When Are Insider Purchases Credible?

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An investor who traded after observing disclosures of nearly 270,000 insider purchases over the past 25 years, would earn a six-month abnormal return averaging 7%. Yet a third of those transactions would result in a loss and another third would have near zero returns. While post-trade abnormal returns are widely regarded as evidence that insider trades reduce information asymmetry, there is little in prior work examining how insiders provide their information to investors. The price system, a prime candidate for such information transfer, is not initially successful: announcement returns are on average small, often negative, and uninformative about post-purchase trade profitability. So, having received a noisy signal, how do investors interpret insider purchases? We provide evidence consistent with investors making a credibility assessment—where credibility depends on whether insiders bear higher wealth risk after the purchase--before choosing whether to bear further processing costs. We show that credible purchases earn six-month abnormal returns of up to 20%. Our credibility explanation accommodates findings in prior work, but suggests that asymmetry is necessary, but not sufficient for insider purchases to either occur or inform.

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> *"In spite of the attention that insiders' activities receive,* ***we do not observe any major stock price changes around the time of insider trading or around the reporting dates. This is very surprising****… However, we find that insiders' trades are informative for longer investment horizons,* *suggesting that the market underreacts to this information."* ***[emphasis added]***
> *Lakonishok and Lee (2001, p. 82)*

1. Introduction

We find that Lakonishok and Lee (2001)'s surprising findings persist over the next 25 years while studying 270,000 insider purchase transactions: the stock market reaction is primarily significant at longer horizons. Even more surprising, we find that announcement returns are not predictive of the longer horizon's returns that are typically viewed as evidence that insider trades reduce information asymmetry.[1] If the price system does not initially act as an information-revealing mechanism at the time of the trade or its disclosure, how does insider information transfer to investors? And how do investors decide whether to trade when they observe that an insider is purchasing? These questions are the focus of this manuscript.

This paper provides evidence on how investors likely parse out the signal contained in insider purchases. The direction signaled by insider purchases is clear, but a large dispersion of outcomes makes it a noisy signal. We argue that investors first bear the cost of assessing the innate credibility of the purchase. Our central premise is that investors view an open market purchase as credible when they can plausibly infer that risk-averse, under-diversified insiders are bearing higher personal risk. This premise is based on economic theory that recognizes that managers diversify their wealth to assets uncorrelated with their human capital (e.g., Fama, 1980; Amihud and Lev, 1981; Smith and Stulz, 1985; Hall and Liebman, 1998).[2]

[1] Among others, see Jaffe 1974; Seyhun, 1998; Lakonishok and Lee 2001; Jeng, et al. 2003; Frankel and Li, 2004; Huddart and Ke, 2007; Jagolinzer, et al. 2010; Cohen, et al. 2012; Brochet, 2010. Although the conclusion that insider trades reduce information asymmetry holds for both purchases and sales, we focus on open market purchases for two reasons. First, purchases are more likely than sales to be intentional signals as there are less onerous ways for insiders to increase their ownership (e.g., option exercises, stock appreciation rights). Second, whereas purchases are systematically shown to anticipate higher future prices, the evidence on whether sales anticipate price declines is mixed. That is, because sales can occur for non-information reasons such as tax, liquidity, and diversification, they typically require a *filtering* mechanism to point out lower prospects. To this effect, Beneish and Vargus (2002), Beneish et al. (2012), and Cohen et al. (2012) show that partitions based on either abnormal or opportunistic sales are indicative of lower future prices.

[2] It is also related to signaling research, as higher ownership via insider purchases is akin from a risk standpoint to higher IPO ownership retention (e.g., Leland and Pyle, 1977; Welch, 1989; Grinblatt and Huang, 1989).

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Second, depending on its assessed credibility, investors can choose to further acquire and process information, wait for further firm disclosures, or altogether refrain from trading. Although in line with research suggesting that incomplete information and processing costs produce price underreactions to seemingly costlessly available public information (e.g., Allen et al. 2006; Goldstein and Yang, 2017 and Blankenspoor et al. 2020)), the process we describe is centered on assessing credibility, so that we only expect to observe stock price "drift" among credible purchases.

We argue that investors assess credibility by evaluating whether an open market purchase increases an insider's wealth risk. This is equivalent to evaluating whether an increase in the proportion x of an insider's total wealth (W) that is invested in the insider's firm (S) increases the insider's wealth risk. The challenge is that, with the exception of research using Swedish insiders, market participants cannot observe W, x, or how insiders invest their *non-S* wealth.[3] To circumvent the lack of observability we first characterize insider personal risk as the variance of returns on an insiders' wealth portfolio, which, for tractability, we view as consisting of two assets: equity contingent wealth (S) and P, a diversified portfolio of other assets including cash, bonds, real estate, and other stocks that represents *non-S* wealth, so that an insider's total wealth equals $W = S + P$. Second, we assume that *before the open market purchase,* the variance of the insider's wealth portfolio is at its minimum. This enables us to specify the critical point (x) as a function of the ratio of the standard deviations of returns and the correlations of returns of S and P. Using these assumptions, we conduct analyses (see Section 2.3, and Appendix A) that show that insider purchases are more likely to increase wealth risk the larger the standard deviation of returns of S relative to P, and enable us to

[3] Kallunki, Nilsson, and Hellström (2009) study insiders of 297 Swedish publicly traded firms over the period 2000 to 2005 for which they have details on insiders' wealth. They find that insiders who have proportionately more equity-contingent wealth sell more stock before bad news. Kallunki, Kallunki, Nilsson, and Puhakka (2018) study a larger sample of such firms (393 firms over 2000-2008) and additionally find that the level of wealth affects the extent of selling, with less wealthy insiders selling more. Neither study finds that insiders' total wealth or their equity-contingent proportion influences insider buying.

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estimate the likelihood that a purchase increases the risk of an insider's wealth.[4]

We thus view purchases as increasing an insider's personal wealth risk when they occur in riskier firms (e.g., small, high book-to-market, high volatility firms, poor market and financial performance), and in firms where *insiders* are exposed to higher risk as a result of their compensation contract and employment horizon (e.g., share and option holdings, age). While prior work provides evidence consistent with many of these predictions (e.g., purchases are a small firm phenomenon, insiders are contrarian), there are two important differences. First, because many of our risk proxies are also used in prior work as proxies for information asymmetry, we conduct tests to disentangle credibility from asymmetry. Specifically, we partition subsamples widely regarded as containing high asymmetry firms--smaller, high bid-ask, high volatility, or loss firms—into high and low credibility by using the ranks of signal credibility based on the likelihood that purchases increase wealth risk implied by our simulations. Second, unlike prior studies, we view information asymmetry as a necessary but not as a sufficient condition for insider purchases to either occur or inform. For example, our credibility and asymmetry view suggests that insiders refrain from purchasing in low-risk contexts as these are unlikely to be credible.

We test these predictions using all insider purchases with available data over the past 25 years: the sample consists of approximately 270,000 open market purchases by insiders of 9,910 unique firms over the period 1995-2020. Our results on the incidence and signaling value of insider purchases are generally consistent with our predictions. First, we show that insider purchases are more frequent and more profitable where they are more credible, that is (i) in small, high book-to-market, and high idiosyncratic volatility firms than in their lower risk

[4] We consider various possible distributions of the proportion x by parametrizing alternative beta distributions that we benchmark by reference to the Forbes 400 list, the only available estimate of U.S. insiders' total and equity-contingent wealth. We use the market portfolio as a proxy for P as data availability prevents us from considering other holdings such as bonds, cash and real estate. To the extent these would lower the variance of P, our tests identify increases in insider wealth risk less frequently. For this reason, we also conduct simulations by considering variances lower than that of the market portfolio. The simulation results obtain from varying the standard deviation of returns of S relative to P, the correlation of the returns of S and P, as well as considering uniform, right- and left-skewed distributions for x over [0,1].

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counterparts, (ii) in firms where insiders have more out-of-the-money stock options and larger shareholdings. Second, consistent with prior research, we find that routine purchases are less informative (Cohen et al., 2012; Ali and Hirshleifer, 2017). However, when purchases increase an executive's wealth risk, there is no difference in profitability between routine and opportunistic purchases, indicating that purchases in high-risk contexts are uniformly credible.

Third, to show that information asymmetry is not a sufficient condition for trades to be informative, we examine subsamples of firms likely to have high information asymmetry, and we show that within those subsamples, more credible purchases are more frequent and more informative. Fourth, consistent with the notion that processing costs are lower, we find that prices adjust faster for larger firms with have a greater "residual" analyst following. We also find that the speed of price adjustment is related to changes in institutional holdings (i.e., when institutions react to the purchases). Finally, consistent with some investors waiting for corroborating disclosures, we show that prior purchases enhance the market response to subsequent earnings surprises. This view is consistent with the evidence in prior work that insider trades are signals that help investors interpret other information about the firm's activities. That is, insider trading helps assess the effect of dividend initiations (John and Lang, 1991), earnings management (Beneish and Vargus, 2002), firm future earnings (Piotroski and Roulstone, 2005, Veenman 2012), and the effect of restatement announcements (Baderscher et al., 2011).

Our evidence suggests a credibility and information asymmetry rather than simply an information asymmetry explanation for the information conveyed by insider purchases. In other words, the absence of insider purchases does not mean an absence of information asymmetry. Rather, it means that open market purchases are costly ways of increasing ownership (for example, relative to stock option exercises) and do not occur when they are unlikely to signal that insiders bear higher wealth risk. This is analogous to Miller (1977)'s censoring argument, but in the opposite direction: insiders refraining from open market purchases when credibility is

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likely low would result in censoring positive news and thus in undervaluation.

The remainder of the paper is organized in six sections. Section 2 describes research antecedents and Section 3 presents our hypotheses. Sections 4 and 5 describe our method and empirical results, and Section 6 concludes.

2. Expectations

2.1 Information Asymmetry and Insider Trading Profits

Information asymmetry between firm insiders and outside investors is uniformly viewed as a pre-condition to the existence of insider trading profits. Under this assumption, prior work has extensively studied the profitability of insider trading showing that the magnitude of the trading profit depends on the direction of the trade, the volume of trading, and the type of insider who trades (see Appendix B for a discussion).[5] Yet, as we argue below based on prior research findings, the relation between the degree of information asymmetry and magnitude of insider trading profits is not well understood, particularly for purchases.

On one hand, several studies have argued that the greater the degree information asymmetry the higher insider trading profits, and the reverse as well, so that insider trading profits have been used as proxy for the extent of information asymmetry. For example, Aboody and Lev (2000) argue that R&D investing increases information asymmetry between insiders and external investors and show that the profitability of insider trading is greater in firms with R&D expenditures. Similar arguments are made on small and growth firms by Seyhun (1998) among others, and in firms with advertising expenditures by Joseph and Wintoki (2013). Frankel and Li (2004) use this relation in reverse and show that higher analyst following is associated with less profitable insider trades, which they argue is consistent with a decrease in information asymmetry as more analysts engage in equity

[5] As we discuss in Appendix B, the profitability of insider trading has been extensively examined and previous work has shown that the magnitude of the trading profit depends on the direction of the trade, the volume of trading, and the type of insider who trades.

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research and increase the quantity and precision of public information about the firm.

On the other hand, Huddart and Ke (2007) evaluate how trading profits relate to various commonly used empirical proxies for the degree of information asymmetry and find that some of the proxies yield inconsistent results for purchase and sales and that the proxies typically explain a small percentage of the cross-sectional variation in insider trading profits.[6] In addition, there is evidence suggesting that differences in information asymmetry do not result in different insider purchasing profits. In particular, Jagolinzer et al. (2010) show that firms where insider trades require approval by the general counsel (GC) are firms with greater information asymmetry, but insider purchases are not differentially profitable in these authors' GC versus non-GC subsamples. Similarly, Hodgson et al. (2018) suggest that stronger governance in firms with greater information asymmetry reduces the profitability of insider sales but not of purchases. Although these internal controls are likely adopted in firms where there is greater information asymmetry to protect investors from bailing-out-behavior, it remains that differences in the level of information asymmetry are not sufficient to explain the profitability of insider purchases.

In sum, the relation between the degree of information asymmetry and magnitude of insider trading profits merits further study, particularly for insider purchases. As we discuss next, we investigate the relation from the perspective of the investor as a signal receiver, which, surprisingly have not received much attention in prior work.

2.2 Insider Purchases as Noisy Signals

In theoretical models, the trading profits are compensation to informed traders for revealing their information. Kyle (1985)'s informed traders (which he labels 'insiders' for rhetorical convenience) are not price takers: their trades impact prices, and they trade strategically over repeated trading rounds to better exploit their information advantage. Thus,

[6] The proxies they consider include the extent of institutional ownership and analyst following, value-glamour, frequency of reported losses, and R&D expenditures.

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information asymmetry persists, and prices gradually reflect the informed traders' information. Whereas this view could explain why profits are observed over long horizons, it is unlikely to be descriptive about how insiders transmit their information to investors for two reasons. First, Section 16 insiders' trades are too infrequent to affect stock prices in the multiple-round fashion contemplated in Kyle-like models. Second, there is evidence that the price system does not initially act as an information-revealing mechanism at the time of the trade (or its disclosure).

This suggests that if insider information is reflected in prices, it is through the trading of outside investors. Indeed, insider trades are promptly disseminated and costlessly available, but they do not reveal whether the trade was motivated by information or what the insider information was. We take the perspective of the signal receiver, the investor who receives a noisy signal. That is, the direction signaled by insider purchases is clear, but the accuracy of the signal is unknown. In other words, on average, purchases signal insiders' belief that their firm is undervalued but do not indicate why or by how much. For example, assume that the information set used by outside investors to value a firm's stock is given by $O = \{r_1, r_2 \dots r_n, \tilde{p}_1, \tilde{p}_2 \dots \tilde{p}_n, F\}$ where the r_i represent publicly known realizations (e.g., past sales, cash flows, earnings, dividends, number of employees, number and location of plants, servers and distribution centers, etc...), the $\tilde{p}_i$ represents probabilistically known expectations of future value-relevant outcomes, and F is the function that outside investors use to map their information set into the stock price. Assuming insiders use the same mapping function (F), the difference between outside investors and an insider's information sets ($I = \{r_1, r_2 \dots r_n, \tilde{p}_{1I}, \tilde{p}_{2I} \dots \tilde{p}_{nI}, F\}$) relates to the $\tilde{p}_{iI}$ which could slightly differ from the $\tilde{p}_i$ in terms of means and variance. Thus, when an investor observes an insider purchase, they do not know which of the $\tilde{p}_i$ have changed in expectation or by how much. In addition, if the insider's mapping function (F_I) changes or simply differs from that of the outside investor (F_O), this process that would be further exacerbated. Thus, the information conveyed by the purchase could be either or both

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(1) that an unknown element of the insider information set has changed, or (2) that the function mapping the insider's information into price has changed.

Thus, to the extent that the reduction in information asymmetry occurs over the longer horizons over which prior work documents abnormal returns, we argue that insider information is reflected in prices through the actions of external investors that make credibility assessments and either acquire and process further information or wait for new information to become public before deciding whether to trade. This is consistent with Grossman and Stiglitz (1980) to the extent that investors are price takers and they acquire/process information with the expectation of earning a return on their investment.

We thus argue that the insider purchase serves as a trigger for investors to first assess the credibility of the purchase and possibly invest in information acquisition/processing before deciding to trade. We rely on prior economic theory to form our central prediction: that the incidence and informativeness of insider purchases primarily depend on the extent to which investors perceive insiders to bear added wealth risk after the purchase. Indeed, we posit that managers are risk-averse and undiversified with respect to the firm that employs them and propose their willingness to bear added wealth risk as the mechanism by which insider purchases become a credible signal. The extent to which insiders are perceived to concentrate or increase--as opposed to diversify or reduce--their wealth risk has two testable implications. First, we expect the profitability of the insider purchases to increase with the additional risk borne by the insider. Second, we expect to observe virtually no insider purchases when the risk of the firm's equity is lower than the risk of the insider's portfolio of assets other than his/her employer's equity.

2.3. Signal Credibility: Measurement and Predictions

To evaluate whether an open market purchase increases an insider's wealth risk, we need to assess whether an increase in the proportion x of the insider's total wealth (W) that is invested in the insider's firm (S) increases her wealth risk. Because we cannot observe W, x, or

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how insiders invest their *non-S* wealth, we first characterize insider personal risk as the variance of returns on an insiders' wealth portfolio, which, for tractability, we view as consisting of two assets: equity contingent wealth (*S*) and *P*, a diversified portfolio of other assets including cash, bonds, real estate, and other stocks that represents *non-S* wealth, so that an insider's total wealth equals $W = S + P$. Second, we assume that *before the open market purchase,* the variance of the insider's wealth portfolio is at its *minimum*. This enables us to specify the critical point (x_0) as a function of the ratio of the standard deviations of returns and the correlations of returns of *S* and *P* (denoted *k*, $\sigma(R_s)$, $\sigma(R_p)$, and $\rho(R_s,R_p)$, *where* $k = \sigma(R_s)/\sigma(R_p)$):

$$x_0 = (1-k\rho(R_s,R_p))/(1+k^2-2k\rho(R_s,R_p)) \quad (1)$$

Under these assumptions, we can calculate the critical point by choosing a proxy for the portfolio P so that we can measure both $\rho(R_s,R_p)$ and $\sigma(R_p)$. When we specify the portfolio *P* as the CRSP value-weighted market index we find that the mean (median) *k* in our sample equal 3.43 (2.77) and that the range of *k* from 0 to 20 encompasses over 99.8% of our observations. This is important because, assessing whether a purchase increases the risk of an insider's wealth requires determining how likely the proportion *x* of an insider's total wealth that is invested in the insider's firm exceeds the critical point (for further discussions, please see Appendix A).

To gain insights into how the behavior of the proportion *x* of the insider's total wealth invested in *S,* we turn to Forbes 400 wealthiest U.S. individuals which reports an estimate of their wealth.[7] We then search FACTSET for the insider holdings of each of these individuals and are able to collect the value of insider holdings for 164 of these 400 individuals. We find that the market value of insider holdings represents on average 35.9% of total estimated wealth, with a median of 23.9% and a range from 0.02% to 99.99%.

Although the Forbes 400 are not likely representative, we use alternative beta distributions for *x* which range from 5% to 80% of an insider's wealth. In particular, a beta

[7] From: https://www.forbes.com/real-time-billionaires/#2d51538f3d78 filtered to United States captured at 1:11 pm 2/22/22.

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distribution with parameters (α, β) = (2, 38) implies that on average, *x* equals 5%. The following alternative parameters (α, β) = (2, 18), (α, β) = (2, 8), (α, β) = (1, 1) and (α, β) = (8, 2), imply distributions with the mean of *x* equaling 10%, 20%, 50% and 80% respectively. The first three parametrizations correspond to a left-skewed distribution so that *x* is more likely to take on smaller values in the interval [0,1]; (α, β)=(1, 1) corresponds to the uniform distribution and (α,β)=(8, 2) is right-skewed distribution x, which is unlikely to occur frequently within public companies but which we observe in some of the Forbes 400 list with billionaires such as Jeff Bezos (Amazon, 85%), Larry Ellison (Oracle, 83%), Larry Paige and Sergei Brin (92% and 91%, Alphabet Inc). Mark Zuckerberg (98%, Meta Platforms Inc) and Warren Buffet (Berkshire Hathaway 99%).

In Table 1, we present the average probability that a purchase increases an insider's wealth risk. The data are drawn from applying the five parametrizations of the beta distribution to a matrix that combines values of $\rho(R_s,R_p)$ ranging from values -1 to +1 by increments of .01, with values of *k* ranging from zero to five by increments of .10 and from 6 to 20 by increments of 1. In Panel A, we use the standard deviation of the returns on the CRSP value-weighted market index as $\sigma(R_p)$, and in Panels B, C and D we use 90%. 80% and 70% of $\sigma(R_p)$ respectively. Because inferences are similar across all four panels, we focus our discussion on Panel A.

The following results are noteworthy. First, nearly all purchases occur in situations where $k>1$ so that standard deviation of returns of *S* is greater than that of *P.* Indeed, when $k<1$, the critical point tends to be large across return correlation values ranging on average from .95 for k=.10 to .50 for k=1.0. For this reason, in the case $k<1$, the probability that a purchase increases an insider's wealth risk is near zero for the three left-skewed distributions, about 38% for the uniform distribution, and 85% for the right-skewed distribution. Second, purchases by the insiders that own a large ownership percentage (e.g., Jeff Bezos, Larry Paige) nearly always

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increase wealth risk. Third, the larger the *k*, the higher the probability that a purchase increases an insider's wealth risk, with more credible purchases expected to be more informative.

We test that firms with larger *k* are firms that have higher risk: These firms are either small, have high book-to-market firms (Fama and French, 1992), or high volatility (Fama, 1976; Goyal and Santa-Clara, 2003). They have deteriorating financial and market performance--such firms are riskier because there is greater uncertainty about their future cash flows (e.g., Eames and Glover, 2003). In addition, we test whether purchases are more informative in firms where insiders are exposed to higher risk as a result of their compensation contracts and/or their employment horizon. Executives are generally characterized as risk-averse, as their utility is tied to idiosyncratic firm-specific outcomes (e.g., May, 1995), which includes both endogenous and exogenous shocks to firm performance, and person-specific risks such as non-promotion, firing, and employment horizon. Although equity-based pay is expected to align shareholders' long-term interests with the welfare of the executive (Lambert and Larcker, 1987; Morck et al., 1988), this comes at the expense of increasing an executive's risk exposure to firm performance. Therefore, ceteris paribus, we argue that risk-averse executives with a larger proportion of wealth tied to firm value (e.g., Delta, Vega, unvested options, longer horizon) would, a priori, prefer reducing such risk exposure rather than increasing it. Consequently, we expect insider purchases to be more informative when compensation or employment risk is high.

Our credibility arguments suggest that information asymmetry is a necessary, but not a sufficient condition for insider purchases to either occur or inform. For example, we argue that if insiders expect their open market purchases to have little or no credibility in low-risk contexts, they will refrain from such trades, unless they intend the purchases to disguise a pattern of sales. The issue that arises is that many of the above risk proxies have also been used in prior work as proxies for information asymmetry (e.g., size, book-to-market firms, volatility, losses). Therefore, to disentangle the credibility and asymmetry effects, we partition

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the extreme asymmetry quintiles used in prior work (e.g., smaller firms, high bid-ask firms, high volatility firms, or loss firms), by using ranks of signal credibility (e.g., likelihood that purchases increase insider wealth risk) implied by our simulations.

We also argue that depending on how credible they believe the signal to be, investors invest in further processing to relate the signal to other information about the firm. Then, investors can either trade, search for new information, or wait for corroboration until the firm makes a subsequent public report. We expect that insider information is reflected in prices faster for large firms, firms with greater analyst following, and with larger institutional ownership. In the case of size, we posit that investors' processing costs are lower as firms have richer environments and more sophisticated intermediaries. In the case of analysts and institutional investors, we recognize their relation to size and other firm characteristics, and rely on prior work, to estimate orthogonalized versions of these measures for use in our tests, or alternatively, changes in these measures.

3. Method

3.1 Sample

We use a number of datasets to construct our sample, mainly the intersection of firms in the insider trading files, Compustat, CRSP, and Execucomp. We use Compustat for financial statement data, Thomson Financial for insider trading, Execucomp to calculate executive pay structures, and CRSP to calculate returns. We also use other databases as explained in their respective sections. Stock returns are measured starting the day insiders transact. Financial statement data from Compustat is available quarterly; hence, we match current insider trading data with the financial statement data of the previous calendar quarter. Executive pay data are available annually, and we thus match current insider trading activity to compensation data in the immediately preceding year. We start our analysis in the year 1995; the year Execucomp data became widely available, and the sample ends in 2020 (the

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last year of full data available). We allow our sample to vary according to data availability across the various databases. Given that we use daily open market purchases at the firm level as unique data points, our sample has a maximum of 270,953 insider purchases comprised of 9,910 unique firms, with both Compustat, and share price return data on CRSP.

3.2 Variables

For insider trading, data are drawn from Table 1 of the Thomson Financial insider trading files. We measure insider trading by aggregating insider purchases across executives for a particular firm, on a given day. We calculate the profitability of insider purchases following Jagolinzer et al. (2011) as the alpha from the four-factor Fama-French and Momentum models (Fama and French, 1993; Carhart, 1997) over a 180-day period starting with the transaction date. To test our central prediction that the incidence and informativeness of insider purchases depend on the extent to which insiders are *observed* to bear added risk after the purchase, we examine the profitability of insider trades as a function of observable firm-level risk characteristics. As we further describe below, we group these risk characteristics into two categories: firm risk and risk related to the insider's compensation.

We use five proxies for executive wealth risk. We measure firm size (*Size*) as the market value of equity of the firm calculated as share price multiplied by total shares outstanding. For *Market-to-Book*, we normalize *Size* by the book value of equity at quarter end. Both variables are widely used as measures of firm risk (see Fama and French, 1993; Fama and French, 2015). We calculate idiosyncratic volatility using the methodology of Shin and Stulz (2000), as the residual from market model regressions starting 100 days prior to an insider purchase and ending 10 days before it. We view firms with losses and firms with poorer prior year share price performance as riskier. *Loss Firm* is an indicator variable equal to one if the firms' income before extraordinary items is negative, and zero otherwise. We use monthly CRSP to calculate *Prior 12-month Return*, as the compounded raw share returns over the prior 12 months ending the month preceding the insider purchase.

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We also use five measures to proxy for an insider's compensation risk. We cannot observe all individual insiders' firm-specific-related wealth, as such information is only publicly available for the five highest-paid executives within each firm. However, given that firms provide option and share awards uniformly across a firm's executive ranks (e.g., Murphy, 2003), we use the mean share and option holdings of the five highest executives as a proxy for insiders' compensation risk. We calculate insider's risk-related incentives using the Vega of executive stock option holdings divided by the Delta (plus Vega) of executive stock option holdings (*Vega-to-Delta*), following Core and Guay (2002) and others who have implemented their methodology (see Rogers, 2002; Hayes et al., 2012; Bakke et al., 2016). Next, we calculate the out-of-moneyness of stock options. We reverse rank this variable, to obtain *Out-of-Money*. The larger this variable the more the options are out of the money. Third, we calculate a measure of option (un)vestedness, which captures the extent to which an executive is incentivized to generate long-term returns. *Unvested* is calculated as the ratio of the number of unvested options normalized by total options held (vested and unvested). Finally, to ensure we provide a comprehensive analysis of the relation between insider trading and executive wealth incentives, we also look at incentivization through share ownership (see Mehran, 1995), by calculating *Shares*, which is the mean share ownership of insiders normalized by the market value of the firm.[8] As a final measure of an executive's wealth exposure to firm prospects, we calculate *Horizon* as the difference between an insider's age and 65. Ceteris paribus, younger insiders have a longer expected horizon as employees of the firm, and hence their wealth has a longer exposure to firm-specific outcomes.

All our measures capture various aspects of the exposure of insiders' wealth to firm prospects. We winsorize all variables at 1% at each end. All variables used in the analysis are described in Appendix C.

[8] We also examine restricted shares, the latter becoming increasingly popular after 2005 and the changes in accounting for stock option compensation. Results are similar to that of share ownership.

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3.3 Research Methodology

Our research methodology mimics Jagolinzer et al. (2011), where we conduct a multivariate analysis to examine the interplay between insider purchases and firm-level or executive wealth-related characteristics, with respect to future returns. In our model, trading profits are a function of risk-related characteristics (firm risk, performance risk, wealth risk). We estimate the following econometric model:

$$Trading\ Profit_{i,t} = \beta_0 + \beta_1 * Risk\text{-}Related\ Characteristic_{i,t} + \varepsilon_{i,t} \quad (2)$$

i denotes firm while *t* denotes day, while ε_{it} is the residual. The coefficient β_0 measures the average daily risk-adjusted return to insider purchases, while β_1 represents the conditional mean given firm characteristic *j*. The sum of the coefficients, $\beta_0 + \beta_1$, would measure percentage returns, on a daily basis, over the 6-month window subsequent to the trade. Therefore, a β_1 that equals 0.01 would imply that insider purchases would earn over the 180-day calendar period, an average excess daily return of 0.01% times the mean of executive incentive or firm characteristic *j*.

We estimate equation (2) using ordinary least squares (OLS), correcting the standard errors for correlation across observations of a given firm and across observations of a given year by clustering on both firm and transaction date, following Thompson (2011) and Cameron et al. (2011). We use this double-clustering technique for all our regressions unless otherwise specified, and our inferences are robust to using a firm-fixed effects specification.

4. Empirical Results

4.1 Sample Descriptive Statistics

Table 2 reports the descriptive statistics of our sample, which is the universe of insider purchases over the period 1995-2020. *Trading Profit* has a mean of 9.03% (median = 6.27%), indicating that the average insider purchase exhibits positive returns, a result that is in line with the findings of Jagolinzer et al. (2011) who report a mean trading profit of 0.06% daily

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(7.56% yearly, Table 4, p. 1260), and also in line with prior studies on insider purchases. As in Jagolinzer et al. (2011), the first quartile of Trading Profit is negative, and indeed open market purchases generate a trading loss for 39% of the observations in our sample. These losses are more likely to occur among firms whose characteristics we argue diminish the signaling value of the open market purchase. Indeed, in subsequent analysis, we find these trading losses occur in larger, higher market-to-book, lower volatility, more profitable firms.

(Insert Table 2 over here)

Table 2 also reports distributional statistics on several firm characteristics. Our sample firms are large with an average (median) *Market Value* of $1.81 billion (196 million). This right skew is representative of the large publicly listed firms in the U.S. economy and accounts for why researchers use a log transform or decile ranks of *Market Value* in regression tests. *Market-to-Book* has a mean (median) of 2.52 (1.63). *Idiosyncratic Volatility* has a mean (median) of 0.14% (0.07%), and it is right-skewed, indicating that at the right end of the distribution, firms are generally far riskier. *Loss Firm* has a mean of 0.33, indicating that at the quarterly level, a third of the firms report losses. This is plausible for two reasons. First, the incidence of losses is, given seasonality, typically much higher at the quarterly level than at the annual level. Second, our sample consists of firms whose insiders purchase shares, and insiders are normally contrarian (Seyhun, 1992). Indeed, in unreported analyses, if we also consider firms in which insiders sell, the proportion of loss firms is 21%, in line with prior work. Finally, the ratio of volatilities, *Ratio of Volatilities*, is the standard deviation of firm returns over the standard deviation of the value-weighted CRSP index, calculated over the prior 12 months using monthly data. This variable has a mean of 3.48 and a median of 2.77, indicating that the average firm is approximately 3 times riskier than the market index.

Vega-to-Delta has a mean of 0.35 which is in line with Conyon, Core, and Guay (2011). Approximately 32% of a CEO's options are not vested (*Unvested),* indicating that there are large incentives associated with future stock price performance. Median *Moneyness*

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of options is about $5 million, while the mean is around $286 million. This value, which is the number of options held times the difference between the current stock price and exercise price, is unsurprisingly right-skewed. In our sample firms, many of the firms are heavy in options usage: Amgen, Texas Instruments, Yahoo, Sun Microsystems, Cendant, and others, all have moneyness values that are in the billions. Also as expected, many firms have options that are on average underwater, as observed by the negative first quartile of *Moneyness*. Given this large positive skew, we rank this variable from 1-10, and reverse code it, to arrive at our final variable, *Out-of-Money*. Finally, *Horizon*, which is the difference between insiders' age and 65, has a mean of 11.5, indicating that the average insider is slightly less than 55 years of age.

4.2 Announcement and Long-Term Abnormal Returns after Insider Purchases

Table 3, Panel A reports descriptive statistics on market reactions at and following announcements of insider purchases. The mean and median announcement abnormal returns equal 0.85% and 0.41% which is consistent with findings in prior research documenting a numerically positive price response to insider purchases. However, it is not easy to infer large long-term positive returns from these, as the direction of the announcement abnormal returns is mixed (only 54.9% are positive), and its magnitude shows little immediate price impact.

Assuming the purpose of trading on an insider purchase is to identify conditions in which investors could earn the most economically significant six-month abnormal returns, we examine the usefulness of announcement returns, trade size and trade timing to achieve that purpose. In Panel B, we show that announcement returns are not particularly useful: the correlation coefficients between announcement and six-month abnormal returns are trivial, and less than 1%. Even if we split purchase announcement returns into quintiles, their correlation to long term returns is minimal.

(Insert Table 3 over here)

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In Panel C, we report market reactions by trade size deflated by average trading volume in the month prior to the trade. We show that announcement returns increase with trade size, and the increase is uniform across quintiles of trade size: the highest trade size quintile (Q5) is 51 bp higher than the lowest quintile (Q1) and 16 bp higher than Q3.[9] Whereas Q5 averages seem informative about signal credibility, it remains that only 54.4% of Q5 announcement returns are positive which is similar to the whole sample those percentage (54.6%).

In sum, this analyses in Panels A, B, and C, reveals that announcement returns are not particularly useful in predicting the six-month profitability of emulating insider purchases.

4.3 Predicting the likelihood of insider purchases

We conduct a multivariate analysis at the firm/quarter level to explain the incidence of insider purchases. Our dependent variable *Purchase* equals 1 when the firm is a net purchaser in a given quarter, and 0 if the firm is a net seller. The results, which we present in Table 4, are organized into our two risk-based categories: firm risk and insider compensation risk. We estimate regressions by quarter and the coefficients we report are time-series averages over 102 quarters, using the Fama-MacBeth methodology (Fama and MacBeth, 1973). The results that we discuss below are similar to those we obtain when estimating the logit model using all observations, or when specifying daily purchases for each firm as the unit of observation rather than a firm-quarter.

(Insert Table 4 over here)

In Model (1), our independent variables are quartile indicators for firm size, market-to-book, idiosyncratic volatility, loss firms, and prior 12-month raw returns. Coefficients are significant and in the expected direction, e.g., there is a higher frequency of purchases in small, high book-to-market. Moreover, there is a higher incidence of purchases in firms that exhibit losses, and firms that have had lower prior share price returns. The explanatory power of the

[9] We also conduct the analysis after deflating trade size by the trading volume on the day of the trade. Our analysis reveals similar but slightly weaker results: the spread in announcement returns is not uniform, and the distance Q5-Q1 is 23bp rather than 51bp.

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model averages 14.5%, which compares favorably with Frankel and Li (2004). Indeed, these authors are more successful at explaining the incidence of sales rather than that of purchases: Frankel and Li find that a model examining insider sales (purchases) intensity explained on average 12.7% of the variation in sales but only 1.8% of the variation in purchases.

In Model (2), we examine the relationship between purchases and insider compensation risk, and find three coefficients significant, except for *Shares Owned* and *Horizon*. There is a higher frequency of purchases in firms in which insiders have more *Out-of-Money* and *Unvested* options, which is consistent with more purchases occurring in riskier settings, e.g., in which they have greater signaling value. On the other hand, *Horizon* is negative and insignificant. Finally, an indicator for the highest quartile of *Vega-to-Delta* is significant, as expected.

In Model (3) we consider all these insider risk measures simultaneously, to assess their incremental predictive power. Idiosyncratic volatility is now significant. *Shares Owned* and *Horizon* are now also significant, with the latter only at $p < 0.10$. This indicates that insiders with higher share ownership are less likely to increase their shareholdings. We conjecture this occurs because at the margin, a given purchase increases wealth risk less, the higher the shares owned before the purchase. This finding contrasts with our earlier univariate result that insider purchases marginally increase with larger shareholdings. Finally, firms with younger executives are less likely to voluntarily purchase shares in the open market. Perhaps indicating higher risk aversion given their lower wealth, or lower stock-picking ability.

4.4 The informativeness of insider purchases

To test our prediction that the informativeness of open market purchases depends on the extent of the incremental wealth risk borne by the insider, we evaluate whether the profitability of such purchases is higher (lower) in high-risk (low-risk) contexts. We define high-risk contexts, alternatively, as firms that have higher risk (e.g., small, high book-to-market, high volatility firms, loss firms, poor prior returns), and firms where insiders are exposed to higher

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risks as a result of their compensation contracts and/or their employment horizon (e.g., share and option holdings, and employment horizon). We thus analyze whether firm risk-based characteristics explain cross-sectional differences in abnormal returns associated with insider purchases. For ease of economic interpretation and consistency with our incidence analysis, we use decile transformations of all our variables which we code from 0 to 9 (inferences are unchanged if we use continuous variables). Note that all our variables are measured prior to the occurrence of the insider trade, so that ranks are observable prior to the release of the insider purchase information.

4.4.1 Firm risk and purchase informativeness

Table 5 presents our results with respect to firm risk. Model (1) measures the average trading profit associated with insider purchases in our sample, and serves as a means of benchmarking results. We find that the intercept (β_0 in equation (2)) has a value of 0.0717 and is significantly positive (*t*-statistic = 33.26, $p < 0.01$). As expected, this equals the mean *Trading Profit* in Table 1 and indicates that insider purchases earn an average excess return of approximately 0.0717% per day over the 180-day period where *Trading Profits* are measured or approximately 9.03% over a 6-month period following the purchase. This value is economically plausible in comparison to the Jagolinzer et al. (2011) finding of trading profits to insider purchases of 0.06% per day in their analysis (see their Table 4, Models 2 and 3, p. 1260).

(Insert Table 5 over here)

In columns (2)-(7) we examine our measures of risk both separately and jointly. In Column (2), the coefficient on *Size* is negative and significant (-0.0129, *t*-statistic = 19.40, $p < 0.01$), indicating that insider purchases in smaller firms are more profitable than in their larger counterparts. Moreover, the constant term now increases from 0.0717% to 0.1136%, suggesting that, in the smallest 10% of sample firms, insiders earn abnormal returns of about 0.114% per day (approximately 14.4% over the 6-month period following their purchase),

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whereas, for the largest 10% of firms, insiders make only about -0.32% over the following 6-month period).[10] The results are similar for the regressions in columns (3) and (4). That is, purchases in firms with higher *Market-to-Book* ratios generate lower trading profits ranging from 4.72% to 11.55% over the 6-month period in the highest and lowest decile of *Market-to-Book*. With respect to *Idiosyncratic Volatility* in column (4), trading profits vary from -1% to 16.19% over the following 6-month period. Similarly, both *Loss Firm* and *Prior 12-month Return* lead to more than a 5% return differential between the highest and lowest deciles. The joint estimation in Model (7) reveals that size, market-to-book, and idiosyncratic volatility retain their significance in explaining risk-adjusted returns in the 6-month period following insider purchases, which suggests they capture different aspects of the informativeness of insider purchases. Interestingly, estimating all the variables together, we find that the combination of these variables results in 6-month abnormal returns ranging from -7.77% up to 20.35%: the credibility of purchases leads to a large cross-sectional variation in the profitability of insider purchases.[11]

Given this large variation in the profitability of a strategy emulating insider purchases, we repeat our prior analysis on a yearly basis to assess whether the returns are concentrated in specific time periods with unusual circumstances, and thus estimate our joint model (Model 7 of Table 5) annually. For each year, we calculate the maximum 6-month return that is obtained by the highest linear combination of our risk variables, and also the return to mimicking all insider purchases (hereafter the naïve strategy), which is given by the intercept,

[10] For ease of economic interpretation, note that all our independent variables are decile ranks ranging from 0-9, and the dependent variable is returns in %, per day. For example, in Table 5 Model 2, when the firm is in the smallest size decile, *Market Value* is 0, and returns equal the constant of 0.114% per day or 14.37% over 180 calendar days. When the firm is in the highest size decile, *Market Value* is 9 and returns are (9)*(-0.0129) + 0.1136 = -0.0025% per day or -0.32% over 180 calendar days.

[11] Similar to prior studies, we conduct analyses on trading strategies based on insider purchases in supplemental analysis. We conduct analyses on large vs. small purchases sizes, and on whether the trades are conducted by high versus low level executives. We also analyze insider purchases under different mispricing conditions. We also provide a more comprehensive analyses on the incidence of purchases. Finally, we also examine situations where insider purchases provide mixed signals about insider wealth risk. These analyses are available upon request as we need to conform with the 50-page submission limit. Our inferences remain unchanged.

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similar to Model 1 of Table 5. Rather than tabulating the annual regressions, we report the results graphically in Figure 1. The figure depicts that our strategy of linearly combining the highest decile of firm size, market-to-book, etc., yields positive returns in every year except for 2007 (the last period preceding the crisis); and that its annual returns are also greater than the returns to a naïve strategy of investing in firms in which insiders' purchase, every year except in 2007 and 2018. In addition, the maximum 6-month returns to our strategy are often double (i.e. 2002, 2011, 2012, 2013), and sometimes triple (i.e. 1995, 1997, 2004), the returns to the naïve strategy.

These results, presented in Table 5 and Figure 1, indicate that purchase credibility helps explains a large swathe of the cross-section of profits to insider trading, above and beyond the role of information asymmetry, a necessary condition for profits to exist. Moreover, these credibility tests inform us about the existence of a credibility assessment indirectly implying that credibility is a cost borne by investors.

In Table 5, Panel B we examine whether our results are robust to partitioning the sample between opportunistic and routine purchases. This classification of insider open market transactions has become prevalent in studies examining the informativeness of insider trades after the being introduced by Cohen et al. (2012). Our tests reproduce both the Cohen et al. (2012), and the Ali and Hirshleifer (2017) classifications, and present the results in the eight columns of Table 5, Panel B.

Specifically, in the first four columns we present results using the Cohen et al. (2012) opportunistic (Columns 1 & 2) / routine classifications (Columns 3 & 4). For each partition, we show the returns to the naïve strategy (intercept only) in one column, followed by another column with the full model (the full model is similar to Model 7 in Table 5, Panel A). When we examine the maximum 6-month return, we find that naïve strategy returns to opportunistic insider purchases are 9.54% (Column 1) when purchases are opportunistic, but only 4.64% when purchases are routine (Column 3). This finding confirms the prior results obtained by

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Cohen et al. (2012). However, when using the full model, we find that the maximum 6-month returns average 19.38% (Column 2) for opportunistic purchases and 18.03% (Column 4) for routine purchases. The difference between the coefficients in Models 2 (opportunistic) and 4 (routine) is not statistically significant. Because similar minimum and maximum returns are obtained in firms with higher risk profiles, the finding that opportunistic and routine purchases lead to the same trading profits suggests that in such firms, open market purchases are likely to be strategic (see also Kallunki et al., 2018).

We also consider an alternative opportunistic/routine partition using the Ali and Hirshleifer (2017) methodology. Thus, we present estimation results for opportunistic purchases in Columns 5 & 6 and for routine purchases in Columns 7 & 8. Although the sample size differs, we obtain similar results: opportunistic purchases earn returns that are 1.5 times greater than routine purchases when we consider a naïve strategy (0.0689% vs. 0.0413% per day). However, our high-risk linear combination yields similar abnormal returns to opportunistic and routine purchases of 17.01% and 14.74% over a 6-month period following the purchase.

The finding that returns to our high-risk strategy do not differ whether an insider's trade is classified as routine or opportunistic, suggests that insider purchases are strategic, and vary with the extent to which investors perceive the purchases increase the risk borne by the insider. In all specifications, a linear combination of firm size, market-to-book, etc., yields economically relevant trading profits, whether they are opportunistic or routine.

4.4.2 Compensation risk exposure and purchase informativeness

In Table 6, we examine factors related to insiders' exposure to compensation risk. In unreported analysis similar to Model (1) of Table 5, we examine baseline returns for this subsample because requiring data availability on Execucomp significantly restricts the sample (to approximately 65,000 observations from 270,000). The subsample of Execucomp firms contains predominantly large firms, in which, ceteris paribus, our analysis so far has indicated a

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lower incidence and informativeness of insider purchases. Indeed, in un-tabulated tests, we find that β_0, the intercept in the base model for this subsample equals 0.0464%, which is approximately 35% lower than the average of 0.0717% for the whole sample (see Table 5, Model 1). In Columns (2) to (6), we examine the relation between insider purchase trading profits and deciles of *Vega-to-Delta*, *Share Owned*, the proportion of *Unvested Options* to total options, *Out-Of-Money* options, and the insider's employment *Horizon*. Individually, the coefficients on all these variables are significantly related to *Trading Profit*, except for *Vega-to-Delta*. For example, the coefficient on *Shares Owned* is 0.0054 yielding a trading profit that ranges from 2.75% to 8.44% over the following 6-month period; that of *Unvested* is 0.0038 (range of trading profit from 3.85% to 8.06% over the six month period) and that of *Out-Of-Money* is 0.0049 (range of trading profit from 2.61% to 8.30% over a 6-month period). In Model (5), we estimate that the relation between insider purchases and *Horizon* is positive and significant, and the trading profits vary from 6.79% to 3.95% between the oldest and youngest insiders. This indicates that purchases by insiders with longer horizons are more informative, as they signal a longer commitment (e.g., Phua, Tham, and Wei, 2018).

(Insert Table 6 over here)

Considering these compensation risk variables together (Model 6), we find that only *Shares Owned*, *Out-of-Money*, and *Horizon* remain significant in a joint regression (6-month returns are up to 13.89%). This is partly expected: *Out-of-Money*, which is a dollar-based measure, is a better predictor of compensation risk exposure than *Unvested*, which measures the proportion of unvested to vested options, without considering the amounts involved. Indeed, from a compensation-based risk perspective, the dollar moneyness of options appears to subsume the effects of both *Unvested* and *Vega-to-Delta.*

4.5 Distinguishing credibility from information asymmetry

The firm characteristics we use to proxy for signal credibility are also used in prior research to proxy for the extent of information asymmetry. For example, we argue that

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purchases in smaller firms are more likely to be credible because they are more likely to result in an increase in insider wealth risk, whereas prior research has viewed insider purchases as a small firm phenomenon owing to greater information asymmetry in smaller firms. As well, researchers have used book-to-market, idiosyncratic volatility, and losses as empirical proxies for information asymmetry (see Huddart and Ke (2007), Jagolinzer et al. (2011)), whereas we use them as proxies for credibility. This creates an entanglement that requires the introduction of a new construct to assess whether our credibility and asymmetry view of purchases--where information asymmetry is a necessary but not a sufficient condition for insider purchases to either occur or inform--is descriptive.

The construct is the probability that a purchase increases the risk of an insiders' wealth (as discussed in Table 1), estimated based on simulations and alternative beta distributions for the proportion *x* of the insider's wealth invested in their firm. The probabilities depend on the ratio of the volatility of the firm to that of the stock market, computed as the standard deviation of firm returns, normalized by the standard deviation of the CRSP value-weighted returns, both calculated over the prior 12-month period. This enables us to rank firms by the likelihood that a purchase increases the risk of an insiders' wealth.

Our tests examine how increases in insider wealth variance affect the profitability of insider purchases in high information asymmetry environments. If the signaling value of insider trading is driven by information asymmetry, then a partition based on the likelihood of an increase in insider wealth variance should not yield differing trading profits. Alternatively, if asymmetry is necessary but not sufficient for insider purchases to inform, our credibility and asymmetry view suggest that a higher likelihood of an increase in insider wealth variance should yield higher trading profits.

In Table 7, our tests rely on prior work and identify high asymmetry firms as those in the lowest *Size* quintile, firms in the highest quintile of bid-ask spreads, firms in the highest

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quintile of idiosyncratic volatility firms, and loss firms.[12] Although we tabulate the partition using the ranks of signal credibility (e.g., likelihood that purchases increase insider wealth risk) relying on the beta (1,1) distribution for the proportion *x* of an insider's total wealth that is invested in the insider's firm. Our results are similar for the tests based on alternative beta distributions also.

(Insert Table 7 over here)

The table reports results in two panels containing 4 columns organized in groups of two for each asymmetry proxy, partitioned based on whether the likelihood of an increase in insider wealth variance is low or high (the highest versus lowest tercile). In Panel A, we report results for *Size* (Columns 1-2) and *Lambda* (Columns 3-4) as asymmetry measures. Column 1 reveals that for small-sized firms, the partition on whether the probability of an increase in insider wealth variance is high or low reveals that the coefficient is more than double in the high probability case (0.1594 vs. 0.0641). This suggests that controlling for the extent of information asymmetry, an increase in the wealth risk borne by an insider makes the signal considerably more informative. Additionally, Table 7 also indicates that there is more than twice as much insider purchases in high wealth variance firms as compared to their low variance counterparts (46,680 versus 20,216), augmenting our analysis in Table 4 regarding the incidence of purchases: purchases occur when they can credible signal risk bearing by insiders.

The results are similar in Columns 3-4, where we use the adverse selection component of the bid-ask spread as a measure of information asymmetry (*Lambda*). The highest quintile of *Lambda* has a considerably larger coefficient when the probability of an increase in insider wealth variance is high (0.1656 v. 0.0451, while N is 8,456 versus 19,591). These results extend to Panel B where we use both loss firms, and idiosyncratic volatility, as measures of

[12] Specifically, to extract information asymmetry from bid-ask spreads, we calculate *Lambda* as the highest quintile of the adverse selection component of the bid-ask spread calculated from the TAQ database following the methodology in Armstrong, Core, Taylor and Verrecchia, 2011.

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information asymmetry. In the case of loss firms, the profitability of purchases is approximately x2.7 higher, while in the case of idiosyncratic volatility, the profitability is 68% higher. In both cases, the incidence of purchases is more than 4 four times higher.

In sum, our analyses are consistent with an asymmetry and credibility view of insider purchases, where information asymmetry is a necessary, but not a sufficient, condition for insider purchases to signal profitability.

4.6 The speed of price adjustment

In Table 8, we report results on the role of processing costs on the speed of price adjustment following insider purchases. We show the speed of adjustment due to insider purchases for all firms in Panel A, and we use cuts based on firm size (Panel B), analyst revision activity and institutional purchasing as proxies for the level of processing costs (Panels C and D). We argue that costs are lower for larger firms, as more analysts issue more revisions, or more institutions invest. In the case of size, we argue that investors' processing costs are lower as large firms operate in richer environments with more sophisticated intermediaries. In the case of analysts and institutional investors, we recognize their correlation with size and other firm characteristics, and following prior work, we also use constructs that orthogonalize these measures (Panels E and F).[13]

(Insert Table 8 over here)

In Panel A, for our sample as a whole, we observe that on average prices drift upwards gradually over the six-month period subsequent to the trade. For example, 32% of the price adjustment occurs in the first month, 64% by the third month, and 91% by the fifth month. In Panel B, we repeat this analysis on a partition of the sample by firm size and report a

[13] We draw on the methodology in Yu (2008) and calculate *Residual Analyst* as the residual from regressions where the log of analyst following is regressed on the log of firm market value, lagged return on assets, the change in assets, the volatility of cash flows, and the dollar value of debt and equity financing. We follow Gompers and Metrick (2001) and calculate *Residual Institution* as the residual from regressions where the percentage of shares held by institutions is regressed on the log of firm market value, share price volatility, the log of firm age, the log of the market-to-book ratio, the log of the dividend yield, the log of share price, the log of sales turnover, and lagged market adjusted share price return.

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comparison of the returns after purchases that occur in the highest and lowest size quintiles (we provide further detailed data on this as presented in Figure 2). Note that there are many more purchase transactions in firms in the lowest size quintile (approximately 106,000) relative to the highest size quintile (approximately 24,000), which is not surprising as purchase transactions occurring in a given day are our unit of analysis. We find that in the largest size quintile the drift reaches its maximum between two and three months after insiders purchase (it is 73% by month two and 90% by month four), whereas the speed of price adjustment is about two months slower in the smallest size quintile (it is 78% by month four and 91% by month five).

In Panels C and D, we report results based on institutional purchasing, and analyst forecasting activity, from the period preceding the insider purchase to the period after. We obtain institutional ownership data from the Thomson Financial 13F filings, available on a quarterly level, and calculate the change in institutional ownership from the prior quarter to the quarter after the insider purchase. We partition this variable into quintiles: the lowest quintile is where institutions decreased their holdings the most after a purchase (and retail investors increased), while the highest quintile is where retail investors decreased the most and institutions increased. Results are as expected: we observe that the price adjustment is faster (slower) when institutional purchases increase (decrease) and retail investors decrease (increase) their holdings. By month two the adjustment is 47% (60%) in the lowest (highest) quintiles of institutional change. Similarly, the numbers are at 63% (76%) for month 3. Returns consistently converge to 6-month values faster when institutions are buying, and retail investors selling. Alternatively, retail institutional buying (and institutional selling) does not lead to quick price convergence.

In Panel D we repeat the same analysis for analyst forecasts. We measure revision activity in analyst forecasts as the number of analyst revisions (upward revisions plus downward revisions) in the period after the insider purchase, normalized by total analyst

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following. If we are measuring returns in the month (2 months) after the insider purchase, we measure revision activity in the month (2 months) after the purchase, for three months of returns we measure 3 months of revision activity, etc. Analyst forecasts are drawn from the I/B/E/S summary files. Panel D reveals that when analyst forecasting activity is more frequent, price adjustment is quicker in the first month (59% percent price adjustment v. 36%), but the pace is the same in the remaining months. The faster price adjustment is consistent with a greater number of analyst revision activity reducing processing costs as they produce and disseminate their analyses to their clients.

In Panels E and F, rather than using analyst/institutional activity, we report results based on rankings that rely on residual analysts and residual institutional ownership. In Panel E, in our test on residual institutions, we find no difference in the speed of price adjustment in the extreme quintiles. However, for the lowest residual analyst quintile, we find that 30% and 47% percent of the six-month average price rise is realized in the first and second month after the purchase, whereas the corresponding percentages are higher in the highest residual analyst quintile (52% and 69%). The faster price adjustment is consistent with a greater number of analysts reducing processing costs as they produce and disseminate their analyses to their clients.

4.7 Insider purchasing and stock prices during earnings announcements

To examine whether insider purchases make for timelier incorporation of information into stock prices, we conduct an analysis similar in spirit to that of Choi et al. (2022), but limited to purchases. If insider purchases signal information to the market participants that reduces information asymmetry, we expect that (a) insider purchases add credibility to the earnings surprise signal, and (b) insider purchases lead to a larger stock price reaction around the earnings announcement date.

We examine three time horizons to measure the impact of insider purchases around announcement dates. The pre-earnings announcement period is measured over 10 trading days

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and ending 2 days prior to the earnings date (Panel A of Table 9). The earnings announcement period from the day prior to the day after (Panel B). The post-earnings announcement drift period starts 2 days after the announcement and extends to 1 day after the subsequent earnings announcement date (Panel C). For each of these horizons, we calculate cumulative abnormal returns as buy and hold returns on the firm less buy and hold returns on the equal-weighted market return. Our analysis is at the firm-year and quarter level and requires I/B/E/S data availability to calculate earnings surprises.

(Insert Table 9 over here)

We calculate our insider purchasing variables from one day after the prior earnings announcement date to one day before the current announcement date. We use three purchasing measures, in three different sub-samples, in order to assess the robustness of the results. In the first sample, we use all firm-quarters with available data (N = 267,215), and we calculate *Purchase*, which is a dummy variable equal to one if there is an insider purchase in the prior period, zero otherwise. Next, we eliminate all firm quarters where there is a net insider selling, hence retaining observations if there is either net insider purchasing, or no trading (N = 171,360), and calculate *Purchase2* which is a dummy variable that is equal to 1 if a firm is a net purchaser during the quarter prior to the announcement, and 0 if there are no prior insider trades. Finally, we eliminate all firm-quarters where there are no insider trades, and only keep observations where there was either a purchase, a sale, or both. We calculate *Purchase Ratio* (see Piotroski and Roulstone, 2005), which is the insider purchase rate calculated as the dollar value of purchases normalized by the dollar value of purchases and sales. All regressions have share price returns as the dependent variable and control for firm size, leverage, market-to-book ratio, earnings surprises, number of analysts, industry, and time effects.

In Panel A of Table 9, we investigate the relation between insider purchases and the pre-earning announcement stock drift. It is well known that stock prices start to drift toward

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the direction of the earnings news, in the period leading to the announcement, in part because of news contained in early announcers (Foster, 1981), or because market participants start paying more attention in the immediate period prior to an announcement (DeHaan et al., 2015), or because of news leakages (Patell and Wolfson, 1984). In the context of insider trading, Hirschleifer and Ali (2017) argue that opportunistic insider trades lead to a price impact in the days leading up to the earnings announcement. Therefore, we start our analysis by examining how purchases lead to returns in the pre-announcement period. In all 3 columns of Panel A, we see that insider purchases are related to a higher $CAR_{(-10, -2)}$, and where returns are larger by a magnitude ranging from 27 bps to 40 bps. These results are significant whether a purchase occurs, whether insiders are net purchasers, or when we compare purchases to sales (Columns 1 – 3, respectively).

Next, in Panels B and C, we investigate the effect of purchases on both abnormal returns during the earnings announcement and the ensuing drift. In Panel B we see that in all three columns insider purchasing leads to higher returns, with an economic effect ranging from 29 bps to 55 bps. Inferences are similar in Panel C where the economic effects range from 72 bps to 92 bps. The total effect of purchases around earnings announcements ranges from 128 bps (sum of coefficients in Column 1 of Panels A, B, and C) to 187 bps (sum of coefficients in Column 3 of Panels A, B, and C), and occurs while controlling for the earnings surprise and is independent of it. These economic magnitudes are large, because our dataset includes only firms followed by I/B/E/S – hence, a subsample where insider trading is generally neither prevalent nor highly credible.

In sum, results in Table 9 confirm those obtained in prior research: insider purchases lead to higher CARs around the period of the earnings announcement. These results are consistent with a subset of investors waiting for corroborating evidence after an insider purchase, as they are unwilling to bear processing costs at the time of the initial purchase. In turn, this leads to heightened credibility of the earnings signal in the presence of prior

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purchases, where insider purchases act as a confirmatory signal to the quality/persistence of the earnings number. Nonetheless, market participants do not completely adjust for the informational value embedded into the insider purchase signal, where we show that a large part of the economic effect occurs in the ensuing drift in prices after the earnings announcement.

5. Conclusion

The paper presents a framework to explain the incidence and signaling value of insider open market purchases and describes a plausible processing cost scenario by which insider information is reflected in stock prices. Our central premise is that the existence and informativeness of insider open market purchases depend on the extent to which investors infer that insiders bear added risk after the purchase.

Our hypotheses differ from prior research in that we view the existence of information asymmetry as a necessary, but not a sufficient condition for insider purchases. Thus, conditional on the existence of information asymmetry, purchases occur in cases when they observably increase the risk of the insider's wealth, but not when they do not. In other words, the absence of insider purchases does not mean an absence of information asymmetry. Rather, it means that in low-risk contexts, open market purchases do not occur because they are costly and unlikely to signal that insiders bear higher wealth risk. This censoring of good news is analogous to Miller (1977) but in the opposite direction.

We test our predictions using the universe of insider trades over the period 1995-2020 and show that purchases are more frequent and informative in firms with higher risk, and in firms where insiders are exposed to higher compensation risk. Our predictions are consistent with the evidence in prior work that purchases are more frequent and more profitable in firms that are small, have high book-to-market ratios, and high idiosyncratic volatility, and can also accommodate findings in prior work where differences in information asymmetry do not result

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in different insider purchasing profits. Moreover, we show prices adjust faster when there are more informed intermediaries, such as institutions or analysts, who reduce investors' processing costs to interpret the insider purchasing signal.

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References

Aboody, D., & Lev, B. (2000, December). Information Asymmetry, R&D, and Insider Gains. *The Journal of Finance, 55*(6), 2747-2766.

Ali, A., & Zhang, W. (2015). CEO Tenure and Earnings Management. *Journal of Accounting and Economics, 59*(1), 60-79.

Ali, U., & Hirshleifer, D. (2017). Opportunism as a Firm and Managerial Trait: Predicting Insider Trading Profits and Misconduct. *Journal of Financial Economic, 126*(3), 490-515.

Allen, F., Morris, S. and Shin, H. S. (2006), "Beauty Contests and Iterated Expectations in Asset Markets", Review of Financial Studies, 19, 720-752.

Amihud, Y., & Lev, B. (1981). Risk Reduction as a Managerial Motive for Conglomerate Mergers. *The Bell Journal of Economics, 12*(2), 605-617.

Armstrong, C. S., Core, J. E., Taylor, D. J., & Verrecchia, R. E. (2011). When does information asymmetry affect the cost of capital?. *Journal of Accounting Research*, *49*(1), 1-40.

Badertscher, B. A., Hribar, S. P., & Jenkins, N. T. (2011). Informed Trading and the Market Reaction to Accounting Restatements. *The Accounting Review, 86*(5), 1519–1547.

Baesel, J. B., & Stein, G. R. (1979, September). The Value of Information: Inferences from the Profitability of Insider Trading. *Journal of Financial and Quantitative Analysis, 14*(3), 553-571.

Bakke, T.-E., Mahmudi, H., Fernando, C. S., & Salas, J. M. (2016). The Causal Effect of Option Pay on Corporate Risk Management. *Journal of Financial Economics, 120*(3), 623-643.

Barker, V. L., & Mueller, G. C. (2002). CEO Characteristics and Firm R&D Spending. *Management Science, 48*(6), 782-801.

Beneish, M. D., & Vargus, M. E. (2002). Insider Trading, Earnings Quality, and Accrual Mispricing. *The Accounting Review, 77*(4), 755-791.

Beneish, M. D., Press, E., & Vargus, M. E. (2012, March). Insider Trading and Earnings Management in Distressed Firms. *Contemporary Accounting Research, 29*(1), 191-220.

Blankespoor, E., deHaan, E., & Marinovic, I. (2020). Disclosure Processing Costs, Investors' Information Choice, and Equity Market Outcomes: A Review. *Journal of Accounting and Economics, 70*(2-3), 101344.

Brochet, F., (2010). Information Content of Insider Trades before and after the Sarbanes-Oxley Act. The Accounting Review 1 March 2010; 85 (2): 419–446.

Cameron, A. C., Gelbach, J. B., & Miller, D. L. (2011). Robust Inference With Multiway Clustering. *Journal of Business & Economic Statistics, 29*(2), 238-249.

Carhart, M. M. (1997). On Persistence in Mutual Fund Performance. *The Journal of Finance, 52*(1), 57-82.

Carpenter, J. N. (1998). The Exercise and Valuation of Executive Stock Options. *Journal of Financial Economics, 48*(2), 127-158.

Choi, L., Faurel, L., & Hillegeist, S. A. (202). *Do Proprietary Costs Deter Insider Trading?* Arizona State working paper. SSRN.

Cohen, J. R., Bierstaker, J. L., DeZoort, T. F., & Hermanson, D. R. (2012, May). Audit Committee Compensation, Fairness, and the Resolution of Accounting Disagreements. *Auditing: A Journal of Practice & Theory, 31*(2), 131-150.

Conyon, M. J., Core, J. E., & Guay, W. R. (2011). Are U.S. CEOs Paid More Than U.K. CEOs? Inferences from Risk-adjusted Pay. *Review of Financial Studies, 24*(2), 402-438.

Electronic copy available at: https://ssrn.com/abstract=3478344

Core, J., & Guay, W. (2002). Estimating the Value of Employee Stock Option Portfolios and Their Sensitivities to Price and Volatility. *Journal of Accounting Research, 40*(3), 613-630.
DeHaan, E., Shevlin, T., & Thornock, J. (2015). Market (in) attention and the strategic scheduling and timing of earnings announcements. Journal of Accounting and Economics, 60(1), 36-55.
Eames, M. J., & Glover, S. M. (2003). Earnings Predictability and the Direction of Analysts' Earnings Forecast Errors. *The Accounting Review, 78*(3), 707-724.
Edmans, A., Gabaix, X., & Landier, A. (2009). A Multiplicative Model of Optimal CEO Incentives in Market Equilibrium. *Review of Financial Studies, 22*(12), 4881-4917.
Fahlenbrach, R., & Stulz, R. (2011). Bank CEO Incentives and the Credit Crisis. *Journal of Financial Economics, 99*(1), 11-26.
Fama, E. (1976). Efficient Capital Markets: Reply. The Journal of Finance, 143-145.
Fama, E. F. (1980). Agency Problems and the Theory of the Firm. *Journal of Political Economy, 88*(2), 288-307.
Fama, E. F., & French, K. R. (1992). The Cross-Section of Expected Stock Returns. *The Journal of Finance, 47*(2), 427-465.
Fama, E. F., & French, K. R. (1993). Common Risk Factors in the Returns on Stocks and Bonds. *Journal of Financial Economics, 33*(1), 3-56.
Fama, E. F., & French, K. R. (2015). A Five-Factor Asset Pricing Model. *Journal of Financial Economics, 116*(1), 1-22.
Fama, E. F., & MacBeth, J. D. (1973). Risk, Return, and Equilibrium: Empirical Tests. *The Journal of Political Economy, 81*(3), 607-636.
Finnerty, J. E. (1976). Insiders and Market Efficiency. *The Journal of Finance, 31*(4), 1141-1148.
Foster, G. (1981). Intra-industry information transfers associated with earnings releases. Journal of accounting and economics, 3(3), 201-232.
Frankel, R., & Li, X. (2004). Characteristics of a Firm's Information Environment and the Information Asymmetry Between Insiders and Outsiders. *Journal of Accounting and Economics, 37*(2), 229-259.
Goldstein, I., & Yang, L. (2017). Information Disclosure in Financial Markets. *Annual Review of Financial Economics, 9*, 101-125.
Goyal, A., & Santa-Clara, P. (2003). Idiosyncratic Risk Matters! *The Journal of Finance, 58*(3), 975-1007.
Grinblatt, M., & Hwang, C. Y. (1989). Signaling and the Pricing of New Issues. *The Journal of Finance, 44*(2), 393-420.
Grossman, S. J., & Stiglitz, J. E. (1980). On the Impossibility of Informationally Efficient Markets. *The American Economic Review, 70*(3), 393-408.
Hall, B. J., & Liebman, J. B. (1998). Are CEOs Really Paid Like Bureaucrats? *The Quarterly Journal of Economics, 13*(3), 653-691.
Hayes, R. M., Lemmon, M., & Qiu, M. (2012). Stock Options and Managerial Incentives for Risk Taking: Evidence from FAS 123R. *Journal of Financial Economics, 105*(1), 174-190.
Hodgson, A., Seamer, M., & Uylangco, K. (2018). Does Stronger Corporate Governance Constrain Insider Trading? Asymmetric Evidence from Australia. *Accounting & Finance, 60*(3), 2665-2687.
Holmstrom, B. (1999). Managerial Incentive Problems: A Dynamic Perspective. *The Review of Economic Studies, 66*(1), 169-182.
Holmstrom, B., & Milgrom, P. (1987). Aggregation and Linearity in the Provision of Intertemporal Incentives. *Econometrica, 55*(2), 303-328.

Electronic copy available at: https://ssrn.com/abstract=3478344

Huddart, S., & Ke, B. (2007). Information Asymmetry and Cross-sectional Variation in Insider Trading. *Contemporary Accounting Research, 24*(1), 195-232.
Jaffe, J. F. (1974). Special Information and Insider Trading. *The Journal of Business, 47*(3), 410-428.
Jagolinzer, A. D., Armstrong, C. S., & Larcker, D. L. (2010). Chief Executive Officer Equity Incentives and Accounting Irregularities. *Journal of Accounting Research, 48*(2), 225-271.
Jagolinzer, A. D., Larcker, D. F., & Taylor, D. J. (2011). Corporate Governance and the Information Content of Insider Trades. *Journal of Accounting Research, 49*(5), 1249-1279.
Jegadeesh, N., & Titman, S. (1993). Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency. *The Journal of Finance, 48*(1), 65-91.
Jeng, L. A., Metrick, A., & Zeckhauser, R. (2003, May). Estimating the Returns to Insider Trading: A Performance-Evaluation Perspective. *Review of Economics and Statistics, 85*(2), 453-471.
John, K., & Lang, H. H. (1991). Insider Trading around Dividend Announcements: Theory and Evidence. *The Journal of Finance, 46*(4), 1361-1389.
Joseph, K., & Wintoki, B. M. (2013). Advertising Investments, Information Asymmetry, and Insider Gains. *Journal of Empirical Finance, 22*, 1-15.
Kallunki, J., Kallunki, J., Nilsson, H., & Puhakka, M. (2018). Do an Insider's Wealth and Income Matter in the Decision to Engage in Insider Trading? *Journal of Financial Economics, 130*(1), 135-165.
Kallunki, J., Nilsson, H., & Hellström, J. (2009). Why do insiders trade? Evidence based on unique data on Swedish insiders. *Journal of Accounting and Economics, 48*(1), 37-53.
Kyle, A. S. (1985). Continuous Auctions and Insider Trading. *Econometrica, 53*(6), 1315-1335.
Lakonishok, J., & Lee, I. (2001). Are Insider Trades Informative? *The Review of Financial Studies, 14*(1), 79-111.
Lambert, R. A., & Larcker, D. F. (1987). An Analysis of the use of Accounting and Market Measures of Performance in Executive Compensation Contracts. *Journal of Accounting Research, 20*, 85-125.
Lambert, R. A., Larcker, D. F., & Verrecchia, R. E. (1991). Portfolio Considerations in Valuing Executive Compensation. *Journal of Accounting Research, 29*(1), 129-149.
Leland, H. E., & Pyle, D. H. (1977). Informational Asymmetries, Financial Structure, and Financial Intermediation. *The Journal of Finance, 32*(2), 371-387.
Lin, J.-C., & Howe, J. S. (1990). Insider Trading in the OTC Market. *The Journal of Finance, 45*(4), 1273-1284.
Madden, G. P. (1981). Potential Corporate Takeovers and Market Efficiency: A Note. *The Journal of Finance, 36*(5), 1191-1197.
Matta, E., & Beamish, P. W. (2008). The Accentuated CEO Career Horizon Problem: Evidence From International Acquisitions. *Strategic Management Journal, 29*(7), 683-700.
May, D. O. (1995). Do Managerial Motives Influence Firm Risk Reduction Strategies? *The Journal of Finance, 50*(4), 1291-1308.
Mehran, H. (1995). Executive Compensation Structure, Ownership, and Firm Performance. *Journal of Financial Economics, 38*(2), 163-184.
Miller, M. H. (1977). Debt and Taxes. *The Journal of Finance, 32*(2), 261-275.
Morck, R., Shleifer, A., & Vishny, R. W. (1988). Management Ownership and Market Valuation: An Empirical Analysis. *Journal of Financial Economics, 20*(1-2), 293-315.
Murphy, K. (2003). Stock-based Pay in New Economy Firms. Journal of Accounting and Economics, 129-147.

Electronic copy available at: https://ssrn.com/abstract=3478344

Nunn, K. P., Madden, G. P., & Gombola, M. J. (1983). Are Some Insiders More "Inside" Than Others? *The Journal of Portfolio Management, 9*(3), 18-22.
Ofek, E., & Yermack, D. (2000). Taking Stock: Equity-Based Compensation and the Evolution of Managerial Ownership. *Journal of Finance, 55*(3), 1367-1384.
Patell, J. M., & Wolfson, M. A. (1984). The intraday speed of adjustment of stock prices to earnings and dividend announcements. Journal of financial economics, 13(2), 223-252.
Piortroski, J., & Roulstone, D. (2005). Do insider trades reflect both contrarian beliefs and superior knowledge about future cash flow realizations? Journal of Accounting and Economics, 55-81.
Prendergast, C. (2002). The Tenuous Trade-off between Risk and Incentives. *Journal of Political Economy, 110*(5), 1071-1102.
Phua, K., Tham, T. M., & Wei, C. (2018). Are overconfident CEOs better leaders? Evidence from stakeholder commitments. Journal of Financial Economics, 127(3), 519-545.
Ravina, E., & Sapienza, P. (2010). What Do Independent Directors Know? Evidence from Their Trading. *The Review of Financial Studies, 23*(3), 962-1003.
Rogers, D. A. (2002). Does Executive Portfolio Structure Affect Risk Management? CEO Risk-Taking Incentives and Corporate Derivatives Usage. *Journal of Banking & Finance, 26*(2-3), 271-295.
Rozeff, M. S., & Zaman, M. A. (1988). Market Efficiency and Insider Trading: New Evidence. *Journal of Business, 61*(1), 25-44.
Seyhun, H. N. (1986). Insiders' Profits, Costs of Trading, and Market Efficiency. *Journal of Financial Economics, 16*(2), 189-212.
Seyhun, H. N. (1998). *Investment Intelligence from Insider Trading.* Cambridge, Massachusetts: The MIT Press.
Shin, H.-H., & Stulz, R. M. (2000). *Firm Value, Risk, and Growth Opportunities (NBER Working Paper No. 7808).* Cambridge, MA: National Bureau of Economic Research.
Smith, C. W., & Stulz, R. M. (1985, December). The Determinants of Firms' Hedging Policies. *Journal of Financial and Quantitative Analysis, 20*(4), 391-405.
Thompson, S. B. (2011). Simple Formulas for Standard Errors that Cluster by Both Firm and Time. *Journal of Financial Economics, 99*(1), 1-10.
Veenman, D. 2012. "Disclosures of Insider Purchases and the Valuation Implications of Past Earnings" The Accounting Review Vol. 87, No. 1 (January): 313-334.
Welch, I. (1989). Seasoned Offerings, Imitation Costs, and the Underpricing of Initial Public Offerings. *The Journal of Finance, 44*(2), 421-449.
Zwiebel, J. (1995). Corporate Conservatism and Relative Compensation. *Journal of Political Economy, 103*(1), 1-25.

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Appendix A-Insider Purchases and Wealth Risk

We measure the risk of an insider's wealth as the variance of the returns on wealth. If the purchase is funded by an insider's cash holdings, the purchase increases the variance of the returns as it trades off a zero-variance security (cash in nominal terms), for another that has a non-zero variance. However, the purchase is likely funded by disposing of one of more other securities, so that the effect on the variance of returns on wealth depends on what securities are being traded off.

Consider that insiders seek to maximize their wealth (W), which consists of their employer's equity-contingent wealth (S) and a diversified portfolio of other assets (P) including cash, bonds, real estate, and other stocks. Noting that S is the only component of W that is observable, let x be the proportion of the insider's total wealth invested in S such that $0 < x \leq 1$. The expected return on the insider's wealth can then be written as $E(R_w)=x\,E(R_s) + (1-x)\,E(R_p)$ and its variance is given by:

$$\sigma^2(R_w)=x^2\,\sigma^2(R_s) + (1-x)^2\,\sigma^2(R_p)+ 2x(1-x)\sigma(R_s)\sigma(R_p)\rho(R_s,R_p) \quad (1)$$

where S and P are two securities with expected returns R_s and R_p, $\sigma(R_s)$ and $\sigma(R_p)$ are the standard deviation of the expected returns on S and P, and $\rho(R_s, R_p)$ is the correlation between those same expected returns. An insider purchase means an increase x, e.g., an increase in equity-contingent wealth that we assume is accompanied by a reduction in cash or some other asset from the diversified portfolio. We are thus interested in assessing the effect of an increase in x on the wealth return variance in (1). Setting the first derivative of $\sigma^2(R_w)$ with respect to x to zero enables us to determine the critical point that achieves minimum variance as:

$$x_0 =(\sigma^2(R_p) - \sigma(R_s)\sigma(R_p)\rho(R_s,R_p))/(\sigma^2(R_p) + \sigma^2(R_s)- 2\sigma(R_s)\sigma(R_p)\rho(R_s,R_p)) \quad (2)$$

Because only the variance of S is observable, we specify a general relation between the standard deviation of S and P such that $\sigma(R_s) = k\,\sigma(R_p)$ (where we require k>0) which yields:

$$x_0 = (1-k\rho(R_s,R_p))/(1+ k^2 – 2k\rho(R_s,R_p)) \quad (3)$$

The expression in (3) relates x to the ratio of the standard deviations of the returns on S and P, and the correlation between the returns on these securities. Note that if $k=1$ the optimal proportion invested in S is independent of the correlation and equal to ½. As well, the requirement that x is between 0 and 1, implies both that $k> \rho(R_s,R_p)$, and that $(1/k)> \rho(R_s,R_p)$. These conditions are always met if $\rho(R_s,R_p)<0$, and for several positive values of $\rho(R_s,R_p)$, (e.g., Fama (1976, 229)).

Our analysis of changes in the variance of wealth is based on the assumptions that wealth can be represented by two assets, and that before the purchase the variance of the insider's wealth is at its minimum. The variance function in (1) reaches a minimum at the critical point given by (3), but of course, we cannot observe x. As such, to gain a sense of whether an insider purchase increases the variance of an insider's wealth, we rely on (3) to calculate the critical point values for a range of values of $\rho(R_s,R_p)$ from -1 to +1 by increments of .01, and for a range of values of k from .10 to 20. Then, when the critical point is in the interval between 0 and 1, we consider that the proportion x of the insider's total wealth invested in S follows a beta distribution for which we consider alternative α and β parameters as we discuss in Section 2.3

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Appendix B: Prior Research

1. The profitability of insider trading

The stock market effect of insider trading has been widely studied. Early research established that insiders act as informed traders, buying (selling) in advance of stock price increases (declines) by documenting trading profits to insider trades and to those who mimic the trading of insiders (e.g., Jaffe, 1974; Finnerty, 1976; Madden, 1979; Nunn et al., 1983; Seyhun, 1986, Rozeff and Zaman, 1988; Lin and Howe, 1990). Although initially studies argued that the profitability of these strategies could be explained by transaction costs or mismeasured abnormal returns, subsequent studies based on larger samples have corroborated and extended these findings, suggesting that prices do not immediately incorporate the information signaled by insiders' trading (e.g., Seyhun, 1998; Lakonishok and Lee, 2001; Jeng et al., 2003; Jagolinzer et al., 2010; Cohen et al., 2012).

The evidence in prior work suggests that the magnitude of the trading profit depends on (1) the direction of the trade, (2) the type of insider who trades, and (3) the consistency in the directions of current and previous trades. In terms of direction, Seyhun (1998) analyzes insider trading over the 20-year period from 1975-1994 and reports that purchases (sales) are on average associated with one-year ahead abnormal returns of 4.5% (-2.7%). These results, which suggest a stronger signal is conveyed by insider purchases, are both representative of evidence in earlier studies and, in spirit, consistent, with two subsequent studies that report no evidence of abnormal returns following insider sales, and annual abnormal returns of 4.8% and 6% to insider purchases (Lakonishok and Lee, 2001; Jeng et al., 2003).

In terms of who trades, prior work has documented the existence of an "information hierarchy" whereby higher-level insiders possess information that is more valuable and achieve larger abnormal returns when trading (Basel and Stein, 1979; Nunn et al., 1983; Seyhun, 1986, 1998; Lin and Howe, 1990; Beneish and Vargus, 2002). For example, Seyhun (1998) reports gains to trading of 5.0% for top executives, 3.9% for officers, 3.6% for directors, and 0.7% for large shareholders. These results are consonant with those of Ravina and Sapienza (2009) who show that the profitability of outside directors' trading suggests they are also informed insiders. Finally, prior work has shown that the pattern of trading influences the magnitude of trading gains. In an analysis that requires a consistent pattern of either purchases or sales for four consecutive months, Seyhun (1998) reports that purchases (sales) are on average associated with higher one-year ahead abnormal returns of 7.5% (-6.1%) when the trading pattern in previous months is considered relative that when it is ignored (e.g., 4.5% and 2.7% for purchase and sales respectively).

2. Incentives related to compensation and stock ownership

Our discussion of prior research suggests that the profitability of insider trading depends on the existence of information asymmetry, and on certain risk characteristics of firms. In this section, we discuss research that has considered compensation-based incentives and risks faced by the executives of the firm. A long-standing debate contests the underlying drivers of equity-based incentives in executive pay. Proposed explanations suggest optimal contracting as an effective replacement for direct monitoring (Holmstrom and Milgrom, 1987; Prendergast 2002; Edmans and Gabaix, 2009). A desirable facet of providing compensation with stock options or restricted stock (i.e., equity pay) is that it ties a manager's compensation to observable firm-specific signals (i.e., prices). A drawback of such a compensation scheme is that it induces further risk on an already risk-averse executive (Lambert et al., 1991; Carpenter, 1998). To the extent that executives face higher compensation-related risk

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independently of firm risk, it is important to consider this source of risk in assessing the existence and informational impact of insider purchases.

The decision to compensate with stock options is correlated with a host of firm-specific characteristics such as current and expected risks, growth opportunities, governance, and ownership structure that are related to the profitability of insider trades. Nevertheless, we treat insider shares/options as given, and examine their ability to capture insiders' exposure to firm-specific wealth risk, e.g., to the risk-aversion of an undiversified insider (Holmstrom and Milgrom, 1987; Prendergast, 2002). At the most basic level, insiders with stock options have an increased exposure to firm-specific risk, because, in addition to employment risk, and risk due to owning shares, insiders bear the added risk of having part of their wealth contingent on future performance. As such, in addition to the number of options, the structure of such option contracts can induce variability in insiders' wealth.

One source of compensation risk is the presence of convex payoffs (i.e., Vega-to-Delta). Vega is the sensitivity of an insider's stock options, with respect to the volatility of share prices, i.e., firm risk. Delta, on the other hand, captures an insider's exposure to the level of stock prices. For a manager who is compensated with stock options, their wealth is exposed to firm risk through stock price volatility, given a level of stock prices. This is captured by the Vega-to-Delta ratio, which we use in our analysis (see Rogers, 2002; Bakke et al., 2016).

Similarly, we look at the moneyness/vestedness of options, as a measure of how exposed is a CEO's wealth to firm performance. Ceteris paribus, unvested options indicate uncertainty about the realization of such wealth as it depends on future share price outcomes. In a similar vein, out-of-the money options indicate that insider wealth hinges on whether future stock prices increase, which includes forfeiture risk, and necessitates that insiders take on further risky activities to increase share prices (see Fahlenbrach and Stulz, 2011).

Optimal hedging for a manager holding stock options necessitates continuous portfolio adjustments over the life of the option contract. The riskiness of such option portfolios, as captured by the Vega-to-Delta ratio, vestedness, or moneyness, implies that an insider needs to sell rather than purchase her shares in the open market in order to reduce risk (e.g., see Ofek and Yermack, 2000). Consequently, if Vega-to-Delta is high, or options are unvested, or options are deep out-of-the money, insiders are unlikely to load on more firm-specific risk by purchasing shares on the open market, unless insiders possess future-oriented private information: it is in such situations that insider purchases are the most informative.

Using a similar argument, the longer the insider's horizon with respect to her firm, the higher the firm-specific wealth exposure of said insider. First, older insiders are wealthier given the time-accumulation of capital, having had ample time to diversify their personal portfolios. At the same time, younger insiders are more risk-averse because they do not have the track record of their peers, hence tend to follow conservative investment policies (Holmstrom, 1999; Zwiebel, 1995; Matta and Beamish, 2008). This is also partly explained by the notion that the market is uncertain about the expected performance of young CEOs, hence younger CEOs tend to work harder in the beginning of their tenure. As such, studies find that R&D spending is higher when insiders are younger (Barker and Mueller, 2002). Moreover, firms with younger insiders suffer from higher levels of information risk (Ali and Zhang, 2015), to the extent that managers are more likely to report inflated measures of performance to signal their ability. Therefore, insider purchases in the presence of longer horizons amplify firm-specific wealth-risk, by disproportionately increasing personal wealth tied to employment (relative to older insiders), and by doing so in the face of inherently higher personal risk-aversion.

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Appendix C: Variable Definitions

Trading Profit: the alpha from the four-factor Fama-French and Momentum models (Fama and French, 1993; Carhart, 1997) over the 180-day period starting with the transaction date (CRSP and Kenneth French website).

Purchase: indicator variable equal to 1 if the average transaction in a firm / year / quarter combination is a purchase, and 0 if it is a sale.

Market Value: the market value of equity at the last available quarterly date prior to the insider purchase, measured at the calendar quarter prior to the insider purchase (Compustat).

Market-to-Book: the market value of equity divided by its book value, measured at the calendar quarter prior to the insider purchase (Compustat).

Idiosyncratic Volatility: the residual from market model regressions starting 100 days prior to an insider purchase and ending 10 days before it (CRSP).

Loss Firm is an indicator variable equal to one if ROA is negative, zero otherwise, measured at the calendar quarter prior to the insider purchase (Compustat).

Prior 12-month Return: the compounded raw returns over the prior 12 months using monthly data, ending the month preceding the insider purchase (CRSP).

Vega-to-Delta: the vega of executive stock option holdings divided by the delta plus vega. Vega is a measure of an executive's exposure to increases in risk. Vega is based upon the partial derivative of the Black–Scholes option pricing formula with respect to the annual standard deviation of stock returns. Delta is based upon the partial derivative of the Black–Scholes option pricing formula with respect to share price, used as a deflator to adjust compensation incentives per unit of stock options held. On balance, the vega-to-delta ratio measures the sensitivity of an option to firm risk (Execucomp).

Share Ownership: the dollar value of shares held by insiders, measured at the fiscal year prior to the insider purchase (Execucomp).

Unvested Options: the ratio of the number of unvested options normalized by total options held (vested and unvested), measured at the fiscal year prior to the insider purchase (Execucomp).

Out-of-the-Money: the difference between the current stock price and the average strike price of options held, multiplied by the number of options owned by the executive, measured at the fiscal year prior to the insider purchase (Execucomp).

Horizon: 65 minus the age of the executive. All executive incentive data is for the average of the top five executives with publicly available compensation plan data on Execucomp, measured at the fiscal year prior to the insider purchase (Execucomp).

Ratio of Volatilities: is the standard deviation of firm returns over the standard deviation of the value-weighted CRSP index, calculated over the prior 12 months using daily data.

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Lambda: the adverse selection component of the bid-ask spread calculated from TAQ, according to the methodology of Armstrong, Core, Taylor and Verrecchia (2011).

Firm Risk: a linear combination of indicators that denote the lowest quartile of firm size, lowest quartile of market-to-book, the highest quartile of idiosyncratic volatility, if the firm is a loss making firm, or is in the highest quartile of prior 12 month raw returns. This variable ranges from 0-5.

Compensation Risk: a linear combination of indicators that denote the highest quartile of Moneyness, Out-of-the-Money, and Horizon. This variable ranges from 0-3.

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Table 1: The Average Probability that an Insider Purchase Increases an Insider's Wealth Risk

We view an insider's total wealth (W) as consisting of two assets: the wealth invested in the insider's firm (S), and P, a diversified portfolio of other assets including cash, bonds, real estate, and other stocks that represents *non-S* wealth, so that an insider's total wealth equals $W = S + P$. Because we cannot observe W, P or the proportion x invested in S (e.g., $x=S/W$), we assume that *before the open market purchase,* the variance of the insider's wealth portfolio is at its *minimum*, and assess the probability that after a purchase, the proportion x of an insider's total wealth that is invested in the insider's firm exceeds the critical point. The critical point is given by $x_0 = (1-k\rho(R_s,R_p))/(1+k^2-2k\rho(R_s,R_p))$ where $k=\sigma(R_s)/\sigma(R_p)$ and $\sigma(R_s)$, $\sigma(R_p)$, and $\rho(R_s,R_p)$, are the standard deviations of returns and the correlations of returns of S and P—calculated before the purchase. We conduct simulations on (1) alternative distributions of x values in the interval [0,1], (2) consider 201 values of $\rho(R_s,R_p)$ ranging from -1 to +1 by .01, and (3) use the value-weighted CRSP index as a benchmark for P, and simulated instances where the variance of the benchmark would be reduced by 10%, 20% and 30%.

Panel A: Ratio using Standard Deviation of Market Returns

Ratio of Std. Deviations (k)	N	Cumulative	Cumulative Percentage	Trading Profit	Percent Negative	If x ~ Beta(2,38) Mean x=5%	If x ~ Beta(2,18) Mean x=10%	If x ~ Beta(2,8) Mean x=20%	If x ~ Beta(1,1) Mean x=50%	If x ~ Beta(8,2) Mean x=80%
if k<=1	10,417	10,417	3.9%	4.9%	41.7%	0.00%	0.00%	0.86%	38.36%	84.67%
if 1<k<=2	69,647	80,064	29.6%	4.1%	40.2%	22.00%	31.04%	52.05%	81.32%	99.92%
if 2<k<=3	72,113	152,177	56.4%	5.4%	40.5%	53.02%	69.14%	86.44%	94.13%	99.96%
if 3<k<=4	45,697	197,874	73.3%	8.2%	38.7%	68.99%	84.26%	94.56%	96.91%	99.96%
if 4<k<=5	44,517	242,391	89.8%	10.6%	38.0%	80.32%	91.78%	97.51%	98.11%	99.96%
if 5<k<=6	9,135	251,526	93.1%	13.0%	37.0%	87.05%	95.27%	98.68%	98.68%	99.96%
if 6<k<=7	6,362	257,888	95.5%	12.7%	38.8%	88.62%	96.02%	98.92%	98.81%	99.96%
if 7<k<=8	3,986	261,874	97.0%	17.1%	33.4%	91.58%	97.22%	99.25%	99.04%	99.96%
if 8<k<=9	2,442	264,316	97.9%	14.6%	35.7%	94.00%	98.12%	99.51%	99.24%	99.96%
if 9<k<=10	5,193	269,509	99.8%	19.0%	33.8%	93.92%	98.05%	99.48%	99.23%	99.96%
if k>10	526	270,035	100.0%	21.0%	33.7%	97.49%	99.10%	99.73%	99.59%	99.95%

Panel B: Ratio where Standard Deviation of Market Returns is Reduced by 10%

Ratio of Std. Deviations (k)	N	Cumulative	Cumulative Percentage	Trading Profit	Percent Negative	If x ~ Beta(2,38) Mean x=5%	If x ~ Beta(2,18) Mean x=10%	If x ~ Beta(2,8) Mean x=20%	If x ~ Beta(1,1) Mean x=50%	If x ~ Beta(8,2) Mean x=80%
if k<=1	6,793	6,793	2.5%	4.73%	43.8%	0.00%	0.00%	0.90%	39.03%	85.68%
if 1<k<=2	56,352	63,145	23.4%	3.93%	40.1%	23.28%	32.62%	53.61%	81.92%	99.92%
if 2<k<=3	69,735	132,880	49.2%	5.14%	40.2%	54.83%	70.29%	86.96%	94.36%	99.96%
if 3<k<=4	49,053	181,933	67.4%	7.35%	39.3%	70.89%	85.23%	94.89%	97.09%	99.95%
if 4<k<=5	51,063	232,996	86.3%	9.44%	38.4%	81.92%	92.47%	97.72%	98.25%	99.95%
if 5<k<=6	12,500	245,496	90.9%	12.35%	37.7%	87.18%	95.29%	98.68%	98.70%	99.95%
if 6<k<=7	7,480	252,976	93.7%	12.79%	37.1%	90.53%	96.74%	99.11%	98.97%	99.95%

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if 7<k<=8	5,414	258,390	95.7%	14.08%	37.9%	91.85%	97.26%	99.26%	99.08%	99.95%
if 8<k<=9	3,468	261,858	97.0%	16.69%	33.7%	93.46%	97.90%	99.44%	99.19%	99.95%
if 9<k<=10	7,405	269,263	99.7%	17.69%	34.2%	94.49%	98.26%	99.53%	99.28%	99.95%
if k>10	772	270,035	100.0%	19.13%	34.3%	97.60%	99.18%	99.75%	99.59%	99.95%

Panel C: Ratio where Standard Deviation of Market Returns is Reduced by 20%

Ratio of Std. Deviations (k)	N	Cumulative	Cumulative Percentage	Trading Profit	Percent Negative	If x ~ Beta(2,38) Mean x=5%	If x ~ Beta(2,18) Mean x=10%	If x ~ Beta(2,8) Mean x=20%	If x ~ Beta(1,1) Mean x=50%	If x ~ Beta(8,2) Mean x=80%
if k<=1	4,036	4,036	1.5%	5.57%	45.1%	0.00%	0.00%	0.90%	39.09%	85.56%
if 1<k<=2	42,540	46,576	17.2%	3.82%	39.6%	24.05%	33.27%	54.26%	82.21%	99.92%
if 2<k<=3	64,082	110,658	41.0%	4.47%	40.6%	56.26%	71.42%	87.57%	94.59%	99.96%
if 3<k<=4	51,996	162,654	60.2%	6.31%	40.1%	73.02%	86.31%	95.25%	97.29%	99.95%
if 4<k<=5	58,313	220,967	81.8%	8.84%	38.6%	83.10%	92.98%	97.88%	98.36%	99.95%
if 5<k<=6	15,540	236,507	87.6%	11.22%	37.2%	88.15%	95.60%	98.75%	98.79%	99.95%
if 6<k<=7	9,974	246,481	91.3%	13.19%	36.7%	91.23%	96.96%	99.16%	99.04%	99.95%
if 7<k<=8	6,460	252,941	93.7%	12.50%	37.5%	93.17%	97.74%	99.38%	99.20%	99.95%
if 8<k<=9	4,928	257,869	95.5%	13.45%	38.5%	93.69%	97.94%	99.44%	99.24%	99.95%
if 9<k<=10	11,073	268,942	99.6%	17.40%	34.0%	94.79%	98.36%	99.56%	99.31%	99.95%
if k>10	1,093	270,035	100.0%	19.34%	34.4%	97.62%	99.20%	99.76%	99.59%	99.95%

Panel D: Ratio where Standard Deviation of Market Returns is Reduced by 30%

Ratio of Std. Deviations (k)	N	Cumulative	Cumulative Percentage	Trading Profit	Percent Negative	If x ~ Beta(2,38) Mean x=5%	If x ~ Beta(2,18) Mean x=10%	If x ~ Beta(2,8) Mean x=20%	If x ~ Beta(1,1) Mean x=50%	If x ~ Beta(8,2) Mean x=80%
if k<=1	2,181	2,181	0.8%	5.51%	48.6%	0.00%	0.00%	0.90%	38.69%	84.52%
if 1<k<=2	29,069	31,250	11.6%	3.66%	39.2%	23.34%	32.67%	54.04%	82.17%	99.92%
if 2<k<=3	55,513	86,763	32.1%	4.30%	40.5%	57.57%	72.48%	88.08%	94.78%	99.96%
if 3<k<=4	52,277	139,040	51.5%	5.58%	40.1%	74.94%	87.32%	95.62%	97.49%	99.95%
if 4<k<=5	64,867	203,907	75.5%	7.60%	39.3%	83.92%	93.27%	97.95%	98.44%	99.95%
if 5<k<=6	19,222	223,129	82.6%	10.20%	38.4%	89.79%	96.19%	98.91%	98.94%	99.94%
if 6<k<=7	13,326	236,455	87.6%	11.36%	37.1%	91.95%	97.22%	99.23%	99.11%	99.94%
if 7<k<=8	8,961	245,416	90.9%	13.02%	36.9%	93.73%	97.91%	99.42%	99.26%	99.94%
if 8<k<=9	6,016	251,432	93.1%	13.43%	36.4%	95.22%	98.46%	99.57%	99.38%	99.94%
if 9<k<=10	16,873	268,305	99.4%	15.38%	36.1%	94.93%	98.40%	99.57%	99.33%	99.95%
if k>10	1,730	270,035	100.0%	20.74%	32.0%	97.99%	99.34%	99.80%	99.63%	99.95%

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Table 2: Descriptive Statistics for Select Variables

Table 1 presents descriptive statistics for the sample of a maximum of 270,953 insider purchases between the years 1995 and 2020. The unit of analysis is at the transaction level aggregated per day for each firm. *Trading Profit* is the daily alpha, from the four-factor Fama-French and Momentum models (Fama & French, 1993; Carhart, 1997) over a 180-day period starting with the transaction date. *Market Value* is the market value of equity at the last available quarterly date prior to the insider purchase. *Market-to-Book* is the market value of equity divided by its book value. *Idiosyncratic Volatility* is the residual from market model regressions starting 100 days prior to an insider purchase and ending 10 days before it. *Loss Firm* is a dummy variable that equals to one if net income before extraordinary items is negative, and zero otherwise. *Prior 12-month Return* is the compounded raw returns over the prior 12 months using monthly CRSP data, ending the month preceding the insider purchase. *Ratio of Volatilities* is the standard deviation of firm returns over the standard deviation of the value-weighted CRSP index, calculated over the prior 12 months using daily data. *Vega-to-Delta* is the vega of executive stock option holdings divided by the delta plus vega, where vega measures an option´s sensitivity to a unit change in stock price volatility and delta measures an option´s sensitivity to a unit change in stock price. *Unvested Options* is calculated as the ratio of the number of unvested options normalized by total options held (vested and unvested). *Moneyness* is the difference between the current stock price and the average strike price of options held and multiply it by the number of options owned by the executive. *Horizon* is 65 minus the age of the executive. All executive incentive data is for the average of the top five executives with publicly available compensation plan data on Execucomp. All variables are winsorized at 1% at each end.

	N	*Mean*	*Median*	*Std.Dev.*	*25%*	*75%*
Trading Profit	270,953	9.0342	6.2748	34.776	-9.1224	24.7212
Market Value ($m)	270,288	1,806	196	8,071	65	721
Market-to-Book	269,966	2.52	1.63	4.43	1.04	2.75
Idiosyncratic Volatility	270,171	0.14%	0.07%	0.2%	0.03%	0.17%
Loss Firm	270,614	0.33	0.00	0.47	0.00	1.00
Prior 12-month Return	253,133	0.017	-0.037	0.544	-0.314	0.228
Ratio of Volatilities	267,603	3.481	2.771	2.715	1.816	4.303
Vega-to-Delta	55,920	0.350	0.346	0.177	0.217	0.473
Unvested Options	65,405	0.321	0.228	0.311	0.050	0.507
Moneyness ($000s)	65,455	286,110	5,347	6,131,981	-50	53,276
Horizon	64,987	11.5	11.6	5.2	8.3	15.0

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Table 3: The Relation between Insider Purchase Announcement Abnormal Returns and Ensuing Long Term Returns.

Six-month abnormal returns is calculated as the daily alpha, from the four-factor Fama-French and Momentum models (Fama & French, 1993; Carhart, 1997) over a 180-day period starting with the transaction date, this variable is named *Trading Profit* in ensuing analyses in Table 1 onwards. 3-day CAR is the daily alpha from the four-factor Fama-French and Momentum models over a 3-day period starting with the sec filing date.

Panel A: Stock Market Reaction at, and Following Insider purchase Announcements

	N	Mean	Std. Dev.	Median	P25	P75	Percent Positive
3-day CAR	270,953	0.85%	5.74%	0.41%	-1.96%	3.17%	54.94%

Panel B: Relation between Announcement and Six Months Abnormal returns

		Overall	Q1	Q2	Q3	Q4	Q5
Pearson Correlation between 3-day CAR and 6-month abnormal returns		0.0032*	-0.0132**	0.0093***	-0.0061	-0.001	-0.0071*
Mean 6-month abnormal returns by Quintiles of 3-day CAR	**Mean**		3.26%	3.46%	3.18%	3.54%	4.08%
	Percent Positive		46.55%	50.55%	51.1%	49.82%	46.23%

Panel C: Partitions by Trade Size

		Q1	Q2	Q3	Q4	Q5
3-Day CAR						
Trade size divided by average trading volume on day of purchase	**Mean**	0.58%	0.92%	0.98%	0.99%	0.81%
	Percent >0	54.60%	56.17%	55.02%	54.79%	52.72%
Trade size divided by average trading volume measured one month prior	**Mean**	0.53%	0.80%	0.88%	0.99%	1.04%
	Percent >0	54.24%	55.47%	54.22%	54.78%	54.40%
Six-month abnormal returns						
Trade size divided by average trading volume on day of purchase	**Mean**	4.49%	7.97%	9.96%	10.66%	11.24%
	Percent >0	58.91%	62.27%	63.06%	63.38%	63.89%
Trade size divided by average trading volume measured one month prior	**Mean**	4.31%	7.57%	9.36%	10.41%	12.86%
	Percent >0	0.59	0.61	0.63	0.63	0.66

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Table 4: Determinants of Insider Purchases

This Table presents Fama-MacBeth regressions where the dependent variable is *Purchase*, an indicator variable equal to 1 if the firm's insiders are net purchasers in a particular calendar quarter and 0 if they are net sellers. All independent variables are 1/0 indicators as such: *Market Value* indicates the highest quartile of the market value of equity at the last available quarterly date prior to the insider purchase. *Market-to-Book* indicates the lowest quartile of the market value of equity divided by its book value. *Idiosyncratic Volatility* indicates the highest quartile of firm idiosyncratic volatility, which is the residual from market model regressions starting 100 days prior to an insider purchase and ending 10 days before it. *Prior 12-month Return* is the lowest quartile of the compounded raw returns over the prior 12 months using monthly CRSP data. *Loss Firm* is an indicator variable equal to one if ROA is negative, zero otherwise. *Vega-to-Delta* indicates the highest quartile of the vega of executive stock option holdings divided by the delta plus vega. *Unvested Options* indicates the highest quartile of unvested options, calculated as the ratio of the number of unvested options normalized by total options held (vested and unvested). *Out-of-the-Money* indicates the highest quartile of the moneyness of stock options, as the difference between the current stock price and the average strike price of options held and multiply it by the number of options owned by the executive. *Horizon* indicates the highest quartile of the horizon of the executive, which is 65 minus the age of the executive. *Shares Owned* indicates the highest quartile of shareholdings, which is shares owned normalized by firm market value. The constant is not reported. t-statistics are reported in brackets and ***, **, * denote significance levels at 1%, 5%, and 10% respectively.

	Purchase	*Purchase*	*Purchase*
Market Value	-0.2332***		-0.1367***
	[-31.09]		[-12.35]
Market-to-Book	0.1299***		0.0674***
	[25.83]		[7.12]
Idiosyncratic Volatility	-0.0003		0.0710***
	[-0.04]		[6.69]
Loss Firm	0.0252***		0.0288***
	[5.11]		[4.81]
Prior 12 month Return	0.1578***		0.1975***
	[24.74]		[18.09]
Out-of-Money		0.0947***	0.0553***
		[7.78]	[5.00]
Unvested Options		0.0483***	0.0354***
		[7.06]	[6.54]
Horizon		-0.0070	-0.0163***
		[-1.00]	[-2.89]
Shares Owned		-0.0120	-0.0426***
		[-1.34]	[-4.11]
Vega-to-Delta		0.0719***	0.0645***
		[7.69]	[5.63]
Observations	232,262	85,103	82,020
R-Squared	0.145	0.052	0.133
Groups	102	102	102

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Table 5: Insider Purchases and Firm Risk

Panel A:

This Table presents coefficients from OLS regressions of insider trading profits on various facets of firm risk. Regressions are conducted using OLS clustering on firm and transaction date. *t*-statistics are reported in brackets and ***, **, * denote significance levels at 1%, 5%, and 10% respectively. All independent variables are ranked by magnitude into 10 groups ranging from 0 (smallest) to 9 (largest). *Market Value* is the market value of equity at the last available quarterly date prior to the insider purchase. *Market-to-Book* is the market value of equity divided by its book value. *Idiosyncratic Volatility* is the residual from market model regressions starting 100 days prior to an insider purchase and ending 10 days before it. *Loss Firm* is an indicator variable equal to one if ROA is negative, zero otherwise. *Prior 12 month Return* is the compounded raw share returns over the prior 12 months using monthly CRSP data, ending the month preceding the insider purchase.

	(1) *Trading Profit*	(2) *Trading Profit*	(3) *Trading Profit*	(4) *Trading Profit*	(5) *Trading Profit*	(6) *Trading Profit*	(7) *Trading Profit*
Market Value		-0.0129***					-0.0072***
		[-19.42]					[-9.49]
Market-to-Book			-0.0060***				-0.0038***
			[-7.46]				[-4.17]
Idiosyncratic Volatility				0.0151***			0.0137***
				[22.46]			[19.21]
Loss Firm					0.0343***		-0.0014
					[7.50]		[-0.30]
Prior 12-month Ret.						-0.0053***	-0.0000
						[-7.43]	[-0.01]
Constant	0.0717***	0.1136***	0.0913***	-0.0079***	0.0603***	0.0893***	0.0376***
	[33.26]	[31.65]	[27.37]	[-2.82]	[31.17]	[25.35]	[6.47]
Max 6-month Return %	9.03	14.37	11.55	16.19	11.97	11.30	20.35
Min 6-month Return %	9.03	-0.32	4.72	-1.00	7.63	5.26	-7.77
Observations	270,953	270,351	269,966	270,171	270,614	253,133	251,896
R-squared	0.000	0.016	0.004	0.025	0.003	0.003	0.036

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Panel B:

Panel B presents routine versus opportunistic insider purchases. In the first 4 columns, opportunism is calculated as per Cohen et al. (2012). Routine insiders are those where the insider trades in the same month over a period of 3 consecutive years and is opportunistic otherwise. In the next 4 columns (5-8), opportunistic insider purchases are based on the Ali and Hirshleifer (2017) routine / opportunistic classification. An insider is an opportunistic trader if her trade results in a top quintile earnings reaction in the subsequent earnings announcement, routine otherwise. The Table presents coefficients from OLS regressions of insider trading profits on various facets of firm risk. Regressions are conducted using OLS clustering on firm and transaction date. *t*-statistics are reported in brackets and ***, **, * denote significance levels at 1%, 5%, and 10% respectively. All independent variables are ranked by magnitude into 10 groups ranging from 0 (smallest) to 9 (largest). *Market Value* is the market value of equity at the last available quarterly date prior to the insider purchase. *Market-to-Book* is the market value of equity divided by its book value. *Idiosyncratic Volatility* is the residual from market model regressions starting 100 days prior to an insider purchase and ending 10 days before it. *Loss Firm* is an indicator variable equal to one if ROA is negative, zero otherwise. *Prior 12-month Return* is the compounded raw share returns over the prior 12 months using monthly CRSP data, ending the month preceding the insider purchase

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		Cohen et al. (2012)				Ali and Hirschleifer (2017)		
	Opportunistic	Opportunistic	Routine	Routine	Opportunistic	Opportunistic	Routine	Routine
	Trading Profit	*Trading Profit*	*Trading Profit*	*Trading Profit*	*Trading Profit*	*Trading Profit*	*Trading Profit*	*Trading Profit*
Market Value		-0.0086***		-0.0099***		-0.0092***		-0.0127***
		[-6.63]		[-2.68]		[-2.95]		[-3.26]
Market-to-Book		-0.0045***		-0.0022		-0.0050		-0.0020
		[-3.34]		[-0.86]		[-1.33]		[-1.10]
Idiosyncratic Volatility		0.0163***		0.0142***		0.0175***		0.0118***
		[15.18]		[10.03]		[5.85]		[8.60]
Loss Firm		0.0035		0.0092		-0.0280		0.0045
		[0.48]		[0.89]		[-1.47]		[0.41]
Prior 12mo. Return		0.0030***		0.0055**		0.0050*		0.0058**
		[2.66]		[2.29]		[1.69]		[2.38]
Constant	0.0754***	0.0217***	0.0367**	0.0071	0.0689***	0.0106	0.0413**	0.0206*
	[20.68]	[2.73]	[2.12]	[0.74]	[7.27]	[0.49]	[2.46]	[1.69]
Max 6-month Return %	9.54	19.38	4.64	18.03	8.72	17.01	5.22	14.74
Min 6-month Return %		-12.17		-12.88		-14.83		-14.13
Observations	126,703	126,703	69,467	69,467	16,768	16,768	74,530	74,530
R-squared	0.000	0.047	0.000	0.073	0.000	0.040	0.000	0.056

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Table 6: Insider Purchases and Compensation Risk

This Table presents coefficients from OLS regressions of insider trading profits on various executive characteristics. Regressions are conducted using OLS clustering on firm and transaction date. *t*-statistics are reported in brackets and ***, **, * denote significance levels at 1%, 5%, and 10% respectively. All independent variables are ranked by magnitude into 10 groups ranging from 0 (smallest) to 9 (largest). All compensation data is the average value for the top 5 insiders whose compensation plans are publicly available. *Vega-to-Delta* is the vega of executive stock option holdings divided by the delta plus vega, where vega measures an option´s sensitivity to a unit change in stock price volatility and delta measures an option´s sensitivity to a unit change in stock price. *Shares Owned* is shares owned normalized by firm market value. *Unvested Options* is calculated as the ratio of the number of unvested options normalized by total options held (vested and unvested). *Out-of-the-Money* is the difference between the current stock price and the average strike price of options held, and multiply it by the number of options owned by the executive. *Horizon* is 65 minus the age of the executive. All executive incentive data is for the average of the top 5 executives with publicly available compensation plan data.

	(1) *Trading Profit*	(2) *Trading Profit*	(3) *Trading Profit*	(4) *Trading Profit*	(5) *Trading Profit*	(6) *Trading Profit*
Vega-to-Delta	0.0014					-0.0013
	[1.31]					[-1.00]
Shares Owned		0.0054***				0.0053***
		[4.91]				[4.27]
Unvested Options			0.0038***			0.0019
			[3.90]			[1.48]
Out-of-Money				0.0049***		0.0042***
				[4.80]		[3.16]
Horizon					0.0032***	0.0032***
					[3.03]	[2.88]
Constant	0.0464***	0.0269***	0.0377***	0.0299***	0.0344***	-0.0101
	[8.16]	[5.46]	[7.51]	[5.92]	[7.83]	[-0.97]
Max 6-month Return %	6.84	8.44	8.06	8.30	6.79	13.89
Min 6-month Return %	4.57	2.75	3.85	2.61	3.95	-1.66
Observations	55,920	63,616	65,405	65,455	64,987	52,920
R-squared	0.000	0.004	0.002	0.003	0.002	0.010

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Table 7: Credibility v. Information Asymmetry

This Table presents coefficients from OLS regressions of insider trading profits on the probability whether the increase in wealth variance is low or high (highest versus lower tercile of k, assuming a Beta (1,1) distribution), for firms in the highest quintile of information asymmetry. k is the standard deviation of firm returns over the standard deviation of the value-weighted CRSP index, calculated over the prior 12 months using daily data. The table is organized in groups of 2, whether the wealth variance is low or high. Columns 1-2 examine the lowest quintile of firm size, Columns 3-4 examine the highest quintile of the adverse selection component of the bid-ask spread calculated from TAQ (Lambda), Columns 5-6 look at loss firms, and Columns 7-8 look at the highest quintile of idiosyncratic volatility. Regressions are conducted using OLS clustering on firm and transaction date. t-statistics are reported in brackets and ***, **, * denote significance levels at 1%, 5%, and 10% respectively.

Panel A: Size and Bid-Ask Spread as Asymmetry Measures

	Small Size	Small Size	High Lambda	High Lambda
	Prob. Increase Wealth Variance Low	Prob. Increase Wealth Variance High	Prob. Increase Wealth Variance Low	Prob. Increase Wealth Variance High
	(1) *Trading Profit*	(2) *Trading Profit*	(3) *Trading Profit*	(4) *Trading Profit*
Constant	0.0641***	0.1594***	0.0451***	0.1656***
	[12.01]	[27.58]	[6.77]	[17.23]
Observations	20,216	46,680	8,456	19,591
R-squared	0.000	0.000	0.000	0.000

Panel B: Loss and Idiosyncratic Volatility as Asymmetry Measures

	Loss Firm	Loss Firm	High Idio.Volat.	High Idio.Volat.
	Prob. Increase Wealth Variance Low	Prob. Increase Wealth Variance High	Prob. Increase Wealth Variance Low	Prob. Increase Wealth Variance High
	(5) *Trading Profit*	(6) *Trading Profit*	(7) *Trading Profit*	(8) *Trading Profit*
Constant	0.0459***	0.1265***	0.0971***	0.1633***
	[4.93]	[21.12]	[8.26]	[28.87]
Observations	12,686	49,244	6,569	48,802
R-squared	0.000	0.000	0.000	0.000

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Table 8: Insider Purchases, Processing Costs, and the Speed of Price Adjustment

This Table presents coefficients from OLS regressions of insider trading profits on various aspects of firm-level processing costs, and the speed of price adjustment presented from 1 to 6 month periods. *Change in Institution* is the change in the percentage of institutional ownership from the quarter prior to the insider purchase to the one after. *Analyst Revision Activity* is the number of analyst revisions (revisions up plus revisions down) in the month after the insider purchase. *Residual Analyst* is the residual from regressions where the log of analyst following is regressed on the log of firm market value, lagged return on assets, the change in assets, the volatility of cash flows, and the dollar value of debt and equity financing (see Yu, 2008). *Residual Institution* is the residual from regressions where the percentage of shares held by institutions is regressed on the log of firm market value, share price volatility, the log of firm age, the log of the market-to-book ratio, the log of the dividend yield, the log of share price, the log of sales turnover, and lagged market-adjusted share price return (see Gompers & Metrick, 2001). Regressions are conducted using OLS clustering on firm and transaction date. *t*-statistics are reported in brackets and ***, **, * denote significance levels at 1%, 5%, and 10% respectively.

Panel A: All Firms

VARIABLES	(1) *Trading Profit 30 days*	(2) *Trading Profit 60 days*	(3) *Trading Profit 90 days*	(4) *Trading Profit 120 days*	(5) *Trading Profit 150 days*	(6) *Trading Profit 180 days*
All Purchases						
Constant	0.1340***	0.1033***	0.0882***	0.0803***	0.0749***	0.0717***
	[37.65]	[36.97]	[35.03]	[34.55]	[34.00]	[33.26]
Cumulative Return	2.81%	4.34%	5.56%	6.75%	7.86%	8.68%
Speed of Adjustment	32%	50%	64%	78%	91%	100%
Observations	270,774	270,820	270,856	270,889	270,928	270,953

Panel B: Size

Lowest *Size* Quintile						
Constant	0.1662***	0.1369***	0.1244***	0.1178***	0.1139***	0.1101***
	[27.36]	[29.21]	[29.12]	[29.36]	[29.75]	[29.47]
Cumulative Return	3.49%	5.75%	7.84%	9.90%	11.96%	13.32%
Speed of Adjustment	26%	43%	59%	74%	90%	100%
Observations	106,352	106,387	106,415	106,444	106,476	106,498
Highest *Size* Quintile						
Constant	0.0640***	0.0426***	0.0317***	0.0264***	0.0212***	0.0203***
	[10.62]	[9.63]	[8.04]	[7.38]	[6.29]	[6.48]
Cumulative Return	1.34%	1.79%	2.00%	2.22%	2.23%	2.46%
Speed of Adjustment	55%	73%	81%	90%	91%	100%
Observations	24,412	24,412	24,412	24,412	24,412	24,412

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Panel C: Change in Institution

	(1) *Trading Profit 30 days*	(2) *Trading Profit 60 days*	(3) *Trading Profit 90 days*	(4) *Trading Profit 120 days*	(5) *Trading Profit 150 days*	(6) *Trading Profit 180 days*
Lowest *Change in Institution* quintile						
Constant	0.1161***	0.0926***	0.0832***	0.0766***	0.0715***	0.0688***
	[15.63]	[16.59]	[16.90]	[17.28]	[17.13]	[17.24]
Cumulative Return	2.44%	3.89%	5.24%	6.43%	7.51%	8.32%
Speed of Adjustment	29%	47%	63%	77%	90%	100%
Observations	61,534	61,550	61,555	61,561	61,567	61,569
Highest *Change in Institution* quintile						
Constant	0.1834***	0.1476***	0.1242***	0.1057***	0.0932***	0.0856***
	[18.79]	[19.62]	[18.61]	[17.34]	[16.39]	[15.96]
Cumulative Return	3.85%	6.20%	7.82%	8.88%	9.79%	10.36%
Speed of Adjustment	37%	60%	76%	86%	94%	100%
Observations	24,353	24,356	24,360	24,362	24,362	24,368

Panel D: Analyst Forecasting Activity

Lowest "*Analyst Forecasting Activity*" quintile						
Constant	0.1376***	0.1131***	0.0927***	0.0676***	0.0774***	0.0672***
	[21.31]	[18.81]	[17.19]	[13.39]	[16.55]	[14.13]
Cumulative Return	2.89%	4.75%	5.84%	5.68%	8.13%	8.13%
Speed of Adjustment	36%	58%	72%	70%	100%	100%
Observations	66,923	39,708	44,643	44,532	45,368	46,030
Highest "*Analyst Forecasting Activity*" quintile						
Constant	0.1182***	0.0592***	0.0474***	0.0711***	0.0376***	0.0346***
	[16.05]	[9.25]	[8.08]	[11.43]	[7.12]	[6.69]
Cumulative Return	2.48%	2.49%	2.99%	5.97%	3.95%	4.19%
Speed of Adjustment	59%	59%	71%	78%	94%	100%
Observations	35,249	30,087	32,770	23,295	30,574	29,736

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Panel E: Residual Analyst

	(1) *Trading Profit 30 days*	(2) *Trading Profit 60 days*	(3) *Trading Profit 90 days*	(4) *Trading Profit 120 days*	(5) *Trading Profit 150 days*	(6) *Trading Profit 180 days*
Lowest *Residual Analyst* quintile						
Constant	0.1490***	0.1164***	0.1026***	0.0930***	0.0860***	0.0831***
	[19.29]	[18.33]	[18.17]	[17.57]	[16.51]	[16.79]
Cumulative Return	3.17%	4.95%	6.54%	7.91%	9.14%	10.51%
Speed of Adjustment	30%	47%	62%	75%	87%	100%
Observations	51,057	51,083	51,097	51,112	51,121	51,131
Highest *Residual Analyst* quintile						
Constant	0.1404***	0.0928***	0.0675***	0.0539***	0.0473***	0.0451***
	[13.34]	[11.58]	[9.04]	[7.63]	[7.14]	[7.06]
Cumulative Return	2.98%	3.94%	4.30%	4.58%	5.03%	5.71%
Speed of Adjustment	52%	69%	75%	80%	88%	100%
Observations	33,227	33,227	33,230	33,230	33,231	33,232

Panel F: Residual Institutional Ownership

Lowest *Residual Institution* quintile						
Constant	0.1436***	0.0993***	0.0779***	0.0677***	0.0581***	0.0542***
	[19.07]	[17.69]	[15.82]	[15.34]	[14.13]	[13.91]
Cumulative Return	1.26%	1.64%	1.75%	1.70%	1.66%	1.76%
Speed of Adjustment	46%	64%	75%	87%	93%	100%
Observations	50,102	50,102	50,102	50,102	50,102	50,102
Highest *Residual Institution* quintile						
Constant	0.1235***	0.0926***	0.0759***	0.0616***	0.0543***	0.0499***
	[14.55]	[13.23]	[12.31]	[11.70]	[11.03]	[10.05]
Cumulative Return	2.62%	3.94%	4.84%	5.24%	5.77%	6.31%
Speed of Adjustment	42%	62%	77%	83%	91%	100%
Observations	27,769	27,769	27,769	27,769	27,769	27,769

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Table 9: Insider Purchases and Stock Prices around the Earnings Announcement Date
This Table presents coefficients from OLS regressions of insider purchases on CARs around the earnings announcement date. Panel A presents the pre-announcement drift, calculated as cumulative abnormal returns minus equal weighted returns over 10 trading days and ending 2 days prior to the earnings announcement. Panel B presents *CAR* at the earnings announcement date [-1, +1], calculated as cumulative returns over three days minus equal-weighted market returns. Panel C presents the post-earnings announcement drift, *PEAD*, measured starting the second day after the earnings announcement date and ending the day after the earnings announcement of the following quarter. *Purchase* is a dummy variable indicating that at least one insider purchase has occurred in the prior quarter, and zero otherwise. *Purchase2* is a dummy variable that is equal to 1 if a firm is a net purchaser during the quarter prior to the announcement, and 0 if there are no prior insider trades, firm quarters where there is net selling are eliminated from the sample. *Purchase Ratio* is the insider purchase rate calculated as dollar value of purchases normalized by the dollar value of purchases and sales, firm quarters where insider trading does not occur are eliminated from the sample. Earnings announcements occurring after market hours are shifted to the following date. $Surprise_{IBES}$ is reported earnings minus the last consensus analyst forecast available prior to the earnings announcement date, normalized by share price. All variables are winsorized at the 1% level at both ends. Reported regressions below are conducted using OLS clustering on firm and year-quarter. *t*-statistics are reported in brackets and ***, **, * denote significance levels at 1%, 5%, and 10% respectively. All control variables are included but are not reported. FF-48 Industry/ year / quarter dummies also included but not reported.

Panel A:

	(1) $CAR_{(-10,-2)}$	(3) $CAR_{(-10,-2)}$	(4) $CAR_{(-10,-2)}$
Constant	0.0066	0.0092	0.0355***
	[1.49]	[1.25]	[11.76]
Purchase	0.0027***		
	[4.42]		
Purchase2		0.0027***	
		[5.24]	
Purchase Ratio			0.0040***
			[3.08]
Observations	267,215	171,360	156,304
R-squared	0.011	0.013	0.013

Panel B:

	(1) $CAR_{(-1,+1)}$	(3) $CAR_{(-1,+1)}$	(4) $CAR_{(-1,+1)}$
Purchase	0.0029***		
	[6.20]		
Purchase2		0.0020***	
		[4.13]	
Purchase Ratio			0.0055***
			[7.41]
$Surprise_{IBES}$	0.0723***	0.0676***	0.0764***
	[18.37]	[17.67]	[17.65]
Observations	265,622	170,198	155,297
R-squared	0.083	0.082	0.085

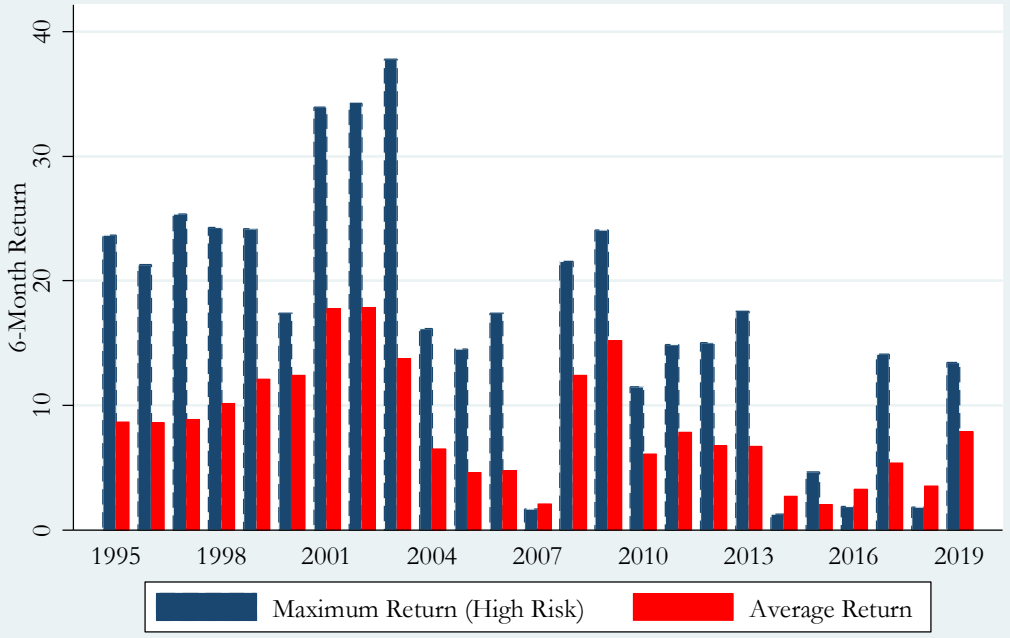
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Panel C:

	(1) $PEAD_{(+2, q+1)}$	(3) $PEAD_{(+2, q+1)}$	(4) $PEAD_{(+2, q+1)}$
Purchase	0.0072***		
	[4.99]		
Purchase2		0.0077***	
		[5.46]	
Purchase Ratio			0.0092***
			[2.64]
$Surprise_{IBES}$	0.0300***	0.0318***	0.0271***
	[6.74]	[7.27]	[5.42]
Observations	260,216	165,133	154,836
R-squared	0.020	0.021	0.021

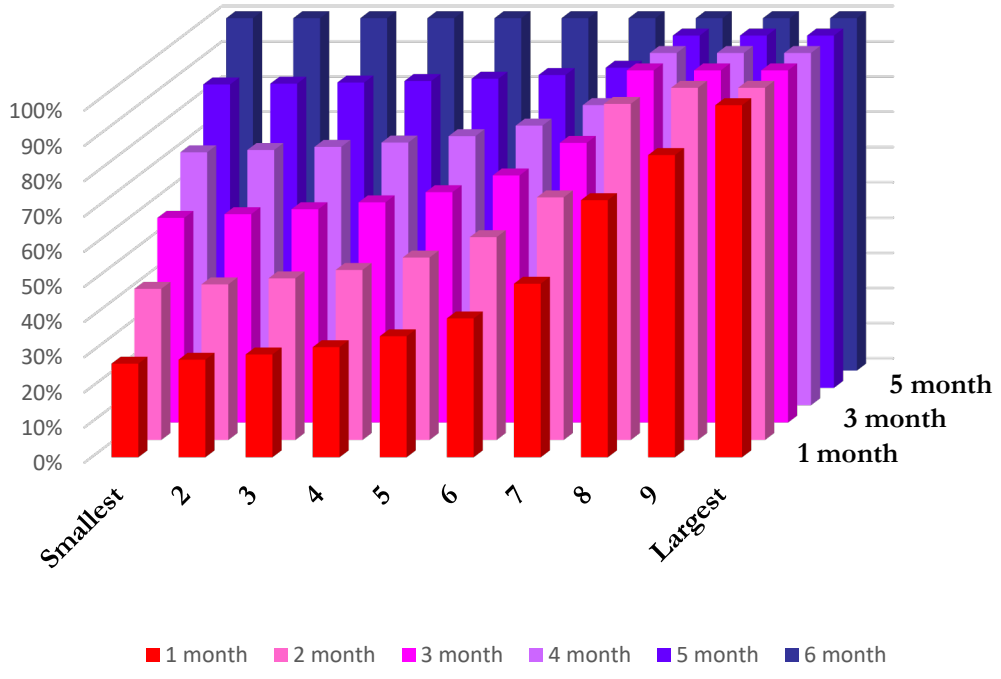
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Figure 1: 6-Month Abnormal Return by Year of Transaction



Data: Thomson Reuters Insiders Filing Data

Figure 2: Speed of Adjustment by Size Decile



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