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

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Abstract

Although empirical studies often use Tobin's Q as a proxy for operating performance, our theoretical framework highlights its ambiguity when evaluating corporate governance. In particular, capital in the denominator of Tobin's Q is endogenous since entrenched managers can *enjoy the quiet life* and underinvest (Bertrand and Mullainathan, 2003). Firms that underinvest operate below their firm's profit-maximizing scale. Despite reducing a firm's net present value, underinvestment increases Tobin's Q. Furthermore, strong governance can either decrease Tobin's Q by mitigating underinvestment or increase Tobin's Q by lowering costs. Therefore, the net impact of governance on Tobin's Q is ambiguous. Our framework then provides measures of operating efficiency to assess a firm's scale decisions and cost discipline. These measures capture the benefits of acquisitions that improve scale and lower costs as well as the inefficiencies associated with empire building. Their estimation confirms that underinvestment is responsible for inflating Tobin's Q.

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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, proxies result in joint tests of the stated hypotheses and the validity of the chosen proxies. Ideally, empirical proxies would originate from a theoretical model that justifies their use under different assumptions.

Tobin's Q is a widely used proxy for operating performance in studies of corporate governance. For example, Gompers, Ishii and Metrick (2003) conclude that firms with more shareholder rights are better governed since they have a higher Tobin's Q.[1] 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.

This paper provides a theoretical framework to highlight an endogeneity problem when Tobin's Q is used to measure the economic implications of corporate governance. Our framework then offers a solution to this endogeneity problem by examining managerial decisions regarding scale and cost discipline. For the single-product firm in our framework, scale is defined as the number of units produced. The operating efficiency measures we propose are based on revenue, to assess scale decisions, and costs. Our theoretically-motivated proxies originate from the maximization of firm value net of invested capital, hence the maximization of a firm's net present value, and are also consistent with recent empirical research.

Intuitively, normalizing firm value by a proxy for capital in the denominator of Tobin's Q controls for the resources transferred from investors to management. Unfortunately, when evaluating governance, capital is endogenous because of its dependence on governance. In particular, entrenched managers can *enjoy the quiet life* and underinvest (Bertrand and Mullainathan, 2003). Firms that underinvest operate below their firm's profit-maximizing scale. Higher profit margins, a lower likelihood of being fired due to negative demand shocks, and the need for less monitoring make underinvestment attractive to managers while lowering the denominator of Tobin's Q. Our framework demonstrates that underinvestment, which

[1]In an earlier study, Morck, Shleifer, and Vishny (1988) interpret the non-monotonic relationship between managerial ownership and Tobin's Q as evidence that managerial ownership has countervailing influences on corporate governance.

corresponds to weak governance, increases Tobin's Q. Consequently, underinvestment can inflate Tobin's Q.

More formally, 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. Underinvestment restricts output below the firm's optimal scale, and results in a proportional reduction in capital but a less than proportional reduction in revenue since demand curves are downward sloping. Specifically, as marginal revenue decreases with output, operating at a suboptimal scale causes the ratio of market value divided by capital, hence Tobin's Q, to be higher than optimal. Indeed, while investment is optimal until its marginal benefit is zero, restricting investment increases its average benefit, hence 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 project requiring \$20 of additional capital that increases its market value by \$24, Tobin's Q declines from 1.5 to 1.3, (\$15 + \$24) / (\$10 + \$20). Thus, despite its positive net present value of \$4, this investment lowers Tobin's Q.

Our framework highlights two conflicting implications of corporate governance on Tobin's Q. First, strong governance can decrease Tobin's Q by mitigating underinvestment. Second, strong governance can also increase Tobin's Q by improving cost discipline. Therefore, the net impact of governance on Tobin's Q is ambiguous as it depends on the relative importance of scale decisions versus cost discipline. Scale decisions are especially important for firms whose products have steep downward sloping demand curves.[2]

Similarly, return on assets is ambiguous with respect to corporate governance. A high return on assets can either be attributed to underinvestment or stringent cost discipline that signify weak and strong governance, respectively. The ambiguous influence of governance on Tobin's Q and return on assets leads us to propose separate measures of operating efficiency based on revenue, which reflects managerial decisions regarding scale, and cost discipline. Although these operating efficiency measures normalize revenue and costs by capital, they both decrease with stronger governance. In particular, a low revenue-to-capital ratio is

[2]A downward sloping demand curve is equivalent to the firm earning some monopoly rents in its respective product market.

consistent with managers maximizing firm value net of capital by choosing an output level that ensures marginal revenue equals marginal cost.

Our framework's assumption that weak assumption that weak governance leads to underinvestment is motivated by prior empirical research. Bertrand and Mullainathan (2003) report that entrenched managers enjoy the quiet life by underinvesting.[3] Aggarwal and Samwick (2006) confirm that weak governance results in underinvestment and conclude that managers incur private costs when investing such as the need for additional monitoring. John and Knyazeva (2006) also report that weak corporate governance leads to underinvestment. Furthermore, after an exogenous increase in managerial entrenchment, Low (2009) finds evidence of greater managerial conservatism. The second assumption that weak governance results in poor cost discipline also originates from prior empirical research. Cronqvist, Heyman, Nilsson, Svaleryd, and Vlachos (2009) conclude that entrenched managers obtain private benefits by paying higher wages, while Core, Holthausen, and Larcker (1999) find that weaker corporate governance results in higher CEO compensation. Giroud and Mueller (2009) provide additional evidence that weak governance leads to higher costs.

Graham, Lemmon, and Wolf (2002) find that target firms have lower normalized valuations than acquiring firms. This finding is consistent with managers focusing on the *marginal* benefit of acquisitions, and challenges the assumption that acquisitions destroy value simply by lowering the combined entity's *average* valuation. This conclusion parallels our framework's implication that increasing output until marginal profits are zero reduces Tobin's Q. The theoretical framework of Maksimovic and Phillips (2001, 2002) also has managers allocating resources to ensure that marginal profits are zero.

Our operating efficiency measures are able to capture the benefits of increased scale and cost-savings arising from acquisitions. Alternatively, if managers assemble a collection of inefficient enterprises that increase firm size without improving operating efficiency, our measures are compatible with Jensen and Meckling (1976)'s empire building hypothesis. While our framework investigates a single-product firm, the operating efficiency of a con-

[3]Our framework is designed for measuring the governance implications of individual firms. At the country level, cross-sectional differences in legal environments are more likely to capture variation in capital investment and its productivity.

glomerate is the combined operating efficiency of its individual divisions (products). Thus, a combination of inefficient enterprises is identified as being inefficient by our measures of operating efficiency.

Our operating efficiency measures are not intended to replace existing proxies for corporate governance since operating efficiency is the result of governance. The corporate governance index of Gompers, Ishii, and Metrick (2003), abbreviated as the G index hereafter, assigns firms a score between zero and twenty-four by counting the number of their charter provisions that inhibit the replacement of management. Firms with a higher G index are are labelled dictatorship firms as their shareholders have less rights. Gompers, Ishii, and Metrick (2003) report that firms with a higher G index have a lower Tobin's Q, while Cremers and Nair (2005) report that the G index complements internal governance mechanisms such as the presence of large investors. However, the G index is not designed to capture important dimensions of governance such as board independence. Besides the G index, which is not theoretically-motivated, we also use institutional ownership to proxy for corporate governance since institutional investors can improve governance by facilitating takeovers and thereby enhance the market for corporate control (Shleifer and Vishny, 1986).[4] Nonetheless, proxies for corporate governance are only invoked to verify our assumptions that stronger governance coincides with less underinvestment and lower costs. Proxies for governance are not required to examine the relationship between operating efficiency and Tobin's Q that defines our main empirical contribution.

Our operating efficiency measures are estimated using COMPUSTAT data. These measures are interpreted using a cross-sectional comparison of firms within Fama and French (1997) industry classifications. Our empirical analysis finds that differences in operating efficiency are captured by the G index and institutional ownership. Specifically, a high G index and low institutional ownership, which correspond to weak governance, are associated with underinvestment and high costs. Moreover, Tobin's Q is lower for firms with better operating efficiency. This finding indicates that decisions regarding scale are crucially important as

[4]High managerial ownership can either mitigate agency problems or inhibit the market for corporate control. Although earnings management can signify weak governance, well governed firms may manage earnings to lower their cost of capital.

underinvestment appears to inflate Tobin's Q in our sample. Overall, stronger governance improves operating efficiency but better operating efficiency does not improve Tobin's Q.

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, while Section 4 contains our conclusions and suggestions for future research.

2 Theoretical Framework

Our intention is to provide a general framework for analyzing the economic implications of corporate governance rather than construct a detailed structural model. In our framework, corporate managers are entrusted with two crucial tasks. They determine their firm's scale and control its costs. Therefore, management determines the number of units of output denoted y and per unit costs denoted c, where $c_0 > 0$ denotes the lowest possible cost to produce a single unit of output. With c being constant, the firm's total costs equals cy.

The assumption that total costs are linear in output is a local approximation. Furthermore, the novel implications of our framework regarding Tobin's Q arise from scale decisions rather than cost discipline. Nonetheless, monopoly power often stems from economies of scale that imply c is a decreasing function of output. Thus, economies of scale reinforce the negative implications of underinvestment.

The amount of capital required to produce one unit of output equals $k > 0$. A linear production function implies the total amount of required capital to produce y units of output equals ky. Consequently, capital depends on a firm's corporate governance through its dependence on output.

The price of the firm's output is determined by managerial decisions regarding its level of output since firms are assumed to earn some monopoly rents in their respective product market. The following demand function determines the price (per unit) of the firm's output

$$\text{Price}(y) \quad = \quad P_0 - \frac{y}{2a} \,. \tag{1}$$

The a parameter in this downward-sloping demand function links prices with output, with a large a parameter indicating that prices are insensitive to output.

2.1 Tobin's Q

As revenue equals output y times the price in equation (1), revenue minus costs equals $y\left(P_0 - \frac{y}{2a}\right) - cy$. This quantity represents the firm's earnings. With the discount rate for future cashflows equaling r, these per period earnings yield a market value of[5]

$$M(y,c) \;=\; \sum_{i=1}^{\infty} \frac{y\left(P_0 - \frac{y}{2a}\right) - cy}{(1+r)^i} = \frac{y\left(P_0 - c\right) - \frac{y^2}{2a}}{r}\,, \tag{2}$$

while normalizing this market value by capital, ky, yields Tobin's Q

$$Q(y,c) \;=\; \frac{P_0 - c - \frac{y}{2a}}{kr}\,. \tag{3}$$

Observe that Tobin's Q is a decreasing function of output as the partial derivative $\frac{\partial Q}{\partial y}$ equals $-\frac{1}{2a}$. Thus, Tobin's Q is more sensitive to output when prices are more sensitive to output. Moreover, corporate governance has an ambiguous influence on Tobin's Q. Specifically, stronger governance decreases c while increasing y, which causes Tobin's Q to increase and decrease, respectively.[6] Therefore, the net influence of governance on Tobin's Q is ambiguous. Nonetheless, provided scale decisions are important, stronger governance can decrease Tobin's Q.

In empirical applications that regress Tobin's Q on proxies for corporate governance, including proxies for capital as independent variables does not alleviate the ambiguity surrounding the governance coefficients. Furthermore, underinvestment pertains to the difference between a firm's optimal scale and the scale chosen by management. However, only proxies for the the capital chosen by management are observable.

Finally, as stronger governance results in lower costs and lower marginal revenue, the net impact of governance on any capital-adjusted *profitability* metric is ambiguous. Indeed, with operating profit being approximately equal to revenue minus costs, return on assets (ROA) is proportional to the *difference* between our operating efficiency measures; $R_y - R_c$, since ROA is defined as operating profit normalized by total assets. Thus, ROA is ambiguous with respect to governance. For example, a high ROA can be attributed to a high R_y, which

[5] Core, Guay, and Rusticus (2006) document that expected stock returns are not sensitive to governance.

[6] The lower bound for c is c_0 while an upper bound for y is provided in the next subsection.

signifies weak governance, or a low R_c, which signifies strong governance.[7] Consequently, while R_y and R_c are both decreasing functions of governance, the existing literature examines the difference between these measures despite the ambiguity of this difference with respect to governance.

2.2 Operating Efficiency

Our framework does not examine the incentive contracts required to mitigate underinvestment and improve cost discipline. This issue is examined in Aggarwal and Samwick (2006) as well as Low (2009). Instead, our analysis proposes operating efficiency measures to capture the economic implications of corporate governance by identifying underinvestment and lax cost discipline.

Our ideal manager maximizes their firm's market value minus the invested capital

$$\max_{c,y} \; M - ky \;\; = \;\; \max_{c,y} \; \frac{y\,(P_0 - c - rk) - \frac{y^2}{2a}}{r} \, . \tag{4}$$

This objective function is equivalent to maximizing the firm's net present value (NPV). Equation (4) is a concave function with respect to y that is maximized by

$$y^* \;\; = \;\; a\,(P_0 - c_0 - rk) \; . \tag{5}$$

Weak governance allows managers to underinvest by producing less than y^* and to shirk their responsibility to control costs by having c exceed c_0. The maximization in equation (4) is equivalent to maximizing

$$\frac{\text{Revenue - Costs - } \textit{rent} \text{ on Capital}}{r} \;\; = \;\; \frac{y\left(P_0 - \frac{y}{2a}\right) - cy - rky}{r} \, , \tag{6}$$

where the rental cost for capital equals rky. In contrast to the level of output $a\,(P_0 - c_0)$ that maximizes (Revenue - Costs)/ r, hence the firm's market value M in equation (2), incorporating the rent on capital yields y^* in equation (5).

To clarify, investors want managers to produce a level of output that exploits the firm's monopoly power while setting marginal revenue equal to marginal cost. The optimal level

[7] When a fraction $0 \leq f < 1$ of the firm's capital is financed by borrowing, its earnings is reduced by the periodic borrowing cost of $frky$ and generated from a lower capital investment of $(1-f)ky$.

of output y^* is too low from the perspective of consumers but too high from the perspective of entrenched managers that underinvest by producing below y^*.

Using the maximization in equation (4), we propose two operating efficiency ratios to measure the economic implications of corporate governance. The first operating efficiency measure is derived from revenue, defined as $y\left(P_0 - \frac{y}{2a}\right)$ based on the demand function in equation (1). The second measure is derived from costs.

The first operating efficiency ratio, R_y, isolates the impact of corporate governance on managerial decisions regarding scale through revenue

$$\frac{\text{Revenue}}{\text{Capital}} = \frac{y\left(P_0 - \frac{y}{2a}\right)}{ky} = \frac{P_0 - \frac{y}{2a}}{k} \geq \frac{P_0 + c_0 + rk}{2k}, \tag{7}$$

with the lower bound being independent of a after invoking y^* from equation (5). The normalization of revenue by capital ensures that R_y is a decreasing function of y. Observe that the influence of corporate governance on R_y is not complicated by costs. Furthermore, while y^* defines the lower bound in equation (7), this lower bound is not required for empirical tests since R_y is decreasing with stronger governance. More importantly, measuring deviations between y and y^* is unnecessary.

The second operating efficiency ratio, R_c, isolates the impact of corporate governance on costs

$$\frac{\text{Costs}}{\text{Capital}} = \frac{cy}{ky} = \frac{c}{k} \geq \frac{c_0}{k}. \tag{8}$$

The normalization of costs by capital ensures that R_c is not complicated by management decisions regarding output. This ratio is smaller for firms with stronger governance since c decreases with stronger governance. Moreover, measuring deviations between c and c_0 is unnecessary.

Ang, Cole, and Lin (2000) estimate a sales-to-assets ratio that parallels R_y. However, as this ratio is not theoretically motivated, they 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 is a decreasing function of output. Moreover, their empirical methodology is based on the assumption that firms owned entirely by management have zero agency costs. Therefore, despite the high concentration of managerial wealth in these firms, their benchmark does not allow managerial conservatism to be suboptimal and manifest itself through underinvestment.

The optimal Tobin's Q in our framework, denoted Q^*, equals

$$Q^* = \frac{P_0 - c_0 - \frac{(y^*)^2}{2a}}{kr}. \tag{9}$$

However, our intention is not to provide a detailed structural model that is sufficient to estimate Q^*. More importantly, managers are expected to have better information regarding demand and costs than investors. Indeed, one motivation for managers to underinvest is the inability of investors to accurately differentiate between unpredictable negative demand shocks and poor management. If investors are able to easily estimate y^* and c_0, then they could simply devise a contract that requires managers to produce the optimal number of units at the lowest possible cost. Our framework recognizes that Q^* is difficult to estimate and does not require the estimation of y^* and c_0.

Finally, the maximization in equation (4) provides an alternative measure of operating efficiency as the difference between a firm's market value and its capital. However, discount rate innovations, which can arise from changes in the market's risk premium, affect market valuations but not operating efficiency. Instead, revenue and costs capture realized operating efficiency while market valuations manifest a multitude of factors that determine cashflow expectations beyond governance. Furthermore, according to equation (2), the earnings-to-price ratio equals r as governance influences both its numerator and denominator. Therefore, the earnings-to-price ratios is independent of governance.

2.3 Robustness of Operating Efficiency Measures

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. While our framework investigates a single-product firm, the combined operating efficiency of two divisions equals their combined efficiency. Specifically, the combined revenue-based operating efficiency measure for two divisions equals

$$
\begin{aligned}
\frac{\text{Combined Revenue}}{\text{Combined Capital}} &= \frac{y_1\left(P_0 - \frac{y_1}{2a_1}\right) + y_2\left(P_0 - \frac{y_2}{2a_2}\right)}{ky_1 + ky_2} \\
&\geq \left(\frac{y_1}{y_1 + y_2}\right)\frac{P_0 + c_0 + rk}{2k} + \left(\frac{y_2}{y_1 + y_2}\right)\frac{P_0 + c_0 + rk}{2k} \\
&= \frac{P_0 + c_0 + rk}{2k}.
\end{aligned}
$$

Thus, for a conglomerate, a lower R_y measure continues to signify better operating efficiency in terms of scale. Similarly, the following holds for our cost-based measure of operating efficiency

$$
\begin{aligned}
\frac{\text{Combined Costs}}{\text{Combined Capital}} &= \frac{c_1 y_1 + c_2 y_2}{ky_1 + ky_2} \\
&\geq \frac{c_0}{k}\left(\frac{y_1}{y_1 + y_2}\right) + \frac{c_0}{k}\left(\frac{y_2}{y_1 + y_2}\right) \\
&= \frac{c_0}{k}.
\end{aligned}
$$

Therefore, our operating efficiency measures are valid for conglomerates.

Nonetheless, our framework has two limitations. First, weak governance may allow managers to utilize an excess amount of capital while simultaneously producing a suboptimal amount of output. This "overinvestment" in *unproductive* capital is identifiable through a normalization of capital by output to facilitate a comparison of k across firms. However, y is not reported in standard financial databases and is difficult to compare across firms that have some monopoly power in their respective product market. Nonetheless, our cross-sectional comparisons are unlikely to be compromised by all managers utilizing excess capital and having low R_y and R_c metrics as a consequence. As demonstrated in the next section, heterogeneity in firm-level governance validates cross-sectional comparisons of operating efficiency.

Second, capital structure is not examined. Berger, Ofek, and Yermack (1997) find evidence that managers may *play it safe* by issuing a suboptimal amount of debt. However, Stulz (1990) allows managers to entrench themselves by issuing too much debt. The uncertainty surrounding the role of debt in corporate governance is one motivation for leaving its introduction into our framework for future research.

3 Empirical Implementation

We focus our empirical relationships between corporate governance, operating efficiency, and Tobin's Q. Although Gompers, Ishii, and Metrick (2003) attempt to link corporate governance with stock returns, Core, Guay, and Rusticus (2006) find no evidence that governance influences expected returns.

Our first empirical analysis utilizes the G index and institutional ownership to proxy for corporate governance. This analysis is intended to verify the assumptions of our reduced form model that strong governance improves operating efficiency. Our second empirical analysis determines the response of Tobin's Q to operating efficiency. This second analysis implicitly tests the relative importance of scale decisions, and consequently sheds light on the appropriateness of using Tobin's Q to measure the economic implications of corporate governance.

3.1 Data

COMPUSTAT data is used to estimate our operating efficiency measures and Tobin's Q. Total assets is our primary proxy for capital. The numerator of 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 assets in its denominator, we also use assets as a proxy for capital in the denominator of our operating efficiency ratios for consistency.

Revenue (REVT) proxies the numerator of R_y in equation (7) while several expenses comprise the numerator of R_c in equation (8). These costs include expenses for advertising (XAD), sales and administration (XSGA), staff (XLR), and rent (XRENT). Cost of goods sold (COGS) is used to define return on assets but is excluded from the numerator of R_c given the high correlation between COGS and revenue. Intuitively, a firm's total cost cy consists of two components; COGS plus expenses, with R_c defined by expenses to prevent R_c and R_y from being too highly correlated.

The G index in 1990, 1993, 1995, 1998, 2000, 2002, and 2004 is obtained from the Investor Responsibility Research Center (IRRC).[8] Quarterly institutional ownership data is obtained

[8]Institutional Shareholder Services produces the Corporate Governance Quotient (CGQ) that evaluates

from 13f filings with the SEC and are averaged within each year. A total of 10,792 firm-year observations are available for our empirical study.

Four digit SIC codes are obtained from CRSP to implement the 49 industry classifications in Fama and French (1997). Bizjak, Lemmon, and Nguyen (2009) use these industry classifications in their study of CEO compensation and relative performance. The operating efficiency measures R_y and R_c are standardized within these industries. Thus, positive and negative operating efficiency ratios represent above-average and below-average operating efficiency relative to a firm's industry, respectively. This normalization relaxes the assumption that k and c are identical across different industries. We also remove firms in the banking, insurance, real estate, and financial trading industries.

Table 1 reports industry-level averages for Tobin's Q and ROE as well as the three proxies for corporate governance and our operating efficiency measures. In Table 1, the operating efficiency measures are not normalized within individual industries. The results in Table 1 confirm that Tobin's Q and ROA as well as operating efficiency vary across industries, while the corporate governance proxies exhibit less industry-level variation. Furthermore, the standard deviations in Panel B reveal considerable variation in operating efficiency within individual industries. This property justifies our later cross-sectional comparisons of operating efficiency within these industries.

Panel A of Table 2 summarizes the distribution across firms of Tobin's Q and ROE as well as the proxies for corporate governance and operating efficiency. The operating efficiency measures R_y and R_c are both normalized within each industry using their respective mean and standard deviation. Panel B reports on the correlations between these variables and also evaluates their respective correlations with market value. With Tobin's Q being highly positively correlated with ROA, we focus our empirical analysis on Tobin's Q. Panel B also indicates that more shareholder rights (low G index) and higher institutional ownership coincide with lower R_y measures, hence better operating efficiency. These relationships are explored more thoroughly in the next subsection. Furthermore, the positive correlation

firm characteristics in eight categories; audit, board, charter/bylaws, director education, executive and director compensation, ownership, progressive practices, and state of incorporation. The G index is concentrated in the charter/bylaws category.

between R_y and R_c confirms our framework's implicit assumption that underinvestment coincides with poor cost discipline. Although market capitalization is not highly correlated with the other variables in our study, large firms tend to have better operating efficiency in terms of scale and slightly worse operating efficiency in terms of cost discipline.

3.2 Hypotheses and Tests

To evaluate the relationship between corporate governance and operating efficiency, we estimate the following regression specification

$$R_y = \alpha_0 + \alpha_1 \, \mathrm{G} + \alpha_2 \, \mathrm{IO} + \gamma \, X + \epsilon \,, \tag{10}$$

where G and IO denote the G index and institutional ownership, respectively. The X vector denotes industry and time dummy variables along with the log of total assets and the log of market capitalization that serve as control variables. Standard errors are clustered at the firm level. The above regression is also repeated with R_c as the dependent variable instead of R_y.

A positive α_1 coefficient indicates that a high G index captures the operating inefficiencies associated with weak governance, while a negative α_2 coefficient indicates that lower institutional ownership, hence weaker governance, also coincides with poor operating efficiency. These respective coefficients verify the assumptions underlying our reduced-form framework.

Table 3 reports on the coefficient estimates in equation (10). The positive coefficients for the G index and negative coefficients for institutional ownership indicate that these governance proxies capture operating efficiency. For example, firms with a high G index and low institutional ownership, which are associated with weak corporate governance, appear to underinvest.[9] Higher institutional ownership also coincides with greater cost discipline.

In unreported results, a regression of ROA on the G index

$$\mathrm{ROA} = \alpha_0 + \alpha_{\mathrm{ROA}} \, \mathrm{G} + \epsilon \,, \tag{11}$$

produces an α_{ROA} estimate of -0.0020 (t-statistic of -2.17). As in the existing literature, this negative coefficient indicates that firms with more shareholder rights earn a higher return

[9]Institutional investors may invest in firms with stronger governance rather than improve governance. Chung and Zhang (2009) report that institutional investors gravitate towards firms with strong governance.

on assets. The numerator of ROA is defined as revenue minus cost of goods sold (COGS) minus the expenses that define the numerator of R_c in equation (8). Consequently, ROA equals $R_y - R_{\tilde{c}}$ where $R_{\tilde{c}} = \frac{\text{COGS}}{\text{Assets}} + R_c$. When the dependent variable ROA in equation (11) is replaced with R_y and $R_{\tilde{c}}$,

$$
\begin{aligned}
R_y &= \alpha_0 + \alpha_{R_y}\,\mathrm{G} + \epsilon \\
R_{\tilde{c}} &= \alpha_0 + \alpha_{R_{\tilde{c}}}\,\mathrm{G} + \epsilon
\end{aligned}
$$

the equality ROA$=R_y - R_{\tilde{c}}$ implies that $\alpha_{\text{ROA}} = \alpha_{R_y} - \alpha_{R_{\tilde{c}}}$. Indeed, the estimates for α_{R_y} and $\alpha_{R_{\tilde{c}}}$ are 0.0055 (t-statistic of 2.04) and 0.0075 (t-statistic of 3.09), respectively. Thus, the inverse relationship between the G index and ROA is attributable to $R_{\tilde{c}}$ having a larger coefficient than R_y when the high correlation between revenue and COGS is ignored. Intuitively, a lower G index coincides with better operating efficiency in terms of scale and cost discipline, with the greater sensitivity of the latter yielding an inverse relationship between ROA and the G index.

We estimate the following regression specification to examine the relationship between Tobin's Q and operating efficiency

$$
Q = \beta_0 + \beta_y\,R_y + \beta_c\,R_c + \gamma\,X + \epsilon\,. \tag{12}
$$

The X vector industry and time dummy variables, while the standard errors of the regression coefficients are clustered at the firm level. Total assets and market capitalization are not included as control variables since they define the numerator and denominator of Tobin's Q. Instead, the G index and institutional ownership are included as control variables, although their presence exerts little influence on the β_y and β_c estimates.

A positive β_y coefficient is consistent with underinvestment, specifically poor operating efficiency with respect to scale, being able to increase Tobin's Q. Thus, a positive β_y coefficient indicates that a high Tobin's Q is not evidence of strong governance.

Panel A of Table 4 reports the estimates from equation (12). The positive β_y coefficients indicate that Tobin's Q is higher for firms with lower operating efficiency in terms of scale. Consequently, this finding is inconsistent with the prior literature's interpretation of Tobin's Q when evaluating the economic implications of governance. The regression specification in equation (12) controls for the correlation between our measures of operating efficiency. After controlling for R_y, the negative albeit insignificant β_c coefficient is consistent with better cost discipline increasing Tobin's Q. Overall, underinvestment appears to exert a greater influence on Tobin's Q than cost discipline. Specifically, a large R_y ratio, which corresponds with poor operating efficiency, coincides with a high Tobin's Q. This finding challenges the existing corporate governance literature's interpretation of Tobin's Q that assumes strong governance increases Tobin's Q.

Panel B of Table 4 is intended to provide additional intuition regarding the importance of scale decisions. In Panel B, we report the five industries with the largest and smallest β_y coefficients after estimating equation (12) at the industry-level rather than the entire cross-section of firms. The five industries with the largest five β_y coefficients have significantly positive β_y coefficients and include publishing, computer hardware, as well as retail. These large positive coefficients may arise from the uniqueness of their products, which allows managers to benefit more from underinvestment. Unreported results find that over 50% of the industries have significantly positive coefficients (at the 10% level). Panel B of Table 4 reports that the five lowest β_y coefficients are negative, albeit insignificant.

3.3 Robustness Tests

Several robustness tests verify our conclusion that better operating efficiency does not increase Tobin's Q due to underinvestment.

Instead of using industry-level averages, our first robustness test industry-adjusts the firm-level operating efficiency measures using deviations from their respective industry-level *minimum*. These deviations from the minimum R_y and R_c ratio in an industry are then standardized by each industry's largest deviation from its minimum to ensure that large outliers (very inefficient firms) are not unduly influencing the regression coefficients. In particular, the normalized R_y ratios are defined as follows

$$\frac{R_y^i - \min\left(R_y^1, \ldots, R_y^n\right)_j}{\max\left(R_y^1, \ldots, R_y^n\right)_j - \min\left(R_y^1, \ldots, R_y^n\right)_j} \tag{13}$$

for firm $i = 1, 2, \ldots, n$ in industry j. An identical normalization is also applied to the R_c ratios. The positive β_y coefficient estimated from equation (12) reported in Table 5 confirms that poor scale decisions under this alternative industry-adjustment increase Tobin's Q.

Our second robustness test uses property, plant, and equipment (PPE) to proxy for capital in the denominators of R_y and R_c, while total assets remains as the denominator of Tobin's Q. Table 5 confirms that using PPE as an alternative proxy for capital does alter our conclusions regarding the impact of underinvestment on Tobin's Q. In particular, the β_y coefficient remains significantly positive.

Furthermore, our findings are not driven by a subset of firms with extremely low or extremely high assets. As total assets defines the denominator of Tobin's Q as well as our operating efficiency measures, a third robustness test removes firms whose total assets are either below the 2^{nd} percentile or above the 98^{th} percentile. The β_y coefficient of 0.068 (t-statistic of 2.89) estimated after their removal indicates that the relationship between operating efficiency and Tobin's Q is not driven by firms with extremely low or high assets.

To better understand the role of intangible assets such as patents on operating performance, we classify firms according to the uniqueness of their assets. This firm characteristic is defined in Berger, Ofek, and Yermack (1997) as R&D divided by revenue. In the absence of stronger governance, provided firms with high R&D-to-revenue ratios produce more unique products, they have greater monopoly power and consequently the potential for greater underinvestment. Nonetheless, a high R&D-to-revenue ratio can also yield intangible assets such as patents that lower costs. For firms in the highest asset uniqueness tercile, we re-estimate the regression in equation (12) and find a large β_y coefficient. Specifically, firms with the highest R&D-to-revenue ratios have a β_y coefficient of 0.107 (t-statistic of 2.17) that is significantly higher than 0.064 in Table 4 for the entire cross-section of firms. Thus, underinvestment appears to be more acute for firms with unique products.

Finally, Lindenberg and Ross (1981) document considerable variation in Tobin's Q across different industries. Therefore, besides the use of industry dummies, our fourth robustness test examines industry-adjusted Tobin's Q measures that use each industry's respective mean and standard deviation to normalize each firm's Tobin's Q. According to Table 5, the β_y coefficient remains significantly positive when these industry-adjusted Tobin's Q metrics are used as the dependent variable in equation (12).

Overall, the results in Table 5 confirm that better operating efficiency lowers Tobin's

Q. Therefore, our theoretical framework and empirical analysis caution that a high Tobin's Q does not necessarily result from strong corporate governance. In unreported results, we also confirm that underinvestment is unlikely to be attributable to financing constraints. Specifically, firms with high R_y measures do not have abnormally low credit ratings that could potentially prevent them from expanding their output.

4 Conclusion

We provide a simple theoretical framework to demonstrate that underinvestment by entrenched managers confounds the relationship between Tobin's Q and corporate governance. In particular, stronger corporate governance can decrease Tobin's Q as well as return on assets. Overall, the relationship between corporate governance and Tobin's Q is ambiguous. This ambiguity arises from managerial decisions regarding scale and cost discipline having offsetting effects on Tobin's Q.

Our framework then develops two unambiguous measures of operating efficiency. The first measure uses revenue to assess managerial decisions regarding their firm's level of output, while the second measure uses costs to assess the cost discipline of management. These operating efficiency measures are derived from the maximization of market value net of invested capital.

Empirically, the corporate governance index in Gompers, Ishii, and Metrick (2003) and institutional ownership capture cross-sectional differences in operating efficiency. In particular, firms associated with stronger governance exhibit better operating efficiency. However, better operating efficiency lowers Tobin's Q, a finding that is consistent with underinvestment's ability to inflate Tobin's Q.

A number of issues remain for future research. Our framework can be extended by introducing leverage as entrenched managers may *play it safe* by using a suboptimal amount of debt. In addition, future empirical research can examine whether mergers improve or reduce operating efficiency.

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Table 1: Summary Statistics within Industries

Panel A and Panel B of this table reports industry-level averages and standard deviations, respectively, for Tobin's Q, return on assets (ROA), the G index in Gompers, Ishii, and Metrick (2003), institutional ownership (IO), and our operating efficiency measures denoted R_y and R_c. These summary statistics are computed within the industry classifications of Fama and French (1997). The number of observations denoted N within each industry is also reported. Our operating efficiency measures R_y and R_c are defined in equation (7) and equation (8) as $\frac{P_0 - \frac{y}{2a}}{k}$ and $\frac{c}{k}$, respectively. The demand curve $P_0 - \frac{y}{2a}$ determines the output price, hence revenue, corresponding to output y conditional on its intercept P_0 and the sensitivity of prices to output denoted a. The cost and capital associated with producing a single unit of output are denoted c and k, respectively.

Panel A: Average firm characteristics

Industry	N	Tobin's Q	ROA	G	IO	R_y	R_c
Agriculture	43	2.67	0.33	7.79	0.58	0.94	0.02
Food Products	208	1.78	0.36	9.49	0.40	1.46	0.08
Confectionery	55	2.98	0.43	6.98	0.38	1.01	0.10
Liqueur	25	1.74	0.27	7.48	0.38	0.96	0.14
Tobacco	28	2.86	0.46	9.43	0.33	0.94	0.03
Toys	58	1.52	0.40	8.59	0.57	1.24	0.08
Entertainment	69	1.69	0.24	8.72	0.48	0.71	0.06
Publishing	182	1.83	0.31	8.84	0.54	0.91	0.12
Consumer Goods	240	1.97	0.43	10.25	0.49	1.30	0.10
Apparel	131	1.54	0.49	9.10	0.58	1.70	0.13
Healthcare	163	1.96	0.13	8.58	0.54	1.26	0.16
Medical Equipment	182	2.68	0.48	9.23	0.62	0.90	0.03
Pharmaceutical	339	3.24	0.26	9.10	0.50	0.61	0.04
Chemicals	274	1.69	0.31	10.03	0.56	0.99	0.04
Rubber and Plastic	56	1.74	0.37	10.16	0.53	1.11	0.03
Textiles	69	1.10	0.30	7.80	0.52	1.33	0.05
Construction Materials	255	1.61	0.32	9.74	0.58	1.17	0.03
Construction	119	1.30	0.18	9.06	0.51	1.34	0.02
Steel	213	1.23	0.18	9.49	0.53	1.09	0.04
Fabricated Products	31	1.34	0.25	9.74	0.50	1.00	0.01
Machinery	406	1.60	0.33	10.02	0.55	1.10	0.02
Electrical Equipment	186	2.09	0.32	9.53	0.51	0.91	0.05
Automobiles	231	1.42	0.28	9.72	0.52	1.48	0.04
Aerospace	67	1.36	0.16	9.21	0.56	1.10	0.10
Shipbuilding and Railroad	32	1.32	0.11	8.00	0.58	0.98	0.03
Defense	25	1.76	0.17	8.60	0.60	1.05	0.08
Precious Metals	29	1.82	0.06	10.34	0.37	0.39	0.01
Mining	56	1.21	0.19	8.79	0.50	1.00	0.01
Coal	20	1.41	0.21	9.65	0.35	1.16	0.04
Petroleum and Natural Gas	437	1.56	0.19	9.17	0.51	0.81	0.03
Utilities	778	1.19	0.08	9.41	0.25	0.47	0.02
Communications	221	1.71	0.19	8.31	0.40	0.48	0.03
Personal Services	99	2.19	0.25	9.13	0.55	0.91	0.13
Business Services	450	2.14	0.24	8.64	0.56	1.24	0.15
Computer Hardware	332	1.95	0.41	8.64	0.48	1.14	0.03
Software	485	2.79	0.44	8.10	0.55	0.86	0.05
Semiconductors	518	2.10	0.31	7.94	0.59	0.91	0.02
Measurement Equipment	120	2.31	0.42	9.22	0.61	0.96	0.03
Paper and Office Supplies	220	1.48	0.29	10.15	0.51	1.04	0.05
Boxes and Shipping	69	1.61	0.28	9.59	0.48	1.17	0.06
Transportation	246	1.47	0.12	8.62	0.43	1.16	0.30
Wholesale	414	1.52	0.40	9.05	0.51	2.18	0.04
Retail	622	1.87	0.50	8.84	0.53	1.98	0.14
Restaurants and Hotels	246	1.83	0.12	8.97	0.47	1.14	0.20
Average	221	1.77	0.26	9.01	0.50	1.01	0.06

Panel B: Standard deviation of firm characteristics (within industries)

Industry	Tobin's Q	ROA	G	IO	R_y	R_c
Agriculture	1.68	0.20	2.44	0.24	0.56	0.02
Food Products	0.87	0.21	2.79	0.27	0.66	0.11
Confectionery	1.91	0.19	2.11	0.20	0.34	0.11
Liqueur	0.86	0.11	2.79	0.27	0.23	0.11
Tobacco	2.97	0.41	2.63	0.30	0.63	0.03
Toys	0.81	0.18	2.82	0.24	0.52	0.09
Entertainment	0.75	0.21	2.91	0.32	0.36	0.08
Publishing	0.71	0.23	2.95	0.27	0.37	0.14
Consumer Goods	1.19	0.25	2.62	0.29	0.54	0.12
Apparel	0.73	0.21	3.06	0.28	0.53	0.13
Healthcare	0.96	0.22	2.59	0.37	0.77	0.23
Medical Equipment	1.73	0.15	3.04	0.23	0.27	0.05
Pharmaceutical	2.24	0.38	2.60	0.30	0.46	0.06
Chemicals	0.75	0.15	2.50	0.26	0.37	0.07
Rubber and Plastic	0.83	0.18	2.63	0.30	0.33	0.04
Textiles	0.35	0.18	2.75	0.29	0.49	0.10
Construction Materials	0.77	0.14	2.83	0.22	0.44	0.04
Construction	0.46	0.14	3.10	0.33	0.79	0.02
Steel	0.47	0.11	2.90	0.29	0.47	0.09
Fabricated Products	0.41	0.11	3.42	0.26	0.29	0.01
Machinery	0.74	0.16	2.69	0.31	0.38	0.06
Electrical Equipment	2.17	0.18	3.02	0.28	0.37	0.10
Automobiles	0.61	0.13	2.60	0.26	0.61	0.10
Aerospace	0.47	0.12	3.20	0.22	0.37	0.17
Shipbuilding and Railroad	0.45	0.10	1.72	0.29	0.54	0.10
Defense	0.86	0.11	3.16	0.27	0.25	0.19
Precious Metals	0.71	0.16	1.90	0.19	0.15	0.01
Mining	0.44	0.11	1.96	0.25	0.60	0.01
Coal	0.51	0.12	2.48	0.38	0.57	0.03
Petroleum and Natural Gas	0.65	0.14	2.62	0.33	0.67	0.08
Utilities	0.16	0.04	2.46	0.25	0.23	0.04
Communications	0.99	0.15	2.93	0.35	0.32	0.04
Personal Services	2.06	0.36	2.39	0.30	0.49	0.16
Business Services	1.44	0.29	2.35	0.31	1.00	1.01
Computer Hardware	1.88	0.18	2.47	0.31	0.50	0.04
Software	2.86	0.27	2.08	0.31	0.51	0.06
Semiconductors	1.72	0.17	2.58	0.28	0.47	0.05
Measurement Equipment	1.89	0.17	2.33	0.31	0.36	0.04
Paper and Office Supplies	0.61	0.21	2.88	0.28	0.47	0.08
Boxes and Shipping	0.91	0.22	2.75	0.30	0.40	0.10
Transportation	0.74	0.15	2.74	0.33	0.82	0.35
Wholesale	1.00	0.22	2.70	0.31	1.21	0.06
Retail	1.20	0.21	2.76	0.32	0.80	0.11
Restaurants and Hotels	1.00	0.18	2.85	0.33	0.56	0.24
Average	1.03	0.18	2.70	0.29	0.49	0.11

Table 2: Summary Statistics and Correlations

Panel A of this table reports on the distribution for Tobin's Q, return on assets (ROA), the G index in Gompers, Ishii, and Metrick (2003), institutional ownership (IO), and our operating efficiency measures. The operating efficiency measures R_y and R_c are defined in equation (7) and equation (8), respectively, as $\frac{P_0 - \frac{y}{2a}}{k}$ and $\frac{c}{k}$. The demand curve $P_0 - \frac{y}{2a}$ determines the output price, hence revenue, corresponding to output y conditional on its output P_0 and the sensitivity of prices to output denoted a. The cost and capital associated with producing a single unit of output are denoted c and k, respectively. The operating efficiency measures are not industry-adjusted in Panel A but are normalized within the industry classifications of Fama and French (1997) in Panel B. The correlations between the variables in Panel A along with market capitalization (M) are reported in Panel B.

Panel A: Summary statistics

	Percentiles				
Variable	10^{th}	25^{th}	50^{th}	75^{th}	90^{th}
Tobin's Q	0.96	1.08	1.33	1.89	2.93
ROA	0.04	0.08	0.23	0.38	0.46
G	5.00	7.00	9.00	11.00	13.00
IO	0.00	0.27	0.55	0.73	0.85
R_y	0.15	0.42	0.86	1.31	1.88
R_c	0.00	0.01	0.02	0.05	0.17

Panel B: Correlations

Variable	M	Tobin's Q	ROA	G	IO	R_y	R_c
M	1.00	0.24	0.00	-0.01	0.02	-0.05	0.01
Tobin's Q		1.00	0.32	-0.07	0.13	0.07	0.02
ROA			1.00	-0.03	0.11	0.30	0.16
G				1.00	0.03	0.03	0.00
IO					1.00	-0.05	-0.08
R_y						1.00	0.19
R_c							1.00

Table 3: Operating Efficiency, Corporate Governance, and Tobin's Q

This table reports the coefficient estimates from the regression specification in equation (10), $R_y = \alpha_0 + \alpha_1\,\mathrm{G} + \alpha_2\,\mathrm{IO} + \gamma\,X + \epsilon$, that examines the relationship between operating efficiency and corporate governance. The X vector contains the log of total assets and the log of market capitalization as well as industry and time dummy variables. Below each regression coefficient, t-statistics are reported in parentheses, with the standard errors of the regression coefficients clustered at the firm level. Besides the G index of Gompers, Ishii, and Metrick (2003), institutional ownership (IO) proxies for corporate governance. The regression is also repeated by replacing the dependent variable R_y with R_c. The operating efficiency measures R_y and R_c are defined in equation (7) and equation (8), respectively, as $\frac{P_0 - \frac{y}{2a}}{k}$ and $\frac{c}{k}$. The demand curve $P_0 - \frac{y}{2a}$ determines the output price, hence revenue, corresponding to output y conditional on its intercept P_0 and the sensitivity of prices to output denoted a. The cost and capital associated with producing a single unit of output are denoted c and k, respectively. Both measures of operating efficiency are normalized within the industry classifications of Fama and French (1997).

	intercept α_0	G index α_1	IO α_2	log(size) γ_1	log(assets) γ_2	time / industry dummies	adjusted R^2	number of obs
R_y	0.902	0.026	-0.003	0.173	-0.330	Yes	9.80%	10792
	(3.55)	(4.21)	(-2.06)	(9.00)	(-14.66)			
R_c	1.110	0.008	-0.156	0.198	-0.345	Yes	10.17%	10792
	(4.41)	(1.24)	(-2.69)	(9.15)	(-13.41)			

Table 4: Operating Efficiency and Tobin's Q

Panel A of this table reports the β coefficients from the regression specification in equation (12), $Q = \beta_0 + \beta_y R_y + \beta_c R_c + \gamma X + \epsilon$, which examines the relationship between Tobin's Q and operating efficiency. The X vector contains industry and time dummy variables. Below each regression coefficient, t-statistics are reported in parentheses, with the standard errors of the regression coefficients clustered at the firm level. The operating efficiency measures R_y and R_c are defined in equation (7) and equation (8), respectively, as $\frac{P_0 - \frac{y}{2a}}{k}$ and $\frac{c}{k}$. The demand curve $P_0 - \frac{y}{2a}$ determines the output price, hence revenue, corresponding to output y conditional on its intercept P_0 and the sensitivity of prices to output denoted a. The cost and capital associated with producing a single unit of output are denoted c and k, respectively. Both operating efficiency measures are normalized within the industry classifications of Fama and French (1997). In Panel B, the five largest and five smallest industry-level β_y estimates are reported after estimating equation (12) within each industry.

Panel A: Relationship between Tobin's Q and operating efficiency

	intercept β_0	scale β_y	costs β_c	time / industry dummies	adjusted R^2	number of obs
Tobin's Q	1.585	0.106		Yes	18.22%	10792
	(10.51)	(5.12)				
Tobin's Q	1.556		0.126	Yes	18.49%	10792
	(10.28)		(1.98)			
Tobin's Q	1.575	0.064	-0.030	Yes	18.68%	10792
	(10.15)	(2.78)	(-1.78)			

Panel B: Largest and smallest scale coefficients by industry

Largest β_y Estimates			Smallest β_y Estimates		
Industry	β_y	t-stat.	Industry	β_y	t-stat.
Publishing	0.365	3.83	Construction Materials	-0.058	-0.94
Communications	0.335	2.52	Toys	-0.083	-0.63
Computer Hardware	0.323	2.43	Business Services	-0.101	-1.32
Transportation	0.304	3.10	Agriculture	-0.284	-1.02
Retail	0.208	3.15	Defense	-0.409	-1.57

Table 5: Robustness Tests

This table investigates the robustness of the β_y coefficient from the regression specification in equation (12), $Q = \beta_0 + \beta_y R_y + \beta_c R_c + \gamma X + \epsilon$. This regression examines the relationship between Tobin's Q and operating efficiency. The X vector contains industry and time dummy variables. Below each regression coefficient, t-statistics are reported in parentheses, with the standard errors of the regression coefficients clustered at the firm level. The operating efficiency measures R_y and R_c are defined in equation (7) and equation (8), respectively. Several robustness tests are conducted. First, the operating efficiency measures are normalized within the industry classifications of Fama and French (1997) using *deviations* from the lowest measure within an industry, as defined in equation (13). Second, property, plant, and equipment abbreviated *PPE* replaces total assets in the denominator of R_y and R_c as a proxy for capital. Third, within each industry, firms whose *total assets* are either below or above the 2^{nd} and 98^{th} percentile, respectively, are removed from the regression to ensure they are not unduly influencing the β_y coefficient. Fourth, firms with *unique products*, defined in Berger, Ofek, and Yermack (1997) as R&D divided by revenue, are examined. In the fifth robustness test, the dependent variable Tobin's Q is normalized within each industry using its respective mean and standard deviation to construct *industry-adjusted* Tobin's Q measures.

Robustness Test	intercept β_0	scale β_y	costs β_c	time / industry dummies	adjusted R^2	number of obs
Deviations from Minimum	1.406 (9.96)	0.391 (2.72)	-0.540 (-1.13)	Yes	17.31%	10239
PPE as Capital	1.604 (11.94)	0.093 (3.31)	-0.030 (-1.52)	Yes	15.59%	9687
Total Assets (non-extreme)	1.582 (10.28)	0.098 (2.89)	-0.038 (-1.02)	Yes	18.75%	10362
Unique Products	3.872 (2.13)	0.107 (2.17)	-0.012 (-0.47)	Yes	15.60%	3508
Industry-Adjusted Tobin's Q	0.188 (0.86)	0.136 (6.18)	-0.061 (-1.69)	Yes	5.45%	10792