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S.I.: RISK IN FINANCIAL ECONOMICS

A measure of total firm performance: new insights for the corporate objective

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Abstract

Because heterogenous and unknown shareholder utility functions make it difficult to define a corporate objective common to all shareholders based on utility, the traditional theory of the firm concentrates on wealth maximization as the main measure of performance. Using the concept of ranked marginal utility, we develop a multi-dimensional measure of firm performance (TPM) that reflects the preferences of all risk averse shareholders towards all aspects of risk. We verify empirically that this is, in fact, the case for the first four moments of a large sample of US stocks over the period 2002–2010. Then, using the manager/shareholder agency conflict as the analytical framework, we show that TPM is a reliable, multi-dimensional performance measure and that one dimensional performance measures, such as mean returns, volatility or Tobin's Q can lead to erroneous inference. By including shareholder preferences towards risk in the measure of firm performance as the corporate objective, we bring together the corporate finance literature and the literature on portfolio investment theory and practice.

Keywords Corporate objectivity · Utility maximization · Firm performance · Managerial ownership · Agency theory

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1 Introduction

The cornerstone concept of performance and the "corporate objective" in the traditional theory of the firm is shareholder wealth maximization.[1] For example, the corporate agency conflict literature,[2] sparked by the seminal paper of Jensen and Meckling (1976), has focused for the most part on some form of wealth creation, such as stock returns or Tobin's Q, and has ignored how stock returns or the changes in Tobin's Q are distributed.[3] Modern investment theory, however, has shown the importance of the distribution of wealth outcomes as well as the level of wealth itself.[4] Although the literatures on corporate finance and modern investment theory are both based on the principle of utility maximization (see, for example, Ross 1973; Jensen and Meckling 1976), heterogenous and unknown shareholder utility functions make it difficult to define a firm goal common to all shareholders based on maximum utility. In other words, all unsatiated, risk averse shareholders prefer more to less, but their attitudes to volatility, skewness, kurtosis, etc. can vary according to each individual utility function, thereby isolating wealth maximization as the only obvious preference common to all investors. The Fisher Separation Theorem shows that in a short run, partial equilibrium framework where no risk exists or where it can be perfectly hedged, return distributions can be excluded from the analysis and that wealth maximization is the common firm goal that also maximizes shareholder utility.[5]

Excluding return distributions from the analysis overcomes the problem of heterogenous shareholders with different and unknown utility functions, but it comes at the cost of ignoring crucial information affecting shareholder preferences and investment decision making, which is at the heart of utility theory and modern portfolio analysis. Consider, for example, two firms with the same mean returns and the same volatility but firm A has positive skewness and low kurtosis while firm B has negative skewness and high kurtosis. Since it is well known that investors show a preference for positive skewness and an aversion to kurtosis (see, Kraus and Litzenberger 1976; Athayde and Flôres 2000; Fang and Lai 1997; Dittmar 2002; Post et al. 2008), other things being equal, investment A would be preferred to investment B by any risk averse investor.

[1] See Machlup (1967) and Sundaram and Inkpen (2004a) for a summary of the background debate. Sundaram and Inkpen (2004a) provide a recent literature review and make a strong argument that shareholder wealth maximization is the best among all available alternatives, and thus the preferred goal for managers formulating and implementing strategy. Sundaram and Inkpen (2004b) highlight the weaknesses of stakeholder theory presented in Freeman et al. (2004).

[2] There is a huge and growing literature on the principal-agent conflict. For some of the best original work, see: Berle and Means (1932), Coase (1937), Cyert and March (1963), Williamson (1964), Machlup (1967), Alchian and Demsetz (1972) and Jensen and Meckling (1976).

[3] For example, studies that have used stock returns as a performance proxy include Kirchmaier and Grant (2005), Zhang (2009) and Von Lilienfeld-Toal and Ruenzi (2014). Studies that have used Tobin's Q include McConnell and Servaes (1990), De Miguel et al. (2004), Morck et al. (1988), Short and Keasey (1999), Faccio and Lasfer (1999) and Holderness et al. (1999), Hermalin and Weisbach (1991), and Davies et al. (2005).

[4] For example, mean–variance (MV) analysis, the most popular model of utility maximization, looks at the trade-offs between the first and second moments (the mean and the variance) of the distribution of wealth outcomes. Given that the conditions for MV to be analytically consistent with expected utility maximization, such as quadratic utility functions and/or normally distributed returns, seldom hold in practice, risk measures other than variance must also be considered. It has 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 2000; Fang and Lai 1997; Dittmar 2002; Post et al. 2008).

[5] See Fisher (1930) for a presentation of the theorem and Machlup (1967) for a summary of the subsequent background debate.

This paper seeks to fill this void by developing a measure of firm performance compatible with the preferences of all risk averse shareholders that incorporates all the moments of the distribution—including the mean, the variance, the skewness and the kurtosis as well as all the higher moments. The total performance measure (TPM) we propose reflects the relative performance of the firm with respect to the market portfolio ranked by the marginal utilities of all risk averse shareholders. By including shareholder preferences towards risk in the measure of firm performance, we bring together the corporate finance literature and the literature on portfolio investment theory and practice. We argue that TPM contains a different set of information that can be useful in understanding the complicated relationships between decision making and firm performance. Our approach is very general. We make no assumptions about the return distributions, the specific form of the utility functions or the efficiency of the market portfolio. The only assumptions are that investors are risk averse and hold their wealth in the market portfolio.

The empirical testing involves two stages. First, we show that TPM does reflect the individual moments of the return distribution. We then use TPM to study the effect of managerial ownership (MO) on firm performance, the well-known manager/shareholder agency conflict has been a major issue in economics and management science for over 70 years. We show that there is a significant quartic relationship between firm performance measured as TPM and MO, a relationship with a straightforward interpretation for the risk averse shareholder's utility over each interval. When we examine the relationship between MO and other measures of firm performance, such as returns, return volatility, skewness and kurtosis, the effects on whether or not they enhance the risk averse shareholder's utility are often conflicting. This is evidence that the individual moments provide only a partial and potentially misleading picture of overall stock performance that is difficult to interpret when standing alone. It is also evidence that the more comprehensive TPM provides additional insights into firm performance. We pursue this proposition and show that after orthogonalizing TPM with respect to Tobin's Q, another common measure of firm performance, TPM retains a significant amount of performance information. These results are robust to controls for endogeneity, institutional ownership, firm size, leverage, firm age, and auditing quality.

This paper extends the previous literature by adding a basic but versatile measure of firm performance to the corporate finance empirical literature that goes beyond wealth to include the distribution of wealth outcomes as well. As such, it refines the corporate objective to reflect utility maximization and brings together the portfolio investment and corporate finance literature.

The remainder of the paper is organized as follows. The next section develops the framework and methodology for constructing TPM. Section 3 analyzes TPM in the framework of the manager/shareholder agency conflict. Section 4 compares the information content of TPM with other popular performance measures, such as Tobin's Q and the raw moments of the return distribution. Section 5 concludes.

2 Total firm performance: framework and methodology

To construct the utility based proxy for firm performance, noted as TPM, we proceed as follows. We assume that shareholder wealth is represented by the market portfolio and that shareholders are rational, non-satiating and risk averse. Each investor has a utility function $u(r)$ satisfying the following conditions:

$$u'(r) \geq 0, \quad u''(r) \leq 0 \quad \forall r \tag{1}$$

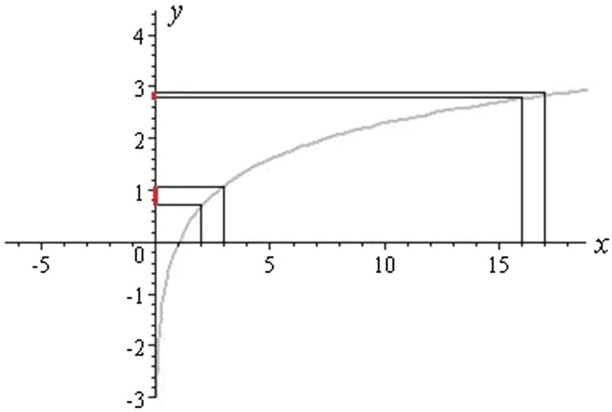

Fig. 1 Graph of a risk averse utility function y = ln(x)

where primes denote derivatives and r is the rate of return of an investment. Let x_i represent the percent of asset i in the market portfolio, $r_M = \sum_{i=1}^{n} x_i r_i$ represent the return on the market, and $q_i = x_i(r_i - r_M)$ represent the change in r_M due to asset i. The contribution to utility by asset i can be found by expanding $u(r_M - q_i)$ in a Taylor series around r_M and ignoring terms above the first derivative:

$$u(r_M - q_i) = u(r_M) - q_i u'(r_M) \tag{2}$$

where $q_i = x_i(r_i - r_M)$. Rearranging gives:

$$u(r_M) = u(r_M - q_i) + q_i u'(r_M) \tag{3}$$

Thus, asset i's contribution to utility is equal to $q_i u'(r_M) = x_i(r_i - r_M)u'(r_M)$. For a given value of q_i the contribution to total utility depends on r_M. Since $u''(r) \leq 0$, the contribution will be greater the lower the level of r_M. For example, in Fig. 1 an increase in one unit of wealth from 3 to 4 on the x-axis increases utility on the y-axis by approximately 0.3, whereas an increase of one unit of wealth from 16 to 17 only increases it by about 0.1.

Because the marginal utilities of individual shareholders are different and unknown, we cannot estimate the utility of specific shareholders. To overcome this problem, we build on the condition of decreasing marginal utility and rank the states of nature according to the returns on the market portfolio from lowest to highest. Ranking in this way is equivalent to ranking by decreasing marginal utility for each shareholder because utility is defined over total wealth reflected in the market portfolio.[6] Thus, all risk averse shareholders, regardless of their individual utility functions and ownership in the company, must be in agreement with this ranking. Individual shareholders may not derive the same marginal utility from returns on the market portfolio, but they all agree on the ranking of the marginal utilities of these returns. From this it is clear that the ranking of the states of nature with respect to portfolio returns is the necessary and sufficient information to provide a ranking with respect to marginal utility. We can use this ranking to derive a measure of performance for each firm that reflects decreasing marginal utility.

We start by matching the returns on each firm with the ranked returns on the market portfolio. We then calculate $(r_i - r_M)$, the difference between the firm returns and the returns on

6 This type of ordering is similar to that found in Shalit and Yitzhaki (1994).

the market portfolio, for each value of r_M. These differences reflect the relative performance of each firm with respect to the market portfolio at each state of nature. The higher (lower) the difference, the better (worse) is the relative performance.

The partial performance measure we propose is based on the statistic developed by Chow (2001) calculated as the average excess return, $E(r_i - r_M)$, divided by its standard deviation. This test is designed to reflect the effect of decreasing marginal utility on performance. It follows a studentized maximum modulus distribution. The critical values are available in Stoline and Ury (1979). It has been used primarily in studies based on marginal conditional stochastic dominance (e.g. Clark et al. 2011; Belghitar et al. (2011); Clark and Kassimatis 2013). Its construction involves dividing the vector of relative performance for each firm into deciles.[7] We use the deciles to form subsamples of the data that we use to construct partial performance measures for each firm. The first subsample is comprised of return differences obtained from the first decile of the ranking. The second subsample is comprised of return differences obtained from the first and second deciles of the ranking. The third subsample is comprised of return differences obtained from the first, second and third deciles and so on, until the whole distribution is included in the final subsample. This can be written formally as:

$$Z^k(\tau_i) = \frac{\overline{\Phi}^k(\tau_i)}{\hat{S}^k(\tau_i)}, \quad \text{for} \quad \text{i} = 1, \ldots, \text{m}. \tag{4}$$

where

$$\bar{\Phi}^k(\tau_i) = \overline{r_{pk} I(\tau_i)} - \overline{r_M I(\tau_i)}, \quad \text{i} = 1, 2, \ldots, \text{m and k} = 1, 2, \ldots, \text{K}, \tag{5}$$

and $\overline{\Phi}^k(\tau_i)$ is the mean excess conditional return of stock k relative to the market portfolio below a target rate of return τ. The index i denotes the set of prespecified target rates of return. $\hat{S}^k(\tau_i)$ is the estimated standard error of $\overline{\Phi}^k(\tau_i)$ and $I(\tau_i)$ is an indicator variable such that $I(\tau_i) = 1$ if $r_M \leq \tau$ and 0 otherwise.[8] Using deciles, (i.e. $i = 1, \ldots, 10$), gives 10 individual Z statistics as partial performance measures.

It is important to note that we make no assumptions about any of the return distributions, such that each partial performance measure reflects the complete empirical distribution of a firm's returns compared to the return on the market over each subsample. Since it is measured over the entire empirical distribution of each subsample, it will also reflect all the moments of the distribution of the subsamples, including the third, fourth and higher moments. TPM is calculated as the average of these ten partial performance measures. It reflects the attribute of decreasing marginal utility by giving more weight to the outcomes at the lower states of nature. For example, the outcomes of the first decile count for approximately 28.5% of TPM, the outcomes of the second decile for approximately 19.5%, etc.

As an example of how TPM is calculated, consider a period of 50 working days, which gives 50 daily returns for the market portfolio (M) and stock i. First, market returns are ranked from lowest to highest and matched with the corresponding returns of stock i so that the return on stock i is conditional on the return on the market portfolio. The sample is then split into deciles, each consisting of 5 pairs. Columns 2 and 3 in Table 1 report the 15 lowest

[7] There is no "correct" percentile for the subsamples. The percentile must be large enough to avoid rank reversal with respect to marginal utility but contain enough observations for statistical inference. For example, when the sample is broken down by deciles, the first ten percent of observations count for 29.5% of the TPM statistic. When broken down into quintiles, the first ten observations count for only 22.8% of the TPM statistic. In the context of MCSD Chow (2001) recommends deciles.

[8] For detailed information on the Z test, see Chow (2001).

Table 1 Steps in the calculation of TPM

Obs.	R_M (%)	R_i (%)	$R_i - R_M$ (%)	Aver. ($R_i - R_M$)	St.Dev. ($R_i - R_M$)	Z (Aver/st.dev)
1	− 9.00	− 7.60	1.40			
2	− 7.50	− 7.60	− 0.10			
3	− 7.20	− 7.00	0.20			
4	− 7.10	− 6.40	0.70			
5	− 6.80	− 5.20	1.60	(obs. 1–5) 0.76%	(obs. 1–5) 0.737%	1.03
6	− 5.50	− 5.10	0.40			
7	− 4.90	− 5.10	− 0.20			
8	− 4.80	− 6.00	− 1.20			
9	− 4.70	− 5.20	− 0.50			
10	− 4.10	− 3.50	0.60	(obs. 1–10) 0.29%	(obs. 1–10) 0.848%	0.34
11	− 3.82	− 4.10	− 0.28			
12	− 3.00	− 2.20	0.80			
13	− 2.10	− 1.80	0.30			
14	− 1.96	− 2.25	− 0.29			
15	− 1.70	0.50	2.20	(obs. 1–15) 0.38%	(obs. 1–15) 0.884%	0.42

The table provides a hypothetical example for the construction of TPM (Total Performance Measure). R_M is the daily market return sorted in ascending order, R_i is the respective daily stock return, Aver. ($R_i - R_M$) is the average difference between R_i and R_M, St.Dev. ($R_i - R_M$) is the standard deviation of $R_i - R_M$ and Z is calculated as the average ($R_i - R_M$) divided by the standard deviation of ($R_i - R_M$). The table reports 3 of the 10 deciles in the hypothetical example. TPM is the average Z value over the 10 deciles

hypothetical returns for the market portfolio and the corresponding returns for stock i. For example, the 3rd lowest return of the market portfolio during the 50 day period was − 7.2%. On that day the return of stock i was − 7%. The third step is to calculate the difference for each pair of returns, which is reported in the 4th column of the table. Next, we calculate the average difference in returns for the first 5 observations, the first 10 observations, the first 15 observations, and so on, until we include the entire sample. Finally, we calculate the standard deviation of the differences in returns [St.Dev.($R_i - R_M$)] reported in column 5. The Z statistic is calculated as the average difference in returns divided by the standard deviation of these differences for each sub-sample. In the hypothetical example, the TPM statistic is the equally weighted average of the ten Z statistics for the 50 day period. In the analysis that follows, TPM is calculated on an annual basis, employing daily returns over each calendar year.

By design, TPM should reflect the range of shareholder preferences embedded in the return distributions. To test this proposition we use a sample that includes all listed non financial firms on three US exchanges—New York Stock Exchange (NYSE), American Stock Exchange (AMEX), and Nasdaq—for the period 2002–2010. The market portfolio is proxied by the S&P 500. We then regress TPM on the first four moments of the return distributions with respect to the market portfolio, i.e. excess returns (ERET), covariance (COV), coskewness (COSK) and cokurtosis (COKU). In this way we control for market based effects while respecting that TPM is measured against the market portfolio. Thus, we offer the following

Table 2 The relationship between TPM and Excess returns

	(1)	(2)
ERET	240.4**	236.0**
	(45.13)	(77.03)
COV	− 7095.3**	− 5178.2**
	(− 67.68)	(− 96.27)
COSK	0.336**	0.451**
	(2.14)	(4.50)
COKU	− 8.392*	− 8.353**
	(− 1.86)	(− 7.27)
Constant	2.005**	1.906**
	(31.26)	(130.14)
Year dummies	Yes	Yes
Industry dummies	Yes	
Firm-fixed effects		Yes
N	14,728	14,728
Adj. R^2	0.547	0.501

The dependent variable is total performance measure (TPM). ERET is the annual average excess daily stock returns including dividends. COV is the covariance between the annual daily stock returns and the daily returns of the market portfolio, COSK is the co-skewness and COKU is the co-kurtosis between a firm's returns and the market portfolio's returns. The coefficients' standard errors are based on adjusted for the effects of non-independence by clustering on each firm (Petersen 2009). t statistics in parentheses. $^*p < 0.10$l; $^{**}p < 0.05$

specification, where the coefficients' standard errors are adjusted for the effects of non-independence by clustering on each firm:

$$TPM_{it} = \kappa_0 + \kappa_1 ERET_{it} + \kappa_2 COV_{it} + \kappa_3 COSK_{it} + \kappa_4 COKU_{it} + \varepsilon_{it} \tag{6}$$

where ERET, COV, COSK and COKU are the explanatory variables defined above, the $\kappa' s$ are estimated coefficients and ε_t is the error term.

Table 2 reports the results. The adjusted R^2 is over 50% in both specifications, the four explanatory variables are highly significant in both specifications and have the right signs for risk averse investors with decreasing absolute risk aversion. Average excess returns and coskewness have a positive coefficient while covariance and cokurtosis have a negative coefficient. This is strong evidence that TPM reflects the individual moments of the return distribution and that it is compatible with utility maximization for risk averse investors, which makes it a good proxy for firm performance.

3 Managerial ownership and firm performance

We now turn to the application of TPM to an important problem in the corporate finance literature, the effect of managerial ownership (MO) on firm performance. The effect of managerial ownership on the manager/shareholder agency conflict has been a major issue in economics and management science for over seventy years.[9] The conflict, which arises when corporate ownership is separate from corporate control and the interests of managers and shareholders diverge, can result in opportunistic behavior by managers that is incompatible with their mandate to act in the best interest of shareholders.[10] The seminal paper of Jensen and Meckling (1976) argued that this "agency conflict" can be mitigated through managerial compensation that aligns the interests of managers and shareholders.[11]

The initial thrust of the literature that analyzes the effect of managerial ownership on firm performance was that greater managerial ownership benefits shareholders because it increases managers' incentives to accept riskier, more profitable projects that increase firm value (e.g. Jensen and Meckling 1976; Morck et al. 1988; Stulz 1988; Tosi et al. 1997).[12] Other studies pointed out, however, that if managers own a substantial percentage of a firm's shares, they may try to entrench themselves in the company they manage[13] by over-investing (empire building)[14] and accepting negative present value projects that reduce corporate wealth (e.g. Demsetz 1983; and Fama and Jensen 1983).[15] Another strand of the literature focuses on the principle of diversification. Acharya and Bisin (2009) argue that managers are restricted in trading the stock of the firm they manage and, thus, they cannot diversify their firm specific risk through the financial markets. However, they are not restricted in trading other securities so they may favor projects with greater market risk, but which is diversifiable and can be hedged in the financial markets using instruments such as stock indices. The higher market risk increases the firm's cost of capital and reduces the firm's market value. Thus, because of under-diversification, higher levels of managerial ownership decrease firm value and increase the misalignment between managerial and shareholder interests.[16]

In the traditional theory of the firm, the empirical literature has focused for the most part on some form of wealth creation, such as stock returns or Tobin's Q, and has ignored how stock returns or the changes in Tobin's Q are distributed. For example, Kirchmaier and

[9] There is a huge and growing literature on the principal-agent conflict. For some of the best original work, see: Berle and Means (1932), Coase (1937), Cyert and March (1963), Williamson (1964), Machlup (1967), Alchian and Demsetz (1972) and Jensen and Meckling (1976).

[10] See, for example, Denis et al. (1999) and Dalton et al. (2007). More generally, Eisenhardt (1989) and Nyberg et al. (2010) show how agency theory can help us gain a better understanding of organizational behavior.

[11] For a discussion of MO and risk sharing incentives in the agricultural sector see Stiglitz (1974). Spence and Zeckhauser (1971) deal with the difficulty and cost of monitoring an agent's actions in the insurance sector.

[12] The positive relationship between managerial ownership and risk is also reflected in the debt market. For example, Shaw (2012) shows that yield spreads are higher for firms whose CEOs hold more shares and stock options.

[13] Berger et al. (1997, p. 1411) define entrenchment as: "The extent to which managers fail to experience discipline from the full range of corporate governance mechanisms, including monitoring by the board, the threat of dismissal or takeover, and stock or compensation-based performance incentives."

[14] 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 et al. (2008), Faccio and Lasfer (1999) and Guest (2008). Chang et al. (2013) have shown that cash is more likely used to finance acquisitions when target management ownership levels are high, which is consistent with a reduced monitoring hypothesis, where bidding firm managers seek to avoid the formation of a large block holder that may become an active monitor.

[15] 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.

[16] The evidence for this argument is ambiguous. Brockman et al. (2010) document a negative relationship between managerial ownership and financial alignment while others, such as Liu and Mauer (2011), and Daniel and Naveen (2004) provide evidence of a positive relationship. Coles et al. (2006) provide evidence for both types of relationship.

Grant (2005), Zhang (2009) and Von Lilienfeld-Toal and Ruenzi (2014) have used stock returns as a performance proxy. Another important strand of this literature uses Tobin's Q to test for non-linearity. McConnell and Servaes (1990) find quadratic non-linearity while De Miguel et al. (2004) find quadratic and cubic non-linearity; Morck et al. (1988), Short and Keasey (1999), Faccio and Lasfer (1999) and Holderness, Kroszner, and Sheehan (1999) (for their 1935 sample) find cubic non-linearity; Hermalin and Weisbach (1991) find quartic non-linearity and Davies et al. (2005) find the non-linearity is quintic.

The overall thrust of the empirical literature suggests that there is a significant, non-linear relationship between firm value and managerial ownership, but besides Gadhoum and Ayadi (2003), who examine how ownership structure affects the volatility of Canadian companies and identify a non-linear positive relationship between volatility and managerial ownership, and Chen and Steiner (1999), who find a similar relationship for U.S. companies, there has been little or no research on how MO affects the distribution of wealth outcomes.

Using TPM as a performance measure provides some interesting insights into the foregoing discussion. It furnishes evidence that firm performance does change as a result of a change in investment strategy due to incentives embedded in different levels of MO and that this change includes changes in shareholder returns as well as how these returns are distributed. It also shows that overall performance that reflects all the moments of wealth outcomes can differ sharply from the one dimensional performance measures considered in the literature.

3.1 Sample description

The sample includes the sample described above of all listed non financial firms on three US exchanges—New York Stock Exchange (NYSE), American Stock Exchange (AMEX), and Nasdaq—for the period 2002–2010 with available data for the analysis. Specific firm data was obtained from Worldscope. Data on firm ownership structure was obtained from Thomson One Banker. Following Holderness et al. (1999), Helwege et al. (2007), and Fahlenbrach and Stulz (2009), managerial ownership, *MO*, is measured as the percentage of total shares held by firm executive directors.[17,18] The market portfolio used to calculate TPM is proxied by the S&P 500.

We consider 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 any of the dependent variables. 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 financial institutions. The fifth and sixth control variables are firm age (AGE), defined as the number of years since firm creation, suggested by Bennett 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

[17] Relevant data are available from 2002.

[18] We use this measure for two reasons. First, since modern corporations are typically managed by a "team", it corresponds best to the agency theory proposition. Second, it makes our results comparable with previous studies (also see, Thomsen and Pedersen 2000).

final unbalanced sample consists of 2936 firms for the period 2002–2009. Table 3 reports correlations between our variables and Table 4 reports descriptive statistics for the data series.

3.2 Empirical results

One important question to be addressed in the analysis is whether the empirical results are the interpretation of equilibrium or out-of-equilibrium phenomena. In equilibrium managerial ownership is likely to be endogenously determined (Demsetz and Lehn 1985; Demsetz and Villalonga 2001). 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 optimal managerial ownership rests on the firm's contracting environment that may change over time (Cheung and Wei 2006).

To account for sub-optimal contracting, 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:

$$TPM_{it} = \gamma TPM_{it-1} + \sum_{j=1}^{4}\left(\varsigma_j MO_{it}^{j}\right) + \delta X_{it} + n_i + \lambda_t + \xi_{it} \tag{7}$$

where *TPM* is the dependent variable, the total performance measure, *MO* is managerial ownership, 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 γ *is* a scalar, ς and δ are k-dimensional vectors of coefficients. The variables n_i and λ_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 firm's control. Similarly, the lagged dependent variable in Eq. (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 Eq. (7), where the lagged dependent variable (TPM_{it-1}) and endogenous regressors (*MO*) are instrumented. The preferred estimator for Eq. (7) is the Generalised Method of Moments (GMM) system estimator (Arellano and Bover 1995; Blundell and Bond 1998) because: (a) the panel consists of a small number of time periods (small *T*) and a large number of firms (large *N*); (b) the dependent variable (*TPM*) is dynamic, in the sense that it depends on past realizations;[19] (c) the GMM system explicitly allows for heteroscedasticity and autocorrelation within firms.

Following Arellano and Bover (1995), the dynamic performance model is estimated by the forward orthogonal deviations transform in order to purge the data of unobserved firm heterogeneity.[20] Thus, the GMM system estimator combines a set of orthogonal deviation

[19] This is intuitively true, as a firm's performance is likely to experience time clustering (Magalhaes et al. 2008). 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."

[20] 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 2011).

Table 3 Correlation matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. TPM	1												
2. COV	**−0.387**	1											
3. COSK	**0.085**	**−0.302**	1										
4. COKU	−0.009	**0.059**	**0.027**	1									
5. ERET	**0.337**	**−0.111**	**0.147**	**0.028**	1								
6.MO	**0.024**	**−0.043**	**−0.037**	0.014	0.012	1							
7. INST	**−0.062**	**−0.031**	**0.122**	**−0.026**	−0.009	**−0.198**	1						
8. SIZE	**−0.131**	**0.190**	0.013	**−0.023**	0.019	**−0.197**	**0.281**	1					
9.LEV	**0.053**	**0.062**	**−0.056**	**0.030**	**−0.036**	**−0.041**	**0.042**	**0.252**	1				
10.DIV	**0.161**	0.0001	0.005	−0.010	**0.039**	0.012	**−0.074**	**0.098**	**0.076**	1			
11. AGE	**0.063**	**0.043**	0.016	−0.014	**0.034**	**−0.028**	−0.003	**0.293**	**0.044**	**0.170**	1		
12. AUD4	**−0.097**	**0.066**	−0.001	−0.013	0.002	**−0.085**	**0.128**	**0.231**	**0.055**	0.001	−0.007	1	
13. Q	0.005	0.0064	0.0027	0.0056	0.001	−0.0027	−0.0193	−0.0073	−0.0013	−0.0017	−0.0068	−0.0138	1

The table reports correlations between our variables. TPM is the total performance measure. COV is the covariance between the annual daily stock returns and the daily returns of the market portfolio, COSK is the co-skewness and COKU is the co-kurtosis between a firm's returns and the market portfolio's returns. ERET is the annual average excess daily stock returns including dividends. MO is the total number of shares held by firm executive directors to total number of shares. INST is the total shares held by financial institutions 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 Q is Tobin's Q is measured as the ratio of the market value of assets to the book value of assets, where the market value of assets is measured as the book value of assets less the book value of equity plus the market value of equity. Bold texts indicate statistically significant at 1% level or better

Table 4 Descriptive statistics

Variables	Mean	SD	Median	Min	Max
TPM	0.443	1.857	0.345	− 3.413	6.112
Q	5.160	108.89	1.730	0.030	10,272.87
ERET	0.0001	0.002	0	− 0.025	0.027
COV	0.0001	0.0002	0.0001	− 0.0009	0.002
COSK	− 0.0126	0.077	− 0.0013	− 1.232	1.706
COKU	0.0004	0.006	0	0	0.662
MO	0.046	0.118	0	0	0.620
INST	0.212	0.208	0.150	0	0.780
SIZE	12.823	2.083	12.782	8.115	17.741
LEV	0.216	0.231	0.154	0	1.048
DIV	0.010	0.025	0	0	0.181
AGE	26.442	24.710	18	1	111
AUD4	0.3985	0.489	0	0	1

TPM is the total performance measure. Q is Tobin's Q is measured as the ratio of the market value of assets to the book value of assets, where the market value of assets is measured as the book value of assets less the book value of equity plus the market value of equity ERET is the annual average excess daily stock returns including dividends. COV is the covariance between the annual daily stock returns and the daily returns of the market portfolio, COSK is the co-skewness and COKU is the co-kurtosis between a firm's returns and the market portfolio's returns.MO is the total number of shares held by firm executive directors to total number of shares. INST is the total shares held by financial institutions 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. All variables are winsorized at the 1 and 99% percentiles, respectively

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, ξ_{it}.

To determine the order of non-linearity we employed a stepwise procedure starting with the quadratic. The squared variable was significant at the 5% level. We then added the cubed variable, which was significant at the 5% level without reducing the significance or changing the sign of the squared variable. When we added the variable raised to the 4th power it was significant without reducing the significance or changing the signs of the squared and cubed variables. The variable raised to the 5th power was not significant at any conventional level. Thus, we concluded that the quartic relationship was appropriate for our sample.

The results of the GMM system of tests are reported in Table 5. 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 year's performance (TPM_{t-1}) is positive and significant. The adjustment speed (which is given by $1-\gamma$) for model 1 is 0.575 and model 2 is 0.568. This gives, on average, an adjustment speed of 0.571. This is equivalent to a Koyck duration interval of 5.34 with $p=95\%$, where p is the percentage of the decay. This implies that it requires 5.34 years to complete a 95% adjustment, suggesting that adjustment costs

Table 5 GMM system results for TPM

	(1) TPM	(2) TPM
TPM_{t-1}	0.425**	0.432**
	(17.03)	(17.43)
MO	– 18.46**	
	(– 5.70)	
MO^2	151.0**	
	(4.40)	
MO^3	– 375.5**	
	(– 3.57)	
MO^4	286.2**	
	(2.99)	
MO [0–8.7%]		– 8.767**
		(– 6.89)
MO (8.7–32%]		4.709**
		(4.37)
MO (32–57.2%]		– 3.181*
		(– 1.68)
MO (57.2–100%]		– 10.69
		(– 0.81)
INST	– 0.597**	– 0.630**
	(– 4.77)	(– 5.04)
SIZE	– 0.261**	– 0.267**
	(– 9.69)	(– 9.70)
LEV	1.860**	1.887**
	(7.17)	(7.24)
DIV	3.777**	4.154**
	(2.30)	(2.53)
AGE	0.0267**	0.0265**
	(11.56)	(11.39)
AUD4	– 0.398	– 0.317
	(– 1.56)	(– 1.20)
Constant	2.683**	2.736**
	(10.77)	(10.79)
N	13,017	13,017
F-test	139.45**	139.89**
Sargan test	8.61	13.50
AR (1)	– 28.45**	– 28.72**
AR (2)	0.57	0.58

The dependent variable is TPM, the total performance measure. MO is the level of managerial ownership and is measured as the number of shares held by firm executive directors to total number of shares. MO^2 is the square term of MO, MO^3 is the cube term of MO and MO^4 is the cubic term of MO. MO [0–8.7%], (8.7–32%], (32–57.2%] and (57.2–100%] are sub-samples of MO based on the level of managerial ownership. INST is the total shares held by financial institutions 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 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) give the GMM system estimates where 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. $*p < 0.10$; $**p < 0.05$

are quite high.[21] This finding along with the instrumented *MO* is consistent with Demsetz's (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.

As indicated in Eq. (7), we test for the nonlinearity by including in the analysis the square root, the cube and the quartic of managerial ownership (MO^2, MO^3, MO^4). Consistent with prior studies, all MO coefficients are statistically significant (model 1) suggesting that the relationship between TPM and MO is not linear. The quartic relationship suggests that there are four distinct managerial ownership intervals with three turning points. Given this evidence, in model 2 we consider a piecewise linear specification to test the relationship between TPM and MO over each interval. The turning points can be optimally derived by taking the first derivative of

$$\varsigma_4 MO^4 + \varsigma_3 MO^3 + \varsigma_2 MO^2 + \varsigma_1 MO \tag{8}$$

and setting it equal to zero. This gives

$$4\varsigma_4 MO^3 + 3\varsigma_3 MO^2 + 2\varsigma_2 MO + \varsigma_1 = 0 \tag{9}$$

Solving for MO gives turning points at 8.7, 32 and 57.2%

Since $\varsigma_1 = -18.46$, the interval between 0 and 8.7% is downward sloping and 8.7% is a local minimum. This result is evidence of the under-diversification theory of managerial misalignment with shareholder preferences. The most likely explanation for the negative relationship is that at low levels of ownership, increased ownership increases the costs associated with under-diversification more than the potential gains from the shareholder friendly projects that would improve TPM. These costs can also be exacerbated by issues such as restrictions on short sales, restrictions on trading during blackout periods, and required minimum levels of stock ownership.

With $\varsigma_2 = 151.0$, the interval between 8.7 and 32% is upward sloping with a local maximum at 32%. This is strong evidence supporting managerial alignment. With the coefficient $\varsigma_3 = -375.5$ negative, the interval between 32 and 57.2% is negative with a local minimum at 57.2%. This result supports the argument for entrenchment and/or empire building. The coefficient $\varsigma_4 = 286.2$ is positive, which means that the fourth interval is positive. This result supports the argument that at high levels of MO managerial and shareholder interests coincide.

The piecewise regression (Table 5, model 2) results support the conclusion derived from model 1. Over the interval 0–8.7%, MO has a negative, statistically significant effect at the 5% level on TPM. This is further evidence of misalignment. It has a positive, statistically significant (5% level) effect over the interval 8.7–32%, which is further evidence for alignment. Over the interval 32–57.2%, the effect is negative and statistically significant, but only at the 10% level. This is weak evidence for the entrenchment hypothesis. After 57.2% of managerial ownership, the relationship between MO and TPM seems to break down, probably because at this level of ownership the managers own so much of the company that their preferences coincide with those of the normal shareholder to the extent that there is nothing to be gained from further increases.

[21] The Koyck duration is calculated as $[\ln(1-p)/\ln(1-\gamma)]$ (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.

Overall, our results show that there is a statistically significant relationship between managerial ownership and our measure of firm performance. This relationship is non-linear, as suggested elsewhere in the literature based on other, less comprehensive measures of performance. We find that alignment occurs at ownership levels between 8.7 and 32% and above 57.2%. Between 32 and 57.2% we find evidence for misalignment and entrenchment. Interestingly and importantly, we find that at very low levels of MO (up to 8.7%) increasing managerial ownership actually exacerbates the agency conflict of manager/shareholder misalignment and reduces performance.

4 Analyzing and testing TPM's information content

4.1 TPM versus the raw moments of the return distribution

In Sect. 2 we showed that TPM represents a broad measure of firm performance that is measured over the entire empirical distribution of shareholder returns and, thus, reflects returns to shareholders as well as how those returns are distributed. In the preceding section we documented a strong statistical, non-linear relationship between TPM and MO. In this section we study whether and how TPM contributes to understanding firm performance. We start by testing the relationship between MO and the first four moments of the distribution of the raw returns and analyzing their effect on shareholder utility. We then compare the results with those of TPM in Table 5. We show that MO significantly affects the individual moments of firm returns, but the effects on whether or not they enhance the risk averse shareholder's utility are often conflicting.

Consider, for example, the results on the piecewise regressions reported in Table 6. In the first segment from 0 to 8.7%, returns, skewness and kurtosis decrease with MO, while volatility increases. Increased volatility and decreased returns and skewness are bad for risk averse investors, whereas decreased kurtosis is good. The trade-offs reflected in this conflicting information is resolved with TPM. The piecewise regressions Table 5 shows that the overall effect of MO from 0 to 8.7% on TPM is negative and significant. Over the second segment, the information does not conflict. Returns and skewness increase with MO, while volatility and kurtosis decrease, all of which is good for the risk averse investor, a result verified by the positive coefficient for TPM in Table 5 for the same segment. In the 3rd segment in Table 6, returns increase and volatility decreases, which is good for the risk averse investor, but skewness decreases and kurtosis increases, which is bad. Furthermore, none of the coefficients are significant. Based on returns alone or returns and volatility as the performance indicators, the conclusion would be no significant relationship or a weak positive one. Based on all four moments, no significant relationship would be forthcoming. Using TPM as the performance measure makes it possible to reconcile this conflicting information. In column 2 of Table 5 the coefficient of MO on TPM, which reflects the trade-offs of these four moments, is negative and statistically significant at the 10% level. In the fourth segment, all moments increase with MO and only the coefficient for volatility is statistically significant. Thus, there are two good effects (increased returns and skewness) and two bad ones (increased volatility and kurtosis). Taken together these results are difficult to interpret with respect to overall stock performance. The results for TPM in Table 5 show a negative coefficient that is not statistically different from zero at any reasonable level of significance, which is evidence that for MO above 57%, there is no overall relationship between stock performance and MO. The gist of this analysis is that examining the effect of MO on individual measures of stock

Table 6 GMM system results for piecewise moments

	(1) RET	(2) VOL	(3) SKE	(4) KUR
RET_{t-1}	− 0.122**			
	(− 5.14)			
VOL_{t-1}		0.512**		
		(20.69)		
SKE_{t-1}			0.149**	
			(2.86)	
KUR_{t-1}				0.163**
				(2.90)
MO [0–8.7%]	− 4.373**	0.228**	− 7.549**	− 2.595
	(− 19.09)	(15.61)	(− 5.99)	(− 0.23)
MO (8.7–32%]	1.684**	− 0.0806**	2.986**	− 9.134
	(8.74)	(− 6.83)	(2.75)	(− 0.93)
MO (32–57.2%]	0.0480	− 0.0209	− 2.235	1.747
	(0.14)	(− 1.01)	(− 1.14)	(0.10)
MO (57.2–100%]	1.372	0.263*	9.665	10.23
	(0.57)	(1.83)	(0.71)	(0.08)
INST	0.607**	− 0.0296**	0.104	− 0.680
	(35.99)	(− 26.13)	(1.14)	(− 0.78)
SIZE	− 0.0510**	− 0.000,857**	− 0.183**	0.0908
	(− 10.82)	(− 2.58)	(− 6.50)	(0.38)
LEV	− 0.355**	0.0544**	− 0.0602	− 1.291
	(− 7.05)	(17.27)	(− 0.21)	(− 0.50)
DIV	− 0.876**	0.0404**	− 1.174	− 27.45*
	(− 2.77)	(2.08)	(− 0.65)	(− 1.68)
AGE	0.00677**	− 0.000114**	0.0165**	− 0.0988**
	(15.46)	(− 4.23)	(6.51)	(− 4.07)
AUD4	− 0.0419	0.00931**	− 0.205	− 5.127**
	(− 0.88)	(3.29)	(− 0.74)	(− 2.18)
Constant	0.482**	0.0198**	2.111**	11.48**
	(11.30)	(5.11)	(8.44)	(5.40)
N	13017	13,017	13,017	13,017
F-test	201.66**	231.97**	17.85**	9.64**
Sargan test	3.69	3.84	9.19	5.67
AR (1)	− 19.22**	− 21**	− 11.73**	− 10.29**
AR (2)	1.19	1.12	1.61	1.02

The dependent variable are: raw mean return (RET) in model 1, firm volatility (VOL) in model 2, skewness (SKE) in model 3, kurtosis (KUR) in model 4. MO [0–8.7%], (8.7–32%], (32–57.2%] and (57.2–100%] are sub-samples of MO based on the level of managerial ownership. INST is the total shares held by financial institutions 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 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) give the GMM system estimates where 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. $*p<0.10$; $**p<0.05$

performance provides a partial and potentially misleading picture of overall performance that can be resolved by using the more comprehensive TPM.

4.2 TPM versus Tobin's Q

We now turn our attention to examining the relationship between TPM and Tobin's *Q* vis-à-vis managerial ownership. TPM represents the performance proxy for expected utility in the investment literature. As outlined above, Tobin's *Q,* defined as the ratio of the market value of assets to the book value of assets, where the market value of assets is measured as the book value of assets less the book value of equity plus the market value of equity, is often used in the corporate finance literature as the wealth variable to proxy for firm performance.

To explore the relationships among TPM, Tobin's Q and MO, we begin by testing the relationship between TPM and Tobin's Q in a regression of TPM on Tobin's *Q*. We find a strong, significant relationship. Tobin's Q is significant at the 1% level and the overall equation has an R^2 of 17%.[22] The implication is that TPM reflects the performance information contained in Tobin's *Q*. We then save the residuals from this regression and re-run the regressions of Table 5 with the saved residuals in place of TPM. The intuition behind this test is straightforward. The residuals, orthogonalized with respect to Tobin's Q, contain all the information included in TPM after eliminating the effect of Tobin's *Q*. The results of this regression measure the effect of MO on expected utility net of the Tobin's Q wealth effect. If the effect of managerial ownership on firm performance is predominantly a wealth effect, then using TPM instead of Tobin's *Q* for this type of analysis should offer no additional benefits. In this case we should find no relationship between the residuals and MO. The results are reported in Table 7. Clearly, there is a strong relationship between the residuals and MO. The magnitude of the coefficients is different to those reported in Table 5, which is expected because we removed the wealth effect from TPM. Besides that, the results reported in Tables 5 and 7 are identical. This is strong evidence that TPM provides additional insights into the effect of MO on firm performance.

5 Discussion and conclusion

In this paper we propose a methodology to address the problem of heterogenous and unknown shareholder utility functions that make it difficult to define a corporate objective common to all shareholders based on maximum utility. Using the concept of ranked marginal utility, we develop a multi-dimensional measure of firm performance that reflects the preferences of all risk averse shareholders towards all aspects of risk. We verify empirically that this is, in fact, the case for the first four moments of a large sample of US stocks over the period 2002–2010. When we use TPM in the manager/shareholder agency conflict, we show that it provides some novel insights. First of all, we verify that the non-linear relationship between managerial ownership and firm performance documented in the literature holds for TPM. We show that TPM reflects the trade-offs in utility caused by changes in the first four moments of the return distribution and that one dimensional performance measures, such as mean returns, volatility or Tobin's Q can lead to erroneous inference. Importantly, we also show that after orthogonalizing with respect to Tobin's Q, TPM contains significant information content on shareholder preferences. By including shareholder preferences towards risk in

[22] The complete results are available on request.

Table 7 GMM system results for TPM information not included in Tobin's q

	(1) TPM res	(2) TPM res
TPM res_{t-1}	0.440**	0.431**
	(14.97)	(14.46)
MO	– 23.37**	
	(– 6.39)	
MO^2	208.1**	
	(5.40)	
MO^3	– 549.0**	
	(– 4.65)	
MO^4	441.0**	
	(4.11)	
MO [0–8.7%]		– 10.35**
		(– 6.98)
MO (8.7–32%]		6.334**
		(5.38)
MO (32–57.2%]		– 3.630*
		(– 1.72)
MO (57.2–100%]		– 5.678
		(– 0.42)
INST	– 0.600**	– 0.577**
	(– 3.92)	(– 3.75)
SIZE	– 0.234**	– 0.249**
	(– 7.99)	(– 8.30)
LEV	1.831**	1.971**
	(5.31)	(5.68)
DIV	1.411	1.127
	(0.67)	(0.53)
AGE	0.0262**	0.0279**
	(9.69)	(10.07)
AUD4	– 0.593**	– 0.606**
	(– 2.10)	(– 2.06)
Constant	2.167**	2.285**
	(7.81)	(8.13)
N	13,017	13,017
F-test	88.38**	88.71**
Sargan test	56.32	42.07
AR (1)	– 22.21**	– 21.88
AR (2)	0.15	0.14

The dependent variable is TPM res, which is the total performance measure orthogonal on Tobin's q. MO is the level of managerial ownership and is measured as the number of shares held by firm executive directors to total number of shares. MO^2 is the square term of MO and MO^3 is the cube term of MO. MO [0–8.7%], (8.7–32%], (32–57.2%] and (57.2–100%] 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 by financial institutions 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) give the GMM system estimates where all the independent variables are treated as endogenous. Second lag period and earlier are used as instruments. *$p < 0.10$; **$p < 0.05$

the measure of firm performance as the corporate objective, we bring together the corporate finance literature and the literature on portfolio investment theory and practice.

References

Acharya, V. V., & Bisin, A. (2009). Managerial hedging, equity ownership, and firm value. *The Rand Journal of Economics, 40*(1), 47–77.

Aggarwal, R. K., & Samwick, A. A. (2006). Empire-builders and shirkers: Investment, firm performance, and managerial incentives. *Journal of Corporate Finance, 12*(3), 489–515.

Alchian, A., & Demsetz, H. (1972). Production, information costs and economic organization. *American Economic Review, 62,* 777–795.

Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics, 68*(1), 29–51.

Athayde, G. M. D., & Flôres, J. R. G. (2000). Introducing higher moments in the CAPM: Some basic ideas. In C. L. Dunis (Ed.), *Advances in quantitative asset management*. Norwell, MA: Kluwer Academic Publishers.

Belghitar, Y., Clark, E., & Kassimatis, K. (2011). The prudential effect of strategic institutional ownership on stock performance. *International Review of Financial Analysis, 20*(4), 191–199.

Bennett, J., Sias, R., & Starks, L. T. (2003). Greener pastures and the impact of dynamic institutional preferences. *Review of Financial Studies, 16*(4), 1199–1234.

Berger, P. G., Ofec, E., & Yermack, D. L. (1997). Managerial entrenchment and capital structure decisions. *Journal of Finance, 52*(4), 1411–1438.

Berle, A. A., & Means, G. C. (1932). *The modern corporation and private property*. New York: Macmillan.

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics, 87*(1), 115–143.

Bond, S. (2002). *Dynamic panel data models: A guide to microdata methods and practice*. Working paper 09/02, Institute for Fiscal Studies, London.

Brockman, P., Martin, X., & Unlu, E. (2010). Executive compensation and the maturity structure of corporate debt. *Journal of Finance, 65*(3), 1123–1161.

Chang, S., Mais, E., & Sullivan, M. J. (2013). The effect of target managerial ownership on the choice of acquisition financing and CEO job retention. *Review of Quantitative Finance and Accounting, 40*(3), 423–442.

Chen, C. R., & Steiner, T. L. (1999). Managerial ownership and agency conflicts: A nonlinear simultaneous equation analysis of managerial ownership, risk taking, debt policy, and dividend policy. *Financial Review, 34*(1), 119–136.

Cheung, W. K. A., & Wei, K. C. J. (2006). Insider ownership and corporate performance: Evidence from the adjustment cost approach. *Journal of Corporate Finance, 12*(5), 906–925.

Chow, K. V. (2001). Marginal conditional stochastic dominance, statistical inference, and measuring portfolio performance. *Journal of Financial Research, 24*(2), 289–307.

Clark, E., Jokung, O., & Kassimatis, K. (2011). Making inefficient market indices efficient. *European Journal of Operational Research, 209,* 83–93.

Clark, E., & Kassimatis, K. (2013). International equity flows, marginal conditional stochastic dominance, and diversification. *Review of Quantitative Finance and Accounting, 40*(2), 251–271.

Coase, R. H. (1937). The nature of the firm. *Economica, 4,* 386–405.

Coles, J. L., Daniel, N. D., & Naveen, L. (2006). Managerial incentives and risk-taking. *Journal of Financial Economics, 79,* 431–468.

Coles, J. L., Lemmon, M. L., Wang, Y. A. (2008). *The joint determinants of managerial ownership, board independence, and firm performance*. Working paper, University of Utah.

Core, J. E., Guay, W. R., & Larcker, D. F. (2003). Executive equity compensation and incentives: A survey. *Economic Policy Review, 9,* 27–50.

Cyert, R. M., & March, J. G. (1963). *A behavioral theory of the firm*. Englewood Cliffs, NJ: Prentice-Hall.

Dalton, D. R., Hitt, M. A., Certo, S. T., & Dalton, C. M. (2007). Chapter 1: The fundamental agency problem and its mitigation. In J. F. Walsh & A. P. Brief (Eds.), *Academy of management annals 1* (pp. 1–64). New York: Erlbaum.

Daniel, N. D., Martin, J. S., & Naveen, L. (2004). *The hidden cost of managerial incentives: Evidence from the bond and stock markets*, Working paper, Arizona State University.

Davies, J. R., Hillier, D., & McColgan, P. (2005). Ownership structure, managerial behavior and corporate value. *Journal of Corporate Finance, 11*(4), 645–660.

De Miguel, A., Pindado, J., & De la Torre, C. (2004). Ownership structure and firm value: New evidence from Spain. *Strategic Management Journal, 25*(12), 1199–1207.

Demsetz, H. (1983). The structure of ownership and the theory of the firm. *The Journal of Law and Economics, 26*(2), 375.

Demsetz, H., & Lehn, K. (1985). The structure of corporate ownership: Causes and consequences. *The Journal of Political Economy, 93*(6), 1155–1177.

Demsetz, H., & Villalonga, B. (2001). Ownership structure and corporate performance. *Journal of Corporate Finance, 7*(3), 209–233.

Denis, D. J., Denis, D. K., & Sarin, A. (1999). Agency theory and the influence of equity ownership structure on corporate diversification strategies. *Strategic Management Journal, 20*(11), 1071–1076.

Dittmar, R. F. (2002). Nonlinear pricing kernels, kurtosis preference, and evidence from the cross section of equity returns. *Journal of Finance, 57*(1), 369–403.

Eisenhardt, K. M. (1989). Agency theory: An assessment and review. *Academy of Management Review, 14,* 57–74.

Faccio, M., Lasfer, M. (1999). *Managerial ownership, board structure and firm value: The UK evidence*. Working paper, Cass business School.

Fahlenbrach, R., & Stulz, R. M. (2009). Managerial ownership dynamics and firm value. *Journal of Financial Economics, 92*(3), 342–361.

Fama, E. F., & Jensen, M. C. (1983). Separation of ownership and control. *Journal of Law and Economics, 26*(2), 301–325.

Fang, H., & Lai, T. (1997). Co-kurtosis and capital asset pricing. *Financial Review, 32*(2), 293–307.

Fisher, I. (1930). *The theory of interest*. New York: The Macmillan Co.

Florackis, C., Kostakis, A., & Ozkan, A. (2009). Managerial ownership and performance. *Journal of Business Research, 62*(12), 1350–1357.

Freeman, R. E., Wicks, A. C., & Parmar, B. (2004). Stakeholder theory and "the corporate objective revisited": A reply. *Organization Science, 15*(3), 364–369.

Gadhoum, Y., & Ayadi, M. A. (2003). Ownership structure and risk: A Canadian empirical analysis. *Quarterly Journal of Business and Economics, 42*(1/2), 19–39.

Gorbachev, O. (2011). Did household consumption become more volatile? *American Economic Review, 101,* 2248–2270.

Guest, P. M. (2008). The determinants of board size and composition: Evidence from the UK. *Journal of Corporate Finance, 14*(1), 51–72.

Helwege, J., Pirinsky, C., & Stulz, R. M. (2007). Why do firms become widely held? An analysis of the dynamics of corporate ownership. *The Journal of Finance, 62*(3), 995–1028.

Hermalin, B. E., & Weisbach, M. S. (1991). The effects of board composition and direct incentives on firm performance. *Financial Management, 20*(4), 101–112.

Holderness, C. G., Kroszner, R. S., & Sheehan, D. P. (1999). Were the good old days that good? Changes in managerial stock ownership since the great depression. *The Journal of Finance, 54*(2), 435–469.

Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics, 3*(4), 305–360.

Kirchmaier, T., & Grant, J. (2005). Corporate ownership structure and performance in Europe. *European Management Review, 2*(3), 231–245.

Koyck, L. M. (1954). *Distributed lags and investment analysis*. Amsterdam: North-Holland.

Kraus, A., & Litzenberger, R. H. (1976). Skewness preference and the valuation of risk assets. *The Journal of Finance, 31*(4), 1085–1100.

Lilienfeld-Toal, U., & Ruenzi, S. (2014). CEO ownership and stock market performance, and managerial discretion. *The Journal of Finance, 69*(3), 1013–1050.

Liu, Y., & Mauer, D. (2011). Corporate cash holdings and CEO compensation incentives. *Journal of Financial Economics, 102,* 183–198.

Machlup, F. (1967). Theories of the firm: Marginalist, behavior, managerial. *American Economic Review, 57,* 1–33.

Magalhaes, R., Urtiaga, M. G., Tribo, J.A. (2008). *Banks' ownership structure, risk and performance*. Working paper, Universidad Carlos III de Madrid.

McConnell, J. J., & Servaes, H. (1990). Additional evidence on equity ownership and corporate value. *Journal of Financial Economics, 27*(2), 595–612.
Morck, R., Shleifer, A., & Vishny, R. W. (1988). Management ownership and market valuation: An empirical analysis. *Journal of Financial Economics, 20,* 293–315.
Nyberg, A. J., Fulmer, I. S., Gerhart, B., & Carpenter, M. A. (2010). Agency theory revisited: CEO return and shareholder interest alignment. *Academy of Management Journal, 53*(5), 1029–1049.
Petersen, M. A. (2009). Estimating standard errors in finance panel data sets: Comparing approaches. *Review of Financial Studies, 22*(1), 435–480.
Post, T., van Vliet, P., & Levy, H. (2008). Risk aversion and skewness preference. *Journal of Banking & Finance, 32*(7), 1178–1187.
Ross, S. (1973). The economic theory of agency: The principal's problem. *American Economic Review, 63*(2), 134–139.
Shalit, H., & Yitzhaki, S. (1994). Marginal conditional stochastic dominance. *Management Science, 40*(5), 670–684.
Shaw, K. W. (2012). CEO incentives and the cost of debt. *Review of Quantitative Finance and Accounting, 38*(3), 323–346.
Short, H., & Keasey, K. (1999). Managerial ownership and the performance of firms: Evidence from the UK. *Journal of Corporate Finance, 5,* 79–101.
Spence, A. M., & Zeckhauser, R. (1971). Insurance, information and individual action. *American Economic Review, 61*(2), 380–387.
Stiglitz, J. E. (1974). Incentives and risk sharing in share-cropping. *Review of Economic Studies, 41*(2), 219–255.
Stoline, M., & Ury, H. K. (1979). Tables of the studentized maximum modulus distribution and an application to multiple comparisons among means. *Technometrics, 21,* 87–93.
Stulz, R. (1988). Managerial control of voting rights: Financing policies and the market for corporate control. *Journal of Financial Economics, 20,* 25–54.
Sundaram, A. K., & Inkpen, A. C. (2004a). The corporate objective revisited. *Organization Science, 15*(3), 350–363.
Sundaram, A. K., & Inkpen, A. C. (2004b). Stakeholder theory and "the corporate objective revisited": A reply. *Organization Science, 15*(3), 370–371.
Thomsen, S., & Pedersen, T. (2000). Ownership structure and economic performance in the largest European companies. *Strategic Management Journal, 21,* 689–705.
Tosi, H. L., Katz, J. P., & Gomez-Mejia, L. R. (1997). Disaggregating the agency contract: The effects of monitoring, incentive alignment, and term in office on agent decision making. *The Academy of Management Journal, 40*(3), 584–602.
Williamson, O. E. (1964). *The economics of discretionary behavior: Managerial objectives in a theory of the firm*. Englewood Cliffs, NJ: Prentice-Hall.
Zhang, F. (2009). *Managerial ownership and equity prices*. Working paper, University of British Columbia.