# LIMITED ARBITRAGE AND PROFITABLE TRADING: EVIDENCE FROM INSIDER AND FIRM TRANSACTIONS

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First Draft: March 2005
Current Draft: November 2005

*Corresponding author. We appreciate the helpful comments and suggestions of David Aboody, Ray Ball, John Cochrane, Jennifer Francis, Chris Hansen, Jack Hughes, Richard Mendenhall, Per Olsson, Lukasz Pomorski, Jonathan Rogers, Andy Van Buskirk, and workshop participants at the University of Arizona, University of California-Los Angeles, the University of Chicago, the Duke/UNC Fall camp, Northern Illinois University and the University of Notre Dame. All errors are our own. Data on analyst forecasts has been generously provided by I/B/E/S International Inc. We gratefully acknowledge the financial support of the Graduate School of Business at the University of Chicago and the Centel Foundation/Robert P. Reuss Faculty Research Fund.

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**ABSTRACT**

We examine how insiders and firms trade when arbitrage is limited. When arbitrage is costly (proxied by high idiosyncratic risk), insiders and firms earn higher absolute returns on their trades (insider trading, share repurchases, and seasoned equity offerings) in the following year. Furthermore, they initiate their trades following greater past price movements in the preceding year. These results are not driven by information asymmetry or firm size. Overall, our results are consistent with the idea that insiders and firms compete with outside arbitrageurs in exploiting mispricings and benefit when outside arbitrage is limited.

JEL Classification: G11, G12, G14, G32, G35
Key Words: Limits to Arbitrage, Insider Trading, Share Repurchases, Seasoned Equity Offerings

# I. Introduction

When arbitrage forces are weak, sophisticated investors may delay trading against mispricing if they believe the mispricing will worsen in the near future (Abreu and Brunnermeier (2002)). Consistent with this idea Brunnermeier and Nagel (2004) present a clinical study documenting that some hedge funds were long in glamour technology stocks during the peak of the "tech bubble". Rather than short-selling these stocks, these hedge funds held on to them, benefiting from additional increases in price, before selling individual stocks as their prices peaked.

In this paper, we present evidence that insiders and firms similarly benefit from delaying trading against mispricing when arbitrage is weak. When hedging concerns limit outside arbitrageurs' ability to trade on mispricing, insiders earn higher returns on their trades and their trades are associated with return reversals (indicative of trading on mispricing). Moreover, the abnormal returns following the insider and firm trades realize slowly over the course of the year following the trade, suggestive of weak arbitrage forces. We show that these effects are not driven by information asymmetry, nor are they limited to small firms.

Studies of limits to arbitrage are prompted by research documenting apparent stock market anomalies.[1] Researchers have attempted to explain these anomalies with the inability of arbitrageurs to perfectly hedge the fundamental risk in their trades. To capitalize on mispricing, arbitrageurs should purchase (sell short) under-valued (over-valued) firms. To hedge against the fundamental risk in such a strategy (the risk that news about the mispriced firms' fundamental values moves price in the "wrong" direction before the arbitrageur can close out his/her position) the arbitrageur can take an opposing position in a stock that is a close substitute for the mispriced stock. However, if a mispriced stock has few close substitutes (i.e., is highly idiosyncratic), it will be difficult to engage in arbitrage

[1]Ball and Brown (1968) were the first to document post-earnings announcement drift. Other market anomalies that have received attention are the index-inclusion effect (Shleifer 1986), the discount on closed-end funds (Lee, Shleifer, and Thaler 1991), the book-to-market effect (Fama and French 1993), the long-term abnormal returns to SEOs and IPOs (Loughran and Ritter 1995), and the accrual anomaly (Sloan 1996).

trades that are free from fundamental risk and, thus, the demand of arbitrageurs for such trades will be limited. As long as arbitrageurs are risk-averse and insufficiently diversified, the inability to perfectly hedge fundamental risk implies arbitrage will be restricted (Shleifer 2000, Barberis and Thaler 2003).[2]

Past research has documented that arbitrageurs are, in fact, averse to trading against mispricing when firms are idiosyncratic (Pontiff 2005). Several papers have documented that financial anomalies are concentrated among idiosyncratic firms: Pontiff (1996) (closed-end fund discounts), Wurgler and Zhuravskaya (2002) (index-inclusion anomaly), Ali, Hwang, and Trombley (2003) (book to market effect), Mendenhall (2004) (post-earnings announcement drift), and Mashruwala, Rajgopal, and Shevlin (2005). We add to this literature by showing that insider and firm returns to trading on mispricing are highest at idiosyncratic firms.

Specifically, we document that the magnitude of post-trade returns is increasing in idiosyncratic risk: insider purchases and share repurchases precede higher (lower) returns when idiosyncratic risk is high (low), while insider sales and SEOs precede lower (higher) returns when idiosyncratic risk is high (low).[3] We then examine determinants of insider and firm trading and how the effects of these determinants vary with idiosyncratic risk. Prior research has shown that insiders and firms trade on public information such as past returns and the market to book ratio (Rozeff and Zaman (1998),[4] Seyhun (1986), Loughran and Ritter (1995),[5] and Graham and Harvey (2001)[6]) and private information such as future earnings innovations (Piotroski and Roulstone 2005). We find that insiders and

[2]Even if a mispriced stock has close substitutes, noise trader risk (DeLong, Shleifer, Summers, and Waldmann 1990) combined with risk aversion and short horizons limits arbitrage activity as do excessive costs to learn about the mispricing (Barberis and Thaler 2003).

[3]The results for SEOs are sensitive to model specification.

[4]Rozeff and Zaman (1998) present evidence that corporate insiders trade on past returns and that these trades are motivated by perceived mispricing, i.e., insiders are "contrarians". Insiders buy after price decreases and sell after price increases and these trades are presumably made to take advantage of price reversals.

[5]Loughran and Ritter (1995) report a mean, one-year return prior to SEOs of 72%. Further discussion of SEOs and repurchases appears in Baker, Ruback, and Wurgler (2005).

[6]Graham and Harvey (2001) report that 62% of CFOs they survey list "If our stock price has recently risen, the price at which we can sell is 'high"' as important or very important in their decision to issue equity.

firms require greater past price movements before initiating trades when idiosyncratic risk is high, consistent with insiders and firms trading on mispricing. Consistent with these findings, past price movements are more extreme before insider trades and SEOs (and, for large firms, before share repurchases) when idiosyncratic risk is high. Finally, a month-by-month analysis of the abnormal returns following trades supports a limited arbitrage story: prices do not rebound instantaneously once information about the informed trade is disseminated; it takes about three months to eliminate half of the mispricing.

We examine alternative explanations for our findings. In particular, we consider whether the trading behavior we observe could result from insiders' private information, portfolio re-balancing, or from insiders themselves being constrained in their actions by hedging concerns. We believe none of these alternative stories can explain the entire set of empirical results. First, the relationship between trading profitability and idiosyncratic risk could be driven by a relationship between private information and idiosyncratic risk. We directly control for future earnings innovations which have been linked to insider trading (Piotroski and Roulstone 2005). We also control for proxies for information information such as firm size, analyst following, and institutional ownership. In addition, we control for earnings quality (measured as abnormal accruals and errors in the mapping between accruals and cash flows). Earnings quality measures are correlated with idiosyncratic risk (Rajgopal and Venkatachalam 2005) and are associated with returns to several financial anomalies (Francis, Lafond, Olsson, and Schipper (2004)) and returns to insider trading (Aboody, Hughes, and Liu (2005)). Our results are robust to controlling for earnings quality. Finally, we show that our results are not driven by firm size (which is correlated with information asymmetry). Second, if insiders simply re-balance their portfolios as a response to past returns, then their trades should not be followed by abnormal returns as we find. Further, while a re-balancing story may be valid in explaining personal behavior, it cannot explain the behavior of firms repurchasing shares and making seasoned equity offerings. Finally, insiders and especially firms are unlikely to be constrained by concerns about the idiosyncratic risk of arbitrage trades.

Closely related to our study are Pontiff and Schill (2003) and Aboody, Hughes, and Liu (2005). Pontiff and Schill (2003) show that 3-year abnormal returns following seasoned equity offerings (SEOs) are lower when stocks have greater idiosyncratic risk. Aboody, Hughes, and Liu (2005) document a relationship between returns to insider trading and earnings quality, a measure which is correlated with idiosyncratic risk. In our paper, we expand on these works in three ways. First, we examine together insider trading, stock repurchases and seasoned equity offerings. Second, we control for earnings quality and show that idiosyncratic risk is not affecting insider and firm trades solely through its relation with earnings quality. Third, we show that insider and firm profits at highly idiosyncratic firms are related to measures of mispricing, consistent with idiosyncratic risk limiting arbitrage trades that otherwise would reduce mispricing.

Overall, our results indicate that managers compete with outside arbitrageurs in arbitraging away mispricings. When stocks are highly idiosyncratic, outside arbitrageurs have limited ability to engage in arbitrage trades because these trades are not risk-free. Insiders and firms, who are unlikely to be averse to idiosyncratic risk to the same degree as outsiders, are able to patiently exploit mispricing in these situations. Like hedge funds that rode the technology bubble (Brunnermeier and Nagel 2004), insiders and firms are able to delay trades while mispricing aggravates due to the constraints on outside arbitrageurs.

The study proceeds as following. In Section II we describe the data we use. In Section III we describe the empirical tests and their results, and conduct robustness tests. In Section IV we discuss alternative explanations. We conclude in Section V.

# II. Data

## A. Data Sources

We employ data from the Compustat, CRSP, I/B/E/S, SDC Platinum, Thomson Financial Insider Trading Data Feed and Thomson Financial 13F databases. The sample covers the years 1986 to 2003 which is the period covered by the Thomson Financial Insider Trading Data Feed database and for which we have full CRSP data available.

The basic unit of our dataset is a firm-month. To be included in the data set, each firm-month must have at least 24 valid monthly observations in CRSP and 8 quarterly financial reports in the Compustat Quarterly file in the preceding 4 years. For each firm-month we assign indicator variables to whether any of the following transactions took place: stock purchase by a manager or director ($INDBUY$), stock sale by a manager or director ($INDSAL$), stock repurchase by the firm ($INDREP$) and seasoned equity offering by the firm ($INDSEO$).[7] We follow the insider trading literature regarding the definition of purchases and sales by insiders (Rozeff and Zaman 1998, for example). We limit the population of insiders to officers and directors and consider only open-market purchases and sales with a size of more than 100 shares and a reported stock price of below $1,000. In the final sample, we have 54,734 firm-months with purchases by insiders, and 67,185 firm-months with sales by insiders.

Data on stock repurchases and SEOs are provided by Compustat and SDC Platinum, respectively. From Compustat, we prepare a list of all firms that repurchased between 1% and 15% of their shares outstanding during any quarter between the years 1986 and 2003.[8] Repurchases are defined as Compustat item #93. From SDC Platinum, we generate a list of all firms that conducted seasoned equity offerings between the years 1986 and 2003. Overall, the sample includes 84,217 firm-months that conducted repurchases and 2,473 firm-months that conducted SEOs.[9]

We compute control variables from the CRSP, Compustat, I/B/E/S, and Thomson Financial 13F databases. From CRSP, we calculate for each firm-month $t$ the one-month

[7]Results are similar when the indicator variables equal one only when sufficiently large transactions have occurred. Large transactions were defined having an above-median trade size for all no-zero trades of that type.

[8]Small repurchases are likely be related to the use of stock compensation rather than mispricing or private information while the limitation on the maximum size of repurchases follows from Lie (2002) who finds that large repurchases are likely to be defensive in nature.

[9]Note that while we have the exact date of SEOs, we know only the fiscal quarter in which firms conducted their repurchases. Hence, in our analysis we assume that all repurchases took place in the last month of the fiscal quarter.

lagged market value of equity ($MVE$), six and twelve-month cumulative, market-adjusted returns from $t + 1$ to $t + 6$ or $t + 12$ ($FUTRET6$, $FUTRET12$), and six and twelve-month cumulative, market-adjusted returns from $t - 6$ or $t - 12$ to $t - 1$ ($PASTRET6$, $PASTRET12$). Using Compustat Quarterly File, we compute the market-to-book ratio ($M/B$) as the market value of equity scaled by the book value of equity (item #60). We compute the future change in operating performance, $FDROA$, as the difference between the next quarter's operating income before depreciation (item #21) and the same data item four quarters before, all scaled by total assets (item #44). Our measure of earnings quality is the $EQ1$ measure used in Aboody, Hughes, and Liu (2005): $EQ1$ is the absolute residual from a cross-sectional, by-industry regression of total accruals on changes in sales revenue and the level of property, plant, and equipment.[10] From I/B/E/S, we computed the number of analysts issuing one-quarter ahead earnings forecast in each month ($ANALYST$). From the Thomson Financial 13F database, we computed for each firm-quarter the percentage of aggregate institutional shareholding ($INST$) and applied that percentage to each month in the quarter.

To keep our results robust to extreme values and skewed distributions we transform the data in several ways. First, we exclude from the analysis all firm-months with a negative market-to-book ratio. Second, we winsorize all variables used in our regressions at the 1% level. Third, we log variables that have a skewed distribution ($MVE$ and $ANALYST$).

## B. Measures of Arbitrage Risk

Pontiff (1996) argues that arbitrage activity is costly when idiosyncratic risk is high because arbitrageurs cannot hedge their positions effectively. Similarly, Wurgler and Zhuravskaya (2002) present a model in which arbitrageurs are sensitive to the risk of the hedge portfolio they form when engaging in arbitrage. They measure the risk of this hedge portfolio as the variance of the residuals from a regression of a firm's stock returns on the returns of

[10] Aboody, Hughes, and Liu (2005) also use measures based on the error in the mapping between accruals and cash flows. We report results controlling for the $EQ1$ measure because this measure produced the strongest results in Aboody, Hughes, and Liu (2005); however, our results our robust to using their other measures as controls in our tests.

the market portfolio. Several studies have used similar measures of idiosyncratic risk (e.g., Ali, Hwang, and Trombley (2003), Mashruwala, Rajgopal, and Shevlin (2005)). Pontiff and Schill (2003) who, like us, examine returns following SEOs, use the standard deviation of residuals from regressions of three years of monthly firm returns on industry, market, and Fama-French factor-mimicking portfolios.

We proxy for arbitrage risk ($IRISK$) with the variance of residuals from a regression of monthly returns on a four-factor model ($MKT$, $SMB$, $HML$ and $UMD$). We measure idiosyncratic risk with respect to size, book-to-market, and momentum factors (in addition to the market factor) to exclude idiosyncratic risk that is correlated with the trading strategy of insiders and firms.[11] Our proxy is constructed as follows: for each firm-month $t$ we collect monthly excess returns from months $t - 54$ through $t - 6$ and regress these excess returns on the four factors. We then compute the variance of the residuals from each monthly firm-specific regression. This variance has high skewness and kurtosis; a logarithmic transformation results in a relatively normal variable (skewness near zero and kurtosis of 2.9). We use the log-transformed version of $IRISK$ in all of our tests; results are similar using the standard deviation of the residuals (without the log transformation) instead of the variance or creating fractional ranks of the raw variance. Results are also similar if we use the variance of residuals from a regression of the past year's daily returns on the value-weighted market index as our proxy for idiosyncratic risk. Our proxy for systematic risk ($SYSRISK$) is the total variance of monthly returns over months $t-54$ through $t-7$, minus $IRISK$. To ease interpretation of our regression output, we center both $IRISK$ and $SYSRISK$ so that they have means of zero.

Our proxy for arbitrage risk, $IRISK$, may be endogenous with respect to insider and firm trading, and thus, requires further econometric treatment to achieve valid identification. Arbitrage risk makes arbitrageurs reluctant to trade in securities that have few close substitutes. Their reluctance to trade exacerbates mispricing increasing the idiosyncratic component of the firm's returns, i.e., $IRISK$. We resolve the endogeneity problem by instrumenting $IRISK$ with the idiosyncratic component of accounting return

[11]For example, Rozeff and Zaman (1998), Jenter (2005), and Piotroski and Roulstone (2005) show that insiders are value investors.

($ACCRISK$).[12] We compute $ACCRISK$ for each firm-month as follows: First, we compute the quarterly return on assets of firm $i$ at quarter $t$, $ROA_{it}$, calculated as operating income before depreciation (item #21 from Quarterly Compustat) divided by lagged total assets (item #44). Then, for each firm $i$ in quarter $q$, we computed a quarterly index of the 2-digit SIC industry accounting return, $ROAIND_{iq}$, which is weighted by lagged total assets and excludes firm $i$. Each firm-quarter, we regress up to 16 quarters, (from $t-3$ through $t-48$ months) of firm-level $ROA$ on aggregate industry $ROAIND$. Finally, we calculate the variance of the residuals of these regressions, $ACCRISK$, as the proxy for the idiosyncratic risk from operating income. As with $IRISK$, we use the centered, log-transformed version of $ACCRISK$ in our tests. From the correlation coefficients in Table II, it is evident that the idiosyncratic risk in stock returns is highly correlated with the idiosyncratic risk of operating income ($\rho = 0.577$).

# III. Empirical Tests

## A. Descriptive Statistics

Table I presents descriptive statistics for the firm-months in our sample. Insider buys (insider sells, share repurchases, SEOs) occur in 8.7% (10.7%, 13.4%, 0.39%) of our firm-months. The mean past (future) six-month, market-adjusted return is 1.3% (1.5%), while the mean firm has market value of equity of $1.6 billion, has a market-to-book ratio of 2.6, is followed by 4.2 analysts and has 27.4% of its shares held by institutions. Raw idiosyncratic risk has a mean (median) value of 0.024 (0.012); raw systematic risk has a mean (median) value of 0.007 (0.004), and raw, idiosyncratic cash flow volatility has a mean (median) value of 0.002 (0.0002).[13]

Table II presents correlation coefficients for our main variables. Idiosyncratic and systematic risk are highly correlated as are idiosyncratic risk and its instrument $ACCRISK$.

[12]Irvine and Pontiff (2005) show that idiosyncratic variance in cash flows is highly correlated with idiosyncratic variance in stock returns.

[13]By construction, the centered, log-transformed values of these three variables have means of zero.

Insider buys and share repurchases occur after negative returns and prior to positive returns, while insider sales and SEOs occur after positive returns and prior to negative returns (although the latter correlation for SEOs is not statistically significant).

## B. Arbitrage Risk and Returns from Trade

### B.1. Pooled Regressions

To test whether firms and insiders earn returns that are positively correlated with arbitrage risk, we regress market-adjusted returns accumulated over six and twelve months following the observation month on indicator variables for type of trade, $IRISK$, and the interaction between the trade indicator variables and $IRISK$. We also interact $IRISK$ with our mreasures of systematic risk ($SYSRISK$) and earnings quality ($EQ1$) to control for the effects of total volatility and earnings quality on returns to insider and firm trades. We include control variables for size ($MVE$), market-to-book ($M/B$), analyst following ($ANALYST$), institutional ownership ($INST$), and future earnings innovations ($FDROA$). We control for market and industry shocks by adding fixed effects for time (indicator variables for each calendar month from 1986 to 2003) and industry (defined by two-digit SIC codes). Statistical significance is assessed with standard errors that are robust to heteroscedasticity and allow for correlation across firms within two-digit SIC industries. By adding the interactions to the regression, we assess whether the future returns following a trade by an insider or a firm are more extreme for high idiosyncratic risk stocks:

$$
\begin{aligned}
& FUTRET6/12_{it} = \beta_0 + \beta_1 IRISK_{it} + \beta_2 SYSRISK_{it} + \beta_3 EQ1_{it} \\
& + \beta_4 INDBUY_{it} + \beta_5 INDBUY_{it} * IRISK_{it} \\
& + \beta_6 INDSAL_{it} + \beta_7 INDSAL_{it} * IRISK_{it} \\
& + \beta_8 INDREP_{it} + \beta_9 INDREP_{it} * IRISK_{it} \\
& + \beta_{10} INDSEO_{it} + \beta_{11} INDSEO_{it} * IRISK_{it} \\
& + \beta_{12} FDROA_{it} + \beta_{13} PASTRET6/12_{it} + \beta_{14} M/B_{it}
\end{aligned}
$$

$$+\beta_{15}LN(MVE)_{it} + \beta_{16}LN(ANALYST)_{it} + \beta_{17}LN(INST)_{it}$$
$$+Industry\ Fixed\ Effects + Time\ Fixed\ Effects + EQ1\ Interactions +$$
$$SYSRISK\ Interactions + \varepsilon_{it}$$

The results in Table III suggest that insider trades and share repurchases earn higher returns when idiosyncratic risk is high: the interaction variables are all statistically significant and with the expected signs. In terms of economic significance, the results in Table III column (3) indicate that the returns to insider purchases increase with $IRISK$. Ceteris paribus, the mean predicted value of six-month returns following insider purchases and share repurchases is 4.3% when $IRISK$ is at its mean. This increases (decreases) to 11.2% (-1.5%) when $IRISK$ is greater than or equal to one standard deviation above (below) its mean. For shares sold by insiders, six-month returns are roughly -2.27% (0.3%) when $IRISK$ is greater than or equal to one standard deviation above (below) its mean. Twelve-month returns (column (4) of Table III) show a similar spread in returns across the level of $IRISK$ for insider purchases, insider sales, and share repurchases. To make sure that the results are not driven by small stocks, we repeated the analysis with a subsample restricted to the top half of the firms. The results, which are presented in column (5), indicate the effects of the interactions remain significant in this subsample.

The significance of the SEO results is lower than for the other trades. Although idiosyncratic risk is negatively related to post-SEO returns in columns (1) and (2), this relation is insignificant. In column (3) the interaction between SEOs and idiosyncratic risk is only marginally significant (one-tailed p-value of 0.09). In column (4), with 12-month returns, the interaction is more significant (two-tailed p-value of 0.084). This suggests that the time-frame over which the post-SEO returns are measured is important to detecting under-performance. This is consistent with Pontiff and Schill (2003) who measure the relation between SEO under-performance and arbitrage risk over a 36-month window. To summarize: insider and firm purchases (sales) are followed by larger (smaller) returns as idiosyncratic risk increases although the results for SEOs are sensitive to our time-frame for measuring returns.

### B.2. Calendar-Time Portfolios

As a robustness check of the results in the previous subsection, we conform to Fama (1998) who advocates the use of the calendar-time method to measure the abnormal returns from a trading strategy. With the calendar-time method, one tests a trading strategy by regressing excess returns (returns minus the risk free rate) generated by the trading strategy on the contemporaneous returns of risk factor portfolios. If the intercept of these regressions is significantly different from zero, the trading strategy produces abnormal returns, i.e., returns which cannot be subsumed by the known risk factors. As a matter of practice, most researchers use three- or four-factor models where the factors are the market excess return ($MKT$), small minus big ($SMB$), high book-to-market minus low book-to-market ($HML$) and a momentum factor ($UMD$).[14]

To illustrate the calendar-time methodology, we describe the process for assessing abnormal returns in the six months following insider purchases. For each calendar month in our sample, we form a portfolio of all firms that experienced an insider purchase in the preceding six months and did not experience an insider sale during that time. Within each monthly portfolio we then form four sub-portfolios based on the rank of $IRISK$ at the beginning of the month. We then compute the equally-weighted return for each sub-portfolio and subtract the risk-free rate to give a monthly portfolio excess return.[15] This calculation gives us four time-series of monthly observations, one for each level of $IRISK$. The excess returns to these monthly portfolios are then regressed on the contemporaneous returns to the factor-mimicking portfolios with the intercepts in these regressions representing the average monthly return in the six-months following the specified transaction:[16]

$$R_{pt} - R_{ft} \quad = \quad \beta_0 + \beta_1 MKTRF_t + \beta_2 HML_t + \beta_3 SMB_t + \beta_4 UMD_t + \varepsilon_t$$

Similar procedures are carried out for insider sales, repurchases, and SEOs.

[14] For further details on the calendar-time portfolios technique, see Mitchell and Stafford (2000).

[15] Value-weighting the portfolio return yields similar results.

[16] The dependent variable in these regressions is a mean value calculated using varying numbers of firms from month to month. This can result in heteroscedastic residuals; we deal with this by weighting each monthly portfolio return by the square root of the number of firms used to calculate the portfolio return.

The results are presented in Table IV. In Table IV Panel A we present the results for purchases by insiders. The average abnormal, monthly return in the six months following an insider purchase is 97 basis points for high $IRISK$ firms versus 41 basis points for low $IRISK$ firms, a difference significant at the 1% level. This compares to the findings in Jeng, Metrick, and Zeckhauser (2003) that, without partitioning on idiosyncratic risk, insiders earn 52 basis points per month in the six months following insider purchases. Similar results are evident for insider sales (Panel B) and stock repurchases (Panel C): insider sales at high (low) $IRISK$ firms earn monthly returns of $-71$ (-8) basis points; while monthly returns following stock repurchases by high (low) $IRISK$ firms earn returns of 67 (22) basis points. The exception is SEOs which show insignificant abnormal returns across all levels of $IRISK$.[17]

Results for twelve-month returns are similar to the six-month results although significance levels are sometimes lower. For example, the difference between $IRISK$ portfolios in twelve-month returns following insider purchases is only 17 basis points per month and this difference is only marginally significant (one-tailed significance at the 10% level). Results for insider sales are similar across the two cumulation periods while share repurchases, like insider purchases, show a much smaller spread across $IRISK$ levels. For SEOs, the difference in 12-month abnormal returns between high and low $IRISK$ is 28 basis points and this difference has one-tailed significance at the 10% level. Thus, the calendar-time regressions provide weak evidence supporting the Table III results for the effect of $IRISK$ on returns following SEOs.[18]

The intercepts in Table IV provide the average monthly abnormal return following insider and firm transactions but do not indicate how quickly these returns occur. Figure 1 graphs the cumulative monthly intercepts from our four-factor regressions for the 12 months

[17] Note that our calendar-time analyses may understate the returns to insider and firm trades if these trades are based on mispricing related to the market-to-book ratio. This is particularly important in our regressions as insiders tend to buy "value" stocks and sell "glamor" stocks (Rozeff and Zaman 1998). For a discussion of this issue, see Daniel, Hirshleifer, and Subrahmanyam (2005).

[18] (Pontiff and Schill 2003) find decreasing 36-month returns to SEOs as idiosyncratic risk increases. When we examine calendar-time returns in the 36-months following an SEO we find similar results: average monthly returns (after controlling for Fama-French and four-factor returns) are significantly lower for high-$IRISK$ firms than for low-$IRISK$ firms.

following insider and firm transactions, stratified by $IRISK$. Consistent with the average monthly results, cumulative monthly returns to insider trades and repurchases are greater in magnitude across the quartiles of $IRISK$. Further, the returns do not occur immediately following the trades; abnormal returns continue to increase (for insider buys and share repurchases) and decrease (for insider sales and SEOs) for up to a year following the trade event. Of particular note, SEOs show under-performance one-year after the issuance, with this under-performance most severe for the highest idiosyncratic risk quartiles.

In sorting firms by $IRISK$ there is a concern that we are implicitly sorting by firm size which is highly correlated with $IRISK$. To alleviate this concern we perform a double-sort where we first sort firms on the one-year lagged market value of equity, and then, within these size quartiles, sort firms into quartiles of $IRISK$. With this procedure, the Pearson (Spearman) correlation between the $IRISK$ portfolio assignment and lagged market value is -0.08 (-0.03). Results with this double-sort are presented in Panel A of Table V. Returns to insider purchases and share repurchases (insider sales) increase (decrease) across the quartiles of idiosyncratic risk. Results for SEOs continue to be weak with differences in twelve-month returns marginally significant across the high and low $IRISK$ quartiles. Sorting by idiosyncratic risk may also pick up the effects of earnings quality (Aboody, Hughes, and Liu (2005)). We sort firms by quartiles of the earnings quality measure $EQ1$ and then sort into quartiles of idiosyncratic risk (this produces a correlation between the $IRISK$ portfolio assignment and $EQ1$ of 0.02). Four-factor intercepts with this double-sort are presented in Panel B of Table V. As before, intercepts continue to increase (decrease) across quartiles of idiosyncratic risk for insider purchases and share repurchases (insider sales). Results continue to be weak for SEOs.

Past studies have shown that idiosyncratic risk may be associated with future abnormal returns (Goyal and Santa-Clara 2003). Such an association between abnormal returns and idiosyncratic risk should not explain our results as we document a positive relation between idiosyncratic risk and returns for purchase events and a negative relation between idiosyncratic risk and returns for sales events. In contrast, the idiosyncratic risk literature generally documents a monotonic relation between idiosyncratic risk and returns (Pontiff

(2005) also makes this point). For robustness, we investigate this issue. First, we form calendar-time portfolios of all firms stratified by the level of $IRISK$. Regressions of one-month excess portfolio returns on the four-factor model provide estimates of the average abnormal return each month to firms stratified by idiosyncratic risk. Results (in row (1) of Panel C) provide only weak evidence that, with the four-factor model, idiosyncratic risk is priced by the market: only the intercept for the lowest level of $IRISK$ is significantly different from zero and the significance is marginal. Intercepts for the top-three quartiles of $IRISK$ are not significantly different from zero while the spread in intercepts between the top and bottom quartile is 61 basis points.

Second, we construct a factor based on $IRISK$, and include this factor in our calendar-time analysis. We construct this factor in a manner similar to the Fama-French $HML$ (value/glamor) factor: using all firms, we measure each month the mean return to large and small firms with a high (above the median) level of $IRISK$, as well as the mean return to large and small firms with a low (below or equal to the median) level of $IRISK$. The difference of these returns is our $IRISK$ factor ($I\_FACTOR$). The second row of Panel C of Table V presents our universal calendar-time regressions with this factor included:

$$R_{pt} - R_{ft} = \beta_0 + \beta_1 MKTRF_t + \beta_2 HML_t + \beta_3 SMB_t + \beta_4 UMD_t + \beta_5 I\_FACTOR_t + \varepsilon_t$$

As can be seen in the table, intercepts for all levels of $IRISK$ are insignificantly different from zero when $I\_FACTOR$ is included in the calendar-time regression. The intercept spread between the top and bottom quartiles of $IRISK$ is now only 17 basis points and is insignificant.

Table V, panel C also assesses the effects of including $I\_FACTOR$ in our calendar-time estimations of returns to insider and firm trades. As can be seen in the table, the inclusion of $I\_FACTOR$ does not significantly alter our inferences: abnormal returns following insider buys, insider sales, and share repurchases still have greater magnitudes when $IRISK$ is high than when $IRISK$ is low. In fact, the 12-month results for insider purchases and share repurchases are stronger with $I\_FACTOR$ included in the regressions: the spread between the top and bottom quartiles of $IRISK$ is now significant at the 1% level for both.

These robustness tests support our hypothesis that insiders and firms are better able to exploit profitable trading opportunities when idiosyncratic risk is high rather than low. First, our measure of idiosyncratic risk is not proxying for firm size or earnings quality. Second, the abnormal returns in the $IRISK$-based portfolios are not subsumed by the return difference between high and low idiosyncratic risk firms. Rather, controlling for this return difference, trades occurring at high-$IRISK$ firms are followed by more extreme returns than trades occurring at low-$IRISK$ firms.

## C. The Decision to Trade

Given that returns following insider and firm trades appear to be correlated with arbitrage risk, we examine the source of this correlation by testing the hypothesis that insiders and firms can more easily exploit public information about mispricing and private information about firm prospects when arbitrage risk is high. We do this by studying the determinants of trading by insiders and firms. Results are presented in Table VI, Panels A (insider purchases), B (insider sales), C (repurchases) and D (SEOs). The dependent variable in all the regressions is an indicator variable for whether the event in question took place in a particular firm-month.

We follow previous studies which have identified past returns as an important trigger for insider and firm trades (Rozeff and Zaman 1998, Piotroski and Roulstone 2005, Graham and Harvey 2001, Loughran and Ritter 1995, Jenter 2005). The variables of interest are the proxy for arbitrage risk ($IRISK$) and its interactions with (1) past returns ($PASTRET6$ or $PASTRET12$); (2) the market-to-book ratio ($M/B$); and (3) the one-quarter ahead change in $ROA$ ($FDROA$):

$$INDBUY/SAL/REP/SEO_{it} = \beta_0 + \beta_1 IRISK_{it} + \beta_2 SYSRISK_{it} + \beta_3 EQ1_{it}$$
$$+\beta_4 PASTRET6_{it} + \beta_5 PASTRET6_{it} * IRISK_{it} + \beta_6 PASTRET6_{it} * SYSRISK_{it}$$

$$+\beta_7 PASTRET6_{it} + \beta_8 PASTRET6_{it} * EQ1_{it} + \beta_9 M/B_{it} + \beta_{10} M/B_{it} * IRISK_{it}$$
$$+\beta_{11} M/B_{it} * SYSRISK_{it} + \beta_{12} M/B_{it} * EQ1_{it} + \beta_{13} FDROA_{it}$$
$$+\beta_{14} FDROA_{it} * IRISK_{it} + \beta_{15} FDROA_{it} * SYSRISK_{it} + \beta_{16} FDROA_{it} * EQ1_{it}$$
$$+\beta_{17} LN(MVE)_{it} + \beta_{18} LN(ANALYST)_{it} + \beta_{19} LN(INST)_{it}$$
$$+Industry\ Fixed\ Effects + Time\ Fixed\ Effects + \varepsilon_{it}$$

We do not predict the sign of the coefficient on $IRISK$, however, we can make a prediction regarding the coefficient on the interaction between $IRISK$ and the trade signals. As $IRISK$ increases, insiders and firms will initiate buys (sells) after lower (higher) past returns and when the firm has a lower (higher) market-to-book ratio: i.e., when $IRISK$ is high insiders and firms will trade when public signals of mispricing are more pronounced. This is because higher $IRISK$ discourages outside arbitrage activity and allows insiders and firms to be more patient in timing the market. Thus, for insider purchases and share repurchases, the sign on the interaction between $IRISK$ and, $PASTRET6/12$ or $M/B$, should be positive: low returns and low market-to-book ratios lead to insider purchases and share repurchases but stronger signals are needed as the risk of arbitrage increases. For insider sales and SEOs the sign on the coefficient of the interaction term will be negative: high returns and high market-to-book ratios lead to insider sales and SEOs but stronger signals are needed as the risk of arbitrage increases. Put another way, a larger decrease (increase) in price and a lower (higher) valuation will occur before initiation of purchases (sales) when $IRISK$ is high.

The relation between $IRISK$ and the private signal of future earnings changes ($FDROA$) is not so clear. Unlike public signals such as past returns, insiders have a clear advantage in using knowledge of future earnings changes relative to outside arbitrageurs. At the same time, trading on private information about earnings carries with it litigation concerns not attached to trading on public signals of mispricing. Litigation concerns imply that high idiosyncratic risk will decrease the use of earnings news because idiosyncratic risk prevents outsiders from trading on public signals, allowing insiders to trade on those signals (which carry less litigation risk than private information). Alternatively, if idiosyncratic risk prevents outsiders from trading on public signals *and* private signals such as earnings news, we would expect the use of $FDROA$ to increase with idiosyncratic risk.

To investigate whether the source of stock return volatility is important for arbitrage activity (and thus, to the activities of insiders), we include systematic risk ($SYSRISK$) and its interaction with the trading signals in our regressions. If all types of volatility deter arbitrage then we expect that the signs on the coefficient of the interaction between $SYSRISK$ and the trading signals would follow the signs of the coefficient on the interaction between $IRISK$ and the trading signals. However, when $IRISK$ is held constant, greater $SYSRISK$ implies a stock's returns are closer to those of the market, providing an arbitrageur greater ability to hedge the fundamental risk in a trade. This outcome then implies that the sign of the coefficient on the interaction between $SYSRISK$ and the trading signals will be opposite to the sign on the coefficient on the interaction between $IRISK$ and the trading signals. Thus, including $SYSRISK$ and its interaction in our regressions provides an additional test of our prediction that idiosyncratic risk increases the risks of arbitrage by limiting the hedging of fundamental risk. We also include the interaction between trading signals and $EQ1$ to test whether poor-quality financial reporting affects the use of trading signals by insiders.

Our trade determinants regression is a linear probability model. In such models, the variance of the error term is always heteroscedastic (Wooldridge 2002). As in our future returns regressions, we assess significance with standard errors that are robust to heteroscedasticity. To mitigate concerns that the increase over time in idiosyncratic volatility (Campbell, Lettau, Malkiel, and Xu 2001) is correlated with changes in trading patterns we include time fixed effects. Similarly, we include fixed effects for industry membership to control for the possibility that idiosyncratic industries make heavy use of stock-based compensation resulting in increased insider trading and stock repurchases. Finally, we add firm size ($MVE$), analyst following ($ANALYST$), institutional ownership ($INST$)to control for information asymmetry between insiders and shareholders.

Ordinary Least Squares (OLS) and Two-Stage Least Squares (2SLS) regressions of the determinants of trading are presented in Table VI. In column (1) we regress the transaction indicator on $IRISK$, $PASTRET6$, $M/B$, $FDROA$, and the control variables. In column (2) we add interactions between $IRISK$ and the trading signals along with the fixed effects. In column (3), we present results where we instrument for $IRISK$ using $ACCRISK$. Finally, column (4) repeats the analysis in column (3) with $PASTRET12$ instead of $PASTRET6$. Table VI confirms the findings of previous studies (Rozeff and Zaman 1998, Piotroski and Roulstone 2005) that past returns predict transactions of insiders and firms: insider purchases and share repurchases follow negative returns while insider sales and SEOs follow positive returns. As predicted, the interaction between $IRISK$ and $PASTRET6$ is positive for purchases and repurchases and negative for sales and SEOs suggesting that in the presence of arbitrage risk, insiders trade after greater past mispricing. However, results are only marginally significant for SEOs (one-tailed $p$-value of 0.09 for column (3) in Panel D).

Results with the market-to-book ratio ($M/B$) are not as clear. Insider purchases occur when the ratio is low (i.e., insiders are value investors) but this relation is unaffected by idiosyncratic or systematic risk. On the other hand, insider sales occur when the ratio is high and higher values are needed to induce sales as idiosyncratic risk increases (with the opposite result for systematic risk). Finally, share repurchases and SEOs show little variation in their relation with market-to-book ratios as idiosyncratic risk varies. Overall, only insiders sales support the hypothesis that misvaluation (as proxied by the market-to-book ratio) is greater at trade initiation when idiosyncratic risk is high relative to when it is low.

The final trading signal is future earnings changes ($FDROA$). Insider purchases occur when future earnings changes are positive; however, this relation decreases as idiosyncratic risk increases and this decrease is significant in the 2SLS regressions. Thus, as with past returns, greater future earnings innovations are required to initiate inside purchases when idiosyncratic risk is high. This suggests than when idiosyncratic risk is high, insiders purchase after greater price declines and before greater positive earnings surprises. Conversely, when idiosyncratic risk is low and systematic risk is high, insider purchases occur after smaller price declines and before smaller earnings surprises. These results are consistent with insiders trading on public and private signals of mispricing when idiosyncratic risk prevents non-insiders from using this information.

Surprisingly, insider sales occur before positive earnings surprises; however, this relation is unaffected by idiosyncratic and systematic risk. This may be due to litigation worries as insider sales ahead of bad earnings news are likely to draw regulatory scrutiny.[19] In addition, many insider sales are made for liquidity reasons and the prior literature has concluded that insider sales contain little private information (Lakonishok and Lee 2001). Strangely, share repurchases are also more likely as earnings decrease with this relation decreasing (increasing) in idiosyncratic (systematic) risk. Finally, SEOs are unaffected by short-term earnings changes.

Table VI suggests that idiosyncratic risk has a statistically significant effect on the probability of trading. The economic significance of this effect can be assessed as follows using the data from column (2) of Table VI Panel A: $IRISK$ has a mean of zero (by construction) and a standard deviation of 1.1251. When $IRISK$ is one-standard deviation above zero, a ten percent decrease in price over the past six months increases the probability of an insider purchase by 0.22% $(= 10\% * (-0.047 + (1.1251 * 0.0219)))$. When $IRISK$ is one-standard deviation below zero, a ten percent decrease in price over the past six months increases the probability of an insider purchase by 0.72% $(= 10\% * (-0.047 + (-1.1251 * 0.0219)))$. Thus, the effect of past returns (a public signal of mispricing) on insider purchases is over three times as strong when arbitrage risk is low (one-standard deviation below its mean) relative to when it is high (one-standard deviation above its mean).

Overall, the results in Table VI imply that when idiosyncratic risk is high, insiders delay trading against mispricing in order to take advantage of further, favorable price movements. Similarly, insiders at idiosyncratic firms sell when the firm is more over-valued (as measured by the market-to-book ratio) than insiders at systematic firms. Private information about earnings changes is used by insiders at idiosyncratic firms when making purchase decisions.

[19] See Ke, Huddart, and Petroni (2003) for a discussion of this issue and evidence that insiders prefer to sell several quarters ahead of negative earnings news.

However, the use of earnings news for insider sales and SEOs is unrelated to idiosyncratic risk (and the main effect is of the opposite sign for insider sales), while the use of earnings news in share repurchase decisions is contrary to expectations. Overall, the consistent driver of trading decisions is past returns with trades occurring after more extreme past returns as idiosyncratic risk increases.

## D. Returns Prior To Trades

We provide more evidence on the relation between past returns and trading by regressing past returns on indicator variables for trade occurrence and interactions of these indicator variables with $IRISK$. Table VII presents these results; column (1) presents the base regression; column (2) adds control variables; column (3) adds fixed effects for industry and time; column (4) repeats the model of column (3) substituting $PASTRET12$ for $PASTRET6$ as the dependent variable. Column (5) presents the column (3) regression with a sample of firms falling in the top half of all firms ranked on size. For insider sales the results are as implied by the Table VI regressions: six-month returns before sales are positive and past-return magnitudes increase as $IRISK$ increases. In economic terms, insider sales are preceded on average by a share price increase of 9.6%; when $IRISK$ is greater than or equal to one-standard deviation above (below) its mean, the six-month return before insider sales is roughly 16% (2%). Similarly, our results indicate that equity is issued following high returns and, the greater the value of $IRISK$, the greater the past returns observed.

In contrast to the sales results, results for insider purchases are insignificant in columns (3) and (4), while results for repurchases are contrary to expectations: repurchases occur after after price declines, but as $IRISK$ increases smaller past declines are observed. This result may be due to repurchases which occur for reasons other than undervaluation. For example, stock options are more valuable at idiosyncratic firms. These firms may repurchase shares to avoid EPS dilution following option exercises; these repurchases will tend to follow the positive returns associated with option exercises. This interpretation is supported by the column (5) results where we eliminate the bottom half of firms ranked on size. In this sample, returns prior to repurchases are more negative as idiosyncratic risk increases. This is consistent with smaller firms being more likely to face dilution issues from option use. In addition, column (5) reveals that for large firms, the interaction between past returns and idiosyncratic risk is significantly negative for insider purchases.

Thus, our cross-sectional regressions indicate that, for large firms, returns before insider and firm trades are greater in magnitude when idiosyncratic risk is high. This result is consistent with idiosyncratic risk limiting the activities of non-insider arbitrageurs and allowing insider arbitrageurs more freedom to exploit profitable trading opportunities associated with past return movements.

## E. Arbitrage Forces following Trades

The time required for returns to reach equilibrium following insider and firm trades implies weak arbitrage forces after the trades. We investigate this issue by examining holdings of institutional investors in firms undergoing trading events. This analysis produces the following (untabulated) results. First, we find that institutions prefer to hold firms with low levels of $IRISK$: the number of institutions holding a stock declines across quartiles of $IRISK$. (To ensure we are not assessing ownership across size quartiles–which are correlated with $IRISK$ quartiles–we sort firms first by size, and then by $IRISK$ to determine $IRISK$ quartile assignments). This finding is similar to the finding in Lev and Nissim (2003) that institutions avoid extreme accrual stocks, leading to the persistence of the accrual anomaly.

Second, we find that institutional buying and selling after trades is stronger for low $IRISK$ stocks than for high $IRISK$ stocks after insider sales, share repurchases, and SEOs. In other words, conditional on one of these events occurring, institutions push prices in the right direction with more force at stocks with low idiosyncratic risk relative to stocks with high idiosyncratic risk. Given that mispricing is more severe at high $IRISK$ stocks, this pattern of institutional trading is consistent with mispricing being corrected slowly after insider and firm trades. After insider purchases however, institutions concentrate their buying at firms with extremely high and low idiosyncratic risk.

## F. Other Proxies for Arbitrage Risk

We have used idiosyncratic risk as our proxy for impediments to arbitrage trades. As noted earlier however, arbitrage will also be limited by transactions costs and the extent of noise trading. For robustness we replicate our analysis in Table III using other proxies for arbitrage risk. The proxies we use are drawn from Ali, Hwang, and Trombley (2003) who examine the relation between proxies for arbitrage risk and the returns to a trading strategy based on the book-to-market ratio.

In unreported results we run our Table III regressions including interactions between the trade indicators and share price, firm size, analyst following, institutional ownership, and bid-ask spreads. This analysis reveals two main points: first, the relations between idiosyncratic volatility and the trade indicators are robust to including these additional arbitrage cost proxies. Second, the returns to insider trades are generally increasing in the additional proxies for limits to arbitrage. As share prices, firm size, analyst following, and institutional ownership (bid-ask spreads) decrease (increase), returns to insider trades increase. However, as in Ali, Hwang, and Trombley (2003) these relations are generally subsumed by the idiosyncratic risk relation: when the trade indicators are interacted with both idiosyncratic risk and the other proxies, only the interaction with idiosyncratic risk is significant. Only size and the bid-ask-spread retain significance in the presence of idiosyncratic risk. Overall, this analysis indicates that the relation between insider trading profits and limits to arbitrage is robust to multiple proxies for limits to arbitrage; however, idiosyncratic risk is the strongest example of this relation.

# IV. Alternative Explanations

The results from the previous section indicate that insiders and firms modify their trading behavior with respect to trading signals and with respect to the degree of idiosyncratic risk. We find that in order to initiate a purchase (sale), insiders and firms require a greater decline (a greater increase) in price when idiosyncratic risk is high relative to when it is low (Table VI). Further, the magnitude of post-trade returns is more extreme in high idiosyncratic risk stocks (Table III). This is consistent with a world in which idiosyncratic risk limits the ability of outside arbitrageurs to exploit mispricing: given these limits, insiders (who face fewer barriers to arbitrage activity than outsiders) are better able to time their trades and thus, we observe them trading after greater mispricing, i.e., after more extreme returns (all trades), after greater market valuation relative to book value (insider sales), and before greater earnings innovations (insider purchases).

We now consider alternative explanations for our results such as private information, portfolio re-balancing, and hedging concerns by insiders. We argue that none of these alternative explanations can explain the full scope of our results.

## A. Alternative Explanations I: Private Information

The first alternative explanation for our findings is that idiosyncratic risk proxies for information asymmetry between corporate insiders and outside market participants. Insiders and corporate decision makers exploit this information asymmetry to trade on private information. In particular, according to this explanation, asymmetric information is correlated with idiosyncratic risk, so that it is not surprising that insiders perform better when idiosyncratic risk is higher. This explanation is supported with Aboody, Hughes, and Liu (2005) who show that insiders perform better when earnings quality is poor, and with Rajgopal and Venkatachalam (2005) who show that earnings quality is correlated with idiosyncratic risk.

First, to gauge whether private information story is plausible, consider our results for insider purchases. Of the four types of trades discussed in this study, insider purchases have been the most closely linked to private information (Jeng, Metrick, and Zeckhauser 2003, for example). The results in Table III and in Table VII, however, indicate that when idiosyncratic risk is high, insider purchases are taking advantage of mispricing. Figure 2, documenting cumulative, monthly, calendar-time returns over the 12 months prior to and following insider purchases, supports this idea: for high idiosyncratic risk firms, returns prior to trades are negative, while returns following the trade are just positive enough to cancel out the past decline by roughly 2%. In contrast, at low idiosyncratic risk firms, returns prior to insider purchases are largely flat, but the purchases are followed by positive returns of approximately 5.5%. Thus, Figure 2 suggests that most of the returns earned by insiders in high idiosyncratic risk stocks are due to prior abnormal decline, likely mispricing, while most of the returns earned on low idiosyncratic stocks are due to private information. Furthermore, if insiders and firms were simply acting on private information, we would expect prices to correct quickly once the insider and firm trades are disclosed (for insider trades, disclosure occurs, on average, within 30 days of the trade). The fact that it takes more than six months for the market to fully react to the trades reinforces a limited arbitrage story.

Second, we address the concerns of asymmetric information by employing a series of controls in our pooled regressions. We include several proxies for information asymmetry (firm size, analyst following and institutional ownership) and proxies for specific private information (future earnings innovations). In addition, we control for earnings quality which is correlated ((Aboody, Hughes, and Liu 2005)) with the ability of insiders to earn abnormal returns. We find that including this measure in our tests does not affect the relation between insider profits and idiosyncratic risk.

Third, we verify that our calendar-time results are not driven by the quality of information reported by insiders to outsiders, proxied by earnings quality (Table V, Panel B). We repeat the calendar-portfolio regressions where portfolios are first sorted on the earnings quality measure and then on idiosyncratic risk. Our results, as reported in Table V, remain the same.

Fourth, we take additional precautions to ensure our results are not driven by small firms as private information problems are likely to be stronger in these firms, where the information environment is poor and outside monitoring is weak. In Tables III and VII we show that our pooled-regressions results are robust to size. In the last column of each table we rerun the main test with large firms only (market value above the median, industry-adjusted market value). Our results remain robust to this stratification. In Table V, Panel A, we redo the calendar-time portfolio regressions after double sorting our portfolios, first on size and then on idiosyncratic risk. The results are robust to this sort.

## B. Alternative Explanations II: Portfolio re-balancing

The relation between trading and past returns could be due to portfolio rebalanacing: when prices rise (fall), insiders will sell (buy) to maintain an optimal portfolio value. However, if insiders re-balance following price changes, we would expect the relation between this re-balancing and past returns to be increased by idiosyncratic risk (because, as idiosyncratic risk rises, the costs of a sub-optimal portfolio increase). Further, if insider trades are motivated by re-balancing considerations, the trades should not be informative about future returns. Finally, portfolio re-balancing cannot account for the behavior of firm equity transactions.

## C. Alternative Explanations III: Hedging Concerns

A third alternative explanation for our results is that insiders and firms themselves are deterred from trading by the difficulty of hedging fundamental risk. This deterrence effect leads to insiders at high idiosyncratic risk firms trading only after mispricing becomes strong enough to compensate them for the risk involved in the trade, a prediction consistent with our results in Tables VI and VII. However, it is unlikely that managers making decisions about SEOs and share repurchases are sensitive to idiosyncratic risk in the manner depicted in the limits to arbitrage literature. For example, firms are unlikely to hedge themselves against the risk involved in issuing equity or repurchasing shares. Further, of all possible arbitrageurs, insiders and firms are the least susceptible to worries about fundamental risk.

### D. Alternative Explanations IV: Information Uncertainty

Finally, Kumar (2004) shows that retail investors exhibit greater behavioral biases in their trading behavior when idiosyncratic risk is high. This effect is attributed to idiosyncratic risk proxying for retail investors' uncertainty about a firm's value. As insiders may be among the traders taking the opposite position in retail investors' trades, this effect may partially explain our results. We provide a partial response to this explanation by regressing $IRISK$ on $ACCRISK$ and using the residual from this regression (a measure of idiosyncratic volatility unrelated to firm fundamentals) as our measure of idiosyncratic risk. Using this residual measure our main results are largely unaffected (results not tabulated). Thus, idiosyncratic risk does not appear to be proxying for uncertainty about firm fundamentals.

## V. Conclusion

In this paper we provide evidence that idiosyncratic risk affects arbitrage activities. Consistent with idiosyncratic risk limiting arbitrage trades by non-insiders, we show that insiders and firms trade more profitably in firms with high idiosyncratic risk than in firms with low idiosyncratic risk. Specifically, trades of insiders and firms capitalize more on extreme past returns and are followed by higher returns, when idiosyncratic risk is high than when it is low. Our results imply that when arbitrage risk is high the price of a stock may deviate from its fundamental value to a greater extent than if arbitrage risk is low, due to the lack of trades intended to profit from this mispricing. Consistent with Brunnermeier and Nagel (2004) who show that sophisticated traders profited from mispricing in technology stocks during the tech "bubble", our results are consistent with insiders exploiting mispricing in their stocks when outside arbitrage is limited.

We discount alternative explanations for our work including idiosyncratic risk proxying for information asymmetry, portfolio re-balancing, limits on the arbitrage activities of insiders and firms, and idiosyncratic risk proxying for investor biases. In addition, our results are not driven by small stocks: eliminating small firms and orthogonalizing our arbitrage-risk measures with respect to size does not significantly alter our findings.

Given the returns that insiders and firms make on their trades in high idiosyncratic stocks, the question arises whether a trading strategy based on mimicking them will prove profitable. We conclude in this study that insiders and firms do not initiate trades immediately when price deviates from fundamental value because they wait for the mispricing to aggravate (in line with idiosyncratic risk constituting a risk to outsiders). Our finding that prices do not react immediately to insider and firm trades implies that arbitrageurs attempting to mimic insiders face limits to arbitrage. This is supported by our (untabulated) finding that institutional investors avoid firms with high idiosyncratic risk, the very firms earnings the highest returns after insider and firm trades. Thus, consistent with Seyhun (1998), our findings suggest that traders attempting to mimic insider and firm trades face limits to their arbitrage activities.

# References


Aboody, D., J. Hughes, and J. Liu (2005): "Earnings quality, insider trading, and the the cost of capital," Working Paper, University of California Los Angles, Anderson School of Management.

Abreu, D., and M. Brunnermeier (2002): "Synchronization Risk and Delayed Arbitrage," *Journal of Financial Economics*, 66, 341–360.

Ali, A., L.-S. Hwang, and M. A. Trombley (2003): "Arbitrage risk and the book-to-market anomaly," *Journal of Financial Economics*, 69, 355–374.

Baker, M., R. S. Ruback, and J. Wurgler (2005): "Behavioral Corporate Finance: A Survey," in *Handbook in Corporate Finance: Empirical Corporate Finance*. Elsevier/North Holland, New York, ed. B. Espen Eckbo, forthcoming.

Ball, R., and P. Brown (1968): "An empirical evaluation of accounting income numbers," *Journal of Accounting Research*, 6, 159–178.

Barberis, N., and R. Thaler (2003): "A Survey of Behavioral Finance," in *the Handbook of the Economics*. North-Holland, eds. George Constantinides, Milton Harris and René M. Stulz.

Brunnermeier, M. K., and S. Nagel (2004): "Hedge Funds and the Technology Bubble," *Journal of Finance*, 59, 2013–2040.

Campbell, J. Y., M. Lettau, B. G. Malkiel, and Y. Xu (2001): "Have Individual Stocks Become More Volatile- An Empirical Exploration of Idiosyncratic Risk," *Journal of Finance*, 56, 1–43.

Daniel, K. D., D. Hirshleifer, and A. Subrahmanyam (2005): "Investor Psychology and Tests of Factor Pricing Models," Working Paper, Northwestern University.

DeLong, J. B., A. Shleifer, L. Summers, and R. J. Waldmann (1990): "Noise Trader Risk in Financial Markets," *Journal of Political Economy*, 98(4), 703–738.

Fama, E. F. (1998): "Market Efficiency, Long-Term Returns and Behavioral Finance," *Journal of Financial Economics*, 49(3).

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

Francis, J., R. Lafond, P. Olsson, and K. Schipper (2004): "Financial Anomalies and Information Uncertainty," Working Paper, Fuqua School of Business, Duke University.

Goyal, A., and P. Santa-Clara (2003): "Idiosyncratic risk matters!," *Journal of Finance*, 58, 975–1008.

Graham, J. R., and C. R. Harvey (2001): "The theory and practive of corporate finance: Evidence from the field," *Journal of Financial Economics*, 60, 187–243.

Irvine, P. J., and J. Pontiff (2005): "Idiosyncratic return volatility, cash flows, and product market competition," Working Paper, Boston College.

Jeng, L. A., A. Metrick, and R. Zeckhauser (2003): "Estimating the Returns to Insider Trading: A Performance-Evaluation Perspective," *The Review of Economics and Statistics*, 85.

Jenter, D. (2005): "Market Timing and Managerial Portfolio Decisions," *Journal of Finance*, 60, 1903–1949.

Ke, B., S. Huddart, and K. Petroni (2003): "What Insiders Know about Future Earnings and How They Use It: Evidence from Insider Trades," *Journal of Accounting and Economics*, 35, 315–346.

Kumar, A. (2004): "When do investors exhibit stronger behavioral biases?," Working Paper.

Lakonishok, J., and I. Lee (2001): "Are Insiders' Trades Informative?," *Review of Financial Studies*, 14, 79–111.

Lee, C., A. Shleifer, and R. Thaler (1991): "Investor Sentiment and the Closed-end Fund Puzzle," *Journal of Finance*, 46, 75–109.

Lev, B., and D. Nissim (2003): "The Persistence of the Accruals Anomaly," *Contemporary Accounting Research*, forthcoming.

Lie, E. (2002): "Do Firms Undertake Self-Tender Offers to Optimize Capital Structure?," *Journal of Business*, 75, 609–639.

Loughran, T., and J. Ritter (1995): "The New Issues Puzzle," *Journal of Finance*, 50(1), 23–52.

Mashruwala, C., S. Rajgopal, and T. Shevlin (2005): "Why is the Accrual Anomaly not Arbitraged Away?," *Journal of Accounting and Economics*, forthcoming.

Mendenhall, R. (2004): "Arbitrage Risk and Post-Earnings-Announcement Drift," *Journal of Business*, 77, 875–894.

Mitchell, M., and E. Stafford (2000): "Managerial Decisions and Long-Term Stock Price Performance," *Journal of Business*, 73(3), 287–320.

Piotroski, J. D., and D. Roulstone (2005): "Do Insider Trades Reflect Both Contrarian Beliefs and Superior Knowledge about Future Cash-Flow Realizations?," *Journal of Accounting and Economics*, 39.

Pontiff, J. (1996): "Costly Arbitrage:Evidence from Closed-End Funds," *Quarterly Journal of Economics*, 111, 1135–1151.

——— (2005): "Costly Arbitrage and the Myth of Idiosyncratic Risk," Working Paper, Boston College.

Pontiff, J., and M. Schill (2003): "Arbitrage Holding Costs and Long-run Returns: Evidence from Seasoned Equity Offerings," Working Paper, Boston College.

Rajgopal, S., and M. Venkatachalam (2005): "Financial Reporting Quality and Idiosyncratic Return Volatility over the Last Four Decades," Working Paper.

Rozeff, M. S., and M. A. Zaman (1998): "Overreaction and Insider Trading: Evidence from Growth and Value Portfolios," *Journal of Finance*, 53(2), 701–716.

Seyhun, H. N. (1986): "Insiders' Profits, Costs of Trading, and Market Efficiency," *Journal of Financial Economics*, 61(2), 189–212.

Seyhun, H. N. (1998): *Investment Intelligence From Insider Trading*. MIT Press.

Shleifer, A. (1986): "Do Demand Curves for Stocks Slope Down?," *Journal of Finance*, 41, 579–590.

——— (2000): *Inefficient markets: an introduction to behavioral finance*. Oxford University Press, Oxford.

Sloan, R. (1996): "Do stock prices fully reflect information in accruals and cash flows about future earnings?," *Accounting Review*, 71, 289–315.

Wooldridge, J. M. (2002): *Introductory Econometrics: A Modern Approach*. Thomson South-Western Publishers, second edn.

Wurgler, J., and E. V. Zhuravskaya (2002): "Does Arbitrage Flatten Demand Curves for Stocks?," *Journal of Business*, 75, 583–608.

# Appendix: Variable Definitions

| Variable | Definition |
|---|---|
| $IRISK$ | Centered log of the variance of residuals from a regression of monthly returns on the monthly Fama-French factors plus a momentum factor; data from month $t-6$ through $t-54$, minimum 24 months of returns to be in sample |
| $SYSRISK$ | Centered log of the total variance of monthly returns minus the variance of residuals used to calculate $IRISK$ |
| $ACCRISK$ | Centered log of the variance of residuals from a regression of quarterly return on assets on value-weighted industry index of return on assets; data from months $t-3$ through $t-48$ |
| $INDBUY(SAL)$ | Indicator variable equal to one if at least one insider purchase (insider sale) occurred during the month |
| $INDREP(SEO)$ | Indicator variable equal to one if a share repurchase (SEO) occurred during the month |
| $PASTRET6(12)$ | Six-month (12-month) market adjusted, buy and hold return over month $t-1$ through $t-6$ ($t-12$) |
| $FUTRET6(12)$ | Six-month (12-month) market adjusted, buy and hold return over month $t+1$ through $t+6$ ($t+12$) |
| $MVE$ | The market value of equity at the end of month $t$ |
| $M/B$ | Market value of equity scaled by the book value of equity |
| $ANALYST$ | The number of analysts issuing a one-quarter ahead earnings forecast for the firm in month $t$ |
| $INST$ | The percentage of shares outstanding owned by institutional investors |
| $FDROA$ | One-quarter ahead seasonal change in quarterly return on assets |
| $EQ1$ | Absolute value of abnormal accruals from cross-sectional Jones model |
| $\mathrm{R}_f$ | Risk-free rate of return in month $t$, proxied by one-month treasury bill rate |
| $MKTRF$ | Excess return on the market defined as the value-weighted monthly return to all stocks on CRSP less the one-month treasury bill rate |
| $SMB$ | Mean monthly return on portfolio of small firms less mean monthly return on portfolio of large firms |
| $HML$ | Mean monthly return on portfolio of value firms less mean monthly return on portfolio of glamor firms |
| $UMD$ | Mean monthly return on portfolio of winners less mean monthly return on portfolio of losers |
| $I\_FACTOR$ | Mean monthly return on portfolio of high $IRISK$ firms less mean monthly return on portfolio of low $IRISK$ firms |

## Table I
## Descriptive Statistics

The table presents descriptive statistics of the sample used. The sample consists of all firms with: Complete data from Compustat, CRSP, I/B/E/S, CDA/Spectrum, Thomson Financial's Insider Trading Data Feed for 1986-2003. For the monthly Fama-French variables ($R_f$, $MKTRF$, $HML$, $SMB$, and $UMD$) statistics are based on 215 monthly observations. $IRISK$ is the centered log of the variance of residuals from a regression of monthly returns on the monthly Fama-French factors plus a momentum factor; data from month $t-6$ through $t-54$, minimum 24 months of returns to be in sample. $SYSRISK$ is the centered log of the total variance of monthly returns minus the variance of residuals used to calculate $IRISK$. $ACCRISK$ is the centered log of the variance of residuals from a regression of quarterly return on assets on value-weighted industry index of return on assets; data from months $t-3$ through $t-48$. $INDBUY(SAL)$ is an indicator variable equal to one if at least one insider purchase (insider sale) occurred during the month. $INDREP(SEO)$ is an indicator variable equal to one if a share repurchase (SEO) occurred during the month. $PASTRET6(12)$ is a six-month (12-month) market adjusted, buy and hold return over month $t-1$ through $t-6$ ($t-12$). $FUTRET6(12)$ is a six-month (12-month) market adjusted, buy and hold return over month $t+1$ through $t+6$ ($t+12$). $MVE$ is the market value of equity at the end of month $t$. $M/B$ is the market value of equity scaled by the book value of equity. $ANALYST$ is the number of analysts issuing a one-quarter ahead earnings forecast for the firm in month $t$. $INST$ is the percentage of shares outstanding owned by institutional investors. $FDROA$ is one-quarter ahead seasonal change in quarterly return on assets. $EQ1$ is the absolute value of abnormal accruals. $R_f$ is the risk-free rate of return in month $t$, proxied by one-month treasury bill rate. $MKTRF$ is the excess return on the market defined as the value-weighted monthly return to all stocks on CRSP less the one-month treasury bill rate. $SMB$ is the mean monthly return on portfolio of small firms less mean monthly return on portfolio of large firms. $HML$ is the mean monthly return on portfolio of value firms less mean monthly return on portfolio of glamor firms. $UMD$ is the mean monthly return on portfolio of winners less mean monthly return on portfolio of losers. $I\_FACTOR$ is the mean monthly return on portfolio of high $IRISK$ firms less mean monthly return on portfolio of low $IRISK$ firms.

| Variable | Mean | Standard Deviation | Q1 | Median | Q3 |
|---|---|---|---|---|---|
| $IRISK$ (unlogged, uncentered) | 0.0240 | 0.0771 | 0.0052 | 0.0118 | 0.0262 |
| $IRISK$ | 0.0000 | 1.1251 | -0.8242 | -0.0168 | 0.7806 |
| $SYSRISK$ (unlogged, uncentered) | 0.0070 | 0.0398 | 0.0015 | 0.0036 | 0.0074 |
| $SYSRISK$ | 0.0000 | 1.2359 | -0.7753 | 0.0676 | 0.7950 |
| $ACCRISK$ (unlogged, uncentered) | 0.0016 | 0.0053 | 0.0001 | 0.0002 | 0.0008 |
| $ACCRISK$ | 0.0000 | 2.4840 | -1.1930 | 0.1796 | 1.5368 |
| $INDBUY$ | 0.0964 | 0.2951 | 0.0000 | 0.0000 | 0.0000 |
| $INDSAL$ | 0.1090 | 0.3116 | 0.0000 | 0.0000 | 0.0000 |
| $INDREP$ | 0.1608 | 0.3673 | 0.0000 | 0.0000 | 0.0000 |
| $INDSEO$ | 0.0039 | 0.0622 | 0.0000 | 0.0000 | 0.0000 |
| $PASTRET6$ | 0.0133 | 0.3875 | -0.2112 | -0.0321 | 0.1591 |
| $PASTRET12$ | 0.0157 | 0.5908 | -0.3431 | -0.0727 | 0.2257 |
| $FUTRET6$ | 0.0148 | 0.3911 | -0.2100 | -0.0297 | 0.1635 |
| $FUTRET12$ | 0.0340 | 0.6034 | -0.3273 | -0.0590 | 0.2412 |
| $MVE$ ($millions) | 1620.0 | 9940.0 | 27.5 | 115.0 | 593.0 |
| $M/B$ | 2.5851 | 3.3563 | 1.0274 | 1.6127 | 2.7435 |
| $ANALYST$ | 4.1886 | 6.7011 | 0.0000 | 1.0000 | 6.0000 |
| $INST$ | 0.2740 | 0.2690 | 0.0137 | 0.1990 | 0.4760 |
| $FDROA$ | -0.0002 | 0.0213 | -0.0006 | 0.0000 | 0.0001 |
| $EQ1$ | 0.1424 | 0.3648 | 0.0258 | 0.0626 | 0.1366 |
| $R_f$ | 0.0040 | 0.0016 | 0.0030 | 0.0042 | 0.0049 |
| $MKTRF$ | 0.0064 | 0.0464 | -0.0217 | 0.0111 | 0.0380 |
| $HML$ | 0.0030 | 0.0336 | -0.0158 | 0.0030 | 0.0193 |
| $SMB$ | 0.0005 | 0.0362 | -0.0209 | -0.0013 | 0.0197 |
| $UMD$ | 0.0087 | 0.0468 | -0.0055 | 0.0108 | 0.0287 |
| $I\_FACTOR$ | -0.0004 | 0.0534 | -0.0233 | -0.0003 | 0.0207 |

## Table II
## Correlation Table

The table presents the correlation table of the variables in the sample used. The sample consists of all firms with: Complete data from Compustat, CRSP, I/B/E/S, CDA/Spectrum, Thomson Financial's Insider Trading Data Feed for 1986-2003. $IRISK$ is the centered log of the variance of residuals from a regression of monthly returns on the monthly Fama-French factors plus a momentum factor; data from month $t-6$ through $t-54$, minimum 24 months of returns to be in sample. $SYSRISK$ is the centered log of the total variance of monthly returns minus the variance of residuals used to calculate $IRISK$. $ACCRISK$ is the centered log of the variance of residuals from a regression of quarterly return on assets on value-weighted industry index of return on assets; data from months $t-3$ through $t-48$. $INDBUY(SAL)$ is an indicator variable equal to one if at least one insider purchase (insider sale) occurred during the month. $INDREP(SEO)$ is an indicator variable equal to one if a share repurchase (SEO) occurred during the month. $PASTRET6(12)$ is a six-month (12-month) market adjusted, buy and hold return over month $t-1$ through $t-6$ ($t-12$). $FUTRET6(12)$ is a six-month (12-month) market adjusted, buy and hold return over month $t+1$ through $t+6$ ($t+12$). Bolded coefficients are significant at the 1% level.

| | $IRISK$ | $SYS$ $RISK$ | $ACC$ $RISK$ | $IND$ $BUY$ | $IND$ $SAL$ | $IND$ $REP$ | $IND$ $SEO$ | $PAST$ $RET6$ | $FUT$ $RET6$ |
|---|---|---|---|---|---|---|---|---|---|
| $IRISK$ | 1 | | | | | | | | |
| $SYSRISK$ | **0.687** | 1 | | | | | | | |
| $ACCRISK$ | **0.577** | **0.419** | 1 | | | | | | |
| $INDBUY$ | **-0.045** | **-0.038** | **-0.069** | 1 | | | | | |
| $INDSAL$ | **-0.037** | **0.021** | **-0.035** | **0.033** | 1 | | | | |
| $INDREP$ | **-0.095** | **-0.039** | **-0.009** | **0.010** | **0.024** | 1 | | | |
| $INDSEO$ | 0.000 | **0.005** | 0.000 | **0.009** | **0.024** | **-0.016** | 1 | | |
| $PASTRET6$ | **0.059** | **0.030** | **-0.012** | **-0.051** | **0.098** | **-0.032** | **0.049** | 1 | |
| $FUTRET6$ | **0.026** | **0.033** | **-0.019** | **0.030** | **-0.014** | **0.025** | -0.002 | **0.049** | 1 |

## Table III
## Returns *Following* Trades

The table presents results from OLS and 2SLS regressions of 6- and 12-month returns following all firm-months with: Complete data from Compustat, CRSP, I/B/E/S, CDA/Spectrum, Thomson Financial's Insider Trading Data Feed for 1986-2003. $IRISK$ is the centered log of the variance of residuals from a regression of monthly returns on the monthly Fama-French factors plus a momentum factor; data from month $t-6$ through $t-54$, minimum 24 months of returns to be in sample. $SYSRISK$ is the centered log of the total variance of monthly returns minus the variance of residuals used to calculate $IRISK$. $ACCRISK$ is the centered log of the variance of residuals from a regression of quarterly return on assets on value-weighted industry index of return on assets; data from months $t-3$ through $t-48$. $INDBUY(SAL)$ is an indicator variable equal to one if at least one insider purchase (insider sale) occurred during the month. $INDREP(SEO)$ is an indicator variable equal to one if a share repurchase (SEO) occurred during the month. $EQ1$ is earnings quality, measured as the absolute value of abnormal accruals. $PASTRET6(12)$ is a six-month (12-month) market adjusted, buy and hold return over month $t-1$ through $t-6$ ($t-12$). $FUTRET6(12)$ is a six-month (12-month) market adjusted, buy and hold return over month $t+1$ through $t+6$ ($t+12$). $MVE$ is the market value of equity at the end of month $t$. $M/B$ is the market value of equity scaled by the book value of equity. $ANALYST$ is the number of analysts issuing a one-quarter ahead earnings forecast for the firm in month $t$. $INST$ is the percentage of shares outstanding owned by institutional investors. $FDROA$ is one-quarter ahead seasonal change in quarterly return on assets. *, **, *** denote two-tailed significance at the 10%, 5%, and 1% level respectively. Standard errors are robust to heteroscedasticity and dependence across observations in the same industry (defined by two-digit SIC). In IV regressions $IRISK$ is instrumented by $ACCRISK$. The sample for the fifth column of results consists of firms in the top half of the size distribution.

| | Predicted Sign | OLS $FUTRET6$ | OLS $FUTRET6$ | 2SLS $FUTRET6$ | 2SLS $FUTRET12$ | Top Half (2SLS) $FUTRET6$ |
|---|---|---|---|---|---|---|
| $IRISK$ | ? | -0.0037 | -0.0164*** | -0.0328*** | -0.0592** | -0.0341*** |
| | | (0.0026) | (0.0025) | (0.0113) | (0.0227) | (0.0106) |
| $INDBUY$ | + | 0.0497*** | 0.0465*** | 0.0466*** | 0.0574*** | 0.0399*** |
| | | (0.0023) | (0.0027) | (0.0031) | (0.0047) | (0.0056) |
| $INDBUY*IRISK$ | + | 0.0196*** | 0.0159*** | 0.0294*** | 0.0277*** | 0.0229*** |
| | | (0.0029) | (0.0024) | (0.0054) | (0.0093) | (0.0085) |
| $INDSAL$ | - | -0.0206*** | -0.0127*** | -0.0124*** | -0.0082 | -0.0146*** |
| | | (0.0022) | (0.0026) | (0.0026) | (0.0054) | (0.0040) |
| $INDSAL*IRISK$ | - | -0.0138*** | -0.0125*** | -0.0146** | -0.0390*** | -0.0129* |
| | | (0.0025) | (0.0026) | (0.0069) | (0.0112) | (0.0076) |
| $INDREP$ | + | 0.0374*** | 0.0332*** | 0.0334*** | 0.0584*** | 0.0471*** |
| | | (0.0051) | (0.0041) | (0.0046) | (0.0099) | (0.0083) |
| $INDREP*IRISK$ | + | 0.0203*** | 0.0121*** | 0.0204** | 0.0321* | 0.0423*** |
| | | (0.0036) | (0.0045) | (0.0099) | (0.0174) | (0.0133) |
| $INDSEO$ | - | -0.0316*** | -0.0098 | -0.0106 | -0.0302 | -0.0136 |
| | | (0.0061) | (0.0081) | (0.0114) | (0.0223) | (0.0131) |
| $INDSEO*IRISK$ | - | -0.0049 | 0.0029 | -0.0353 | -0.0958* | -0.0237 |
| | | (0.0035) | (0.0082) | (0.0262) | (0.0547) | (0.0316) |
| $SYSRISK$ | ? | 0.0103*** | 0.0053** | 0.0137** | 0.0267** | 0.0077 |
| | | (0.0028) | (0.0022) | (0.0055) | (0.0106) | (0.0052) |
| $FDROA$ | + | 0.8765*** | 0.8384*** | 0.8353*** | 1.1366*** | 1.1708*** |
| | | (0.0841) | (0.0874) | (0.0874) | (0.1093) | (0.1822) |
| $PASTRET6(12)$ | + | 0.0719*** | 0.0602*** | 0.0621*** | -0.0019 | 0.0686*** |
| | | (0.0074) | (0.0049) | (0.0052) | (0.0068) | (0.0070) |
| $M/B$ | - | -0.0069*** | -0.0056*** | -0.005*** | -0.0068*** | -0.0042*** |
| | | (0.0011) | (0.0008) | (0.0007) | (0.0011) | (0.0009) |
| $LN(MVE)$ | ? | -0.0094*** | -0.0170*** | -0.0202*** | -0.0402*** | -0.0098*** |
| | | (0.0017) | (0.0024) | (0.0029) | (0.0066) | (0.0026) |
| $LN(ANALYST)$ | ? | 0.0063*** | 0.0184*** | 0.0187*** | 0.0377*** | 0.0096*** |
| | | (0.0020) | (0.0033) | (0.0033) | (0.0062) | (0.0029) |
| $INST$ | ? | 0.0503*** | -0.0088 | -0.0134 | -0.0639*** | 0.0124 |
| | | (0.0105) | (0.0077) | (0.0088) | (0.0169) | (0.0085) |
| $EQ1$ | ? | | 0.0182*** | 0.0194*** | 0.0317*** | 0.0101* |
| | | | (0.0067) | (0.0069) | (0.0107) | (0.0059) |
| Industry Fixed Effects | | NO | NO | YES | YES | YES |
| Time Fixed Effects | | NO | NO | YES | YES | YES |
| $SYSRISK$ Interactions | | YES | YES | YES | YES | YES |
| $EQ1$ Interactions | | NO | YES | YES | YES | YES |
| N | | 731413 | 626593 | 626593 | 603963 | 300859 |

## Table IV
## Calendar-Time Portfolio Returns By $IRISK$ Quartiles

The table presents results from calendar-time regressions of monthly, portfolio excess returns, stratified by $IRISK$ quartiles, on factor-mimicking portfolio returns. Each regression is based on 215 monthly observations. $IRISK$ is the centered log of the variance of residuals from a regression of monthly returns on the monthly Fama-French factors plus a momentum factor; data from month $t-6$ through $t-54$, minimum 24 months of returns to be in sample. $R_f$ is the risk-free rate of return in month $t$, proxied by one-month treasury bill rate. $MKTRF$ is the excess return on the market defined as the value-weighted monthly return to all stocks on CRSP less the one-month treasury bill rate. $SMB$ is the mean monthly return on portfolio of small firms less mean monthly return on portfolio of large firms. $HML$ is the mean monthly return on portfolio of value firms less mean monthly return on portfolio of glamor firms. $UMD$ is the mean monthly return on portfolio of winners less mean monthly return on portfolio of losers. The regression weights each monthly observation by the square root of the number of firms in the monthly portfolio. *, **, *** denote two-tailed significance at the 10%, 5%, and 1% level respectively.

$$\mathrm{R}_{pt} - R_{ft} = \beta_0 + \beta_1 MKTRF_t + \beta_2 HML_t + \beta_3 SMB_T + \beta_4 UMD_t + \varepsilon_t$$

**Panel A: OLS coefficients for returns following Insider Purchases**

| | $IRISK$ | Intercept | $MKTRF$ | $HML$ | $SMB$ | $UMD$ | Adj. $R^2$ |
|---|---|---|---|---|---|---|---|
| Six-Month | 1 | 0.0041*** | 0.6804*** | 0.5637*** | 0.2538*** | -0.0660*** | 0.813 |
| Returns | 2 | 0.0049*** | 0.9302*** | 0.6886*** | 0.5227*** | -0.1879*** | 0.885 |
| | 3 | 0.0083*** | 0.9875*** | 0.3869*** | 1.0022*** | -0.3580*** | 0.849 |
| | 4 | 0.0097*** | 0.9433*** | -0.1463 | 1.3016*** | -0.6065*** | 0.751 |
| | $4-1$ | 0.0056*** | | | | | |
| Twelve-Month | 1 | 0.0035*** | 0.6394*** | 0.5420*** | 0.2444*** | -0.0555*** | 0.821 |
| Returns | 2 | 0.0031*** | 0.9016*** | 0.6886*** | 0.5693*** | -0.1633*** | 0.882 |
| | 3 | 0.0053*** | 0.9768*** | 0.4302*** | 1.0224*** | -0.3101*** | 0.836 |
| | 4 | 0.0052 | 0.9553*** | -0.0581 | 1.3193*** | -0.5875*** | 0.733 |
| | $4-1$ | 0.0017 | | | | | |

**Panel B: OLS coefficients for returns following Insider Sales**

| | $IRISK$ | Intercept | $MKTRF$ | $HML$ | $SMB$ | $UMD$ | Adj. $R^2$ |
|---|---|---|---|---|---|---|---|
| Six-Month | 1 | -0.0008 | 0.8509*** | 0.5196*** | 0.1414*** | 0.0453** | 0.836 |
| Returns | 2 | -0.0024** | 1.0009*** | 0.4977*** | 0.4728*** | 0.0052 | 0.889 |
| | 3 | -0.0021* | 1.1164*** | 0.1574*** | 0.9298*** | -0.0691*** | 0.933 |
| | 4 | -0.0071*** | 1.1542*** | -0.3734*** | 1.3192*** | -0.3105*** | 0.872 |
| | $4-1$ | -0.0063*** | | | | | |
| Twelve-Month | 1 | -0.0001 | 0.8135*** | 0.5018*** | 0.1591*** | 0.03142 | 0.826 |
| Returns | 2 | -0.0019* | 0.9776*** | 0.4959*** | 0.4754*** | -0.0067 | 0.886 |
| | 3 | -0.0023* | 1.0820*** | 0.1292*** | 0.8942*** | -0.1139 | 0.928 |
| | 4 | -0.0060** | 1.1096*** | -0.4092*** | 1.3111*** | -0.4031*** | 0.855 |
| | $4-1$ | -0.0059*** | | | | | |

Table IV: Calendar-Time Portfolio Returns By $IRISK$ Quartiles (Cont.)

**Panel C: OLS coefficients for returns following Share Repurchases**

| | $IRISK$ | Intercept | $MKTRF$ | $HML$ | $SMB$ | $UMD$ | Adj. $R^2$ |
|---|---|---|---|---|---|---|---|
| Six-Month | 1 | 0.0022** | 0.8569*** | 0.5236*** | 0.1530*** | -0.0575*** | 0.829 |
| Returns | 2 | 0.0023** | 0.9263*** | 0.5843*** | 0.4608*** | -0.1498*** | 0.877 |
| | 3 | 0.0053*** | 0.9803*** | 0.3181*** | 0.8266*** | -0.2960*** | 0.897 |
| | 4 | 0.0067** | 0.9911*** | -0.0940 | 1.1256*** | -0.4556*** | 0.784 |
| | 4 − 1 | 0.0045** | | | | | |
| Twelve-Month | 1 | 0.0035*** | 0.6394*** | 0.5420*** | 0.2444*** | -0.0555*** | 0.821 |
| Returns | 2 | 0.0031*** | 0.9016*** | 0.6886*** | 0.5693*** | -0.1633*** | 0.882 |
| | 3 | 0.0053*** | 0.9768*** | 0.4302*** | 1.0224*** | -0.3101*** | 0.836 |
| | 4 | 0.0052 | 0.9553*** | -0.0581 | 1.3193*** | -0.5875*** | 0.733 |
| | 4 − 1 | 0.0017 | | | | | |

**Panel D: OLS coefficients for returns following SEOs**

| | $IRISK$ | Intercept | $MKTRF$ | $HML$ | $SMB$ | $UMD$ | Adj. $R^2$ |
|---|---|---|---|---|---|---|---|
| Six-Month | 1 | 0.0010 | 0.7570*** | 0.5138*** | 0.2796*** | 0.1476*** | 0.682 |
| Returns | 2 | -0.0021 | 1.0778*** | 0.4814*** | 0.4421*** | 0.0708* | 0.768 |
| | 3 | -0.0006 | 1.3289*** | 0.7080 | 0.8938*** | 0.2364*** | 0.814 |
| | 4 | -0.0005 | 1.2808*** | -0.2920** | 1.1556*** | 0.1511** | 0.744 |
| | 4 − 1 | -0.0015 | | | | | |
| Twelve-Month | 1 | 0.0001 | 0.7477*** | 0.4991*** | 0.1874*** | 0.0775*** | 0.721 |
| Returns | 2 | -0.0029* | 1.0882*** | 0.4602*** | 0.4188*** | 0.0383 | 0.809 |
| | 3 | -0.0023 | 1.2447*** | 0.0203 | 0.8683*** | 0.0370 | 0.839 |
| | 4 | -0.0027 | 1.2948*** | -0.3778*** | 1.1258*** | -0.0129 | 0.805 |
| | 4 − 1 | -0.0028 | | | | | |

## Table V
## Calendar-Time Portfolio Returns By $IRISK$ Quartiles with double sorts and $I\_FACTOR$

The table presents results from calendar-time regressions of monthly, portfolio excess returns on factor-mimicking portfolio returns. Panel A presents results where firms are first sorted into quartiles based on one-year lagged market value before being sorted into quartiles of IRISK. Panel B presents results where firms are first sorted into quartiles based on the earnings quality measure EQ1 before being sorted into quartiles of IRISK. Panel C presents results where, in addition to the Fama-French and momentum factors, we include a factor ($I\_Factor$) based on the return difference between high and low idiosyncratic stocks. Each regression is based on 215 monthly observations. $IRISK$ is the centered log of the variance of residuals from a regression of monthly returns on the monthly Fama-French factors plus a momentum factor; data from month $t-6$ through $t-54$, minimum 24 months of returns to be in sample. $R_p$ is the time-series of mean monthly return of a portfolio which includes event-firm-months stratified by $IRISK$ quartile. $EQ1$ is the absolute value of abnormal accruals. $R_f$ is the risk-free rate of return in month $t$, proxied by one-month treasury bill rate. $MKTRF$ is the excess return on the market defined as the value-weighted monthly return to all stocks on CRSP less the one-month treasury bill rate. $SMB$ is the mean monthly return on portfolio of small firms less mean monthly return on portfolio of large firms. $HML$ is the mean monthly return on portfolio of value firms less mean monthly return on portfolio of glamor firms. $UMD$ is the mean monthly return on portfolio of winners less mean monthly return on portfolio of losers. $I\_FACTOR$ is the mean monthly return to a portfolio of high $IRISK$ firms less the mean monthly return to a portfolio of low $IRISK$ firms. The regression weights each monthly observation by the square root of the number of firms in the monthly portfolio. *, **, *** denote two-tailed significance at the 10%, 5%, and 1% level respectively.

$$R_{pt} - R_{ft} = \beta_0 + \beta_1 MKTRF_t + \beta_2 HML_t + \beta_3 SMB_t + \beta_4 UMD_t + \beta_5 I\_FACTOR_t + \varepsilon_t$$

**Panel A: Intercepts of 4 factor calendar-time portfolio regs: double sort on Size first**

| Intercept for: | Returns | $IRISK = 1$ | $IRISK = 2$ | $IRISK = 3$ | $IRISK = 4$ | $4 - 1$ |
|---|---|---|---|---|---|---|
| Insider Purchases | 6-month | 0.0047*** | 0.0048*** | 0.0086*** | 0.091*** | 0.0044* |
| Insider Sales | 6-month | -0.0013* | -0.0025** | -0.0025 | -0.0049*** | -0.0036** |
| Repurchases | 6-month | 0.0025 | 0.0031* | 0.0047*** | 0.0061*** | 0.0036** |
| SEOs | 6-month | 0.0016 | 0.0001 | -0.0006 | -0.0022 | -0.0038 |

**Panel B: Intercepts of 4 factor calendar-time portfolio regs: double sort on $EQ1$ first**

| Intercept for: | Returns | $IRISK = 1$ | $IRISK = 2$ | $IRISK = 3$ | $IRISK = 4$ | $4 - 1$ |
|---|---|---|---|---|---|---|
| Insider Purchases | 6-month | 0.0040*** | 0.0063*** | 0.0074*** | 0.0100*** | 0.0060** |
| Insider Sales | 6-month | -0.0021** | -0.0022** | -0.0017 | -0.0075*** | -0.0054** |
| Repurchases | 6-month | 0.0021** | 0.0039*** | 0.0058*** | 0.0061** | 0.0040** |
| SEOs | 6-month | 0.0005 | -0.0023 | 0.0008 | 0.0002 | -0.0003 |

**Panel C: Intercepts of 4 factor and $I\_FACTOR$ calendar-time portfolio regs.**

| Intercept for: | Returns | $IRISK = 1$ | $IRISK = 2$ | $IRISK = 3$ | $IRISK = 4$ | $4 - 1$ |
|---|---|---|---|---|---|---|
| All Firm-Months | | | | | | |
| w/o $I\_FACTOR$ | 1-month | 0.0017* | 0.0000 | -0.0002 | -0.0044 | 0.0061 |
| w/$I\_FACTOR$ | 1-month | 0.0010 | -0.0003 | 0.0011 | -0.0007 | -0.0017 |
| Insider Purchases | 6-month | 0.0036*** | 0.0046*** | 0.0095*** | 0.0123*** | 0.0087*** |
| | 12-month | 0.0031*** | 0.0030*** | 0.0065*** | 0.0079*** | 0.0048*** |
| Insider Sales | 6-month | -0.0017* | -0.0030** | -0.0016 | -0.0047*** | -0.0030** |
| | 12-month | -0.0010 | -0.0025** | -0.0016 | -0.00345*** | -0.0025* |
| Repurchases | 6-month | 0.0014 | 0.0021* | 0.0061*** | 0.0094*** | 0.0080*** |
| | 12-month | 0.0031*** | 0.0030*** | 0.0065*** | 0.0079*** | 0.0048*** |
| SEOs | 6-month | -0.0002 | -0.0028 | -0.0003 | 0.0008 | 0.0010 |
| | 12-month | -0.0008 | -0.0038** | -0.0019 | -0.0012 | -0.0004 |

# Table VI
# Cross-Sectional Regressions of the Decision to Trade

The table presents results from OLS and 2SLS regressions of event-indicator variables for all firms with: Complete data from Compustat, CRSP, I/B/E/S, CDA/Spectrum, Thomson Financial's Insider Trading Data Feed for 1986-2003. $IRISK$ is the centered log of the variance of residuals from a regression of monthly returns on the monthly Fama-French factors plus a momentum factor; data from month $t-6$ through $t-54$, minimum 24 months of returns to be in sample. $SYSRISK$ is the centered log of the total variance of monthly returns minus the variance of residuals used to calculate $IRISK$. $ACCRISK$ is the centered log of the variance of residuals from a regression of quarterly return on assets on value-weighted industry index of return on assets; data from months $t-3$ through $t-48$. $INDBUY(SAL)$ is an indicator variable equal to one if at least one insider purchase (insider sale) occurred during the month. $INDREP(SEO)$ is an indicator variable equal to one if a share repurchase (SEO) occurred during the month. $PASTRET6(12)$ is the six-month (12-month) market adjusted, buy and hold return over month $t-1$ through $t-6$ ($t-12$). $MVE$ is the market value of equity at the end of month $t$. $M/B$ is the market value of equity scaled by the book value of equity. $ANALYST$ is the number of analysts issuing a one-quarter ahead earnings forecast for the firm in month $t$. $INST$ is the percentage of shares outstanding owned by institutional investors. $FDROA$ is one-quarter ahead seasonal change in quarterly return on assets. *, **, *** denote two-tailed significance at the 10%, 5%, and 1% level respectively. Standard errors are robust to heteroscedasticity and dependence across observations in the same industry (defined by two-digit SIC). Column (4) results replace $Pastret6$ with $Pastret12$. In 2SLS regressions, $IRISK$ is instrumented by $ACCRISK$.

**Panel A: Insider Purchases**

| | Predicted Sign | OLS $INDBUY$ | OLS $INDBUY$ | 2SLS $INDBUY$ | 2SLS $INDBUY$ |
|---|---|---|---|---|---|
| $IRISK$ | ? | 0.0025 | -0.0041** | -0.0044 | -0.0031 |
| | | (0.0016) | (0.0019) | (0.0057) | (0.0080) |
| $SYSRISK$ | ? | -0.0042** | 0.0018 | 0.0012 | 0.0013 |
| | | (0.0017) | (0.0014) | (0.0044) | (0.0045) |
| $EQ1$ | + | -0.0051** | -0.0030 | -0.0028 | -0.0026 |
| | | (0.0025) | (0.0025) | (0.0023) | (0.0023) |
| $PASTRET6(12)$ | - | -0.0525*** | -0.0466*** | -0.0525*** | -0.0058*** |
| | | (0.0028) | (0.0023) | (0.0028) | (0.0014) |
| $PASTRET6(12) * IRISK$ | + | 0.0245*** | 0.0219*** | 0.0345*** | 0.0158*** |
| | | (0.0019) | (0.0016) | (0.0037) | (0.0027) |
| $PASTRET6(12) * SYSRISK$ | - | -0.0079*** | -0.0065*** | -0.0130*** | -0.0058*** |
| | | (0.0011) | (0.0011) | (0.0021) | (0.0014) |
| $PASTRET6(12) * EQ1$ | + | 0.0100*** | 0.0093*** | 0.0073** | 0.0044* |
| | | (0.0027) | (0.0029) | (0.0033) | (0.0024) |
| $M/B$ | - | -0.0016*** | -0.0015*** | -0.0014*** | -0.0014*** |
| | | (0.0005) | (0.0003) | (0.0003) | (0.0003) |
| $M/B * IRISK$ | + | -0.0003* | 0.0000 | 0.0002 | -0.0002 |
| | | (0.0002) | (0.0002) | (0.0008) | (0.0008) |
| $M/B * SYSRISK$ | ? | 0.0003 | 0.0000 | 0.0001 | 0.0001 |
| | | (0.0002) | (0.0002) | (0.0006) | (0.0006) |
| $M/B * EQ1$ | + | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| | | (0.0002) | (0.0002) | (0.0002) | (0.0002) |
| $FDROA$ | + | 0.0681*** | 0.0641*** | 0.1104*** | 0.0645*** |
| | | (0.0170) | (0.0178) | (0.0290) | (0.0185) |
| $FDROA * IRISK$ | - | -0.0217 | -0.0223 | -0.1141*** | -0.1204*** |
| | | (0.0172) | (0.0177) | (0.0480) | (0.0486) |
| $FDROA * SYSRISK$ | ? | -0.0035 | -0.0028 | 0.0490 | -0.0029 |
| | | (0.0142) | (0.0149) | (0.0326) | (0.0153) |
| $FDROA * EQ1$ | - | 0.0193 | 0.0104 | 0.0263 | 0.0085 |
| | | (0.0353) | (0.0348) | (0.0407) | (0.0326) |
| $LN(MVE)$ | ? | 0.0017* | -0.0008 | -0.0006 | -0.0005 |
| | | (0.0009) | (0.0009) | (0.0013) | (0.0014) |
| $LN(ANALYST)$ | ? | 0.0047*** | 0.0067*** | 0.0065*** | 0.0065*** |
| | | (0.0014) | (0.0011) | (0.0012) | (0.0013) |
| $INST$ | ? | -0.0073 | -0.0194*** | -0.0185*** | -0.0180*** |
| | | (0.0065) | (0.0052) | (0.0063) | (0.0064) |
| Industry Fixed-Effects | | NO | YES | YES | YES |
| Time Fixed-Effects | | NO | YES | YES | YES |
| N | | 626593 | 626593 | 626593 | 625506 |
| Adj. $R^2$ | | 0.0046 | 0.018 | | |

Table VI: Cross-Sectional Regressions of the Decision to Trade (Cont.)

**Panel B: Insider Sales**

| | Predicted Sign | OLS $INDSAL$ | OLS $INDSAL$ | 2SLS $INDSAL$ | 2SLS $INDSAL$ |
|---|---|---|---|---|---|
| $IRISK$ | ? | 0.008** | 0.0175*** | 0.0236** | 0.0244** |
| | | (0.0037) | (0.0026) | (0.0114) | (0.0114) |
| $SYSRISK$ | ? | 0.005** | -0.0013 | -0.0046 | -0.005 |
| | | (0.0023) | (0.0017) | (0.0058) | (0.0059) |
| $EQ1$ | - | -0.0017 | 0.0019 | 0.0008 | -0.0009 |
| | | (0.0040) | (0.0021) | (0.0020) | (0.0017) |
| $PASTRET6(12)$ | + | 0.079*** | 0.078*** | 0.0899*** | 0.012*** |
| | | (0.0046) | (0.0038) | (0.0065) | (0.0037) |
| $PASTRET6(12) * IRISK$ | - | -0.0295*** | -0.0276*** | -0.0548*** | -0.0320*** |
| | | (0.0038) | (0.0035) | (0.0097) | (0.0072) |
| $PASTRET6(12) * SYSRISK$ | + | 0.0098*** | 0.0076*** | 0.0217*** | 0.0120*** |
| | | (0.0022) | (0.0022) | (0.0046) | (0.0037) |
| $PASTRET6(12) * EQ1$ | - | -0.0077* | -0.0095*** | -0.0049 | -0.0002 |
| | | (0.0039) | (0.0032) | (0.0039) | (0.0029) |
| $M/B$ | + | 0.0056*** | 0.0043*** | 0.0042*** | 0.0037*** |
| | | (0.0013) | (0.0009) | (0.0009) | (0.0009) |
| $M/B * IRISK$ | ? | -0.0024*** | -0.0024*** | -0.0026** | -0.0028** |
| | | (0.0006) | (0.0005) | (0.0012) | (0.0013) |
| $M/B * SYSRISK$ | ? | 0.0014* | 0.0016*** | 0.0018** | 0.0018* |
| | | (0.0008) | (0.0006) | (0.0009) | (0.0009) |
| $M/B * EQ1$ | ? | -0.0005* | -0.0003 | -0.0003 | -0.0002 |
| | | (0.0002) | (0.0002) | (0.0002) | (0.0002) |
| $FDROA$ | - | 0.0798*** | 0.0728*** | 0.0741*** | 0.0774*** |
| | | (0.0229) | (0.0225) | (0.0231) | (0.0214) |
| $FDROA * IRISK$ | ? | -0.0380* | -0.0411** | -0.0429** | -0.0419** |
| | | (0.0192) | (0.0184) | (0.0187) | (0.0174) |
| $FDROA * SYSRISK$ | ? | -0.0036 | 0.0027 | 0.0046 | 0.005 |
| | | (0.0124) | (0.0114) | (0.0119) | (0.0120) |
| $FDROA * EQ1$ | ? | -0.0575 | -0.0545 | -0.0541 | -0.0476 |
| | | (0.0390) | (0.0372) | (0.0372) | (0.0347) |
| $LN(MVE)$ | ? | 0.0132*** | 0.0202*** | 0.0214*** | 0.0203*** |
| | | (0.0010) | (0.0011) | (0.0021) | (0.0022) |
| $LN(ANALYST)$ | ? | 0.0155*** | 0.0098*** | 0.0098*** | 0.0113*** |
| | | (0.0041) | (0.0032) | (0.0031) | (0.0032) |
| $INST$ | ? | 0.0466*** | 0.0632*** | 0.0638*** | 0.0593*** |
| | | (0.0127) | (0.0080) | (0.0077) | (0.0076) |
| Industry Fixed Effects | | NO | YES | YES | YES |
| Time Fixed Effects | | NO | YES | YES | YES |
| N | | 626593 | 626593 | 626593 | 625506 |
| Adj. $R^2$ | | 0.0456 | 0.0643 | | |

## Table VI: Cross-Sectional Regressions of the Decision to Trade (Cont.)

**Panel C: Share Repurchases**

| | Predicted Sign | OLS $INDREP$ | OLS $INDREP$ | 2SLS $INDREP$ | 2SLS $INDREP$ |
|---|---|---|---|---|---|
| $IRISK$ | ? | -0.0046 | -0.0226*** | -0.087*** | -0.0868*** |
| | | (0.0116) | (0.0064) | (0.0243) | (0.0244) |
| $SYSRISK$ | ? | -0.0057 | -0.0119*** | 0.0221* | 0.0217* |
| | | (0.0056) | (0.0029) | (0.0127) | (0.0128) |
| $EQ1$ | + | -0.0027 | -0.0143*** | -0.0083 | -0.0080 |
| | | (0.0077) | (0.0053) | (0.0060) | (0.0055) |
| $PASTRET6(12)$ | - | -0.0649*** | -0.0578*** | -0.0591*** | -0.0443*** |
| | | (0.0057) | (0.0048) | (0.0087) | (0.0081) |
| $PASTRET6(12) * IRISK$ | + | 0.0378*** | 0.0333*** | 0.0505*** | 0.0369*** |
| | | (0.0030) | (0.0025) | (0.0093) | (0.0082) |
| $PASTRET6(12) * SYSRISK$ | - | -0.0120*** | -0.0104*** | -0.0193*** | -0.0158*** |
| | | (0.0028) | (0.0024) | (0.0052) | (0.0045) |
| $PASTRET6(12) * EQ1$ | + | 0.0059** | 0.0073** | 0.0032 | 0.0042 |
| | | (0.0025) | (0.0029) | (0.0034) | (0.0035) |
| $M/B$ | - | 0.0005 | -0.0009 | -0.0010 | -0.0006 |
| | | (0.0022) | (0.0014) | (0.0015) | (0.0015) |
| $M/B * IRISK$ | + | -0.0035** | -0.0016** | 0.0040* | 0.0037 |
| | | (0.0014) | (0.0007) | (0.0022) | (0.0022) |
| $M/B * SYSRISK$ | ? | 0.0001 | -0.0002 | -0.0039** | -0.0037** |
| | | (0.0008) | (0.0006) | (0.0017) | (0.0017) |
| $M/B * EQ1$ | + | -0.0004 | 0.0002 | -0.0004 | -0.0005 |
| | | (0.0004) | (0.0003) | (0.0004) | (0.0004) |
| $FDROA$ | + | -0.1265*** | -0.1110*** | -0.1118*** | -0.1157*** |
| | | (0.0338) | (0.0269) | (0.0262) | (0.0268) |
| $FDROA * IRISK$ | - | 0.1148*** | 0.0998*** | 0.0833*** | 0.0865*** |
| | | (0.0244) | (0.0188) | (0.0225) | (0.0239) |
| $FDROA * SYSRISK$ | ? | -0.0299** | -0.0234* | -0.0162 | -0.0178 |
| | | (0.0143) | (0.0136) | (0.0168) | (0.0178) |
| $FDROA * EQ1$ | - | -0.0231 | -0.0096 | -0.0154 | -0.0197 |
| | | (0.0213) | (0.0179) | (0.0191) | (0.0189) |
| $LN(MVE)$ | ? | 0.0103** | 0.0130*** | 0.0022 | 0.0028 |
| | | (0.0040) | (0.0023) | (0.0048) | (0.0049) |
| $LN(ANALYST)$ | ? | -0.0106*** | -0.0045 | -0.0021 | -0.0030 |
| | | (0.0037) | (0.0033) | (0.0034) | (0.0033) |
| $INST$ | ? | 0.1312*** | 0.0565*** | 0.0393** | 0.0426** |
| | | (0.0343) | (0.0155) | (0.0185) | (0.0186) |
| Industry Fixed Effects | | NO | YES | YES | YES |
| Time Fixed Effects | | NO | YES | YES | YES |
| N | | 626593 | 626593 | 626593 | 625506 |
| Adj. $R^2$ | | 0.0297 | 0.0761 | | |

Table VI: Cross-Sectional Regressions of the Decision to Trade (Cont.)

**Panel D: SEOs**

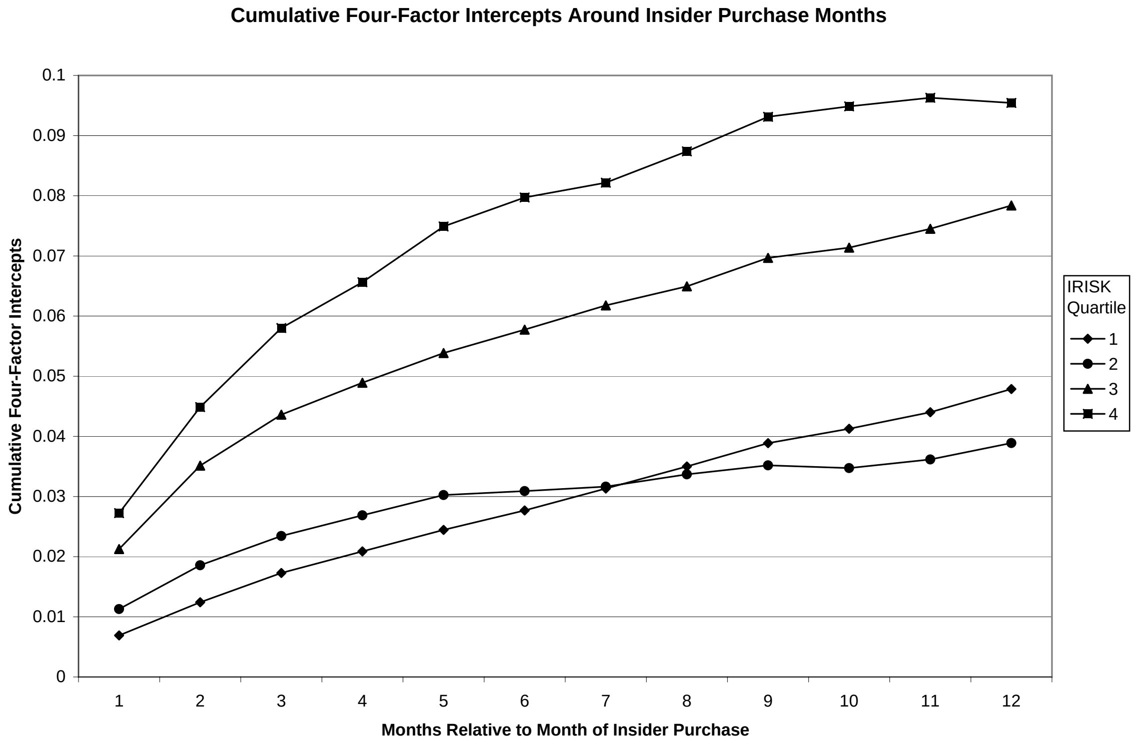
| | Predicted Sign | OLS *INDSEO* | OLS *INDSEO* | 2SLS *INDSEO* | 2SLS *INDSEO* |
|---|---|---|---|---|---|
| $IRISK$ | ? | 0.0008* | 0.0016*** | 0.0066** | 0.0067** |
| | | (0.0004) | (0.0003) | (0.0030) | (0.0030) |
| $SYSRISK$ | ? | -0.0005** | -0.0002 | -0.0028** | -0.0029** |
| | | (0.0002) | (0.0002) | (0.0014) | (0.0014) |
| $EQ1$ | - | 0.0013** | 0.0018*** | 0.0014*** | 0.0012*** |
| | | (0.0006) | (0.0004) | (0.0005) | (0.0004) |
| $PASTRET6(12)$ | + | 0.0093*** | 0.0093*** | 0.0092*** | 0.0014 |
| | | (0.0006) | (0.0006) | (0.0016) | (0.0012) |
| $PASTRET6(12) * IRISK$ | - | -0.0039*** | -0.0040*** | -0.0047 | -0.0039 |
| | | (0.0004) | (0.0004) | (0.0036) | (0.0025) |
| $PASTRET6(12) * SYSRISK$ | + | 0.0018*** | 0.0016*** | 0.0020 | 0.0014 |
| | | (0.0005) | (0.0005) | (0.0017) | (0.0012) |
| $PASTRET6(12) * EQ1$ | - | 0.0014* | 0.0011 | 0.0014 | 0.0009 |
| | | (0.0008) | (0.0009) | (0.0013) | (0.0010) |
| $M/B$ | + | -0.0002*** | -0.0002*** | -0.0002*** | -0.0003*** |
| | | (0.0001) | (0.0000) | (0.0000) | (0.0000) |
| $M/B * IRISK$ | ? | 0.0001** | 0.0001** | -0.0004 | -0.0004 |
| | | (0.0000) | (0.0000) | (0.0003) | (0.0003) |
| $M/B * SYSRISK$ | ? | 0.000 | 0.000 | 0.0003 | 0.0003 |
| | | (0.0000) | (0.0000) | (0.0002) | (0.0002) |
| $M/B * EQ1$ | ? | -0.0001** | -0.0001*** | -0.0001 | 0.000 |
| | | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| $FDROA$ | - | 0.009* | 0.0076 | 0.0076* | 0.0078* |
| | | (0.0047) | (0.0047) | (0.0045) | (0.0044) |
| $FDROA * IRISK$ | ? | -0.0041* | -0.0034 | -0.0020 | -0.0023 |
| | | (0.0021) | (0.0021) | (0.0025) | (0.0025) |
| $FDROA * SYSRISK$ | ? | 0.0046** | 0.0043** | 0.0037** | 0.0038** |
| | | (0.0018) | (0.0018) | (0.0017) | (0.0017) |
| $FDROA * EQ1$ | ? | -0.0014 | -0.0011 | -0.0006 | -0.0001 |
| | | (0.0039) | (0.0037) | (0.0035) | (0.0035) |
| $LN(MVE)$ | ? | 0.0003*** | 0.0004** | 0.0012** | 0.0011** |
| | | (0.0001) | (0.0002) | (0.0005) | (0.0005) |
| $LN(ANALYST)$ | ? | 0.0000 | -0.0004 | -0.0006 | -0.0004 |
| | | (0.0005) | (0.0005) | (0.0006) | (0.0006) |
| $INST$ | ? | 0.0111*** | 0.0149*** | 0.0162*** | 0.0156*** |
| | | (0.0014) | (0.0012) | (0.0018) | (0.0018) |
| Industry Fixed Effects | | NO | YES | YES | YES |
| Time Fixed Effects | | NO | YES | YES | YES |
| N | | 626593 | 626593 | 626593 | 625506 |
| Adj. $R^2$ | | 0.0057 | 0.0081 | | |

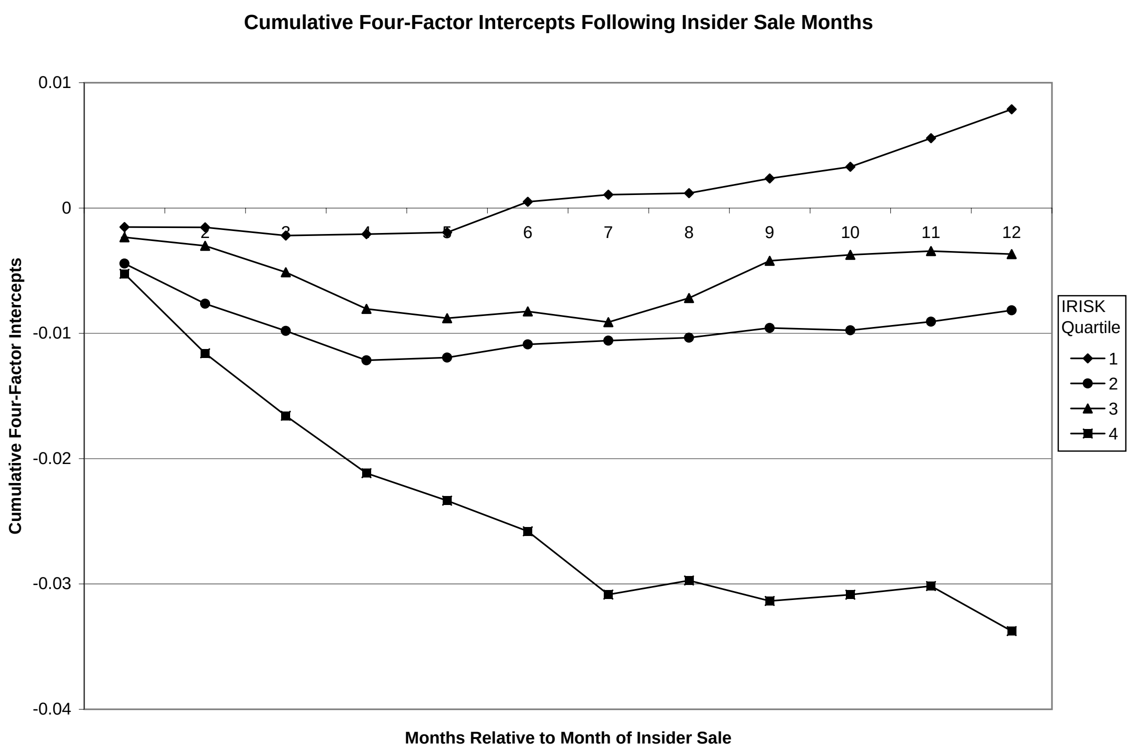
# Table VII
# Returns *Prior* to Trades

The table presents results from 2SLS regressions of $PASTRET6(12)$ for all firms with: Complete data from Compustat, CRSP, I/B/E/S, CDA/Spectrum, Thomson Financial's Insider Trading Data Feed for 1986-2003. $IRISK$ is the centered log of the variance of residuals from a regression of monthly returns on the monthly Fama-French factors plus a momentum factor; data from month $t-6$ through $t-54$, minimum 24 months of returns to be in sample. $SYSRISK$ is the centered log of the total variance of monthly returns minus the variance of residuals used to calculate $IRISK$. $ACCRISK$ is the centered log of the variance of residuals from a regression of quarterly return on assets on value-weighted industry index of return on assets; data from months $t-3$ through $t-48$. $INDBUY(SAL)$ is an indicator variable equal to one if at least one insider purchase (insider sale) occurred during the month. $INDREP(SEO)$ is an indicator variable equal to one if a share repurchase (SEO) occurred during the month. $PASTRET6(12)$ is a six-month (12-month) market adjusted, buy and hold return over month $t-1$ through $t-6$ ($t-12$). $EQ1$ is the absolute value of abnormal accruals. $MVE$ is the market value of equity at the end of month $t$. $M/B$ is the market value of equity scaled by the book value of equity. $ANALYST$ is the number of analysts issuing a one-quarter ahead earnings forecast for the firm in month $t$. $INST$ is the percentage of shares outstanding owned by institutional investors. $FDROA$ is one-quarter ahead seasonal change in quarterly return on assets. *, **, *** denote two-tailed significance at the 10%, 5%, and 1% level respectively. Standard errors are robust to heteroscedasticity and dependence across observations in the same industry (defined by two-digit SIC). In IV regressions $IRISK$ is instrumented by $ACCRISK$. The sample for the fifth column of results consists of firms in the top half of the size distribution.

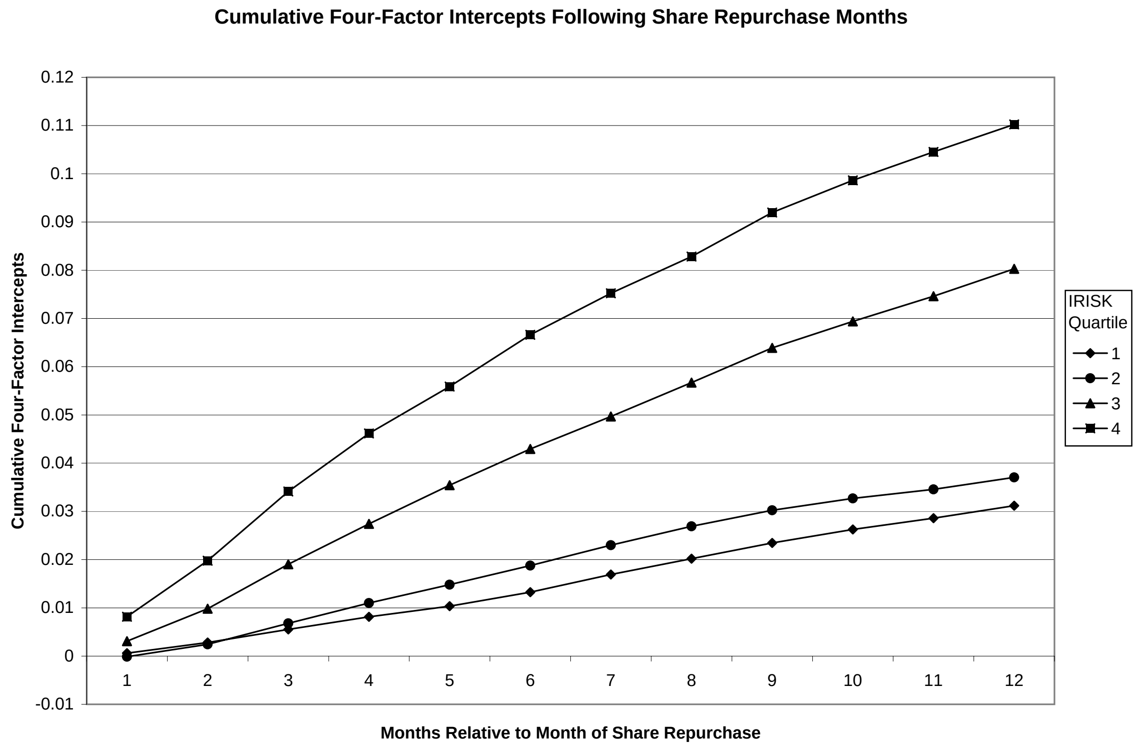
| | Predicted Sign | OLS $PASTRET6$ | OLS $PASTRET6$ | 2SLS $PASTRET6$ | 2SLS $PASTRET12$ | Top Half (2SLS) $PASTRET6$ |
|---|---|---|---|---|---|---|
| $IRISK$ | ? | 0.0310*** | 0.0442*** | -0.0261 | -0.0519 | 0.0277 |
| | | (0.0044) | (0.0037) | (0.0159) | (0.0335) | (0.0239) |
| $INDBUY$ | - | -0.0599*** | -0.0592*** | -0.0613*** | -0.0808*** | -0.0771*** |
| | | (0.0046) | (0.0026) | (0.0026) | (0.0041) | (0.0055) |
| $INDBUY*IRISK$ | - | -0.0163*** | -0.0159*** | -0.0072 | -0.0165 | -0.0285** |
| | | (0.0020) | (0.0021) | (0.0159) | (0.0125) | (0.0113) |
| $INDSAL$ | + | 0.0949*** | 0.0904*** | 0.0963*** | 0.1629*** | 0.0968*** |
| | | (0.0036) | (0.0044) | (0.0057) | (0.0109) | (0.0097) |
| $INDSAL*IRISK$ | + | 0.0122*** | 0.0087** | 0.0580*** | 0.1207*** | 0.0536** |
| | | (0.0035) | (0.0038) | (0.1315) | (0.0241) | (0.0215) |
| $INDREP$ | - | -0.0551*** | -0.0433*** | -0.0460*** | -0.0935*** | -0.0802*** |
| | | (0.0081) | (0.0046) | (0.0055) | (0.0103) | (0.0077) |
| $INDREP*IRISK$ | - | 0.0108** | 0.0048 | 0.0267** | 0.0490** | -0.0373* |
| | | (0.0052) | (0.0053) | (0.0115) | (0.0225) | (0.0191) |
| $INDSEO$ | + | 0.2504*** | 0.2455*** | 0.2647*** | 0.4587*** | 0.2858*** |
| | | (0.0163) | (0.0158) | (0.0184) | (0.0335) | (0.0242) |
| $INDSEO*IRISK$ | + | 0.0863*** | 0.0800*** | 0.1917*** | 0.2774*** | 0.2468*** |
| | | (0.0159) | (0.0160) | (0.0392) | (0.0588) | (0.0392) |
| $SYSRISK$ | ? | -0.0069** | -0.0194*** | 0.0164* | 0.0434** | 0.0058 |
| | | (0.0032) | (0.0018) | (0.0092) | (0.0189) | (0.0130) |
| $FDROA$ | ? | -0.1475*** | -0.1674*** | -0.1820*** | -0.3464*** | -0.0430 |
| | | (0.0517) | (0.0558) | (0.0566) | (0.0776) | (0.1069) |
| $M/B$ | ? | 0.0135*** | 0.0144*** | 0.0168*** | 0.0332*** | 0.0173*** |
| | | (0.0018) | (0.0018) | (0.0018) | (0.0037) | (0.0024) |
| $LN(MVE)$ | ? | 0.0383*** | 0.0418*** | 0.0276*** | 0.0584*** | 0.0186*** |
| | | (0.0035) | (0.0037) | (0.0044) | (0.0090) | (0.0051) |
| $LN(ANALYST)$ | ? | -0.0642*** | -0.0636*** | -0.0621*** | -0.1183*** | -0.0558*** |
| | | (0.0083) | (0.0084) | (0.0081) | (0.0152) | (0.0084) |
| $INST$ | ? | 0.1400*** | 0.1307*** | 0.1093*** | 0.2402*** | 0.1692*** |
| | | (0.0176) | (0.0164) | (0.0171) | (0.0359) | (0.0277) |
| $EQ1$ | ? | | 0.0140 | 0.0185* | 0.0415** | 0.0148 |
| | | | (0.0099) | (0.0100) | (0.0184) | (0.0108) |
| Industry Fixed Effects | | NO | NO | YES | YES | YES |
| Time Fixed Effects | | NO | NO | YES | YES | YES |
| $SYSRISK$ Interactions | | YES | YES | YES | YES | YES |
| $EQ1$ Interactions | | NO | YES | YES | YES | YES |
| N | | 731413 | 626593 | 626593 | 625506 | 300859 |

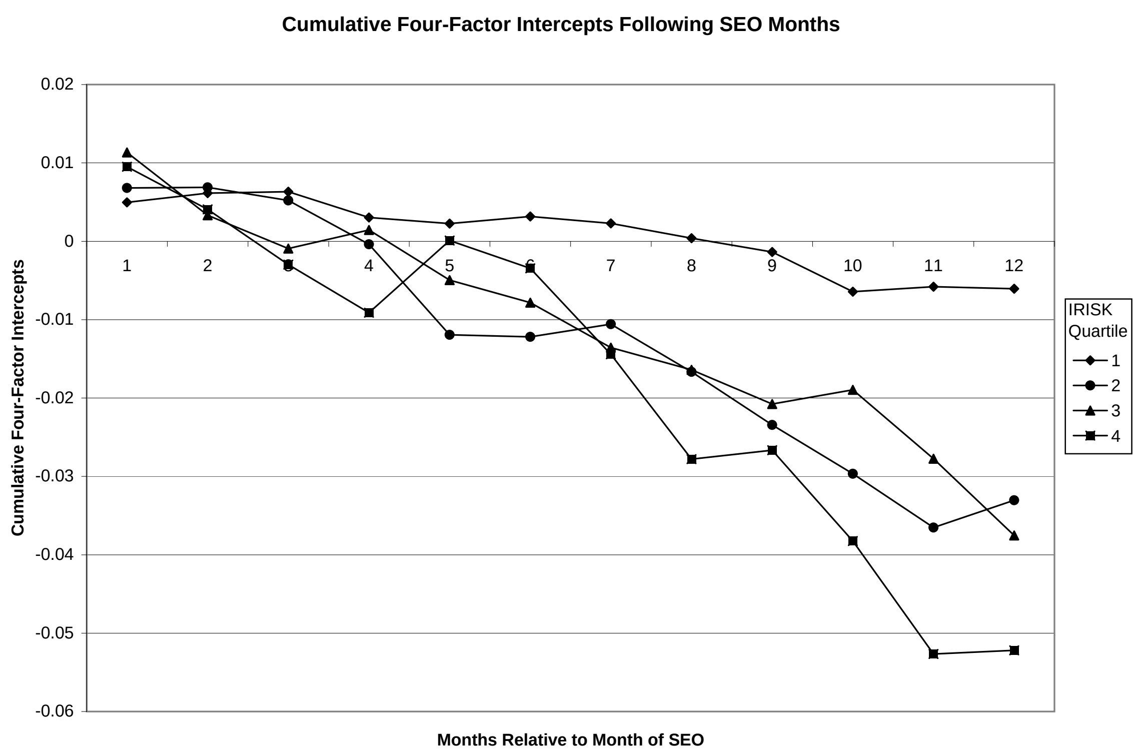
## Figure 1. Cumulative Four-Factor Intercepts Following Trade Events



## Figure 1. Cumulative Four-Factor Intercepts Following Trade Events (Cont.)



## Figure 2. Cumulative Four-Factor Intercepts Around Insider Purchases