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# Average $q$, marginal $q$, and the relation between ownership and performance

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**Abstract**

Using average performance measures—as the literature does—to investigate the relation between ownership structure and performance suffers from severe drawbacks. We propose a marginal Tobin's $q$ and argue for its superiority.



*Keywords:* Average Tobin's $q$; Marginal Tobin's $q$; Insider ownership; Performance

*JEL classification:* G32; G34; L21

## 1. Introduction

The relation between ownership and performance has been the subject of an important and ongoing debate in the corporate governance literature. The debate goes back to Berle and Means (1932), who suggest an inverse relation between the diffuseness of shareholdings and firm performance. While some authors, most notably Morck et al. (1988),[1] find significant effects of ownership structures, others, e.g. Demsetz and Lehn (1985) and Himmelberg et al. (1999), disagree.[2]

The above studies differ in many respects, in performance measures and samples used, in estimating technique applied, in whether and how they account for the endogeneity of ownership

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[1] See also McConnell and Servaes (1990).

[2] See also Loderer and Martin (1997), Agrawal and Knoeber (1996), Cho (1998), and Demsetz and Villalonga (2001). For a critique, see Zhou (2001).

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structure, and in results obtained.[3] *All* of the above studies, however, use an *average* performance measure, such as Tobin's $q$ or the return on total assets. Such average measures suffer from severe drawbacks that have prevented the literature from reaching a broader consensus. First, average measures of performance confound inframarginal and marginal returns and thus are less than ideal for testing hypotheses regarding managerial behavior. Second, the use of average performance measures implies the need to specify a fully structural model of the determinants of performance, a model we do not have. The usual problems of omitted variables, reverse causation, and/or endogeneity follow.

An ideal measure of performance for testing hypotheses about agency problems should identify *marginal* returns, so what is needed is a *marginal* Tobin's $q$. We employ such a measure, the ratio of a firm's returns on *investment* to its costs of capital, a ratio we call $q_m$. This return measure has a number of advantages. First, it obviates the need to specify a fully structural model of performance, since a sufficient condition for bad managerial decisions is $q_m < 1$. Second, reverse causation or endogeneity are not likely to be problems with marginal return measures. For example, low *average* Tobin's $q$'s for firms with a diffuse ownership structure might not indicate that the shareholders are poor monitors of managers, but rather that original large shareholders have diffused their holdings because investment opportunities were bound to decline or simply because they wanted to diversify their wealth. An estimated $q_m$ of less than one, on the other hand, *must* be interpreted as a management failure. If firm investment opportunities are low, *and its managers are maximizing shareholder wealth*, they will invest little and the returns on this investment will (at least) equal the cost of capital. Similarly, falling $q_m$'s with rising management holdings *must* be interpreted as increasing agency problems due to entrenchment.

The next section presents the methodology for calculating $q_m$ and the data set. Section 3 estimates these $q_m$'s, and relates them as well as average Tobin's $q$ to managerial shareholdings. Section 4 concludes.

## 2. Methodology and data[4]

Let $I_t$ be a firm's investment in period $t$, $CF_{t+j}$ the cash flow this investment generates in $t+j$, and $i_t$ the firm's discount rate in $t$.

$$PV_t = \sum_{j=1}^{\infty} \frac{CF_{t+j}}{(1+i_t)^j} \tag{1}$$

We can then take $PV_t$ from (1) and the investment $I_t$ that created it, and calculate the ratio of pseudo-permanent return $r_t$ to $i_t$, a ratio that we call $q_{mt}$

$$PV_t = \frac{I_t r_t}{i_t} = q_m I_t \tag{2}$$

If the firm had invested the same amount $I_t$ in a project that produced a permanent return $r_t$, this

[3] See Gugler (2001) for a survey.
[4] The methodology was developed by Mueller and Reardon (1993).

project would have yielded the exact same present value as the one actually undertaken. The market value of the firm at the end of period $t$ can be defined as

$$M_t = M_{t-1} + PV_t - \delta_t M_{t-1} + \mu_t \tag{3}$$

where $\delta_t$ is the depreciation rate for the firm's total capital as evaluated by the capital market, and $\mu_t$ is the market's error in evaluating $M_t$. Subtracting $M_{t-1}$ from both sides of (3) and replacing $PV_t$ with $q_{mt}$ $I_t$ yields

$$M_t - M_{t-1} = q_{mt} I_t - \delta_t M_{t-1} + \mu_t \tag{4}$$

That $q_{mt}$ is a marginal $q$ can easily be seen from (2) and (4) by contrasting it with (average) Tobin's $q$. Tobin's $q$ is the market value of the firm divided by its capital stock and thus is an average return on capital. Marginal $q$ is the change in the market value of a firm divided by the change in its capital stock (investment) that caused it.

If $\delta_t = 0$ and a firm invests 100 at an $r_t < i_t$, i.e. $q_{mt} < 1$, then Eq. (4) implies that its market value increases by less than 100. Its managers *over*-invested: they invested more funds than the market thought this investment is worth (given depreciation). Conversely, if $\delta_t = 0.05$ and $M_{t-1} = 1000$, then the firm must invest 50 at an $r_t = i_t$ just to keep its market value unchanged.

Two additional features of $q_{mt}$ are worth noting. First, its use as a measure of performance obviates the need to calculate company costs of capital. Eqs. (2) and (4) define the *ratio* of a company's return on investment to its cost of capital, which is precisely the statistic needed to test hypotheses about agency problems. Second, the procedure for calculating $q_{mt}$ allows for different degrees of risk across companies. The stock market will demand a greater future stream of cash flows from an investment of 100 before it raises the market value of a high risk company by 100, than it demands of a low risk company.

The assumption of capital market efficiency implies that the error term in (4) has an expected value of zero, and thus that Eq. (3) can be used to estimate both $\delta_t$ and $q_{mt}$ under the assumption that they are either constant across firms or over time, or both. Dividing both sides of (4) by $M_{t-1}$ yields

$$\frac{M_t - M_{t-1}}{M_{t-1}} = -\delta + q_m \frac{I_t}{M_{t-1}} + \frac{\mu_t}{M_{t-1}} \tag{5}$$

To estimate (5) we need data on the market value of each firm and its investments. A firm's market value at the end of year $t$, $M_t$, is defined as the market value of its outstanding shares at the end of $t$ plus the value of its outstanding debt. Since this number reflects the market's evaluation of the firm's total assets, we wish to use an equally comprehensive measure of investment. Accordingly we define investment as

$$I = \textit{After tax profits} + \textit{Depreciation} - \textit{Dividends} + \Delta D + \Delta E + R\&D + ADV$$

$\Delta D$ and $\Delta E$ are funds raised using new debt and equity issues. Since *R&D* and advertising expenditures (*ADV*) are also forms of investment that can produce 'intangible capital' which contributes to a company's market value, we add them to investment to obtain a measure of the firm's additions to its total capital.

The financial data are taken from the 1996–2001 versions of the Global Vantage and 1997 version

Table 1
Summary statistics: means

| *IO* (%) | Number of observations | Tobin's $q$ | $(M_t - M_{t-1})/M_{t-1}$ | $I_t/M_{t-1}$ | $M_t$ |
|---|---|---|---|---|---|
| 0–5 | 4507 | 1.271 | 0.094 | 0.119 | 3522.5 |
| 5–10 | 2121 | 1.444 | 0.131 | 0.145 | 944.0 |
| 10–20 | 2774 | 1.476 | 0.160 | 0.157 | 606.5 |
| 20–30 | 2059 | 1.483 | 0.158 | 0.154 | 347.8 |
| 30–40 | 1645 | 1.470 | 0.156 | 0.156 | 298.7 |
| 40–50 | 1192 | 1.439 | 0.164 | 0.164 | 251.6 |
| 50–60 | 1014 | 1.397 | 0.171 | 0.171 | 237.6 |
| 60–70 | 664 | 1.362 | 0.164 | 0.185 | 214.3 |
| 70–80 | 313 | 1.476 | 0.177 | 0.151 | 253.5 |
| 80–90 | 118 | 1.426 | 0.161 | 0.154 | 296.9 |
| 90–100 | 47 | 1.561 | 0.249 | 0.160 | 205.5 |
| Total | 16,454 | 1.404 | 0.139 | 0.147 | 1311.2 |
| Total number of firms | 3673 | | | | |
| Average *IO* | 22.11% | | | | |

*IO* is insider ownership. $M_t$ is the market value of the firm in 1995 Mio USD. Tobin's $q$ is defined as $M_t$ divided by total assets. $I_t$ is total investment.

of the Compustat databases (Appendix A). The percentage of insider ownership (*IO*) is provided by the Compact Disclosure (CD) database. The sole source of ownership data used by CD is the Securities and Exchange Commission's corporate proxy statement. *IO* is defined as the total number of shares held in aggregate by all officers and directors divided by the number of shares outstanding.

Table 1 reports mean values on the main variables. In total, we have 3673 firms and 16,454 observations with insider ownership data. The time period is 1989–1998.

## 3. The Results

Table 2 presents the regression results. For comparison, Table 2A presents the results on a standard (average) Tobin's $q$ specification, with power functions up to degree three of *IO* included. We estimate by OLS and 2SLS instrumenting *IO* by firm size (up to power three), risk (the standard deviation of monthly stock returns), and a full set of two-digit industry dummies. We do not obtain a significant influence of *IO* on Tobin's $q$, except possibly with the squared and cubed terms in the 2SLS estimation. This reflects the ambiguous results obtained so far in the literature.

Table 2B presents the results of Eq. (5). The intercept in Eq. (5) is an estimate of the depreciation rate; the expected fall in a company's market value in any given year, if it makes no investments. We assign each company to a two-digit SIC industry, and estimate a separate depreciation rate (intercept) for each industry (not reported).

To test whether insider ownership systematically affects $q_m$, we include, in addition to $I_t/M_{t-1}$, interaction terms of $I_t/M_{t-1}$ and *IO*, *IO* squared and *IO* cubed. We lag *IO* one period, however, results are identical if we take *IO* in the same period. We obtain a significant positive/negative/positive pattern with both estimation techniques. For the OLS estimates, when *IO* is zero, $\hat{q}_m = 0.935$. This

Table 2
Regression results

| Estimation method | OLS | | 2SLS | |
|---|---|---|---|---|
| | Coeffic. | *t*-Value | Coeffic. | *t*-Value |
| A: Dependent variable average Tobin's $q$ | | | | |
| $(IO)_{t-1}$ | −0.08 | −0.37 | 11.73 | 0.76 |
| $(IO)^2_{t-1}$ | −0.47 | −0.69 | −2.88 | −2.81 |
| $(IO)^3_{t-1}$ | 0.62 | 1.10 | 3.32 | 2.91 |
| $\text{Log(size)}_t$ | −0.03 | −7.94 | −1.07 | −5.49 |
| $\text{Leverage}_t$ | −0.55 | −15.55 | −0.98 | −1.48 |
| $\text{R\&D/sales}_t$ | 0.76 | 20.88 | 0.44 | 1.04 |
| Adj. $R^2$ | 0.186 | | | |
| No. observations | 16,365 | | 15,278 | |
| B: Dependent variable $(M_t - M_{t-1})/M_{t-1}$ | | | | |
| $I_t/M_{t-1}$ | 0.94 | 31.62 | 0.86 | 15.71 |
| $I_t/M^*_{t-1}(IO)_{t-1}$ | 1.41 | 4.02 | 2.13 | 2.39 |
| $I_t/M^*_{t-1}(IO)^2_{t-1}$ | −4.39 | −4.14 | −1.21 | −2.66 |
| $I_t/M^*_{t-1}(IO)^3_{t-1}$ | 3.47 | 3.94 | 1.65 | 2.37 |
| Adj. $R^2$ | 0.274 | | | |
| No. observations | 16,454 | | 14,037 | |

The coefficient of the *IO* terms are multiplied with 100, $100^2$, and $100^3$, respectively. Size is total assets, leverage total debt divided by total assets.

implies that company managers invest in projects that earn 6.5% less than the costs of capital, on average, when insider ownership is zero. Our results further imply that $\hat{q}_m$ rises with *IO* until *IO* reaches 21.5%. At this point, $\hat{q}_m = 1.069$. Thus, incentive alignment brought about by increasing share holdings of managers induces them to invest in projects that earn at least the company costs of capital. However, in the range 21.5–63.0% we find an inverse relation between $q_m$ and insider ownership. At $IO = 63.0\%$, $\hat{q}_m = 0.945$. Managerial entrenchment lowers investment returns relative to costs of capital, sometimes below costs of capital. From this point, we again measure a positive association between $q_m$ and *IO*. For a hypothetical firm that is wholly owned by management, we estimate returns that are 41.7% higher than costs of capital ($\hat{q}_m = 1.417$).[5]

## 4. Conclusions

Using average performance measures to investigate hypotheses on corporate governance failures is not ideal. We propose a marginal performance measure, the ratio of a firm's returns on *investment* to its costs of capital, $q_m$.

The usual criticism of the relation between average measures and ownership structure, such as

[5] Insider holdings for these firms may proxy for the youth of the firm and good investment opportunities. Asymmetric information or other factors that drive a wedge between the costs of inside and outside funds may prevent them from reaching their optimal investment level at $q_m = 1$.

endogeneity or omitted variables, *cannot* explain why $q_m$ would fall below 1.0, or a *negative* relationship between $q_m$ and managerial holdings over middle ranges of holdings.

We estimate a $q_m < 1$ when insider holdings are zero or are near zero. We find a positive relation between insider ownership and $q_m$ until insider ownership reaches 21.5%, a negative relation between 21.5 and 63%, and from then on again a positive relation.

## Appendix A. Variable construction

The variables (Compustat data item numbers) are as follows. The market value is the sum of the market value of common stock, the book value of total debt and preferred stock. The market value of common stock is the end-of-fiscal year number of shares (54) times the end-of-fiscal year price per share (199). The book value of total debt is short-term and long-term debt (9 + 34). Preferred stock is, in order and as available, redemption value (56), liquidating value (10), or par value (130). After tax profits is income before extraordinary items (18), depreciation (14) is accounting depreciation and dividends (21) is total dividends paid in the fiscal year. New debt ($\Delta D$) is the change in total debt since the previous period. Net new equity ($\Delta E$) is sales (108) less purchases (214) of common and preferred stock. Missing values of *R&D* expenditures (46) are approximated using *R&D*-sales ratios at the three-digit SIC code level from the FTC's Annual Line of Business Reports. Missing values of advertising expenses (45) are approximated using two-digit advertising to sales ratios from the 1990 IRS Reports on Corporation Returns. All variables are deflated by the CPI (1995 = 1.00).

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