

Changes in Market Values and Analysts' EPS Forecasts around

Insider Ownership Changes

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Abstract

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The empirically-observed cross-sectional relationship between the *level* of insider share ownership and the *level* of firm value has often been interpreted to mean that a change in share ownership can lead to a change in firm value. Such an interpretation has been criticized for ignoring potential endogeneity. In this paper, we perform two sets of tests to circumvent this alleged endogeneity. First, we measure *changes* in value over the 6-day interval around announcements of insider share purchases and find that the cross-sectional variability in changes in value is described by a curvilinear relation between firm value and insider ownership where the value of the firm first increases, then decreases, as insider share ownership increases. In a related analysis, we find that revisions to analysts' EPS forecasts at the time of insider purchases are consistent with the same curvilinear relation. Second, we conduct tests to determine (1) whether the insider purchases are moving firms toward a new optimal equilibrium ownership level or (2) whether insiders are purchasing shares to signal that the firm is undervalued. We find no evidence to support these interpretations. Overall, our results are consistent with a causal interpretation of the relation between insider ownership and firm value.

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Morck, Shleifer, and Vishny (MSV) (1988), McConnell and Servaes (1990, 1995), Hermalin and Weisbach (1991), Holderness, Kroszner and Sheehan (1999) and others document a statistically significant cross-sectional correlation between the level of share ownership by corporate insiders (usually defined as managers and members of the board) and corporate performance, where performance is measured either as Tobin's Q or return on assets. This observed empirical relationship has often been interpreted to mean that ownership "matters" and that a change in share ownership by insiders can be used to change corporate value. Such interpretations have been criticized for ignoring the potential endogeneity that may arise when external pressures push firms toward optimal ownership structures that jointly optimize over ownership and value.

Such criticisms have their origins in Demsetz (1983) who argues that the observed *level* of share ownership by insiders and firm performance is the outcome of market forces such that each firm's ownership structure will be optimal for that firm. If so, changes in ownership cannot be used to enhance corporate value. He further argues that any observed cross-sectional empirical relationship between the level of insider share ownership and firm performance must be spurious. Studies by Demsetz and Lehn (1985), Agrawal and Knoeber (1996), Loderer and Martin (1997), Cho (1998), Demsetz and Villalonga (2001), Himmelberg, Hubbard, and Palia (HHP) (1999), and Coles, Lemmon, and Meschke (CLM) (2003) support Demsetz' criticism empirically.

In particular, in an effort to control for the alleged endogeneity in regressions using levels of insider ownership and firm value, HHP estimate a firm fixed effects regression in which the

dependent variable is a proxy for firm value and the key independent variable is insider share ownership. With this procedure, they find no relation and, thereby, conclude that the significant relations reported in earlier studies were spurious. However, Zhou (2001) points out that a fixed effects estimation has shortcomings of its own when used with annual panel data of the type employed by HHP. He argues that in annual panel data with firm fixed effects it would be difficult to detect a meaningful relation between ownership and performance, even if one exists, because such tests have little power.

Specifically, Zhou observes that insider ownership typically changes slowly from year to year and in most years, for an individual firm, no change occurs at all; whereas, for the same firm, value can change dramatically over the course of a year for a host of reasons unrelated to inside ownership. That is not to say that a fixed effects analysis has no merit. In particular, a fixed effects model does control for unobserved firm-specific heterogeneity. The fixed effects model accomplishes this by, in essence, considering changes in ownership and changes in value rather than levels. When changes are considered, any firm fixed effect cancels and, therefore, any relationship that remains cannot be due to endogeneity that arises from such an effect.

In this study, we employ a methodology that preserves the virtues of a firm fixed effects analysis while overcoming the concerns raised by Zhou. Specifically, we estimate the relation between changes in insider share ownership and changes in stock prices over the 6-day interval commencing with the announcement of share purchases by corporate insiders. By conducting the analysis using changes in share ownership and changes in value, we control for any unobserved firm-specific fixed effect. Furthermore, by design, each of the firms in our sample experiences a change in insider ownership over the interval of analysis, thereby addressing the problem caused by many zero change observations encountered with annual panel data. Finally,

because the stock price change is observed over a short time interval, the firm value observations embed less “noise,” thereby increasing the ability of the tests to detect a relationship if one exists. To put this last point a bit differently, over the 6-day interval of analysis, other factors that are likely to affect corporate value are unlikely to be changing in a systematic way across firms.

As the starting point of our analysis, we employ the curvilinear relation reported by McConnell and Servaes (1990):

$$\begin{aligned} \text{Tobin's } Q = & b_0 + b_1(\text{Insider ownership}) + b_2(\text{Insider ownership})^2 \\ & + c_1(\text{Block ownership}) + c_2(\text{Institutional ownership}) + c_3(\text{Control variables}) \end{aligned} \quad (1)$$

where Tobin’s Q is the market value of the firm divided by the replacement value of assets, insider ownership is the fraction of shares controlled by officers and directors, block ownership is ownership by large blockholders and institutional ownership is ownership by institutional investors. McConnell and Servaes report that b_1 is positive and significant and that b_2 is negative and significant in cross-sectional regressions.

Starting from equation (1), if insiders increase their ownership by Δ Insider ownership (and blockholder/institutional ownership along with the control variables is stable over a short interval) then subtracting the initial level of Tobin’s Q from the new level of Tobin’s Q gives:

$$\begin{aligned} \Delta Q = & b_1(\Delta \text{ Insider ownership}) + b_2(\Delta \text{ Insider ownership})^2 \\ & + 2b_2(\Delta \text{ Insider ownership} \times \text{Insider ownership}) \end{aligned} \quad (2)$$

where the initial level of insider ownership is measured before the change in ownership¹.

¹ Adding Δ Insider ownership to Insider ownership yields:

$$Q + \Delta Q = b_0 + b_1(\text{Insider ownership} + \Delta \text{ Insider ownership}) + b_2(\text{Insider ownership} + \Delta \text{ Insider ownership})^2 + c_1(\text{Block ownership}) + c_2(\text{Institutional ownership}) + c_3(\text{Control variables})$$

Solving the squared term yields:

If the alleged endogeneity in a regression of the level of firm value on the level of insider ownership is due to a firm fixed effect, all explanatory variables in the change regression of equation (2) will be insignificant. If the relationship is causal, however, the predicted sign of b_1 will be positive and the predicted sign of b_2 will be negative. In addition, the predicted sign of the coefficient of the third term will be negative and its magnitude will be twice that of the coefficient of the second term. Henceforth, we refer to the coefficient of the third term as b_3 .

The first two terms of equation (2) say that an increase in share ownership by insiders gives rise to an increase in firm value up to a point after which value declines with further increases in insider share ownership. The third term says that the increase in firm value associated with an increase in insider ownership depends upon the initial level of insider ownership. Further, the increase in corporate value due to an increase in share ownership by insiders becomes progressively smaller the higher the initial level of insider ownership. That is, the market value effect associated with a given share purchase by insiders is smaller the higher the initial level of insider ownership, and can be negative for sufficiently high initial levels of insider ownership.

We test the predictions of (2) in two ways. First, we use stock price changes around announcements of share purchases by managers and members of the board as a proxy for changes in firm value (i.e., as a proxy for changes in Q). When these announcement period returns are regressed against the change in the fraction of shares owned by insiders, the change in the fraction of shares owned by insiders squared, and the cross product of the change in and the pre-purchase level of insider ownership, the results are largely consistent with a causal

$$Q + \Delta Q = b_0 + b_1(\text{Insider ownership}) + b_1(\Delta \text{Insider ownership}) + b_2(\text{Insider ownership})^2 + b_2(\Delta \text{Insider ownership})^2 + 2b_2(\Delta \text{Insider ownership} \times \text{Insider ownership}) + c_1(\text{Block ownership}) + c_2(\text{Institutional ownership}) + c_3(\text{Control variables})$$

Subtracting equation (1) from the above equation yields equation (2).

interpretation of the relationship between insider ownership and firm value. We find that b_1 is positive and significantly different from zero and that b_2 and b_3 are negative and significantly different from zero. Further, in none of the tests we conduct, can we reject the hypothesis that the coefficient of the interaction term (i.e., b_3) is twice the magnitude of b_2 at the 10% level of significance. However, in most regressions, the point estimate of b_3 is actually smaller than b_2 . For example, in our base case regression, $b_2 = -1.58$ and the coefficient of the interaction term is -1.10 . This result dampens, to an extent, an interpretation of (1) as being a literal description of the relationship between firm value and insider ownership, but the data are still consistent with a causal interpretation that can generally be described by equation (1).

Second, because equity market analysts are considered to be informed capital market intermediaries, we investigate their response to the changes in insider share ownership. We regress changes in analysts' earnings per share (EPS) forecasts around insider share purchases against the same explanatory variables employed in the cross-sectional analysis of announcement period stock returns. The results are consistent with analysts adjusting their earnings expectations consistent with the predictions of equation (2).

While the announcement period valuation and forecast revision results are consistent with a causal interpretation of the relationship between firm value and insider ownership, it is also possible that they come about because insiders are trading as underlying firm characteristics are changing, requiring an adjustment in the optimal level of ownership. To address this concern, we conduct tests to determine whether insider purchases appear to be moving firms toward an "optimal" ownership structure. Given an independently specified model of optimal ownership,² insider share purchases are not consistent with movement toward such an optimum. Additionally, when announcement period abnormal returns are regressed against the "ownership

² Specifically, we use the model of ownership developed by HHP (1999).

deficit” as determined by this model of optimal ownership, the coefficients are not statistically significant.

Finally, we conduct tests to determine whether the abnormal returns associated with announcements of insider share purchases are more consistent with a signaling explanation in which insider purchases convey information about the intrinsic value of the firm. These tests reject such an interpretation.

In sum, after conducting a battery of tests, the only explanation that survives is that of a causal relationship between the fraction of shares held by corporate insiders and the value of the firm, where firm value first increases and then decreases as insiders own more shares.

The remainder of this paper is organized as follows. The next section gives an overview of related literature and motivates our empirical analysis. Section 2 describes our data. Section 3 studies the relation between ownership changes and abnormal announcement returns. Section 4 presents various tests of robustness these results. Section 5 studies the relation between ownership changes and analyst EPS forecast revisions. Section 6 considers the question of whether the insider share purchases in our sample should be viewed as moving firms toward their optimal equilibrium levels of insider share ownership. Section 7 addresses the question of whether the results should be interpreted to mean that market participants merely view share purchases by insiders as a signal that the firm is undervalued. Section 8 summarizes our findings and sets forth our conclusions.

1. Background

Theoreticians have made a compelling case for the proposition that ownership of shares by corporate decision makers (i.e., managers and members of the board of directors) can have an

important influence on the way in which the firm is managed and, therefore, on the firm's observed market value (Baumol (1959), Jensen and Meckling (1976), Demsetz (1983), Stulz (1988)). While supporting this theory, Demsetz (1983) argues that no relationship between ownership structure and value will be observed empirically or, if one is, it is spurious. That is, if each firm has optimized its ownership structure, in a cross-section of firms any correlation between market value and ownership structure must be accidental. And, thus, the empirical relationship should not be interpreted as an indication of a causal relationship between ownership structure and firm value.

Empirically, Demsetz and Lehn (1985) use a sample of 511 U.S. companies for which they have ownership data for 1980 to examine the relationship between corporate profitability and the fraction of outstanding shares held by the top five (or top 20) shareholders. They find no correlation between profitability and ownership concentration. They conclude that their results are consistent with the argument that ownership structure is endogenous. Loderer and Martin (1997) consider the role of inside ownership on the value created in corporate acquisitions. Though they find a statistically significant correlation between value and ownership, the explanatory power of their regression is small and the statistical significance disappears altogether in a simultaneous equations specification. Similar to Loderer and Martin, Agrawal and Knoeber (1996), Cho (1997), and Demsetz and Villalonga (2001) each use a system of equations to examine the determinants of insider ownership and firm value simultaneously for various samples of U.S. firms. The latter two studies conclude that corporate value and/or profitability affects the level of inside ownership, but not vice versa. The first study reports no connection between insider ownership and value.

As we noted, (HHP) (1999) use a firm fixed model with annual data and find no significant relation between insider ownership and firm value. Coles, Lemmon, and Meschke (2003) construct a structural model to study the determinants of ownership. They argue that a spurious curvilinear relationship between firm value and insider ownership may emerge in cross-sectional regressions even though each firm is at its optimal ownership level and they present data to support their argument. These studies all support Demsetz' contention.

On the other side of the coin, MSV (1988) use a sample of 371 *Fortune* 500 firms to estimate a piecewise linear regression with Tobin's Q as the dependent variable and the fraction of shares owned by members of the company's board of directors as the independent variable of interest. They find a significant correlation in which value initially increases with ownership of shares by the board up to 5% and then declines up to ownership of 25% after which the relationship again becomes positive. They hypothesize that this nonlinear relationship is due to the interaction of two offsetting factors – an incentive effect and an entrenchment effect. They allow for the possibility that the observed relationship is causal with “too much” ownership causing a decline in value.

In similar spirit, McConnell and Servaes (1990, 1995) estimate the relationship between Tobin's Q and the fraction of shares held by managers and directors (i.e., corporate insiders), large-block shareholders, and institutional investors for large samples of NYSE and AMEX firms for the years 1976, 1986, and 1988. Among other things, they report a significant curvilinear relationship in which the value of the firm first increases and then decreases as insider ownership increases. They cautiously interpret their results as being “...consistent with the hypothesis that corporate value is a function of the structure of equity ownership” (McConnell and Servaes (1990), p. 595). Hermalin and Weisbach (1991), Holderness, Kroszner

and Sheehan (1999), and Habib and Ljungqvist (2005) also report evidence of a significant relationship between insider ownership and the value of the firm for publicly traded U.S. companies. Anderson and Reeb (2003) and Gompers, Ishii, and Metrick (2004) take slightly different tacks. Anderson and Reeb consider 141 “family firms” among the *Fortune* 500. Similar to McConnell and Servaes, they report a significant curvilinear relationship between firm value and family ownership. Gompers et al. study 168 dual-class US firms. They make the distinction between voting rights (i.e., votes per share times shares owned) and cash flow rights (i.e., dividend paying shares). They report two curvilinear relations, one between corporate value and cash flow rights (it is concave) and one between value and voting rights (it is convex). They propose that these reflect the effects of incentives and entrenchment, respectively. In the same vein, Adams and Santos (2006) construct a measure of the separation between insider control and cash flow rights by examining the relation between cash flow rights and Q in banks that control the right to vote their own shares, but receive none of the cash flow rights because the shares are held in trust for bank customers. They find a curvilinear relation between control stakes and firm value in which value first increases then decreases as managerial control of bank votes increases.

On the international front, La Porta, Lopez-de-Silanes, Shleifer and Vishny (LLSV) (2002), Claessens, Djankov, Fan and Lang (CDFL) (2002), and Lins (2003) examine the correlation between value and ownership structure across a variety of countries. They focus on the frequent separation between ownership of voting/control rights and ownership of cash flow rights. LLSV and CDFL report that firm value increases as management ownership of cash flow rights increases; Lins reports that value declines as management ownership of control rights increases.

Our study is largely motivated by the results in McConnell and Servaes (1990, 1995) in that we ask whether *changes* in the fraction of shares owned by insiders exhibit a relationship with *changes* in the value of the firm that is consistent with the curvilinear relationship documented by them for the relationship between the level of insider ownership and the level of firm value. McConnell and Servaes, in turn, motivate their study on the basis of Stulz (1988), although their analysis could also have been motivated by the arguments put forth by MSV (1988).

In particular, Stulz (1988) constructs a model in which the takeover premium that a bidder must pay to gain control increases as the fraction of shares owned by management increases, but the probability that the takeover will succeed declines. Initially, an increase in ownership by insiders has the effect of increasing the value of the firm (i.e., increasing the expected value of the takeover premium) but because increasing ownership reduces the likelihood of a successful takeover offer, value eventually reaches a peak, then declines. That is, the firm's value reflects the intersection of two opposing forces. Similarly, MSV (1988) present an argument in which value is a function of two opposing forces – the incentive effects of ownership and the entrenchment effects that arise from a desire to maintain control. They do not specify a curvilinear relationship, but their argument allows for that possibility. As we described at the outset, we use stock returns from an event study around share purchases by insiders to investigate the relationship between changes in share ownership and changes in corporate value as specified in equation (2). Further, because analysts provide important incremental information to market participants, we test whether their forecast revisions around insider share purchases are consistent with the curvilinear relationship specified in equation (2).

2. Data

Data on insider purchases are taken from *Thomson Financial* over the period 1994 through 1999. Individuals defined by the Securities and Exchange Commission (SEC) as insiders are required to report any personal trades in the shares of their firms to the SEC by the 10th of the month following the trade date. This includes open market purchases and sales, shares acquired and sold through the exercise of options, and a variety of other types of transactions.

For the analyses in this paper, we focus on a subset of the reported trades. First, we include only purchases of at least 10,000 shares. Second, we consider only open market purchases. Acquisitions of shares through the exercise of options are more likely to be anticipated by the market because information on option holdings is publicly available. Moreover, Ofek and Yermack (2000) document that when executives exercise options to acquire stock, nearly all of the shares are sold shortly thereafter. Thus, the increase in insider ownership that comes about through option exercise is unlikely to be permanent. For this reason, we also exclude sales, many of which are likely to be related to option exercise and, therefore, are likely to have been anticipated by the market. Third, we exclude trades by individuals who are considered by the SEC to be insiders, but who are not officers or members of the board. For example, owners of more than 10% of the shares of the company are deemed insiders by the SEC even if they are not part of the management team or the board. (Hereafter we refer to the fraction of shares owned by management and the board as insider ownership.) Fourth, it is sometimes the case that one insider reports a purchase and another reports a sale on the same day. These days are removed from our analysis; only days when no insider sales are reported are considered in

this study. If more than one insider from the same company reports a purchase on the same day, we sum those trades and use the total as the insider purchases on that day.

Data on the level of share ownership by officers and members of the board of directors are taken from *Compact Disclosure*. *Compact Disclosure* gathers such data from annual corporate proxy statements. These share ownership figures also include options that can be exercised within six months. Within each year, we update the level of insider ownership after each insider trade. However, at the beginning of each year, we reset the level of insider ownership using *Compact Disclosure*.

To determine the reliability of these data, we selected 200 firms at random across all years and sought to hand collect ownership data for them from corporate proxies. We were able to collect data for 172 firms.³ We then compared the insider ownership from the proxies with the insider ownership reported by *Compact Disclosure*. In most instances, insider ownership is precisely the same from the two sources. Further, the correlation coefficient between insider ownership from the two sources is 0.92, and the means and medians of the ownership levels are nearly identical. In the tests that follow, for the 172 firms for which we collected data from proxies, we use the proxy data. For all others, we use the *Compact Disclosure* data.

The announcement period abnormal return (APAR) for each purchase is computed by subtracting the return of the value-weighted CRSP Index from the return of the company's stock for the day on which the insider reported the trade to the SEC and the five following days. These six daily abnormal returns are summed to give the APAR for the relevant insider share purchase. We use this 6-day interval because the information usually does not enter the public domain for several days after it is filed with the SEC (Lakonishok and Lee (2001)). To avoid problems with outliers, we remove any APAR that is not within three standard deviations of the mean APAR.

³ We do not have access to proxies for 28 of the companies.

We also delete firms whose share price was below \$2 at the time of the announcement and cases where the price at which the insider bought differed by more than 20% from the closing price on the day of the trade. Finally, we find that in about 11% of the cases, insiders report trades after the required reporting deadline. Such trades are retained in the sample if they are reported within 90 days of the reporting deadline. Otherwise, they are deleted.

Table 1 provides summary statistics of the data. Our sample includes 4,141 different purchases by insiders representing 1,700 different companies, or about 2.5 trades per company. The mean and median purchases are 61,158 and 20,000 shares, respectively, which represent 0.42% and 0.15% of the company's outstanding stock (recall that we dropped all trades of less than 10,000 shares). In dollar value terms, the mean and median purchases are \$898,783 and \$213,750, respectively. Thus, the typical purchase in our sample is not small. Before the purchase, mean and median insider ownership levels were a substantial 19.88% and 13.83% of total outstanding shares. Purchases are spread reasonably evenly through time although 1998 has a modest bulge relative to other years. The final row of the top panel of Table 1 gives the mean and median 6-day APARs of 0.94% and 0.35%, respectively. Both are highly statistically significant with p-values < 0.001.

3. A direct test of the relationship between insider purchases and changes in firm value

Our goal in undertaking this study is to circumvent the possible spurious correlation that may arise when firm value is regressed against the level of insider ownership. In this section, we conduct tests that alleviate the concern that there are unobserved firm-specific characteristics that influence both firm value and insider ownership.

As we noted, we employ the 6-day announcement period abnormal return, APAR, commencing with the day before the announcement of insider purchases, to proxy for the change in Q. Thus, we estimate the following regression model:

$$\begin{aligned} \text{APAR} = & b_1(\Delta \text{ Insider ownership}) + b_2(\Delta \text{ Insider ownership})^2 \\ & + b_3(\Delta \text{ Insider ownership} \times \text{ Insider ownership}) + e. \end{aligned} \quad (3)$$

We test the hypothesis that b_1 is positive; b_2 is negative; and b_3 , the coefficient of the interaction of the change in insider ownership with the pre-purchase level of insider ownership, is negative and twice the size of b_2 . The independent variables are the number of shares purchased divided by the number of shares outstanding (i.e., the increase in the fraction of shares held by insiders), the increase in the fraction of shares held by insiders squared, and the cross product of the initial level of insider ownership and the increase in the fraction of insider share ownership. As we noted, insider trades must be reported by the 10th day of the month after the trade. Not surprisingly, many trades for many different companies are reported on the 10th of each month. Additionally, trades in more than one firm are sometimes reported on the same day even when it is not the 10th. Because the abnormal returns are likely to be correlated for trades that are reported on the same day, we include an indicator variable for each reporting day. That is, we estimate a model with reporting-day fixed effects. There are 934 reporting days in the sample.

The results of the regression are presented in column 1 of Table 2. As shown in the table, b_1 is positive and significantly different from zero (p-value = 0.04); b_2 is negative and significantly different from zero (p-value = 0.07); and b_3 is negative and significantly different from zero (p-value = 0.07). Additionally, an F-test indicates that b_3 is not significantly different from $2b_2$ at any traditionally acceptable level of statistical significance for rejection of a null hypothesis (p-value = 0.26). These results are consistent with a causal interpretation of equation

(1). In particular, an increase in share ownership by insiders can give rise to either an increase or decrease in the value of the firm depending upon the initial level of insider ownership – at a low initial level of insider ownership, the value of the firm increases; at a high initial level of inside ownership, the value of the firm falls.

In many respects, these results are powerful evidence in support of the hypothesis that changes in share ownership by insiders can and do increase corporate value up to a point after which “too much” insider ownership can and does reduce value. However, the results are not perfect. The fly in the ointment is the comparative magnitudes of the point estimates of b_2 and b_3 . The point estimate of b_3 is actually less than the point estimate of b_2 . Obviously, either a lower estimated value for b_2 or a higher estimated value for b_3 or a combination of the two would make for even more compelling evidence.

4. Other announcement return specifications

In this section, we examine the sensitivity of our base-case results to alternative specifications.

4.1 Institutional and block ownership

The starting point for our tests is equation (2) which evolves as the first difference in (1) with respect to a change in insider ownership, assuming that institutional and block ownership along with the control variables are stable or has no effect on ΔQ . As reported in McConnell and Servaes (1990), estimation of (1) yields an insignificant coefficient for block ownership and a positive and significant coefficient for institutional ownership. In their estimation, the control variables include debt/assets, R&D/assets, advertising expense/assets, and assets. The coefficient of each of these is also statistically significant.

Clearly, given a change in inside ownership, there must be an offsetting change in share ownership by other investors. The omitted ownership category in (1) is ownership by atomistic “outsiders.” If we assume that the insider trades with atomistic outsiders, then blockholder ownership and institutional ownership fall out when we take the first difference of (1). Alternatively, the insignificant coefficient of blockholder ownership reported by McConnell and Servaes (1990) implies that if the trade is with blockholders, that factor would have no effect on firm value. However, the reported positive effect of institutional ownership indicates that, if the insider is buying from an institutional holder, the decline in institutional ownership reduces the effect of the trade on firm value. Failing to include the change in institutional ownership could lead to biased results. For example, suppose that purchases by insiders are actually always received positively by the market, while sales by institutions are associated with a negative stock price response. Suppose further that insider purchases are from small atomistic investors when insider ownership is small, while they are from institutional investors when insider ownership is large. If this is the case, our findings could well emerge, even though the relationship between insider ownership and firm value is positive over the entire ownership range; the stock price reaction to an insider purchase would be positive when insider ownership is low, but negative when insider ownership is high because this purchase leads to a reduction in institutional ownership. Thus, it is important to determine whether insiders are trading with institutions.

Unfortunately, daily ownership positions by institutional investors are not available. We can, however, investigate changes in institutional ownership on a quarterly basis. That is what we do. Specifically, from *Thomson Financial*, we download institutional ownership for each company for the quarter-ends just prior to the announcement and just after announcement of the insider share purchase. We then compute the change in institutional ownership over this period.

We do, indeed, find a decline, on average, in institutional ownership in the quarter in which the insider traded (mean decline is 0.95%, and median decline is 0.43%).

We investigate whether our results could be due to changes in institutional ownership. To do this, we re-estimate equation (3) and, when the data are available, include the change in institutional ownership as an explanatory variable. When the institutional ownership data are not available we include an indicator variable and set the change in institutional ownership to zero. This procedure ensures that we do not lose observations due to data unavailability. The results of this model are reported in column 2 of Table 2. The coefficient of the change in institutional ownership during the quarter is positive and significant.⁴ However, the coefficients of the insider ownership variables are nearly identical to those reported in column 1. Thus, controlling for the change in institutional ownership does not affect our findings.

4.2 Other control variables

As regards the control variables, these factors (that include book value of assets, debt/assets, advertising expense and R&D expense) would not literally be constant over the 6-day event period of analysis. However, the changes are likely to be very small. Furthermore, to ensure that there were no major changes in these items, we searched *Factiva* for contaminating announcements during the 6-day announcement period. We search for announcements involving recapitalizations, mergers, acquisitions, dividends, share repurchases, equity issuances and other events related to corporate financing and investment decisions for each of the 4141 share purchase events. In those cases where we identified an event that could possibly be contaminating, we excluded that observation from the sample and re-estimated our base case

⁴ Note that these results do not imply that changes in institutional ownership over the quarter affect the stock price reaction around the 6-days over which we measure abnormal returns. It is possible that institutions simply purchase shares where prices have increased and vice versa.

regression. This required that we drop 402 observations from the analysis. The results reported in column 3 of Table 2 are very similar to those in the base case model.

4.3. *Trimming the distribution of announcement period abnormal returns*

In our base case regression, we trimmed the distribution of 6-day APARs at three standard deviations from the mean. We did so because the full distribution includes several extreme observations – the highest APAR is +95.93% and the lowest is –71.24%. We also estimate the regression using the full distribution of APARs. The results, which are reported in column 4 of Table 2, are similar to those reported in column 1: the coefficients have the same sign, they are larger in magnitude, and the significance levels actually improve. We then go in the opposite direction and remove APARs if they lie outside of two standard deviations of the mean. The results given in column 5 of Table 2 are similar to those in our base regression in column 1.

4.4. *Cut-off for the minimum purchase of shares*

In our base case regression, we include only purchases of at least 10,000 shares. We now re-estimate our regression including all purchases of at least 5,000 shares. This regression contains 6,831 purchases and 2,264 firms with an average APAR of 0.78%. The results of this regression (reported in column 6 of Table 2) tell the same story as those in column 1. When we restrict ourselves to purchases of 20,000 shares or more, the coefficients (reported in column 7 of Table 2) are also similar to those in column 1. As one further test, we include only purchases that are at least 10,000 shares and amount to $1/10^{\text{th}}$ of 1% of total shares outstanding. These results (not reported in the table) are also similar to those in column 1.

4.5. Option ownership

As we noted above, our insider share ownership data include all options that can be exercised within 6 months. Ideally we would like to investigate whether our findings are different if we remove option ownership or if we include all option ownership. Unfortunately, the source for executives' stock option data, *Execucomp*, has less extensive coverage than *Thomson Financial*. Thus, we are able to obtain data for total insider option holdings for only 1,645 purchases (out of 4,141 in our sample). As a fraction of total shares outstanding, ownership of options is modest. For the sample of 1,645 observations, option ownership averages 2.7%, of which 1.37% cannot be exercised within 6 months and 1.33% can. Median option ownership is 1.48% (0.77% cannot be exercised within 6 months and 0.71% can be). This compares with an average insider share ownership of 19.88% and a median of 13.83% for the sample. We repeat our base case regression including and excluding all option ownership for those insider purchases for which such data are available. The results (reported in columns 8 and 9 of Table 2) are essentially the same as those in column 1.

4.6. Other announcement period intervals

In our base case regression, we use the 6-day interval including the announcement day and the following five days to calculate APARs. We experimented with APARs calculated over other intervals ranging from four to ten days around announcements of insider share purchases. The results are essentially the same as those in column 1 of Table 2. Because we have a number of these regressions, we do not report the results here.⁵

4.7. Other reporting lags

In our base case regression, we include purchases only if they were reported within 90 days of the reporting deadline. We experimented with allowing purchases to be included with

⁵ These results are available from the authors upon request.

longer and shorter lags between the required reporting date and the actual reporting date. Regardless of the cut-off for the allowable reporting lag, the results of these regressions are essentially the same as those in column 1 of Table 2. Because we have multiple variations of the reporting lag, we do not report the results here.

4.8. *Trimming the distribution of share ownership*

In our regressions, the third explanatory variable is the cross product of the initial level of insider share ownership and the change in insider share ownership from that initial level. We attach substantial importance to the magnitude of the coefficient of this variable which depends, perhaps critically, on the pre-purchase level of insider share ownership. To assure that our results do not come about because of purchases by just a few large-block shareholders, we remove observations in which the initial level of insider ownership is more than three standard deviations above the mean. This trims the distribution of pre-purchase insider ownership at 75.38% and drops 54 observations from the sample. These results are given in the 10th column of Table 2 and are nearly identical to those in the base case regression of column 1.

Although we have less concern about the bottom tail of the distribution causing a peculiar outcome, we remove firms that comprise the bottom 1% of the distribution of insider ownership along with firms with ownership more than three standard deviations above the mean.⁶ These results are given in the 11th column of Table 2 and, again, are nearly identical to those in our base case regression of column 1.

4.9. *Forcing b_3 to equal $2b_2$*

Although our results are consistent with equation (1), b_2 is “too big” and/or b_3 is “too small” for the fit to be considered perfect in every way. One way to determine whether the data

⁶ We cannot use a cut-off in ownership of three standard deviations below the mean because such a cut-off would be less than zero.

actually fit a curvilinear relationship is to estimate a constrained regression in which b_3 is forced to be equal to $2b_2$. If this forced relationship does not fit the data, the regression coefficients will, then, not be statistically significant. As shown in column 12 of Table 2, such is not the case. Each of coefficients is significant and each has the predicted sign: b_1 is 0.38 (p-value = 0.08); b_2 is -0.49 (p-value = 0.04); and, of course, at -0.98 (p-value = 0.04), b_3 is precisely twice b_2 .

4.10. Controlling for selection

When a sample selected in an event study is based on a choice, coefficients estimated using OLS can be biased [see Heckman (1979)]. This problem is pervasive in event studies in corporate finance, but it is often not addressed. We tackle this problem by estimating a regression model with a Heckman correction for selection. Two selection variables are employed in this specification: the logarithm of the dollar amount of insider ownership and the stock price volatility measured with daily returns over the calendar year prior to the purchase. We expect fewer insider purchases in firms with a more volatile stock price because the cost of the lack of diversification is higher in these firms [see Leland and Pyle (1977)]. Similarly, we expect fewer insider purchases when insiders have already invested large sums in their firms.⁷

The results of the abnormal return regression with self-selection correction are similar to the ones reported previously. If anything, the coefficients are larger in absolute magnitude and they are more significant: b_1 is 0.73 (p-value = 0.00), b_2 is -1.55 (p-value = 0.03) and b_3 is -1.60 (p-value = 0.01).⁸

⁷ We estimate the selection equation for all firms with data available on the cross-section of *CRSP*, *Compustat*, and the *Compact Disclosure* database.

⁸ As an alternative, we estimate selection models using the difference between the optimal level of insider ownership and the actual level of insider ownership as the selection variable. Estimation of these models of optimal ownership is discussed in Section 6 of the paper. The base case results continue to hold when we use this difference in selection equations.

4.11. Summary of other announcement return specifications

In short, the results in our base case regression are robust to a variety of alternative decisions regarding sample selection, measurement of the dependent and independent variables, screening for confounding events, and questions regarding trading by institutional investors. These results are consistent with a causal interpretation of the relationship between insider share ownership and firm value. We now turn to a consideration of other possible explanations of these results. In particular, we consider whether the results are consistent with an interpretation that share purchases are moving the firm towards an optimal ownership structure and/or that the stock price response to insider purchases is merely a signal that the firm is undervalued.

5. Changes in insider ownership and changes in analysts' EPS forecast

As a further test of the relation in (3), we examine revisions to analysts' EPS forecasts around insider share purchases. Schipper (1991) describes how analysts, as informed intermediaries, can provide insights into the activities and beliefs of investors that cannot be observed directly. Healy and Palepu (2001) and Kothari (2001) review a large body of research indicating that analyst forecasts are a source of incremental information in the capital markets. If the change in firm value is a reflection of the change in expected earnings, we would expect analysts' EPS forecast revisions to be consistent with equation (3). In particular, when we estimate the following regression:

$$\begin{aligned} \text{Forecast Revision} = & \text{Intercept} + d_1(\Delta \text{ Insider ownership}) + d_2(\Delta \text{ Insider ownership})^2 \\ & + d_3(\Delta \text{ Insider ownership} \times \text{ Insider ownership}) + e. \end{aligned} \quad (4)$$

we expect d_1 to be positive, d_2 to be negative and d_3 to be negative and twice the size of d_2 .

To investigate this conjecture, we study all EPS forecasts for annual earnings for the firms in our sample that are covered by IBES. In line with Ivković and Jegadeesh (2004) and Lustgarten and Mande (1995), we compute the forecast revision as:

$$(\text{New median forecast} - \text{Old median forecast}) / |\text{Old median forecast}| \quad (5)$$

We focus on revisions that span the insider share purchase announcement date. Specifically, we compare the first available EPS forecast after the announcement date with the most recent pre-announcement forecast. Forecast revisions that are more than three standard deviations from the mean forecast revision are removed to minimize the influence of outliers. We include EPS forecast revisions for all fiscal years available and adjust the standard errors for the lack of independence of revisions made at the same point in time for the same firm.

Table 3 contains the findings. The first column contains the coefficients of the base case regression model. Forecast revisions are positively related to the change in insider ownership, negatively related to the change in ownership squared, and negatively related to the interaction between the change in ownership and the pre-purchase level of ownership. Thus, analysts do not uniformly increase their EPS forecasts in response to insider share purchases. Rather, the change in EPS forecast is sometimes negative. Equally importantly, the response depends on the pre-purchase level of ownership. Further, we cannot reject the hypothesis that the coefficient of the interaction term (d_3) is twice the size of the coefficient of the squared term (d_2) (p -value = 0.36).

In the second column, we control for firm size, the number of analysts and the prior forecast revision, which is the most recent revision before the insider purchase took place, computed as in (5). The inclusion of these variables does not alter the significance of the variables of interest. We continue to find that analysts' forecast revisions are positively related

to the change in the level of insider ownership, negatively related to the change in ownership squared, and, importantly, depend upon the pre-purchase level of insider ownership.

In sum, analysts revise their EPS forecasts in line with the model of the relation between insider ownership and value as described by equation (1). The EPS data represent an important independent consideration of the role of insider ownership in affecting corporate value.

6. Optimal insider ownership

6.1. Overview

As we noted at the outset, a major concern regarding the cross-sectional regressions of MSV (1988), McConnell and Servaes (1990, 1995) and others derives from Demsetz' (1983) argument that ownership is determined endogenously and all firms are at their optimal ownership structures at all times. If so, no relationship should be observed in a cross-sectional regression of performance against ownership and, if one is, it must be spurious. Taken to the extreme, this observation raises the question of why insiders trade at all and, if they purchase, why such trades are associated with an increase in stock prices on average. That is, if all firms are at their optimal ownership structures, arguably, any trading should be associated with negative stock price reactions. We do, of course, observe some negative stock price changes when insiders buy more shares, but those negative stock price changes tend to be concentrated over a specific range of share ownership. That is, negative stock price reactions tend to occur when initial inside ownership is already high. These results are difficult to reconcile with the proposition that all firms are at their optimal ownership structures all the time.

A less extreme variation of the Demsetz argument is proposed by Core and Larcker (2002). They propose that ownership structures tend to be at their optimal levels most of the

time, but, because there are costs of adjustment, ownership structures sometimes drift away from their optima. When this occurs, and when the cost/benefit calculus makes it worthwhile to do so, executives either voluntarily purchase more shares or they are forced to do so by the company's board of directors. In support of this proposition, Core and Larcker (2002) study 195 firms that adopted "target ownership plans" over the period 1992 through 1997. They report that these firms had low managerial equity ownership relative to peers and poor performance relative to peers prior to plan adoption. After plan adoptions, managers increased their share ownership, and the firms' accounting and stock price performance improved as well.

As the size of the Core and Larcker sample indicates, adoptions of formal target ownership plans are relatively rare. That does not mean, however, that these are the only instances in which boards have exerted pressure on management to purchase additional shares. Indeed, it is possible that many of the cases of insider share purchases that we study represent instances in which the board has informally coerced top-level managers into buying more stock. It is possible that the board recognized that insider ownership was "too low" and urged officers to purchase more shares. Thus, the purchases by insiders that we observe may simply be trades pushing insider ownership back toward its optimal level.

In this section, we address the question of whether share purchases by insiders are potentially moving firms toward their optimal insider ownership levels. This analysis is complementary to that of Section 3. In Section 3, we analyze whether the endogeneity is due to unobservable firm-specific effects. In this section, we analyze whether the endogeneity could come about because observable firm characteristics have changed, and these changes in characteristics could lead to changes in both insider ownership and firm value.

We undertake this investigation from several perspectives. First, we use the model proposed by HHP (1999) to determine whether the firms in our sample can be viewed as experiencing insider share purchases because their pre-purchase levels of insider share ownership were “too low.” In particular, we use the HHP model to estimate each firm’s optimal equilibrium level of insider ownership.⁹ We then ask whether the firms in our sample have an insider ownership “deficit” relative to their optimal equilibrium levels such that the insider share purchases that we observe are moving these firms towards their optimal insider ownership levels. Second, we ask whether announcement period abnormal stock returns are correlated with the equilibrium ownership deficit as determined by the HHP model. That is, does the market respond as if the purchases were moving the firms towards their optimal insider ownership levels? Third, we step away from a specific equilibrium model of optimal insider share ownership and ask whether insider purchases, regardless of whether they can be viewed as purchases that move the firm toward a specified optimal ownership level, are correlated with announcement period stock price changes, ignoring the squared term and the cross-product of the two terms in equation (2).

6.2. *An empirical model of the optimal level of insider ownership*

To construct their model, HHP gather share ownership data from proxy statements for a random sample of 600 *Compustat* firms as of 1982. These firms are tracked through 1992 with ownership data being collected each year from proxy statements. Regression models of (a transformation of) insider share ownership as a function of certain firm characteristics are estimated. The transformation of insider share ownership is:

⁹ We use the HHP model for this purpose because of its relatively recent vintage and because it is widely recognized.

transformed inside share ownership = $\log(\text{inside ownership} / (1 - \text{inside ownership}))$. (6)

The explanatory variables in their models are listed in our Appendix. HHP estimate their model using OLS regression. They estimate the model with and without 3-digit SIC code industry fixed effects and with and without firm fixed effects.

We initially estimate the HHP model with firm fixed effects and use the model to predict the “optimal” level of inside ownership for the firms in our sample. We place quotes around optimal to denote that we employ the HHP model to predict ownership structure. In using the HHP model to determine whether firms are at their optimal ownership structures, we might be accused of using the model in a fashion not intended by the authors. We acknowledge that possibility. However, HHP do “...propose an equilibrium interpretation of the observed differences in ownership structure across firms.” (p. 354). Nevertheless, we recognize the limitations of the model and consider other possibilities later.

To estimate the HHP model, we use annual data for the years preceding the announcement dates of the insider purchases. To begin, we estimate the model using all firms available on both the *Compustat* and *Compact Disclosure* databases for the years 1987 through 1992. We use this estimation to predict the optimal insider ownership for firms with insider purchases in 1993. To predict subsequent years, we add one year of data as we move through subsequent years so that, by the final year of our analysis, the model is estimated with data from 1987 through 1997 to predict insider ownership in 1998.

To determine whether the insider purchases move firms toward or away from their “optimal” inside ownership levels, for each firm with an insider purchase we subtract pre-purchase insider ownership from predicted ownership for the year of the purchase, and refer to these differences as the insider share ownership “deficit”. Deficits are calculated in two ways.

First, we calculate the deficit for each purchase. Second, we calculate the deficit based on the average purchase during the year for each individual firm for which there is a purchase.

In Panel A of Table 4, we present the means and medians of these deficits. The mean deficit is not significantly different from zero regardless of whether we consider individual purchases or whether we consider the average purchase for an individual firm. The median deficit, when we consider individual purchases, is significantly different from zero, but it is negative indicating “too much” rather than “too little” insider ownership. When we consider the average purchase for an individual firm, the median deficit is not significantly different from zero.

We also experimented with a host of variations in calculating the ownership deficit. For example, we compared the predicted level of ownership to insider ownership in the year prior to the purchase instead of the year of the purchase. We also employed predictions based on HHP’s model estimated without any fixed effects and with only industry fixed effects (and no firm fixed effects). As with the median deficit based on individual purchases, most of these variations imply that the firms in our sample had too much rather than too little insider ownership when the insider purchase took place.¹⁰

Our analysis considers the means and medians of the distributions. It could be that consideration of only the means and medians is masking a correlation between the size of the deficit and the size of the purchase. That is, it could be that firms with the largest ownership deficits experience the largest insider share purchases. To examine that possibility, we estimate a simple regression with the change in the fraction of shares owned by corporate insiders as the dependent variable and the ownership deficit as the explanatory variable. We use the same measure of the ownership deficit as in panel A. Panel B of Table 4 contains the result.

¹⁰These results are available from the authors upon request.

As shown in the table, there is a negative relation between the amount of the purchase and the deficit, which is the opposite of what would be expected if the purchases were meant to move firms toward their optimal levels of insider ownership, and further undermines an argument that insider purchases are aimed at moving firms towards an optimal ownership structure.

Given that our tests find no evidence of an ownership deficit at the time of the purchase, and that there is a negative correlation between the size of the deficit and the size of the purchase, the results are inconsistent with an argument that the insider share purchases are moving firms toward their optimal insider ownership levels.

6.3. The change in the value of the firm and the insider ownership deficit

We document in Section 3 that the market does not always react positively to announcements of insider share purchases. It is therefore possible that the market reacts positively when the purchase moves the level of insider ownership towards the optimal, but negatively when the purchase moves insider ownership away from the optimal. To examine this possibility, we relate the APARs to the size of the deficit. For this analysis, we regress APARs against three independent variables: (1) the change in insider ownership, (2) the insider ownership deficit, and (3) the interaction between the change in insider ownership and the insider ownership deficit. We include the ownership deficit in the regression to examine whether the change in the value of the firm depends on whether the purchases occur in firms with “too little” rather than those with “too much” insider ownership. Further, we interact the size of the purchase with the size of the deficit. Our reasoning for doing so goes as follows: when insiders buy shares to make up for a larger deficit, the stock price reaction should be higher.

The hypothesis that insider purchases are moving firms toward an optimal ownership structure predicts positive coefficients for each of the variables. The ownership deficit is measured using the fixed effects regression described in Section 6.2. The results of the regression are displayed in panel C of Table 4. None of the coefficients in this model are statistically significant. As with our other tests, this result does not support the idea that insider share purchases are moving firms toward an optimal ownership structure.

6.4. *A simple model of insider share purchases and optimal insider ownership*

An argument might be made that our failure to find a significant relationship between the APARs and the insider ownership deficit occurs because we have used a specific, and incorrect, model to obtain an optimal ownership benchmark for our firms. Thus, our failure is not due to the lack of a correlation, but due to model misspecification. One way to address such a concern is to investigate whether “raw” insider purchases, which can be thought of as un-benchmarked changes in ownership, are correlated with changes in the value of the firm. The idea is to assume, as HHP do, that existing ownership structures for each firm are roughly in equilibrium, but to also assume that we cannot accurately model the determinants of these ownership structures. Rather, we propose that if the insider purchases are not anticipated by market participants, larger purchases should have a more substantial stock price response than smaller purchases because, presumably, they correct a more substantial deviation from the optimum. Thus, a finding that unanticipated insider purchases are positively correlated with changes in firm value supports the argument that insiders are buying to move within range of an optimal holding.¹¹

¹¹ We emphasize that this result occurs only when the purchases are unanticipated because if market participants can determine the optimal equilibrium ownership level, presumably, they can also determine how much firms deviate from that optimum, and they can anticipate when and by how much those deviations will be rectified.

To investigate whether larger purchases do have a larger impact on firm value, we regress APARs around announcements of insider share purchases against the associated increase in the fraction of insider share ownership. We continue to include indicator variables for every trade reporting day, but we exclude the other explanatory variables. The results of this simple regression are reported in panel D of Table 4. The coefficient on the increase in insider ownership is negative, albeit not significantly different from zero (p-value = 0.71). This result does not support the idea that increases in share ownership by insiders typically represent movement toward an optimal level of share ownership. Thus, this test, in which ownership is not benchmarked, yields conclusions consistent with our previous tests in which we benchmarked optimal ownership with a specific model.

7. Insider share purchases as signals about the value of the firm

A further possibility is that purchases by the insiders are simply a signal that the firm is undervalued and the positive stock price reaction to the announcement is merely a reflection of this signal (Seyhun (1986) and Piotroski and Roulstone (2005)). As we demonstrated in Section 6, we do not find a positive relation between the size of the purchase and the stock price response. Thus, we must develop a more elaborate signaling explanation to explain the observed stock price reaction.

One possibility is that the marginal information conveyed by the signal is decreasing in the size of the purchase such that the stock price reaction declines as the size of the purchase increases. This explanation is consistent with the APAR being positively correlated with the size of the share purchase as a fraction of total shares outstanding and negatively correlated with this fraction squared, as reported in Table 4. However, this signaling explanation has no implication

for the coefficient of the cross-product of initial ownership with the change in ownership. To investigate this version of a signaling story, we regress APARs against the change in insider ownership and the change in insider ownership squared but we omit the cross-product term. We also include the reporting-day indicator variables.

The results of the regression are reported in the column 1 of Table 5. The signs of the coefficients are positive and negative as the signaling story would predict, but with p-values of 0.32 and 0.12 neither coefficient is significantly different from zero. Furthermore, while the signaling story can reasonably predict a declining marginal effect of the signal as the size of the purchase increases, it is difficult to envision a signaling story that predicts a negative stock price reaction and the coefficients of this regression imply a negative stock price reaction for purchases of more than 13.5% of outstanding shares. This result cannot be reconciled with a signaling explanation.

We employ a variety of other specifications to examine other versions of the signaling explanation. For example, an argument might be made that the dollar amount of a purchase is more informative than the fraction of shares purchased. For that reason, we estimate a regression in which the dollar amount of the purchase is the independent variable along with the reporting-day indicators. As shown in the column 2 of Table 5, the coefficient of the dollar purchase is positive, but not significantly different from zero (p-value = 0.62).

In column 3 of Table 5, we report the results of a regression in which the independent variables are the change in the fraction of inside share ownership and the interaction between this change and the market value of the firm. We estimate this regression because an argument might be made that a given percentage increase in share ownership will have a greater impact on a smaller firm because there is less available information about such firms. However, as shown in

column three, this proposition is not supported by the data. Both the coefficients of the change in ownership and the interaction term are insignificant (p-values of 0.63 and 0.56).

Finally, Leland and Pyle (1977) argue that one cost of signaling with stock ownership by insiders is the possible resultant reduction in diversification on the part of the manager's portfolio. This cost should be higher for firms with more volatile stock prices. We would, therefore, expect the stock price response to a given share purchase to be stronger for firms with more volatile stock prices. In column 4 of Table 5, we present the results of a regression in which the independent variables are the change in insider ownership and the interaction of the change in ownership with the stock return volatility, where stock return volatility is computed using daily returns over the calendar year prior to the year in which the purchase is announced. In this specification as well, neither of the independent variables is statistically significant.

We should emphasize that we are not arguing that the market does not interpret purchases by insiders as signals. The fact that the market responds to the trades clearly indicates that purchases provide information to market participants. But the way in which the market interprets the information is consistent with a curvilinear relation between firm value and insider ownership specified in equation (1) and is not just an indication that the firm is undervalued.

8. Conclusion

In this study we examine stock price responses to announcements of share purchases by corporate insiders for a sample of U.S. firms over the interval 1994 through 1999. In particular, we investigate whether the stock price reaction is consistent with the curvilinear relationship between insider ownership and firm value documented by McConnell and Servaes (1990, 1995). They estimate a quadratic relationship in which the standardized value of the firm is positively

correlated with the fraction of shares owned by insiders up to a point, after which additional insider share ownership is associated with a reduction in the value of the firm. Although we use the McConnell and Servaes studies (1990, 1995) to motivate our investigation, as we have noted, theirs is not the only research that documents a non-linear relationship between the level of share ownership by insiders and the value of the firm.

One interpretation of the relationship estimated by McConnell and Servaes (1990, 1995) and others is that insider ownership can be used to increase firm value up to a point, after which additional ownership actually reduces firm value. Such an interpretation has been criticized because it ignores the endogeneity that might arise when other factors cause both value and ownership to evolve optimally and in harmony one with one another. This study seeks a way around the endogeneity by directly examining instances in which changes in share ownership are observed. We ask whether the changes in firm value that occur when share purchases by insiders are announced are consistent with the model of the non-linear relationship between share ownership and firm value documented by many prior studies. We do so by regressing announcement period abnormal returns when insiders purchase shares against the change in the fraction of shares owned by insiders, the square of the change in the fraction of shares owned, and the interaction of the change in insider ownership and the pre-purchase level of insider ownership. Consistent with the curvilinear relation between insider ownership and firm value, we find that the coefficient on the change in ownership is positive, the coefficient on the change in insider ownership squared is negative, and the coefficient on the interaction is negative. These results are consistent with the causal interpretation of the relation between insider ownership and firm value. We also show that analysts' EPS forecast revisions surrounding the insider trading announcement follow the same pattern as the value changes.

We also examine two alternative interpretations of our results, but find little evidence to support either one. First, we examine whether insiders purchase shares because they do not hold enough stock according a model of optimal ownership. Our evidence shows that this is unlikely to be the case. If anything, it might be argued that the firms in our sample have too much insider ownership to begin with, and those firms with too much ownership actually experience the largest purchases. Moreover, the stock price change is not significantly related to the fraction of shares purchased or the size of the empirically estimated ownership deficit. Second, we study whether the stock price response is consistent with a signaling interpretation where insiders purchase shares to inform the market that the share price is too low. Our tests do not support this interpretation either.

A causal interpretation of our results is certainly not at odds with the existence of an optimal ownership structure. However, the causal interpretation is at odds with the argument that firms are at their optimal ownership structures all the time. It is also inconsistent with the argument that all changes in insider ownership are aimed at moving the firm toward an optimal ownership structure. One implication of the causal interpretation of our empirical results is that managers, the board and other shareholders do not jointly maximize the value of the firm with respect to ownership structure. In some cases, insiders own “too much” stock and in other cases, they do not own enough. In those cases where managers own too much stock, they may be doing so to enhance their entrenched positions. In such cases, forcing insiders to sell shares would be difficult for the board to implement. In those cases where managers do not own enough stock, boards may wish to consider targeted share ownership plans of the type studied by Core and Larcker (2002). We conclude that changes in share ownership by insiders can (and do) affect firm value.

Appendix: Explanatory variables employed in the HHP models explaining insider ownership

(1) $\log(\text{sales})$, (2) $\log(\text{sales})^2$, (3) property, plant, and equipment (PP&E), divided by sales, (4) $\text{PP\&E} / \text{sales}$, squared, (5) the residual standard deviation of a market model estimated annually for each firm using daily data, (6) an indicator variable set equal to one if data are available to estimate the residual standard deviation – when this indicator variable is zero, the residual standard deviation is set equal to zero, (7) operating income to sales, (8) the ratio of R&D to PP&E, (9) an indicator variable set equal to one if data on R&D are available and zero otherwise – when this indicator variable is zero, the ratio of R&D to PP&E is set equal to zero, (10) the ratio of advertising expenditures to PP&E, (11) an indicator variable set equal to one if data on advertising are available and zero otherwise – when this indicator variable is zero, the ratio of advertising to PP&E is set equal to zero, (12) the ratio of capital expenditures to PP&E, and (13) an indicator variable set equal one if capital expenditures are available – when this indicator variable is zero, the ratio of capital expenditures to PP&E is set equal to zero.

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Table 1
Summary statistics on open market purchases by corporate insiders

Summary statistics for open market insider purchases of at least 10,000 shares as reported by *Thomson Financial* over the period 1994 through 1999. Insiders are defined as officers and members of the board of directors. Insider purchases are excluded from the sample if any of the following occurs: (1) insider sales activity is reported on the same day as the purchase; (2) the purchase is reported more than 90 days after the required reporting deadline; (3) the share price is below \$2 at the time of the announcement; or (4) the price at which the insider bought differs by more than 20% from the closing price on the day of the purchase. Insider ownership data are from *Compact Disclosure* and proxy statements. Announcement period abnormal returns (APARs) are computed as the sum of a firm's market-adjusted returns on the reporting day and five subsequent days, where the CRSP value-weighted index is employed as a proxy for the market. Trades are removed from the analysis if the corresponding APAR is not within three standard deviations of the mean APAR for all purchases in the sample. P-values for tests that the mean and median APARs are equal to zero are in parentheses. The market value of equity is computed at the end of the month before the trade.

Variable	Mean	Median	25 th Percentile	75 th Percentile
Shares purchased	61,158	20,000	11,000	40,000
Fraction of ownership purchased	0.42%	0.15%	0.06%	0.35%
Insider ownership before purchase	19.88%	13.83%	5.65%	28.85%
Market value of equity (in \$ millions)	1,123	139	49	522
Amount of purchase (in \$)	898,783	213,750	98,175	503,200
Abnormal return	0.94% (0.00)	0.35% (0.00)	-3.47%	4.82%

Year	Number of purchases	Number of companies
1994	712	450
1995	627	438
1996	711	509
1997	624	412
1998	898	577
1999	569	391
Total	4141	

Table 2

Regressions of announcement period abnormal returns (APARs) on the change in insider ownership, the change in insider ownership squared, and the cross-product of the change in insider ownership and the level of insider ownership before the insider share purchase

The dependent variable is the announcement period abnormal return (APAR) associated with open market purchases of at least 10,000 shares by officers and directors over the period 1994 through 1999. The APAR is computed as the sum of a firm's market-adjusted returns on the reporting day and five subsequent days, where the CRSP value-weighted index is employed as a proxy for the market. Insider purchases are excluded from the sample if any of the following occurs: (1) insider sales activity is reported on the same day as the purchase; (2) the purchase is reported more than 90 days after the required reporting deadline; (3) the share price is below \$2 at the time of the announcement; or (4) the insider purchase price differs by more than 20% from the closing price on the day of the purchase. Insider ownership is the fraction of shares owned by officers and directors. Pre-purchase ownership refers to ownership before the share purchase. All regression models contain reporting-day fixed effects. Column (1) is the base case regression which excludes APARs outside three standard deviations of the mean APAR. The other columns contain sensitivity tests: column (2) includes two additional explanatory variables: the change in institutional ownership over the quarter surrounding the announcement of the trade, obtained from *Thomson Financial*, and an indicator variables, set equal to 1 if institutional ownership is not available for that firm; if the indicator is set equal to 1, the change in institutional ownership is set equal to zero; column (3) contains the model estimated after possibly confounding events have been removed; column (4) does not remove any outliers in APARs; column (5) removes APARs if they are more than 2 standard deviations removed from the mean; column (6) includes all purchases of 5,000 shares or more; column (7) includes all purchases of 20,000 shares or more; column (8) includes ownership of options that cannot be exercised within 6 months for 1,645 firms with these data available from *Execucomp*; column (9) excludes all option ownership for 1,645 firms with these data available from *Execucomp*; column (10) excludes firms with insider ownership more than 3 standard deviations above the mean; column (11) excludes firms with insider ownership more than 3 standard deviations above the mean and firms with insider ownership below the 1st percentile of the distribution; and column (12) constrains the relative magnitudes of the coefficients of b_2 and b_3 . P-values are in parentheses.

Table 2 (continued)

Variable	Base case	Including the change in instit. ownership	Removing confounding events	All APARs	Excludes APARs > 2 SDs from mean	5,000 shares or more	20,000 shares or more
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Δ Insider ownership (b_1)	0.58 (0.04)	0.58 (0.06)	0.56 (0.06)	1.16 (0.00)	0.60 (0.02)	0.66 (0.01)	0.60 (0.04)
Δ Insider ownership squared (b_2)	-1.58 (0.07)	-1.61 (0.05)	-1.43 (0.08)	-2.75 (0.01)	-1.21 (0.10)	-2.54 (0.06)	-1.85 (0.09)
Δ Insider ownership x Pre-purchase insider ownership (b_3)	-1.10 (0.07)	-1.07 (0.06)	-1.18 (0.06)	-1.91 (0.01)	-1.14 (0.03)	-1.05 (0.04)	-1.12 (0.08)
Δ Institutional ownership		0.06 (0.02)					
Indicator if institutional ownership is missing		-0.00 (0.19)					
P-value on test: $2 b_2 = b_3$	0.26	0.16	0.35	0.10	0.43	0.16	0.19
Adjusted r-squared	0.07	0.07	0.06	0.05	0.07	0.06	0.07
# of observations	4141	4141	3739	4211	4004	6831	2089
# of reporting day indicators	934	934	893	941	917	1129	667

Table 2 (continued)

Variable	Including all option ownership for 1,645 firms (8)	Excluding option ownership for 1,645 firms (9)	Excl. own > 3 SDs above mean (10)	Excl. own > 3 SDs above mean & <1 st perc. (11)	Constrained regression: $b_3 = 2b_2$ (12)
Δ Insider ownership (b_1)	0.59 (0.06)	0.56 (0.07)	0.60 (0.04)	0.62 (0.03)	0.38 (0.08)
Δ Insider ownership squared (b_2)	-1.59 (0.05)	-1.55 (0.05)	-1.55 (0.08)	-1.59 (0.07)	-0.49 (0.04)
Δ Insider ownership x Pre-purchase insider ownership (b_3)	-1.29 (0.05)	-1.05 (0.06)	-1.21 (0.06)	-1.24 (0.05)	-0.98 (0.04)
P-value on test: $2 b_2 = b_3$	0.26	0.18	0.30	0.29	
Adjusted r-squared	0.07	0.07	0.07	0.07	
# of observations	4141	4141	4087	4044	4141
# of reporting day indicators	934	934	931	927	934

Table 3

Regressions of analyst earnings forecast revisions on the change in insider ownership, the change in insider ownership squared, and the cross-product of the change in insider ownership and the level of insider ownership before the insider share purchase

The dependent variable is the revision in the EPS forecast computed using the IBES Summary dataset. The revision is based on the first forecast made after the announcement of the insider purchase and the last forecast made before the announcement of the insider purchase and computed as: $(\text{New median forecast} - \text{Old median forecast}) / |\text{Old median forecast}|$. Only forecasts of annual earnings are included. Forecast revisions that are more than three standard deviations away from the mean are removed. The standard errors are adjusted for the fact that revisions for several fiscal year-end earnings are made during the same statistical period. Column (1) contains the base case regression while column (2) includes control variables. P-values are in parentheses.

Variable	Base case (1)	Including control variables (2)
Intercept	-0.05 (0.00)	-0.24 (0.00)
Δ Insider ownership (d_1)	1.81 (0.00)	2.72 (0.00)
Δ Insider ownership squared (d_2)	-2.79 (0.03)	-5.93 (0.00)
Δ Insider ownership x Pre-purchase insider ownership (d_3)	-2.74 (0.05)	-2.59 (0.07)
Log market value equity		0.02 (0.00)
Log number of estimates		-0.01 (0.07)
Lagged forecast revision		0.01 (0.06)
P-value on test: $2 d_2 = d_3$	0.36	0.08
Adjusted r-squared	0.01	0.01
# of observations	7146	6778

Table 4
Tests to determine whether the insider purchases move ownership to an optimal level

A model of “optimal” insider ownership is estimated using data for the period 1987 until the year prior to the announcement of the insider purchase, using the explanatory variables of HHP, as listed in the Appendix. The model is estimated using OLS with firm fixed effects. For each purchase, the pre-purchase insider ownership is subtracted from the optimal insider ownership and the resulting value is called the “insider ownership deficit.” A positive number indicates that a firm has “too little” insider ownership before the purchase.

Panel A reports mean and median values for the insider ownership deficit in which the optimal level of insider ownership is computed for the end of the year in which the purchase occurred. These statistics are reported using all purchases in a given year and using the average purchase per firm in the year. P-values of t-tests for means and sign rank tests for medians are in parentheses. Panel B reports a simple regression in which the change in insider ownership associated with a purchase is the dependent variable and the insider ownership deficit, computed for each purchase, is the independent variable. Panels C and D report regressions in which the announcement period abnormal return (APAR) is the dependent variable and the explanatory variables are the change in insider ownership, the insider ownership deficit, and an interaction between the change in insider ownership and the insider ownership deficit. The regressions include reporting day indicator variables. APARs are defined in Tables 1 and 2. For panels B, C, and D, p-values of the t-tests of significance of the regression coefficients are in parentheses.

Panel A: Insider ownership deficit measured as predicted optimal insider ownership less actual pre-purchase insider ownership

	Mean	Median	N
Insider ownership deficit (all purchases)	-0.0021 (0.24)	-0.0013 (0.04)	3109
Insider ownership deficit (average purchase per firm-year)	0.0025 (0.21)	-0.0002 (0.46)	2069

Panel B: OLS regression estimating the relation between the change in insider ownership associated with the purchase and the insider ownership deficit

Intercept	0.0041 (0.00)
Insider ownership deficit	-0.0078 (0.00)
Adjusted r-squared	0.01
Number of observations	3109

Table 4 (continued)

Panel C: OLS regression estimating the relation between the announcement period abnormal returns and the change in insider ownership, the insider ownership deficit, and the cross-product of the change in insider ownership and the insider ownership deficit

Δ Insider ownership	-0.04 (0.74)
Insider ownership deficit	-0.01 (0.71)
Δ Insider ownership * insider ownership deficit	0.43 (0.60)

Adjusted r-squared	0.06
Number of observations	3069
Number of reporting day indicators	766

Panel D: OLS regression estimating the relation between announcement period abnormal returns and the change in insider ownership

Δ Insider ownership	-0.04 (0.71)
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Adjusted r-squared	0.06
Number of observations	4141
Number of reporting day indicators	934

Table 5**Regressions models used to examine alternative interpretations of the results**

The dependent variable is the announcement period abnormal return (APAR) associated with open market insider purchases of at least 10,000 shares by officers and directors over the period 1994 through 1999. APAR is defined in Tables 1 and 2. Insider purchases are removed from the sample if the corresponding APAR is not within three standard deviations of the mean APAR for all purchases by insiders. Insider purchases are also excluded from the sample if any of the following occurs: (1) insider sales activity is reported on the same day as the purchase; (2) the purchase is reported more than 90 days after the required reporting deadline; (3) the share price is below \$2 at the time of the announcement; or (4) the price at which the insider bought differs by more than 20% from the closing price on the day of the purchase. Stock price volatility is computed as the standard deviation of daily returns over the year before the year in which the insider purchase took place. All regression models contain reporting-day fixed effects. P-values of the t-tests of significance of the regression coefficients are in parentheses.

Variable	(1)	(2)	(3)	(4)
Δ Insider ownership	0.18 (0.32)		-0.06 (0.63)	-0.46 (0.20)
Δ Insider ownership squared	-1.37 (0.12)			
Dollar amount of purchase (in \$ millions)		0.0001 (0.62)		
Δ Insider ownership x market value of firm			0.0001 (0.56)	
Δ Insider ownership x stock price volatility				3.65 (0.13)
Adjusted r-squared	0.06	0.06	0.06	0.07
Number of observations	4141	4134	4141	3927
Number of reporting day indicators	934	933	934	915