**Managerial ownership and firm performance: A re-examination using marginal conditional stochastic dominance**

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## Abstract

There is an extensive literature on the relationship between managerial ownership and firm performance. Most studies examining the effect of managerial ownership on firm performance use stock returns, accounting profits or Tobinôs Q as a performance proxy without accounting for risk. The present study proposes a new measure which captures stock performance adjusted for risk in a single variable. This measure is general enough to apply to all risk averse investors, irrespective of their utility function. Our findings suggest that low and high levels of managerial ownership hinder firm performance, while intermediate levels of managerial ownership enhance it.



JEL Classification: G30, G32

**Key words:** Ownership structure, Marginal Conditional Stochastic Dominance, Performance, Value, GMM.

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## 1. Introduction

The manager-shareholder agency conflict that arises when the ownership of a firm is separate from its control is a major issue in contemporary corporate finance that has generated an extensive literature on the effect of managerial ownership on firm performance (e.g. Jensen and Meckling, 1976, Morck, Shleifer and Vishny, 1988, Stulz, 1988, Stiglitz and Edlin, 1995). However, in spite of its solid theoretical foundations, the empirical evidence linking the two is weak and inconclusive, at best. These results call into question the validity of the relationship itself and the many compensation theories it has spawned.

A close look at the literature on the subject of managerial ownership and firm performance, which is reviewed in the following section, raises serious questions about how firm performance has been measured and tested. Most measurements of firm performance have been one dimensional, focusing either on firm value (measured as Tobinôs Q), equity returns, volatility of equity returns or some other accounting measure designed to proxy performance. However, expected utility maximization, which lies at the heart of modern investment theory and practice, emphasizes the tradeoffs for risk averse investors across the different moments of the wealth variable, such as mean,

volatility, skewness and kurtosis. For example, in mean-variance (MV) space, Tobinôs Q or equity returns have to be compared with their volatility in order to measure performance. Failure to include trade-offs such as this across moments when estimating performance for empirical work on the relationship between managerial ownership (MO) and firm performance would call into question the results and conclusions. No studies on the relationship between MO and firm performance have used a performance proxy that take these trade-offs into consideration. In a first step to fill this gap, this paper constructs an appropriate performance proxy and revisits the MO/performance relationship.

Since the focus of our study is the shareholder-manager agency conflict and the effect of MO on firm performance, the performance proxy should reflect benefits to shareholders, which we define as total equity returns (returns to shareholders).[1] The performance measure we construct from the vector of total equity returns reflects the trade-off between returns and return volatility as well as the tradeoffs across returns, volatility and all the higher moments of the equity return distribution. In other words, we abandon the MV framework for a more general framework of expected utility maximization that reflects all the moments of the return distribution rather than only the first two. There are strong reasons to believe that third moments and higher are important determinants of diversification opportunities. First of all, it is well known that the first

[1] Clearly, for the study of the shareholder-manager agency conflict, Tobinôs Q is much less appropriate as the performance proxy than shareholder returns. Since Tobinôs Q refers to the total value of the firm, is not specific to shareholders such that a higher/lower Q does not necessarily reflect higher/lower shareholder value. It might reflect higher/lower bondholder value. Furthermore, given the unavailability of the market values of most liabilities other than equity, practical measures of Q are unreliable measures of firm value because they use the book value of debt rather than its market value in the numerator.

and second moments are only appropriate for quadratic utility maximizers or normally distributed returns. However, it is also well known that quadratic utility functions have many shortcomings[2] and it is a well documented fact since Mandelbrot (1963) that asset distributions are generally not normally distributed. It has also been shown that the third and the fourth moments of return distributions - skewness and kurtosis respectively - do matter to investors, who show a preference for positive skewness and an aversion to kurtosis (see, Kraus and Litzenberger (1976), Athayde and Flôres (1999), Fang and Lai (1997), Dittmar (2002), Post et. al. (2008)).

In mean-variance space the only trade-off is between risk and return. Adding higher moments multiplies the number of trade-offs and complicates the analysis. For example, if skewness, the third moment, is included, the performance proxy should reflect tradeoffs between moments one and two (mean and variance), moments one and three (mean and skewness) and moments two and three (variance and skewness) or some combination of these three moments, such as a decrease in return offset by a decrease in variance and an increase in skewness. Adding a fourth moment increases the possible direct trade-offs from three to six plus multiple combinations of the four individual moments.

The innovation of this paper is that firm performance is measured to include the whole distribution (all the moments) of stock returns and thus reflect all the trade-offs across all moments of the distribution. We then examine the relationship between

[2] For example, third derivatives and higher are equal to zero or do not exist, which rules out prudent and temperant behaviour. For a discussion of prudence and temperance see Eeckhoudt and Schlesinger (2006)

managerial ownership and firm performance. To this end, we use the concept of Marginal Conditional Stochastic Dominance (MCSD), introduced by Shalit and Yitzhaki (1994), and a small but growing literature that seeks to operationalize it, to construct a performance proxy that reflects all the moments of the distribution of equity returns.[3] MCSD is perfectly suited to this task. It makes no assumptions about the return distributions, the specific form of the utility functions or the efficiency of the market portfolio. The only assumption is that investors are risk averse.

The major contribution of this study is strong evidence that MO has a significant effect on firm performance that varies with the degree of ownership. Contrary to much of the empirical literature, our results are compatible with the theory that low levels of managerial ownership may hinder firm performance due to managersôpersonal costs, and high levels of managerial ownership may also hinder firm performance due to managerial entrenchment. At intermediate levels, however, managerial ownership is positive and highly significant. These results are robust with respect to a range of conventional control variables. More importantly, our results hold even after we account for endogeneity and unobserved firm heterogeneity using a dynamic analysis estimation technique.[4] Interestingly, we also confirm that managerial ownership is not the whole story. Our results show that institutional ownership, firm size, firm age and dividends are also significant determinants of firm performance.

[3] Shalit and Yitzhaki (2010) relate SSD rules to MV theory, Clark and Jokung (1999) derive conditions for determining MCSD efficient portfolio weights and Clark et al. (forthcoming) generalize the Clark and Jokung (1999) conditions to generate MCSD efficient portfolios.

[4] As we discuss in the next section, there is a strand of literature which argues that the empirical relationship between MO and firm performance disappears if we account for endogeneity and unobserved firm heterogeneity.

The remainder of the paper is organized as follows: the next section discusses the existing literature. Section three briefly presents the concept of MCSD, its implications for asset allocation and formalizes our testing hypotheses. Section four presents the data we use, in section five we report our results and section six concludes.

## 2. Literature Review

The initial thrust of the literature that analyzes the effect of managerial ownership on firm value was that greater managerial ownership benefits shareholders because it increases managersô incentives to increase firm value (e.g. Jensen and Meckling, 1976, Morck, Shleifer and Vishny, 1988, Stulz, 1988). Other studies pointed out, however, that if managers own a substantial percentage of a firmôs shares, they may try to entrench themselves in the company they manage by over-investing (empire building) [5] and accepting negative present value projects that reduce corporate wealth (e.g. Demsetz, 1983, and Fama and Jensen, 1983).[6] As such, this literature suggests that the relationship between firm value and managerial ownership is not monotonic, and there is an optimal level of ownership.[7] Tobinôs Q, equity returns and firm volatility have been used to test these propositions.

[5] One manifestation of the entrenchment hypothesis is the choice by the CEO of a board of directors that cannot monitor him. For an empirical examination on the matter see: Coles, Lemmon and Wang (2008), Faccio and Lasfer (1999) and Guest (2008).

[6] Aggarwal and Samwick (2006) find that the empire-building hypothesis has been over-stated. Instead, they find that managers under-invest and that this problem can be addressed through properly designed incentive packages for the managers.

[7] The optimal level of managerial ownership may vary from country to country due to differences in the enforcement of the legal system (e.g. de Miguel, Pindado and de la Torre, 2003, Lisboa and Esperanca, 2006)

Many empirical studies find no relationship between managerial ownership and firm performance (e.g. Brick, Palia and Wang (2005), Cho (1998), Demsetz and Villalonga (2001), Loderer and Martin (1997), Seifert et. al. (2005) and Vafeas and Theodorou (1998)). Faccio and Lasfer (1999) find that this relationship is only weak. Other studies have found that there is a relationship but that it is non-linear. For example, Morck, Shleifer and Vishny (1988) find a positive relationship between Tobinôs Q and managerial ownership for ownership levels between 0 and 5 percent and above 25 percent. For intermediate levels, the relationship is negative. McConnell and Servaes (1990) find a similar relationship in their study, but identify the inflection point between 40 and 50 percent ownership. Holderness et. al. (1999) examine this relationship for U.S. firms from 1935 and reach the same conclusion. Hermalin and Weisbach (1991) find a positive relationship between firm performance and managerial ownership for ownership levels between 0 and 1 percent and between 5 and 20 percent and a negative relationship for other ownership levels.[8] Other studies, such as Cebenoyan et. al. (2000), Cui and Mak (2002), Davies et. al. (2005), Kim et. al. (2004), and McConnell, Servaes and Lins (2008), provide support for the non-linear relationship between managerial ownership and firm performance.

When measures other than Tobinôs Q, such as stock returns or accounting quantities, are used to proxy performance, results are also mixed. Kirchmaeir and Grant (2006) use quarterly stock market returns from five European countries as a measure of performance and find that in three countries ownership affects firm performance and that

[8] Teshima and Shuto (2008) find a non-linear relationship between managerial ownership and earnings management.

the dominant ownership structures are not related to higher firm performance. Zhang (2009) finds for the U.S. market that an arbitrage portfolio, long on shares with high managerial ownership and short on shares with low managerial ownership earns an abnormal annual return of 6.4 percent. Von Lilienfeld-Toal and Ruenzi (2009) report that firms where CEO share ownership is more than 5 percent earn significant abnormal stock returns. Ortiz-Molina (2006) finds a concave relation between managerial ownership and yield spreads of corporate bonds and Datta, Datta and Raman (2005) find an inverse relationship between managerial shareholding and corporate debt maturity.

Evidence of non-linearity in the effect of managerial ownership on firm performance is also present when firm volatility is used as the performance proxy.[9] For example, Chen and Steiner (1999) identify a positive, nonlinear relationship between risk and managerial ownership for a sample of US companies and Gadhoum and Ayadi (2003) find a similar relationship for their sample of Canadian companies.

Acharya and Bisin (2009) find that an appropriate level of managerial ownership can serve to mitigate the moral hazard associated with managersô inability to diversify their firm specific risk due to legal restrictions and that firms with high levels of managerial ownership also have high levels of firm specific risk. [10] Earlier studies in the literature (e.g. Amihud and Lev, 1981, Denis, Denis and Sarin, 1997, May, 1995) also identify a

[9] Monsen and Downs (1965) argue that there is asymmetry between risk and reward for managers and owners so managers will opt for less risk than the owners.

[10] Acharya and Bisin (2009) argue that this type of moral hazard can explain the relationship between managerial ownership and firm performance found among others by Morck et. al. (1988), for low levels of managerial ownership.

relationship between firm diversification and managerial ownership, but the evidence they provide is inconclusive.[11]

Although the nonlinear relationship between firm performance and managerial ownership is consistent with agency theory, Fahlenbrach and Stulz (2009) discuss whether this relationship is the result of the incentive effects of managerial ownership or of the endogeneity of ownership. Demsetz (1983), for example, reasons that this relationship arises empirically because the firmôs environment is not captured properly in the empirical tests[12]. He argues that an ownership structure should arise endogenously and that there should be no systematic relation between managerial ownership and firm performance. Demsetz and Lehn (1985) argue that given the shareholdersô constraints, managerial ownership would always be set to a level that maximizes firm value, so any changes in managerial ownership cannot increase firm value. Based on this argument, the cross-sectional relationship between managerial ownership and firm value is difficult to interpret.[13]

After controlling for endogeneity using fixed effects and instrumental variable estimations, Himmelberg et. al. (1999) find weak evidence of a causal link from

[11] Aggarwal and Samwick (2003), however, argue that managers diversify not to reduce exposure to risk but because their motives for empire-building change through time.

[12] Becker et. al. (forthcoming) examine the effects of large non-managerial shareholders on firms and control for endogeneity using a geographic instrument.

[13] The agency theory suggests that increasing managerial ownership up to a point, increases managersô incentives to serve the interest of the shareholders. However, if the firm environment is such that the moral hazard problem for managers is low, then the optimal point of managerial ownership may be very low. On the endogeneity of managerial ownership, see also: Jensen and Warner, 1988.

ownership to Tobinôs Q.[14] Fahlenbrach and Stulz (2009) use lagged changes in managerial ownership to control for endogeneity and find that increases in managerial ownership increase Tobinôs Q but decreases in ownership do not decrease it.

The main issue with the extant studies is that it is still unclear whether a relationship between MO and firm performance actually exists and, if it does exist, whether it is linear or non-linear. Another question is whether the empirical results are the interpretation of equilibrium or out-of-equilibrium phenomena. According to Core et al. (2003), the interpretation depends largely on the magnitude of adjustment costs in correcting suboptimal contracts. For example, when the costs of ownership adjustments are high, managerial ownership will change only occasionally. Demsetz (1983) argues that firms are not able to re-contract because they are hindered by the large adjustment costs. This implies that the observed ownership levels may deviate from optimal levels for a period of time (Cheuang and Wei, 2006).

One explanation for the wide range of often conflicting results is that the proxies for firm performance reflect only one or two dimensions, such as Tobinôs Q, returns or volatility, of a multiple dimensioned phenomenon. As argued at the outset of this paper, expected utility maximization emphasizes the tradeoffs for risk averse investors across the different moments of the wealth variable, such as mean, volatility, skewness and kurtosis. Since these trade-offs can vary from one level of wealth to another, the different results might be due to trade-off changes at different levels of wealth rather than to

[14] Kole (1996) also argues that managerial ownership and firm performance are endogenously determined but she finds that causality operates from performance to ownership.

changes in the effect of MO. This is the question we seek to answer in the following sections.

**3. Construction of the firm performance proxy**

In this section, we employ the concept of Marginal Conditional Stochastic Dominance (MCSD) developed by Shalit and Yitzhaki (1994) to develop a performance proxy, called the total stock performance (TSP) statistic, that reflects the trade-offs across all the moments of the distribution. The only assumptions behind MCSD are that investors are risk averse, expected utility maximizers.

The concept of Marginal Conditional Stochastic Dominance gives the conditions under which all risk-averse individuals will prefer to increase the share of one risky asset over another when presented with a given portfolio.

Let $R$ be the rate of return of a given portfolio $P = \sum_{i=1}^{n} \alpha_i A_i$ . That means $R = \sum_{i=1}^{n} \alpha_i X_i$ with weights given by $\alpha_1, \alpha_2, ..., \alpha_n$ such that $\sum_{i=1}^{n} \alpha_i = 1$ and $X_i$ represents the return on asset $A_i$ measured as $\frac{A_i^{t+1} - A_i^t}{A_i^t}$. Let $f(x_1, x_2, ..., x_n)$ be the density function of the vector of random variables $(X_1, X_2, ..., X_n)$ and let $F_{X_1}, F_{X_2}, ..., F_{X_n}$ be the cumulative distribution functions of $X_1, X_2, ..., X_n$ respectively. The program to solve is the following:

$$\underset{\alpha_1, \alpha_2, ... \alpha_n}{Max} \; E[u(R)] \tag{1}$$

where $u$ is the utility function and $E$ stands for the expectation operator.[15] The first-order condition is given by:

$$E\left[X_i\, u'(R)\right] = 0 \;\; \forall i = 1,\ldots,n \tag{2}$$

Let $d\alpha_k$ and $d\alpha_j$ be the marginal changes in holding asset $A_k$ and asset $A_j$ such that $d\alpha_k + d\alpha_j = 0$, the marginal change in expected utility will be:

$$dE\left[u(R)\right] = E\left[(X_k\, d\alpha_k + X_j\, d\alpha_j)u'(R)\right] \tag{3}$$

It will be optimal to increase the weight of asset $A_k$ at the expense of asset $A_j$ if and only if this expression is non-negative. Or, equivalently if and only if:

$$\frac{dE\left[u(R)\right]}{d\alpha_k} = E\left[(X_k - X_j)u'(R)\right] \geq 0 \tag{4}$$

Asset $A_k$ dominates asset $A_j$ according to the Marginal Conditional Stochastic Dominance (MCSD) if and only if the former expression is non-negative for all risk-averse individuals.

From the foregoing it is clear that a test of MCSD is a test of the complete distribution of one asset compared to another. Since a stock to stock application of this rule is difficult in practice because it requires infinite pair-wise comparisons of alternative probability distributions, we follow an alternative application suggested by

[15] For risk aversion the necessary and sufficient conditions are $u' > 0$ and $u'' < 0$.

Shalit and Yitzhaki (1994). In this application, individual assets are compared to the market portfolio. If the market portfolio dominates one security, increasing the share of all other securities in the portfolio and reducing the proportion of the dominated security improves the portfolio for all risk-averse investors. The opposite also applies: if a security dominates the market portfolio, increasing its proportion in the market portfolio and reducing the proportion of all other securities, improves the portfolio for all risk-averse investors. Since for binary relations, the transitivity property for MCSD applies, that is, if stock A dominates stock B which in turn dominates stock C, then A also dominates stock C, we can use MCSD with respect to the market to measure and compare overall stock return distributions.

To compute the TSP, we follow Chow (2001), who proposes the following test for MCSD:

$$Z^{i-j}(\tau_k) = \frac{\overline{\Phi}^{i}(\tau_k) - \overline{\Phi}^{j}(\tau_k)}{\hat{S}^{i-j}(\tau_k)}, \text{ for } k = 1,..., m. \tag{5}$$

where

$$\overline{\Phi}^{i}(\tau_k) = \overline{r_{pi} I(\tau_k)} - \overline{r_M I(\tau_k)}, \text{ k = 1,2,...,}m \text{ and } i=1,2,...,n \tag{6}$$

$\overline{\Phi}^{i}(\tau_k)$ is the mean excess conditional return of stock *k* relative to the market portfolio below a target rate of return $\tau$. The subscript *k* denotes the set of prespecified target rates

of return. $\hat{S}^{i-j}(\tau_k)$ is the estimated standard error of $\overline{\Phi}^{i}(\tau_k) - \overline{\Phi}^{j}(\tau_k)$ and $I(\tau_k)$ is an indicator variable such that $I(\tau_k)$=1 if $r_M$ ÒÚand 0 otherwise.[16] For the Chow test we use deciles for each pair of stocks, (i.e. $k$ = 1, ..., 10), which gives ten Z statistics. The Z statistics are used to compare the return distribution of assets $i$ and $j$, where, in our case, asset $j$ is always the market portfolio.

We calculate one TSP statistic for each stock every year. To calculate the TSP statistic, we first estimate the Z statistics. The procedure for estimating the Z statistics is the following: first, for each year, we rank the market portfolioôs daily returns from lowest to highest. Then we match each return with the corresponding stockôs return for that day. This way, if we have 250 daily returns during a year, we obtain 250 pairs of returns. We split the sample in deciles, i.e. for 250 daily returns, each decile has 25 pairs of daily returns. The first decile is the one with the lowest market returns, the second decile the one with the immediately higher market returns and so on. The first Z statistic is the average difference between the stockôs and the marketôs returns for the first decile, divided by the standard deviation of these differences. The second Z statistic is the average difference between the stockôs and the marketôs returns for the first *and* second deciles, divided by the standard deviation of these differences, and so on. The last (tenth) Z statistic is the average difference between the stockôs and the marketôs returns for the all ten deciles, divided by the standard deviation of these differences. The idea is that each time we look at how the stock performed compared to the market portfolio, always starting from the lowest end of the return distribution, and adding one decile at a time.

[16] For detailed information on this test, see Chow (2001).

The reason the test always starts from the lowest end of the return distribution is because risk averse investors care more about losses than gains so, the lowest end of the distribution is always important for them. The TSP statistic is the average value of the ten Z statistics obtained for each stock each year. It measures the relative performance of a given stock to that of the market portfolio for any risk averse investor.

## 4. Data

The sample includes all listed non financial firms on three US exchanges -New York Stock Exchange (NYSE), American Stock Exchange (AMEX), and Nasdaq - for the period 2002-2009. Specific firm data was obtained from Worldscope. Data on firm ownership structure was obtained from Datastream. Following Holderness, Kroszner, and Sheehan (1999), Helwege, Pirinsky, and Stulz (2007), and Fahlenbrach, and Stulz, (2009), managerial ownership is measured as the percentage of total shares held by firm directors and officers.[17]

The dependent variable is stock performance as measured by TSP. To provide insight into the details of the ownership-performance relation, we also consider individually the first four moments of stock performance: stock returns, stock return volatility, coskewness and cokurtosis. Stock returns, *RET*, is measured as the annual, average, arithmetic, daily stock return. Stock return volatility, *TR*, is measured as the annual standard deviation of daily stock returns. To capture the asymmetry and

[17] Relevant data are available from 2002.

peakedness of the return distributions, we compute the co-skewness, *COSK*, and the co-kurtosis, *COKU*, in relation to returns on the market portfolio, proxied by the S&P 500.[18]

Besides managerial ownership, we also include a number of control variables suggested in the empirical studies on the relationship between managerial ownership and stock performance. Given the dearth of theoretical analysis and empirical evidence relating the control variables to third and higher moments of the return distribution, we have no strong priors on the signs of the control variables with respect to TSP. The first control variable is the size effect (SIZE), measured as the log of total assets (see, e.g. Florackis et. al., 2009). The second control variable is financial distress, represented by leverage (LEV), measured as total debt to total assets. The third control variable is dividend yield (DIV), measured as total cash dividend to total assets. The fourth control variable is institutional ownership (INST),

measured as the percentage of the total number of shares held by investment banks, pension funds and endowment funds. The fifth and sixth control variables are firm age (AGE), defined as the number of years since firm creation, suggested by Bennet et al. (2003), and auditing quality (AUD4) represented by a dummy variable that takes the value of one if the audit firm is from the Big 4 and zero otherwise. After excluding firms without the requisite ownership information and firm specifics, the final sample consists of 14,728 firm-year observations for 4,654 firms.

[18] The S&P 500 is a popular benchmark for professional investors. Shalit and Yitshaki, (1994) point out that since there is no need to specify the utility functions, any monotone transformation of individual wealth is an appropriate proxy for the market portfolio.

Table 1 reports the correlation coefficients for the sample data. TSP is positively correlated to return (RET) and negatively to total risk (TR). This indicates that TSP increases with returns and decreases with risk. Additionally, it is positively correlated to coskewness and negatively correlated to cokurtosis with the market portfolio. These correlations correspond to what would be expected of risk averse behavior. Table 2 reports descriptive statistics for the data series. The average value of TSP is close to zero as expected.

[INSERT TABLE 1 AND 2 ABOUT HERE]

As an additional check of the relationship between TSP and specific conditional moments of the return distribution of the sample stocks, we regressed TSP on the first four moments of the return distributions: average daily excess returns to the market, covariance, coskewness and cokurtosis with the market portfolio. The results are reported in Table 3. The four explanatory variables are highly significant in both specifications and have the right signs for risk averse investors. Average excess returns and coskewness have a positive coefficient while covariance and cokurtosis have a negative coefficient. This is evidence that TSP reflects the individual moments of the return distribution and that it is compatible with utility maximization for risk averse investors. In the discussion that follows, we report results on the relationship between TSP and managerial ownership as well as on the relationship between the first four individual moments of stock return distributions and managerial ownership. This allows us to make comparisons on results

using TSP as a measure of performance with results using individual moments reported in the literature.

[INSERT TABLE 3 ABOUT HERE]

## 5. Results

Table 4 reports panel data regression results on the relationship between managerial ownership and firm performance. Columns 1 through 4 report the results where the dependent variables are the conventional measures of performance found in the MO literature, stock returns and volatility, as well as two other measures, co-skewness and co-kurtosis, known to be important to risk averse investors.[19] The results on the relationship between firm performance and managerial ownership are mixed. MO has a negative effect on returns (Col. 1) and a positive effect on volatility (Col. 2), which suggests that managerial ownership has an adverse effect on firm performance. On the other hand, MO has a positive effect on coskewness (Col. 3) and a negative effect on cokurtosis, which suggests a beneficial effect of managerial ownership on firm performance. In these four regressions, MO is statistically significant only for cokurtosis.

The same type of trade-offs are present in the control variables. INST is significant and negative in all four regressions. Thus, INST decreases both the positive and negative measures of performance. SIZE is significant in three of the four equations and has a positive effect on returns, a negative effect on volatility and a positive effect on co-skewness, which is all performance enhancing, but it increases co-kurtosis, which is

[19] Remember that risk averse investors show a preference for positive skewness and an aversion to kurtosis.

performance reducing. The effect of LEV, which is significant in three of the four regressions, is also mixed. It increases returns, which is performance enhancing, but increases volatility, reduces co-skewness and increases co-kurtosis, all of which are performance reducing. Aud4 increases returns and decreases volatility, which is performance enhancing, but it decreases co-skewness and increases co-kurtosis, which is performance reducing. Only DIV, significant in one equation, and AGE, significant in all four, are performance enhancing in all four equations. Taken together this evidence cannot provide a clear answer as to whether the explanatory variables in general and managerial ownership in particular are good or bad for firm performance. To answer this question, we turn to column 5, which gives the results for the total performance proxy, TSP.

[INSERT TABLE 4 ABOUT HERE]

TSP measures the relative performance of a given stock to that of the market portfolio for any risk averse investor and reflects the tradeoffs across the individual moments of the return distribution. In the regression on TSP, all the control variables except LEV are significant at the 5% level. Most interestingly, MO is positive and significant at the 5% level, which is preliminary evidence that managerial ownership improves a firmôs performance for all risk averse investors. In other words, the higher the managerial stake in a company, the better the company performs. This evidence provides support for the principal/agent theory in that managerial ownership enhances firm performance. Note that these results do not contradict previous evidence that risk

increases with managerial ownership as in Acharya and Bisin (2009) and column 2 in this table. They show that even if volatility increases, the effects of managerial risk taking reflected in the other moments of the return distribution is value enhancing.

### *5.1. Non-linearity in the managerial ownership - firm performance relationship*

There is evidence, reported in section 2, that the relationship between firm performance and managerial ownership is non-linear and that at some point it turns from positive to negative and then back to positive.[20] In table 5 we test for non-linearity by including the square of managerial ownership ($MO^2$) in the regressions. For all performance measures except for coskewness $MO^2$ is statistically significant suggesting that the relationship between firm performance and MO is not linear. Most importantly, it is significant at the 5% level for TSP.[21] Given this evidence, we follow Morck, Shleifer and Vishny (1988) and estimate a piecewise linear specification where we allow for different coefficients for MO for the segments 0%-5%, 5%-25% and 25%-100%. The results are reported in Table 6. The first 4 columns give inconclusive evidence on the effect of MO on the individual measures of firm performance for each segment. For the first segment (0%-5%) we find that return, standard deviation of returns and cokurtosis deteriorate with managerial ownership, while coskewness increases. In other words, the $2^{nd}$, $3^{rd}$ and $4^{th}$ moments of the return distribution improve with increased managerial ownership but returns deteriorate. For the middle segment, we find a negative effect on stock returns which concurs with the findings in the literature on managerial

[20] Aggarwal and Samwick (2006) find that the relationship between management incentives and Tobinôs Q is non-linear but positive in every segment.
[21] We also tested for non-linearity using the square *and* the cube of MO. In results not reported here we find that the cube of MO is only significant in the RET regression.

entrenchment for that segment. However, for the same segment, we also find a negative effect on total risk and cokurtosis, and a positive effect on coskewness, which means that all the return distribution moments except for the first improve in this segment. Similarly, for the 3rd segment, returns improve but all other moments deteriorate. In other words, the evidence suggests that for each segment of ownership, if we consider four first moments of the stocksô return distribution individually, we cannot conclude whether managerial ownership helps or hinders stock performance. To answer this question we turn to the results on TSP in column 5.

The regression on TSP shows that the overall effect on firm performance is positive for the middle segment of MO between 5% and 25% only. Interestingly, this segment is also the only one where MO is statistically significant. For the segments 0%-5% and 25%-100% the relationship is negative but not significant. This result suggests a non-linear relationship that is opposite to that cited in the literature based only on the first moment of Tobinôs q or returns. This is further evidence for the principal/agent theory where increasing managerial ownership from low levels (in our case from 0%-5% to 5%-25%) increases the value of the firm. The negative effect of MO for the 25% to 100% segment could be attributed to managerial entrenchment above that level of ownership.

[INSERT TABLE 5 ABOUT HERE]

[INSERT TABLE 6 ABOUT HERE]

### *5.2. Dynamic Analysis*

A possible issue with the foregoing analysis is that managerial ownership is likely to be endogenously determined in equilibrium (Demsetz and Lehn, 1985; Demsetz and Villalonga (2001). For instance, a positive relationship between managerial ownership and firm performance could be the result of managers aligning their interests to those of the shareholders. It could also be that managers of well performing firms increase their stake in the company they manage. Another source of endogeneity may arise from the correlation between managerial ownership and unobserved firm heterogeneity (for a discussion, see Palia, 2001). Furthermore, the foregoing results are based on a static model, which, for reasons discussed in section 2, may not fully capture the true relation between managerial ownership and firm performance. Thus, in this section we recognise that there are impediments that prevent firms from moving towards an optimal managerial ownership. Moreover, as pointed out by Cheuang and Wei (2006), the optimal managerial ownership rests on the firmôs contracting environment that may change over time. To account for this, we examine the managerial-performance relation in a dynamic setting. The dynamic setting recognizes the possibility that firms adjust to their targeted managerial ownership levels gradually over time and sheds light on the dynamics of managerial ownership and its relationship to changes in firm performance.

We employ the following dynamic panel data specification:

$$TSP_{it} = \alpha TSP_{it-1} + \beta MO_{it} + \gamma X_{it} + n_i + \delta_t + \varepsilon_{it} \qquad (7)$$

where *TSP* is the estimated total stock performance,[22] *MO* is a vector of managerial ownership measures, and *X* is a vector of control variables that include institutional ownership (*INST*), firm size (*SIZE*), leverage (*LEV*), dividends (*DIV*), and firm age (*AGE*). The parameter $\alpha$ *is* a scalar, $\gamma$ and $\beta$ are k-dimensional vectors of coefficients. The variables $\eta_i$ and $\lambda_t$ are respectively unobserved firm fixed effects and time effects that capture the effects of unobserved firm heterogeneity and economy-wide factors that are outside the firmôs control. Similarly, the lagged dependent variable in equation (7) is allowed to be correlated with unobserved heterogeneity.

The problems of endogeneity outlined above suggest the use of an instrumental variables (IV) methodology to estimate equation (7), where the lagged dependent ($TSP_{it-1}$) variable and endogenous regressors (*MO*) are instrumented. The preferred estimator for equation (7) is the Generalised Method of Moments (GMM) system estimator (Arellano and Bover, 1995; Blundell and Bond, 1998) because: (a) the panel consists of few time periods (small *T*) and a large number of firms (large *N*); (b) the dependent variable (*TSP*) is dynamic, in the sense that it depends on past realizations;[23] c) the GMM system explicitly allows for heteroscedasticity and autocorrelation within firms.

Following Arellano and Bover (1995), the dynamic performance model is estimated by forward orthogonal deviations transform in order to purge the data of

[22] As argued in this paper the measure of choice for a firmôs performance is TSP, total stock performance, and hence, for the purpose of saving space, the dynamic specification results for other performance measures are not reported but are available upon request.

[23] This is intuitively true, as a firmôs performance is likely to experience time clustering (Magalhaes et al. 2007). Moreover, Bond (2002, p.1) argues that "even when coefficients on lagged dependent variables are not of direct interest, allowing for dynamics in the underlying process may be crucial for recovering consistent estimates of other parameters."

unobserved firm heterogeneity.[24] Thus, the GMM system estimator combines a set of orthogonal deviation equations with equations in levels, where instrumental variables are generated within the system. The consistency of the GMM estimates is subject to an optimal choice of instruments and the absence of higher-order serial correlation in the idiosyncratic error term, $\varepsilon_{it}$.

[INSERT TABLE 7 ABOUT HERE]

The results of GMM system are reported in Table 7. The Sargan test of over-identifying restrictions is not significant, indicating that the instruments used in the GMM estimation are not correlated with the error term (i.e. valid instruments). As expected, the *AR(1)* and *AR(2)* tests confirm the existence of serial correlation of order one, but not of order two. The results suggest that the dynamic nature of firm performance is not rejected. Specifically, the estimated coefficient of the previous yearôs performance ($TSP_{t-1}$) is positive and significant at the 1% level. The adjustment speed (which is given by 1-ɔ) for models 1 and 2 is 0.66, and 0.54 for models 3 and 4. This gives, on average, an adjustment speed of 0.6. This is equivalent to a Koyck duration interval of 5.86 with p = 95%, where p is the percentage of the decay. This implies that it requires 5.86 years to complete a 95% adjustment, suggesting that the adjustment cost is considerably high.[25]

[24] The main advantage of orthogonal transformation over first differences is that the former reduces the loss of observations when the panel data is unbalanced (for more discussion, see Gorbachev (2010).

[25] The Koyck duration is calculated as [ln(1ī p) / ln(1-ɔ)] (for more information see Koyck , 1954). The Koyck duration interval measures the time lag between a change in managerial ownership and the moment that p percent of its effect has decayed.

This finding is consistent with Demsetzôs (1983) argument which suggests that firms are not able to re-contract because they face substantial adjustment costs when they wish to adjust to the equilibrium level of managerial ownership, where the optimal level is not constant over time and moves with the changes in the determinants of firm performance.

The dynamic specification results are similar to the static analysis and provide more robust results. $MO^3$ is highly statistically significant suggesting that there are at least two inflection points. The piecewise linear specification re-enforces the previous results. MO is now statistically significant in every segment with very high t-statistics. Overall, our results show that there is a statistically significant relationship between managerial ownership and firm performance. This relationship is non-linear, as suggested elsewhere in the literature based on individual first moments. However, when all the moments are taken together we find that the sign of this relationship is opposite to that suggested in the literature. Accounting for total performance using TSP instead of a simple valuation measure, we find that low levels of managerial ownership reduce firm performance. Increasing the level of MO from low to intermediate levels between 5% and 25% enhances firm performance. However, after 25%, managerial ownership hinders overall performance, which could be attributed to managerial entrenchment. These results strongly support the theory of managerial ownership that argues that increasing the level of managerial ownership initially helps align the interest of managers and shareholders but for high levels of MO the relationship breaks down and becomes negative as managers use their power to pursue their own objectives.

## 6. Summary and conclusions

This paper revisits the relationship between managerial ownership and firm performance in the framework of expected utility maximization for risk averse investors. It builds on the insight that performance criteria for risk averse investors involves more than the first two moments of the return distribution and the fact that the outstanding literature has not integrated this into its analysis. In a first step, it uses the concept of Marginal Conditional Stochastic Dominance to construct a performance proxy that includes all the moments of the distribution of equity returns. There are no assumptions about the return distributions, the specific form of the utility functions or the efficiency of the market portfolio. The only assumption is that investors are risk averse. The resulting total performance proxy is then used to investigate the relationship between managerial ownership and firm performance.

There are two major conclusions. The first is that when individual moments of the firmôs return distribution are used to measure performance they give conflicting results, which calls into doubt the conclusions of much of the outstanding empirical literature. The second and major conclusion of this study is the strong evidence that MO has a significant effect on firm performance that varies with the degree of ownership. Contrary to much of the empirical literature, our results are compatible with the theory that low levels of managerial ownership may hinder firm performance due to managersô personal costs and high levels of managerial ownership may also hinder firm performance due to managerial entrenchment. At intermediate levels, however, managerial ownership is positive and highly significant. These results are robust with respect to a range of model

specifications, conventional control variables and estimation techniques. Interestingly, we also confirm that managerial ownership is not the whole story. Our results show that institutional ownership, firm size, firm age and dividends are also significant determinants of firm performance.

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Table 1: Correlation Matrix.

| | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.RET | 1.00 | | | | | | | | | | |
| 2.TR | -0.29 | 1.00 | | | | | | | | | |
| 3.COSK | 0.24 | -0.18 | 1.00 | | | | | | | | |
| 4.COKU | -0.37 | 0.30 | -0.33 | 1.00 | | | | | | | |
| 5.TSP | 0.31 | -0.21 | 0.08 | -0.16 | 1.00 | | | | | | |
| 6.INST | 0.04 | -0.19 | 0.13 | -0.12 | -0.06 | 1.00 | | | | | |
| 7.MO | 0.00 | 0.10 | -0.03 | -0.01 | 0.02 | -0.18 | 1.00 | | | | |
| 8.SIZE | 0.03 | -0.47 | 0.03 | 0.13 | -0.10 | 0.29 | -0.21 | 1.00 | | | |
| 9.LEV | -0.04 | 0.05 | -0.05 | 0.05 | 0.04 | 0.03 | -0.04 | 0.20 | 1.00 | | |
| 10.DIV | 0.01 | -0.12 | 0.00 | 0.02 | 0.10 | -0.05 | 0.01 | 0.06 | 0.04 | 1.00 | |
| 11.AGE | 0.05 | -0.23 | 0.02 | 0.03 | 0.09 | 0.01 | -0.03 | 0.27 | 0.03 | 0.09 | 1.00 |
| 12.AUD4 | 0.01 | -0.14 | 0.00 | 0.04 | -0.09 | 0.16 | -0.10 | 0.25 | 0.03 | 0.01 | 0.00 |

RET is the annual average daily stocks returns including dividends. TR is the standard deviation of annual daily stock returns. COSK is the co-skewness between a stockôs returns and the market portfolioôs returns. COKU is the co-kurtosis between a stockôs returns and the market portfolioôs returns. TSP is the total stock performance statistic. INST is the total shares held strategically by pension funds and investment companies to total number of sharesMO is the total number of shares held by firm directors to total number of shares. SIZE is the natural logarithm of total assets. LEV is total debts to total assets. DIV is total cash dividends to total assets. AGE is the age of a company measured as the number of years since incorporation date. AUD4 is a dummy variable indicating whether a company is audited by one of the big four auditing companies.

Table 2 Descriptive Statistics

| Variable | Mean | SD | Median | Min | Max |
|---|---|---|---|---|---|
| RET | 0.0087 | 0.2662 | 0.0267 | -2.6467 | 2.7916 |
| TR | 0.0364 | 0.0252 | 0.0302 | 0.0046 | 0.5608 |
| COSK | -0.0126 | 0.0772 | -0.0013 | -1.2323 | 1.7069 |
| COKU | 0.0094 | 0.0235 | 0.0006 | -0.1018 | 0.2804 |
| TSP | 0.4522 | 1.9185 | 0.3458 | -5.4849 | 13.163 |
| INST | 0.213 | 0.2102 | 0.15 | 0 | 0.98 |
| MO | 0.0474 | 0.1235 | 0 | 0 | 0.99 |
| SIZE | 12.818 | 2.1465 | 12.7822 | 0 | 20.782 |
| LEV | 0.2335 | 1.386 | 0.1549 | 0 | 231 |
| DIV | 0.0198 | 0.3811 | 0 | 0 | 49.7567 |
| AGE | 26.5902 | 25.3466 | 18 | 0 | 193 |
| AUD4 | 0.3985 | 0.4896 | 0 | 0 | 1 |

RET is the annual average daily stocks returns including dividends. TR is the standard deviation of annual daily stock returns. COSK is the co-skewness between a stockôs returns and the market portfolioôs returns. COKU is the co-kurtosis between a stockôs returns and the market portfolioôs returns. TSP is the total stock performance statistic. RET, COSK, COKU are multiplied by 100. INST is the total shares held strategically by pension funds and investment companies to total number of shares. MO is the total number of shares held by firm directors to total number of shares. SIZE is the natural logarithm of total assets. LEV is total debts to total assets. DIV is total cash dividends to total assets. AGE is the age of a company measured as the number of years since incorporation date. AUD4 is a dummy variable indicating whether a company is audited by one of the big four auditing companies.

Table 3 Determinants of total stock performance (TSP)

| | (1) | (2) |
|---|---|---|
| RET | 203.3** | 190.5** |
| | (16.13) | (34.11) |
| COV | -6167.7** | -4123.2** |
| | (-48.89) | (-37.46) |
| COSK | 0.684** | 0.574** |
| | (3.25) | (3.33) |
| COKU | -7.000** | -6.712** |
| | (-2.37) | (-4.02) |
| Constant | 2.155** | 1.874** |
| | (15.22) | (33.63) |
| Year dummies | Yes | Yes |
| Industry dummies | Yes | |
| Firm-fixed effects | | Yes |
| N | 6518 | 6523 |
| Adjusted $R^2$ | 0.509 | 0.441 |

The dependent variable is total stock performance (TSP). RET is excess returns measured as the difference between a firmôs raw return and the market return. COV is the covariance between a firmôs returns and the market portfolioôs returns . COSK is the co-skewness between a firmôs returns and the market portfolioôs returns. COKU is the co-kurtosis between a firmôs returns and the market portfolioôs returns. The models are estimated using pooled OLS estimation. The coefficientsô standard errors are based on adjusted for the effects of non-independence by clustering on each firm (Petersen 2009). t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$.

Table 4 The effect of Managerial ownership on firm performance

| | RET | TR | COSK | COKU | TSP |
|---|---|---|---|---|---|
| MO | -0.0122 | 0.000962 | 0.0124 | -0.00605** | 0.492** |
| | (-0.74) | (0.53) | (1.57) | (-4.00) | (2.65) |
| INST | -0.0375** | -0.00791** | -0.00590** | -0.00322** | -0.916** |
| | (-4.62) | (-7.42) | (-2.08) | (-6.18) | (-8.25) |
| SIZE | 0.000656 | -0.00373** | 0.00189** | 0.00120** | -0.112** |
| | (0.87) | (-27.52) | (5.13) | (17.16) | (-8.21) |
| LEV | 0.00785 | 0.0127** | -0.00956** | 0.000716* | -0.0740 |
| | (0.90) | (9.02) | (-3.39) | (1.81) | (-1.11) |
| DIV | 0.0196 | -0.0342** | 0.00623 | -0.00155 | 2.286** |
| | (0.52) | (-5.04) | (0.28) | (-0.49) | (3.34) |
| AGE | 0.000108** | -0.0000587** | 0.0000802** | -0.0000221** | 0.00477** |
| | (2.44) | (-7.42) | (3.69) | (-4.95) | (4.48) |
| AUD4 | 0.00322 | -0.000122 | -0.00221* | 0.00107** | -0.265** |
| | (1.17) | (-0.31) | (-1.81) | (4.59) | (-5.60) |
| CONS | 0.204** | 0.0846** | -0.0306** | -0.00977** | 2.279** |
| | (17.04) | (40.57) | (-6.15) | (-10.14) | (11.86) |
| N | 14728 | 14728 | 14728 | 14728 | 14728 |
| Adj. $R^2$ | 0.342 | 0.458 | 0.169 | 0.706 | 0.164 |

RET, COSK and COKU are multiplied by 100. All the independent variables have been lagged for one year. MO is the level of managerial ownership and is measured as the number of shares held by firm all directors to total number of shares INST is the total shares held strategically by pension funds and investment companies to total number of shares. LEV is total debts to total assets. DIV is total cash dividends to total assets. AGE is the age of the company. AUD4 is a dummy variable indicating whether a company is audited by one of the big four auditing companies. The models are estimated using pooled OLS estimation. The coefficientsô standard errors are adjusted for the effects of non-independence by clustering on each firm (Petersen 2009). t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$.

Table 5 Non-linearity in managerial ownership regressions

| | RET | TR | COSK | COKU | TSP |
|---|---|---|---|---|---|
| MO | -0.0996** | -0.00914** | 0.0230 | -0.0173** | 1.428** |
| | (-2.32) | (-2.22) | (1.20) | (-4.98) | (3.48) |
| $MO^2$ | 0.174** | 0.0201** | -0.0211 | 0.0224** | -1.858** |
| | (2.13) | (2.77) | (-0.65) | (3.66) | (-2.64) |
| INST | -0.0372** | -0.00787** | -0.00595** | -0.00318** | -0.920** |
| | (-4.58) | (-7.38) | (-2.10) | (-6.11) | (-8.28) |
| SIZE | 0.000430 | -0.00376** | 0.00192** | 0.00117** | -0.110** |
| | (0.57) | (-27.68) | (5.24) | (16.85) | (-8.06) |
| LEV | 0.00786 | 0.0127** | -0.00956** | 0.000717* | -0.0741 |
| | (0.90) | (9.05) | (-3.40) | (1.82) | (-1.12) |
| DIV | 0.0197 | -0.0342** | 0.00621 | -0.00153 | 2.284** |
| | (0.52) | (-5.04) | (0.28) | (-0.48) | (3.32) |
| AGE | 0.000110** | -0.0000585** | 0.0000800** | -0.0000218** | 0.00475** |
| | (2.48) | (-7.40) | (3.68) | (-4.90) | (4.47) |
| AUD4 | 0.00320 | -0.000125 | -0.00221* | 0.00106** | -0.265** |
| | (1.16) | (-0.31) | (-1.81) | (4.58) | (-5.60) |
| CON | 0.207** | 0.0849** | -0.0309** | -0.00944** | 2.252** |
| | (17.14) | (40.71) | (-6.25) | (-9.80) | (11.73) |
| N | 14728 | 14728 | 14728 | 14728 | 14728 |
| A. $R^2$ | 0.342 | 0.458 | 0.169 | 0.707 | 0.164 |

All the independent variables have been lagged for one year. MO is the level of managerial ownership and is measured as the number of shares held by firm directors to total number of shares. $MO^2$ is the square term of MO. INST is the total shares held strategically by pension funds and investment companies to total number of shares. LEV is total debts to total assets. DIV is total cash dividends to total assets. AGE is the age of the company. AUD4 is a dummy variable indicating whether a company is audited by one of the big four auditing companies. The models are estimated using pooled OLS estimation and include year and industry dummies. The coefficientsô standard errors are adjusted for the effects of non-independence by clustering on each firm (Petersen 2009). t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$

Table 6 Piecewise analysis

| | RET | TR | COSK | COKU | TSP |
|---|---|---|---|---|---|
| MO[0-5] | -0.284* | -0.00847 | 0.0321 | -0.0161 | -0.430 |
| | (-1.91) | (-0.60) | (0.41) | (-1.19) | (-0.31) |
| MO(5-25] | -0.0115 | -0.00442 | 0.0219 | -0.0130** | 1.669** |
| | (-0.18) | (-0.72) | (0.66) | (-2.38) | (2.85) |
| MO(25-100] | 0.0609 | 0.00900** | -0.00278 | 0.00382 | -0.454 |
| | (1.43) | (2.06) | (-0.15) | (1.09) | (-1.11) |
| INST | -0.0367** | -0.00786** | -0.00600** | -0.00317** | -0.917** |
| | (-4.52) | (-7.38) | (-2.11) | (-6.08) | (-8.25) |
| SIZE | 0.000269 | -0.00376** | 0.00194** | 0.00117** | -0.111** |
| | (0.35) | (-27.41) | (5.41) | (16.94) | (-8.12) |
| LEV | 0.00798 | 0.0127** | -0.00958** | 0.000732* | -0.0755 |
| | (0.91) | (9.06) | (-3.41) | (1.85) | (-1.14) |
| DIV | 0.0195 | -0.0342** | 0.00624 | -0.00156 | 2.285** |
| | (0.51) | (-5.04) | (0.28) | (-0.49) | (3.32) |
| AGE | 0.000110** | -0.0000585** | 0.0000799** | -0.0000219** | 0.00476** |
| | (2.47) | (-7.41) | (3.68) | (-4.91) | (4.47) |
| AUD4 | 0.00316 | -0.000127 | -0.00220* | 0.00106** | -0.265** |
| | (1.15) | (-0.32) | (-1.80) | (4.57) | (-5.60) |
| CONS | 0.209** | 0.0849** | -0.0311** | -0.00943** | 2.267** |
| | (17.21) | (40.38) | (-6.40) | (-9.81) | (11.79) |
| N | 14728 | 14728 | 14728 | 14728 | 14728 |
| Adj. $R^2$ | 0.342 | 0.458 | 0.169 | 0.707 | 0.164 |

RET, COSK and COKU are multiplied by 100. All the independent variables have been lagged for one year. MO is the level of managerial ownership and is measured as the number of shares held by firm all directors to total number of shares. MO[0-5], (5-25] and (25-100) are sub-samples of MO based on the level of managerial ownership. SIZE is the natural logarithm of total assets. INST is the total shares held strategically by pension funds and investment companies to total number of shares. LEV is total debts to total assets. DIV is total cash dividends to total assets. AGE is the age of the company. AUD4 is a dummy variable indicating whether a company is audited by one of the big four auditing companies. The models are estimated using pooled OLS estimation and include year and industry dummies. The coefficientsô standard errors are adjusted for the effects of non-independence by clustering on each firm (Petersen 2009). t statistics in parentheses. * p < 0.10, ** p < 0.05. *t* statistics in parentheses

Table 7 GMM system results

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| TSP(lag) | 0.343** | 0.345** | 0.467** | 0.462** |
| | (10.61) | (10.57) | (18.93) | (18.33) |
| MO | -0.570 | | -7.017** | |
| | (-0.48) | | (-5.88) | |
| $MO^2$ | 10.19* | | 29.04** | |
| | (1.79) | | (5.15) | |
| $MO^3$ | -12.41** | | -29.97** | |
| | (-1.98) | | (-4.83) | |
| MO[0-5] | | -7.960** | | -19.38** |
| | | (-2.69) | | (-7.15) |
| MO(5-25] | | 5.694** | | 6.992** |
| | | (4.39) | | (5.70) |
| MO(25-100] | | -1.109 | | -3.225** |
| | | (-1.32) | | (-3.87) |
| INST | -0.480** | -0.476** | -0.644** | -0.687** |
| | (-7.38) | (-7.26) | (-4.92) | (-5.22) |
| SIZE | -0.0565** | -0.0565** | -0.231** | -0.248** |
| | (-7.49) | (-7.36) | (-8.37) | (-8.67) |
| LEV | 0.0692 | 0.0528 | 1.726** | 1.512** |
| | (1.56) | (1.20) | (6.02) | (5.27) |
| DIV | 1.376** | 1.391** | 5.388** | 5.515** |
| | (4.83) | (4.84) | (3.28) | (3.32) |
| AGE | 0.00370** | 0.00366** | 0.0233** | 0.0226** |
| | (7.92) | (7.82) | (9.06) | (8.67) |
| AUD4 | -0.146** | -0.142** | -0.516* | 0.0917 |
| | (-6.36) | (-6.18) | (-1.81) | (0.32) |
| Constant | 0.830** | 0.840** | 2.423** | 2.472** |
| | (8.26) | (8.10) | (9.48) | (9.51) |
| N | 13017 | 13017 | 13017 | 13017 |
| *F- test* | 127.93** | 131.89** | 141.3**5 | 141.50** |
| *Sargan test* | 93.04 | 12.20 | 93.55 | 78.95 |
| *AR(1)* | -7.01** | -6.94** | -2.18* | -6.70** |
| *AR(2)* | 1.59 | 1.43 | 0.53 | 0.42 |

The dependent variable is TSP, the total stock performance statistic. MO is the level of managerial ownership and is measured as the number of shares held by firm directors to total number of shares. $MO^2$ is the square term of MO and $MO^3$ is the cube term of MO. MO[0-5], (5-25] and (25-100] are sub-samples of MO based on the level of managerial ownership. SIZE is the natural logarithm of total assets. INST is the total shares held strategically by pension funds and investment companies to total number of shares. LEV is total debts to total assets. DIV is total cash dividends to total assets. AGE is the age of the company. AUD4 is a dummy variable indicating whether a company is audited by one of the big four auditing companies. The models are estimated using GMM System and include year dummies. Columns (1) and (2) gives the GMM system estimates where only the lagged dependent variable and managerial ownership are treated as endogenous, while in columns (3) and (4) all the independent variables are treated as endogenous. Second lag period and earlier are used as instruments. F-test is a test of the joint significance of reported coefficient estimates under null hypothesis. Sargan test is a test of overidentifying restrictions under the null of instrument validity. AR(1) and AR(2) are tests for first and second order serial correlation in residuals. * $p < 0.10$, ** $p < 0.05$. *t* statistics in parentheses.