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Ownership structure, investment, and the corporate value: an empirical analysis

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Abstract

This paper examines the relation among ownership structure, investment, and corporate value, focusing on whether ownership structure affects investment. Ordinary least squares regression results suggest that ownership structure affects investment and, therefore, corporate value. However, simultaneous regression results indicate that the endogeneity of ownership may affect these inferences, suggesting that investment affects corporate value which, in turn, affects ownership structure. The evidence shows that corporate value affects ownership structure, but not vice versa. These findings raise questions regarding the assumption that ownership structure is exogenously determined, and bring into question the results in studies that treat ownership structure as exogenous.

Keywords: Ownership structure; Investment; Corporate value; Endogeneity

JEL classification: G31; G32

1. Introduction

Morck et al. (1988) and McConnell and Servaes (1990) find a non-linear relation between ownership structure and corporate value. I extend this line of research in two ways. First, by exploring how ownership structure affects corporate value, I hypothesize that ownership structure affects investment

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which, in turn, affects corporate value. Because McConnell and Muscarella (1985) have shown that investment positively affects corporate value, I test whether ownership structure affects investment. Second, by testing whether it is appropriate to treat ownership structure as exogenous, I explore the possibility that ownership structure, investment, and corporate value are endogenously determined rather than assuming that ownership structure is exogenous. If ownership structure is, in fact, endogenously determined as Demsetz and Lehn (1985) contend, then ordinary least squares (OLS) will generate inconsistent parameter estimates which can lead to a misinterpretation of regression results and incorrect management decisions.

Using a cross section of Fortune 500 manufacturing firms in 1991, I find a significant relation between insider ownership and corporate value, consistent with Morck et al. (1988). I also find a similar non-monotonic relation between insider ownership and investment, where investment is measured by both capital expenditures and research and development (R&D) expenditures. The relation between insider ownership and investment is positive for ownership levels below 7%, negative for levels between 7% and 38%, and positive for levels above 38%. Based on this analysis, one can conclude that ownership structure affects investment and, therefore, corporate value.

This specification, however, does not control for endogeneity. When I estimate a simultaneous equation regression instead of OLS, I find that corporate value affects ownership structure but not the reverse, thereby reversing the interpretation of the relation between ownership structure and corporate value. This finding raises important questions regarding the implicit assumption that ownership structure is exogenously determined, and suggests that previous studies may be misspecified.

This paper is organized as follows. Section 2 discusses the theoretical predictions. Section 3 describes the data. I discuss empirical specifications and results in Section 4. Section 5 contains a summary and conclusions.

2. Theoretical predictions

I discuss the relation among ownership structure, investment, and corporate value, focusing on whether ownership structure affects investment. I then address the issue of endogeneity of ownership structure, and discuss potential problems in treating ownership structure as exogenous.

2.1. Ownership structure, investment, and corporate value

Jensen and Meckling (1976) and Stulz (1988) show that ownership structure affects corporate value. In particular, in their explanation of how ownership structure affects corporate value, Jensen and Meckling (1976) argue that

ownership structure affects corporate value by its effect on investment. If we view these effects as a two-stage process, the first stage is the impact of ownership structure on investment, while the second stage is the effect of investment on corporate value. Morck et al. (1988) and McConnell and Servaes (1990) empirically explore the overall relation between ownership structure and corporate value using Tobin's Q as a proxy for corporate value. Tobin's Q may serve as a proxy for other things such as corporate quality or corporate opportunities (see McLaughlin et al. (1996) for the use of Tobin's Q as a measure of corporate opportunities). They find non-monotonic relations and interpret this finding as consistent with the hypothesis that ownership structure affects corporate value. They suggest that, at low levels of managerial ownership, an increase in managerial ownership more closely aligns the interests of managers and shareholders, thereby increasing corporate value. However, at high levels of managerial ownership, an increase in managerial ownership makes management more entrenched and less subject to market discipline, thereby reducing corporate value.

McConnell and Muscarella (1985) and Chan et al. (1990) explore the second stage of Jensen and Meckling's (1976) implication concerning the link between investment and corporate value, and find evidence in support of the hypothesis that investment affects corporate value. Specifically, McConnell and Muscarella find that, on average, the stock market reacts positively to announcements of increases in planned capital expenditures and negatively to decreases in planned capital expenditures. Chan et al. show that share-price responses to announcements of increased R&D spending are significantly positive.

Yet there is little empirical evidence regarding the first stage, which is the link between ownership structure and investment. The empirical literature on the cross-sectional variation in investment has focused on whether liquidity affects investment without considering the possible effects of ownership structure. For example, Fazzari et al. (1988) present evidence that liquidity affects investment, emphasizing the importance of asymmetric information problems and agency problems in investment financing decisions. In that regard, my paper can be viewed as an empirical investigation of whether ownership structure affects investment.

2.2. Endogeneity issues

While Morck et al. (1988) and McConnell and Servaes (1990) treat ownership structure as exogenous in exploring the relation between ownership structure and corporate value, Demsetz and Lehn (1985) argue that ownership structure is endogenously determined in equilibrium. Furthermore, Kole (1994) provides evidence of a reversal of causality in the ownership-corporate value relation, suggesting that corporate value could be a determinant of the ownership structure rather than being determined by ownership structure.

These results raise doubts about the fundamental assumption that ownership structure is exogenously determined. In particular, Kole's (1994) finding suggests that, other things being equal, managers may prefer equity compensation when they expect their firm to perform well and, consequently, the value of the firm to increase. This rationale is consistent with Murphy (1985), who finds that managerial compensation is strongly positively related to corporate performance, suggesting that ownership structure can represent an endogenous outcome of the compensation contracting process. Taken together, this possibility and the results of previous studies lead to the hypothesis that ownership structure, investment, and corporate value might be interdependent. That is, ownership structure affects investment which, in turn, affects corporate value, and corporate value, again, affects ownership structure and so forth.

To the extent that ownership structure is endogenously determined, OLS will yield inconsistent coefficients. Furthermore, treating ownership structure as exogenous can confuse the direction of causality. For example, if corporate value affects ownership structure, then regressing a measure of corporate value against a measure of ownership structure is problematic. This false attribution of causality can lead to a misinterpretation of the relation between ownership structure and corporate value and to incorrect management decisions such as a compensation policy that emphasizes stock grants to the executives. To solve this problem, I use simultaneous equation regression when I explore the possibility that ownership structure, investment, and corporate value are endogenously determined.

3. Data

My sample consists of the 1991 Fortune 500 manufacturing firms. I define insider ownership as the fraction of shares, not including options, held by officers and directors of the board, which I get from corporate proxy statements and 1991 editions of the Value Line Investment Survey. I employ two measures of corporate investment, capital expenditures and R&D expenditures, obtained from Standard and Poor's Compustat and the Business Week Annual R&D Scoreboard. Finally, I calculate Tobin's Q, my measure of corporate value, using Compustat data and the algorithm proposed by Lindenberg and Ross (1981).[1]

I eliminate 147 of the 500 firms which are either privately held or have incomplete ownership structure. I drop an additional 27 firms from the sample because they are missing capital expenditures data or other accounting measures needed to calculate Tobin's Q. As a result, the final sample contains 326 firms. In the analysis on R&D expenditures, I use 230 firms because the

[1] I thank Michael Weisbach and John McConnell for providing me with the algorithm and relevant information.

Table 1
Summary statistics for a sample of 326 Fortune 500 firms. Firm characteristics include insider ownership, asset size, Tobin's Q measured at the end of the year, the ratio of capital expenditures to replacement cost of assets, the ratio of research and development (R&D) expenditures to replacement cost of assets, and the ratio of cash flow to replacement cost of assets. Data is displayed for 1991, unless otherwise noted.

	Mean	Median	Standard deviation
Insider ownership (%)	12.14	4.45	18.10
Replacement cost of assets ($millions)[a]	$5459.14	$1985.52	$13511.22
Tobin's Q (1990)	1.10	0.90	0.68
Tobin's Q (1991)	1.23	0.98	0.99
Capital expenditure to replacement cost	0.07	0.04	0.04
R&D expenditure to replacement cost[b]	0.04	0.02	0.04
Cash flow to replacement cost[c]	0.06	0.06	0.05

[a]Replacement cost of assets is the book value of a firm's assets with inflation adjustments to property, plant and equipment, inventories, intangibles, and investment in unconsolidated subsidiaries. Costs are displayed in million dollars.
[b]R&D data are available for 230 firms.
[c]Cash flow is after-tax income plus depreciation and amortization.

R&D expenditures data for 96 firms are not identified in either Compustat or the Business Week R&D Scoreboard.

Tables 1 and 2 contain summary statistics for the sample. Table 1 describes insider ownership, Tobin's Q, and other important firm characteristics. The mean combined ownership stake of all board members is 12.14%. The median ownership stake, however, is only 4.45%, suggesting that the distribution is skewed. Table 1 also shows a higher variability of Tobin's Q in 1991 than in 1990. In the sample, Q values in 1991 range from 0.10 to 8.82, including two observations with values greater than six, while such outliers do not exist in 1990. McConnell and Servaes (1990) use the Q value of six as the cutoff point in determining outliers, while Morck et al. (1988) do not provide any information about outliers. To examine the influence of outliers on the OLS regression of corporate value and the simultaneous regression where the Tobin's Q for 1991 is used, I reestimate the regressions excluding the outliers. The results are discussed in Sections 4.1.1 and 4.2.2. To examine the influence of the two outliers on the higher variability of Q values in 1991, I exclude the outliers and recalculate the standard deviation of Tobin's Q in 1991. The result of the recalculation shows that the standard deviation decreases from 0.99 to 0.80, suggesting that the two outliers are the main sources of the higher variability of Q values in 1991.

Table 2 reports the distribution of the sample statistics, grouped by level of insider ownership. The sample distributions are skewed towards low levels of

Table 2
Average 1991 levels of firm characteristics for a sample of 326 Fortune 500 firms, grouped by level of insider ownership (I/O). Firm characteristics include replacement cost of assets (RC), the ratio of capital expenditures to replacement cost of assets, the ratio of research and development (R&D) expenditures to replacement cost of assets, and the ratio of cash flow to replacement cost of assets, and Tobin's Q measured at the end of the year. Replacement cost of assets is defined as the book value of a firm's assets with inflation adjustments to property, plant and equipment inventories, intangibles, and investment in unconsolidated subsidiaries, and is displayed in million dollars. R&D statistics are available for 230 firms. cash flow is defined as after-tax income plus depreciation and amortization.

Insider ownership level	Number of firms	RC	Capital expenditures/ RC	R&D expenditures/ RC	Cash flow/ RC	Tobin's Q
$0 \leqslant I/O < 5\%$	171[a]	\$7788.80	0.063	0.038	0.053	1.020
$5 \leqslant I/O < 10\%$	51	\$2639.13	0.078	0.040	0.067	1.317
$10 \leqslant I/O < 20\%$	40	\$3519.57	0.077	0.058	0.069	1.234
$20 \leqslant I/O < 30\%$	20	\$5092.09	0.060	0.030	0.053	1.145
$30 \leqslant I/O < 40\%$	11	\$2264.54	0.052	0.024	0.067	1.047
$I/O \geqslant 40\%$	33	\$1327.72	0.053	0.020	0.047	1.014

[a]These are five firms with 0% insider ownership and 42 firms with insider ownership less than 1%.

insider ownership. In 171 firms, comprising 52% of the sample, board members own less than 5% of the firm. In 42 firms, total board holdings constitute no more than 1% of equity. However, the holdings do span a wide range of insider ownership. In 104 firms, 32% of the sample, board members own more than 10% of the firm, and in 64 firms, 20% of the sample, board members own more than 20% of the firm. These numbers are consistent with the findings of Demsetz and Lehn (1985) and Morck et al. (1988), suggesting the prevalence of significant management ownership in the U.S.

Table 2 also suggests that there is an inverse relation between level of insider ownership and replacement cost of assets although not statistically significant. The level of insider ownership is low at large firms, and generally higher at small firms. The statistics for capital and R&D expenditures indicate that the variation of R&D expenditures is greater than capital expenditures across different levels of insider ownership.

4. Empirical specifications and results

This section describes the methods for investigating the relation among ownership structure, investment, and corporate value and the results and implications are then discussed. The OLS regression model is discussed first, and then the simultaneous equations regression model is presented.

4.1. Piecewise OLS regression analysis

Following Morck et al. (1988), I estimate a piecewise OLS linear regression of corporate value on ownership structure. I assume two changes in the slope coefficient on insider ownership because this study and Morck et al. use similar data sets, Fortune 500 firms. Similarly, I estimate the following model of the investment equation to investigate whether ownership structure affects investment:

$$INV_i = \alpha + \beta_1 INS1_i + \beta_2 INS2_i + \beta_3 INS3_i + u_i, \tag{1}$$

where INV_i is the investment level for firm_i, and $INS1_i$ represents insider ownership of firm_i if insider ownership is less than some first significant breakpoint, k. $INS1_i$ will equal k if insider ownership is above that breakpoint. $INS2_i$ will be zero if the insider ownership for firm_i is less than the first breakpoint, k. $INS2_i$ is calculated as being equal to the level of insider ownership less k if insider ownership is equal to k or falls between k and some second breakpoint, m, or as being equal to $m - k$ if the insider ownership is greater than or equal to the second breakpoint, m. Finally, $INS3_i$ will equal zero if insider ownership of firm_i is below the second breakpoint, m, or will equal the level of insider ownership less m if insider ownership is greater than or equal to m.

In the investment equation, there are three insider ownership variables representing three different levels of ownership. To find two breakpoints that define these levels, I use a grid search technique. First, I seek to find the level of insider ownership, starting with 0%, that produces the most significant slope coefficient on the first insider ownership variable in the regression. I fix this level, and then search for the second ownership level that yields the most significant slope coefficients on the second and the third insider ownership variables in the regression. Finally, using an iterated search technique around the two initial points, I seek to find the two levels of ownership that provide the most significant slope coefficients on the three insider ownership variables simultaneously.

4.1.1. Corporate value regression results

As a preliminary step, I estimate the corporate value regression to test whether the well-established relation between ownership structure and corporate value holds with my data. I identify the two breakpoints of 7% and 38% using the grid search technique described above. The piecewise OLS regression provides the following results:

$$Q = 1.1101 + 7.766^{*}INS1 - 1.949^{*}INS2 + 0.959^{*}INS3,$$
$$\quad (9.68) \quad (2.65) \quad (-2.18) \quad (0.94)$$
$$\text{Adj. } R^2 = 0.014, \quad F = 2.540, \quad N = 326. \tag{2}$$

T-statistics are shown in parentheses below coefficients. The relation between insider ownership and Tobin's Q is significantly positive for ownership levels below 7%, significantly negative for levels between 7% and 38%, and positive, but insignificant, for levels above 38%.

I also estimate the corporate value regression with control variables that Morck et al. (1988) advanced as important determinants of Tobin's Q. The control variables include firm size, financial leverage, and dummy variables representing industry effect, based on two-digit Standard Industrial Classification (SIC) codes. I measure firm size as the logarithm of the replacement cost of assets. Morck et al. (1988) and McConnell and Servaes (1990) use the replacement cost of assets as their measure of firm size. Note, however, that the replacement cost of assets is used as the denominator of the dependent variable, Tobin's Q. If the replacement cost of assets is measured with error there will be a spurious negative relation between firm size and corporate value. To alleviate this problem, I use the logarithm of the replacement cost of assets as my measure of firm size. Another way to correct this problem would be to use other measures of firm size, such as the book value of assets. I measure leverage as the market value of the long-term debt divided by the replacement cost of assets. Although the regression results show that leverage has a strong negative correlation with corporate value, and that the adjusted R-squares are substantially increased, the non-linear relation between Q and insider ownership remains significant. These results are consistent with Morck et al. (1988).

Finally, to examine the possible influence of the outliers on the corporate value regression, I estimate the regression excluding two observations with Q values greater than six in 1991. The results show that the ownership variables are weaker, but still statistically significant at the 10% level. Overall, the preliminary investigation reveals that my data set is similar to that used in Morck et al. (1988), and that the results of corporate value regression corroborate their findings.

4.1.2. Investment regression results

Table 3 shows the results of OLS regressions of capital expenditures and R&D expenditures regressions on insider ownership and other firm characteristics. All of these regressions use breakpoints of insider ownership to test whether different levels of insider ownership have different effects on investment expenditures. I impose breakpoints of 7% and 38% of insider ownership to be consistent with the earlier analysis, although grid search reveals that the natural breakpoints are 9% and 36% of insider ownership for capital expenditures and 10% and 34% of insider ownership for R&D expenditures. I normalize both capital and R&D expenditures using the firm's replacement cost of assets to eliminate scale effect. Since there is no widely accepted structural model of investment, I first estimate the investment regressions including only insider ownership variables.

Table 3
Piecewise linear ordinary least-squares regressions analysis of investment in capital expenditures, and investment in research and development (R&D) expenditures, on insider ownership and other firm characteristics. The capital expenditure model is based on data for 326 Fortune 500 firms, and the R&D expenditure model is based on data for 230 Fortune 500 firms. In the analysis, capital expenditures and R&D expenditures are divided by the replacement cost of assets, to adjust for the size of the firm. Breakpoints for the effects of the levels of insider ownership on investment are 7% and 38% of total firm ownership. All data are for 1991, except Tobin's Q, which is calculated at the end of 1990. t-statistics in parentheses.

	Capital expenditures		R&D expenditures	
INS1[a]	0.285	0.256	0.356	0.135
	(3.02)	(2.89)	(2.74)	(1.24)
INS2[b]	− 0.106	− 0.097	− 0.130	− 0.045
	(− 3.69)	(− 3.43)	(− 2.77)	(− 1.07)
INS3[c]	0.036	0.046	0.025	0.029
	(1.11)	(1.52)	(0.49)	(0.66)
Liquidity[d]		0.188		0.107
		(4.61)		(2.30)
Tobin's Q		0.008		0.022
		(2.33)		(5.07)
Volatility[e]		− 0.00007		− 0.00006
		(− 0.14)		(− 0.63)
Industry dummy[f]		Yes		Yes
Number of firms	326	326	230	230
Adj. R^2	0.038	0.235	0.036	0.372
F	5.295	4.017	3.884	6.014

[a]INS1 = insider ownership if insider ownership < 0.07,
= 0.07 if insider ownership of firm $\geqslant 0.07$.
[b]INS2 = 0 if insider ownership < 0.07,
= insider ownership − 0.07 if $0.07 \leqslant$ insider ownership < 0.38,
= 0.31 if insider ownership $\geqslant 0.38$.
[c]INS3 = 0 if insider ownership of firm < 0.38,
= insider ownership − 0.38 if insider ownership $\geqslant 0.38$.
[d]Liquidity = cash flow divided by the replacement cost of assets.
[e]Volatility = standard deviation in changes in profit rate during the period of 1986–1991. Profit rate is defined as profit before extraordinary items divided by the replacement cost of assets.
[f]Set of variables identifying industry of firm, based on 2-digit Standard Industrial Classification Code.

The regressions reported in the first and third columns of Table 3 strongly suggest that there is a significant non-monotonic relation between the level of investment and insider ownership. For both capital expenditures and R&D expenditures, the level of investment rises as insider ownership increases up to 7%. It declines as insider ownership increases up to 38% and then rises after 38%. The relation between insider ownership and investment is significant for

ownership levels between 0% and 38%, but is insignificant for levels above 38%. Estimation results using the natural breakpoints are a bit stronger than, but similar to, those using the imposed points.

One interesting result is the similarity of the size of coefficients on the insider ownership variables in both capital expenditures and R&D expenditures regressions. In Tables 1 and 2, I have shown that the ratio of capital expenditures to the replacement cost of assets is higher than that of R&D expenditures to the replacement cost of assets. Ignoring the endogeneity issues, the similar coefficient size may suggest that a change in insider ownership will have a greater proportional impact on R&D.

Next, I estimate the investment equations with control variables. I include a liquidity variable, which is defined as cash flow divided by the replacement cost of assets and is meant to control for the effect of liquidity on investment. Cash flow is defined as after-tax income plus depreciation and amortization. I also include Tobin's Q, calculated at the end of 1990, to control for the possible effects of corporate value on investment. Firms with higher corporate values may have more investment opportunities and, therefore, invest more. Hoshi et al. (1991) and Kaplan and Zingales (1995) provide evidence that investment is related to Tobin's Q. Note that the use of Tobin's Q also helps control for the possibility that liquidity may serve as a proxy for corporate value or investment opportunities. High liquidity may signal that the firm has done well and will likely continue to do so. Firms with higher liquidity may, therefore, have higher corporate values and more investment opportunities.[2] In the estimation, I use 1990 Tobin's Q as an instrument of 1991 Tobin's Q to reduce the potential endogeneity that corporate value may be a function of investment. I also use a volatility variable to control for variability of profits, since volatile profits may adversely affect investment due to the uncertainty of the expected relation between current and future profitability. The variable is defined as the standard deviation of the changes in yearly profit rate over the five-year period 1986–1991, where profit rate is measured as income before extraordinary items divided by the replacement cost of assets in each year. Finally, industry dummy variables based on two-digit SIC codes are introduced to control for industry effects.

The second and fourth columns of Table 3 provide the regression estimates with control variables. The capital expenditures regression results presented in the second column show that the non-monotonic relation between insider

[2] The inclusion of Tobin's Q is a crude means of avoiding the problem and may not resolve the possible bias in the coefficient on the Liquidity variable. However, since the primary objective of this paper is to investigate whether insider ownership affects investment, I believe that introducing Tobin's Q will be sufficient to alleviate the problem. More advanced methods to deal with this problem are presented in Hoshi et al. (1991), Fazzari and Peterson (1993), and Kaplan and Zingales (1995).

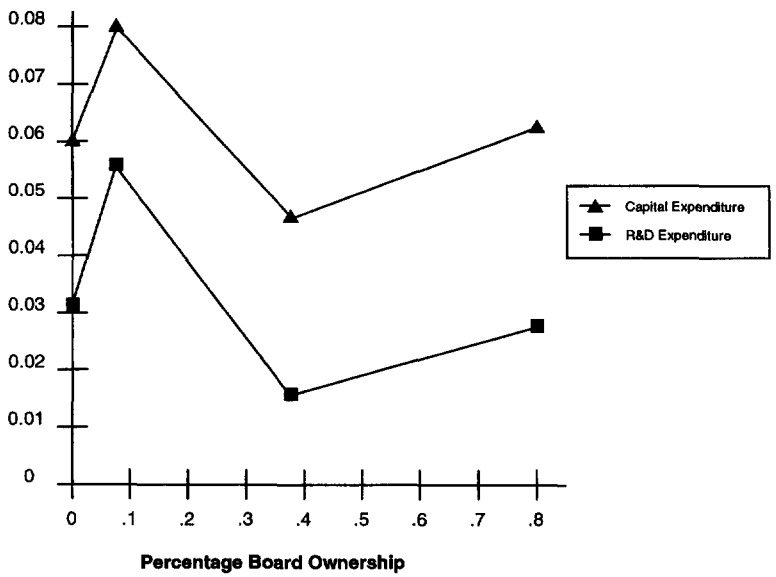

Fig. 1. The relationship between insider ownership and investment in capital expenditures and research and development (R&D) expenditures implied by the piecewise linear ordinary least squares regression of 1991 investment on insider ownership and other firm characteristics for 326 Fortune 500 firms. Capital expenditures and R&D expenditures are divided by the replacement cost of assets to control for firm size.

ownership and capital expenditures remains significant after inclusion of the control variables. The results also indicate that liquidity and Tobin's Q affect capital expenditures, consistent with Fazzari et al. (1988). The R&D expenditures regression results, however, indicate that the non-monotonic relation between insider ownership and R&D expenditures becomes insignificant when I introduce the control variables. I examine the possibility that this result may be caused by a potential reporting bias, because only 230 out of 326 firms disclose their R&D expenditures, by estimating the capital expenditures regression using the 230 firms. The result shows that the non-linear relation between insider ownership and capital expenditures remains significant. This finding suggests that the weak relation between insider ownership and R&D expenditures is not the outcome of using the 230 firms that voluntarily report their R&D expenditures. Estimation results of the R&D expenditures regression using the natural breakpoints of insider ownership, 10% and 34%, show that the relation becomes weakly significant at the 10% level. Fig. 1 illustrates the relation between insider ownership and investment, where investment is measured by both capital expenditures and R&D expenditures.

Though not reported, I estimate the investment regressions using other specifications. First, I use the lagged value of the liquidity variable as an

instrument to control for the possibility that liquidity may be endogenously determined. Second, I replace the replacement cost of assets with capital stock as a scalar. This scaling has been frequently used in the previous research on capital expenditures investment. Finally, I examine whether insider ownership significantly enters the regression through a spurious correlation with sales growth, dividends, or firm size. The regression results using these different specifications are qualitatively similar to those in Table 3.

The investigation in this section shows that there is a non-linear relation between ownership structure and investment, although the evidence is weak in the R&D expenditures regression. One concern is that this result is obtained using a single year's data, and therefore may be subject to the question of stability over time. However, the findings of McConnell and Servaes (1995) that the relation between ownership structure and corporate value is consistent across years suggests that the investment regression results may be time invariant.

Ignoring the endogeneity issue, the investment regressions suggest that ownership structure affects investment. Taken together, this finding and the results from the corporate value regression suggest that ownership structure affects investment and, therefore, corporate value, which is consistent with Jensen and Meckling (1976). Note that the non-linear relation between ownership structure and investment reported in this section is very similar to the non-linear relation between ownership structure and corporate value in Section 4.1.2.

4.2. Simultaneous equation regression analysis

To address the potential endogeneity effect, I estimate a simultaneous equations system of ownership structure, investment, and corporate value using the two-stage least squares (2SLS) method. Because two-stage least squares regression and three-stage least squares regression provide qualitatively similar results, I only report the results from the 2SLS model. Specifically, I estimate the following simultaneous equations system:

$$\text{Insider ownership} = f(\text{Market value of firm's common equity, Corporate value, Investment, Volatility of earnings, Liquidity, Industry}), \quad (3)$$

$$\text{Corporate value} = g(\text{Insider ownership, Investment, Financial leverage, Asset size, Industry}), \quad (4)$$

$$\text{Investment} = h(\text{Insider ownership, Corporate value Volatility of earnings, Liquidity, Industry}). \quad (5)$$

Eq. (3), the insider ownership equation, is similar to the one estimated by Demsetz and Lehn (1985). I use the market value of the firm's common equity,

measured at the end of 1991, to examine whether managerial wealth constraints and risk aversion may affect the level of insider ownership. The simultaneous regression results obtained by using the logarithm of replacement cost of assets instead of the market value of common equity in the insider ownership regression are similar to those reported in Table 4. Managerial wealth constraints and risk aversion may limit the ability and willingness of managers to hold a large fraction of their company's shares, implying a low level of insider ownership at large equity-size firms. The use of Tobin's Q captures the possibility that corporate value affects insider ownership. Other things being equal, managers may prefer equity compensation when they expect their firm to perform well and, consequently, the value of the firm to increase. As a result, higher levels of insider ownership are expected at firms with high corporate values. I also include investment variables, capital and R&D expenditures divided by the replacement cost of assets, and a liquidity variable, cash flow divided by the replacement cost of assets, to examine the effect that investment and liquidity may have on ownership structure. A higher level of investment may lead to a greater corporate value which, in turn, induces a higher level of insider ownership. Liquidity may also indirectly affect insider ownership by its effect on investment. Finally, I employ a measure of volatility of earnings, described previously, to examine the possibility that high firm-specific uncertainty affects the level of insider ownership. There are two possible effects of earnings volatility. On the one hand, volatility may increase the value of insider ownership because the uncertainty makes it difficult to monitor the contribution of managers to firm performance. On the other hand, volatility may add to managerial risk aversion, making higher insider ownership more costly and, therefore, less likely.

The corporate value equation, Eq. (4), is similar to the one used in the OLS corporate value regression. I use the lagged value of the leverage variable, measured as the market value of the long-term debt divided by the replacement cost of assets in 1990, as an instrument to control for the possibility that financial leverage is endogenously determined. This approach avoids estimating a separate debt equation, which is not a focus of this paper. Despite this, I explore whether simultaneous regression is affected by potentially different roles of debt in firms with different growth opportunities. The results are discussed in the robustness tests section.

The investment equation, Eq. (5), is also similar to the one used in the OLS investment regression. I use both capital expenditures and R&D expenditures as measures of investment. In a manner different from the OLS investment regression, however, I employ Tobin's Q measured at the end of 1991 instead of Tobin's Q measured at the end of 1990 to fully reflect the potential simultaneity between investment and corporate value. As discussed in Section 2.2, investment may affect corporate value and corporate value, in turn, may affect investment. Recall that I used Tobin's Q measured at the end of 1990 to

Table 4
Simultaneous equation analysis of insider ownership, corporate value, and investment for 326 Fortune 500 firms, using the two-stage least squares method to estimate the following equations:

Insider ownership $= f$ (Market value of common equity, Corporate value, Investment, Volatility of earnings, Liquidity, Industry),
Corporate value $= g$ (Insider ownership, Investment, Financial leverage, Asset size, Industry),
Investment $= h$ (Insider ownership, Corporate value Volatility of earnings, Liquidity, Industry).

In the above equation, insider ownership is measured as insider equity ownership as fraction of total shares of outstanding equity, MVEQ is the market value of firm's common equity in 1991, and Tobin's Q is used to measure corporate value. Two measures of investment are used and the model is repeated to use first, capital expenditures, and second, research and development (R&D) expenditures to measure investment. Both investment measures are normalized by replacement cost of assets. t-statistics are in parentheses.

Variable	Capital expenditures model			R&D expenditures model		
	Insider ownership	Corporate value	Investment	Insider ownership	Corporate value	Investment
MVEQ[a]	− 6.759			− 4.903		
	(− 2.96)			(− 2.57)		
Tobin's Q (1991)	0.202		0.033	0.188		0.033
	(2.67)		(2.04)	(2.60)		(2.87)
Volatility[b]	0.001		0.00014	0.001		0.00005
	(1.49)		(1.12)	(1.81)		(0.30)
Liquidity[c]	0.067		0.110	− 0.176		0.126
	(0.07)		(2.14)	(− 0.35)		(1.87)
INS1[d]		1.087	− 0.123		− 1.774	− 0.084
		(0.45)	(− 1.26)		(− 0.60)	(− 0.80)
INS2[d]		0.957	− 0.060		1.370	− 0.091
		(0.44)	(− 1.53)		(0.54)	(− 0.73)
INS3[d]		1.431	− 0.124		2.613	− 0.065
		(0.61)	(− 1.03)		(0.93)	(− 0.44)

Investment	− 5.377	22.978		− 3.385	23.614	
	(− 1.01)	(4.46)		(− 1.23)	(3.12)	
Leverage[e]		− 0.967			− 0.181	
		(− 1.32)			(− 1.26)	
Asset size[f]		− 0.029			0.017	
		(− 0.47)			(0.14)	
Industry dummy[g]	Yes	Yes	Yes	Yes	Yes	Yes
Number of firms	326	326	326	230	230	230
Adj. R^2	0.046	0.171	0.183	0.076	0.189	0.285
F	1.492	3.010	3.187	1.732	2.967	4.344

[a]Coefficient estimate on MVEQ should be multiplied by 10^{-6}.

[b]*Volatility* = standard deviation in changes in profit rate during the period of 1986–1991. Profit rate is defined as profit before extraordinary items divided by the replacement cost of assets.

[c]Liquidity = cash flow divided by the replacement cost of assets.

[d] Levels of insider ownership.

*INS*1 = insider ownership if insider ownership < 0.07,
= 0.07 if insider ownership of firm ⩾ 0.07.

*INS*2 = 0 if insider ownership < 0.07,
= insider ownership − 0.07 if 0.07 ⩽ insider ownership < 0.38,
= 0.31 if insider ownership ⩾ 0.38.

*INS*3 = 0 if insider ownership of firm < 0.38,
= insider ownership − 0.38 if insider ownership ⩾ 0.38.

[e]Leverage = market value of the long-term debt in 1990 divided by the replacement cost of assets.

[f]Asset size = logarithm of the replacement cost of assets.

[g]Set of variables identifying industry of firm, based on 2-digit Standard Industrial Classification Code.

reduce this potential simultaneity when I estimated the OLS investment regression.

In all of these three equations, industry dummy variables based on two-digit SIC codes are included. The inclusion of industry dummy variables helps control for industry effects on ownership structure, corporate value, and investment.

4.2.1. Simultaneous equation regression results

Table 4 reports the two-stage least squares estimation results of the simultaneous regression in which a piecewise linear specification with imposed breakpoints at 7% and 38% of ownership is used for both the corporate value and investment regressions. The first three columns of Table 4 contain the regression estimates obtained by using capital expenditures as a measure of investment. The last three columns of Table 4 contain regression estimates obtained by using R&D expenditures as a measure of investment. The primary result is that endogeneity indeed affects the results of OLS regressions. This finding holds irrespective of which measure of investment is used.

Consistent with Demsetz and Lehn (1985), the insider ownership regressions reported in the first and fourth columns show that insider ownership is a function of market value of equity and industry type. More importantly, the regressions also show that Tobin's Q is an important determinant of insider ownership. This result suggests that managers in firms with higher corporate values or with better investment opportunities hold a larger fraction of their firm's shares. In contrast, the Tobin's Q variable is insignificant when I estimate the insider ownership equation in isolation.

The corporate value regressions appear in the second and fifth columns of Table 4. They show that investment is an important determinant of corporate value, confirming earlier findings. However, these results do not show any evidence that ownership structure affects corporate value, a finding that contrasts with the OLS corporate value regression results. Taken together, this finding and the insider ownership regression results suggest that ownership structure is a function of corporate value. However, the reverse is not true, which is consistent with Kole (1994) who shows that corporate value affects ownership structure in her causality test of the relation between ownership structure and corporate value.

The third and sixth columns contain the investment regressions. Consistent with Fazzari et al. (1988), the regression results indicate that liquidity and corporate value positively affect investment. More importantly, the results do not show any non-linear relation between insider ownership and investment. This finding differs from the OLS investment regression results, suggesting that ownership structure may not significantly affect investment.

In conclusion, the findings in this section suggest that investment affects corporate value which, in turn, affects ownership structure, thereby reversing the

interpretation of the results from OLS regressions. These findings also imply that ignoring the endogeneity of ownership structure affects the results of previous studies such as Morck et al. (1988) and the investment regressions reported in Table 3.

4.2.2. Robustness tests

Although not reported, I examine the robustness of the simultaneous equation regression results in Table 4. One reason that insider ownership variables are not significant in both the investment and the Tobin's Q regressions may be due to a specification problem. If the relation between insider ownership and investment, and between insider ownership and corporate value is, in fact, linear, then the piecewise linear specification of the Tobin's Q and the investment regressions may not be appropriate. To explore this possibility, I estimate a simultaneous equation regression in which Tobin's Q and investment are specified as a linear function of insider ownership. The regression results show that the insider ownership variables in the Tobin's Q and the investment regressions are insignificant, while Tobin's Q in the insider ownership regression is significantly positive. Restricting the linear specification to either the Tobin's Q or the investment regressions provides qualitatively similar results. These findings suggest that the results in Table 4 are not the outcome of a specification error.

I also explore whether the simultaneous regression results in Table 4 are affected by possibly different effects of debt on the value of the firms with different growth opportunities. McConnell and Servaes (1995) find that the relation between corporate value and debt is negative for high growth firms and positive for low growth firms. Following McConnell and Servaes, I group firms according to their end-of-year price-to-operating-earnings (P/E) ratio and place the one-third of the firms with the highest and lowest P/E ratios, respectively, into high- and low-growth samples. For both subgroups, I estimate the simultaneous equation regression. The results reveal that the coefficient on the leverage variable becomes positive but insignificant for the low-growth sample, while the coefficient remains negative but insignificant for the high-growth sample. The regression estimates also show that other variables remain qualitatively similar to those reported in Table 4, suggesting that my findings are not sensitive to the possibly different effects of debt on the value of the firms with different growth opportunities.

Next, I examine whether the use of breakpoints other than imposed ones affects the results from simultaneous regression. The estimation results using a variety of alternative breakpoints, including the natural breakpoints, are qualitatively similar to those in Table 4. I do not find any evidence that ownership structure non-monotonically affect corporate value or investment.

Finally, I exclude two firms with Tobin's Q values greater than six in 1991 to eliminate the impact of outliers. The regression results are qualitatively similar

to those in Table 4, suggesting no influence of the potential outliers on the inferences from the simultaneous regression analysis.

5. Summary and conclusions

This paper examines the relation among ownership structure, investment, and corporate value, focusing on the possible role of ownership structure as a determinant of investment. Unlike previous studies, the paper also explores the possibility that ownership structure, investment, and corporate value are endogenously determined. The evidence presented in the paper shows that endogeneity significantly affects the inferences one can draw regarding the relation among ownership structure, investment, and corporate value.

OLS regressions suggest that ownership structure affects investment and, therefore, corporate value. However, simultaneous regressions reveal that investment affects corporate value which, in turn, affects ownership structure, but not vice versa. These findings suggest that the implicit assumption of exogenous ownership structure severely affects the results from OLS regressions and leads to a misinterpretation of the results. The findings also bring into question the results in previous studies, such as Morck et al. (1988), that treat ownership structure as exogenous.

The results in this paper also offer an important managerial implication. In particular, the main finding that investment affects corporate value which, in turn, affects ownership structure, but not the reverse suggests that ownership may not be an effective incentive mechanism to induce managers to make value-maximizing investment decisions. This casts doubt upon the frequent assumption that compensation policies such as stock grants to executives provide strong incentives for managers to take actions that maximize corporate value.

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