4-1-2010

What is the Effect of Product Market Competition on Chief Executive Officer Compensation?

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What is the Effect of Product Market Competition on Chief Executive Officer Compensation?

Erica Graboyes
Advisor: Professor Gary Krueger
Readers: Professors Karl Egge and Sarah West

Honors Thesis
Spring 2010

Abstract: This paper examines the relationship between the degree of product market competition and the level of executive compensation for the largest 216 publically traded companies in U.S. manufacturing. Using 2005 CapitalIQ and Census data this paper finds that firm size has a substantial positive effect on the CEO’s total and annual cash compensation. These results also indicate that holding firm size as well as other measures constant, the degree of industry competition these firms face plays a small, but interesting role. Consistent with the hypothesis based on the literature, industry concentration has a parabolic relationship with compensation such that boards offer the lowest compensation in oligopolistic markets. This result may be due to an increased ability of boards and shareholders to monitor CEOs at intermediate levels of competition.
Acknowledgements:

I would like to extend my gratitude to the many individuals who have provided extensive guidance and reassurance throughout the course of this thesis. Thank you to my advisor Professor Krueger for his daily reassurance and encouragement. Also I would like to thank my readers Professors Egge and West for their insightful comments and edits, which were integral to the completion of this project. I would like to extend a special thank you to Professor Aslanian for listening to my worries and concerns and guiding me through to the end. Additionally I would like to extend a special thank you to Chad Burton at Piper Jaffray & Co. for providing me with the Capital IQ data, for without his help the completion of this thesis would not have been possible. I would like to recognize my fellow honors seminar students, in particular Alice Anigacz and Zachary McDade, for their daily humor and support. Additionally I would like to thank my family, and in particular to my parents, Gwenn and Joseph Graboyes, and my brother Evan Graboyes, for their continual support in my academic endeavors. Lastly, I extend a thank you to my many friends, and in particular to my dear friends Iain Johnson and Maria Princen, for all the wonderful memories over the past four years. All of you forever shaped and made my Macalester experience incredible.
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“The best of all monopoly profits is a quiet life” (J.R. Hicks, p.8, 1935)

1. Introduction

It is beyond dispute that competition has an important effect on a firm’s performance. Nevertheless the linkages between competition and performance are not well understood. At some level the linkages must operate through influences on managerial and employee behavior. One expects firms to operate with higher levels of efficiency when the degree of industry competition is high and one expects the opposite when competition is lower. This intuition is consistent with Leibenstein (1966), who finds large “x-inefficiencies” in less competitive markets. He also finds that “organizational slack” causes more social welfare loss than the deadweight loss that results from monopoly price distortions. Consider the organization slack within Enron in which CEO Jeffery Skilling earned $14 million in salary and bonus and harvested $89 million from stock and options from 1998-2001 despite the fact that Enron filed for bankruptcy in December 2001. In perfectly competitive markets, however, social loss does not exist. Machlup (1967) contends there is no room for slack since the market will force or drive out any firm that does not minimize costs completely.

Despite the compelling theoretical argument that competition improves managerial decision making, there is mixed support for this hypothesis. Hart (1983) and Schmidt (1997) suggest competition acts as a substitute or disciplinary mechanism to

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1 Leibenstein shows the welfare loss due to price distortions (i.e. monopoly pricing or tariffs) is often less than or equal to 1/10 of 1 per cent, while the loss from organizational slack is often above 25%.

2 Organizational slack is the excess capacity within an organization that occurs when resources are not used efficiently. This may occur when firms pay employees too much, or do not utilize resources completely.
reduce managerial slack and agency costs.³ When the degree of competition increases, shareholders are able to offer weaker incentives given that CEOs are implicitly motivated to work harder. Others, such as Raith (2003) and Karuna (2007), find that when competition increases shareholders need to offer stronger incentives in order to help offset the greater risk of bankruptcy and to encourage the CEO to maximize performance.

This paper examines whether competition acts as a substitute for monetary incentives and thus allows shareholders to pay executives less. Principal-agent theory is related to CEO compensation (incentives) in section 2. The objective is to discern if competition affects CEO compensation, and if so, how. Section 3 presents prior literature on performance, compensations, and competition. Section 4 discusses the sample selection, methodology employed, and the dependent and independent variable specification used herein. Section 5 presents the results and Section 6 describes a robustness check. Section 7 summarizes key findings and proposes directions for future research.

2. Theory of CEO Compensation

Unlike most employees’ compensation, which relates closely to education, skill, experience, and job specific conditions such as heavy labor, CEO compensation is less straightforward. Gayle and Miller (2009) discuss that since it is challenging to monitor CEOs’ activities, CEOs are rarely compensated for their inputs. Instead, the board and shareholders structure compensation packages relating the CEO’s compensation to

³ Agency costs are part of executive compensation, which are unrelated to maximizing performance or shareholder interests.
various measures of performance such as improvements in the firm’s stock price, which are thought to proxy the CEO’s effort.

Tying a CEO’s compensation to the firm’s performance typically requires the CEO to hold a substantial amount of assets, such as options, stock and or restricted stock which are sensitive to firm performance. Moral hazard may exist if a substantial portion of the CEO’s wealth is tied up in the firm.\(^4\) From a shareholder’s perspective if 80% of the CEO’s net wealth is tied to firm performance, this may induce the CEO to be more risk averse than the shareholders view is optimal.\(^5\) However, if the CEO holds a considerable amount of options that are “at-the money”, he might concentrate on meeting short-term earnings at the expense of creating long-term shareholder value, in order to maximize his personal wealth. The board faces two key challenges with respect to monitoring and motivating the CEO to run the firm in the shareholder’s best interest. The first is asymmetrical information, since the CEO knows more about the day-to-day operations and short-term forecasts for the firm than do both the shareholders and board of directors. The second is that the CEO’s and shareholders’ preferences are incompatible in which case interests may diverge (Sappington, 1991; Stiglitz, 1988).

2.1.1 Principal-Agent Theory

Figure 1 (see page 5) models the problem in which principals have coarse information concerning the agent’s abilities and that the agent’s preferences diverge from

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\(^4\) Moral hazard exists when a party, in this case the CEO, is insulated from risk which may induce him to behave differently that if he were fully exposed to the same risks as shareholders.

\(^5\) Note that hereafter this paper uses “he” when referring to CEOs given that the vast majority of CEOs in the sample and among US companies are males.
those of the principal. The shaded region in figure 1 represents asymmetrical information, which prevents the board from setting an optimal performance target. If the principal has perfect information, the plan/performance target would be a single point on the graph. Note that the agent’s (CEO’s) incentive function in figure 1 is sloped differently from the principals (shareholders) apparent preferences (approximately 45 degrees from the origin). The difference in preferences is captured by the fact that for the same amount of effort the CEO would prefer to maximize his own compensation and receive greater pay.

The inherent “agency cost” is shown in the difference in compensation (and preferences) between points B and C for a given performance level. The shareholders prefer point C, as they can offer fewer incentives to the CEO to obtain the desired performance. The CEO’s most optimal point to operate - in which he can optimize his own preferences and avoid shareholder interference - is point B. Ultimately the CEO prefers to be at point A as it maximizes his own preferences, however this point is not optimal from the shareholders’ perspective as it is outside the range of discretion. At any point outside of the range it is impossible for the CEO to meet any combination of the acceptable performance. If the CEO were to operate at point A the likelihood that the shareholders interfere and the CEO would be caught increases drastically.

In this paper I hypothesize that as the degree of industry competition increases, shareholders and the board should obtain additional information that should shrink the range of discretion. With more firms in an industry, shareholders and boards should have

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6 This approach is adopted from John Michael Montias who first applied this graph to the case of a hypothetical manager in Soviet Style central planning. See Montias in Bornstein, Morris “Plan and Market: Economic Reform in Eastern Europe.” Yale University Press, 1973.
more information about true performance possibilities reducing the distance between points B and C, and attenuate the agency cost. The smaller range of discretion effectively disciplines the CEO as it limits the possibility for the CEO to cheat without detection. It is also possible that a greater risk of bankruptcy (associated with a higher degree of competition) aligns the preferences of the agent with the principal such that the shareholders’ preferences \((U^p) = \text{CEO’s preferences} (U^A)\). The preference compatibility enables shareholders to offer the CEO weaker incentives.

Figure 1

2.1.2 Oligopoly Theory: Building off Principal-Agent Theory

Just as competition serves to align the CEO’s and shareholders’ incentives, it also minimizes the CEO’s asymmetrical information advantage. Given the CEO’s proximity to the company’s daily operations, he has an information advantage over the board and shareholders, \(I_{\text{agent}} >> I_{\text{principal}}\). The CEO seeks to preserve this advantage and to pursue

---

7 Note that the real situation of agency cost and operating in the range of discretion is far more complex and multi-dimensional. The graph shown is static and thus does not include the dynamic nature of how competition shrinks the range of discretion.

8 If the CEO were to operate outside of the range of discretion the likelihood that he would be caught increases, as the CEO has not met an appropriate target level.
his objectives which may not be consistent with the shareholders’. Consider for instance the CEO who might prefer short-term profits that materially affect his bonus, but which come at the expense of impairing long run profits.

The board’s inability to determine the CEO’s true potential or production possibility frontier (PPF) represents asymmetric information, which is a standard depiction of the principal-agent problem. The board can only approximate a range of the CEO’s feasible capabilities, which complicates determining the optimal performance level. As the degree of competition increases, it provides the board with increased information about the CEO’s true capabilities which may help the board set a more feasible performance target. Additionally, CEOs which face increased competition may be less likely to undertake dysfunctional behavior that might allow rival CEOs to capture their market share. That is they might lack Hick’s “quiet life.”

The idea that competition acts as a disciplinary mechanism enabling shareholders and the board to offer CEO’s weaker incentives is straightforward. Up to a certain point, competition makes it easier for the board and shareholders to monitor the CEO’s actions, thereby reducing the CEO’s ability to slack. As more firms enter the market, the board is able to observe the actions and performance of other CEOs in the same industry as a reference point, which enables them to better evaluate managerial actions. Competition helps not only to reduce not only the asymmetrical advantage but also to minimize agency costs – which increases the likelihood that the CEO will run the firm in the best interest of shareholders. For example, in the beverage industry it might be easier for shareholders of Pepsi to monitor their CEO by simply looking at the performance of Coke.
It is possible that there exists a signal-to-noise ratio wherein it is more difficult for the board/shareholders to extract useful information concerning CEO performance when the number of competing firms gets too large. When there are only a few CEOs in the industry, the CEOs may choose to enter into strategic decisions dependent on each other’s actions. At a level of industry concentration similar to oligopoly market structure, shareholders may be able to better monitor the CEO via information from the tactical decisions and co-operations. As more firms enter the industry, the board’s ability to monitor the CEO decreases, and thus the CEO has an increased impetus to cheat. Figure 2 (see below) shows the parabolic relationships among industry concentration, the board’s ability to monitor the CEO, and CEO compensation.⁹

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Fig. 2: Parabolic relationship among industry concentration, the board’s ability to monitor the CEO, and CEO compensation.

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⁹ The notion of managerial entrenchment being associated with higher compensation is taken from Shleifer and Vishny Management Entrenchment (1989).
3.1 Literature Review: Compensation and Performance

Earlier literature adopts the labor market approach to focus on determinants of CEO pay. Roberts (1956) is one of the first authors to apply this economic theory. He uses financial and compensation data from the Securities and Exchange Commission of 2,000 corporations over four different one-year periods. After calculating the partial correlation coefficients on both size (net sales) and profit (net income), Roberts concludes that size has a greater effect on executive compensation than profit. Using pooled CEO compensation data, Agarwal (1981) and the team of Finkelstein and Hambrick (1989) support Roberts’s findings regarding size and performance as determinants of compensation. Finkelstein and Hambrick find a positive relationship when they conduct multiple cross-sectional regressions on pooled compensation data from Forbes and Compustat.\footnote{Finkelstein and Hambrick measure firm size with the log of total assets to reduce heteroskedasticity, and express all dollars in 1983 dollars (deflated by the CPI).} The positive relationship among company size, job complexity, performance, and compensation supports the labor market theory regarding determinants of compensation.

More recent literature adopts the principal-agent theory to address the notion of “pay-performance”. Jensen and Murphy (1990) conduct multiple difference in difference regressions to analyze how performance affects multiple facets of CEO compensation; their paper is one of the earliest studies in this literature.\footnote{Note that Jensen and Murphy address the endogeneity issue by using first differences as opposed to simultaneous equations. They examine how a change in shareholder wealth affects the change in CEO compensation (this is the basis of the difference in difference regression). Please see their 1990 paper “Performance Pay and Top Management Incentives” for all their measures of compensation. The change in shareholder wealth is \( r_t V_{t-1} \), where \( r_t \) = inflation adjusted rate of return on common stock, and \( V_{t-1} \) = firm value at the end of the prior year.} They match compensation data from the Forbes Executive Compensation Surveys (1974-1986) with fiscal-year
corporate performance data from *Compustat*. They find that for every $1,000 increase in shareholder wealth, the average CEO’s pay increases $3.25 (of which $2.50 is attributable to gains from stock ownership but only 1.35 ¢ to increases in his salary and bonus). They contend that the increase in CEO pay is too small to properly align shareholder and CEO’s interests and suggest that performance and compensation are not closely related.

Hall and Liebman (1998) refute the argument that CEOs, like bureaucrats, are paid independent of their firm’s performance. They use new CRSP data to measure precisely how a change in the company’s share price affects the CEO’s stock and option value. They note that a 10% increase in firm value results on average in a $1.25 million increase in CEO wealth (of which salary and bonus comprise only $24,300). Hall and Liebman argue that since stock and options awards account for approximately 98% of the pay-performance relationship, CEO pay is more sensitive to firm performance than initially indicated.

The endogeneity between CEO compensation and firm performance is a central issue in empirical investigations. If these two factors determine one another, the result is a circular effect in which compensation affects performance, which in turn affects compensation. Such a relationship suggests that compensation or incentives cannot be a function solely of performance but that instead a feedback effect exists. Barnhart & Rosenstein (1998) use three systems of simultaneous equations to contend that CEO pay, firm performance, and board composition are jointly determined. Agrawal & Knoeber

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12 The CRSP data contains detailed information on option grants, option gains, and total options held as well as the number, exercise price, and the time to maturity of the options, which enables the researchers to precisely calculate the change in the value of a CEO’s stock option holdings for a given change in firm value.
(1996), who also use simultaneous equations, argue that only board composition has a significant effect on compensation and performance.

3.2 Competition and Compensation

Within the pay-performance literature, prior research (Aboud and Kaplan, 1996 and Hartzell and Starks, 2003) attempts to proxy competition with industry specific dummy variables. Hartzell and Starks (2003) use an industry dummy variable to control for pay similarities in industries, but they do not capture any measure of industry concentration or market structure. This is a coarse measure of competition as it incorporates all other industry specific characteristics unrelated to competition. This paper attempts to add to the existing literature as it directly incorporates measures for the degree of competition and their effect on executive compensation. Given that prior literature has indicated that the relationship between competition and compensation is ambiguous, this paper uses an additional measure of competition in an attempt to better capture competition’s complex nature. Similar to Karuna (2007) this paper uses product-substitutability as an additional dimension of competition instead of using only the single measure of industry concentration to measure competition.13

3.2.1 Competition and Compensation: Theory

Assuming that firms’ cost structures are related, an increase in the number of competitors generates additional information not available in a monopoly. The board can use the information to better monitor executive behavior and minimize managerial slack.

13 Karuna argues concentration alone is a poor proxy for competition. Thus he and this paper use additional variables to measure multiple dimensions of competition.
Nalebuff and Stiglitz (1983) examine how competition affects compensation and managerial slack. They argue that if the costs of implementing a lower level of effort are less than the costs of implementing a higher level of effort, as the degree of competition increases, then the average manager will subsequently work less (i.e. slack more). They find the manager can increase his pay if he is able to exploit the additional information, but that competition has an ambiguous overall effect on effort.

Scharfstein (1988) supports Nalebuff and Stiglitz’s findings which show that executives can receive increased pay under increased levels of competition. Scharfstein creates a purely theoretical compensation structure in which each manager’s wage depends solely on his firm’s performance. He shows that if a manager’s marginal utility from income is strictly positive, then an increase in the degree of competition may increase managerial slack and ultimately compensation. His results contradict Hart’s (1983), who contends that competition unambiguously reduces slack – that managerial slack is lower with competition than in a single non-profit maximizing monopolist firm.\(^{14}\) Managerial preference specifications are largely responsible for how the degree of competition can either increase or decrease incentives. The mixed results among Hart (1983), Nalebuff and Stiglitz (1983), and Scharfstein (1988) suggest that the mechanism through which competition affects compensation (incentives).

Schmidt (1997) constructs a purely theoretical optimal incentive scheme for executive compensation as a function of competition. He finds that an increase in competition increases the firm’s likelihood of exiting the marketplace (being acquired of going bankrupt), which motivates the manager to exert more effort. In this scenario the

\(^{14}\) Hart (1983) assumes managers are inherently risk adverse and that income above a subsistence level holds no value while income below that level is catastrophic.
board provides weaker incentives, since managers are implicitly motivated to work harder to remain in the market. Schmidt concludes with standard economics that increased competition reduces a firm’s profit. He also contends, however, that reduced profits make it less attractive for the CEO to work more effectively. Consequently shareholders may need to provide additional incentives to motivate these CEOs to compensate for the increased expected utility loss. Schmidt argues that the total effect of competition on effort is ambiguous in part, because the amount of effort the CEO exerts is contingent on the amount of competition.

More recently, Raith (2003) uses a purely theoretical principal-agent model to examine the effect of competition in an oligopoly setting. A critical aspect is the assumption in his model is that free-entry and exit endogenously determine the market structure. Raith notes that if market structure is endogenous, then changes in the nature of competition lead to changes in the market. In such a scenario, the degree of competition, the optimal incentive plan, and market fundamentals such as entry cost, market size, and product substitutability determine the equilibrium market. As the degree of competition increases due to lower entry cost or industry concentration, shareholders provide stronger incentives to their managers.

3.2.2 Competition and Compensation: Prior Empirical Literature

Aggarwal and Samwick (1999) empirically test the hypothesis that competition reduces incentives; see table 1 for an overview. They derive an optimal executive compensation contract, which includes both firm and industry performance, under differentiated Bertrand competition. They conduct a cross-sectional analysis using 1995
executive compensation data from Standard and Poor's ExecuComp and the 1992 Herfindahl Indices from the Commerce Department’s Census of Manufactures. They find that in more competitive industries, firms place a greater weight on rival firm performance than on their own firm performance. They also find that the sensitivity of compensation to rival firm performance increases as the degree of industry competition increases.

Karuna (2007) conducts an empirical analysis on public companies from 1992-2003 to determine how managerial incentives are a function of competition. He argues that since the relationship between industry concentration and compensation is unknown, a single variable cannot completely measure competition. Karuna uses a price-cost margin (proxy for product substitutability), market size, entry cost, and industry concentration to measure multiple dimensions of competition. He finds negative coefficients on both the price-cost margin and entry cost variables.¹⁵ This implies that overall shareholders will offer stronger incentives when the degree of industry competition increases. Karuna also shows the ambiguous nature of the relationship between concentration and incentives, suggesting that concentration alone may not be a good proxy for competition.

Adding to Raith’s (2003) and Karuna’s (2007) findings, this paper uses data from Standard and Poor’s CapitalIQ database, Morningstar Financial, and the Census of Manufactures report in the 1997 and 2002 Economic Census to test the effect of competition on executive incentives. To measure incentives, this paper uses total CEO compensation as well as the component defined only as annual cash compensation (salary

¹⁵ The coefficient on the entry cost variable is significant at 1%. The negative coefficient on both variables suggests as entry cost and price-cost margin increase (the degree of competition falls) and compensation decreases.
+ bonus). As measures of competition this paper uses the traditional industry concentration measure – the Herfindahl Index – as well as a price-cost ratio as a proxy for the degree of product substitutability.\textsuperscript{16} This paper constructs a model to examine whether competition provides shareholders and the board with increased information to enable them to offer lower compensation (weaker incentives).

\textsuperscript{16}See Table 8 & 9 in the appendix for variable definition and construction
<table>
<thead>
<tr>
<th>AUTHOR</th>
<th>DATA AND METHODOLOGY</th>
<th>RELEVANCE, RESULTS, AND HIGHLIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jensen &amp; Murphy (1990)</td>
<td>* 1974-1986</td>
<td>* CEO stock holdings are driving force behind changes in the “pay-performance relationship”</td>
</tr>
<tr>
<td></td>
<td>* Forbes Executive Compensation surveys, Compustat, CRSP</td>
<td>* CEO wealth changes $3.25 for every $1,000 change in shareholder wealth</td>
</tr>
<tr>
<td></td>
<td>* OLS with first differences on dependent variable</td>
<td></td>
</tr>
<tr>
<td>Agrawal &amp; Knoeber (1996)</td>
<td>* 1987</td>
<td>* Statistically significant relationship among performance, inside ownership, and outsiders on the board</td>
</tr>
<tr>
<td></td>
<td>* Forbes Executive Compensation survey</td>
<td>* Under simultaneous equations only board composition is significant</td>
</tr>
<tr>
<td></td>
<td>* implement simultaneous equations**</td>
<td></td>
</tr>
<tr>
<td>Hall &amp; Liebman (1998)</td>
<td>* 1980-1994</td>
<td>* Changes in wealth from stock and options are 50 times larger than changes from salary and bonus alone</td>
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<tr>
<td></td>
<td>* OLS cross-sectional analysis</td>
<td>* CEO wealth changes $6.00 for every $1000 in shareholder wealth from 1980-1994</td>
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<td></td>
<td>* CRSP, Compustat, Yermack data, and corporate proxies</td>
<td></td>
</tr>
<tr>
<td>Aggarwal &amp; Samwick (1999)</td>
<td>* 1995</td>
<td>* Firms place more weight on rival performance vs own firm performance as competition increases</td>
</tr>
<tr>
<td></td>
<td>* OLS cross-sectional and first difference analysis</td>
<td>* In least concentrated industry: 17.71¢ increase in Rival pay-performance (rpp) sensitivity → $1,000 increase CEO total compensation</td>
</tr>
<tr>
<td></td>
<td>* Compustat, and Commerce Department's Census of Manufactures data (1992)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>* CRSP and Compustat</td>
<td>* Greater product substitutability and lower entry costs → stronger incentives</td>
</tr>
<tr>
<td></td>
<td>* OLS and random coefficient model</td>
<td>* 7% reduction in incentive strength when product substitutability decreases by 1 standard deviation</td>
</tr>
</tbody>
</table>
Model Overview: Compensation = $F$ (performance, competition)

4.1 Methodology & Sample Selection

To investigate the relationship between the extent of industry competition and CEO compensation, this paper conducts numerous OLS regressions at the firm-specific level, which allows for inter-firm differences that may affect incentives. This paper uses the following equation:

\[
\text{Compensation} = \beta_0 + \beta_1 \text{Performance} + \beta_2 \text{Revenue} + \beta_3 \text{Employees} + \\
\beta_4 \text{CEOtenure} + \beta_5 \text{Age} + \beta_6 \text{Concentration} + \beta_7 \text{Concentration}^2 + \\
\beta_8 \text{Substitutability} + \beta_9 \text{Substitutability}^2 + \beta_{10} \text{Capitalconstraint} + \\
\beta_{11} \text{Institutions} + \beta_{12} \text{Outsidedirectors} + D_1 \text{CEOchair}
\]

In an agency setting the amount of total compensation and annual cash compensation affect firm performance. The compensation variable serves as an incentive mechanism to maximize firm performance. In addition, the level of performance affects the level of compensation. Thus firms that perform well may reward the CEO with higher compensation. CEO pay is contingent upon factors, such as competition which affect the agency problem. Theory suggests that the degree of industry competition is related to CEO compensation in a non-linear or potentially parabolic manner. Therefore the estimating equation includes the squared values of industry concentration and product substitutability.

In an industry with minimal competition, there could exist the quiet monopolist – such that the CEO does not maximize performance as he might assume it is unlikely he will get caught if he performs below capacity. As additional firms enter this industry, CEOs might co-operate and essentially enter into tactical decisions. In these situations
the board and shareholders may be better able to monitor a CEO’s actions, and improve
the likelihood of detection (i.e. if the CEO exhibits managerial slack or cheats) However,
as the degree of industry competition continues to increase there could be a point when
the board is unable to accurately/closely monitor a CEO’s behavior. Also firms in
competitive markets face an increased risk of bankruptcy or liquidation so they have to
offer CEOs greater pay in order to compensate for the increased risk. It is plausible that
firms do not maximize performance due to either managerial slack (in a highly
concentrated or monopoly market) or to bankruptcy risk (in highly competitive markets).
This suggests that the degree of competition has a parabolic relationship with
performance and consequently compensation.

The CEO’s human capital and experience as well as the firm size affect the level
of CEO pay. Following the accepted practice in literature to correct for the non-normal
distribution, this paper uses the natural log of full time employees and annual revenue. In
addition this paper uses the natural log of CEO compensation and the number of years as
CEO.

The data for this paper come from 2005 cross-sectional data about the largest 216
public companies, published in the 1996 Forbes Fortune 500 and 2009 Forbes Global
2000.\textsuperscript{17} Firms which were acquired, went bankrupt, or went private over the 12 year
period are not included in the sample. This creates a potential survivor bias, since the
included companies are the largest publicly traded companies in both 1995 and 2008,

\textsuperscript{17} The largest companies are based on market capitalization. 2005 refers to the 2005 fiscal year. This
paper excludes Apple Corporation as Steve Jobs received only $1 for both annual cash and total
compensation. Such compensation is atypical for a CEO and thus does not represent an accurate picture of
managerial incentives.
which were still public companies in 2009. Survivor bias may be an issue if the firms that exited the market and those that “survived” responded differently to competition.

If there is a survivor bias, it is possible that the effect of the degree of competition and the level of compensation of survivor firms do not represent the larger population of firms. This paper uses a dummy variable and an interaction term to capture the effect of degree of competition on compensation for firms that have exited the market and those which are public companies today. The data used to investigate this possible bias and to check for robustness are a 2005 cross-section of the largest 258 public companies published in the *Forbes Fortune 500 and Global 2000* in 1996, 2006, and 2009. The results of this analysis (discussed later in the robustness section) suggest there is little if any survivor bias.

Initially this paper sought to use panel data, but given the limitation within the industry concentration data from the Census of Manufacturers report, such an analysis was not possible.\(^\text{18}\) While a panel dataset is ideal, as it would allow for the use of fixed effects to control for unobservable time-invariant firm-specific determinants of compensation (i.e. corporate culture), the use of a cross-sectional analysis is acceptable. Consider a firm with a “big-pay” culture in which there is a sort of “slack” versus a firm with a “low-pay” culture such as 3M, which many would argue has a “good corporate culture” and little “slack”. A cross-sectional analysis is not able to disentangle the potential relationship between culture and competition to establish which if either is a determinant of pay. This paper uses a first difference analysis in attempt to control for

\(^{18}\) This paper can only use the 1997 and 2002 Census data to measure industry concentration as the 2007 industry concentration measures are not available until fall 2010. It is therefore not possible to use panel data, for the static nature of the competition variable cannot capture the change in performance and compensation.
the effect of culture on compensation and thus examine whether the degree of
competition has an effect on compensation.

While the initial regression uses 2005 CEO compensation and 2002 Census data
in the cross-sectional analysis, the first difference approach uses the change in
compensation (2004-2005) and degree or level of competition (from either the 1997 or
2002 Census). The dependent variable in the first difference equation is the change in
CEO compensation from 2004 to 2005 and the competition variables are the Herfindahl
index and the price-cost ratio in either 2002 or 1997. The results of this analysis show
that while statistically insignificant, the coefficient on industry concentration and price-
cost ratio are consistent with the cross-sectional analysis. This supports the oligopoly
theory; however the coefficient on the industry concentration and price-cost variables are
insignificant and not pursued. This paper uses the 2005 fiscal year in order to limit the
difference in time (from 2002 to 2005), which derives from combining different data
sources.

The CEO compensation data as well as CEO tenure and age are from CapitalIQ.
This paper combines compensation data with firm specific data from proxy statements
with competition data from the Census Manufactures report in the 2002 Economic
Census (at the disaggregated 4 digit North American Industrial Classification Scheme -
NAICS level). The US Census Bureau provides comprehensive narrowly defined
industry data for the manufacturing sectors (2-digit SIC codes ranging from 20 to 39).\textsuperscript{19,20}
The final sample contains 216 firms for the 2005 fiscal year.

\textsuperscript{19} The sample excludes any company which has an SIC code outside of 20-39 as the Census only calculates
an industry concentration (Herfindahl Index) measure for the manufacturing industry (SIC codes 20-39).
Consequently the number of firms falls from 880 to 216; 880 are the largest firms in 1995 and 2005 across
all industries.
4.2 Variable Specification

Measures of Executive Compensation

Previous literature (Jensen and Murphy, 1990; Yermack, 1995; and Hall and Liebman 1998) finds that equity-based compensation is the most performance sensitive part of CEO compensation. Equity-based compensation generally comprises the bulk of incentive compensation and dominates other forms of compensation such as salary, bonus, and other forms of short-term and long-term compensation. For the 216 CEOs which comprise the initial sample, equity-based compensation comprises only 27% of the total compensation. The CEO receives restricted stock and option awards that provide him with an additional impetus to maximize performance and firm value. The stock and option awards directly relate the CEO’s and shareholders’ preferences, which helps to partly mitigate the principal-agent problem.

This paper uses annual cash compensation (Hall & Liebman, 1998, and Core et al., 1999) and total compensation to measure CEO incentives. Figure 3 (Appendix 1) shows for the select sample, each component’s percentage of the total compensation.

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20 In 1997 the census shifted the classification system from SIC to NAICS. They constructed concordance tables to enable comparison between the industries at the four-digit SIC code level in 1992 and the same industries in the NAICS code levels. The Census defines comparable as: “NAICS derivable from SIC”, almost comparable: “sales or receipts from SIC are within 3% of NAICS”, and non comparable as “NAICS sales or receipts cannot be estimated within 3% from SIC data”. None of the industries I matched fell into the non comparable category.

21 One potential reason that restricted stock grants are 27% of total compensation is that the Financial Accounting Standards Board (FASB) did not require corporations to expense restricted stock or option grants until 2006. Prior to 2006 firms did not have to report the value of restricted stock or option grants. Rather firms could report the number of shares granted without any value. Thus the portion of equity-based compensation in this sample is likely smaller than the actual % of equity-based compensation due to reporting regulations.

22 Note this paper uses the natural log to measure compensation in an attempt to correct for the non-normal distribution of the raw data.
Annual cash compensation is the sum of salary + annual bonus. The average cash compensation is approximately 47% of total compensation for the 216 CEOs in this paper’s sample. Total compensation contains all sub-categories of compensation, and includes equity-based components (restricted stock and option grants) and “other perks”.

If a firm grants too large a percentage of compensation in options or restricted stock, then the CEO may seek to maximize near-term profits at the cost of long-term earnings. If however, the CEO believes, that the incentives are too low, then he may not exert sufficient effort to meet the performance target. The board and shareholders often offer additional non-performance related components of compensation to entice the executive to maximize shareholder value. These “perks”, for example, include personal use of corporate aircraft, retirement plans, and company-paid premiums for supplemental life and health insurance. One challenge with measuring CEO compensation is the variation in reporting which many companies report in the annual executive compensation table. Thus one company may define as “other annual compensation” what another may define as “annual other compensation even though the average CEO may receive both categories of compensation annually.”23 Given the complex nature of CEO compensation, detailed information on the multiple components of “perks” or “other compensation” could provide a more comprehensive picture about the actual incentive structure.

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23 Components which might be included as annual other compensation are personal travel expenses or country club memberships. Firms may include items such as the use of corporate aircrafts and retirement plans as other annual compensation.
Measures of Product Market Competition

Since competition is a multifaceted concept, it is challenging to capture both price and non-price components of competition that a firm faces. As prior literature often uses a single measure for industry concentration such as the Herfindahl index (HHI) to measure the degree of competition (i.e. Aggrawal and Samwick, 1999; Defond and Park, 1999), so too does this paper. The Census calculates the HHI index based on the sum of the market share squared for the 50 largest firms at the 4-digit NAICS code level.

One limitation of the Herfindahl or industry-based measure of concentration is that it assumes a one-to-one correspondence between the industry code and the firm’s product market(s). Thus a conglomerate such as 3M is assigned one industry code, despite its products being spread across many industries (ranging from health care, industrial transportation, to consumer and office business). Another limitation of using a Herfindahl or similar index as the sole measure of the degree of competition is that it assumes that market structure is exogenous. As concentration falls prices fall, and, therefore, the degree of competition increases for a given industry, when market structure is exogenous. More recently Raith (2003) contends that when market structure is taken as endogenous, it is not clear whether low values of concentration capture low or high competition.

Karuna (2007) constructs a price-cost margin variable, which he defines as: industry sales / (cost of materials + production workers’ wages). This paper uses this same variable in an additional measure to capture the degree of competition. The variable should reflect economic intuition such that as an industry moves closer to perfect

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24 Aspects of non-price competition include product development, brand differentiation, advertising, and promotional expenditures.
competition, marginal revenue (i.e. price) comes closer to equaling marginal cost. As the price-cost ratio becomes smaller, it presumably represents a higher level of product substitutability (and degree of competition). One limitation of this variable is the inability to compare two firms in which one subcontracts out its manufacturing (e.g., Nike) versus another does its own. A more accurate measure would be to construct the variable as (revenue / cost of goods sold) for each firm in a given business or industry segment.

**Measures of Control Variables**

This paper includes multiple control variables in the regressions which, prior research indicates, affect incentives. To measure firm performance this paper uses the one-year total stock return for a given year and the prior year. Both measures are consistent with previous literature (i.e. Gibbons and Murphy, 1989; Core et al., 1999; and Cyert et al., 2002). A problem with using only a single one-year stock return is that there could be too much variance in too short a time period to capture normalized firm performance.

To control for institutional ownership and regulation, this paper uses the percentage of stock which the top 250 institutional shareholders own. Stiglitz (1985) argues that concentrated ownership is one of the most important ways shareholders can monitor a CEO’s behavior. Jensen’s (1986) free cash flow theory suggests that an increased amount of debt limits CEO behavior; thus this paper constructs a (long-term debt) / assets ratio to measure the firm’s free cash flow. To capture the level of regulation within a firm this paper uses the percentage of the board comprised of outside
directors. Presumably outside directors are more independent of the CEO and thus may better monitor the CEO.

Prior research (Jensen and Murphy, 1990; Baker and Hall, 2004) shows that firm size affects CEO compensation. This paper uses the natural log of total revenue to measure size. CEO’s of larger firms often have more complex jobs, thus this paper includes the natural log of the number of full time employees to proxy for job complexity. A CEO’s age and experience influence the CEO’s stock of human capital, and ultimately his compensation. This paper uses the natural log of the number of years as CEO at that firm to help capture the portion of human capital and tenure as well as serve as a proxy for industry, or firm specific knowledge.

4.3 Summary Statistics

CapitalIQ, a division of Standard and Poor’s, compiles data on various measures of compensation for CEO’s at over 47,000 publicly traded companies, including detailed data on components of long-term compensation. Table 10 presents details on the variable measures for the initial sample of 216 firms in 2005. Table 11 presents the descriptive statistics for the firms included in the first difference regressions from 2004 vs. 2005.

The average annual cash compensation (defined as salary + bonus) in 2005 is $2,583,189 (average salary is $940,685 and average bonus is $1,655,744). In 2004 it was $2,566,260 (average salary was $910,029 and average bonus was $1,631,186). The long-term compensation includes the value of restricted stock and options grants, payouts from long-term incentive plans, and all other compensation. The average total annual compensation (short and long-term compensation) in 2005 is $5,528,518. In 2004 it was
$5,005,665. Both measures of compensation increase year-over-year, and have non-normal distributions (skewed to the right). This is not unreasonable.

This paper uses the 2002 Census of Manufactures (US Census-Commerce Department) data for the Herfindahl Index (HHI). The Herfindahl Index (HHI) at the four-digit NAICS code level is the sum of squared market shares for the largest 50 firms in that industry. The U.S Department of Justice considers industries with a value of less than 1,000 to be competitive, 1,000-1,800 to be concentrated, and values over 1,800 to be highly concentrated. In the initial sample the average HHI based on the 4-digit industry code in 2002 is 525.75 and was 393.90 in 1997 which shows that markets are “competitive” but for these two time periods but suggests markets became more concentrated.

*Morningstar Financial* provides the measure of performance, which represent the one of the independent variables. Within the initial sample for 2005, the average one-year total stock return is 12.7%. For the firms used in the first difference sample, the average stock return in 2005 is 13.71% versus 25.06% in 2004. This shows that the average stock’s rate of return for the sample firms fell by half during 2005 – but is still positive. Other independent variables include market capitalization, the number of full time employees, total revenue, and the ratio of long-term debt to total assets. Within the initial sample for 2005, the average firm has a $21.2 billion market capitalization, 31,503 full time employees, $13 billion in annual revenue, and a 15% long-term debt to total assets ratio. Within the firms used in the first difference sample, the average market capitalization in 2004 was $19.4 billion, but $19.3 billion in 2005. Average revenue was $11.3 billion in 2004, but $12.9 billion in 2005.
5. Results

Table 2 (see page 29) shows the OLS regression results with the natural log of total annual compensation as the dependent variable while Table 3 (see page 33) uses only the cash component as the dependent variable. The results in Tables 2 and 3 are based on the simplified equation, which excludes prior performance and the governance variables. The coefficients in Column I, which are only the control variables, are generally as predicted and in accordance with prior literature. For example the coefficient on the natural log (total revenue) is approximately .4, which indicates that when total revenue increases by 10% the average shareholders/board increase total CEO compensation by 4%. Column II adds the industry concentration and concentration squared variables, and column III adds the product substitutability and substitutability squared variable. Tables 5 and 6 (see appendix) include both prior performance and the governance variables as additional controls.

5.1 Total Compensation

The coefficient on the industry concentration variable (HHI) shows that a 100-unit change in the Herfindahl index (decrease in the degree of competition) leads to a 5% decrease in total compensation. This coefficient has a small negative statistically significant coefficient at 5%, and is supportive of the oligopoly theory, i.e. CEOs which

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25 The F-stat of .1747 (between columns I and II in table 5) and .927 (between columns I and II in table 6) are both less than the critical F-statistic. This indicates that governance variables do not help explain determinants of compensation but rather mask the explanatory power of the other included variables. Additionally prior empirical papers find mixed results for the governance variables as determinants of compensation. For these reasons the governance variables are excluded from Tables 2 and 3.

26 For total and annual compensation, the only control variables that contradict prior literature are chair and institutional ownership.
face a greater degree of competition receive higher total pay. The positive sign on the coefficient for the concentration squared variable (HHI^2) indicates that the degree of competition’s effect on CEO compensation, while small and statistically rather weak, is a parabolic one. As the HHI variable increases, it eventually causes the initial regression relationship to switch from a negative to a positive one. A graph shows this relationship on page 30.

Since the minimum predicted total compensation occurs when the Herfindahl index (HHI) is 1,225, which is considered a “concentrated industry” this then suggests that shareholders may be better able to monitor CEO actions in oligopolistic markets. In such a market, CEO’s are able to engage in strategic decisions and co-operate more easily. As shareholders reduce the CEO’s asymmetric information advantage, the shareholders are theoretically able to offer weaker incentives. The parabolic relationship supports this theory and shows that total compensation falls as the Herfindahl decreases (degree of competition increases) up until 1,225 at which total compensation rises as the Herfindahl decreases (degree of competition increases) from 1,225 – 0. However, only 4 of the 216 firms have HHI values greater than 1,225. While the coefficient on industry concentration indicates shareholders offer more compensation when the degree of competition increases, this estimate is statistically insignificant.

---

27 When the product substitutability variable is added, the concentration variables (HHI, HHI^2) become statistically insignificant.

28 The firms in the sample with HHI values > 1,225 drive the negative coefficient on concentration. Without these four firms the relationship between concentration and compensation is negligible. See column IV in Table 2, the coefficient on industry concentration becomes statistically insignificant when these 4 firms with HHI values > 1,225 are excluded. Note as well that the price-cost ratio (pricecost) becomes significant at 10% while previously it was insignificant.
Price-cost ratio (pricecost), the proxy for product substitutability, has a negative statistically insignificant coefficient and supports the oligopoly theory. The negative coefficient suggests that as price cost ratio increases, product substitutability (competition) decreases, and CEOs earn less. As with industry concentration the sign on the competition variable switches from negative to positive on the squared term (pricecost$^2$), which again implies a parabolic function. Note that since the competition variables are insignificant at the 5% level, it is not possible to say definitely that increased competition allows the board and shareholders to offer weaker or stronger managerial incentives.

Among the remaining independent variables, for every one percentage point increase in the firm’s 1-yr total stock return (TSR) the CEO’s total compensation increases by approximately 0.6%. For every 10% increase (or $1,000,000 increase) in total revenue the average CEO’s total compensation increases roughly 4% (or $173). These two independent variables have the greatest positive t-values, are statistically significant at 1%, and are in accordance with prior empirical findings. The positive relationship between firm performance and compensation shows an alignment between the shareholders’ and CEO’s interests.

The other independent variable which is a significant determinant of compensation is age. The positive coefficient indicates that for every year increase in the CEO’s age, the average total compensation increases by 1.8 - 2.1%, the variable is significant at 5%. Only the coefficient on the number of employees is significant at 10%; the remaining coefficients are all statistically insignificant.
| Table 2  
Regression Results  
Primary OLS Regressions (excluding governance variables) |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>(dependent variable)</td>
<td>Column I (Log (Totalpay))</td>
<td>Column II (Log (Totalpay))</td>
<td>Column III (Log (Totalpay))</td>
</tr>
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<td>TSR</td>
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<td>0.006</td>
<td>0.006</td>
</tr>
<tr>
<td></td>
<td>(3.78)***</td>
<td>(3.70)***</td>
<td>(3.56)***</td>
</tr>
<tr>
<td>Log (Total Revenue)</td>
<td>0.415</td>
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<td></td>
<td>(6.35)***</td>
<td>(6.67)***</td>
<td>(4.77)***</td>
</tr>
<tr>
<td>Log (Employees)</td>
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<td>(1.61)</td>
<td>(1.27)</td>
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<td>0.017</td>
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<tr>
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<td>(2.40)**</td>
<td>(2.18)**</td>
<td>(2.03)**</td>
</tr>
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<td>-0.0004</td>
</tr>
<tr>
<td></td>
<td>-</td>
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<td>(1.52)</td>
</tr>
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</tr>
<tr>
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<td>(2.83)***</td>
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<td>0.5058</td>
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<td># of Observations</td>
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<td>216</td>
<td>216</td>
</tr>
</tbody>
</table>

* significant at 10%; ** significant at 5%; *** significant at 1%; Robust t-statistics are in parentheses.
TSR = 1-yr return for 2005 including price changes, dividends, other cash or noncash distributions.
Log (Employees) = natural log (employees). Log (Total Revenue) = natural log (total revenue).
HHI = sum of squared market share of largest 50 firms based on 4 digit NAICS. HHI² = HHI * HHI
Pricecost = Total Value of Shipment / (Cost of Materials + Production Workers' Wages).
Pricecost² = Pricecost * Pricecost
Figure 3 (see above) shows the predicted total compensation is at a minimum when the HHI is 1,225.\textsuperscript{29} Note that the large value of restricted stock grants or stock appreciation rights the shareholders grant as part of the long-term incentive payout drive the high total compensation of the outlier observations. The three CEO’s with the greatest compensation are in the petroleum and coal refining products industry (NAICS code 3241, HHI = 544.9). For these three CEOs for the data used herein, the average value of restricted stock and stock appreciation rights (SAR) is $32,657,768.87.

\textsuperscript{29} Note that if the analysis were to graph the regression equation from columns III in Table 2, then the minimum predicted compensation occurs when the HHI value is 907.6, which is less concentrated than a HHI value of 1,225. If the analysis uses the regression equation from column IV the minimum predicted compensation occurs when HHI is 627.8. It is important to note that since industry concentration is no longer statistically significant in either of these regressions, the estimate is statistically insignificant.
5.2 Annual Cash Compensation

Similar to total compensation, the competition coefficient indicates that a 100-unit increase in industry concentration (HHI) leads to a 6-7% decrease in average annual cash compensation. The industry concentration variables (HHI, HHI$^2$) are significant at 1%. Thus, industry concentration affects annual cash compensation. These two variables support the oligopoly theory that the degree of competition initially reduces annual cash compensation, but then compensation increases. The estimated equations which use annual cash compensation as the dependent variables are more sensitive to the degree of competition. In addition, the signs of the estimated coefficients for both of the squared competition variables (HHI$^2$, pricecost$^2$) switch from negative to positive. This further supports the notion that a parabolic relationship between the degree of competition in the firm’s industry and the CEO’s annual cash compensation.

To further examine the effect of the degree of competition has on annual cash compensation, consider the graph based on the regression equation in Table 3 column II (see page 34). Given that annual cash compensation is at a minimum when the HHI = 1,180, this implies shareholders may be better able to monitor CEO actions and thus offer less compensation in more oligopolistic markets. The parabolic relationship shows that as industry concentration increases from 0 – 1,180 the annual cash compensation falls, but that when the HHI goes beyond 1,180 a CEO’s salary + bonus rise. Consistent with the prior results, based on total CEO compensation, only 4 of the 216 firms in the cash compensation equation have HHI values greater than 1,180. This suggests that only a large increase in the degree of competition is necessary for shareholders to offer greater

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30 Note that the industry concentration and squared concentration variables are significant at 1% while the price-cost ratio variable (pricecost – the proxy for product substitutability) is statistically insignificant.
cash compensation. While the coefficient on industry concentration indicates shareholders offer more compensation when the degree of competition increases, this estimate is statistically insignificant.\(^{31}\)

Among the remaining control or independent variables there are some interesting results: for every one percentage point increase in a firm’s 1-yr total stock return (TSR) the average CEO’s annual cash compensation increases by approximately 0.4%. Additionally, for every 10% increase (or $1,000,000 increase) in total revenue, the average CEO’s annual cash compensation increases roughly 2.6% (or his salary + bonus increase by roughly $51). These two independent variables have the greatest positive t-values and are statistically significant at 1%. The elasticities with respect to total stock return and revenue suggest that annual cash compensation is less sensitive than total compensation to an increase in annual revenue and total stock return. While the coefficients are small, they are in accordance with prior empirical findings.

The other independent variables, which are significant determinants of compensation, are age and the number of employees. The positive coefficient indicates that for every 10% increase in the number of employees, CEO cash compensation increases by approximately 1.2% and that salary and bonus increase roughly 1% for each additional year of age.\(^{32}\) This shows that current performance and the number of employees have a positive effect on a CEO’s salary and bonus.

\(^{31}\) The firms in the sample with HHI values > 1,180 drive the negative coefficient on concentration. Without these four firms the relationship between concentration and compensation is negligible. See column IV in Table 3, the coefficient on industry concentration becomes statistically insignificant when these 4 firms with HHI values > 1,180 are excluded.

\(^{32}\) The significance level on age falls from 5 to 10% when the other competition variables are included.
### Table 3
Regression Results
Primary OLS Regressions (excluding governance variables)

<table>
<thead>
<tr>
<th>(dependent variable)</th>
<th>Column I</th>
<th>Column II</th>
<th>Column III</th>
<th>Column IV</th>
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<td>0.004</td>
<td>0.004</td>
<td>0.004</td>
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<tr>
<td></td>
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<td>(3.20)**</td>
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</tr>
<tr>
<td>Log (Total Revenue)</td>
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<td>0.278</td>
<td>0.254</td>
<td>0.251</td>
</tr>
<tr>
<td></td>
<td>(4.62)**</td>
<td>(5.22)**</td>
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<td>(3.74)**</td>
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<tr>
<td>Log (Employees)</td>
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<td>0.104</td>
<td>0.127</td>
<td>0.129</td>
</tr>
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<td>(2.33)**</td>
<td>(1.87)*</td>
<td>(2.16)**</td>
<td>(2.15)**</td>
</tr>
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<td>age</td>
<td>0.015</td>
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<td>(2.31)**</td>
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<td>-0.0007</td>
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<td></td>
<td>(6.76)**</td>
<td>(6.87)**</td>
<td>(4.67)**</td>
<td>(4.57)**</td>
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</table>

R-squared 0.4453 0.4674 0.4768 0.4754
# of Observations 216 216 216 212

* significant at 10%; ** significant at 5%; *** significant at 1%. Robust t-statistics are in parentheses.
TSR = 1-yr return for 2005 including price changes, dividends, other cash or noncash distributions.
Log (Employees) = natural log (employees). Log (Total Revenue) = natural log (total revenue).
HHI = sum of squared market share of largest 50 firms based on 4 digit NAICS. HHI² = HHI * HHI
Price-cost ratio = Total Value of Shipment / (Cost of Materials + Production Workers' Wages).
Price-cost ratio² = Price-cost ratio * Price-cost ratio
Figure 4 (see above) shows predicted average cash compensation is at a minimum when the HHI is 1,180.\textsuperscript{33} Note that the large annual bonus drives the high annual compensation for the outlier observations which all have annual pay > $6,167,155.\textsuperscript{34} The average annual cash compensation for these 7 CEOs is $9,327,621, with an average salary of $1,685,071 and an average bonus of $7,642,550. The data reveal that of the 28 CEOs in the data set used herein for the industry labeled Semiconductor and Other Electronic Component Manufacturing (NAICS code 3344, HHI = 907.6), 20 have

\textsuperscript{33} Note that if the analysis were to graph either the regression equation from columns III in table 3 the minimum predicted compensation occurs when the HHI value is approximately 1073 rather than a HHI value of 1,180. If the analysis uses the regression equation from column IV the predicted minimum compensation occurs when HHI is 1252. It is important to note that since industry concentration is no longer statistically significant in column IV, then the estimate is statistically insignificant.

\textsuperscript{34} This analysis defines an outlier as any observation which is more than two standard deviations away from the mean. There are 7 CEOs which have annual cash compensation > $6,167,155, the annual cash compensation which is two standard deviations above the mean.
annual cash compensation below the predicted value and 23 have annual cash compensation below the sample average.

5.3 First Difference: Total and Annual Cash Compensation

Table 4 shows the results for the first difference regressions that use the change in total compensation and change in annual cash compensation from 2004 to 2005 as dependent variables. Columns I and III show the results with the change in the control variables and the level of industry concentration variables from the 2002 Census.\footnote{Note that the control variables excluded are those which have been differenced out (age, CEOyrs) and the governance variables excluded from the initial OLS regressions with the exception of “debt/assets”.
} The coefficients on the control variables for total and annual cash compensation are as predicted and in accordance with prior literature.\footnote{For total compensation, the control variables: total revenue and employees are significant at 1 and 5\% respectively. All of the control variables are insignificant for annual cash compensation.} The coefficient on the debt/asset variable is positive for total CEO compensation, which is counter to theory and unexpected; however it is not statistically significant. Columns II and IV add the product substitutability and the substitutability squared variable from the 2002 Census. The coefficient on the change in performance variable are positive which matches theory, however the coefficients are all statistically insignificant which is unexpected.

For both total cash compensation and annual cash the coefficients for the Herfindahl Index (HHI) are all statistically insignificant. The negative coefficient on the industry concentration variable and the positive coefficient on the concentration squared term (HHI from the 2002 Census), while insignificant are consistent the equations in Tables 2 and 3. Note that if the level of industry concentration from the 1997 industry concentration is used instead of the level from the 2002 Census, the coefficients are still
negative and insignificant. The negative coefficient on the industry concentration supports the oligopoly theory that as the degree of competition increases, shareholders pay CEOs more. Note that since the competition variables are insignificant at the 5% level, it is not possible to say definitely that increased competition allows the board and shareholders to offer weaker or stronger managerial incentives.
### Table 4
Regression Results

<table>
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<tr>
<th>variable</th>
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<th>Column III</th>
<th>Column IV</th>
</tr>
</thead>
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<tr>
<td></td>
<td>$\Delta$ Totalpay</td>
<td>$\Delta$ Totalpay</td>
<td>$\Delta$ Cashpay</td>
<td>$\Delta$ Cashpay</td>
</tr>
<tr>
<td>$\Delta$ Performance</td>
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<td>6,121.92</td>
<td>1,969.19</td>
<td>1,975.23</td>
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<td></td>
<td>(1.14)</td>
<td>(1.48)</td>
<td>(1.66)</td>
<td>(1.54)</td>
</tr>
<tr>
<td>$\Delta$ Total Revenue</td>
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<td>0.0002</td>
<td>0.00002</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>(2.89)**</td>
<td>(2.53)*</td>
<td>(2.08)*</td>
<td>(1.08)</td>
</tr>
<tr>
<td>$\Delta$ Employees</td>
<td>238.69</td>
<td>253.6424</td>
<td>34.967</td>
<td>39.14</td>
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<tr>
<td></td>
<td>(2.28)*</td>
<td>(2.46)*</td>
<td>(2.41)*</td>
<td>(2.66)**</td>
</tr>
<tr>
<td>$\Delta$ Debt / Assets</td>
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<td>30,470.34</td>
<td>-3,460.17</td>
<td>-5,025.30</td>
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<tr>
<td></td>
<td>(1.57)</td>
<td>(1.53)</td>
<td>(0.77)</td>
<td>(1.10)</td>
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<td>$HHI^2$</td>
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<tr>
<td></td>
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<td>(0.54)</td>
<td>(0.69)</td>
<td>(0.24)</td>
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<td>(1.84)</td>
<td>(0.58)</td>
<td>(1.43)</td>
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</table>

<table>
<thead>
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<th>Adjusted R-squared</th>
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<th>Column III</th>
<th>Column IV</th>
</tr>
</thead>
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<td>186</td>
<td>186</td>
<td>186</td>
</tr>
</tbody>
</table>

186 Observations are firms from initial sample with same CEO for least 2 years in 2005

** significant at 1%; * significant at 5 robust t-statistics in parentheses

$\Delta$ Performance = 1-yr TSR$_{2005}$ - 1-yr TSR$_{2004}$,
$\Delta$ Total Revenue = Total Revenue$_{2005}$ - Total Revenue$_{2004}$,
$\Delta$ Employees = Employees$_{2005}$ - Employees$_{2004}$,
$\Delta$ Debt / Assets = Debt / Assets$_{2005}$ - Debt / Assets$_{2004}$,
HHI = sum of squared market share of largest 50 firms (4 digit NAICS in 2002), $HHI^2 = HHI \times HHI$
Pricecost = Total Value of Shipment / (Cost of Materials + Production Workers’ Wages),
Pricecost$^2 = $Pricecost $\times$ Pricecost
6. Robustness Check

Given that the initial sample only considers surviving firms, it is important to examine whether the degree of competition has a different effect on firms which exited the market. The analysis uses the estimation equations from Columns II and III in Tables 2 and 3 (these equations exclude the governance variables). Before discussing the results (see Table 7 in appendix), it is important to realize that if the dummy and interaction variable are statistically significant, then the degree of competition will affect surviving and “dead” firms differently. This suggests that there is a potential survivor bias in the initial analysis, and that the sample does not accurately capture how competition affects executive compensation.

In each of the regressions, however, the estimated coefficients for the dummy variables for surviving firms, as well as the interaction term, are statistically insignificant.\(^{37}\) This suggests that the degree of competition has a similar effect on CEO compensation for firms which are still public as it did for those which have been acquired or gone bankrupt. What this regression cannot explain, however, is why these firms exited the market. For instance: were the agency costs so extreme that they drove the firms out of the market or did the firms exit via a strategic acquisition?

The industry concentration (HHI) and price-cost ratio (pricecost – the proxy for product substitutability) variables have the same negative coefficients as regressions II and III (from initial regression Tables 2 and 3). Consistent with the results shown in Tables 2 and 3, the estimated effect of an increase in industry concentration (decrease in

\(^{37}\) Note that the interaction term is significant at the 10% level for total compensation but not for annual cash compensation. This suggests that industry concentration has a slightly different effect on compensation for firms that exited the market. Given that the coefficient is significant only at 10%, this paper is not overly concerned with a potential survivor bias.
The degree of competition is insignificant with respect to total CEO compensation, but is significant at 5% with respect to annual cash compensation. The coefficient on the price-cost ratio variable becomes significant at 5% for total compensation, while previously it generally has been statistically insignificant. For both measures of CEO compensation, annual revenue and total stock return have a positive statistically significant effect at the 1% level.

With respect to annual cash compensation, the coefficient on the employee variable becomes statistically significant at 1% level. The robustness check supports the initial findings that the board and shareholders offer stronger incentives when the degree of competition increases (when either industry concentration or price-cost ratio decreases). The check also supports the initial findings that there is an inflection point; the degree of competition and compensation have a parabolic relationship.

7. Conclusion and Future Considerations

The objective of this research was to investigate the relationship between the degree of competition a firm faces in its product market industry and the amount of its CEO compensation. Two, competing hypotheses concerning this relationship between competition and compensation exist in the literature. Under principal-agent theory as industry concentration decreases (the degree of competition increases) shareholders should be able to pay the CEO less. The oligopoly theory suggests, however, that as industry concentration decreases (degree of competition increases) CEOs receive less pay, until a point at which the CEOs receive more compensation as the degree of competition increases.
This paper’s empirical results from the initial OLS regressions, while weak, generally support the oligopoly theory that competition and compensation have a parabolic relationship. Holding everything else constant (e.g., firm size, CEO age), in general the lowest compensation is among firms with a Herfindahl index that lies at the margin between a competitive and oligopolistic industry. These results support the theory that the board awards the CEOs greater pay when the degree of competition increases in already “competitive” product markets. Similarly, as the degree of competition falls and firms exit those industries which are termed to be more oligopolistic and monopolistic, CEO compensation again rises. These results are tenuous however, and are driven predominantly by the four firms, which exist, in the more concentrated industries (face a lesser degree of competition). This suggests that a large increase in competition is necessary for the board and shareholders to offer the CEO less pay.

It is important to note a number of cautions and shortfalls about the data and approach taken herein, and/or to offer suggestions for future research. The primary data set uses 2004 and 2005 financial results and CEO compensation figures for 216 of the largest 500 firms in the US. Since the Census only calculates an industry concentration measure for the manufacturing industry (SIC code 20-39) all of these firms are in the manufacturing industry. In order to merge the most recent Herfindahl Index values from 2002 (which are used as a proxy for the degree of competition) with the 2005 fiscal year financial date, it was necessary to drop a number of observations. A statistical test for survivor bias shows the parabolic results found in the initial analysis are not affected. The implicit assumption is that the sample of firms used is representative of the general
population of firms. However, if they are not, then the results reported herein could be suspect.

The Herfindahl Index is one of the two measures for the degree of competition this study uses. While used in prior literature, one limitation of the Herfindahl Index is that it “shoe-horns” all firms into a specific industry, as discussed earlier in the example of 3M. One way to supplement the Herfindahl's shortcoming is to look at a firm’s gross profit capacity as an additional measure of the degree of competition. This variable attempts to proxy whether a firm, with a high ratio of revenues to cost of goods sold, faces relatively less competition in the form of product substitutability than a firm with a low ratio. Unfortunately, the available data for this study did not include full income-statement variables necessary to readily calculate this ratio.

This study uses the same variable construction as Karuna (2007), who constructs a gross profit variable from the 2002 census. This “price-cost” variable is “Total value of shipments / (cost of materials + production workers wage) at a given 4-digit NAICS code level. A limitation of this approach would occur when comparing two otherwise comparable-industry firms when one subcontracts out its manufacturing (e.g. Nike) and the other does not. As presented in Tables 2-4 the coefficients on the price-cost variable were consistently small and not statistically different from zero.\textsuperscript{38} Indeed, the coefficients estimated on this second variable are consistently small and not statistically significantly different from zero. Adding them to the equation yields no contribution to the equation's explanatory power (adjusted r-squared).

\textsuperscript{38} Karuna however finds this variable to be statistically significant.
It is important to summarize and point out that the dominant variable affecting CEO compensation is firm size. In general the results show that a 10% increase in a firm's revenue (everything else being held constant) results in roughly a 4% increase in the CEO's compensation. Nearly 50% of the variance in CEO pay can be accounted for by the size variables (a firm’s total revenue and number of full time employees). There is strong support for human capital as an important determinant of CEO compensation as there is a positive statistically significant relationship between CEO age and CEO compensation. This study also employs a number of other control variables suggested from the literature. Interestingly, while some of them receive substantial news coverage (e.g., % of the board that is outsiders), the estimated effects are overshadowed by the effect of firm size. Unfortunately, the same is true of competition variables examined in this research: their estimated effects pale relative to the effect of firm size.

For future research it would be interesting to examine whether the market and shareholders place a premium on how shareholders compensate CEOs. If a firm grants $5 million in total compensation - of which $3 million is defined as other compensation, does the market place an “embarrassment premium” on the value of the company? That is, does that firm have a lower price / earnings (P/E) ratio or other valuation metric such that the CEO is not able to maximize shareholder value. If so, this may provide an explanation for the documented trend in incentives structures over time. It would also be interesting to examine whether parabolic relationship between the degree of competition and level of compensation hold in other industries, outside of the manufacturing industry.
### Appendix 1

#### Table 5
Regression Results

<table>
<thead>
<tr>
<th>(dependent variable)</th>
<th>Column I</th>
<th>Column II</th>
<th>Column III</th>
<th>Column IV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Log (Totalpay)</td>
<td>Log (Totalpay)</td>
<td>Log (Totalpay)</td>
<td>Log (Totalpay)</td>
</tr>
<tr>
<td>TSR</td>
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<td>0.006</td>
<td>0.006</td>
<td>0.0057351</td>
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<tr>
<td></td>
<td>(3.71)**</td>
<td>(3.78)**</td>
<td>(3.48)**</td>
<td>(3.33)**</td>
</tr>
<tr>
<td>Prior TSR</td>
<td>0.00</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Log (Total Revenue)</td>
<td>0.411</td>
<td>0.415</td>
<td>0.438</td>
<td>0.375</td>
</tr>
<tr>
<td></td>
<td>(5.52)**</td>
<td>(6.35)**</td>
<td>(6.31)**</td>
<td>(4.24)**</td>
</tr>
<tr>
<td>Log (Employees)</td>
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<td>0.111</td>
<td>0.098</td>
<td>0.141</td>
</tr>
<tr>
<td></td>
<td>(1.49)</td>
<td>(1.61)</td>
<td>(1.36)</td>
<td>(1.81)*</td>
</tr>
<tr>
<td>Debt / Assets</td>
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<td>-</td>
<td>-0.001</td>
<td>-0.003</td>
</tr>
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<td>(0.20)</td>
<td>-</td>
<td>(0.36)</td>
<td>(0.66)</td>
</tr>
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<td>-0.001</td>
<td>-0.001</td>
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<td>(0.21)</td>
<td>-</td>
<td>(0.28)</td>
<td>(0.21)</td>
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<tr>
<td>Chair</td>
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<td>-</td>
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<td>-0.007</td>
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<tr>
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<td>(0.03)</td>
<td>-</td>
<td>(0.02)</td>
<td>(0.02)</td>
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<td>0.001</td>
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<td>0.015</td>
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<td>(2.03)**</td>
<td>(2.40)**</td>
<td>(1.82)*</td>
<td>(1.76)*</td>
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<td>Log (CEOyrs)</td>
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<td>-</td>
<td>0.043</td>
<td>0.039</td>
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<td>(0.71)</td>
<td>-</td>
<td>(0.71)</td>
<td>(0.65)</td>
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<td>HHI</td>
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<td>-0.0004</td>
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<td>-</td>
<td>-</td>
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<td>-</td>
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<td></td>
<td>(2.81)**</td>
<td>(3.00)**</td>
<td>(2.87)**</td>
<td>(2.72)**</td>
</tr>
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</table>

| Adjusted R-squared  | 0.4887 | 0.5011 | 0.4962 | 0.4964 |
| # of Observations   | 216 | 216 | 216 | 216 |

Notes: * significant at 10%; ** significant at 5%. *** significant at 1%. robust t-statistics in parentheses.

TSR = 1-yr return for 2005 including price changes, dividends, and other cash or non-cash distributions.

Prior TSR = 1-yr return for 2004 including price changes dividends, and other cash or non-cash distributions.

Log (Employees) = natural log (employees). Log (Total Revenue) = natural log (total revenue).

Debt / Assets = Long-term debt / Total Assets

Outside = 100 * (number of outside board members / total board members)

Chair = 0 or 1 dummy (1 if CEO is chairman). Institutions = % common stock top owned by 250 institutional shareholders

Age = CEO age in 2005. Log (CEOyrs) = natural log (years as CEO of that firm)

HHI = sum of squared market share of largest 50 firms based on 4 digit NAICS. HHI^2 = HHI * HHI

Pricecost = Total Value of Shipment / (Cost of Materials + Production Workers' Wages).

Pricecost^2 = Pricecost * Pricecost
## Table 6
Regression OLS Results

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<tr>
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<th>Column III</th>
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<td>Log (Total Revenue)</td>
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<tr>
<td>(3.63)***</td>
<td>(4.62)***</td>
<td>(4.89)***</td>
<td>(3.64)***</td>
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<td>Log (Employees)</td>
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<td>(2.33)**</td>
<td>(1.82)*</td>
<td>(1.94)*</td>
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<td>Debt / Assets</td>
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<td>0.002</td>
<td>0.002</td>
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<td>(0.57)</td>
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<td>0.002</td>
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<td>Log (CEOyrs)</td>
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<td>-0.0007</td>
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<tr>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>(1.09)</td>
</tr>
<tr>
<td>Pricecost^2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.178</td>
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<tr>
<td></td>
<td>-</td>
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<td>(1.38)</td>
</tr>
<tr>
<td>Constant</td>
<td>7.272</td>
<td>6.883</td>
<td>7.059</td>
<td>7.774</td>
</tr>
<tr>
<td>(6.90)***</td>
<td>(6.76)***</td>
<td>(7.00)***</td>
<td>(4.27)***</td>
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<tr>
<td>R-squared</td>
<td>0.4488</td>
<td>0.4453</td>
<td>0.4684</td>
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<tr>
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<td>216</td>
<td>216</td>
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</table>

**Notes:** *significant at 10%; **significant at 5%; ***significant at 1%*, robust t-statistics in parentheses

- TSR = 1-yr return for 2005 including price changes, dividends, and other cash or non-cash distributions
- Prior TSR = 1-yr return for 2004 including price changes dividends, and other cash or non-cash distributions
- Log (Employees) = natural log (employees). Log (Total Revenue) = natural log (total revenue).
- Debt / Assets = Long-term debt / Total Assets
- Outside = 100 * (number of outside board members / total board members)
- Chair = 0 or 1 dummy (1 if CEO is chairman).
- Institutions = % common stock top owned by 250 institutional shareholders
- Age = CEO age in 2005. Log (CEOyrs) = natural log (years as CEO of that firm)
- HHI = sum of squared market share of largest 50 firms based on 4 digit NAICS. HHI^2 = HHI * HHI
- Pricecost = Total Value of Shipment / (Cost of Materials + Production + Workers' Wages).
- Pricecost^2 = Pricecost * Pricecost
<table>
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<tr>
<th>(dependent variable)</th>
<th>Column I</th>
<th>Column II</th>
<th>Column III</th>
<th>Column IV</th>
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<tr>
<td>Log (Totalpay)</td>
<td>0.006</td>
<td>(3.52)***</td>
<td>0.005</td>
<td>(4.02)***</td>
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<tr>
<td>Log (Total Revenue)</td>
<td>0.399</td>
<td>(5.96)***</td>
<td>0.345</td>
<td>(4.81)***</td>
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<tr>
<td>Log (Employees)</td>
<td>0.017</td>
<td>(1.57)</td>
<td>0.145</td>
<td>(2.02)**</td>
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<tr>
<td>Age</td>
<td>0.012</td>
<td>(1.58)</td>
<td>0.011</td>
<td>(1.44)</td>
</tr>
<tr>
<td>HHI</td>
<td>-0.0002</td>
<td>(1.21)</td>
<td>-0.0002</td>
<td>(2.12)**</td>
</tr>
<tr>
<td>HHI^2</td>
<td>1.43E-08</td>
<td>(1.08)</td>
<td>1.31E-08</td>
<td>(2.03)**</td>
</tr>
<tr>
<td>Pricecost</td>
<td>-</td>
<td>-1.259</td>
<td>-</td>
<td>-0.909</td>
</tr>
<tr>
<td>Pricecost^2</td>
<td>-</td>
<td>0.286</td>
<td>-</td>
<td>0.221</td>
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<tr>
<td>Survivor</td>
<td>0.213</td>
<td>(0.84)</td>
<td>0.214</td>
<td>(0.86)</td>
</tr>
<tr>
<td>Bias</td>
<td>-0.0003</td>
<td>(1.42)</td>
<td>-0.0002</td>
<td>(1.73)*</td>
</tr>
<tr>
<td>Constant</td>
<td>4.491</td>
<td>(3.68)***</td>
<td>6.691</td>
<td>(3.67)***</td>
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<td>R-squared</td>
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Notes: 258 Observations are the largest companies in 1996, 2006, and 2009. * significant at 10%, ** significant at 5%, *** significant at 1%, robust t-statistics in parentheses. TSR = 1-yr return for 2005 including price changes, dividends, other cash or noncash distributions. Log (Employees) = natural log (employees). Log (Total Revenue) = natural log (total revenue). HHI = sum of squared market share of largest 50 firms based on 4 digit NAICS. HHI^2 = HHI * HHI Pricecost = Total Value of Shipment / (Cost of Materials + Production Workers' Wages). Pricecost^2 = Pricecost * Price-cost. Bias = HHI * Survivor. Survivor is (0 or 1 dummy, 1 if company is not public in 2009).
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<td>Market Capitalization</td>
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<td>Board Size</td>
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<td>Outside Directors</td>
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<td>(Inside Directors)</td>
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<tr>
<td>CEO Chair Dummy</td>
<td></td>
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<td>X</td>
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<td>CEO Age</td>
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<td>1 Year Stock Return</td>
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<td></td>
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<td>Prior Year Stock Return</td>
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<td>Actual Measure</td>
<td>Method of Calculation</td>
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<tr>
<td>CEO Incentives</td>
<td>Annual Cash Pay</td>
<td>Annual Cash Pay: sum (salary + bonus)</td>
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<tr>
<td>Log (Cashpay)</td>
<td></td>
<td>• natural log (salary + bonus)</td>
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<tr>
<td>Log (Totalpay)</td>
<td>Total Pay</td>
<td>Total Pay: Sum (salary, bonus, stock awards, option awards, non-equity incentive plan pay, change in pension value, deferred pay, other pay)</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>• natural log of (total pay)</td>
<td></td>
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<tr>
<td>Change in CEO Incentives</td>
<td>Change in Annual Cash Pay</td>
<td>• Annual Cash\textsubscript{2005} - Annual Cash\textsubscript{2004}</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>(\Delta \text{cash})</td>
<td></td>
<td>• Total Pay\textsubscript{2005} - Total Pay\textsubscript{2004}</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>(\Delta \text{total})</td>
<td>Change in Total Pay</td>
<td></td>
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<tr>
<td>CEO “expertise”</td>
<td>CEO\text{yrs}</td>
<td>• Number of years as CEO of that firm</td>
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<tr>
<td>Log (CEO\text{yrs}), (Age)</td>
<td>Age</td>
<td>• natural log (ceoyrs)</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>• Age of CEO</td>
<td></td>
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<tr>
<td>Industry Concentration (HHI), (HHI^2)</td>
<td>Herfindahl Hirschman Index (HHI)</td>
<td>The sum of market share squared of 50 largest firms</td>
<td></td>
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<td></td>
<td>(4 digit NAICS)</td>
<td>• Both linear and squared value used</td>
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<td>(Value Added Calculation)</td>
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<td>Change in Industry Concentration (\Delta HHI), (\Delta HHI^2)</td>
<td>Change in HHI (4 digit NAICS)</td>
<td>• HHI\textsubscript{2002} - HHI\textsubscript{1997}</td>
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<td></td>
<td>(4 digit NAICS)</td>
<td>• HHI^2\textsubscript{2002} - HHI^2\textsubscript{1997}</td>
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<td></td>
<td>(Value Added Calculation)</td>
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<tr>
<td>Product Substitutability (pricecost), (pricecost^2)</td>
<td>Price - Cost Ratio (4 digit NAICS)</td>
<td>Total Value of Shipment / (Cost of Materials + Production Workers' Wages)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>• use linear and squared values</td>
<td></td>
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<tr>
<td>Change in Product Substitutability (\Delta Pricecost), (\Delta pricecost^2)</td>
<td>Change in Price - Cost Margin (4 digit NAICS)</td>
<td>• pricecost - pricecost\textsubscript{1997}</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>• pricecost^2\textsubscript{2002} - pricecost^2\textsubscript{1997}</td>
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</tr>
<tr>
<td>Still Public Company (Survivor)</td>
<td>Publicly traded company in 2009</td>
<td>• 0 or 1 dummy variable - 1 if not public in 2009</td>
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<tr>
<td>Bias (Bias)</td>
<td>Interaction of Survivor dummy &amp; Industry Concentration (HHI)</td>
<td>Interaction of survivor dummy and (HHI)</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>• survivor * industry concentration</td>
<td></td>
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</tbody>
</table>

Notes:
Morning Star Financial provides the Total Stock Return variables for 2004 and 2005.
CapitalIQ provides CEO pay, institutional ownership, revenue, employees, debt/asset, CEO years and age variables for 2004-05. The 1997-2002 Economic Census provide the competition variables (Industry Concentration and Product Substitututability)
<table>
<thead>
<tr>
<th>Variable Definition (name)</th>
<th>Actual Measure</th>
<th>Method of Calculation</th>
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<tbody>
<tr>
<td><strong>Performance</strong> (TSR)</td>
<td>Total Stock Return (TSR)</td>
<td>TSR: 1 yr return including price changes, dividends, other cash or noncash distributions</td>
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<tr>
<td><strong>Change in Performance</strong></td>
<td>Change in TSR</td>
<td>• TSR_{2005} - TSR_{2004}</td>
</tr>
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<td>Δ Perform</td>
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<tr>
<td><strong>External Regulation</strong></td>
<td>Institutional ownership</td>
<td>• % of common shares outstanding held by top 250 institutional investors or maximum # of investors if &lt; then 250</td>
</tr>
<tr>
<td>(Institutions)</td>
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</tr>
<tr>
<td><strong>CEO as Board Chairman</strong></td>
<td>CEO as board chairman</td>
<td>• 0 or 1 dummy variable - 1 if CEO is board chairman</td>
</tr>
<tr>
<td>(Chair)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Board Structure</strong></td>
<td>% of outside directors</td>
<td>• 100 * (outside directors) / board size outside directors are defined as directors who have never been employed by the firm</td>
</tr>
<tr>
<td>(Outside)</td>
<td></td>
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</tr>
<tr>
<td><strong>Job Complexity</strong> Log (Employees)</td>
<td>Employees</td>
<td>• Number of full time employees per company 10-k</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• natural log (employees)</td>
</tr>
<tr>
<td><strong>Change in Job Complexity</strong></td>
<td>Change in employees</td>
<td>• Employees_{2005} - Employees_{2004}</td>
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<td>(Δ Employees)</td>
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<tr>
<td><strong>Firm size</strong> (Inrev)</td>
<td>Total Revenue</td>
<td>• Total Revenue for 2005 fiscal year</td>
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<tr>
<td></td>
<td></td>
<td>• natural log (total revenue)</td>
</tr>
<tr>
<td><strong>Change in Firm size</strong></td>
<td>Change in total revenue</td>
<td>• Total Revenue_{2005} - Total Revenue_{2004}</td>
</tr>
<tr>
<td>(Δ Total Revenue)</td>
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</tr>
<tr>
<td><strong>Free Cash Flow</strong> (Debt / Assets)</td>
<td>Long-Term Debt / Total Assets</td>
<td>• The long-term debt divided by total assets for 2005 Fiscal Year</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• long-term debt / total assets</td>
</tr>
</tbody>
</table>

**Notes:**
Morning Star Financial provides the Total Stock Return variables for 2004 and 2005.
CapitalIQ provides CEO pay, institutional ownership, revenue, employees, debt/asset, CEO years and age variables for 2004-05. The 1997-2002 Economic Census provide the competition variables (Industry Concentration and Product Substitutability)
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<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min.</th>
<th>Max.</th>
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<tbody>
<tr>
<td>Total Compensation (in 2005)</td>
<td>5528518</td>
<td>6068761</td>
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<td>48900000</td>
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<td>Annual Cash Compensation (in 2005)</td>
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<td>1791983</td>
<td>13849</td>
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<td>Total Stock Return (% return in 2005)</td>
<td>12.70</td>
<td>37.79</td>
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<td>Total Revenue (in Billions)</td>
<td>13.00</td>
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<tr>
<td>Market Capitalization</td>
<td>21.30</td>
<td>41.40</td>
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<td>Debt / Assets (Long-term Debt / Total Assets)</td>
<td>15.03</td>
<td>13.57</td>
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<td>Institutional Ownership ( % owned by top 250)</td>
<td>57.47</td>
<td>13.40</td>
<td>10.30</td>
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<tr>
<td>Outside Directors ( as % of board)</td>
<td>80.46</td>
<td>10.21</td>
<td>50.00</td>
<td>93.75</td>
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<tr>
<td>Employees ( Full-time employees)</td>
<td>31503.82</td>
<td>38862.85</td>
<td>276</td>
<td>247900</td>
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<td>CEO Years (Years as CEO at that firm)</td>
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<td>7.08</td>
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<td>Age</td>
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<td>CEO as Board Chairman</td>
<td>0.70</td>
<td>0.46</td>
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<td>Industry Concentration (HHI in 2002)</td>
<td>525.75</td>
<td>372.50</td>
<td>25.80</td>
<td>2323.50</td>
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<td>Product Substitutability (Price-cost ratio in 2002)</td>
<td>1.96</td>
<td>0.48</td>
<td>1.17</td>
<td>3.20</td>
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Notes: 216 Observations are the largest firms by market capitalization from the initial sample (in 1995 and 2008)
Total Revenue and Market Capitalization are shown in Billions of dollars. Total Stock Return and Institutional Ownership are shown in percentage
Industry Concentration and Product Substitutability variables are from the 2002 Census of Manufacturers
Total Compensation = Sum (salary, bonus, stock awards, option awards, non-equity incentive plan, change in pension value, deferred pay, other pay) in 2005
Annual Cash Compensation = Salary + Bonus. Total Stock Return = 1-yr return including price changes, dividends, and other cash or non-cash distributions
Debt / Assets = Long-term debt / total assets in 2005. Institutional Ownership = % common stock top owned by 250 institutional shareholders
Outside directors = 100 * (# of outside board members / total board members). Employees = number of full-time employees in 2005
CEO years = Number of years as CEO at that firm through 2005. Age = Age of CEO in 2005. CEO as chairman ( 0 or 1 dummy, 1 if he is)
Industry Concentration = The sum of market share squared of 50 largest firms in 2002
Product Substitutability = Total Value of Shipment / (Cost of Materials + Production Workers' Wages) in 2002
<table>
<thead>
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<td>Total Stock Return (%)</td>
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<td>47.89</td>
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<td>209.30</td>
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<tr>
<td>Total Revenue</td>
<td>9.10</td>
<td>14.10</td>
<td>0.04</td>
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<td>Market Capitalization</td>
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<tr>
<td>Debt / Assets</td>
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<td>Outside Directors (as %</td>
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<td>93.75</td>
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<td>of board)</td>
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<tr>
<td>Employees (full-time</td>
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<tr>
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<td>38</td>
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<td>2505.80</td>
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<tr>
<td>Product Substitutability</td>
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<td>0.47</td>
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Table 12

<table>
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<td>48900000</td>
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<td>1852118</td>
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<td>57.87</td>
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<td>94.62</td>
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<td>79.23</td>
<td>13.57</td>
<td>6.87</td>
<td>93.75</td>
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<tr>
<td>of board)</td>
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<td></td>
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<td>employees)</td>
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<td>CEO Years (Years at that</td>
<td>7.25</td>
<td>7.08</td>
<td>1</td>
<td>38</td>
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<tr>
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<td>Product Substitutability</td>
<td>1.97</td>
<td>0.50</td>
<td>1.17</td>
<td>3.20</td>
</tr>
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</table>

Notes: 186 Observations used are firms in which CEO had at least 2 years experience
Total Revenue and Market Capitalization are shown in Billions of dollars. Total Stock Return and Institutional Ownership are shown in percentage
Industry Concentration and Product Substitutability variables are from the 2002 Census of Manufacturers
Total Compensation = Sum (salary, bonus, stock awards, option awards, non-equity incentive plan, change in pension value, deferred pay, other pay) in 2005. Annual Cash Compensation = Salary + Bonus
Total Stock Return = 1-yr return including price changes, dividends, and other cash or non-cash distributions. Total Revenue = Total Revenue in billions of dollars.
CEO years = Number of years as CEO at that firm through 2005. Age = Age of CEO in 2005.
Industry Concentration = The sum of market share squared of 50 largest firms in 1997 and 2002.
Product Substitutability = Total Value of Shipment / (Cost of Materials + Production Workers' Wages) in 2002.
<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Compensation (in 2005)</td>
<td>4989984</td>
<td>4384820</td>
<td>13849</td>
<td>28900000</td>
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<td>Annual Cash Compensation (in 2005)</td>
<td>2463759</td>
<td>1628977</td>
<td>13849</td>
<td>14300000</td>
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<tr>
<td>Total Stock Return (% return in 2005)</td>
<td>11.27</td>
<td>37.84</td>
<td>-96.76</td>
<td>193.00</td>
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<tr>
<td>Total Revenue (in Billions)</td>
<td>10.90</td>
<td>20.20</td>
<td>0.07</td>
<td>361</td>
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<tr>
<td>Market Cap.talization</td>
<td>18.00</td>
<td>32.40</td>
<td>0.16</td>
<td></td>
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<tr>
<td>Debt / Assets (Long-term Debt / Total Assets)</td>
<td>15.70</td>
<td>13.47</td>
<td>0.00</td>
<td>63.32</td>
</tr>
<tr>
<td>Institutional Ownership ( % owned by top 250)</td>
<td>56.38</td>
<td>15.39</td>
<td>8.41</td>
<td>94.62</td>
</tr>
<tr>
<td>Outside Directors ( as % of board)</td>
<td>80.43</td>
<td>10.21</td>
<td>50.00</td>
<td>93.75</td>
</tr>
<tr>
<td>Employees ( Full-time employees)</td>
<td>31708.34</td>
<td>42233.44</td>
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<td>335000</td>
</tr>
<tr>
<td>CEO Years (Years as CEO at that firm)</td>
<td>7.00</td>
<td>6.71</td>
<td>1</td>
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<tr>
<td>Age</td>
<td>54.95</td>
<td>6.39</td>
<td>38</td>
<td>78</td>
</tr>
<tr>
<td>CEO as Board Chairman</td>
<td>0.70</td>
<td>0.46</td>
<td>0</td>
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<tr>
<td>Survivor</td>
<td>0.07</td>
<td>0.26</td>
<td>0</td>
<td>1</td>
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<tr>
<td>Bias</td>
<td>46.17</td>
<td>235.35</td>
<td>0</td>
<td>2323.5</td>
</tr>
<tr>
<td>Industry Concentration (HHI in 2002)</td>
<td>525.75</td>
<td>316.99</td>
<td>24.40</td>
<td>2505.80</td>
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<td>Product Substitutability (Price-cost ratio in 2002)</td>
<td>1.96</td>
<td>0.48</td>
<td>1.17</td>
<td>3.20</td>
</tr>
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</table>

Notes: 258 Observations are the largest firms by market capitalization from the initial sample (in 1995, 2005, and 2008)

Total Revenue and Market Capitalization are shown in Billions of dollars. Total Stock Return and Institutional Ownership are shown in percentage

Industry Concentration and Product Substitutability variables are from the 2002 Census of Manufacturers

Total Compensation = Sum (salary, bonus, stock awards, option awards, non-equity incentive plan, change in pension value, deferred pay, other pay) in 2005

Annual Cash Compensation = Salary + Bonus. Total Stock Return = 1-yr return including price changes, dividends, and other cash or non-cash distributions


Debt / Assets = Long-term debt / total assets in 2005. Institutional Ownership = % common stock top owned by 250 institutional shareholders

Outside directors = 100 * (# of outside board members / total board members). Employees = number of full-time employees in 2005

CEO years = Number of years as CEO at that firm through 2005. Age = Age of CEO in 2005. CEO as chairman = 0 or 1 dummy, 1 if he is

Industry Concentration = The sum of market share squared of 50 largest firms in 2002

Product Substitutability = Total Value of Shipment / (Cost of Materials + Production Workers' Wages) in 2002

Survivor is (0 or 1 dummy, 1 if company is not public in 2009). Bias = Survivor * HHI
<table>
<thead>
<tr>
<th>Industry Description</th>
<th>Number of Firms</th>
<th>4 Firm Concentration Ratio</th>
<th>HHI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel product manufacturing (purchased steel)</td>
<td>512</td>
<td>14.90%</td>
<td>120.4</td>
</tr>
<tr>
<td>* iron and steel tube and pipe; drawing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>* steel wire; and rolling or drawing shapes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>* from purchased iron or steel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pharmaceutical &amp; medicine manufacturing</td>
<td>1444</td>
<td>33.60%</td>
<td>481.4</td>
</tr>
<tr>
<td>* biological and medicinal products</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>* processing botanical drugs and herbs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>* pharmaceutical products intended for internal and external consumption</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugar &amp; confectionery product manufacturing</td>
<td>1656</td>
<td>43.40%</td>
<td>681.8</td>
</tr>
<tr>
<td>* process agricultural inputs (sugarcane and cacao), to make sugar or chocolate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer &amp; peripheral equipment manufacturing</td>
<td>1517</td>
<td>49.80%</td>
<td>1073.3</td>
</tr>
<tr>
<td>* mainframes, personal computers, laptops, peripheral equipment: storage devices, printers, and monitors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor Vehicle Manufacturing</td>
<td>308</td>
<td>81.20%</td>
<td>2323.5</td>
</tr>
<tr>
<td>* automobile and light duty motor vehicles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>* heavy duty trucks.</td>
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</table>

**Notes:**
Morning Star Financial provides the Total Stock Return variables for 2004 and 2005.
CapitalIQ provides CEO pay, Institutional ownership, Revenue, Employees, Debt/Asset, CEO years and Age variables for 2004-05.
The 1997 and 2002 Economic Census provide the competition variables (Industry Concentration and Product Substitutability)
Appendix 2

Estimation Issues

In order to properly analyze the regressions it is necessary to test the cross-sectional and first difference data for estimation issues. One of the most prevalent issues to test for in cross-sectional data is heteroskedasticity. This paper uses the Breusch-Pagan test to examine the null hypothesis that constant variance exists within the data. The results of these tests all reject the null hypothesis of homoscedasticity. This is not surprising as heteroskedasticity is more likely to occur in cross-sectional data, particularly when there is large variance in the dependant variable. This paper uses robust standard errors to correct for the estimation issue, which is a standard econometric remedy.

The other relevant test for cross-sectional data is the test for multicollinearity. The tables on the following page show the correlation coefficients of the variables and presents evidence of multicollinearity. Despite the presence of multicollinearity, it is not necessary to remove any variables as theory states that multicollinear variables should still be included. For instance, firms with large market capitalization are likely to have greater revenue and are likely to have more employees. Even though these variables are collinear, they should be included as they have different effects on CEO compensation.
Multicollinearity tables

### Initial Sample (From Sample used in Tables 2 and 3)

<table>
<thead>
<tr>
<th></th>
<th>TSR</th>
<th>Log (Total Rev)</th>
<th>Log (Employees)</th>
<th>Log (CEO yrs)</th>
<th>Age</th>
<th>Institutions</th>
<th>Debt / Assets</th>
<th>Outside</th>
<th>Chair</th>
<th>HHI</th>
<th>HHI$^2$</th>
<th>Pricecost</th>
<th>Pricecost$^1$</th>
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<td>Log (CEO yrs)</td>
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### Difference in Difference Sample (From Sample used in Table 4)

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<th>Δ Employees</th>
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<th>Δ Debt / Assets</th>
<th>Δ HHI</th>
<th>Δ HHI$^2$</th>
<th>Δ Pricecost</th>
<th>Δ Pricecost$^1$</th>
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<td>Δ Debt / Assets</td>
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<td>Δ Pricecost$^1$</td>
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<td>-0.0018</td>
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</table>

### Robustness Check Sample (From Sample used in Table 7)

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<th>Age</th>
<th>HHI</th>
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Breakdown of CEO Total Compensation
(In 2005 for 216 firms in initial sample)

Other annual compensation: includes travel expenses, social dues (i.e. country clubs)...this varies from firm to firm

All other compensation: includes 401k matching, tax preparations, life insurance, vacation accruals...this varies from firm to firm

Restricted compensation: value of restricted stock granted to CEO

Other: contains all other compensation, other annual compensation, restricted stock and option grants, long term incentive plan, non-equity incentive plan, changes in Pension plan/non-Qualified Deferred Comp Earnings
References:


