Complementarities among Authority, Responsibility, and Monitoring

Evidence from Japanese Business Groups*

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Abstract

This paper offers an empirical test of complementarities among delegated authority, responsibility, and monitoring, using unique survey data collected from group-affiliated companies in Japan. The survey provides information about how various decisions are made within business groups, each of which consists of a large core parent firm and its network of affiliated firms such as subsidiaries and related companies. We find some evidence that delegated authority and responsibility are complementary, implying that increasing assigned responsibility raises the marginal return from increasing delegated authority. We also obtain a stronger result that performance is likely to be higher under the combination of low authority and low responsibility or that of high authority and high responsibility than under the "mix and match" combinations where one of them is low and the other high. We then study the effects of monitoring intensity on the authority-responsibility pair and find that performance of the firm with the combination of high authority and high responsibility is increasing in monitoring intensity, while the combination of low authority and low responsibility is not. The result is consistent with the theoretical hypothesis that increasing monitoring intensity raises the marginal return from increasing delegated authority and responsibility.

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1 Introduction

Authority is a fundamental concept to understand organizations. Standard textbooks of organization behavior today continue to cover notions of authority by Weber, Barnard, and March and Simon. Economics of organizations seems to accord. Coase (1937) distinguished firms from markets based on the establishment of authority relationships in the former, and transaction cost economics has further developed the framework along this line (Williamson, 1985). The recent property rights approach, as summarized by Hart (1995), presupposes that the owner of an asset is endowed with authority over the use of the asset and uses the idea to determine boundaries of the firm. Although authority relationships may be observed in markets, and there are some arguments against the idea of authority relationships as a fundamental characterization of internal organization (notably Alchian and Demsetz, 1972), casual empiricism appears to confirm the prevalence of authority in organizations.

Business history, however, reveals various kinds of managerial struggle to balance between centralization founded on the hierarchical nature of the firm and decentralization through delegation of authority. Companies like Hewlett Packard in the U.S. and Matsushita (Panasonic) in Japan, both of which are well known for their divisional independence, frequently change their organizational structures to experiment different degrees of centralization and decentralization. The bottom line is that although the firm may be characterized by authority relationships in comparison with the competitive market, decentralization accompanying relinquishment of some of the decision rights is an inevitable consequence of the growth of the firm. The development of multidivisional organizational form (M-form) is a well-known example. Although the headquarters keep control over some critical decisions such as long-term strategy, financing, and resource allocation, authority over most operating decisions is delegated to divisional levels of the organization. Recently popular ideas such as outsourcing, business alliances, networks, team-based production systems, and so on, appear to be associated with further movement toward decentralization.

Two advantages of delegation are often mentioned. First, top management is never able to be well enough informed about detailed operations to make good decisions. It is costly to transmit all the relevant on-the-spot information up to top management, and head office managers, due to their limited attention and information processing capacities, cannot process all the operating information as well as engage in strategic decision making. Second, delegation of authority tends to improve effort incentives of those who are granted delegated decision rights.

However, decentralization has its own costs, and moving too far toward it must be remedied by countervailing centralizing moves. The major costs are those associated with "loss of control." The interest of the division manager who is empowered to make decisions in his

or her unit is not aligned perfectly with that of the headquarters, and hence his or her decision may not be optimal from the overall organizational standpoint. To remedy this "loss of control" problem, the headquarters need to maintain control over delegated decision making. To this purpose, the head office evaluates the division managers' decisions and actions or the performance of the divisions, and link them to the division managers' compensation, future promotion prospects, task assignment, and so on. In other words, authority must be accompanied by responsibility.

The statement that authority and responsibility must go hand in hand is well known, but there is little systematic empirical work that examines whether or not responsibility actually goes with authority.[1] An obvious problem is that delegation of authority is usually not observable and is hard to measure. We attempt to fill this gap by analyzing survey data from Japanese business groups.

We further examine how authority and responsibility interact with monitoring intensity. Theoretical literature built on the principal-agent framework and the incomplete contract paradigm suggests two distinct consequences concerning how optimal authority and responsibility change with monitoring: either monitoring and authority/responsibility are substitutes or they are complements. According to the substitutability result (Aghion and Tirole, 1997; Schmidt, 1996), increasing monitoring intensity by the principal raises the possibility that she intervenes into the agent's decision ex post and hence reduces the probability that the agent exercises his authority. This commitment problem further reduces the agent's real authority because it discourages the agent to work hard ex ante. This set of theoretical work therefore suggests that monitoring intensity and the authority-responsibility pair move to the opposite direction, and the optimal combination is likely to be either of the following two: "high authority, high responsibility, low monitoring," or "low authority, low responsibility, high monitoring."

On the other hand, the basic insight from the standard principal-agent framework is improved performance incentives by monitoring: "...in an optimally designed incentive system, the amount of measurement and the intensity of incentives are chosen together: Neither causes the other. However, setting intense incentives and measuring performance carefully are *complementary* activities,...undertaking either activity tends to make the other more profitable (Milgrom and Roberts, 1992, p.227, emphasis as in the original)." Increasing monitoring intensity improves performance measurement, and hence makes higher-powered incentives to elicit more effort less costly. Extending the standard model to incorporate delegation decisions such as Holmstrom and Milgrom (1991, 1994), Itoh (1994), Prendergast (2002), and so on, then leads to the prediction that control loss associated with delegation of author-

[1] Exceptions include Baiman et al. (1995), Nagar (2002), and DeVaro and Kurtulus (2006).

ity is smaller under more intensive monitoring, and hence it is optimal to provide the agent with more discretion. This set of work therefore suggests that the optimal combination is likely to be either "high authority, high responsibility, high monitoring," or "low authority, low responsibility, low monitoring." We provide some evidence for the latter complementarity hypothesis in our data set.

Our research is related to the recently growing set of literature that studies complementarities among practices in various contexts: Bresnahan et al. (2002) study complementarities among demand for skilled labor, information technology, work reorganization, and product innovation. Ichniowski et al. (1997) examine complementarities among various new "high productivity" human resource management (HRM) practices such as incentive pay, teamwork, employment security, flexible job assignment, skills training, and information sharing. Poppo and Zenger (2002) examine whether formal contracts and relational governance are substitutes or complements. Using Japanese data, Ohkusa and Ohtake (1997) study the productivity effects of introducing profit sharing, information sharing, and ESOP simultaneously.[2] We attempt to join them by analyzing, for the first time as far as we know of, interactions among three basic organizational factors (authority, responsibility, and monitoring).[3]

The rest of the paper is organized as follows. In Section 2, we explain the notion of complementarities to be tested empirically in later sections, and possible interactions among authority, responsibility, and monitoring, based on existing theoretical literature.

In Section 3, we review some empirical work on authority, and then summarize institutional features of Japanese business groups. In this paper, we focus on a particular type of business groups, that consists of a large corporation as the core parent firm and its network of affiliated firms such as subsidiaries and related companies. The business group in this sense is prevalent in Japan: Most large Japanese corporations form such groups. And the allocation of authority between the parent firm and the affiliated firms is a serious problem to be solved.

In Section 4, we explain our data and variables. Our unique survey data is based on questionnaires distributed to more than 2,000 affiliated firms in Japan, and ask each firm how various decisions are made in conjunction with its parent firm. From them we can construct proxies for the degree of delegated authority as well as responsibility and monitoring. The results are reported in Section 5, which are in general consistent with the hypothesis that the three governance variables are complementary. Section 6 offers concluding remarks.

[2]These constitute only a partial list. Other related work includes Arora and Gambardella (1990), Brickley (1999), and Van Biesebroeck (2006).

[3]However, we admit that our analysis cannot escape from the identification problem for testing complementarities (Athey and Stern, 1998).

2 Theoretical Framework

In this section we discuss our theoretical hypotheses based on existing theoretical literature. We adopt the principal-agent framework in which the parent company is the principal and the affiliated firms are her agents. The parent firm chooses various governance variables to maximize her objective function, aiming at motivating the top manager of each affiliated company to cooperate with the parent firm and manage his businesses appropriately.

2.1 Authority and Responsibility

Following Simon (1951), we understand that party 1 exercises authority over party 2 if party 2 accepts and follows party 1's decision concerning what actions party 2 performs on his job. This definition is not explicit in whether party 1's authority is a legitimate right or a de facto control. The economic literature had not distinguished between these two notions of authority until Aghion and Tirole (1997), who call the former *formal authority* and the latter *real authority*. Although one of the features of our data is that we can distinguish between them, theoretical predictions are not different whether formal authority or real authority are assumed. For these reasons, we do not take into consideration the possible disparity between them, unless we discuss those models that are explicit about the distinction. In our empirical analysis, we will use proxies for real authority because it is reasonable to assume that the formal authority always resides with the parent firm.

The parent firm may prefer implementing decentralization because the affiliated firm tends to have more knowledge and be better informed of its business, the parent firm can avoid overload and concentrate on her core businesses and strategic issues, and delegating decisions may work as an incentive device or may facilitate participation and cooperation. However, delegation of authority accompanies "loss of control." The affiliated firm's best decision may not be optimal for the parent firm, or the manager may engage in private activities that do not directly contribute to either the parent's or the affiliated firm's performance.

To remedy the "loss of control" problems, the parent firm needs to maintain control over delegated decision making. To this purpose, she evaluates the affiliate's decisions and actions, or the performance of the affiliated firm, and link them to the manager's compensation, future promotion prospects, task assignment, and so on. In other words, authority has to be accompanied by *responsibility*: authority and responsibility are *complementary*.

To define complementarity formally, let $f(A, R, K)$ be the objective function (performance, profit, earning ratio, productivity, and so on) of the parent firm. Variable $A \in \mathbb{R}$ measures delegation of authority, that is, the extent to which decision is made by the affiliated firm. Variable $R \in \mathbb{R}$ represents the extent to which the agent takes responsibility for his

decision and/or the performance. A typical responsibility the affiliated firm takes is for profit or earning ratio: If the affiliated company fails to attain its target profit, then the company's manager will take responsibility by giving up bonus, leaving office, or being demoted. K represents a vector of other endogenous or exogenous variables.

We say A and R are *complementary* if and only if the following inequality holds for all k, $a > a'$ and $r > r'$:

$$f(a, r, k) - f(a', r, k) \geq f(a, r', k) - f(a', r', k). \tag{AR}$$

That is, increasing responsibility from r' to r raises the additional return from increasing delegated authority from a' to a.[4] By rearranging the inequality, one can see alternatively that the additional return from higher R increases with A:

$$f(a, r, k) - f(a, r', k) \geq f(a', r, k) - f(a', r', k).$$

If f is twice differentiable, then complementarity is equivalent to $\partial f^2(A, R, K)/\partial A \partial R \geq 0$.

Note that the definition does *not* imply anything about whether performance level is increasing or decreasing in A or R. All it means is that performance differential is increasing. For example, suppose $A \in \{0, 1\}$ and $R \in \{0, 1\}$, and define $f(0, 0) = w$, $f(0, 1) = x$, $f(1, 0) = y$, and $f(1, 1) = z$. Figure 1 summarizes the relationship between performance and (A, R). While complementarity (AR) means $z - x \geq y - w$, it has nothing to do with monotonicity $z \geq x$ and $y \geq w$ (performance is increasing in delegated authority) or $z \leq x$ and $y \leq w$ (it is decreasing).

Figure 1: Authority, responsibility, and performance

		R = 0	R = 1
A = 0		w	x
A = 1		y	z

Furthermore, complementarity (AR) does *not* imply that "mix and match" be worse than coherent combinations:

$$z \geq \max\{x, y\} \tag{1}$$

$$w \geq \max\{x, y\} \tag{2}$$

[4] Our definition of complementarity is equivalent to function f having *increasing differences* in (A, R), or f being *supermodular* in (A, R). See Milgrom and Roberts (1990) and Topkis (1998) for the details.

(1) implies that performance is higher when both A and R are high than when only one of them is high and the other is low. Similarly, (2) implies that performance is higher when both A and R are low than when one of them is low and the other is high. These features are intuitively more appealing but we would like to remind the readers that the standard definition of complementarity (AR) does not imply them. More generally, these conditions are stated as follows: For all k, $a > a'$, and $r > r'$,

$$f(a, r, k) \geq \max\{(a', r, k), f(a, r', k)\}, \tag{ARH}$$

$$f(a', r', k) \leq \max\{f(a, r', k), f(a', r, k)\}. \tag{ARL}$$

If (ARH) and (ARL) hold for all k, $a > a'$ and $r > r'$, then complementarity (AR) is satisfied. We empirically test whether or not (ARH) and (ARL) hold as well as (AR) itself.

Holmstrom and Milgrom (1991, 1994) present a formal derivation of complementarity between delegated authority (discretion) and responsibility (incentive intensity in their model). The agent engages in multiple activities, some of which are productive in the sense that higher effort exerted at those activities increases the principal's payoff, while others are private, outside activities. Authority is represented by whether or not the principal allows the agent to engage in unobservable outside activities, and responsibility is measured by the incentive coefficient of the linear compensation scheme. Other things being equal, more delegated authority increases the agent's effort toward outside activities through his incentive compatibility constraint. However, because various activities are cost substitutes, the marginal cost of increasing effort toward productive activities rises with effort toward outside activities. This is the opportunity cost of delegated authority. And this cost is smaller as the incentive scheme provides the agent with higher-powered incentives, that is, more responsibility. The marginal return from delegated authority is therefore increasing in responsibility.

The well-known analysis of delegated authority by Aghion and Tirole (1997) suggests an alternative derivation. They assume, for the most part of their paper, that the agent does not respond to monetary incentives, and hence responsibility is not an issue. However, in one subsection of the paper, they generalize the model to allow the agent to respond to monetary incentives, and show that stronger incentives raise the agent's real authority, because they help the principal and the agent align their interests and mitigate the control loss problem.

The model of Prendergast (2002) also demonstrates complementarity between delegation and responsibility formally. In his model, one of two productive tasks has to be chosen, and the agent has better knowledge about the environment and hence knows precisely which the right task is. The principal can decide whether to restrict the agent's activity to one particular task, or to leave the choice of the task to him. If the principal chooses the task to

be performed, she will chooses task 1 since she enjoys a small private benefit from implementing it. Now suppose that the decision is delegated to the agent. If no responsibility is assumed, the agent will choose task 2 since he obtains a small private benefit from the task. On the other hand, if the agent bears a responsibility for his decision, the agent is motivated to choose the more productive task, which also benefits the principal. Delegation and responsibility thus go hand in hand.

2.2 Monitoring

Although systematic empirical evidence of the link between delegated authority and responsibility is scarce, complementarity between them appears to be uncontested. However, how monitoring intensity affects their link is more subtle. We rewrite the parent firm's objective function as $f(A, R, M, G)$ where $M \in \mathbb{R}$ measures her monitoring intensity over the affiliated firm's decision (input) and performance (output), and G is a vector of exogenous variables. The parent firm could monitor the affiliated firm's decision by sending directors or executives to the latter's board and having joint meetings. The parent firm could check profit and loss (P/L) and balance sheet (B/S) frequently to evaluate the affiliated firm's performance, and use its information to reward or punish the executives.

The analyses of Holmstrom and Milgrom (1991, 1994) suggest that monitoring reinforce benefits from delegated authority and responsibility, and exhibit complementarity with them. Increasing monitoring intensity reduces costs of implementing high-powered incentives by improving performance measurement,[5] and hence raises the additional benefit from delegating authority accompanied with responsibility.

Formally, we define complementarity between the authority-responsibility pair and monitoring as follows:[6] For all g, $(a, r) > (a', r')$ and $m > m'$,

$$f(a, r, m, g) - f(a', r', m, g) \geq f(a, r, m', g) - f(a', r', m', g). \tag{AR-M}$$

That is, the additional gain from *simultaneous* increase in delegated authority and responsibility is increasing in monitoring intensity.[7]

[5] This part is called the Monitoring Intensity Principle by Milgrom and Roberts (1992, p.226) (see the citation from them in Section 1 of the current paper).

[6] $(a, r) > (a', r')$ implies $a \geq a'$, $r \geq r'$, and $(a, r) \neq (a', r')$.

[7] Note that (AR-M) is implied by a more general property that $f(A, R, M, G)$ is *supermodular* in (A, R, M): For all r, g, $a > a'$, and $m > m'$,

$$f(a, r, m, g) - f(a', r, m, g) \geq f(a, r, m', g) - f(a', r, m', g), \tag{A-M}$$

and for all a, g, $r > r'$, and $m > m'$,

$$f(a, r, m, g) - f(a, r', m, g) \geq f(a, r, m', g) - f(a, r', m', g), \tag{R-M}$$

In our empirical analysis we will further test whether the following stronger relation holds: For all g, $a > a'$, $r > r'$, and $m > m'$,

$$f(a, r, m, g) > f(a, r, m', g), \tag{AR-MH}$$

$$f(a', r', m, g) < f(a', r', m', g), \tag{AR-ML}$$

which means that if delegated authority and responsibility are both high (low), then performance increases by raising (reducing, respectively) monitoring intensity as well. (AR-MH) and (AR-ML) imply (AR-M).

Note that monitoring intensity in Holmstrom and Milgrom (1991, 1994) concerns performance measurement. Different conclusion could arise if we instead focus on other aspects of monitoring. In the model of Aghion and Tirole (1997), the principal chooses monitoring intensity which affects the probability that the principal is informed of the profile of the agent's project. More intensive monitoring reduces the agent's real authority by increasing the possibility that the principal is informed and makes her best decision as well as by reducing the agent's incentive to gather information. Their model thus suggest that monitoring intensity reduce the marginal benefit from delegation authority.

The similar result can be obtained from Schmidt (1996) who analyzes the choice between nationalization and privatization. In his model, nationalization implies that the government can obtain more precise cost information and hence cannot avoid intervening to attain ex post efficient production. This commitment problem in turn attenuates the firm manager's incentive to save costs. It is thus better for the principal to keep control of critical decision rights in her hand. In contrast, privatization can work as a commitment device by losing monitoring capability and hence the opportunity to intervene ex post.

One of the main results in Prendergast (2002) is that more uncertainty in the sense of more varying task-specific payoffs leads to a higher degree of delegation associated with higher powered incentives. Thus if monitoring reduces the variance of the task-specific payoffs, delegated authority and responsibility will decrease, in contrast to Holmstrom and Milgrom (1991, 1994).

The mentioned work therefore suggests that some forms of monitoring could discourage delegation of authority and responsibility: The marginal benefit from delegating authority and assigning responsibility is smaller as the parent firm chooses to monitor more intensively. Our empirical analysis does not aim at testing which of these opposite predictions our sample supports: We use a proxy for monitoring intensity that is associated primarily, but not exclusively, with performance measurement, and hence our test is more concerned

hold, in additional to (AR). Although (A-M) and (R-M) are sufficient for (AR-M), we mainly focus on (AR-M) in our empirical analysis.

with Holmstrom and Milgrom (1991, 1994) as well as Milgrom and Roberts (1992).[8]

3 Empirical Analysis: Preliminaries

3.1 Literature Review

In this subsection, we briefly review literature that studies the determinants of authority in decision making empirically, using quantitative data. The main issue is the measurement of authority. The most well-known measure seems to be the one developed by the Aston group in the study of British business organizations (Pugh et al., 1968). The Aston measure of centralization/decentralization is constructed from mean hierarchical level (such as direct worker, supervisor, middle manager, department head, and so on) at which formal authority to make various decisions exists. A series of studies by the Aston group and others examine the relationship of the measure with other aspects of organizations like size, technology, formalization, and so on. The main finding is that the more bureaucratic the organization is (taller hierarchy, more rule-oriented, more formalized, and so on), the greater the delegation of decision making is. This result is consistent with the agency framework in which decentralized decision making must accompany centralized control. These studies also point out importance of technology, such as batch size, automation, and workflow.

Since we focus on the allocation of authority between firms rather than within organizations, we believe these technological factors are less relevant.[9] Furthermore, the unit of analysis is different so that we can measure the degree of decentralization simply by asking which of the core firm or the affiliated firm has authority over decisions, rather than by asking hierarchical levels.[10]

Baiman et al. (1995) is the first empirical study of authority relation, as far as we know, that follows explicitly the agency framework. They use survey data for CEO of business units (groups and divisions) to examine delegation of authority to them. They measure decentralization by the following binary variable: The value is one if the business unit has direct control over makes and purchases decisions without corporate approval for core func-

[8] We should note that Aghion and Tirole (1997), when they analyze monetary incentives, discuss informally how performance measurement affects delegated authority, and state that "better performance measurement raises an agent's real authority." And in Prendergast (2002), if monitoring improves performance measurement, delegation and high-powered incentives are more likely to be optimal. Their results hence do not really contradict those from Holmstrom and Milgrom (1991, 1994) and Milgrom and Roberts (1992).

[9] Even concerning internal organization, these factors are even less relevant for Japanese firms, as Lincoln et al. (1986) show.

[10] Of course, we could complicate the analysis by further opening up the blackbox of the internal organizations of the core firm and the affiliated firm. We however believe such an extension will not add much further insights.

tions applicable to the unit, and zero if the unit has shared control with another part of the company. They test predictions concerning relationships between delegation and importance of businesses or CEO's expertise.

The studies mentioned above focus implicitly on the allocation of formal authority. Nagar (2002) studies the extent of delegation from top management to branch managers in retail banks. He uses survey questions that ask the senior executives about the branch managers' real authority: to what extent do the branch managers have a say in hiring, promoting, setting hours, and changing selling processes. Each answer is one of scales 1 to 7. He then measures the extent of delegation by the standardized aggregated sum of the answers, and examines the link between delegation and incentive intensity that is measured by the proportion of the typical branch manager's pay that is bonus-based.[11]

The only study that distinguishes between real authority and formal authority is Lincoln et al. (1986). In their comparative survey of both U.S. and Japanese manufacturing plants, they construct the Aston-like measure of *de facto* decentralization from mean hierarchical level at which various decisions are *in practice* made. They find, among other things, that the Japanese organization is more formally centralized while it is more decentralized in terms of real authority.

3.2 Background: Japanese Business Groups

Our empirical analysis focuses on the allocation of authority in decision making within business groups in Japan. Although studying Japanese business groups per se is not our objective, providing a brief summary of their important features will help clarify our data and variables, which we do in this subsection.[12]

While there are several types of business groups in Japan, in the current paper, the Japanese business group exclusively refers to the one which consists of a large core com-

[11] After completing the first version of the paper, we have found two more relevant empirical work. Colombo and Delmastro (2004) study delegation of strategic decision making in manufacturing plants by designing a questionnaire analysis. They measure delegation by a three-categorical ordered variable: (a) centralization; (b) partial delegation; and (c) full delegation. The partial delegation can be interpreted as delegation of not formal but real authority, while the full delegation is allocation of both formal and real authority to plant managers. The variable is thus a mixture of formal and real authority. They mainly test how technological characteristics of plants and decisions affect delegation. DeVaro and Kurtulus (2006) conduct an empirical test of Prendergast (2002)'s theory by estimating probit models in which the dependent variable indicates use of performance pay (responsibility), and worker authority over tasks as independent variables. They construct indicator variables for delegated authority from the question "In general, how much influence do you have about the ranges of tasks you do in your job?". They thus measure real authority, as we do.

[12] Recent literature, available in English, that describes institutional features of the Japanese business group (in our sense) in detail includes Ito (1995), Ito and Rose (1994), and Shiba and Shimotani (1997).

pany and its network of affiliated firms such as subsidiaries.[13] The majority of large Japanese corporations form such groups. According to *Kigyo Group nai Jinzai Katsuyo ni kansuru Chosa Kenkyu Hokokusho* (Research Report on Human Resource Management within Business Groups) published in 1987, 88% of the listed corporations own subsidiaries (over 50% of the shares directly owned by the core firm) and related companies (20–50%). The group may also include firms with weaker shareholdings ties, for historical or other transactional reasons. The well-established annual publication *Nihon no Kigyo Group* (Japan's Business Groups) identifies membership of the groups by distributing questionnaires to all listed corporations and other large nonlisted firms (around 3,000 firms in total). The affiliated firms of each group are determined as those which the core firm designates as members. According to the 1998 version of *Nihon no Kigyo Group*, whose data are based on the survey conducted during 1997, the average number of affiliated firms per group headed by the core firms in the manufacturing industries is 30.3, among which 20.4 are domestic firms. These figures are relatively constant during the 1990s.

The affiliated firms play various roles. Many of them are vertically related with the core firm. When the core firm is a manufacturer, the affiliated firms supply parts or materials, assemble the core firm's products, or engage in sales. Some of them also belong to businesses that are different from those of the core firm, and help the group as a whole diversified. *Nihon no Kigyo Group* 1998 reports that approximately 70% of the affiliated firms belong to businesses different from those of the core firm. The 1994 version reports the following figures: When asked to choose a type of the group, 24.5% of the manufacturing core firms choose "vertical division of labor" and 39.0% choose "mixed system of both vertical and horizontal division of labor," and hence the vertically oriented group is dominant in the manufacturing sector. On the other hand, a nontrivial percentage of the manufacturers (19.4%) choose "conglomerate" or "horizontal division of labor." The percentage increases to 40.3% in the non-manufacturing sector.

Personnel ties between the core firm and its affiliated firms are important. The latter often accept employees of the core firm at various levels of positions such as the president, directors and upper management. Temporary transfers from the core firm to its affiliated firms are common (and to a lesser degree, transfers from the affiliates to the core firm). The labor force of some affiliated firms is entirely composed of those transferred from the core firm, and they do not engage in hiring their proper employees.

There are several routes through which the group is formed. Two typical ones are either

[13] It therefore should be distinguished from the *zaibatsu*-originated or bank-oriented group such as Mitsubishi, Mitsui, Sumitomo, Fuyo, Sanwa, and Daiichi Kangyo. This type of business groups, often called financial or horizontal *keiretsu*, is a loose horizontal association of large firms across industries, including general trading companies, banks, insurance companies, as well as manufacturers.

spinoff or takeover.[14] According to Sakamoto (1992), Toyota Motor had 14 listed affiliated firms as of June 1992, of which 6 were spun off as separate firms from Toyota, and 5 were originally independent firms that were taken over by Toyota.[15] Hitachi had 18 listed affiliated firms as of March 1992, of which 11 were formed via spinoff and 7 joined the group via takeover. Two other possibilities are new businesses and joint venture. Affiliated firms may be formed for entry into new businesses, or may originally be formed as joint ventures with other companies and later acquired from them by the core firm.

Why the large Japanese corporation forms a group by creating lots of affiliated firms is an interesting question, although it is beyond the scope of the current paper. The question can be rephrased as one concerning boundaries of the firm: Why cannot the Japanese firm attain the same benefits through creation of internal units as those from creating separate affiliates? We summarize several informal arguments below.

Most of the oft-heard reasons for group formation concern the performance of the core firm rather than that of the separated firm (Aoki, 1984; Odagiri, 1992). First, the large Japanese firm is motivated to make the main body slim and homogeneous, and for that purpose it creates positions outside the core firm for those who are transferred from the firm. Why do the Japanese firm pursue a slim and homogeneous body? There are several possibilities: The permanent employment practice restricts the firm to cut down its labor force flexibly and promptly; it facilitates intra-organizational information flow associated with consensus-based decision making process; centralized personnel department must administer various personnel matters in a comprehensive, career-oriented way, and its burden will be reduced; and enterprise unions can represent their employees more easily. In other words, the business group is an institutional arrangement that supports other prominent features of the Japanese economy, as argued by the leading economists such as Aoki (1994), Milgrom and Roberts (1994), and Williamson (1991).

Second, the large Japanese firm can utilize status and pay differentials between the core firm and affiliated firms to motivate its employees. It separates from the main body businesses/functions such as those which do not require advanced expertise, or those which are located at local regions. The business group thus functions as a strong incentive mechanism for the employees of the core firm.

[14]The usage of the term "spinoff" here is different from the one in finance literature in which spinoff implies the creation of a separate corporation the shares of which are distributed to the shareholders of the original firm, and hence no parent-subsidiary relationship is created. Here spinoff simply means that the new affiliated firm was originally an internal unit of the core firm.

[15]Of the remaining three, Toyota Automatic Loom Works was the parent firm of Toyota Motor, when it was, along with the other two (Toyoda Tsusho and Aichi Steel Works), spun off from the former. Toyota Motor later acquired the shares of the original parent firm and the other two and made them as its affiliated firms.

On the other hand, most surveys of the core firms concerning their motives to create affiliated firms reveal consistently that they are more concerned with the performance of the businesses separated from the main body. For example, according to a 1987 report cited earlier, the core firms, which were asked to choose (possibly multiple) reasons they spin off internal units and create separate firms, believe that separate firms can specialize in narrowly defined fields and grow rapidly than internal units. One possible explanation may be that the divisions of the large Japanese corporation are not as autonomous and responsible for their performance as the U.S. counterparts, and hence separation facilitates the sense of responsibility, performance evaluation, and the provision of incentives. This explanation is incomplete, however, since many of the affiliated firms are subsidiaries and are hence owned by the core firm, and we do not have an established theory to clarify how they are different from internal divisions.[16]

4 Data and Variables

4.1 Data

The data set was constructed from questionnaires distributed to and collected from Japanese firms affiliated with some business groups during January 2001. The 1999 version of *Nihon no Kigyo Group* lists 241 core companies in electronics industry and their 2,581 affiliated firms, based on the survey conducted during 1998. We distributed questionnaires to all the 2,581 affiliated firms and received answers from 713 firms. The response ratio was 27.6%. We dropped from the sample the firms with abnormal values and answers. Tables 1 and 2 show summary statistics for the remaining 578 firms that provide all the information.

Panel (a) of Table 2 first shows median years of operation (as of 2000). The median is 13 years, implying that the median established year was 1977. We will later exclude from the sample for estimation the affiliated firms whose years of operation are 2 years or shorter because the governance variables are not likely to be crucial for the performance of such young affiliated firms. Panel (a) also shows ownership structures. Only a small percentage of the affiliated firms are public corporations, and the majority are subsidiaries, in particular, those wholly owned by their parent firms. The first part of Panel (b) shows that new establishment and separation from the parent firm are the two most common ways

[16] See Hart (1995, p. 63, footnote 12). Itoh and Hayashida (1997) argue that even if a subsidiary is wholly owned by the parent firm, it is different from an internal division in terms of employment relationships: The employees of the subsidiary do not sign employment contracts with the parent firm while the employees belonging to the internal division has contractual relationship with the parent firm. This difference affects the employees' incentives to make relation-specific investment.

the affiliated firms was created. The second part of Panel (b) shows that although the parent firms are in the manufacturing (electronics) sector, nearly 50% of the affiliated firms engage in businesses in the non-manufacturing sector.

4.2 Measuring Delegated Authority, Responsibility, and Monitoring

In this subsection, we discuss how we measure three key governance variables, delegation of authority, extent of responsibility, and monitoring intensity.

Delegation of authority There are numerous decisions to be allocated between the parent firm and her affiliated firms, and hence a single measure of decentralization is of no use. We thus attempt to measure delegated authority of the observation separately for each decision. The questionnaire lists 13 decisions such as budgets, capital investment, organizational change, new product development, where to buy or sell, hiring, promotion, financing, and so on, from which we use three strategic decisions for analysis:

Decision 1: Medium- and long-term strategy.

Decision 2: Annual budget and business planning.

Decision 3: Important changes of organizational structures.

For each decision, the questionnaire asks how *de facto* decision has been made, and the respondent selects one of the following six categories: (a) no opportunity for such a decision, (b) de facto decision is mostly made by the core firm, (c) de facto decision is more or less made by the core firm, (d) cannot say one way or the other, (e) de facto decision is more or less made by the affiliated firm, and (f) de facto decision is mostly made by the affiliated firm. If (a) is chosen, we exclude such an observation from the sample. We then define categorical variable AUTi for Decision i by assigning to each sample firm the following three categories L (for Low), M (for Middle), and H (for High):

AUTi = L: De facto decision is mostly/more or less made by the core firm.

AUTi = M: Cannot say one way or the other.

AUTi = H: De facto decision is mostly/more or less made by the affiliated firm.

The extent to which decision i is delegated to the affiliate increases as AUTi changes from L to M, or from M to H.

Note that we do not use a measure of formal authority but of real authority. The underlying assumption is that as in Baker et al. (1999) the formal authority always resides with

the parent firm. As Panel (a) of Table 2 shows, more than 90% of the sample are majority owned subsidiaries, and more than two thirds are wholly owned. And we will later restrict the sample further by dropping the observations with 50% or less ownership ratio by their parent firms. We thus believe our focus on real authority be reasonable.

Responsibility Responsibility could be measured via executive compensation, promotion, and/or turnover of the affiliated firm's top management. However, these objective measures are not available and hence we must rely on the respondents' subjective judgment. The extent of responsibility each firm takes is measured based on the answer to the following question. "The executives' compensation and careers are *not* affected by failure of achieving the expected standard of P/L (profit and loss)." The respondent selects one of the following categories: (a) definitely true, (b) more or less true, (c) cannot say one way or the other, (d) more or less incorrect, (f) definitely incorrect. We define categorical variable RES by assigning to each sample firm the following three categories:

RES = L**:** Definitely/more or less true.

RES = M**:** Cannot say one way or the other.

RES = H**:** Definitely/more or less incorrect.

Sample firms with RES = H are intepreted as most resposible for its performance, followed by RES = M. Samples with RES = L are least responsible.

Monitoring Monitoring intensity of the parent firm is constructed based on the answer to the following question. Each respondent is first asked whether the parent company checks P/L (profit and loss) of the affiliated firm regularly, and if the answer is yes, the respondent is then asked how frequently the parent firm checks P/L. From the answer we classify the frequency into two categories and construct variable MON as follows.

MON = L**:** The parent firm does not check P/L regularly, or checks P/L every six month or less.

MON = M**:** The parent firm checks P/L every three month or more.

The distribution of this variable is not as scattered as the other variables, and hence we make two categories. Firms with MON = H are regarded as more intensively monitored by the parent firm than those with MON = L. Note that this variable of monitoring intensity is naturally associated with performance measurement.

4.3 Empirical Methods

Our empirical strategy is to look at the parent firms' performance as a function of our governance variables measuring authority, responsibility, and monitoring, and whether it exhibits complementarity.[17] We assume that each parent firm wants to maximize the total profit of its business, which depends on its own profit as well as the affiliated member firms' profits. As we have argued in subsection 3.2, the parent firm is typically far larger than its affiliates, and establishes the affiliates mainly in order to improve its own performance rather than them. The parent firm's performance is thus unlikely to be an appropriate performance measure for the affiliated firm's governance variables.

We thus measure the parent firm's objective by each affiliated firm's performance, in particular, its operating profit to sales ratio (PPS). In other words, we assume that the parent firm wishes to maximize the profit ratio of each of her affiliated firms. To validate this assumption, we further restrict our sample. First, we drop the observations with 50% or less owned by the parent companies. As a result, the parent firm of each observation owns more than 50% (mostly 100%) of the shares, and hence higher profit of the observation benefits its parent firm. Second, in order to further align the interest of each affiliated firm with that of its parent firm, we drop from the sample those affiliate companies whose products/services and their parents' are competing. The questionnaire includes the following question: "Does your parent company sell products/services that are competing with your main products/services? In other words, do your main products/services tend to sell less as your parent's product/services sell more?" Each respondent can choose one of the following four categories: (a) definitely yes; (b) more or less yes; (c) more or less no; (d) definitely no. We exclude from the sample the observations which chose (a) or (b), which correspond to 10.8% of the sample. Since information about the governance variables is available only for a subset of our sample, 324 firms remains for estimation.

Table 3 summarizes the distributions of our governance variables.

We include the following control variables. First, we measure size of the firm by the natural logarithm of capital. Second, three industry dummy variables are included, indicating respectively that whether or not each observation is in the manufacturing category, the sales category, and the other service category. Third, The affiliate firm's performance is likely to depend on how dependent the affiliate is on the parent firm. We include two variables measuring the affiliate's degree of dependence on the parent firm, the ratio of the affiliate's

[17] Three authority variables are positively and significantly correlated, and the responsibility variable is positively and significantly correlated with AUT3. However, the other bivariate correlations are not significant, and various combinations of the values of these variables are found in our sample, maybe due to substantial adjustment costs and simple mistakes. We thus take the approach of estimating the performance function.

sales to the parent firm over the total sales (SDEP), and the ratio of the affiliate's buying expenses from the parent firm over the total purchase expenses (PDEP).

Fourth and finally, because the parent firms create the affiliated firms for various reasons, we constructed two variables to measure types of the affiliated firms. In the questionnaire we listed seventeen possible reasons for creating affiliated companies, and asked the respondent to what extent each reason applies and to choose one of the five categories (definitely true, somewhat true, cannot say one way or the other, somewhat incorrect, definitely incorrect). We then conducted factor analysis using the principal-components factor method. Five common factors are retained. The first factor describes "organizational" reasons and is characterized by specialization, accountability, delegation of authority, and faster decision making. The second factor describes "personnel" reasons and is characterized by reducing personnel expenses and implementing employment system distinct from that of the parent firm. We then created two scores TYPE1 and TYPE2 for these orgainzational and personnel respective reasons, respectively, and included as independent variables in our estimation.[18]

The summary statistics of the control variables are provided in Table 4.

5 Empirical Analysis and Results

Before analyzing the effects of the governance variables, we first summarize briefly the results concerning the coefficients of the control variables not reported in the following tables. The coefficient of the size variable is negative in most cases, and sometimes significant. The affiliated firms in the service sector perform better than those in the manufacturing or sales sector, other things being equal. Those in the manufacturing sector performs significantly worse. The coefficients of two reason variables are positive, and sometimes significant. The performance of the affiliate firm is lower as it is more dependent on the parent firm in terms of purchases.

5.1 Authority and Responsibility

We first examine complementarity between delegated authority and responsibility. To this purpose, we estimate the following equation for each value of MON $\in \{L, H\}$.

$$\text{PPS} = \alpha_0 + \alpha_1(I_L^{ai} \times I_L^r) + \alpha_2(I_H^{ai} \times I_H^r) + \boldsymbol{\gamma}\mathbf{CONT} + \epsilon \tag{E1}$$

where **CONT** is a vector of control variables explained at the end of the preceding section, and I_j^g is a indicator variable for $g = a, r, m$ and $j = H, L$: $I_L^{ai} \times I_L^r = 1$ indicates AUTi =

[18] We do not control parent firms in our main analysis. See subsection 5.4 for an alternative analysis where the parent-firm effects are taken into consideration.

L and RES $= L$ and $I_H^{ai} \times I_H^r = 1$ AUTi $= H$ and RES $= H$. The coefficients of the interaction terms measure the performance effects of (Low Authority, Low Responsibility) and (High Authority, High Responsibility) compared with the remaining patterns (see Figure 2). Complementarity (AR) predicts $-\alpha_1 \leq \alpha_2$. This condition holds if ($\alpha_1 > 0$ and $\alpha_2 = 0$), ($\alpha_1 = 0$ and $\alpha_2 > 0$), or ($\alpha_1 > 0$ and $\alpha_2 > 0$), the last of which corresponds to the stronger relationships (ARH) and (ARL).

Figure 2: How to estimate complementarity between authority and responsibility 1

		Responsibility L	Responsibility M	Responsibility H
Authority	L	$I_L^{ai} \times I_L^r$		
	M			
	H			$I_H^{ai} \times I_H^r$

We also estimate the same equation by dropping the observatinos with intermediate value M for either AUTi or RES (see Figure 3). The cofficeints of the interaction terms then inform us how well firms with (Low Authority, Low Responsibility) and (High Authority, High Responsibility) do compared with those with "mix and match" combinations (Low Authority, High Responsibility) and (High Authority, Low Responsibility). If we find $\alpha_1 > 0$ and $\alpha_2 > 0$ in this estimation, it supports the stronger property (ARH) and (ARL).

Figure 3: How to estimate complementarity between authority and responsibility 2

		Responsibility L	Responsibility M	Responsibility H
Authority	L	$I_L^{ai} \times I_L^r$	drop	
	M	drop	drop	drop
	H		drop	$I_H^{ai} \times I_H^r$

The estimation results are reported in Table 5. In Panel (a), all the samples are included and hence the estimation corresponds to Figure 2, while the samples with AUTi $= M$ or RES $= M$ are dropped in Panel (b) as in Figure 3. First, the coefficient of (Low Authority, Low Responsibility) and that of (High Authority, High Responsibility) satisfy $-\alpha_1 \leq \alpha_2$ for 11 out of 12 cases.[19] These results are consistent, although weak, with the complementarity

[19]F-tests reveal that the difference between $-\alpha_1$ and α_2 is significant at the 10% level in two cases (two AUT3

hypothesis between authority and responsibility (AR).

Furthermore, When monitoring intensity is high, both coefficients are always positive, and the coeffieicnts of (High Authority, High Responsibility) are significant for AUT3. These results are consistent with (ARL) and especially (ARH) that firms with (Low Authority, Low Responsibility) or (High Authority, High Responsibility) perform better than those with the "mix and match" combinations.

When monitoring intensity is low, the coefficients of (High Authority, High Responsibility) are negative but insignificant. On the other hands, the coefficients of (Low Authority, Low Responsibility) are mostly positive, and significant for AUT3 and, when samples are restricted to AUTi, RES $\in \{L, H\}$, for AUT1 as well. These results are consistent with (ARL).

5.2 Effects of Monitoring on Authority and Responsibility

The results in the previous subsection show that firms with (Low Authority, Low Responsibility) are likely to perform better when monitoring intensity is low, and those with (High Authority, High Responsibility) are likely to be superior when monitoring intensity is highr. These observations are consistent with (AR-MH) and (AR-ML). In this subsection we first test these hypotheses by estimating the following equation.

$$\begin{aligned} \text{PPS} = \beta_0 &+ \beta_1 I_L^{ai} + \beta_2 I_H^{ai} + \beta_3 I_L^r + \beta_4 I_H^r \\ &+ \beta_5 I_H^m + \beta_6 (I_L^{ai} \times I_L^r) + \beta_7 (I_H^{ai} \times I_H^r) \\ &+ \beta_8 (I_H^m \times I_L^{ai} \times I_L^r) + \beta_9 (I_H^m \times I_H^{ai} \times I_H^r) \\ &+ \boldsymbol{\gamma}\mathbf{CONT} + \epsilon \end{aligned} \tag{E2}$$

(AR-ML) predicts $\beta_8 < 0$ and (AR-MH) predicts $\beta_9 > 0$: The performance of the firms with (Low Authority, Low Responsibility) decreases and that of the firms with (High Authority, High Responsibility) increases, as the monitoring intensity rises from low to high.

The results are reported in Table 6. The coefficients of (High Authority, High Responsibility, High Monitoring) are positive and mostly significant, supporting (AR-MH) for (High Authority, High Responsibility). On the other hand, although the coefficients of (Low Authority, Low Responsibility) are often positive and significant, monitoring intensity does not reinforce this effect: The coefficients of (Low Authority, Low Responsibility, High Monitoring) are mostly negative, and sometimes significantly so, again consistent with (AR-ML). Note that controlling the interaction terms, we find delegated authority or responsibility alone is not likely to contribute to performance. And the coefficient of High Monitoring

models with high monitoring).

is significantly negative, suggesting that more frequent monitoring alone actually hurt the performance of the firm. This result may be due to reverse causality: Firms with bad performance are likely to be monitored more intensively.

Second, we test complementarities among three variables, that is, (AR), (A-M), and (R-M), by estimating the following equation.

$$\begin{aligned} \text{PPS} = \eta_0 &+ \eta_1 I_L^{ai} + \eta_2 I_H^{ai} + \eta_3 I_L^r + \eta_4 I_H^r \\ &+ \eta_5 I_H^m + \eta_6 (I_L^{ai} \times I_L^r) + \eta_7 (I_H^{ai} \times I_H^r) \\ &+ \eta_8 (I_H^m \times I_H^{ai}) + \eta_9 (I_H^m \times I_H^r) \\ &+ \boldsymbol{\gamma}\mathbf{CONT} + \epsilon \end{aligned} \tag{E3}$$

The supermodularity of the objective function predicts $\eta_8 > 0$ and $\eta_9 > 0$ in addition to $-\eta_6 < \eta_7$. The estimation results are reported in Table 7. The coefficients of (Low Authority, Low Responsibility) and (High Authority, High Responsibility) are similar to those in the previous estimation results in terms of magnitude, sign, and significance, and are consistent with complementarity between authority and responsibility.[20] And the coefficients of (High Responsibility, High Monitoring) are positive and mostly significant, consistent with complementarity between responsibility and monitoring. The coefficients of (High Authority, High Monitoring) are positive except for the case of AUT2 in Panel (a), but all of them are not significantly different from zero.

5.3 Authority and Responsibility as Continuous Variables

To supplement our analysis so far, we also conduct estimation by redefining variables for authority and responsibility and treating them as continuous variables. Remember that for each decision, the questinnaire asks how *de facto* decision has been made, and the respondent selects one of the five categories (firms with "no opportunity for such a decision" are excluded). We redefine AUTi for Decision i such that the higher the numerical value, the more decentralized to the affiliate the decision is:

AUTi = 1**:** De facto decision is mostly made by the core firm.

AUTi = 2**:** De facto decision is more or less made by the core firm.

AUTi = 3**:** Cannot say one way or the other.

AUTi = 4**:** De facto decision is more or less made by the affiliated firm.

AUTi = 5**:** De facto decision is mostly made by the affiliated firm.

[20] The difference between $-\eta_6$ and η_7 is significant at the 1% level for two AUT3 models.

We similarly redefine RES, which is based on the answers to the question "The executives' compensation and careers are *not* affected by failure of achieving the expected standard of P/L (profit and loss)."

RES = 1**:** Definitely true.

RES = 2**:** More or less true.

RES = 3**:** Cannot say one way or the other.

RES = 4**:** More or less incorrect.

RES = 5**:** Definitely incorrect.

We then standardize these variables by subtaracting means and dividing by standard deviations, so that each variable has mean zero and standard deviation one (see, e.g., Bresnahan et al. (2002)), and name them stdAUTi and stdRES. We also construct a variable stdAUT measuring the extent of delegated authority as follows:

$$\text{stdAUT} = \text{std}(\text{std}(\text{AUT1}) + \text{std}(\text{AUT2}) + \text{std}(\text{AUT3}))$$

where $\text{std}(x) = (x - \overline{x})/\sigma$. The summary statistics are provided in Table 8.

We cannot use these standardized variables directly for estimation, however, because both stdAUT and stdRES take positive and negative values. We thus adjust them so as to take only positive values, by generating new variables adjAUT and adjRES with mean one and standard deviation 0.1. The summary statistics are reported in Table 8.

We modify the equations (E1), (E2), and (E3), and estimate the following equations:

$$\text{PPS} = \alpha_0 + \alpha_1 \text{adjAUT} + \alpha_2 \text{adjRES} + \alpha_3 (\text{adjAUT} \times \text{adjRES}) + \boldsymbol{\gamma}\mathbf{CONT} + \epsilon \tag{E1c}$$

$$\begin{aligned}\text{PPS} = {} & \beta_0 + \beta_1 \text{adjAUT} + \beta_2 \text{adjRES} + \beta_3 I_H^m \\ & + \beta_4 (\text{adjAUT} \times \text{adjRES}) + \beta_5 (\text{adjAUT} \times \text{adjRES} \times I_H^m) \\ & + \boldsymbol{\gamma}\mathbf{CONT} + \epsilon\end{aligned} \tag{E2c}$$

$$\begin{aligned}\text{PPS} = {} & \eta_0 + \eta_1 \text{adjAUT} + \eta_2 \text{adjRES} + \eta_3 I_H^m \\ & + \eta_4 (\text{adjAUT} \times \text{adjRES}) + \eta_5 (\text{adjAUT} \times I_H^m) + \eta_6 (\text{adjRES} \times I_H^m) \\ & + \boldsymbol{\gamma}\mathbf{CONT} + \epsilon\end{aligned} \tag{E3c}$$

Table 9 confirms the estimation results previously reported with indicator variables: While each of authority, responsibility, monitoring alone has a negative effect on performance, it also increases performance more as the level of the others is higher. Furthermore, The complementarity effect between authority and responsibility is reinforced by high monitoring intensity. These results are consistent with the complementarity hypotheses.

5.4 Regression with Parent Firms as Clusters

The parent firms are likely to affect the governance variables of their affiliated firms in systematic ways. Each firm in the sample has one parent firm, and our 324 affiliated firms are governed by 127 parent firms. However, there are 70 parent firms each of which has only one affiliated firm in the sample. It is thus inappropriate to include parent-firm dummies in our regressions.

We thus alternatively estimate all the equations by assuming that the affiliated firms are independent across clusters (parent firms) but not necessarily independent when they have the same parent firms, and obtaining robust variance estimates (the Huber/White/sandwich estimators). The estimation results are reported in Tables 10, 11, 12, and 13, which correspond to Tables 5, 6, 7, and 9, respectively. Note that the coefficients are not altered with this alternative method, while the standard errors (and hence t-values) change.

In Table 10, the coefficients of the interaction terms are no longer significant for the low monitoring case. In Table 11, although the coefficients of (Low Authority, Low Responsibility) become insignificant, those of (High Authority, High Responsibility, High Monitoring) continue to be mostly significant. The significance levels do not change much in Table 12, while most of the coefficients are no longer significant in Table 13.

Overall, the results do not essentially change, though levels of significance somehow decline, which suggests that there may be some negative correlation among firms with the same parent firms.

6 Concluding Remarks

Using unique survey data collected from group-affiliated companies in Japan, we have conducted an empirical test of complementarities among delegated authority, responsibility, and monitoring. Our analysis offers some evidence for complementarities:

1. Increasing responsibility raises the marginal return from increasing delegated authority.

2. Performance is likely to be higher under the combination of low authority and low responsibility than the "mix and match" combinations.

3. The combination of high authority and high responsibility is likely to perform better than the "mix and match" combinations, if monitoring intensity is high.

4. Performance under the combination of high authority and high responsibility is increasing in monitoring intensity, while the combination of low authority and low re-

sponsibility does not perform better as monitoring intensity is higher.

5. The marginal return from high authority and that from high responsibility are increasing in monitoring intensity.

We are aware of the limitation that our analysis does not disentangle interdependence of the governance activities and the impact of unobserved factors as pointed by Athey and Stern (1998). This is the first step toward empirical understanding of the relationships among the fundamental oraganizational decisions, authority, responsibility, and monitoring, and pursuing more convincing evidence is an obvious next step.

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Table 1: Summary statistics of affiliated firms

	Mean	Std. Dev.	Min	Max
Capital (million yen)	1059.14	6249.31	1	123286
Employees	353.175	934.763	2	16870
Sales (million yen)	19298.6	70043.8	2	967300
Profit (million yen)	527.630	2558.45	−1820	41910
Profit/Sales	0.03715	0.06295	−0.3	0.5

The number of observations is 578.

Table 2: Summary statistics of affiliated firms (continued)

Panel (a)

Median years of operation (as of 2000)	13 years
Publicly held	4.33%
More than 50% owned	91.18%
Wholly owned	69.72%

Panel (b)

Separated	29.41%
Takeover	17.30%
Newly established	40.31%
Joint venture	9.69%
Manufacturing	50.69%
Sales	13.32%
Service	33.56%

Table 3: Distributions of the governance variables

	L	*M*	*H*
AUT1	21.60%	10.19%	68.21%
AUT2	15.43%	10.19%	74.38%
AUT3	14.20%	10.80%	75.00%
RES	29.63%	27.16%	43.21%
MON	26.23%		73.77%

The number of observations is 324. AUT1 measures delgated authority over medium- and long-term strategy, AUT2 annual budget and business planning, and AUT3 important changes of organizational structures.

Table 4: Summary statiscs of the control variables

	Mean	Std. Dev.	Min	Max
Profit/Sales	0.03513	0.05935	−0.24	0.50
ln (capital)	4.54135	1.62352	0	10.1425
SDEP (%)	67.7284	36.2236	0	100
PDEP (%)	32.5309	35.4698	0	100
TYPE1	0.05006	0.99430	−2.52501	2.23481
TYPE2	0.01468	0.97357	−2.52472	3.04340

The number of observations is 324. SDEP is the ratio of the affiliate's sales to the parent firm over the total sales. PDEP is the ratio of the affiliate's buying expenses from the parent firm over the total purchase expenses. TYPE1 and TYPE2 are the scores measuring the types of the sample affiliate firm (respectively "organizational" and "personnel').

Table 5: Performance effects of authority and responsibility

	Panel (a)			Panel (b)		
Authority	AUT1	AUT2	AUT3	AUT1	AUT2	AUT3
	Samples with MON = H					
Low RES	.00042	.00913	.01072	.00125	.01585	.01928
× Low AUT	(0.89)	(0.62)	(0.89)	(0.09)	(0.93)	(1.24)
High RES	.01151	.00947	.01440**	.01293	.01357	.02285**
× High AUT	(1.55)	(1.29)	(2.08)	(1.30)	(1.42)	(2.13)
Sample size	239	239	239	157	156	155
F value	3.63	3.55	3.89	2.42	1.88	2.67
Adj R^2	0.0905	0.0881	0.0986	0.0759	0.0487	0.0889
	Samples with MON = L					
Low RES	.03657	−.01407	.08439*	.05423*	.01388	.08670**
× Low AUT	(1.02)	(−0.25)	(1.91)	(1.71)	(0.25)	(2.26)
High RES	−.01252	−.00906	−.00700	−.00483	−.00878	−.01164
× High AUT	(−0.69)	(−0.50)	(−0.37)	(−0.28)	(−0.47)	(−0.60)
Sample Size	85	85	85	61	58	53
F value	1.47	1.28	1.75	1.56	1.02	2.22
Adj R^2	0.0484	0.0294	0.0746	0.0773	0.0033	0.1740

Panel (a): all the samples are included. Panel (b): samples with AUTi = M or RES = M are dropped. OLS regression with PPS (operation profit to sales ratio) as the dependent variable. AUT1 measures delgated authority over medium- and long-term strategy, AUT2 annual budget and business planning, and AUT3 important changes of organizational structures. Figures in parentheses are t-values. Other control variables (not shown) in the regressions include (i) size, (ii) two industry dummies (manufacturing and sales), (iii) two variables measring the sample's dependence on its parent firm in terms of sales and purchases, and (iv) two scores for reasons. *** means p-values < 0.01, ** means p-values < 0.05, and * means p-values < 0.10.

Table 6: Effects of monitoring on authority and responsibility

	Panel (a)			Panel (b)		
Authority	AUT1	AUT2	AUT3	AUT1	AUT2	AUT3
Low AUT	.02015	−.01201	−.01876			
	(1.37)	−0.79)	(−1.22)			
High AUT	.01427	.01855	.01284			
	(1.14)	(1.42)	(1.00)			
Low RES	−.01287	−.01266	−.01661*			
	(−1.35)	(−1.39)	(−1.81)			
High RES	−.01140	.01278	−.00140			
	(−0.76)	(0.81)	(−0.09)			
High MON	−.02354**	−.02703***	−.02792***	−.01646	−.03272***	−.03131**
	(−2.60)	(−3.03)	(−3.18)	(−1.30)	(−2.59)	(−2.28)
Low RES × Low AUT	.03967	.02536	.11562***	.05136*	−.00637	.08419**
	(1.26)	(0.57)	(3.14)	(1.84)	(−0.15)	(2.38)
High RES × High AUT	−.01186	−.03821*	−.02790	−.00813	−.01694	−.01250
	(−0.58)	(−1.78)	(−1.33)	(−0.53)	(−1.10)	(−0.74)
Low RES × Low AUT	−.04145	.01521	−.06896*	−.05071	.02177	−.06313
×High MON	(−1.39)	(0.34)	(−1.92)	(−1.61)	(0.47)	(−1.63)
High RES × High AUT	.02904*	.02699*	.03427**	.02115	.03176*	.03806*
×High MON	(1.82)	(1.71)	(2.13)	(1.15)	(1.76)	(1.92)
Sample size	324	324	324	218	214	208
F value	3.14	2.93	3.76	2.99	2.22	3.56
Adj R^2	0.0959	0.0872	0.1203	0.0992	0.0641	0.1292

Panel (a): all the samples are included. Panel (b): samples with AUTi = M or RES = M are dropped. OLS regression with PPS (operation profit to sales ratio) as the dependent variable. AUT1 measures delgated authority over medium- and long-term strategy, AUT2 annual budget and business planning, and AUT3 important changes of organizational structures. Figures in parentheses are t-values. Other control variables (not shown) in the regressions include (i) size, (ii) two industry dummies (manufacturing and sales), (iii) two variables measring the sample's dependence on its parent firm in terms of sales and purchases, and (iv) two scores for reasons. *** means p-values < 0.01, ** means p-values < 0.05, and * means p-values < 0.10.

Table 7: Authority, responsibility, and monitoring

	Panel (a)			Panel (b)		
Authority	AUT1	AUT2	AUT3	AUT1	AUT2	AUT3
Low AUT	.02222	−.01405	−.01912			
	(1.50)	(−0.93)	(−1.23)			
High AUT	.00455	.03236*	.00810			
	(0.25)	(1.88)	(0.49)			
Low RES	−.01259	−.01352	−.01648*			
	(−1.32)	(−1.49)	(−1.77)			
High RES	−.03597*	−.00974	−.01758			
	(−1.85)	(−0.51)	(−0.96)			
High MON	−.03872**	−.01382	−.03791**	−.05106*	−.04883**	−.08975***
	(−2.60)	(−0.83)	(−2.45)	(−2.51)	(−2.03)	(−3.64)
Low RES × Low AUT	.00423	.03747	.05842***	.03415*	.03083	.07955***
	(0.21)	(1.61)	(2.75)	(1.97)	(1.39)	(3.63)
High RES × High AUT	.01286	−.01626	−.00578	−.01500	−.01012	−.01394
	(0.74)	(−0.91)	(−0.33)	(−1.17)	(−0.72)	(−0.95)
High AUT × High MON	.01181	−.02093	.00737	.02394	.02225	.06272***
	(0.71)	(−1.21)	(0.45)	(1.53)	(1.24)	(3.08)
High RES × High MON	.02904**	.02685*	.02704*	.03565**	.02248	.03458**
	(1.97)	(1.83)	(1.83)	(2.32)	(1.35)	(2.01)
Sample size	324	324	324	218	214	208
F value	2.99	3.09	3.33	3.00	2.12	3.73
Adj R^2	0.0898	0.0937	0.1033	0.0997	0.0593	0.1367

Panel (a): all the samples are included. Panel (b): samples with AUTi = M or RES = M are dropped. OLS regression with PPS (operation profit to sales ratio) as the dependent variable. AUT1 measures delgated authority over medium- and long-term strategy, AUT2 annual budget and business planning, and AUT3 important changes of organizational structures. Figures in parentheses are t-values. Other control variables (not shown) in the regressions include (i) size, (ii) two industry dummies (manufacturing and sales), (iii) two variables measring the sample's dependence on its parent firm in terms of sales and purchases, and (iv) two scores for reasons. *** means p-values < 0.01, ** means p-values < 0.05, and * means p-values < 0.10.

Table 8: Summary statiscs of the new variables

	Mean	Std. Dev.	Min	Max
stdAUT1	0	1	−2.17159	1.07827
stdAUT2	0	1	−2.50788	1.02112
stdAUT3	0	1	−2.60112	.973695
stdAUT	0	1	−2.83832	1.19804
stdRES	0	1	−1.77785	1.58579
adjAUT	1	0.1	.716168	1.11980
adjRES	1	0.1	.822215	1.15858

The number of observations is 324.

Table 9: Performance effects of authority, responsibility and monitoring with continuous variables

	MON = H	MON = L	All samples	All samples
adjAUT	−.46900*	−1.27353	−.61485**	−.68483**
	(−1.70)	(−1.62)	(−2.20)	(−2.37)
adjRES	−.45589*	−1.31940*	−.61958**	−.74340**
	(−1.66)	(−1.68)	(−2.23)	(−2.56)
High MON			−.12414**	−.23924**
			(−2.35)	(−2.25)
adjAUT × adjRES	.50642*	1.25279	.56530**	.65772**
	(1.83)	(1.63)	(2.05)	(2.36)
adjAUT × adjRES ×High MON			.10534**	
			(2.02)	
adjAUT × High MON				.07141
				(1.00)
adjRES × High MON				.14929**
				(2.07)
Sample size	239	85	324	324
F value	3.65	1.44	4.04	3.79
R^2	0.1002	0.0501	0.1014	0.1010

OLS regression with PPS (operation profit to sales ratio) as the dependent variable. Figures in parentheses are t-values. Other control variables (not shown) in the regressions include (i) size, (ii) two industry dummies (manufacturing and sales), (iii) two variables measring the sample's dependence on its parent firm in terms of sales and purchases, and (iv) two scores for reasons. *** means p-values < 0.01, ** means p-values < 0.05, and * means p-values < 0.10.

Table 10: Performance effects of authority and responsibility (regression with robust standard errors and parent firms as clusters)

	Panel (a)			Panel (b)		
Authority	AUT1	AUT2	AUT3	AUT1	AUT2	AUT3
	Samples with MON = H					
Low RES	.00042	.00913	.01072	.00125	.01585	.01928
× Low AUT	(0.03)	(0.36)	(0.63)	(0.07)	(0.64)	(1.08)
High RES	.01151	.00947*	.01440**	.01293	.01357*	.02285**
× High AUT	(1.58)	(1.86)	(2.51)	(1.30)	(1.76)	(2.38)
Sample size	239	239	239	157	156	155
Number of clusters	107	107	107	85	85	82
F value	6.71	6.62	7.71	4.79	3.74	4.31
R^2	0.1249	0.1225	0.1327	0.1292	0.1039	0.1421
	Samples with MON = L					
Low RES	.03657	−.01407	.08439	.05423	.01388	.08670
× Low AUT	(0.55)	(−1.13)	(0.90)	(0.79)	(0.72)	(0.94)
High RES	−.01252	−.00906	−.00700	−.00483	−.00878	−.01164
× High AUT	(−0.32)	(−0.67)	(−0.53)	(−0.28)	(−0.56)	(−0.70)
Sample size	85	85	85	61	58	53
Number of clusters	52	52	52	40	41	38
F value	1.31	1.45	1.52	1.80	2.79	2.31
R^2	0.1504	0.1334	0.1737	0.2157	0.1611	0.3169

Panel (a): all the samples are included. Panel (b): samples with AUTi = M or RES = M are dropped. OLS regression with robust standard errors and parent firms as clusters. The dependent variable is PPS (operation profit to sales ratio). AUT1 measures delgated authority over medium- and long-term strategy, AUT2 annual budget and business planning, and AUT3 important changes of organizational structures. Figures in parentheses are t-values. Other control variables (not shown) in the regressions include (i) size, (ii) two industry dummies (manufacturing and sales), (iii) two variables measring the sample's dependence on its parent firm in terms of sales and purchases, and (iv) two scores for reasons. *** means p-values < 0.01, ** means p-values < 0.05, and * means p-values < 0.10.

Table 11: Effects of monitoring on authority and responsibility (regression with robust standard errors and parent firms as clusters)

	Panel (a)			Panel (b)		
Authority	AUT1	AUT2	AUT3	AUT1	AUT2	AUT3
Low AUT	.02015*	−.01201	−.01876*			
	(1.85)	−0.85)	(−1.68)			
High AUT	.01427	.01855*	.01284			
	(1.42)	(1.95)	(1.19)			
Low RES	−.01287*	−.01266*	−.01661**			
	(−1.71)	(−1.71)	(−2.21)			
High RES	−.01140	.01278	−.00140			
	(−1.09)	(1.06)	(−0.13)			
High MON	−.02354**	−.02703**	−.02792**	−.01646	−.03272**	−.03131**
	(−2.16)	(−2.33)	(−2.61)	(−1.28)	(−2.06)	(−2.28)
Low RES × Low AUT	.03967	.02536	.11562	.05136	−.00637	.08419
	(0.62)	(1.55)	(1.18)	(0.80)	(−0.41)	(0.87)
High RES × High AUT	−.01186	−.03821**	−.02790	−.00813	−.01694	−.01250
	(−0.63)	(−2.03)	(−1.44)	(−0.61)	(−1.08)	(−0.89)
Low RES × Low AUT	−.04145	.01521	−.06896	−.05071	.02177	−.06313
×High MON	(−0.64)	(0.55)	(−0.73)	(−0.76)	(0.69)	(−0.65)
High RES × High AUT	.02904**	.02699*	.03427**	.02115	.03176**	.03806**
×High MON	(2.03)	(1.82)	(2.40)	(1.49)	(2.00)	(2.47)
Sample size	324	324	324	218	214	208
Number of clusters	127	127	127	102	100	100
F value	3.71	4.71	4.05	4.41	3.38	4.77
R^2	0.1407	0.1324	0.1638	0.1490	0.1169	0.1797

Panel (a): all the samples are included. Panel (b): samples with AUTi = M or RES = M are dropped. OLS regression with robust standard errors and parent firms as clusters. The dependent variable is PPS (operation profit to sales ratio). AUT1 measures delgated authority over medium- and long-term strategy, AUT2 annual budget and business planning, and AUT3 important changes of organizational structures. Figures in parentheses are t-values. Other control variables (not shown) in the regressions include (i) size, (ii) two industry dummies (manufacturing and sales), (iii) two variables measring the sample's dependence on its parent firm in terms of sales and purchases, and (iv) two scores for reasons. *** means p-values < 0.01, ** means p-values < 0.05, and * means p-values < 0.10.

Table 12: Authority, responsibility, and monitoring (regression with robust standard errors and parent firms as clusters)

	Panel (a)			Panel (b)		
Authority	AUT1	AUT2	AUT3	AUT1	AUT2	AUT3
Low AUT	.02222*	−.01405	−.01912			
	(1.95)	(−1.00)	(−1.61)			
High AUT	.00455	.03236***	.00810			
	(0.21)	(2.77)	(0.45)			
Low RES	−.01259	−.01352*	−.01648**			
	(−1.65)	(−1.80)	(−2.06)			
High RES	−.03597**	−.00974	−.01758			
	(−2.00)	(−0.62)	(−1.19)			
High MON	−.03872	−.01382	−.03791*	−.05106	−.04883*	−.08975*
	(−1.60)	(−0.99)	(−1.67)	(−1.60)	(−1.95)	(−1.71)
Low RES × Low AUT	.00423	.03747	.05842**	.03415	.03083	.07955
	(0.20)	(1.60)	(2.15)	(1.13)	(1.44)	(1.61)
High RES × High AUT	.01286	−.01626	−.00578	−.01500	−.01012	−.01394
	(0.94)	(−1.24)	(−0.40)	(−0.94)	(−0.73)	(−0.72)
High AUT × High MON	.01181	−.02093	.00737	.02394	.02225	.06272
	(0.56)	(−1.51)	(0.36)	(1.09)	(1.27)	(1.52)
High RES × High MON	.02904*	.02685*	.02704	.03565*	.02248	.03458
	(1.77)	(1.75)	(1.55)	(1.74)	(1.60)	(1.39)
Sample size	324	324	324	218	214	208
Number of clusters	127	127	127	102	100	100
F value	4.15	5.44	3.90	4.06	3.41	4.12
Adj R^2	0.1349	0.1386	0.1477	0.1495	0.1123	0.1867

Panel (a): all the samples are included. Panel (b): samples with AUTi = M or RES = M are dropped. OLS regression with PPS (operation profit to sales ratio) as the dependent variable. AUT1 measures delgated authority over medium- and long-term strategy, AUT2 annual budget and business planning, and AUT3 important changes of organizational structures. Figures in parentheses are t-values. Other control variables (not shown) in the regressions include (i) size, (ii) two industry dummies (manufacturing and sales), (iii) two variables measring the sample's dependence on its parent firm in terms of sales and purchases, and (iv) two scores for reasons. *** means p-values < 0.01, ** means p-values < 0.05, and * means p-values < 0.10.

Table 13: Performance effects of authority, responsibility and monitoring with continuous variables (regression with robust standard errors and parent firms as clusters)

	MON = H	MON = L	All samples	All samples
adjAUT	−.46900	−1.27353	−.61485	−.68483
	(−1.29)	(−0.97)	(−1.53)	(−1.56)
adjRES	−.45589	−1.31940	−.61958	−.74340*
	(−1.19)	(−1.03)	(−1.53)	(−1.73)
High MON			−.12414	−.23924
			(−1.56)	(−1.45)
adjAUT × adjRES	.50642	1.25279	.56530	.65772*
	(1.38)	(1.01)	(1.52)	(1.68)
adjAUT × adjRES			.10534	
×High MON			(1.42)	
adjAUT × High MON				.07141
				(0.78)
adjRES × High MON				.14929*
				(1.66)
Sample size	239	85	324	324
Number of clusters	107	52	127	127
F value	6.61	1.13	4.52	4.23
R^2	0.1380	0.1632	0.1348	0.1372

OLS regress with robust standard errors and parent firms as clusters. The dependent variable is PPS (operation profit to sales ratio). Figures in parentheses are t-values. Other control variables (not shown) in the regressions include (i) size, (ii) two industry dummies (manufacturing and sales), (iii) two variables measring the sample's dependence on its parent firm in terms of sales and purchases, and (iv) two scores for reasons. *** means p-values < 0.01, ** means p-values < 0.05, and * means p-values < 0.10.