stock file data item SHROUT);

LAG = Reporting lag, measured as the difference between insider transaction date and Form 4 filing date in business days. If multiple transactions are filed on the same date, the earliest of transaction date is used (Brochet 2010);

RESTRICT = Indicator variable indicating the likelihood of firm-level insider trading restrictions based on Roulstone (2003), set equal to 1 if the total amount of shares traded during the 30-day period after quarterly earnings announcements exceeds 75% of the total amount of shares traded during the year, 0 otherwise;

MV = Market value of equity at fiscal quarter end (PRCCQ * CSHOQ);

BTM = Book value of equity (CEQQ) divided by market value at fiscal quarter end;

NUMEST = Number of analysts following the firm in the month of the insider filing event from the I/B/E/S database, set to zero when missing;

AGE = Numbers of years since company was first covered by the CRSP database;

LOSS = Indicator variable equal to 1 if quarterly earnings before extraordinary items (IBQ) is negative for most recent earnings announcement (RDQ), 0 otherwise;

RND = Indicator variable equal to 1 when firm reports R&D expenses (XRDQ), 0 otherwise;

MAG_AR% = Median of absolute market reactions (in percentage) to prior quarterly earnings announcements, where market reaction is measured as the cumulative abnormal return from two days before to the day of the earnings announcement (Huddart and Ke 2007); median measured over the (maximum) five year period ending the fiscal quarter before quarter *t*;

$|AAC|$ = Absolute value of performance-adjusted abnormal accruals (Francis et al. 2005), see equation (9);

EVOL = Earnings volatility, measured as the standard deviation of asset-deflated earnings before extraordinary items over the most recent 3-5 years.

REFERENCES

Ashbaugh-Skaife, H., D. W. Collins, W. R. Kinney Jr., and R. LaFond. 2008. The effect of SOX internal control deficiencies and their remediation on accrual quality. *The Accounting Review* 83 (1): 217-250.

Atiase, R. K. 1985. Predisclosure information, firm capitalization, and security price behavior around earnings announcements. *Journal of Accounting Research* 23 (1): 21-36.

Baiman, S., and R. E. Verrecchia. 1996. The relation among capital markets, financial disclosure, production efficiency, and insider trading. *Journal of Accounting Research* 34 (1): 1-22.

Ball, R., and L. Shivakumar. 2006. The role of accruals in asymmetrically timely gain and loss recognition. *Journal of Accounting Research* 44 (2): 207-242.

Barth, M. E., D. P. Cram, and K. K. Nelson. 2001. Accruals and the prediction of future cash flows. *The Accounting Review* 76 (1): 27-58.

Beneish, M. D., and M. E. Vargus. 2002. Insider trading, earnings quality, and accrual mispricing. *The Accounting Review* 77 (4): 755-791.

Bhattacharya, N., H. Desai, and K. Venkataraman. 2010a. Earnings quality and information asymmetry. Working paper, Southern Methodist University.

Bhattacharya, N., F. Ecker, P. Olsson, and K. Schipper. 2010b. Direct and mediated associations among earnings quality, information asymmetry and the cost of equity. Working paper, Southern Methodist University and Duke University.

Brav, A., J. R. Graham, C. R. Harvey, and R. Michaely. 2005. Payout policy in the 21st century. *Journal of Financial Economics* 77 (3): 483-527.

Brochet, F. 2010. Information content of insider trades before and after the Sarbanes-Oxley Act. *The Accounting Review* 85 (2): 419.

Carhart, M. M. 1997. On persistence in mutual fund performance. *The Journal of Finance* 52 (1): 57-82.

Cheng, Q., and K. Lo. 2006. Insider trading and voluntary disclosures. *Journal of Accounting Research* 44 (5): 815-848.

Collins, D. W., and S. P. Kothari. 1989. An analysis of intertemporal and cross-sectional determinants of earnings response coefficients. *Journal of Accounting and Economics* 11 (2-3): 143-181.

Collins, D. W., S. P. Kothari, J. Shanken, and R. G. Sloan. 1994. Lack of timeliness and noise as explanations for the low contemporaneous return-earnings association. *Journal of Accounting and Economics* 18 (3): 289-324.

Dechow, P. M., and I. D. Dichev. 2002. The quality of accruals and earnings: The role of accrual estimation errors. *The Accounting Review* 77 (4): 35-59.

Dechow, P. M., S. P. Kothari, and R. L. Watts. 1998. The relation between earnings and cash flows. *Journal of Accounting and Economics* 25 (2): 133-168.

Easton, P. D., and M. E. Zmijewski. 1989. Cross-sectional variation in the stock market response to accounting earnings announcements. *Journal of Accounting and Economics* 11 (2-3): 117-141.

Ecker, F., J. Francis, I. Kim, P. Olsson, and K. Schipper. 2006. A returns-based representation of earnings quality. *The Accounting Review* 81 (4): 749-780.

Fama, E. F., and K. R. French. 1993. Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics* 33 (1): 3-56.

Fidrmuc, J. P., M. Goergen, and L. Renneboog. 2006. Insider trading, news releases, and ownership concentration. *The Journal of Finance* 61 (6): 2931-2973.

Finnerty, J. E. 1976. Insiders and market efficiency. *The Journal of Finance* 31 (4): 1141-1148.
Francis, J., R. LaFond, P. Olsson, and K. Schipper. 2004. Costs of equity and earnings attributes. *The Accounting Review* 79 (4): 967-1010.
Francis, J., R. LaFond, P. Olsson, and K. Schipper. 2005. The market pricing of accruals quality. *Journal of Accounting and Economics* 39 (2): 295-327.
Francis, J., R. LaFond, P. Olsson, and K. Schipper. 2007. Information uncertainty and post-earnings-announcement-drift. *Journal of Business Finance & Accounting* 34 (3-4): 403-433.
Francis, J., D. Nanda, and P. Olsson. 2008. Voluntary disclosure, earnings quality, and cost of capital. *Journal of Accounting Research* 46 (1): 53-99.
Francis, J., P. Olsson, and K. Schipper. 2009. Earnings quality. *Foundations and Trends in Accounting* 1 (4): 259-340.
Frankel, R., and X. Li. 2004. Characteristics of a firm's information environment and the information asymmetry between insiders and outsiders. *Journal of Accounting and Economics* 37 (2): 229-259.
Freeman, R. N., and S. Tse. 1989. The multiperiod information content of accounting earnings: Confirmations and contradictions of previous earnings reports. *Journal of Accounting Research* 27: 49-79.
Gow, I. D., G. Ormazabal, and D. J. Taylor. 2010. Correcting for cross-sectional and time-series dependence in accounting research. *The Accounting Review* 85 (2): 483.
Gray, P., P. Koh, and Y. H. Tong. 2009. Accruals quality, information risk and cost of capital: Evidence from australia. *Journal of Business Finance & Accounting* 36 (1-2): 51-72.
Gu, F., and J. Q. Li. 2007. The credibility of voluntary disclosure and insider stock transactions. *Journal of Accounting Research* 45 (4): 771-810.
Guay, W. R., S. P. Kothari, and R. L. Watts. 1996. A market-based evaluation of discretionary accrual models. *Journal of Accounting Research* 34: 83-105.
Holthausen, R. W., and R. E. Verrecchia. 1988. The effect of sequential information releases on the variance of price changes in an intertemporal multi-asset market. *Journal of Accounting Research* 26 (1): 82-106.
Hribar, P., and D. C. Nichols. 2007. The use of unsigned earnings quality measures in tests of earnings management. *Journal of Accounting Research* 45 (5): 1017-1053.
Huddart, S. J., B. Ke, and C. Shi. 2007. Jeopardy, non-public information, and insider trading around SEC 10-K and 10-Q filings. *Journal of Accounting and Economics* 43 (1): 3-36.
Huddart, S. J., and B. Ke. 2007. Information asymmetry and cross-sectional variation in insider trading. *Contemporary Accounting Research* 24 (1): 195-232.
Imhoff, E. A., and G. J. Lobo. 1992. The effect of ex ante earnings uncertainty on earnings response coefficients. *The Accounting Review* 67 (2): 427-439.
Jaffe, J. F. 1974. Special information and insider trading. *The Journal of Business* 47 (3): 410-428.
Jeng, L. A., A. Metrick, and R. Zeckhauser. 2003. Estimating the returns to insider trading: A performance-evaluation perspective. *Review of Economics and Statistics* 85 (2): 453-471.
Jones, J. J. 1991. Earnings management during import relief investigations. *Journal of Accounting Research* 29 (2): 193-228.
Kim, D., and Y. Qi. 2010. Accruals quality, stock returns, and macroeconomic conditions. *The Accounting Review* 85 (3): 937.
Koch, A. S., and A. X. Sun. 2004. Dividend changes and the persistence of past earnings changes. *The Journal of Finance* 59 (5): 2093-2116.

Kormendi, R., and R. Lipe. 1987. Earnings innovations, earnings persistence, and stock returns. *The Journal of Business* 60 (3): 323-345.

Kothari, S. P., A. J. Leone, and C. E. Wasley. 2005. Performance matched discretionary accrual measures. *Journal of Accounting and Economics* 39 (1): 163-197.

Lakonishok, J., and I. Lee. 2001. Are insider trades informative? *Review of Financial Studies* 14 (1): 79-11.

Lambert, R. A., C. Leuz, and R. E. Verrecchia. 2011. Information asymmetry, information precision, and the cost of capital. *Review of Finance* (forthcoming).

Lang, M. 1991. Time-varying stock price response to earnings induced by uncertainty about the time-series process of earnings. *Journal of Accounting Research* 29 (2): 229-257.

Lev, B. 2007. Discussion of Information asymmetry and cross-sectional variation in insider trading. *Contemporary Accounting Research* 24 (1): 233-234.

Lipe, R. 1990. The relation between stock returns and accounting earnings given alternative information. *The Accounting Review* 65 (1): 49-71.

Lustgarten, S., and V. Mande. 1998. The effect of insider trading on financial analysts' forecast accuracy and dispersion. *Journal of Accounting and Public Policy* 17 (4-5): 311-327.

McNichols, M. F. 2002. Discussion of The quality of accruals and earnings: The role of accrual estimation errors. *The Accounting Review* 77 (4): 61.

Ogneva, M. 2009. Accrual quality and expected returns: The importance of controlling for cash flow shocks. Working paper, Stanford University.

Petersen, M. A. 2009. Estimating standard errors in finance panel data sets: Comparing approaches. *Review of Financial Studies* 22 (1): 435-480.

Piotroski, J. D., and D. T. Roulstone. 2005. Do insider trades reflect both contrarian beliefs and superior knowledge about future cash flow realizations? *Journal of Accounting and Economics* 39 (1): 55-81.

Rogers, J. L. 2008. Disclosure quality and management trading incentives. *Journal of Accounting Research* 46 (5): 1265-1296.

Roulstone, D. T. 2003. The relation between insider-trading restrictions and executive compensation. *Journal of Accounting Research* 41 (3): 525-551.

Roulstone, D. T. 2008. Insider trading and the information content of earnings announcements. Working paper, Ohio State University.

Rozeff, M. S., and M. A. Zaman. 1998. Overreaction and insider trading: Evidence from growth and value portfolios. *The Journal of Finance* 53 (2): 701-716.

SEC. 2005. Important information about EDGAR. Available at: http://sec.gov/edgar/aboutedgar.html.

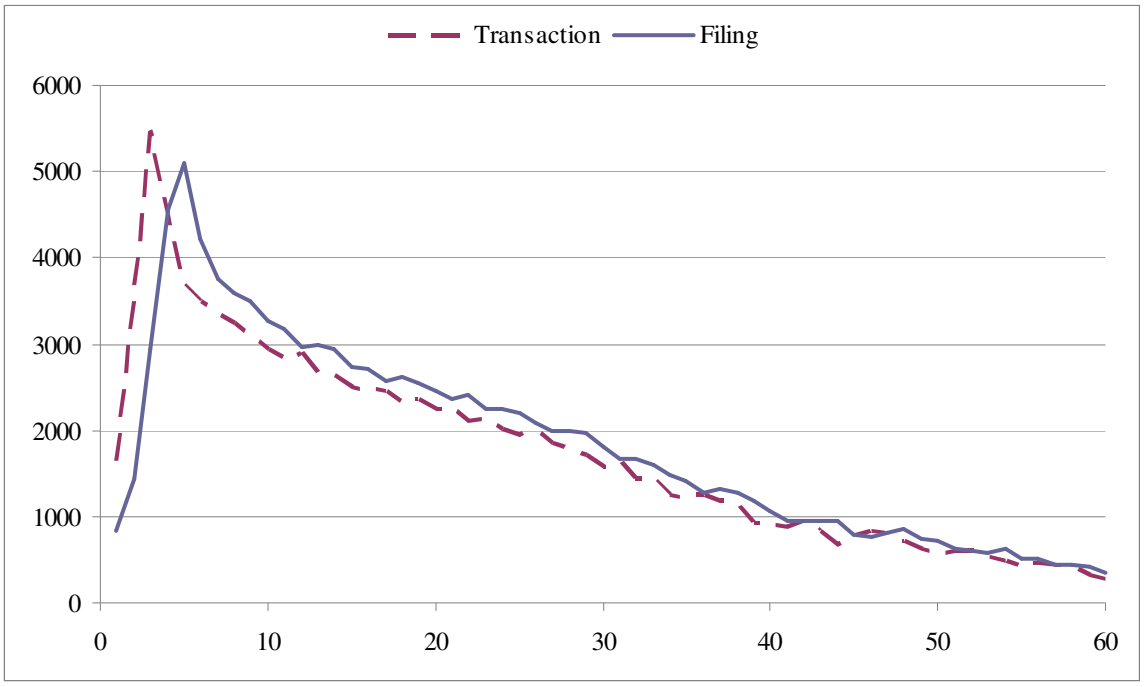
Seyhun, H. N. 1986. Insiders' profits, costs of trading, and market efficiency. *Journal of Financial Economics* 16 (2): 189-212.

Seyhun, H. N. 1998. *Investment intelligence from insider trading*. Cambridge, MA: MIT Press.

Teoh, S. H., and T. J. Wong. 1993. Perceived auditor quality and the earnings response coefficient. *The Accounting Review* 68 (2): 346-366.

Veenman, D., A. Hodgson, B. van Praag, and W. Zhang. 2011. Decomposing executive stock option exercises: Relative information and incentives to manage earnings. *Journal of Business Finance & Accounting* 38 (5-6): 536-573.

FIGURE 1
Frequency of Trading and Form 4 Filing Activity after Earnings Announcements



Overview of the frequency of trading and Form 4 filing activity after earnings announcements. The horizontal axis represents the number of business days after the earnings announcement. The graph is based on the sample of 109,645 filing events (16,951 purchases and 92,694 sales) that are matched with an earnings announcement and available data to compute IU. See Table 1 for more details on the sample selection procedure.

TABLE 1
Sample Selection and Data Filtering Procedure

Panel A: Database matching and data consistency filters

	n	%
Transactions by officers/directors reported on SEC form 4	1,576,180	100.0%
Less: Thomson cleanse code "A" or "S"	-14,649	-0.9%
Less: records with missing values	-1,908	-0.1%
Less: no match (N)CUSIP - PERMNO	-85,804	-5.4%
Less: no NYSE/AMEX/NASDAQ firm	-1,763	-0.1%
Less: no match PERMNO - GVKEY	-82,743	-5.2%
Sample with matched identifiers	1,389,313	88.1%
Less: CRSP share class other than 10 or 11 (non-common shares)	-91,545	-5.8%
Less: no price/return data on CRSP daily stock file	-8,590	-0.5%
Less: number of shares traded >25% of shares outstanding	-53	-0.0%
Less: number of shares traded >25% of CRSP daily volume	-30,817	-2.0%
Less: transaction price outside CRSP bidlo-askhi range	-32,868	-2.1%
Less: filing delay >50 trading days	-6,711	-0.4%
Sample of transactions	1,218,729	77.3%

Panel B: Filing events

	Purchases	Sales
Sample of filing events	37,828	147,219
Less: observations without sufficient quarterly earnings data	-9,210	-30,163
Less: observations without sufficient data to compute IU measure	-11,667	-24,362
Less: observations with confounding events	-4,117	-21,600
Sample of filing events test sample	12,834	71,094
Mean *CAR%*	2.36%	-0.11%
Median *CAR%*	1.35%	-0.22%

Transactions by officers and directors identified on Form 4 filings between 1/1/2003 and 12/31/2008 are collected from Thomson Reuters. Insider transaction data are first matched with CRSP data based on historical (N)CUSIP identifiers. Next, data are matched with Compustat identifiers using the CRSP/Compustat Merged link table. *CAR%* is the five day cumulative size-adjusted return (in percentage) starting on the SEC filing date, where daily size-adjusted returns are computed using the NYSE/AMEX/NASDAQ end-of-year market capitalization deciles. Confounding events are 10-K/Q filings (EDGAR), 8-K filings (EDGAR), and management forecasts (First Call) that occur during the five day return window.

TABLE 2
Descriptive Statistics for Insider Purchase Filings Sample

	n	Mean	St. Dev	Q1	Median	Q3
Dependent variable						
CAR%	12,834	2.361	8.490	-1.782	1.353	5.324
Main variables						
AQ	12,834	0.062	0.056	0.025	0.044	0.076
AQI	12,834	0.063	0.034	0.036	0.056	0.083
AQD	12,834	-0.002	0.044	-0.023	-0.008	0.010
ΔQEARN	12,834	0.000	0.047	-0.009	0.000	0.008
ΔFUTURE	12,834	-0.001	0.144	-0.042	0.001	0.035
Control variables						
CARPRE%	12,834	-4.105	24.481	-16.245	-2.959	8.443
INTENS%	12,834	0.037	0.099	0.003	0.011	0.033
LAG	12,834	1.968	4.109	1	1	2
RESTRICT	12,834	0.368	0.482	0	0	1
MV	12,834	2,240.141	10,178.880	85.231	285.133	1,157.522
BTM	12,834	0.595	0.522	0.274	0.494	0.778
NUMEST	12,834	4.685	5.817	0	3	7
AGE	12,834	17.586	11.561	9	14	23
LOSS	12,834	0.360	0.480	0	0	1
RND	12,834	0.376	0.484	0	0	1
MAG_AR%	12,834	4.023	2.588	2.110	3.467	5.132

Descriptive statistics for the 12,834 Form 4 purchase filing events identified in Table 1. All variables are defined in the Appendix.

TABLE 3
Correlation Matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1 *CAR%*		**0.06**	**0.06**	**0.03**	-0.01	**0.05**	**-0.05**	**0.11**	0.00	-0.01	**-0.07**	**0.05**	-0.02	**-0.07**	**0.06**	**0.04**	-0.01
2 *AQ*	**0.06**		**0.60**	**0.79**	**0.06**	**0.12**	0.01	**0.05**	**-0.03**	0.00	**-0.30**	**-0.16**	**-0.21**	**-0.22**	**0.31**	**0.32**	**0.06**
3 *AQI*	**0.07**	**0.66**		-0.02	**0.05**	**0.12**	**0.04**	**0.06**	**-0.03**	-0.01	**-0.54**	**-0.15**	**-0.36**	**-0.31**	**0.47**	**0.38**	**0.06**
4 *AQD*	0.00	**0.57**	**-0.14**		**0.03**	**0.05**	**-0.02**	0.02	-0.02	0.01	**0.04**	**-0.08**	0.01	**-0.03**	**0.03**	**0.11**	**0.02**
5 *ΔQEARN*	-0.01	0.02	0.00	0.01		**0.07**	**0.13**	**-0.03**	-0.01	**-0.02**	0.01	**-0.07**	**-0.03**	-0.01	**-0.18**	**0.02**	-0.02
6 *ΔFUTURE*	**0.04**	**0.08**	**0.11**	0.00	**0.13**		**0.12**	0.01	0.00	**-0.02**	**-0.08**	**-0.11**	**-0.08**	**-0.03**	**0.09**	**0.04**	0.01
7 *CARPRE%*	**-0.04**	**-0.02**	0.00	**-0.04**	**0.17**	**0.15**		**-0.08**	0.01	**-0.02**	-0.01	**-0.12**	**-0.10**	**0.02**	**-0.09**	-0.01	**0.04**
8 *INTENS%*	**0.16**	**0.22**	**0.32**	**-0.04**	**-0.10**	**-0.03**	**-0.10**		**0.07**	**0.03**	**-0.13**	**0.07**	**-0.07**	**-0.07**	**0.07**	0.01	**0.04**
9 *ln(LAG)*	0.00	**-0.02**	-0.01	**-0.03**	-0.02	0.01	0.01	**0.09**		-0.01	**-0.03**	**0.06**	**-0.05**	**-0.02**	0.00	**-0.05**	-0.01
10 *RESTRICT*	-0.01	-0.01	-0.01	0.01	**-0.02**	**-0.03**	**-0.03**	0.01	-0.01		**-0.02**	**0.04**	0.01	**0.03**	**-0.02**	**0.05**	**-0.05**
11 *ln(MV)*	**-0.05**	**-0.36**	**-0.59**	**0.13**	**0.09**	**-0.04**	0.01	**-0.46**	**-0.04**	**-0.02**		**-0.29**	**0.74**	**0.26**	**-0.33**	**-0.10**	**-0.11**
12 *BTM*	**0.02**	**-0.19**	**-0.16**	**-0.09**	**-0.14**	**-0.13**	**-0.10**	**0.13**	**0.07**	**0.07**	**-0.25**		**-0.16**	**0.03**	**0.05**	**-0.17**	**-0.05**
13 *ln(NUMEST)*	0.00	**-0.26**	**-0.39**	**0.07**	0.01	**-0.07**	**-0.09**	**-0.29**	**-0.06**	0.01	**0.73**	**-0.16**		**0.09**	**-0.20**	0.01	**-0.10**
14 *AGE*	**-0.06**	**-0.23**	**-0.32**	**0.04**	-0.02	**-0.05**	**0.02**	**-0.16**	**-0.04**	-0.01	**0.19**	**0.09**	**0.06**		**-0.19**	**-0.14**	**-0.12**
15 *LOSS*	**0.03**	**0.32**	**0.47**	**-0.04**	**-0.31**	**0.07**	**-0.10**	**0.20**	0.01	**-0.02**	**-0.33**	0.01	**-0.19**	**-0.19**		**0.23**	**0.02**
16 *RND*	**0.05**	**0.32**	**0.36**	**0.08**	0.01	**0.02**	**-0.03**	**0.10**	**-0.05**	**0.05**	**-0.11**	**-0.21**	0.01	**-0.13**	**0.23**		-0.02
17 *MAG_AR%*	0.00	**0.09**	**0.10**	**0.02**	**-0.02**	0.02	**0.02**	**0.07**	0.00	**-0.02**	**-0.13**	**-0.03**	**-0.09**	**-0.12**	**0.04**	-0.01	

Pearson (Spearman) correlations are reported above (below) the diagonal. All variables are defined as in the Appendix. Bold text indicates that correlations are statistically significant at a level of 0.05 or better.

TABLE 4
Information Uncertainty and Market Reactions to Insider Purchase Filings

Panel A: Basic model

Dependent variable: *CAR%*	Model 1 *IU=AQ*	Model 2 *IU=AQI*	Model 3 *IU=AQD*
IU	1.567	1.980	0.124
	(3.87)***	(4.71)***	(0.34)
ΔFUTURE	2.866	2.773	3.140
	(2.99)***	(2.87)***	(3.08)***
Intercept	1.560	1.308	2.305
	(3.80)***	(3.14)***	(6.75)***
n	12,834	12,834	12,834
Adj. R^2	0.006	0.008	0.003

TABLE 4 (continued)

Panel B: Full model with control variables

Dependent variable: *CAR%*	Model 1 *IU=AQ*	Model 2 *IU=AQI*	Model 3 *IU=AQD*
Main variables:			
IU	0.820	0.930	0.306
	(2.15)**	(2.14)**	(0.79)
ΔFUTURE	3.295	3.336	3.296
	(4.23)***	(4.25)***	(4.17)***
Control variables:			
CARPRE%	-0.014	-0.014	-0.014
	(2.20)**	(2.29)**	(2.20)**
INTENS%	8.364	8.364	8.376
	(4.93)***	(4.93)***	(4.89)***
ln(LAG)	-0.107	-0.109	-0.116
	(1.04)	(1.04)	(1.12)
RESTRICT	-0.331	-0.329	-0.336
	(1.92)*	(1.92)*	(1.96)*
ln(MV)	-0.257	-0.208	-0.311
	(2.64)***	(2.34)**	(2.89)***
BTM	0.751	0.777	0.663
	(1.98)**	(2.08)**	(1.65)*
ln(NUMEST)	0.417	0.393	0.424
	(3.11)***	(2.92)***	(3.12)***
AGE	-0.027	-0.027	-0.030
	(1.58)	(1.56)	(1.76)*
LOSS	0.131	0.075	0.220
	(0.70)	(0.36)	(1.13)
RND	0.473	0.471	0.558
	(2.23)**	(2.49)**	(2.64)***
MAG_AR%	-0.073	-0.069	-0.072
	(2.21)**	(2.07)**	(2.18)**
Intercept	2.863	2.525	3.472
	(5.75)***	(4.42)***	(7.48)***
n	12,834	12,834	12,834
Adj. R^2	0.027	0.027	0.027

OLS regressions with robust standard errors adjusted for heteroskedasticity and clustering by firm and time. Variables are defined in the Appendix. *AQ*, *AQI*, and *AQD* are transformed to decile rankings scaled between 0 and 1. *, **, *** denote statistical significance at the 0.10, 0.05, and 0.01 level, respectively (two-tailed).

TABLE 5
Lagged Earnings Responses around Insider Purchase Filings

Panel A: Basic model

Dependent variable: *CAR%*	Model 1 *ΔQEARN*>0	Model 2 *ΔQEARN*>0	Model 3 *ΔQEARN*<0	Model 4 *ΔQEARN*<0
ΔQEARN	1.475		-1.962	
	(3.27)***		(4.99)***	
*ΔQEARN*SIZE1*		-0.772		1.112
		(1.89)*		(2.29)**
*ΔQEARN*SIZE2*		0.008		-0.592
		(0.02)		(1.20)
*ΔQEARN*SIZE3*		1.733		-1.613
		(2.77)***		(4.14)***
*ΔQEARN*SIZE4*		3.647		-3.851
		(4.43)***		(7.30)***
ΔFUTURE	4.662	4.198	1.283	1.258
	(3.43)***	(3.09)***	(1.25)	(1.14)
Intercept	1.321	1.482	1.627	1.800
	(4.80)***	(5.60)***	(4.96)***	(5.88)***
n	6,645	6,645	6,183	6,183
Adj. R^2	0.012	0.027	0.005	0.018

TABLE 5 (continued)

Panel B: Full model with control variables

Dependent variable: *CAR%*	Model 1 *ΔQEARN*>0	Model 2 *ΔQEARN*>0	Model 3 *ΔQEARN*<0	Model 4 *ΔQEARN*<0
Main variables:				
ΔQEARN	1.129		-1.305	
	(2.38)**		(2.28)**	
*ΔQEARN*SIZE1*		-0.533		0.423
		(1.25)		(0.50)
*ΔQEARN*SIZE2*		0.055		-0.864
		(0.11)		(1.11)
*ΔQEARN*SIZE3*		1.663		-1.510
		(3.29)***		(2.25)**
*ΔQEARN*SIZE4*		3.219		-2.462
		(3.14)***		(4.91)***
ΔFUTURE	4.883	4.652	1.771	1.782
	(3.87)***	(3.71)***	(1.71)*	(1.64)
Control variables:				
CARPRE%	-0.010	-0.009	-0.018	-0.016
	(1.05)	(0.92)	(3.55)***	(3.23)***
INTENS%	5.521	2.249	10.191	8.481
	(3.14)***	(1.22)	(3.60)***	(2.69)***
ln(LAG)	-0.127	-0.142	-0.102	-0.102
	(0.94)	(1.05)	(0.70)	(0.73)
RESTRICT	-0.000	-0.009	-0.719	-0.724
	(0.00)	(0.04)	(3.62)***	(3.71)***
ln(MV)	-0.111	0.024	-0.410	-0.305
	(0.78)	(0.15)	(4.01)***	(3.55)***
BTM	0.831	0.802	0.628	0.611
	(1.69)*	(1.68)*	(1.35)	(1.25)
ln(NUMEST)	0.091	0.062	0.753	0.722
	(0.50)	(0.36)	(4.01)***	(3.87)***
AGE	-0.031	-0.032	-0.025	-0.024
	(1.69)*	(1.68)*	(1.46)	(1.39)
LOSS	0.059	0.018	-0.273	-0.289
	(0.16)	(0.05)	(1.00)	(1.04)
RND	0.425	0.378	0.530	0.484
	(1.78)*	(1.71)*	(1.35)	(1.24)
MAG_AR%	-0.070	-0.077	-0.075	-0.073
	(1.20)	(1.28)	(1.72)*	(1.75)*
Intercept	2.178	1.613	3.404	2.942
	(3.22)***	(2.24)**	(5.20)***	(4.77)***
n	6,645	6,645	6,183	6,183
Adj. R^2	0.023	0.032	0.034	0.037

TABLE 5 (continued)

OLS regressions with robust standard errors adjusted for heteroskedasticity and clustering by firm and time. Variables are defined in the Appendix. *ΔQEARN* is transformed to decile ranking scaled between 0 and 1 for positive values and transformed to decile ranking scaled between -1 and 0 for negative values. *SIZE#* is an indicator variable equal to 1 if the magnitude of insider trade (measured by *INTENS%*) falls in quartile # of the distribution of trade size, where #={1,2,3,4}, and 0 otherwise. *, **, *** denote statistical significance at the 0.10, 0.05, and 0.01 level, respectively (two-tailed).

TABLE 6
Lagged Earnings Responses around Insider Purchase Filings: Effect of Information Uncertainty

Panel A: Confirmation sample (positive earnings changes)

Dependent variable: *CAR%*	Model 1 *IU=AQ* *ΔQEARN*>0	Model 2 *IU=AQI* *ΔQEARN*>0	Model 3 *IU=AQD* *ΔQEARN*>0
ΔQEARN	-0.382	-1.355	1.130
	(0.40)	(1.06)	(2.44)**
*ΔQEARN*IU*	1.792	2.834	0.007
	(2.09)**	(2.34)**	(0.01)
ΔFUTURE	4.905	4.949	4.881
	(3.88)***	(3.93)***	(3.88)***
Intercept	1.832	1.512	2.175
	(2.95)***	(2.40)**	(3.50)***
Control variables	Included	Included	Included
n	6,645	6,645	6,645
Adj. R^2	0.024	0.024	0.023

Panel B: Contradiction sample (negative earnings changes)

Dependent variable: *CAR%*	Model 1 *IU=AQ* *ΔQEARN*<0	Model 2 *IU=AQI* *ΔQEARN*<0	Model 3 *IU=AQD* *ΔQEARN*<0
ΔQEARN	0.016	-0.567	-1.363
	(0.02)	(0.43)	(2.25)**
*ΔQEARN*IU*	-1.616	-0.864	-0.618
	(1.45)	(0.53)	(1.06)
ΔFUTURE	1.786	1.776	1.761
	(1.72)*	(1.72)*	(1.68)*
Intercept	4.682	4.066	3.768
	(3.97)***	(3.09)***	(5.31)***
Control variables	Included	Included	Included
n	6,183	6,183	6,183
Adj. R^2	0.034	0.034	0.034

OLS regressions with robust standard errors adjusted for heteroskedasticity and clustering by firm and time. Variables are defined in the Appendix. *ΔQEARN* and *ΔQEARN*IU* are transformed to decile rankings scaled between 0 and 1 for positive values and transformed to decile rankings scaled between -1 and 0 for negative values. *, **, *** denote statistical significance at the 0.10, 0.05, and 0.01 level, respectively (two-tailed).

TABLE 7
Lagged Earnings Responses around Insider Purchase Filings: Effect of Information Uncertainty Partitioned by Trading Magnitude

	Model 1 *IU=AQ* *ΔQEARN*>0	Model 2 *IU=AQ* *ΔQEARN*<0
Main variables:		
*ΔQEARN*SIZE1*	-1.077	-3.133
	(0.99)	(1.08)
*ΔQEARN*SIZE2*	-0.622	-2.300
	(0.44)	(1.61)
*ΔQEARN*SIZE3*	1.526	0.338
	(0.94)	(0.17)
*ΔQEARN*SIZE4*	-1.228	3.272
	(0.51)	(1.47)
*ΔQEARN*IU*SIZE1*	0.779	3.546
	(0.62)	(1.37)
*ΔQEARN*IU*SIZE2*	0.953	1.155
	(0.68)	(0.88)
*ΔQEARN*IU*SIZE3*	0.408	-2.213
	(0.25)	(1.00)
*ΔQEARN*IU*SIZE4*	4.624	-6.157
	(2.27)**	(2.72)***
ΔFUTURE	4.701	1.761
	(3.75)***	(1.62)
Intercept	1.298	2.623
	(1.97)**	(4.23)***
Control variables	Included	Included
n	6,645	6,183
Adj. R^2	0.033	0.040

OLS regressions with robust standard errors adjusted for heteroskedasticity and clustering by firm and time. Variables are defined in the Appendix. *ΔQEARN* and *ΔQEARN*IU* are transformed to decile rankings scaled between 0 and 1 for positive values and transformed to decile rankings scaled between -1 and 0 for negative values. *SIZE#* is an indicator variable equal to 1 if the magnitude of insider trade (measured by *INTENS%*) falls in quartile # of the distribution of trade size, where #={1,2,3,4}, and 0 otherwise. *, **, *** denote statistical significance at the 0.10, 0.05, and 0.01 level, respectively (two-tailed).

TABLE 8
Alternative Measures of Information Uncertainty

	Model 1 *IU*=|*AAC*|	Model 2 *IU*=|*AAC*| *ΔQEARN*>0	Model 3 *IU*=|*AAC*| *ΔQEARN*<0	Model 4 *IU*=*EVOL*	Model 5 *IU*=*EVOL* *ΔQEARN*>0	Model 6 *IU*=*EVOL* *ΔQEARN*<0
IU	0.830			1.220		
	(3.65)***			(4.70)***		
ΔQEARN		0.290	-1.053		-0.154	-0.184
		(0.47)	(1.88)*		(0.20)	(0.25)
*ΔQEARN*IU*		1.089	-0.319		1.614	-1.452
		(2.11)**	(0.54)		(2.67)***	(2.38)**
ΔFUTURE	3.236	4.842	1.757	3.307	4.915	1.765
	(4.15)***	(3.85)***	(1.69)*	(4.26)***	(3.88)***	(1.72)*
Intercept	2.958	1.969	3.313	2.532	1.824	1.575
	(6.39)***	(3.13)***	(4.50)***	(5.44)***	(2.97)***	(1.76)*
Control variables	Included	Included	Included	Included	Included	Included
n	12,834	6,645	6,183	12,834	6,645	6,183
Adj. R^2	0.027	0.024	0.034	0.028	0.024	0.034

OLS regressions with robust standard errors adjusted for heteroskedasticity and clustering by firm and time. Variables are defined in the Appendix. \|*AAC*\| and *EVOL* are transformed to decile rankings scaled between 0 and 1. *ΔQEARN* and *ΔQEARN*IU* are transformed to decile rankings scaled between 0 and 1 for positive values and transformed to decile rankings scaled between -1 and 0 for negative values. *, **, *** denote statistical significance at the 0.10, 0.05, and 0.01 level, respectively (two-tailed).