STRATEGIC MANAGERIAL INCENTIVE COMPENSATION IN JAPAN: RELATIVE PERFORMANCE EVALUATION AND PRODUCT MARKET COLLUSION

Sung Wook Joh*

Abstract—In an oligopolistic product market, shareholders strategically use information on rival firms’ performances when designing management-incentive compensation contracts. When shareholders use industry performance information through relative performances evaluation (RPE), they evaluate their manager’s effort more easily, but hinder collusive behavior in the product market. However, when compensation is positively linked to the industry performance through strategic group performance evaluation (SGPE), the credibility of a manager’s commitment to product market collusion increases, and the sustainability of a collusive outcome increases. I test how industry performance affects management-incentive compensation using the data from 796 Japanese firms during the period 1968 to 1992. The results show that management compensation is positively linked to industry profit, suggesting the use of SGPE in management-incentive compensation. Cross-sectional analysis shows that the positive effect of industry profit on management compensation is higher in competitive industries than in concentrated industries. The positive effect is greater in slow-growing industries than in fast-growing industries. Empirical tests incorporating the risk component method show the same results. These results are consistent with the argument that, in a growing market or in a concentrated market, the value of SGPE diminishes as the value of commitment to collusion diminishes.

I. Introduction

In a modern firm in which ownership and management are separated, managers pursue their own interests rather than those of shareholders.¹ By linking management compensation to firm performance, shareholders motivate the manager to exert effort. For their top executives, shareholders in an oligopolistic product market strategically use information on rival firms’ performances. Shareholders can link their management compensation to industry performance either positively or negatively, thus either increasing or decreasing manager pay when other firms’ profits increase.

Shareholders can improve the monitoring of their manager by comparing this performance to that of his counterparts in rival firms. When a firm’s performance depends on the manager’s effort and industry-wide exogenous shocks, shareholders cannot measure the manager’s effort simply by examining the firm’s own absolute performance. Performances of other firms convey information on the common market shock and are, therefore, informative about the manager’s effort. By linking management compensation negatively to industry performance through relative performance evaluation (RPE), shareholders can filter out the market common shock and evaluate the manager’s effort more precisely.²

While shareholders are better able to evaluate their manager’s effort, using RPE may have a potentially negative impact on strategic interaction among firms in an oligopolistic market. In a one-shot prisoner’s dilemma game or in a finitely repeated game, the shareholder and the manager have exactly the same incentive to defect when the rival cooperates. In a repeated-game situation however, a collusive outcome can be sustainable.³ Consider a situation in which each firm adopts a collusive strategy until a firm deviates from the collusive outcome. Once the collusive outcome is broken, each firm adopts a Nash equilibrium strategy. By doing this, a collusive outcome can be sustainable if the discounted present value of current and future profits from staying in collusion is greater than getting a one-time profit from deviation and earning a competitive profit afterwards. When RPE is used in incentive contracts, a manager’s income increases when the profit of the rival firm decreases.⁴ Because his firm’s defection from collusion lowers the rival firm’s performance and increases his firm’s performance, the manager has an incentive to defect, and he cannot commit to collusion in this situation.

That may explain why previous studies on RPE have yielded mixed empirical results. Using firm-by-firm analysis, Antle and Smith (1986) show that top-management compensation was consistent with RPE in only 16 out of 39 firms. Barro and Barro (1990) find a weak, but positive, effect of industry-average performance on CEO compensation in the banking industry. Aggarwal and Samwick (1996) also show that market performance affects management compensation positively, refuting RPE. Gibbons and Murphy (1990) show that CEO compensation is negatively linked to the industry rate of shareholders’ return (supporting RPE) but is positively linked to the industry rate of return on assets (rejecting RPE).⁵ Using firm-by-firm estimation, Janakiraman et al. (1992) find results similar to Gibbons and Murphy.

If the firms in an oligopolistic market can credibly commit to collusion, they can sustain collusion and earn collusion

Received for publication July 11, 1996. Revision accepted for publication March 9, 1998.

¹ State University of New York, Albany and Korea Development Institute.

I am grateful to the two anonymous referees and Richard Caves (the editor) for very helpful comments. Their detailed and constructive suggestions greatly improved the paper. I also appreciate comments on earlier versions of this paper from Jiro Akita, Ming Chiu, Michael Jerison, Jim Jozefowicz, Yeong-Jae Kang Takao Kato, Jae-Young Kim, Kajal Lahiri, Tong-Wook Park, Jeffrey Pliskin, S.D. Ryoo, Lisa Takeyama, and participants at several seminars.


³ For a discussion of implicit collusion and the folk theorem in general, see Fudenberg and Tirole (1992).

⁴ Choi (1993) argues that RPE for workers in an intrafirm setting may not be effective when the production externality is large.

⁵ See their table 5 on p. 44-S and footnote 13 on p. 45-S.


© 1999 by the President and Fellows of Harvard College and the Massachusetts Institute of Technology

Downloaded from http://www.mitpressjournals.org/doi/pdf/10.1162/003465399558094 by guest on 01 May 2021
profits higher than competitive equilibrium profits. While RPE reduces the sustainability of a collusive outcome, the shareholders can help commit their manager to cooperate with rival firms by adopting strategic group performance evaluation (hereafter, SGPE) to increase a manager’s income as the profits of rival firms rise. Shareholders use their management-incentive contracts as commitment devices.

When shareholders link management compensation positively to the rival firms’ performances, Aggarwal and Samwick (1996) show that firms can reduce product market competition and facilitate a collusive outcome. When shareholders use SGPE in compensation, a manager’s income decreases when the rival firm’s profit decreases due to his firm’s deviation. The manager’s incentive to deviate from product market collusion decreases. Under SGPE, the manager’s commitment to collusion becomes more credible, as the manager’s income is directly related to the success of collusive outcome. If the rules of governing executive compensation are reset only occasionally, SGPE in compensation contracts can be used as a credible commitment device. Under this strategic contractual arrangement, a collusive outcome is sustainable even in a finite model.

Without using SGPE, using the firm’s stock market performance alone in incentive contracts may not be an effective commitment device when information gathering and processing is slow and costly, or when the stock market is not efficient. For example, when the market cannot distinguish whether a firm’s high profit is due to the firm’s deflection from collusion, innovation, or better management, the firm’s market value increases when it deviates from collusion. Furthermore, when a manager has a short time horizon, using the firm’s own performance alone can decrease the collusion sustainability.

Shareholders choose different degrees of SGPE depending on the magnitude of commitment value. As discussed earlier, RPE filters out the common market shock, reducing the risk-adjusted reservation income for a risk-averse manager. In contrast, SGPE increases a manager’s susceptibility to the common market shock by exposing his income to market performance. Hence, SGPE increases the risk-adjusted reservation income. Shareholders implement costly SGPE when the commitment value is large. Commitment is more valuable when a collusive outcome is not likely to be sustained without commitment.

Even in a repeated-game situation, the shareholders and the manager have an incentive to deviate from collusion depending on market conditions such as industry growth and market concentration. When there is uncertainty in the product market, a firm with low demand cannot distinguish whether its lower demand is due to deviation by other firms or due to the low-demand shock. Furthermore, when the market shock is positively correlated across time, a firm in a recession expects even smaller demands in the following periods. In a low-demand state, the current-period gain from deviation is large, while the loss from the punishment in the following periods is small. Similarly, when the demand shock is positively correlated across time, a firm in a boom period expects greater demand in following periods. Since the loss from punishment is large during the boom period, firms have less incentive to defect from collusion in a high-demand period. Therefore, firms are more likely to stay in collusion in boom periods even without commitment. In short, when the market-demand shock is positively autocorrelated, firms have more incentive to stay in collusion in high-demand periods than in low-demand periods. Consequently, the value of SGPE as a commitment device is larger in low-demand periods than in high-demand periods.

Seller concentration in a product market also affects the value of commitment. In a concentrated market, the joint profit maximizing collusion payoff is greater than the competitive equilibrium profit. When a firm defects from collusion in a market with few sellers, the loss of the foregone collusion payoff is great. On the other hand, when a firm deviates from a collusive outcome in the market with many producers, the one-time gain from defection is large, while the loss of losing collusive outcome is small. Therefore, as the market becomes more concentrated, the sustainability of collusion increases and the value of commitment decreases.

Using the 25-year panel data on Japanese management compensation between 1968 and 1992, this paper shows that shareholders in an oligopoly can strategically use industry performance information through RPE or SGPE in incentive contracts. Aggarwal and Samwick (1996) also recognize that strategic use of incentive compensation can reduce product market competition. After deriving their empirical specification from the firms’ strategic product market interactions, they find that market concentration reduces the strategic use of compensation using two-year panel data on U.S. manage-

---

6 Choi (1993) uses the term joint performance evaluation (JPE) when joint production information is used in incentive contracts. Because industry production is different from joint production, I am not using the term here.


8 Fershtman and Judd (1987) argue that firms use not only profits but also sales in manager’s compensation. However, they show that the strategic outcome profits in a quantity game are lower than those in a Cournot-Nash equilibrium case. Instead of using information on its own profits and sales, this paper examines a case in which shareholders use both their own firm’s performance information and the other firms’ performance information.

9 The exact compensation contracts do not have to be observable. Katz (1991) shows that unobservable contracts can still credibly commit the manager under some conditions, while most literature focuses on the observable cases.

10 Kaplan (1994) argues that Japanese top executives have shorter tenures than do U.S. CEOs. He shows that, among the 119 largest Japanese firms, the median stay for Japanese presidents in their positions is 4.3 years.

11 According to Green and Porter (1984), under the trigger strategy, price wars would occur in low-demand states, even if no firm deviates from collusion.

12 Using data on retail gasoline prices, Borenstein and Shepard (1996) argue that an increase in the current profitability in anticipation of increased future demand indicates an increase in collusive margin.
managers. In addition to seller concentration, this paper argues that the use of SGPE or RPE depends on market conditions such as market growth.

This paper employs Japanese management compensation data to study the strategic use of incentive contracts involving industry performance. I have chosen Japan because its economy is considered very collusive by many people, both inside and outside Japan. Furthermore, the Japanese government publicly states that one of its policy goals is to prevent excessive competition. In fact, some government policies allow certain industries to legally engage in cartel-like decision-making regarding capacities.

I use two empirical methods to analyze the Japanese management-compensation data. The first method examines the direct relationship between compensation and performance variables by including a firm’s own performance and its market performance as explanatory variables. Because of the lack of explicit linkage between market performance and compensation in incentive contracts, the second method uses the risk-component approach in Antle and Smith (1986), similar to the method used by Janakiraman et al. (1992). Antle and Smith argue that firm performance is divided into a firm-specific (unsystematic, idiosyncratic) risk factor and a common (systematic) risk component that is shared with other firms in the industry. Because the systematic component impounds the common risk shared by firms in the same industry, the systematic component affects management compensation less than the unsystematic component does with implicit RPE. With implicit use of SGPE, however, industry common shock is magnified rather than filtered out. In this case, the systematic component affects management compensation more than the unsystematic component.

The empirical tests show that management compensation in Japan is positively affected by the industry performance. Also, the cross-sectional variation of the positive effect of industry performance on compensation depends on the market-specific growth rate and seller concentration. A competitive market with small market concentration exhibits a greater positive effect on market performance. In fast-growing industries, the positive effect is smaller than in slow-growing industries. These results suggest that a higher degree of SGPE is applied in management compensation in competitive markets or slow-growing markets, while a lower degree of SGPE or RPE is applied to concentrated markets or fast-growing markets. Incorporating risk components shows the same results. These findings are consistent with the argument that shareholders do not implement SGPE when its commitment value is small because SGPE is costly. Also, it suggests that the commitment value of SGPE is greater in low-growth markets and in highly concentrated industries. Firm-specific estimations show that the compensation and performance relationship is quite firm specific. However, most firm-specific coefficients are not significant.

This paper is organized as follows. Section II describes the data, and the results of the empirical tests appear in section III. Finally, section IV presents conclusions.

II. The Data

The data used in this study are from the Corporate Finance Data Bank issued by the Japanese Development Bank (JDB). The JDB compiles the original financial data that publicly traded firms annually submit to the Ministry of Finance. As Kaplan (1994) and Aoki (1990) argue, the Japanese corporate governance system functions more through consensus than does the CEO-dominated system of the United States. Because the board members make decisions regarding the firm’s product market strategy as a group, I analyze the incentive compensation of directors on the board as a group rather than that of the top manager alone.

This study uses the total cash compensation data of the directors on the board from 796 firms in the manufacturing sector spanning 93 industries, from fiscal year 1968 to 1992. Unlike in the United States, using the cash compensation of the directors would not pose a serious problem in this study because, as Aoki (1988) argues, stocks and stock options are not a common part of compensation in Japan. Moreover, Kaplan (1994) and Lichtenberg and Pushner (1994) show that inside directors’ average stock ownership is low compared to that in the United States.

In this paper, I use two types of performance measures: rate of return on assets (ROA), and rate of return on stock market value (RET). The firm’s short-term accounting profits are directly related to the manager’s decisions and to the firms’ interactions in the product market (although accounting profits are more easily manipulated than capital market variables). Moreover, the sustainability of a collusive outcome would directly affect the accounting profit. Because ROA is closely related to accounting profit and less affected by the firm size, ROA is used as a performance measure. Although Murphy (1985) and Jensen and Murphy (1990) argue that the stock market value of a firm directly affects the shareholders’ payoffs, RET and the stock market value impound all the relevant information regarding discount

---

13 They find that, as product market competition intensifies, the effect of a firm’s own performance on management compensation decreases. They argue that it explains Jensen and Murphy’s (1990) puzzle of low-risk sharing in management compensation.
14 According to van Marion (1993), a total of 276 cartels were approved by the Fair Trade Commission in 1988, and 4,500 in 1989. Many cartels and industry associations play a role in enforcing collusive practices such as controlling domestic sales and sometimes even exports.
15 For Japanese industrial policy, see Komiya et al. (1988).
16 One example is the Temporary Measures Law for Structural Improvement of Specific Industries enacted in 1978 and revised in 1983.
17 The boards in Japan comprise representative and nonrepresentative directors. Representative directors can legally represent the company and include the president (shacho) and the chairman (kaicho). According to Kaplan (1994), boards typically consist of 21 inside directors, including all representative directors. He also noted that the median number of outside directors for 119 large Japanese firms (by sales) was zero.
18 Kato (1997) points out that the compensation data of the directors are subject to systematic under-reporting of the directors’ salary and bonus. When this systematic under-reporting is consistent in each firm, the first-difference method in the analysis controls the systematic problem.
19 For more discussion on forms of compensation, see Kato (1997).
rates and the firm’s expected future profitability (which can be independent of the evaluation of current performance and the current manager’s effort).

Table 1 provides descriptive information on the data.

### III. The Results of Empirical Tests

In this section, I examine the effects of market performance on the Japanese management compensation using two methods: the direct effect of industry average performance, and the effects of systematic and unsystematic risk components.

First, I test how a firm’s own performance and market performance is used in management compensation. Second, I study whether the use of industry-average performance depends on market conditions: market growth condition and seller concentration. I examine the cross-sectional variation of the use of market performance. Also, I estimate firm-specific coefficients and examine whether these vary with market conditions and whether the results are consistent with the results from the pooled data.

#### A. Effects of Industry Average Performance

Management compensation depends on the firm’s own performance and the industry’s average performance. As discussed earlier, shareholders’ use of market performance in incentive compensation depends on the magnitudes of the collusion payoffs and the market shock. This section examines how the Japanese shareholders use information on other firms’ performance in their management-incentive contracts.

Since firms may evaluate the manager based on its accounting profit and stock market performance simultaneously, I use the two types of performance variables in a regression as in Antle and Smith (1986). I control for the firm-specific fixed effects, by using the first-order differences in the analysis.

\[
\Delta y_{it} = \gamma_0 + \gamma_1 \Delta \text{ROA}_{it} + \gamma_2 \Delta \text{ROA}_{it}^m + \gamma_3 \Delta \text{RET}_{it} + \gamma_4 \Delta \text{RET}_{it}^m + e_{it} + \epsilon_{it},
\]

where \(\Delta y_{it}\) is the change in the log value of real management compensation between \(t - 1\) and \(t\), \(\Delta \text{ROA}_{it}\) and \(\Delta \text{RET}_{it}\) are the change of real rate of return on assets and the real rate of return in the stock market for firm \(i\) between year \(t - 1\) and \(t\), \(\Delta \text{ROA}_{it}^m\) and \(\Delta \text{RET}_{it}^m\) represent the change of average ROA and RET of the reference group in industry \(m\), respectively. The time-specific dummy variable \(e_t\) measures the time-specific fixed effect across firms. In specification (1), the constant term can be interpreted as a time trend.

The coefficients of the firm’s own performance variables, \(\gamma_1\) and \(\gamma_2\), are expected to be positive, indicating that compensation increases as firm performance improves. It is not clear ex ante how the shareholders use the information on market performance. They can use it through RPE or SGPE.

Table 2 summarizes the results. As expected, a firm’s own performance measured by ROA and RET significantly affects the management compensation positively at the 1% level in all performance measures. The result also shows that the influence of firm performance as measured by profit rate on assets is far greater than that measured by stock market return. This is consistent with results in Kaplan (1994) showing that the percentage change in compensation is more strongly related to changes in ROA than to stock market return. This result also indicates that the Japanese corporate governance system emphasizes the importance of profit rather than stock market performance.

Table 2 also shows that the industry average ROA significantly affects compensation positively at the 1% level, while the coefficients of RET is negative but insignificant. The significant and positive effect of ROA implies that compensation is designed to reduce product market competition and facilitate market collusion. Through SGPE in management incentive contracts, shareholders manipulate the managers’ incentives and actions toward product market collusion. This outcome is consistent with the aforementioned prevalent collusive outcomes in Japan. Because the stock market performance is the market reaction to the current profit and future profits that are not reflected in current ROA, this result suggests that it has little value as a commitment device as it does not necessarily bind the manager’s decision and choices in the current period.

Because of the lack of explicit and direct linkage between the market performance and compensation, this section employs the two-risk component approach in Antle and Smith (1986). Although management compensation ap-

---

20 All firms in the same four-digit JDB industry code use the same reference group performance. To avoid problems involving changes in firm compositions in a reference group, firms in the reference group have been in the data for at least the last six years including year \(t\). Antle and Smith (1986) construct the industry performance index for each firm with higher weights given to firms whose performance is more closely related to the performance of the sample firm. However, their approach may incur a potential problem in that it weights ex post correlation without distinction between firm-specific error and common market error.

21 The existence of the time trend does not change the estimation results.

22 As discussed earlier, the procedure is similar to Janakiraman et al. (1992).
pears to be linked to the firm’s own performance but not to the industry performance, it may indirectly reflect common market shock. A firm’s performance can be divided into two parts: firm-specific (unsystematic, idiosyncratic) risk component and systematic-risk component. The systematic-risk part reflects the common market shocks that affect all firms in the industry. When shareholders need to monitor their manager’s contribution more precisely, they (at least partially) filter out the common market risk. On the other hand, when shareholders want to commit their manager to a collusive outcome, the manager’s income is affected by other firms’ performances which depend on the common market shock. Therefore, the effect of the common market shock is magnified. The magnitude of exposure of management-incentive compensation to risks differs depending on whether shareholders use RPE or SGPE in incentive contracts.

A time series of a systematic component and another of a firm-specific component of firm performance are derived by decomposing the time series of each firm’s performance. The decomposition process is performed on a firm-by-firm basis using the first-order autocorrelation for the error terms:

\[ x_{it} = \gamma_0 + \gamma_1 \overline{S_{it}} + \xi_{it} \]  

(2)

where \( \xi_{it} = \rho \xi_{i,t-1} + \mu_t \) and \( \mu_t \) are white noise.\(^{23}\) For each firm \( i \), the constant term (\( \gamma_0 \)), the coefficient of market performance (\( \gamma_1 \)), and the error term (\( \xi_{it} \)) are estimated. The firm-specific risk component is constructed by the sum of the estimated residual and the constant term \( \gamma_0 + \xi_{it} \) for each sample firm \( i \) and for each year \( t \). The systematic component is constructed by the product of the estimated coefficient and the industry performance, \( \gamma_1 \times \overline{S_{it}} \).

Once the systematic and the unsystematic components are estimated, the regression proceeds as follows:

\[ \Delta y_{it} = \gamma_0 + \gamma_1 \Delta U-ROA_{it} + \gamma_2 \Delta S-ROA_{it} + \gamma_3 \Delta U-RET_{it} + \gamma_4 \Delta S-RET_{mt} + \epsilon_t + \epsilon_{it}, \]  

(3)

where \( U-ROA_{it} \) and \( S-ROA_{it} \) represent the unsystematic and systematic components of ROA respectively, and \( U-RET_{it} \) and \( S-RET_{mt} \) represent the unsystematic and systematic components of RET respectively.

The second column in table 2 shows that, when performance variables are decomposed into systematic and unsystematic components, the results are similar to those using a firm’s own performance and its industry performance. Both U-ROA and U-RET are positive and significant. The coefficient of U-ROA is much greater than U-RET, which is consistent with the earlier results that accounting performance is more important than the stock market performance in Japan. The coefficient of S-ROA is greater than that of U-ROA, showing that market performance influences compensation more and suggesting that the common risk is added rather than filtered out. This is consistent with SGPE. Both the unsystematic component and systematic components of RET affect compensation positively. However, the coefficient of S-RET is smaller than that of U-RET, suggesting that the common risk is partially filtered out. This result is consistent with the implication of weak RPE. Because connecting management compensation positively to the current average stock market performance does not bind the manager’s current-period behavior, firms do not have an incentive to use costly SGPE in stock market performance. However, they have an incentive to filter out some of the common stock market shock to reduce the risk-averse manager’s reservation income. In short, the greater effect of S-ROA compared to U-ROA suggests that management-compensation contracts consider the strategic interaction of firms in the product market.

B. Effects of Market Growth

This section examines whether the market growth condition in different industries—i.e., fast-growing industries versus slow-growing or shrinking industries—affects the effect of market performance on management compensation. I create interaction terms between performance variables and the industry growth rate. Because the effect of firm’s own performance may also change as the market condition changes, I also include interaction terms between a firm’s own performance and its industry growth rate:

\[ \Delta y_{it} = \gamma_0 + \gamma_1 \Delta ROA_{it} + \gamma_2 \Delta (ROA_{it} \times Growth_{mt}) + \gamma_3 \Delta RET_{it} + \gamma_4 \Delta (RET_{it} \times Growth_{mt}) \]  

(4)

Notes: In Equation 1, a firm’s own performance and its industry-average performance are used directly.

\[ \Delta ROA = \text{ROA}_i - \text{ROA}_{avg}, \]  

\[ \Delta RET = \text{RET}_i - \text{RET}_{avg}, \]

\[ \Delta S-ROA = \text{ROA}_i - \text{ROA}_{sys}, \]

\[ \Delta S-RET = \text{RET}_i - \text{RET}_{sys}, \]

where \( \text{ROA}_i \) and \( \text{RET}_i \) represent the firm’s own rate of return on asset and the firm’s own stock market rate of return, and \( \text{ROA}_{avg} \) and \( \text{RET}_{avg} \) represent the industry-average return on assets and the industry-average stock market rate of return. In Equation 2, a firm’s own performance measures are decomposed into systematic and unsystematic parts. ROA represents an unsystematic risk component (U-ROA), and RET represents a systematic component of a firm’s stock market rate of return (S-RET). In both equations, the dependent variable is change in log of management compensation. \( \Delta \) indicates the change in performance between year \( t \) and year \( t - 1 \).
A one-year growth rate between \( t - 1 \) and \( t \) may not measure whether the market is expanding or shrinking. For example, when a market shrinks temporarily for a year and then recovers in the following year, the high growth rate in the recovery phrase may exaggerate the market expansion. To avoid this problem, I use the average-industry sales information of four consecutive years to measure the growth rate of each industry. Growth
 subscript m measures the three-year moving average of annual growth rates of industry \( m \) between \( t - 1 \) and \( t \), between \( t - 2 \) and \( t - 1 \), and between \( t - 3 \) and \( t - 2 \).

The results in table 3 show that the cross-sectional variation of incentive compensation depends on the market growth rate. As expected, a firm’s own ROA and RET affect compensation positively, and their coefficients are significant. The industry-average ROA coefficient is positive and significant. While the interaction term between the market growth rate and the firm ROA is negative but not significant, the coefficient of the interaction term between industry growth rate and ROA is negative and significant. This suggests that the positive effect of ROA on management compensation decreases in fast-growing industries. Except for the direct effect of a firm’s own RET, the coefficients on stock market-related terms (RET and interaction terms) are not significantly different from zero. In short, the results show that the positive effect of industry-average ROA decreases as the market growth rate increases. Firms in fast-growing industries seem to employ a lower degree of SGPE than those in slow-growing industries. This result is consistent with the earlier argument that shareholders have less incentive to collude in a growing market and firms are more likely to use RPE than SGPE.

The second column in table 3 shows that, when performance variables are decomposed into systematic and unsystematic components, the results are similar to those using a firm’s own performance and its industry performance. The S-ROA and U-ROA affect compensation positively. Moreover, the S-ROA coefficient is greater than the U-ROA coefficient, suggesting that the common risk factor is added, rather than filtered out. While coefficients of both interaction terms of industry growth rate between S-ROA and U-ROA are negative and significant, the magnitude of the coefficient of the interaction term with S-ROA is greater than that with U-ROA. In a growing market, the effect of common market shock on management compensation decreases faster than the effect of the firm-specific shock. This suggests, that in a growing product market, a lower degree of SGPE or RPE is used. The U-RET coefficient is positive and significant at the 1% level. It is also greater than the S-RET coefficient, which is weakly significant at the 10% level. This again suggests the use of weak RPE in stock market performance. The coefficients of interaction terms of market growth rate between S-RET and U-RET are not significantly different from zero.

In short, while S-ROA affects compensation more than U-ROA, the difference decreases as the market growth rate increases. These results imply that SGPE is used in a slow-growing product market, and that RPE or a lower degree of SGPE is used in a fast-growing industry.

### C. Effects of Seller Concentration

In this section, I examine the effects of seller concentration on the use of RPE or SGPE. Interaction terms between market concentration and performance variables measure the cross-sectional effects of seller concentration on the effects of performance on management compensation. As a proxy variable for market competition, I use the Herfindahl index, which is the sum of firms’ squared market share in each industry, \( \sum \) (firm \( i \)’s market share). By construction, an increase in the Herfindahl index indicates greater market concentration. Likewise, a small Herfindahl index indicates a competitive market.

The results in table 4 show that the cross-sectional variation of incentive compensation depends on the seller concentration in product markets. There are positive and significant effects of a firm’s own performance variables on management compensation. Industry average ROA affects

---

24 For shareholders to use SGPE as a commitment device, they should offer a stable contract. As a market structure factor, a longer growth rate can be more suitable. When I use a growth rate for a longer period, the signs of the interaction terms are the same, but are not statistically significant. These results suggest that an industry’s current growth rate is better explained by recent growth rates rather than old growth rates, as each industry experiences a business cycle of high- and low-growth periods.

25 These calculations utilize all available sales information from each industry. However, this information does not include competition from imports or from smaller domestic firms. Since industries may face different degrees of foreign and small business competition, future studies should include such information if possible.
the compensation positively, suggesting the use of SGPE. Meanwhile, industry-average stock return RET has an insignificant effect. The interaction terms between the market concentration variable and performance variables show how market competition affects the pay-to-performance relationship. In more-concentrated markets, the effect of a firm’s own ROA on management compensation increases while the effect of industry average ROA decreases. Such effects suggest that shareholders adopt a lower degree of SGPE in a more concentrated market. These results are consistent with those of Aggarwal and Samwick (1996) using U.S. management compensation.

When performance variables are decomposed into systematic and unsystematic components, the results are similar to those using a firm’s own performance and its industry performance. Moreover, the positive coefficient of S-ROA is greater than the positive coefficient of U-ROA, suggesting that the common risk factor is added rather than filtered out. While both coefficients on interaction terms of market concentration between S-ROA and U-ROA are positive, the magnitude of the coefficient of the interaction term with U-ROA is greater than that with S-ROA. In more-concentrated markets, the effect of U-ROA increases faster than that of S-ROA. While S-ROA affects compensation more than U-ROA does, the difference decreases as the market concentration increases. This is consistent with the earlier argument that a lower degree of SGPE is used in more-concentrated industries.

D. Firm-Specific Estimation

This section examines whether the incentive compensation system varies across firms. As Antle and Smith (1986), Janakiraman et al. (1992), and Dechow et al. (1994) show, the pay-performance relationship can be quite firm specific.

Using the first-order autocorrelation model for the error term, I conduct 796 firm-by-firm estimations. I use two methods for each firm-specific estimation: one examines the effects of a firm’s own performance and its industry average performance, and the other employs the risk-component method that decomposes the firm’s own performance measure into systematic and unsystematic-risk components, then uses the components as regressors.

For each firm, I test the effect of market performance using specifications in equations (1) and (3). In panel A of table 5, I report the distribution of coefficients that are significant at the 5% level. Panel B shows in both methods, less than 25% of the total observations have at least one significant coefficient other than the constant.

Moreover, under the direct method and the risk-component method, almost 18% of the firms have a negative coefficient of a firm’s own ROA (33 out of 197) or its U-ROA (19 out of 110). Also, almost 40% of the firms show a negative coefficient of a firm’s own RET (19 out of 47) and on its U-RET (13 out of 35). The negative and significant coefficients are puzzling because they suggest that managers earn less income when the firm performance increases. Approximately 30% of the firms have a positive industry average ROA coefficient (43 out of 137), or a positive S-ROA coefficient (140 out of 345) suggesting the use of SGPE. On the other hand, the industry-average RET (or S-RET) coefficient is mostly positive: 107 out of 139 firms under the direct method and 125 out of 145 firms under the risk-component method.

Table 6 reports the descriptive distribution of coefficients of firm-by-firm estimation when interaction terms with each industry growth rate and performance variables are included. In panel B, the number of observations with coefficients significant at the 5% level is small compared to the total observations. Fewer than 13% of the firms have a significant firm’s own ROA (5.7% for RET) coefficient, and approximately 79% of the firms (45 out of 57) have a positive industry RET coefficient. Under the risk-component method, fewer than 8% of the firms have a significant U-ROA coefficient (6% for U-RET), and 16.5% have a significant S-ROA coefficient (7.2% for S-RET). Among these, more than 80% have a positive coefficient (49 out of
ROA represents the industry-average rate of return on assets; RET represents a firm’s own stock market rate of return, and RET represents a systematic component of a firm’s stock market rate of return (S-RET). RET represents industry-average stock market rate of return. In Equation 2, a firm’s own performance measures are decomposed into systematic and unsystematic parts. ROA represents a systematic component of a firm’s own rate of return on asset (S-ROA); RET represents an unsystematic risk component (U-RET), and ROA represents a firm’s own rate of return on assets; RET represents a firm’s own stock market rate of return, and RET represents an unsystematic risk component (U-RET), and RET represents an unsystematic risk component (U-RET).

Table 5.—Descriptive Summary Statistics on the Distribution of Firm-by-Firm Estimation Results. Panel A reports the results of 796 firm-specific regressions, while Panel B reports the coefficients that are significant at the 5% level.

Panel A:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Lower Quartile</th>
<th>Median</th>
<th>Upper Quartile</th>
<th>Lower Quartile</th>
<th>Median</th>
<th>Upper Quartile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-0.4035</td>
<td>0.0649</td>
<td>0.6115</td>
<td>-1.0211</td>
<td>0.3178</td>
<td>1.8300</td>
</tr>
<tr>
<td>ROA</td>
<td>-0.2002</td>
<td>1.5408</td>
<td>4.6794</td>
<td>-0.3139</td>
<td>1.1692</td>
<td>3.4713</td>
</tr>
<tr>
<td>ROA</td>
<td>-5.5317</td>
<td>-1.4224</td>
<td>2.1741</td>
<td>-0.7915</td>
<td>1.6598</td>
<td>5.0826</td>
</tr>
<tr>
<td>RET</td>
<td>-0.0962</td>
<td>0.0209</td>
<td>0.1056</td>
<td>-0.0824</td>
<td>0.0051</td>
<td>0.1196</td>
</tr>
<tr>
<td>RET</td>
<td>-0.0888</td>
<td>0.0395</td>
<td>0.2759</td>
<td>-0.1303</td>
<td>0.0434</td>
<td>0.2563</td>
</tr>
</tbody>
</table>

Panel B:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Num.</th>
<th>Num. &gt; 0</th>
<th>Lower Quartile</th>
<th>Median</th>
<th>Upper Quartile</th>
<th>Lower Quartile</th>
<th>Median</th>
<th>Upper Quartile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>427</td>
<td>244</td>
<td>-0.5861</td>
<td>0.4598</td>
<td>0.9242</td>
<td>-2.6614</td>
<td>1.4499</td>
<td>4.9785</td>
</tr>
<tr>
<td>ROA</td>
<td>197</td>
<td>164</td>
<td>3.1797</td>
<td>5.8058</td>
<td>10.7397</td>
<td>2.7736</td>
<td>5.3756</td>
<td>10.0370</td>
</tr>
<tr>
<td>RET</td>
<td>47</td>
<td>26</td>
<td>-0.3008</td>
<td>0.3107</td>
<td>0.6611</td>
<td>-0.3176</td>
<td>0.2987</td>
<td>0.5620</td>
</tr>
<tr>
<td>RET</td>
<td>47</td>
<td>37</td>
<td>0.2748</td>
<td>0.8243</td>
<td>1.2777</td>
<td>0.3443</td>
<td>0.7079</td>
<td>1.1887</td>
</tr>
</tbody>
</table>

Notes: In the regression, the error term follows first-order autocorrelation, and the dependent variable is the log value of total compensation. In Equation 1, a firm’s own performance and the industry-average performance are used directly. ROA represents a firm’s own rate of return on asset, and ROA represents the industry-average rate of return on asset; RET represents a firm’s own stock market rate of return, and RET represents the industry-average stock market rate of return. In Equation 2, a firm’s own performance measures are decomposed into systematic and unsystematic parts. ROA represents an unsystematic risk component (U-ROA), and RET represents a systematic component of a firm’s own rate of return on asset (S-ROA); RET represents an unsystematic risk component (U-RET), and RET represents a systematic component of a firm’s stock market rate of return (S-RET).

Table 6.—Descriptive Summary Statistics on the Distribution of Firm-by-Firm Estimation Results of Cross-Sectional Effect of the Industry Growth. Panel A reports the results of 796 firm-specific regressions, while Panel B reports the coefficients that are significant at the 5% level.

Panel A:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Lower Quartile</th>
<th>Median</th>
<th>Upper Quartile</th>
<th>Lower Quartile</th>
<th>Median</th>
<th>Upper Quartile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-0.5004</td>
<td>-0.0072</td>
<td>0.5950</td>
<td>-0.8768</td>
<td>-0.3392</td>
<td>0.9300</td>
</tr>
<tr>
<td>ROA</td>
<td>-1.6281</td>
<td>1.8534</td>
<td>6.2444</td>
<td>3.8932</td>
<td>8.3620</td>
<td>14.5577</td>
</tr>
<tr>
<td>ROA</td>
<td>-7.1267</td>
<td>-0.2253</td>
<td>5.9529</td>
<td>-20.7267</td>
<td>-11.3487</td>
<td>13.4359</td>
</tr>
<tr>
<td>RET</td>
<td>-0.2434</td>
<td>0.0013</td>
<td>0.2699</td>
<td>-0.1018</td>
<td>0.2888</td>
<td>1.0185</td>
</tr>
<tr>
<td>RET</td>
<td>-0.1290</td>
<td>0.2103</td>
<td>0.7207</td>
<td>0.4285</td>
<td>1.3774</td>
<td>2.4177</td>
</tr>
<tr>
<td>ROA * Industry growth rate</td>
<td>-0.5022</td>
<td>-0.0090</td>
<td>0.4666</td>
<td>-1.1867</td>
<td>0.2119</td>
<td>1.4650</td>
</tr>
<tr>
<td>ROA * Industry growth rate</td>
<td>-0.0346</td>
<td>0.0004</td>
<td>0.0354</td>
<td>-0.1056</td>
<td>0.0380</td>
<td>0.1059</td>
</tr>
<tr>
<td>RET * Industry growth rate</td>
<td>-1.0400</td>
<td>-0.1681</td>
<td>0.5349</td>
<td>-2.6657</td>
<td>-1.4600</td>
<td>-0.6142</td>
</tr>
<tr>
<td>RET * Industry growth rate</td>
<td>-0.0783</td>
<td>-0.0132</td>
<td>0.0295</td>
<td>-0.2258</td>
<td>-0.1039</td>
<td>0.1761</td>
</tr>
<tr>
<td>Industry growth rate</td>
<td>-0.0184</td>
<td>0.0161</td>
<td>0.0534</td>
<td>0.0248</td>
<td>0.0677</td>
<td>0.1195</td>
</tr>
</tbody>
</table>

Table 7 reports the descriptive distribution of coefficients of the interaction terms with market concentration rate and performance variables. In panel B, fewer than 11% of the firms have a significant coefficient of a firm’s own ROA.

Panel B:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Num.</th>
<th>Num. &gt; 0</th>
<th>Lower Quartile</th>
<th>Median</th>
<th>Upper Quartile</th>
<th>Lower Quartile</th>
<th>Median</th>
<th>Upper Quartile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>293</td>
<td>131</td>
<td>-0.877</td>
<td>-0.339</td>
<td>0.930</td>
<td>-4.378</td>
<td>5.410</td>
<td>15.621</td>
</tr>
<tr>
<td>RET</td>
<td>45</td>
<td>23</td>
<td>-1.019</td>
<td>0.289</td>
<td>1.019</td>
<td>-0.682</td>
<td>0.382</td>
<td>1.133</td>
</tr>
<tr>
<td>RET</td>
<td>57</td>
<td>45</td>
<td>0.429</td>
<td>1.377</td>
<td>2.418</td>
<td>0.789</td>
<td>1.301</td>
<td>2.626</td>
</tr>
<tr>
<td>ROA * Industry growth rate</td>
<td>80</td>
<td>41</td>
<td>-1.187</td>
<td>0.212</td>
<td>1.465</td>
<td>-1.213</td>
<td>1.020</td>
<td>2.346</td>
</tr>
<tr>
<td>ROA * Industry growth rate</td>
<td>47</td>
<td>24</td>
<td>-1.106</td>
<td>0.038</td>
<td>0.106</td>
<td>-0.13’</td>
<td>-0.066</td>
<td>0.109</td>
</tr>
<tr>
<td>RET * Industry growth rate</td>
<td>58</td>
<td>13</td>
<td>-2.666</td>
<td>-1.460</td>
<td>-0.614</td>
<td>-2.112</td>
<td>-0.869</td>
<td>0.854</td>
</tr>
<tr>
<td>RET * Industry growth rate</td>
<td>42</td>
<td>15</td>
<td>-0.226</td>
<td>-0.104</td>
<td>0.176</td>
<td>-0.253</td>
<td>-0.088</td>
<td>0.173</td>
</tr>
<tr>
<td>Industry growth rate</td>
<td>102</td>
<td>80</td>
<td>0.025</td>
<td>0.068</td>
<td>0.120</td>
<td>-1.956</td>
<td>-1.080</td>
<td>-0.381</td>
</tr>
</tbody>
</table>

Notes: In Equation 1, a firm’s own performance and its industry-average performance are used directly. ROA represents a firm’s own rate of return on asset, and ROA represents the industry-average rate of return on asset; RET represents a firm’s own stock market rate of return, and RET represents industry-average stock market rate of return. In Equation 2, a firm’s own performance measures are decomposed into systematic and unsystematic parts. ROA represents an unsystematic risk component (U-ROA), and RET represents the industry-average stock market rate of return (S-RET), while RET represents an unsystematic risk component (U-RET), and RET represents a systematic component of a firm’s stock market rate of return (S-RET).
(6.5% for RET) under the direct method. Fewer than 9% of the firms have a significant coefficient of industry-average ROA (7.3% for industry-average RET). Among these, almost 48% of the firms have a positive and significant coefficient on industry-average ROA (53% for industry-average RET). Fewer than 11% of the firms have a significant coefficient interaction term with market concentration. More than 53% (48 out of 90) of the coefficients of interaction terms between industry-average ROA and the economy’s yearly growth rate are negative. Under the risk-component method, fewer than 7.6% of the firms have a significant U-ROA coefficient (6.8% for U-RET). Of these, 53% of the firms have a negative coefficient of U-ROA (54% for U-RET). Also, fewer than 12% of the firms have a significant coefficient on S-ROA (9.5% for S-RET). Of these, almost 55% of the firms have a positive S-ROA coefficient (58% for S-RET). Fewer than 12% of the firms have a significant coefficient on the interaction terms with the market concentration variable. More than 41% (39 out of 95) of the interaction terms between S-ROA and the market concentration have a negative coefficient.

In short, firm-by-firm estimation shows a firm-specific performance and compensation relationship. However, most of these relationships are not significant. In the basic model, fewer than 25% of total sample firms have a significant own-performance coefficient (14% idiosyncratic risk component). Moreover, almost 17% of the firms with a significant coefficient show a negative relationship between firm performance and management compensation. Fewer than 18% of total sample firms have a significant industry-average performance coefficient (22% using the systematic risk component). This becomes an even greater problem when we investigate how these firm-specific coefficients vary with market conditions. Fewer than 13% of the firms have a significant coefficient on its own firm performance (or unsystematic risk component). When we study the effects of market conditions, fewer than 11% (8%) of the firms have a significant industry-average performance coefficient (22% using the systematic risk component).

Firm-by-firm estimation measures the effects of firm performance and industry performance over time. The time-series analysis for each firm implicitly assumes that the incentive-compensation relationship for each firm is stable over time. The stable relation may not hold if a firm can change its incentive compensation as its market environment changes over time. As discussed earlier, a firm’s incentive compensation changes as the common market shock and payoffs from collusion change. For example, firms in fast-growing industries are more likely to use RPE rather than SGPE. Depending on whether or not a firm
belongs to a fast-growing industry, the coefficient of industry performance varies. Firm-specific time-series regression estimation does not control for those structural changes. It also does not control for firm-specific effects or industry-specific effects. Also, the firm-specific estimation may face multicollinearity problems that exist among performance variables in a single unit.

IV. Conclusion

Economists have argued that firms should compare the manager’s performance to rival firms’ performances to filter out the common shock to the industry. However, the literature on incentive contracts has not successfully explained why empirical tests on top-management compensation in an interfirm setting show mixed results on the use of Relative Performance Evaluation (RPE). This paper argues that the mixed results occur because shareholders in an oligopoly can strategically link incentive compensation positively or negatively to industry-performance information.

Interfirm RPE for top managers hinders product market collusion. Shareholders use RPE to improve monitoring of their manager or to reduce the risk in manager’s income, but they may not use RPE when the gain from product market collusion is large. Moreover, shareholders can facilitate product market collusion through a management-commitment device, Strategic Group Performance Evaluation (SGPE), that links management compensation positively with the industry’s average performance. Using management-incentive compensation data from Japan (where collusive outcomes among firms are prevalent), this study provides evidence that firms increase management compensation as the industry’s average performance increases. This study also finds that the positive effect of industry performance on compensation depends on market conditions. The positive effect is stronger in slow-growing industries than in fast-growing industries. It is stronger in more-competitive industries than in concentrated industries.

These results provide another perspective on incentive contracts. Incentive contracts do not necessarily include RPE even when measuring performance is inexpensive and there exists a substantial source of common risk or common uncertainty. When designing incentive contracts, principals weight the benefits and costs of RPE. In an oligopoly, some incentive contracts are strategically designed to facilitate collusion using SGPE as a commitment-device.

Empirical tests on strategic incentive compensation can be extended in several ways. Future studies can examine the relationship between several other market structure factors that affect the commitment to market collusion. In addition, we can examine how firms that belong to corporate groups (for example, Keiretsu or Chaebol) design strategic incentive contracts. Finally, we can extend this work to examine intrafirm incentive contracts when the production externality is large among the workers.
APPENDIX

The results in table 2 also show the magnitude of pay-performance relationship. The management income increases by 59.32% \(((e^{0.4658} - 1) \cdot 100)\) per percentage point change in ROA, and by 0.55% \(((e^{0.0055} - 1) \cdot 100)\) per percentage point change in RET, when other things are equal. This result shows that management compensation is more closely related to product market performance than stock market performance. I also derive the pay-performance relationship by using the change in cash compensation as a dependent variable, and the change in shareholders’ wealth as explanatory variables similar to the method in Jensen and Murphy (1990), instead of deriving the percentage change in management compensation. When shareholders’ wealth is the only performance variable in regression, a 1,000-Yen increase in shareholders’ wealth is associated with a 0.102-Yen increase in management compensation. When the lag value of change in shareholders’ wealth is added to the specification, a 1,000-Yen increase in shareholders’ wealth is associated with a 0.162-Yen increase in management compensation, which is slightly smaller than a 0.22-Yen increase per 1,000-Yen increase in shareholders’ wealth in Kaplan (1994). It also estimate the pay-performance sensitivity by including change in profit and change in shareholders’ wealth as explanatory variables. When both performance variables are used in a single regression, management compensation is more closely related to profit. The data show that a 1,000-Yen increase in shareholders’ wealth is associated with a 0.072-Yen increase in management compensation, while a 1,000-Yen increase in profit is associated with a 1.05-Yen increase.

The regression results used for pay-performance relationship are as follows:

\[
\Delta \text{Manager Income}_t = 0.1055 + 0.1015 \Delta \text{Shareholder Wealth}_t + \text{Year dummies},
\]

\((7.49) (11.91)\)

\[\Delta \text{Manager Income}_t = 0.1072 + 0.0911 \Delta \text{Shareholder Wealth}_t + 0.0704 \Delta \text{Shareholder Wealth}_{t-1} + \text{Year dummies},\]

\((9.94) (10.60) (7.28)\)

\[\Delta \text{Manager Income}_t = 0.1030 + 0.0720 \Delta \text{Shareholder Wealth}_t + 1.047 \Delta \text{Profit}_t + \text{Year dummies},\]

\((7.35) (8.23) (14.20)\)

\(t\) value is in parentheses.