

Tobin's Q Does Not Measure Firm Performance: Theory, Empirics, and Alternative Measures*

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Abstract

Empirical studies in the corporate governance literature often use Tobin's Q as a proxy for firm performance. However, our theoretical framework illustrates that the relationship between firm performance and Tobin's Q is confounded by endogeneity. In particular, inefficiency due to underinvestment lowers firm performance but increases Tobin's Q. We then use our framework to derive two operating efficiency measures that unambiguously capture firm performance. The first measure assesses managerial decisions regarding scale and the second measure assesses managerial cost discipline. These proxies for firm performance are justified by the ideal of maximizing firm value net of invested capital. Consistent with the importance of scale decisions, our empirical implementation indicates that underinvestment inflates Tobin's Q. Consequently, a high Tobin's Q is not evidence of good firm performance. Furthermore, the inverse relationship between the corporate governance index of Gompers, Ishii, and Metrick (2003) and firm performance reverses after replacing Tobin's Q with our scale-based measure of operating efficiency.

Keywords: Tobin's Q, Firm Performance, Corporate Governance

1 Introduction

Empirical finance often requires proxies for variables of interest. However, proxies must be chosen carefully since inappropriate proxies can cause a hypothesis to be spuriously rejected or accepted. Indeed, the need for proxies results in joint tests of the stated hypotheses and the validity of the chosen proxies. Ideally, proxies would originate from a theoretical framework that justifies their use under reasonable assumptions that have empirical support. Following this ideal, we provide a theoretical framework to highlight an endogeneity problem with using Tobin’s Q to measure firm performance. The framework demonstrates that firm performance has an ambiguous impact on Tobin’s Q. We then propose two theoretically-motivated alternative proxies for firm performance. These proxies unambiguously capture firm performance in our framework.

Our theoretical framework is derived from managerial decisions regarding scale and cost discipline. For the single-product firm in our framework, scale is defined as the quantity of output produced. The operating efficiency measures we propose as proxies for firm performance assess scale decisions and cost discipline based on gross margins and operating expenses, respectively. These theoretically-motivated measures originate from a benchmark maximization of firm value net of invested capital, hence the maximization of a firm’s net present value. The measures represent a decomposition of Tobin’s Q into separate scale and cost components. Furthermore, our operating efficiency measures are consistent with empirical evidence of underinvestment and lax cost discipline in poorly governed firms.

Intuitively, the denominator of Tobin’s Q normalizes firm value by a proxy for capital to correct for exogenous differences in scale across firms. This normalization also accounts for the resources transferred from investors to management. However, capital is endogenous because of its dependence on corporate governance. Firms with the same natural scale can produce different quantities of output and consequently utilize different amounts of capital depending on the quality of managerial decisions. As documented by Bertrand and Mullainathan (2003), entrenched managers can decide to underinvest since *the best of all monopoly profits is a quiet life* according to Hicks (1935). Firms that underinvest operate below their firm’s profit-maximizing scale by producing less than the optimal amount of

output. Higher profit margins, a lower likelihood of being replaced due to negative demand shocks, and the need for less monitoring make underinvestment attractive to managers. Nonetheless, our framework does not disallow inefficient acquisitions by entrenched managers that are motivated by empire-building or compensation considerations (Harford and Li, 2007). Indeed, our operating efficiency measures can identify managers whose acquisitions fail to improve operating efficiency.

The ideal manager in our framework maximizes their firm's market value net of invested capital. Operating at a suboptimal scale and lax cost discipline result in deviations from this objective. By restricting output, underinvestment results in a proportional reduction in capital that lowers the denominator of Tobin's Q. However, since the combination of decreasing marginal revenue and increasing marginal costs reduces the marginal profit of additional output, underinvestment results in a less than proportional reduction in the gross margins that determine the numerator of Tobin's Q. The smaller reduction in the numerator of Tobin's Q relative to its denominator causes underinvestment to increase Tobin's Q. Indeed, from the perspective of maximizing shareholder wealth, investment is optimal until the marginal profit is zero. However, restricting investment increases the firm's average profit margin and Tobin's Q. As a simple numerical illustration, consider a firm with a Tobin's Q of 1.5 whose \$15 market value is based on a capital investment of \$10. If the firm initiates a new project requiring \$20 of additional capital that increases its market value by \$24, Tobin's Q decreases to 1.3 instead of increasing.¹ Thus, despite its positive net present value of \$4, this investment lowers Tobin's Q.

Our framework highlights the conflicting implications of better firm performance on Tobin's Q. Better operating efficiency in terms of scale decreases Tobin's Q by mitigating underinvestment while better operating efficiency in terms of cost discipline increases Tobin's Q. The net impact on Tobin's Q from better operating efficiency is ambiguous since this sign depends on the relative importance of scale decisions versus cost discipline. When interpreting a high Tobin's Q as evidence of good governance, the existing literature does not account for the denominator of Tobin's Q being endogenous with respect to managerial scale decisions.

¹Tobin's Q equals $\frac{\$15+\$24}{\$10+\$20} = 1.3$ after the capital investment.

Similarly, return on assets can either increase or decrease following managerial decisions that improve firm performance. Indeed, a high return on assets can either be attributed to underinvestment or stringent cost discipline, respectively. The similarity between return on assets and Tobin's Q follows from the market value in Tobin's Q capitalizing the cash flows that define return on assets.

The ambiguous relationship between firm performance and Tobin's Q as well as return on assets leads us to propose two measures of operating efficiency that proxy for firm performance. These measures capture the implications of scale decisions and cost discipline separately. Management decisions regarding scale are evaluated using gross margins, which equal revenue minus cost of goods sold, while cost discipline is evaluated using operating expenses. Low operating efficiency measures are consistent with managers choosing an output level that equates marginal revenue with the marginal cost of production and choosing to maintain low operating expenses. Therefore, both of our firm performance proxies decrease unambiguously as operating efficiency improves.

Graham, Lemmon, and Wolf (2002) report that target firms have lower normalized valuations than acquiring firms. This finding challenges the assumption that acquisitions destroy value simply by lowering the combined entity's average valuation and parallels our framework's intuition that the optimality of investment is determined by marginal rather than average quantities. Maksimovic and Phillips (2001, 2002) also have managers allocating resources to ensure that marginal profits are zero. Our operating efficiency measures capture the benefits of increased scale and cost-savings arising from acquisitions. Alternatively, if a manager assembles a collection of inefficient enterprises that increase firm size without improving operating efficiency, our measures correctly identify the conglomerate as being inefficient. In particular, absent synergy gains, a conglomerate's operating efficiency is the weighted average of the operating efficiencies of its underlying divisions.

The endogeneity problem afflicting Tobin's Q and our proposed solution to this problem are both consistent with prior empirical research. Bertrand and Mullainathan (2003) report that entrenched managers enjoy the quiet life by underinvesting. Following an exogenous increase in managerial entrenchment attributable to increased takeover protection, Low (2009) also finds evidence of greater managerial conservatism while Giroud and Mueller (2010) find

support for the quiet life hypothesis following changes in external governance. Aggarwal and Samwick (2006) along with John and Knyazeva (2006) also report that poor governance allows managers to underinvest. Furthermore, Giroud and Mueller (2010) report that poor governance leads to higher operating expenses. Cronqvist, Heyman, Nilsson, Svaleryd, and Vlachos (2009) also conclude that entrenched managers obtain private benefits by paying higher wages while Core, Holthausen, and Larcker (1999) find that weaker governance results in higher CEO compensation.

Although our operating efficiency measures reflect firm performance, they are not intended to replace existing proxies for corporate governance. Specifically, we propose to replace Tobin's Q as a proxy for firm performance instead of engaging in a "proxy battle" among alternative governance proxies. Nonetheless, to gauge the economic importance of our operating efficiency measures, we investigate whether the inverse relationship between the corporate governance index of Gompers, Ishii, and Metrick (2003) and Tobin's Q is sensitive to replacing Tobin's Q with our operating efficiency measures as a proxy for firm performance. Our focus on the Gompers, Ishii, and Metrick (2003) governance index is motivated by its attempt to measure managerial entrenchment, which is central to the quiet life hypothesis. This index assigns firms a score between zero and twenty-four by counting the number of their charter provisions that inhibit the replacement of management. Thus, a higher G index is interpreted as being evidence of greater managerial entrenchment.²

Given the ambiguous theoretical relationship between firm performance and Tobin's Q, we empirically examine the relative importance of scale decisions versus cost discipline to Tobin's Q. Our results indicate that underinvestment is responsible for inflating Tobin's Q. By restricting our sample to investment-grade firms, financing constraints and large write-downs are unlikely to be responsible for the underinvestment captured by our scale-based operating efficiency measure. Therefore, in contrast to the assumption in much of the existing literature, we conclude that a high Tobin's Q is not evidence of better firm performance.

²Although the G index fails to capture external governance mechanisms such as the market for corporate control (Shleifer and Vishny, 1986), Giroud and Mueller (2011) highlight the high correlation of 0.68 between the G index and the takeover index of Cremers and Nair (2005). Giroud and Mueller (2011) also document the 0.71 correlation between the G index and the simplified governance index of Bebchuk, Cohen, and Ferrell (2009) that is based on a subset of six charter provisions.

Furthermore, to circumvent the endogeneity problem afflicting Tobin's Q, we re-examine the relationship between the G index and firm performance using our operating efficiency measures. Gompers, Ishii and Metrick (2003) conclude that firms with a lower G index are better governed due to their higher Tobin's Q. Yermack (1996) also analyzes board performance using Tobin's Q while Anderson and Reeb (2003) employ Tobin's Q to examine the governance of family firms. However, we find that a lower G index (better governance) is associated with greater underinvestment. Therefore, the use of Tobin's Q as a proxy for firm performance appears to induce a spurious inverse relationship between the G index and firm performance. Consequently, although a low G index is associated with a high Tobin's Q, the higher Tobin's Q can be attributed to underinvestment being more severe for firms with lower G indices than for firms with higher G indices.

Intuitively, managers may be unwilling to increase investment to its optimal level without being afforded certain protections against their replacement, especially if negative demand shocks can be misinterpreted by shareholders as being evidence of poor management. In this vein, Aghion, Van Reenen, and Zingales (2010) report that institutional investors can mitigate the career concerns of managers and thereby encourage more innovative investment. Furthermore, the G index ignores external governance mechanisms such as the market for corporate control and internal governance mechanisms such as managerial incentives. Bates, Becher, and Lemmon (2008) report that classified boards, a charter provision included in the G index, do not inhibit corporate takeovers while Low (2009) reports that managerial entrenchment can be partially offset by stock options.

Overall, we argue that our proposed pair of operating efficiency measures offer more suitable proxies for firm performance than Tobin's Q. In addition, to the extent that entrenched managers underinvest, the G index does not correctly capture managerial entrenchment.

The remainder of this paper formalizes our framework in Section 2. The operating efficiency measures derived from this framework are then estimated in Section 3. Section 4 contains our conclusions and suggestions for future research.

2 Theoretical Framework

The intent of this section is not to provide a detailed structural model describing the mechanism through which corporate governance affects firm performance. Instead, we provide a theoretical framework to motivate proxies for firm performance that can be used when empirically testing a variety of hypotheses, including those related to corporate governance. In our framework, corporate managers are entrusted with two crucial tasks; they determine their firm's scale and control its operating expenses. For ease of exposition, our framework abstracts from leverage and taxes although an extension to allow for leverage is addressed in a later subsection.

Scale decisions determine the number of units of output the firm produces. This quantity is denoted y . Scale differences across firms depend on firm-level circumstances that are fixed in the short-term. For example, regional firms in small industries confront a different set of scale decisions than large multinational firms. Firm size can also be altered through acquisitions, an issue that is addressed in a later subsection.

We assume that a firm's output level is relevant to its performance for two reasons that are not mutually exclusive. The chosen output level is a determinant of the firm's average price and its average cost of goods sold. Downward sloping demand curves imply that marginal revenue is decreasing while decreasing returns to scale imply that the marginal cost of output is increasing. The slope of the demand curve reflects the firm's monopoly power when setting prices. No assumptions regarding the relative sensitivity of marginal revenue versus marginal costs are imposed on our framework since these sensitivities are expected to vary across firms. Instead, we focus our analysis on gross margins that are reduced by additional output due to a combination of decreasing marginal revenue and increasing marginal costs. Specifically, the average price of the firm's output is given by

$$P(y) = P_0 - a_p y, \quad (1)$$

where $a_p > 0$ represents the sensitivity of prices to output. Furthermore, the average cost of goods sold is given by

$$C(y) = C_0 + a_c y, \quad (2)$$

where $a_c > 0$ represents the sensitivity of production costs to output. Therefore, the gross margin per unit of output $G(y)$ equals the difference between $P(y)$ and $C(y)$

$$\begin{aligned} G(y) &= P_0 - a_p y - (C_0 + a_c y) \\ &= G_0 - \frac{y}{2a}, \end{aligned} \tag{3}$$

where $G_0 = P_0 - C_0$ and $a = \frac{1}{2(a_p+a_c)}$ are both positive by assumption. As output levels are not observed in financial databases, and would be difficult to define in a consistent manner across firms, $G(y)$ is multiplied by y to obtain a dollar-denominated amount for the firm's gross margin, $yG(y)$. This gross margin equals revenue minus cost of goods sold in our later empirical implementation. Management decisions also determine the firm's operating expenses that equal cy . The per unit average operating expense c varies according to a firm's cost discipline with a lower bound of c_0 .³ Thus, the firm's dollar-denominated net profit after operating expenses equals

$$\begin{aligned} yG(y) - cy &= y \left(G_0 - \frac{y}{2a} \right) - cy \\ &= y(G_0 - c) - \frac{y^2}{2a}. \end{aligned} \tag{4}$$

Although the a parameter links profitability with output, a is not sufficient to fully reflect product market competition since increasing competition in an industry would likely reduce G_0 as well as a for each firm.

For simplicity, managerial decisions regarding capital and output are treated as a single decision regarding the quantity of output to produce in our framework. In particular, the amount of capital required to produce one unit of output equals $k > 0$. The assumption of a linear production function implies the total amount of required capital to produce y units of output is ky . Finally, the appropriate interest rate for discounting future cash flows is the constant r . This interest rate also determines the rental cost of capital, which equals rky .

³While y and c are not stochastic, viewing them as expected values does not change our framework's economic implications in the absence of bankruptcy costs and asymmetric information.

2.1 Ambiguity of Tobin's Q

For the simple firm in our framework, the net profit in equation (4) equals its cash flow in a single period. With the discount rate for future cash flows equaling r , this per period cash flow yields a market value of

$$M(y, c) = \sum_{i=1}^{\infty} \frac{y(G_0 - \frac{y}{2a}) - cy}{(1+r)^i} = \frac{y(G_0 - c) - \frac{y^2}{2a}}{r}. \quad (5)$$

Normalizing this market value by capital, ky , yields Tobin's Q⁴

$$Q(y, c) = \frac{G_0 - c - \frac{y}{2a}}{rk}. \quad (6)$$

Observe that Tobin's Q is a decreasing function of output since $\frac{\partial Q}{\partial y} = -\frac{1}{2a}$ is negative. Therefore, in our framework, better operating efficiency has an ambiguous influence on Tobin's Q since better operating efficiency decreases c while increasing y , causing Tobin's Q to increase and decrease, respectively.

The impact of scale decisions on the denominator of Tobin's Q highlights the endogeneity problem that results in Tobin's Q being a poor measure of firm performance. In contrast, the empirical literature on corporate governance assumes that a high Tobin's Q is evidence of better firm performance, thereby allowing firms operating at a suboptimal scale to be misclassified as having good performance.

2.2 Operating Efficiency Measures

Our framework does not examine the managerial incentives required to mitigate underinvestment and improve cost discipline. This issue is examined in Aggarwal and Samwick (2006) as well as Low (2009). Instead, our framework proposes operating efficiency metrics to detect underinvestment and lax cost discipline. The ideal manager in our framework maximizes the firm's market value minus its invested capital

$$\max_{c,y} M - ky = \max_{c,y} \frac{y(G_0 - c - rk) - \frac{y^2}{2a}}{r}. \quad (7)$$

⁴Equation (6) represents the ideal Tobin's Q measure in our framework. However, in empirical studies, the denominator of Tobin's Q is often defined by book values that can deviate from their economic value. This use of book value introduces additional complications, which are not addressed in our framework, from write-downs, depreciation schedules, and other accounting decisions.

This objective maximizes the firm's net present value. Equation (7) is a concave function that achieves its maximum at

$$y^* = a(G_0 - c_0 - rk). \quad (8)$$

Managers who underinvest produce less than y^* while managers who shirk their responsibility to control operating expenses have c exceeding c_0 . The maximization in equation (7) is equivalent to maximizing the net profit in equation (4) minus the rent on capital

$$\frac{y(G_0 - \frac{y}{2a}) - cy - rky}{r}. \quad (9)$$

Investors prefer managers to produce a level of output y^* that sets marginal revenue equal to marginal cost.⁵ However, this level of output is too high from the perspective of entrenched managers that underinvest by producing below y^* .

Using the maximization in equation (7), we propose two operating efficiency measures that proxy for firm performance. The first operating efficiency measure is derived from gross margins while the second measure is derived from operating expenses. In particular, the first operating efficiency measure, R_{gm} , isolates the impact of managerial decisions regarding scale through

$$R_{gm} = \frac{\text{Gross Margin}}{\text{Capital}} = \frac{y(G_0 - \frac{y}{2a})}{ky} = \frac{G_0 - \frac{y}{2a}}{k} \geq \frac{G_0 + c_0 + rk}{2k}, \quad (10)$$

with the lower bound being independent of a after invoking y^* from equation (8). The normalization by capital ensures that R_{gm} is a decreasing function of output. Observe that R_{gm} is not complicated by the expenses that define cy . Furthermore, the lower bound in equation (10) is not required for empirical tests since R_{gm} is decreasing with better operating efficiency. Thus, estimating deviations between y and y^* is unnecessary.

The second operating efficiency measure, R_c , focuses on the operating expenses that define cy

$$R_c = \frac{\text{Operating Expenses}}{\text{Capital}} = \frac{cy}{ky} = \frac{c}{k} \geq \frac{c_0}{k}. \quad (11)$$

⁵Observe that y^* in equation (8) differs from the level of output $a(G_0 - c_0)$ that maximizes the firm's market value in equation (5) but ignores the amount of capital consumed by the firm.

The normalization by capital ensures that R_c is not complicated by management scale decisions. As this measure is smaller for firms with better operating efficiency, estimating deviations between c and c_0 is unnecessary.

Ang, Cole, and Lin (2000) estimate a sales-to-assets ratio that is not theoretically motivated. Instead, the authors interpret a high sales-to-assets ratio as evidence of low agency costs due to high managerial effort. This interpretation does not recognize that marginal revenue decreases with output. Moreover, Ang, Cole, and Lin (2000) assume that firms owned entirely by management have zero agency costs. However, Morck, Shleifer, and Vishny (1988) conclude that high levels of managerial ownership inhibit the market for corporate control. Therefore, despite the high concentration of managerial wealth in these benchmark firms, underinvestment caused by managerial conservatism and a weak market for corporate control are ignored by the sales-to-assets ratio in Ang, Cole, and Lin (2000).

In general, any capital-adjusted profitability metric is ambiguous regarding firm performance. Indeed, when total assets define capital in the denominator of our operating efficiency measures, return on assets (ROA) is proportional to their difference

$$\text{ROA} = R_{gm} - R_c, \quad (12)$$

since ROA is defined as net operating profit normalized by total assets. Consequently, while R_{gm} and R_c both decrease with improved operating efficiency, ROA evaluates the difference between these measures. Therefore, a high ROA can either be attributed to a high R_{gm} or low R_c , which signify poor and good firm performance, respectively.

For emphasis, our framework is not intended to facilitate the estimation of a firm's optimal Tobin's Q denoted

$$Q^* = \frac{G_0 - c_0 - \frac{y^*}{2a}}{rk}, \quad (13)$$

that involves the optimal output level and the lowest level of operating expenses. Instead, managers are expected to have better information regarding demand than investors. Indeed, one motivation for managers to underinvest is the inability of investors to accurately differentiate between negative demand shocks and poor management. If investors knew y^* and c_0 , then they could simply devise a contract that requires managers to produce the optimal

number of units and lower operating expenses to their minimum. In contrast, our operating efficiency measures don't require the estimation of y^* and c_0 .

Besides underinvestment, poor operating efficiency may also arise from managers utilizing an excess amount of capital. This “overinvestment” in unproductive capital can occur while simultaneously producing a suboptimal amount of output, and is identifiable through a normalization of capital by output to facilitate a comparison of k across firms. However, units of output are not reported in standard financial databases and are difficult to compare across firms. Thus, a third operating efficiency based on the amount of capital employed per unit of output would be difficult to estimate and interpret. Instead, the identifying restriction in our framework that managerial entrenchment leads to underinvestment is supported by the empirical evidence in Giroud and Mueller (2010), Low (2009), Aggarwal and Samwick (2006), John and Knyazeva (2006) as well as Bertrand and Mullainathan (2003).

2.3 Robustness of the Framework

Thus far, our framework has ignored the choice of capital structure since empirical evidence on the relationship between leverage and corporate governance is unresolved. Berger, Ofek, and Yermack (1997) find evidence that entrenched managers *play it safe* by issuing a sub-optimal amount of debt. However, John and Litov (2010) report that entrenched managers issue more debt and interpret this finding as evidence that entrenched managers have better access to debt markets because of their conservative investment strategies.

Nonetheless, our framework can be easily extended to include debt. Ignoring the interest tax shield, when a fraction $0 \leq f < 1$ of the firm's capital is financed by debt, its cash flows are reduced by an interest expense equaling $frky$. The remaining per period cash flows equal

$$y \left(G_0 - \frac{y}{2a} - c - frk \right)$$

and are obtained from an equity-financed capital investment of $(1 - f)ky$. Therefore, the firm's return on equity (ROE) is

$$\text{ROE} = \frac{y \left(G_0 - \frac{y}{2a} - c - frk \right)}{(1 - f)ky} = \frac{R_{gm} - R_c - rf}{1 - f}, \quad (14)$$

and equals ROA when $f = 0$. More importantly, better operating efficiency does not necessarily increase a firm's return on equity since ROE also involves the difference between R_{gm} and R_c .

Mergers and acquisitions can improve operating efficiency through synergies and cost-savings. Conversely, acquisitions can reduce operating efficiency by creating a collection of diverse enterprises with insufficient scale. According to Harford and Li (2007), increases in firm size are often motivated by greater managerial compensation instead of improvements in operating efficiency. Although our framework investigates a single firm, consider a merger between firms "A" and "B" that forms a "new" combined firm that is operationally the same. Using firm names as superscripts, the combined firm has a scale-based operating efficiency measure of

$$\begin{aligned} R_{gm}^{new} &= \frac{y^A \left(G_0^A - \frac{y^A}{2a^A} \right) + y^B \left(G_0^B - \frac{y^B}{2a^B} \right)}{k^A y^A + k^B y^B} \\ &= \left(\frac{k^A y^A}{k^A y^A + k^B y^B} \right) \frac{y^A \left(G_0^A - \frac{y^A}{2a^A} \right)}{k^A y^A} + \left(\frac{k^B y^B}{k^A y^A + k^B y^B} \right) \frac{y^B \left(G_0^B - \frac{y^B}{2a^B} \right)}{k^B y^B} \\ &= \tau R_{gm}^A + (1 - \tau) R_{gm}^B, \end{aligned}$$

where τ is defined as $\frac{k^A y^A}{k^A y^A + k^B y^B}$, the fraction of capital in the combine firm that is contributed by firm A. Therefore, the scale-based operating efficiency measure of the merged firm is a weighted average of the scale-based operating efficiency measures of firm A and B. This implies that the scale-based operating efficiency measure remains valid after a merger.

Similarly, if there are no operational changes, the cost-based measure of operating efficiency for a merged firm is given by

$$\begin{aligned} R_c^{new} &= \frac{c^A y^A + c^B y^B}{k^A y^A + k^B y^B} \\ &= \left(\frac{k^A y^A}{k^A y^A + k^B y^B} \right) \frac{c^A y^A}{k^A y^A} + \left(\frac{k^B y^B}{k^A y^A + k^B y^B} \right) \frac{c^B y^B}{k^B y^B} \\ &= \tau R_c^A + (1 - \tau) R_c^B, \end{aligned}$$

which is equal to a weighted average of the cost-based measures of the firms before the merger. Thus, the cost-based measure for the merged firms is the capital-weighted average of the measures for firm A and B. This property implies that the cost-based operating

efficiency measure is appropriate for merged firms. Overall, mergers that fail to improve operating efficiency will not yield a lower operating efficiency measure for the new combined firm.

Finally, the difference between a firm's market value and capital, which is maximized in equation (7), provides an alternative measure of operating efficiency. However, market valuations manifest a multitude of economic factors such as discount rates whose relationship with corporate governance is unclear.⁶ Core, Guay, and Rusticus (2006) document that expected stock returns are insensitive to governance. Therefore, we focus our analysis on realized operating efficiency.

3 Empirical Implementation

We focus our empirical investigation on the relationships between Tobin's Q, operating efficiency, and corporate governance. COMPUSTAT data is used to construct our operating efficiency measures and Tobin's Q.

Measurement error surrounding the replacement cost of assets, especially intangible assets such as intellectual property, complicates the construction of empirical proxies for the investment incentives of firms. Lindenberg and Ross (1981) interpreted a Tobin's Q above one as an indication of economic rents that may be attributable to intangible assets, and pioneered a literature that proposes algorithms for alleviating the measurement error inherent in Tobin's Q. Although Erikson and Whited (2006) conclude that these algorithms are unsuccessful at improving the measurement quality of Tobin's Q, several remedies, including instrumental variables, continue to have their proponents (Erikson and Whited, 2011; Almeida, Campello, and Galvao, 2010). This debate is often motivated by the use of Tobin's Q as an independent variable in regressions that test the sensitivity of investment to cash flow constraints. In contrast, our focus is on the use of Tobin's Q as a dependent variable when testing the sensitivity of firm performance to governance. Therefore, we adopt the standard definition of Tobin's Q in the empirical governance literature. Specifically, the numerator of

⁶According to equation (5), the earnings-to-price ratio equals r since operating efficiency influences its numerator and denominator. Therefore, this ratio is not a valid proxy for firm performance in our framework.

Tobin's Q is computed as total assets plus the market value of equity minus the book value of equity. As the standard definition of Tobin's Q has total assets in its denominator, we also use total assets as a proxy for capital in the denominator of our operating efficiency measures for consistency.

Revenue (REVT) minus cost of goods sold (COGS) define the numerator of R_{gm} in equation (10) while several operating expenses comprise the numerator of R_c in equation (11). These include advertising expenses (XAD), sales, general, and administrative expenses (XSGA), staff expenses (XLR), and rent (XRENT). The G index is obtained from the Investor Responsibility Research Center (IRRC) starting in 1990 every three years until 1998 when it becomes available every two years. Thus, the G index is available in 1990, 1993, 1995, 1998, 2000, 2002, 2004, 2006, and 2008.

Four digit SIC codes are obtained from CRSP to implement the industry classifications in Fama and French (1997). Bizjak, Lemmon, and Nguyen (2011) also use these industry classifications in their study of CEO compensation and relative performance. Firms in the banking, insurance, real estate, and financial trading industries are removed from our sample. Industry fixed effects account for differences in product market competition and relax the assumption that the a and k parameters in our framework are identical across firms.

Table 1 reports industry-level averages and standard deviations for Tobin's Q, the G index, and our operating efficiency measures. The average Tobin's Q measures vary across industries, which motivates our use of industry fixed effects in later empirical specifications. The standard deviations represent the average firm-level deviations within each industry and reveal that Tobin's Q varies more across time for individual firms than operating efficiency.⁷ This observation is consistent with the market values that define Tobin's Q being influenced by time-varying discount rates.

Panel A of Table 2 summarizes the distribution of Tobin's Q, the G index, and our operating efficiency measures across firms. Panel B reports on the correlations between these variables and also evaluates their respective correlations with the log of market capitalization (SIZE). These correlations are computed as cross-sectional averages of firm-level correlations.

⁷The low variability of the cost-based operating efficiency measure suggests that operating expenses are nearly proportional to total assets.

As in the existing literature, Panel B indicates that a lower G index coincides with a larger Tobin's Q, which is consistent with the conclusion of Gompers, Ishii and Metrick (2003). Nonetheless, despite the -0.125 correlation between the G index and Tobin's Q, the 0.278 correlation between Tobin's Q and the G index indicates that a higher Tobin's Q corresponds to a higher R_{gm} measure, which suggests that underinvestment is inflating Tobin's Q.

Furthermore, the 0.270 correlation between R_{gm} and R_c indicates that underinvestment coincides with lax cost discipline. The -0.182 correlation between R_c and SIZE indicates that large firms are better able to control operating expenses while the small (albeit positive) correlation between R_{gm} and SIZE indicates that large firms are not necessarily acting as monopolists by underinvesting.

In unreported results, we find a high positive correlation between Tobin's Q and return on assets (ROA) that is consistent with the existing literature. Furthermore, as a regression of ROA on our operating efficiency measures is trivial according to equation (12), we focus our empirical analysis on Tobin's Q.

3.1 Does Better Operating Efficiency Increase Tobin's Q?

We first examine the theoretically-ambiguous relationship between Tobin's Q and firm performance to determine the relative importance of scale decisions versus cost discipline. This analysis evaluates the appropriateness of the existing literature's assumption that a high Tobin's Q is the result of good firm performance. In the absence of cash flow uncertainty and time-varying discount rates, Tobin's Q is related to the difference between our operating efficiency measures (normalized by r)

$$Q(y, c) = \frac{y(G_0 - \frac{y}{2a}) - cy}{rky} = \frac{R_{gm} - R_c}{r}. \quad (15)$$

With stochastic cash flows, Tobin's Q equals the expectation of this difference. We evaluate the relationship between Tobin's Q and operating efficiency over a long time series to mitigate the errors-in-variables problem associated with comparing realized operating efficiency measures with the cash flow expectations underlying Tobin's Q. The presence of time varying discount rates is also mitigated through the use of a long time series when estimating the

following panel regression whose dependent variable is Tobin's Q

$$Q_{i,t} = \beta_y R_{gm,i,t} + \beta_c R_{c,i,t} + \gamma X + \epsilon_{i,t}. \quad (16)$$

The X vector represents industry fixed effects based on Fama and French (1997) that control for differences in the natural scale of firms and their required capital investments. The standard errors of the regression coefficients are clustered at the firm-level. The ability of underinvestment to inflate Tobin's Q is identified by a positive β_y coefficient. Specifically, a positive β_y coefficient indicates that underinvestment is increasing Tobin's Q.

Besides managerial entrenchment, financing constraints provide an alternative explanation for underinvestment. Although John and Litov (2010) document that entrenched managers have higher credit ratings due to their conservative investment policies, it is possible that financing constraints rather than managerial entrenchment are responsible for firms operating below their optimal scale. Therefore, we estimate equation (16) for investment grade firms whose credit ratings are at least BBB. The use of investment grade firms also guards against the possibility that large asset write-downs by distressed firms are inducing the spurious appearance of underinvestment by causing the denominator of Tobin's Q to be mismeasured.

Panel A of Table 3 reports on the coefficient estimates from equation (16). The β_y and β_c coefficients equal 2.60 and -0.75, respectively, with the former having a t -statistic of 12.88. The positive β_y coefficient is consistent with underinvestment increasing Tobin's Q in our sample. Furthermore, the negative β_c coefficient, with a t -statistic of -3.58, confirms that better operating efficiency in terms of cost discipline also increases Tobin's Q.

While the t -statistic for β_y is large, recall that the decomposition of Tobin's Q in equation (15) has R_{gm} (normalized by the constant r) as its first component. The magnitude and significance of the β_y coefficient is not sensitive to the removal of R_c from the regression as β_y equals 2.49 (t -statistic of 12.39) in the absence of the cost-based operating efficiency measure. The positive β_y coefficients caution that a high Tobin's Q should not be interpreted as evidence of good firm performance.

An additional estimation uses firm-level time series averages for Tobin's Q and our operating efficiency measures. The use of time series averages mitigates the errors-in-variables

problem arising from estimating a relationship between the cash flow expectations that underly the numerator of Tobin's Q and the operating efficiency measures constructed from observations in COMPUSTAT. After computing firm-level time series averages of the dependent and independent variables, both of which are denoted with bar superscripts, beta coefficients are estimated cross-sectionally as follows

$$\bar{Q}_i = \beta_y \bar{R}_{gm,i} + \beta_c \bar{R}_{c,i} + \gamma X + \epsilon_i. \quad (17)$$

Consistent with our earlier results, Panel B continues to report a positive β_y coefficient of 2.38 (*t*-statistic of 15.01), which decreases slightly to 2.28 (*t*-statistic of 14.48) after removing R_c . Indeed, despite having fewer observations, the magnitude and significance of the β_y coefficients are similar in both panels of Table 3.

Overall, better operating efficiency in terms of scale decreases rather than increases Tobin's Q, while better cost efficiency increases Tobin's Q. Therefore, our theoretical framework and empirical analysis both caution that neither a high nor low Tobin's Q is evidence of good firm performance. To avoid the endogeneity problem confounding Tobin's Q, the next subsection re-examines the relationship between corporate governance and firm performance using our operating efficiency measures as proxies for firm performance.

3.2 Does Better Governance Improve Firm Performance?

Better governance can mitigate the agency problems that enable underinvestment and lead to greater managerial effort at reducing costs. To assess the economic relevance of using our proposed operating efficiency measures instead of Tobin's Q, we examine whether the relationship between the G index and firm performance is sensitive to having them replace Tobin's Q as the proxy for firm performance.

We evaluate the influence of the G index on firm performance using our operating efficiency measures by estimating the following panel regression

$$R_{gm,i,t} = \alpha G_{i,t} + \gamma X + \epsilon_{i,t}, \quad (18)$$

The X vector represents industry fixed effects based on Fama and French (1997). Standard errors are clustered at the firm-level. Besides R_{gm} , this regression is also estimated with R_c as the dependent variable.

For emphasis, our framework does not specify an explicit function between governance, output, and operating expenses. Moreover, conclusions based on equation (18) are derived from a joint hypothesis involving the ability of the G index to adequately proxy for managerial entrenchment. Indeed, while our operating efficiency measures circumvent the endogeneity confounding Tobin's Q, Hermalin and Weisbach (2003) document the endogeneity of corporate governance mechanisms. For example, if the size and independence of corporate boards both depend on past performance, which is persistent, then these board characteristics and firm performance are linked endogenously through their common dependence on past performance (Hermalin and Weisbach, 1988).

Table 4 reports on the coefficient estimates from equation (18). The negative α coefficient equaling -0.0015 (t -statistic of -2.95) indicates that a higher G index is associated with a lower R_{gm} measure. According to this finding, worse rather than better governance corresponds to better scale efficiency. In unreported results, this finding is robust to including SIZE as a control variable although including SIZE in the regression specification requires additional theoretical justification given the endogeneity of firm size highlighted by our framework.

The results in Table 3 and Table 4 confirm the earlier correlations reported in Table 2. Specifically, a high Tobin's Q corresponds to a high R_{gm} measure, hence poor operating efficiency in terms of scale as underinvestment inflates Tobin's Q. The positive correlation between Tobin's Q and R_{gm} as well as the positive β_y coefficients support this conclusion. Furthermore, the negative correlation between R_{gm} and the G index and the negative α coefficient both indicate that a low G index is not associated with better scale efficiency. When combined, these findings suggest that the use of Tobin's Q as a proxy for firm performance induces a spurious inverse relationship between firm performance and the G index. Specifically, while a low G index is associated with a high Tobin's Q, as reported in Gompers, Ishii, and Metrick (2003), a high Tobin's Q corresponds with underinvestment that is more severe for firms with lower G indices.

Intuitively, managers may be more willing to increase investment to its optimal level when they are afforded certain protections against their replacement. Bates, Becher, and Lemmon (2008) report that classified boards, a charter provision included in the G index, exert a minor influence on the market for corporate control. Their evidence suggests that

external governance is not necessarily inhibited by this determinant of the G index. Another limitation of the G index is that the entrenchment afforded by a firm’s charter provisions can be partially offset through managerial incentives. Low (2009) finds evidence that an exogenous increase in managerial entrenchment was at least partially overcome by awarding stock options, while Babenko, Lemmon, and Tserlukevich (2010) find that the cash inflows generated through the exercise of stock options increase investment.

The G index does not influence the cost-based measure of operating efficiency since the α coefficient is insignificant in the regression specification with R_c as the dependent variable. Although the existing literature documents a relationship between poor governance and CEO compensation (Core, Holthausen, and Larcker, 1999), our results indicate that more broadly defined operating expenses are not highly sensitive to governance. Nonetheless, the novel implications of our framework are derived from scale decisions rather than cost discipline.

In summary, the prior literature’s conclusion that a lower G index is associated with better firm performance appears to be less credible than our evidence that underinvestment is responsible for inflating Tobin’s Q.

4 Conclusion

We provide a simple theoretical framework to demonstrate that underinvestment confounds the relationship between Tobin’s Q and firm performance since firm performance has an ambiguous impact on Tobin’s Q. Better firm performance can either decrease or increase Tobin’s Q depending on the relative importance of scale decisions versus cost discipline, respectively. In contrast, the existing literature’s interpretation of a high Tobin’s Q does not address the endogeneity of its denominator with respect to managerial scale decisions. In particular, the existing literature does not account for the possibility that underinvestment is able to inflate Tobin’s Q.

Our framework develops separate measures of operating efficiency that provide unambiguous proxies for firm performance. The first measure assesses managerial decisions regarding scale, while the second measure assesses cost discipline. These operating efficiency measures are derived from the maximization of firm value net of invested capital, hence the

maximization of a firm's net present value.

Our empirical results indicate that better firm performance is not necessarily associated with a higher Tobin's Q. This finding is consistent with underinvestment's ability to inflate Tobin's Q but contradicts the prior literature's assumption that a high Tobin's Q is evidence of good firm performance. Furthermore, a lower G index, which proxies for better governance, is associated with greater underinvestment. Therefore, while a lower G index is associated with a higher Tobin's Q, this inverse relationship can be explained by underinvestment inflating Tobin's Q and underinvestment being more severe in firms with lower G indices. In summary, we caution that a high Tobin's Q is not evidence of better firm performance.

References

- Aggarwal, R., and A. Samwick, 2006, Empire-builders and shirkers: Investment, firm performance, and managerial incentives. *Journal of Corporate Finance* 12, 489-515.
- Aghion, P., J. Van Reenen, and L. Zingales, 2010, Innovation and institutional ownership. Working Paper.
- Almeida, H., M. Campello, and A. F. Galvao, Jr., 2010, Measurement errors in investment equations. *Review of Financial Studies* 23, 3279-3328.
- Anderson, R., and D. Reeb, 2003, Founding-family ownership and firm performance: Evidence from the S&P 500. *Journal of Finance* 58, 1301-1328.
- Ang, J., R. Cole, and J. Lin, 2000, Agency costs and ownership structure. *Journal of Finance* 55, 81-106.
- Babenko, I., M. Lemmon, and Y. Tserlukevich, 2010, Employee stock options and investment, Forthcoming in the *Journal of Finance*.
- Berger, P., E. Ofek, and D. Yermack, 1997, Managerial entrenchment and capital structure decisions. *Journal of Finance* 52, 1411-1438.
- Bates, T., D. Becher, and M. Lemmon, 2008, Board classification and managerial entrenchment: Evidence from the market for corporate control. *Journal of Financial Economics* 87, 656-677.
- Bebchuk, L., A. Cohen, and A. Ferrell, 2009, What matters in corporate governance? *Review of Financial Studies* 22, 783-827.
- Bertrand, M., and S. Mullainathan, 2003, Enjoying the quiet life? Corporate governance and managerial preferences. *Journal of the Political Economy* 111, 1043-1075.
- Bizjak, J., M. Lemmon, and T. Nguyen, 2011, Are all CEOs above average? An empirical analysis of compensation peer groups and pay design. *Journal of Financial Economics* 100, 538-555.

Core, J., W. Guay, and T. Rusticus, 2006, Does weak governance cause weak stock returns? An examination of firm operating performance and investors' expectations. *Journal of Finance* 61, 655-687.

Core, J., R. Holthausen, and D. Larcker, 1999, Corporate governance, chief executive officer compensation, and firm performance. *Journal of Financial Economics* 51, 371-406.

Cremers, M., and V. Nair, 2005, Governance mechanisms and equity prices. *Journal of Finance* 60, 2859-2894.

Cronqvist, H., F. Heyman, M. Nilsson, H. Svaleryd, and J. Vlachos, 2009. Do entrenched managers pay their workers more? *Journal of Finance* 64, 309-339.

Erikson, T., and T. Whited, 2011, Treating measurement error in Tobin's Q. *Forthcoming in the Review of Financial Studies*.

Erikson, T., and T. Whited, 2006, On the accuracy of different measures of q. *Financial Management* 35, 5-33.

Fama, E., and K. French, 1997, Industry costs of equity. *Journal of Financial Economics* 43, 153-193.

Giroud, X., and H. Mueller, 2010, Does corporate governance matter in competitive industries? *Journal of Financial Economics* 95, 312-331.

Giroud, X., and H. Mueller, 2011, Corporate governance, product market competition, and equity prices. *Journal of Finance* 66, 563-600.

Gompers, P., J. Ishii, and A. Metrick, 2003, Corporate governance and equity prices. *Quarterly Journal of Economics* 118, 107-155.

Graham, J., M. Lemmon, and J. Wolf, 2002, Does corporate diversification destroy value? *Journal of Finance* 57, 695-720.

Harford, J., and K. Li, 2007, Decoupling CEO wealth and firm performance: The case of acquiring CEOs. *Journal of Finance* 62, 917-949.

Hermalin, B., and M. Weisbach, 1988, The determinants of board composition. RAND Journal of Economics 19, 589-606.

Hermalin, B., and M. Weisbach, 2003, Boards of directors as an endogenously determined institution: A survey of the economic literature. Economic Policy Review 9, 726.

Hicks, J., 1935, Annual survey of economic theory: The theory of monopoly. Econometrica 3, 1-20.

John, K., and D. Knyazeva, 2006, Governance and conservatism in investment decisions. Working Paper.

John, K., and L. Litov, 2010, Corporate governance and financing policy: New evidence. Working Paper.

Lindenberg, E., and S. Ross, 1981, Tobin's q ratio and industrial organization. Journal of Business 54, 1-32.

Low, A., 2009, Managerial risk-taking behavior and equity-based compensation. Journal of Financial Economics 92, 470-490.

Maksimovic, V., and G. Phillips, 2001, The market for corporate assets: Who engages in mergers and asset sales and are there efficiency gains. Journal of Finance 56, 2019-2065.

Maksimovic, V., and G. Phillips, 2002, Do conglomerate firms allocate resources inefficiently across industries? Theory and evidence. Journal of Finance 57, 721-767.

Morck, R., A. Shleifer, and R. Vishny, 1988, Management ownership and market valuation. Journal of Financial Economics 20, 293-315.

Shleifer, A., and R. Vishny, 1986, Large shareholders and corporate control. Journal of the Political Economy 94, 461-488.

Yermack, D., 1996, Higher market valuation of companies with a smaller board of directors. Journal of Financial Economics 40, 185-211.

Table 1: Summary Statistics within Industries

This table reports industry-level averages and standard deviations for Tobin's Q, the G index of Gompers, Ishii, and Metrick (2003), and our operating efficiency measures denoted R_{gm} and R_c within the industry classifications of Fama and French (1997). Tobin's Q and the operating efficiency measures are constructed from COMPUSTAT data over the 1980 to 2008 period while the G index is available between 1990 and 2008. The numerator of Tobin's Q is computed as total assets plus the market value of equity minus the book value of equity. The denominator of Tobin's Q and the operating efficiency measures is total assets. The operating efficiency measures R_{gm} and R_c are defined in equation (10) and equation (11), respectively. The standard deviations represent average firm-level time series variation within each industry.

Industry	Average by industry				Standard Deviation by industry			
	Tobin's Q	G index	R_{gm}	R_c	Tobin's Q	G index	R_{gm}	R_c
Agriculture	2.64	8.05	0.35	0.02	0.83	0.48	0.04	0.00
Food Products	1.84	9.75	0.43	0.06	0.34	0.34	0.08	0.02
Confectionery	3.00	7.38	0.52	0.08	0.59	0.89	0.07	0.02
Liqueur	1.83	8.10	0.35	0.10	0.16	0.26	0.04	0.02
Tobacco	3.15	9.38	0.52	0.03	0.57	0.53	0.10	0.01
Toys	1.59	9.01	0.48	0.08	0.33	0.34	0.05	0.01
Entertainment	1.67	8.62	0.29	0.07	0.52	0.40	0.10	0.03
Publishing	1.91	9.53	0.44	0.11	0.42	0.32	0.06	0.03
Consumer Goods	2.28	10.39	0.54	0.09	0.49	0.38	0.07	0.02
Apparel	1.65	9.28	0.64	0.11	0.43	0.25	0.07	0.02
Healthcare	2.00	8.40	0.35	0.16	0.64	0.41	0.05	0.02
Medical Equipment	2.77	9.50	0.48	0.02	0.75	0.39	0.06	0.01
Pharmaceutical	3.60	9.11	0.37	0.03	1.29	0.41	0.11	0.01
Chemicals	1.72	10.22	0.31	0.02	0.31	0.41	0.04	0.01
Rubber and Plastic	1.60	10.52	0.37	0.02	0.22	0.41	0.04	0.00
Textiles	1.18	7.09	0.37	0.04	0.22	0.42	0.05	0.02
Construction Materials	1.66	10.12	0.34	0.02	0.32	0.34	0.05	0.01
Construction	1.38	9.20	0.22	0.02	0.31	0.36	0.09	0.01
Steel	1.33	9.90	0.22	0.02	0.29	0.43	0.05	0.01
Fabricated Products	1.39	10.12	0.28	0.01	0.25	0.22	0.03	0.00
Machinery	1.84	10.12	0.36	0.02	0.45	0.44	0.06	0.01
Electrical Equipment	2.23	9.40	0.33	0.03	0.72	0.32	0.06	0.01
Automobiles	1.54	10.14	0.30	0.02	0.29	0.49	0.04	0.01
Aerospace	1.67	9.49	0.26	0.07	0.25	0.47	0.03	0.01
Railroads	1.44	7.84	0.18	0.01	0.20	0.52	0.03	0.00
Defense	1.65	8.69	0.24	0.06	0.41	0.31	0.04	0.01
Precious Metals	1.61	10.64	0.14	0.00	0.30	0.73	0.10	0.00
Mining	1.34	8.89	0.22	0.01	0.31	0.29	0.04	0.00
Coal	1.78	9.52	0.21	0.03	0.48	0.24	0.04	0.00
Petroleum and Natural Gas	1.63	9.18	0.23	0.02	0.34	0.43	0.08	0.01
Utilities	1.21	9.87	0.10	0.01	0.10	0.56	0.02	0.00
Communications	1.84	8.49	0.23	0.02	0.43	0.36	0.05	0.00
Personal Services	2.37	9.32	0.46	0.13	0.69	0.42	0.08	0.03
Business Services	2.31	8.68	0.42	0.20	0.60	0.28	0.06	0.03
Computer Hardware	2.23	8.66	0.40	0.02	0.89	0.39	0.07	0.01
Software	2.93	8.41	0.49	0.04	1.05	0.37	0.09	0.01
Semiconductors	2.36	7.99	0.33	0.02	0.86	0.52	0.07	0.01
Measurement Equipment	2.36	9.05	0.43	0.02	0.65	0.37	0.06	0.00
Paper	1.58	10.23	0.33	0.03	0.26	0.48	0.04	0.01
Shipping	1.57	9.44	0.29	0.03	0.19	0.19	0.04	0.02
Transportation	1.66	8.54	0.23	0.26	0.27	0.36	0.04	0.04
Wholesale	1.59	9.42	0.45	0.04	0.32	0.39	0.05	0.01
Retail	2.02	8.88	0.67	0.13	0.54	0.49	0.07	0.02
Restaurants and Hotels	1.94	8.93	0.31	0.20	0.42	0.37	0.03	0.03
Average	1.93	9.17	0.35	0.06	0.46	0.40	0.06	0.01

Table 2: Summary Statistics and Correlations

Panel A of this table reports summary statistics for the distribution of Tobin's Q, the G index of Gompers, Ishii, and Metrick (2003), and our operating efficiency measures. Tobin's Q and the operating efficiency measures are constructed from COMPUSTAT data over the 1980 to 2008 period while the G index is available between 1990 and 2008. The numerator of Tobin's Q is computed as total assets plus the market value of equity minus the book value of equity. The denominator of Tobin's Q and the operating efficiency measures is total assets. The operating efficiency measures R_{gm} and R_c are defined in equation (10) and equation (11), respectively. The correlations between the variables in Panel A along with the log of market capitalization (SIZE) are reported in Panel B. These correlations are computed from average firm-level correlations.

Panel A: Summary statistics

Variable	Percentiles				
	10 th	25 th	50 th	75 th	90 th
Tobin's Q	1.018	1.200	1.550	2.233	3.417
G index	6.0	7.0	9.0	11.0	13.0
R_{gm}	0.115	0.204	0.329	0.491	0.685
R_c	0.002	0.007	0.016	0.047	0.157

Panel B: Correlations

Variable	SIZE	Tobin's Q	G index	R_{gm}	R_c
Size	1	0.675	0.065	0.070	-0.182
Tobin's Q		1	-0.125	0.278	-0.020
G index			1	-0.091	0.015
R_{gm}				1	0.270
R_c					1

Table 3: Tobin's Q and Operating Efficiency

This table reports on the relationship between Tobin's Q and operating efficiency. Panel A records the β coefficients from the panel regression in equation (16), $Q_{i,t} = \beta_y R_{gm,i,t} + \beta_c R_{c,i,t} + \gamma X + \epsilon_{i,t}$. The X vector represents industry fixed effects according to the industry classifications of Fama and French (1997). A positive β_y coefficient indicates that underinvestment increases Tobin's Q while a negative β_c coefficient indicates that better cost discipline increases Tobin's Q. Below each regression coefficient, t -statistics are reported in italics with standard errors clustered at the firm-level. The operating efficiency measures R_{gm} and R_c are defined in equation (10) and equation (11), respectively. Lower values of R_{gm} with R_c correspond to better operating efficiency, hence better firm performance. COMPUSTAT data is used to construct our operating efficiency measures and Tobin's Q during the 1980 to 2008 period. The numerator of Tobin's Q is computed as total assets plus the market value of equity minus the book value of equity. The denominator of Tobin's Q and the operating efficiency measures is total assets. All firms are investment-grade, with credit ratings firms of at least BBB, to mitigate the influence of financing constraints and large write-downs of total assets by distressed firms. Panel B estimates equation (16) using firm-level time series averages of the dependent and independent variables. The β coefficients then estimated cross-sectionally according to equation (17), $\bar{Q}_i = \beta_y \bar{R}_{gm,i} + \beta_c \bar{R}_{c,i} + \gamma X + \epsilon_i$, using these time series averages. This procedure mitigates the errors-in-variables problem associated with estimating a relationship between the cash flow expectations that underlie the numerator of Tobin's Q and the operating efficiency measures based on observed accounting data.

Panel A: Tobin's Q and operating efficiency

	Scale β_y	Costs β_c	Industry fixed effects	Adjusted R^2	Number of observations
coefficient	-	-	Yes	20.68%	8,648
<i>t</i> -statistic	-	-			
coefficient	2.49	-	Yes	32.65%	8,648
<i>t</i> -statistic	<i>12.39</i>	-			
coefficient	2.60	-0.75	Yes	33.21%	8,648
<i>t</i> -statistic	<i>12.88</i>	<i>-3.58</i>			

Panel B: Time series averages of firm-level variables

	Scale β_y	Costs β_c	Industry fixed effects	Adjusted R^2	Number of observations
coefficient	-	-	Yes	19.53%	1,122
<i>t</i> -statistic	-	-			
coefficient	2.28	-	Yes	32.65%	1,122
<i>t</i> -statistic	<i>14.48</i>	-			
coefficient	2.38	-0.77	Yes	33.54%	1,122
<i>t</i> -statistic	<i>15.01</i>	<i>-3.80</i>			

Table 4: Firm Performance and Corporate Governance

This table evaluates the influence of the G index from Gompers, Ishii, and Metrick (2003) on our operating efficiency measures over the 1990 to 2008 period. Coefficients from the following panel regression in equation (18) are reported, $R_{gm,i,t} = \alpha G_{i,t} + \gamma X + \epsilon_{i,t}$. The X vector represents industry fixed effects defined by the industry classifications of Fama and French (1997). This panel regression is also repeated by replacing the dependent variable R_{gm} with R_c . The R_{gm} and R_c operating efficiency measures are defined in equation (10) and equation (11), respectively. Lower values of these measures correspond to better operating efficiency, hence better firm performance, while a lower G index is associated with better governance. Below each regression coefficient, t -statistics are reported in italics, with standard errors clustered at the firm-level.

Dependent variable	G index α	Industry fixed effects	Adjusted R^2	Number of observations
R_{gm}	-0.0015 <i>-2.95</i>	Yes	31.59%	24,404
R_c	-0.0004 <i>-0.58</i>	Yes	5.44%	24,404