

Complementarities among Authority, Accountability, and Monitoring

Evidence from Japanese Business Groups^{*}

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First Version: March 18, 2002

This Version: March 7, 2008

Abstract

This paper offers an empirical test of complementarities among delegated authority, accountability, 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 accountability are complementary, implying that increasing assigned accountability raises the marginal return from increasing delegated authority. We also obtain a stronger result that performance is likely to be better under the combination of low authority and low accountability or that of high authority and high accountability than under the “mix and match” combinations where one is low and the other high. We then study the effects of monitoring intensity on the authority-accountability pair and find that performance of the firm with the combination of high authority and high accountability is increasing in monitoring intensity, while the combination of low authority and low accountability is not. This

^{*}We are grateful to George Baker, Steve Tadelis, Wako Watanabe, and the participants at the TRIO Conference as well as the seminar participants at ISER, Osaka University, Hitotsubashi University, University of New South Wales, and BEW, Aoyama Gakuin University, for helpful comments, and Roko Iwata for her research assistance. Financial support from the former Research Institute of MITI (now RIETI), Seimeikai, and the 21st Century COE program “Dynamics of Knowledge, Corporate System and Innovation” at Graduate School of Commerce and Management, Hitotsubashi University, is gratefully acknowledged. Earlier versions were circulated under the title “Complementarities among Authority, Responsibility, and Monitoring: Evidence from Japanese Business Groups.”

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result is consistent with the theoretical hypothesis that increasing monitoring intensity raises the marginal return from increasing delegated authority and accountability.

1 Introduction

Authority is a fundamental concept in understanding 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 agree that authority is an important concept. 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 this 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 that managers have struggled to balance centralization founded on the hierarchical nature of the firm with 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 with 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 and the 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 keeps 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. Sec-

ond, delegation of authority tends to improve the 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 standpoint of the organizational as a whole. To remedy this “loss of control” problem, the headquarters needs to maintain control over delegated decision making. To this end, the head office evaluates the division managers’ decisions and actions or the performance of the divisions, and links them to the division managers’ compensation, future promotion prospects, task assignment, and so on. In other words, authority must be accompanied by accountability¹.

The idea that authority and accountability must go hand in hand is familiar, but there is little systematic empirical work that examines whether or not accountability actually accompanies authority.² 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 also examine how authority and accountability interact with monitoring intensity. A theoretical literature built on the principal-agent framework and the incomplete contract paradigm suggests two distinct ways in which optimal authority and accountability interact with monitoring: either monitoring and authority/accountability 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 in 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 from working hard *ex ante*. This body of theoretical work therefore suggests that monitoring intensity and the authority-accountability pair move in opposite directions, and that the optimal combination is likely to be one of the following: “high authority, high accountability, low monitoring,” or “low authority, low accountability, high monitoring.”

On the other hand, the basic insight from the standard principal-agent framework is that monitoring improves performance incentives: “...in an optimally designed incentive system, the amount of measurement and the intensity of incentives are chosen together: Neither

¹In earlier versions of the paper we used the word “responsibility” instead of “accountability.” The former is an ambiguous word meaning either the right to make a decision or accountability for the results of the decision. We thus change to “accountability” which is unambiguous. We thank George Baker for suggesting this change.

²Exceptions include Baiman et al. (1995), Nagar (2002), and DeVaro and Kurtulus (2006).

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 makes higher-powered incentives to elicit more effort less costly. Extending the standard model to incorporate delegation decisions as do Holmstrom and Milgrom (1991, 1994), Itoh (1994), Prendergast (2002), and so on, leads to the prediction that the loss of control associated with delegation of authority is smaller under more intensive monitoring; hence it is optimal to provide the agent with more discretion. This body of work, therefore, suggests that the optimal combination is likely to be either “high authority, high accountability, high monitoring,” or “low authority, low accountability, low monitoring.” Our data provide some evidence for the complementarity hypothesis.

Our research is related to the growing body 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.³ We attempt to join them by analyzing, for the first time as far as we know, interactions among three basic organizational factors: authority, accountability, and monitoring.⁴

The rest of the paper is organized as follows. In Section 2, we explain the notion of complementarities that is to be tested empirically in later sections, and discuss possible interactions among authority, accountability, and monitoring, based on the 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 group 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. Within this

³These constitute only a partial list. Other related work includes Arora and Gambardella (1990), Brickley (1999), and Van Biesebroeck (2006).

⁴However, we admit that our analysis cannot escape from the identification problem for testing complementarities (Athey and Stern, 1998).

type of group, 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 are based on questionnaires distributed to more than 2,000 affiliated firms in Japan. The survey asks each firm how various decisions are made in conjunction with its parent firm. From the responses we can construct proxies for the degree of delegated authority as well as accountability 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 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 its agents. The parent firm chooses various governance variables to maximize its objective function, seeking to motivate the top manager of each affiliated company to cooperate with the parent firm and manage his businesses appropriately.

2.1 Authority and Accountability

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 about 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 do not differ depending on whether formal authority or real authority is 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 about its business; the parent firm can avoid overload and concentrate on its core businesses and strategic issues, and delegating decisions may work as an incentive device or may facilitate participation and cooperation. However, loss of control accompanies delegation of authority. 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 problems associated with loss of control, the parent firm needs to maintain control over delegated decision making. To this purpose, the parent evaluates the affiliate's decisions and actions, or the performance of the affiliated firm, and links them to the manager's compensation, future promotion prospects, task assignment, and so on. In other words, authority has to be accompanied by *accountability*: authority and accountability are *complementary*.

To define complementarity formally, let $f(A, C, K)$ be the objective function (performance, profit, earnings 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 $C \in \mathbb{R}$ represents the extent to which the agent assumes accountability for his decision and/or performance. It is typical for the affiliated firm to assume accountability for profit or the earnings ratio: If the affiliated company fails to attain its target profit, then the company's manager will assume accountability by giving up his bonus, leaving the office, or being demoted. K represents a vector of other endogenous or exogenous variables.

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

$$f(a, c, k) - f(a', c, k) \geq f(a, c', k) - f(a', c', k). \quad (\text{AC})$$

That is, increasing accountability from c' to c raises the additional return from increasing delegated authority from a' to a .⁵ By rearranging the inequality, one can see alternatively that the additional return from higher C increases with A :

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

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

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

Furthermore, complementarity (AC) does *not* imply that "mix and match" is worse than

⁵Our definition of complementarity is equivalent to function f having *increasing differences* in (A, C) , or f being *supermodular* in (A, C) . See Milgrom and Roberts (1990) and Topkis (1998) for the details.

Figure 1: Authority, accountability, and performance

		<i>C</i>	
		0	1
<i>A</i>	0	<i>w</i>	<i>x</i>
	1	<i>y</i>	<i>z</i>

coherent combinations:

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

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

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

$$f(a, c, k) \geq \max\{f(a', c, k), f(a, c', k)\}, \tag{ACH}$$

$$f(a', c', k) \leq \max\{f(a, c', k), f(a', c, k)\}. \tag{ACL}$$

If (ACH) and (ACL) hold for all k , $a > a'$ and $c > c'$, then complementarity (AC) is satisfied. We empirically test whether or not (ACH) and (ACL) hold as well as (AC) itself.

Holmstrom and Milgrom (1991, 1994) present a formal derivation of complementarity between delegated authority and accountability (discretion and incentive intensity in their model). The agent engages in multiple activities, some of which are productive in the sense that higher effort exerted in 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 accountability is measured by the incentive coefficient of the linear compensation scheme. Other things being equal, more delegated authority increases the agent's effort exerted in outside activities through his incentive compatibility constraint. However, because various activities are cost substitutes, the marginal cost of increasing effort exerted in productive activities rises with effort exerted in outside activities. This is the opportunity cost of delegated authority. This cost is smaller when the incentive scheme provides the agent with higher-powered incentives, that is, more accountability. The marginal return from delegated authority is therefore increasing in accountability.

The well-known analysis of delegated authority by Aghion and Tirole (1997) suggests an alternative derivation. They assume, in most of their paper, that the agent does not respond to monetary incentives, and hence accountability 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 formally the complementarity between delegation and accountability. 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 is the right task. 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 choose task 1 since she enjoys a small private benefit from implementing it. Now suppose that the decision is delegated to the agent. If no accountability 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 accountability for his decision, the agent is motivated to choose the more productive task, which also benefits the principal. Delegation and accountability thus go hand in hand.

2.2 Monitoring

Although systematic empirical evidence of the link between delegated authority and accountability is scarce, complementarity between them appears to be uncontested. However, the analysis of how monitoring intensity affects their link is more subtle. We rewrite the parent firm's objective function as $f(A, C, M, G)$ where $M \in R$ measures its monitoring intensity over the affiliated firm's performance variable that may be observable with an error and at cost, and G is a vector of exogenous variables. For instance, 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 reinforces benefits from delegated authority and accountability, and exhibits complementarity with them. Increasing monitoring intensity reduces costs of implementing high-powered incentives by improving performance measurement,⁶ and hence provides additional benefit from delegating authority accompanied with accountability.

Formally, we define complementarity between the authority-accountability pair and mon-

⁶This is called the Monitoring Intensity Principle by Milgrom and Roberts (1992, p.226) (see their citation in Section 1 of the current paper).

itoring as follows:⁷ For all g , $(a, c) > (a', c')$ and $m > m'$,

$$f(a, c, m, g) - f(a', c', m, g) \geq f(a, c, m', g) - f(a', c', m', g). \quad (\text{AC-M})$$

That is, the additional gain from a *simultaneous* increase in delegated authority and accountability is increasing in monitoring intensity.⁸

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

$$f(a, c, m, g) > f(a, c, m', g), \quad (\text{AC-MH})$$

$$f(a', c', m, g) < f(a', c', m', g), \quad (\text{AC-ML})$$

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

Note that monitoring intensity in Holmstrom and Milgrom (1991, 1994) concerns performance (“output”) measurement. It is extreme, however, to assume that only output can be monitored. For instance, the parent firm could monitor the affiliated firm’s decision (“input”) by sending directors or executives to the latter’s board and having joint meetings. Caillaud et al. (1988) note that input and output monitoring are generally not equivalent in the context of government intervention in production. However, our focus on output monitoring can be justified even if both input and output can be monitored. In a model of moral hazard,⁹ Prendergast (2000) argues that “the more uncertainty there is in the environment, the more important it is to induce the agent to choose the correct activity rather than assigning him one, which can only be done by basing pay on output”(p.422). Prendergast (2002) shows that the principal may choose to delegate decision rights to the agent and offer an output-based

⁷ $(a, c) > (a', c')$ implies $a \geq a'$, $c \geq c'$, and $(a, c) \neq (a', c')$.

⁸Note that (AC-M) is implied by a more general property that $f(A, C, M, G)$ is *supermodular* in (A, C, M) : For all c, g , $a > a'$, and $m > m'$,

$$f(a, c, m, g) - f(a', c, m, g) \geq f(a, c, m', g) - f(a', c, m', g), \quad (\text{AM})$$

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

$$f(a, c, m, g) - f(a, c', m, g) \geq f(a, c, m', g) - f(a, c', m', g), \quad (\text{CM})$$

hold, in addition to (AC). Although (AM) and (CM) are sufficient for (AC-M), we mainly focus on (AC-M) in our empirical analysis.

⁹In a model of adverse selection, Khalil and Lawarrée (1995), extending Maskin and Riley (1985) who study the choice between input and output monitoring instruments without error, show that the principal will prefer input monitoring if she is the residual claimant, and she will prefer output monitoring if the agent is the residual claimant. However, they do not study the allocation of authority.

contract in order to constrain the possibility that the agent uses his discretion in a way detrimental to the principal's welfare. Athey and Roberts (2001) consider the linkage between the allocation of decision rights and the design of an incentive scheme in a model where the agent's effort incentives conflict with incentives for project selection, and this conflict has impacts on other parts of the organization. They show that when the quality of project selection is more important than inducing effort from the standpoint of the principal's welfare, global performance (output) measures may be heavily weighted in comparison to local performance (input) measures in optimal incentive design, and an authority-based hierarchy emerges endogenously. Baker and Jorgensen (2003) define "volatility" as uncertainty which does affect an agent's optimal action and to which the agent is able to react, and then show that in the presence of volatility, even if the agent's effort is contractible, the principal will use output-based pay in an optimal contract. This is because output-based pay encourages the agent to use his private information in choosing his actions. One of the important implications from Baker and Jorgensen (2003) is the so-called "controllability principle," which states that the agent should be held accountable for controllable risks, and not held accountable for uncontrollable risks.

Different conclusions could arise if we instead focus on aspects of input monitoring. In the model of Aghion and Tirole (1997), the principal chooses the 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 suggests that monitoring intensity reduce the marginal benefit from delegation authority.

A 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 contrast, privatization can work as a commitment device by losing monitoring capability and hence the opportunity to intervene ex post.

The work mentioned above therefore suggests that some forms of monitoring could discourage delegation of authority and accountability: the marginal benefit from delegating authority and assigning accountability is smaller as the parent firm chooses to monitor more intensively. Our empirical analysis does not aim to test 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 in line with

Holmstrom and Milgrom (1991, 1994) as well as Milgrom and Roberts (1992).¹⁰

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. This result is consistent with the agency framework in which decentralized decision making must accompany centralized control. These studies also point out the 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.¹¹ Furthermore, the unit of analysis is different in 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 which hierarchical level has authority.¹²

Baiman et al. (1995) is the first empirical study of authority relationships, as far as we know, that explicitly follows the agency framework. They use survey data on heads 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 purchase decisions without corporate approval for core functions applica-

¹⁰We should note that Aghion and Tirole (1997), when they analyze monetary incentives, informally discuss how performance measurement affects delegated authority, and state that “better performance measurement raises an agent’s real authority.” Their results thus do not really contradict those from Holmstrom and Milgrom (1991, 1994) and Milgrom and Roberts (1992).

¹¹Even concerning internal organization, these factors are even less relevant for Japanese firms, as Lincoln et al. (1986) show.

¹²Of course, we could complicate the analysis by further opening up the black box of the internal organizations of the core firm and the affiliated firm. We, however, believe such an extension will not add much further insight.

ble 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 the head'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 on a scale of 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.¹³

The only study that distinguishes between real 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.¹⁴

While there are several types of business groups in Japan, this paper refers exclusively to the type which consists of a large core company and its network of affiliated firms such

¹³After completing the first version of the paper, we have found two more relevant pieces of empirical work. Colombo and Delmastro (2004) study delegation of strategic decision making in manufacturing plants by designing a questionnaire analysis. They measure delegation using a variable consisting of three ordered categories: (a) centralization; (b) partial delegation; and (c) full delegation. Partial delegation can be interpreted as delegation of not formal but real authority, while 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 (accountability), and the independent variables represent worker authority over tasks. 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.

¹⁴Recent 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).

as subsidiaries.¹⁵ 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 shareholding 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*, 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 to 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 hence increase the degree of diversification of the business group to which they belong. *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 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;" thus 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 president, director, 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 these affiliated firms do not do their own hiring.

There are several routes by which the group is formed. Two typical ones are spinoff or

¹⁵It 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 group, 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.

takeover.¹⁶ 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.¹⁷ 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 ventures. 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 affiliated 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 Japanese firms pursue this goal? There are several possibilities: it facilitates intra-organizational information flow associated with consensus-based decision making process; the lifetime employment practice restricts the firm's ability to cut down its labor force flexibly and promptly; a centralized personnel department must administer various personnel matters in a comprehensive, career-oriented way, and its burden will be reduced with this type of firm structure; 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 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 in local regions. The business group thus functions as a strong incentive mechanism for the employees of the core firm.

¹⁶The 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.

¹⁷Of the remaining three, Toyota Automatic Loom Works was the parent firm of Toyota Motor, along with the other two (Toyoda Tsusho and Aichi Steel Works). Toyota Motor later acquired the shares of the original parent firm and the other two and made them its affiliated firms.

On the other hand, surveys of the core firms concerning their motives to create affiliated firms consistently reveal that they are more concerned with the performance of the businesses separated from the main body. For example, according to the 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 more rapidly than internal units. One possible explanation may be that the divisions of the large Japanese corporation are not as autonomous and accountable for their performance as their U.S. counterparts, and hence separation facilitates the sense of accountability, performance evaluation, and the provision of incentives. This explanation is incomplete, however, since many of the affiliated firms are subsidiaries and thus are owned by the core firm. We do not have an established theory to clarify how they are different from internal divisions.¹⁸

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 the 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 establishment year was 1977. We will later exclude from the sample for estimation the affiliated firms whose years of operation are fewer than 2 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 the affiliated firms

¹⁸See 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 have a contractual relationship with the parent firm. This difference affects the employees' incentives to make relation-specific investments.

were 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, Accountability, and Monitoring

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

Delegation of authority There are numerous decisions to be allocated between the parent firm and its affiliated firms, and hence a single measure of decentralization is of no use. We thus attempt to measure delegated authority 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 a 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 the categorical variable AUT_i for Decision i by assigning to each sample firm one of the following three categories L (for Low), M (for Middle), and H (for High):

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

$AUT_i = M$: Cannot say one way or the other.

$AUT_i = H$: 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 AUT_i 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. We will later restrict the sample further by dropping the observations with 50% or less ownership by their parent firms. We thus believe our focus on real authority is reasonable.

Accountability Accountability 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 accountability each firm assumes is measured based on the answer to the following question. "The executives' compensation and careers are *not* affected by failure to achieve 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 the categorical variable ACC by assigning to each sample firm one of the following three categories:

ACC = L: Definitely/more or less true.

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

ACC = H: Definitely/more or less incorrect.

Sample firms with ACC = H are interpreted as being most accountable for their performance, followed by ACC = M. Samples with ACC = L are the least accountable.

Monitoring The 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 the 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, since the distribution of this variable is not as scattered as that of the other variables, and construct variable MON as follows.

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

MON = H: The parent firm checks P/L every three months or more.

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

Two tests, the correlation test and the productivity test, are typically used to provide evidence about complementarity in the existing literature (Athey and Stern, 1998). As a preliminary test, we conducted the correlation test, following Bresnahan et al. (2002), by obtaining the Spearman partial rank correlations among authority, accountability, and monitoring, controlling for various observables such as size, industry, and dependence on the parent firm (to be explained below in more detail). We find that for important changes of organizational structure, delegation of authority AUT3 is positively and significantly correlated with accountability (with a 10% significance level). However, we also find that for the other decisions, delegated authority and monitoring are negatively correlated (with a 10% significance level), and the remaining combinations show no significant correlation.

However, this negative result does not necessarily imply that there is no complementarity among authority, accountability, and monitoring. As Bresnahan et al. (2002) argue, various combinations of the values of these variables are found in our sample because of substantial delays and costs of adjustment, and/or simple misunderstanding by managers with regard to choice and desirable combinations of policy variables.¹⁹ In this case, the productivity test is more likely to be effective.

Our empirical strategy is thus to look at the parent firms' performance as a function of our governance variables measuring authority, accountability, and monitoring, and whether it exhibits complementarity. 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 theirs. 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).²⁰ In other words, we assume that the parent firm wishes to maximize the profit ratio of each of its affiliated firms. To validate this assumption, we further restrict our sample. First, we drop the observations corresponding to firms with less than a 50% ownership share by their parent companies. As a result, the parent firm of each observation owns more than 50% (usually 100%) of the shares. Hence,

¹⁹It is often argued that in Japan, the relationships between parent companies and their affiliates are not often chosen on the grounds of efficiency. Our later results, in fact, show that the combination of high delegated authority and low monitoring (or low authority and high monitoring) is likely to result in bad performance.

²⁰In Japan not only firms but also mass media consider PPS an important performance measure. Although this ratio is generally quite different between the manufacturing and the non-manufacturing sectors, we control for this effect in estimation.

the higher the profits of the observed firm, the more the parent firm benefits.²¹ 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 remain 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 if each observation is in the manufacturing category, the sales category, or 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 sales to the parent firm over total sales (SDEP), and the ratio of the affiliate's buying expenses from the parent firm over the total purchase expenses (PDEP).²²

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.

²¹Readers may suspect that the parent firm will be more likely to seek private benefit by sacrificing the affiliate firm's profit when the parent owns a larger share of the affiliate. This might be true if that parent's private benefit is negatively correlated with the affiliate's profit, and hence the parent's interest conflicts with that of the minority shareholders of the affiliate firm. However, we can show that as the parent firm owns more shares, its interest aligns further with that of the minority shareholders because seeking private benefit is more costly. On the other hand, if the parent firm's private benefit is positively correlated with or complementary to the affiliate's profit, the conflict of interest may not arise regardless of how many shares the parent owns, because seeking private benefit is not inconsistent with improving the affiliate's profit.

²²The affiliate firm's performance may also be affected by how it depends on the parent firm in terms of human and financial resources. We conducted additional analysis using two other explanatory variables, "the ratio of board members of the affiliate who belong concurrently to the board of the parent firm" and "the ratio of finance from the parent firm." We find that these are not significant and do not change most empirical results.

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 an employment system distinct from that of the parent firm. We then created two scores TYPE1 and TYPE2 for these organizational and personnel reasons, respectively, and included them as independent variables in our estimation.²³

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 perform significantly worse. The performance of the affiliate firm is lower when it is more dependent on the parent firm in terms of purchases. The coefficients of the organizational and personnel reason variables are positive, and sometimes significant.

5.1 Authority and Accountability

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

$$\text{PPS} = \alpha_0 + \alpha_1(I_L^{ai} \times I_L^c) + \alpha_2(I_H^{ai} \times I_H^c) + \gamma \text{CONT} + \epsilon \quad (\text{E1})$$

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 $g = ai, c, m$ and $j = H, L$: $I_L^{ai} \times I_L^c = 1$ indicates $\text{AUTi} = L$ and $\text{ACC} = L$ and $I_H^{ai} \times I_H^c = 1$ $\text{AUTi} = H$ and $\text{ACC} = H$. The coefficients of the interaction terms measure the performance effects of (Low Authority, Low Accountability) and (High Authority, High Accountability) compared with the remaining patterns (see Figure 2). Complementarity (AC) 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 (ACH) and (ACL).

We also estimate the same equation by dropping the observations with intermediate value M for either AUTi or ACC (see Figure 3). The coefficients of the interaction terms then

²³We do not control for parent firms in our main analysis. See subsection 5.3 for an alternative analysis where the parent-firm effects are taken into consideration.

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

		Accountability		
		<i>L</i>	<i>M</i>	<i>H</i>
Authority	<i>L</i>	$I_L^{ai} \times I_L^c$		
	<i>M</i>			
	<i>H</i>			$I_H^{ai} \times I_H^c$

inform us how well firms with (Low Authority, Low Accountability) and (High Authority, High Accountability) do compared with those with “mix and match” combinations (Low Authority, High Accountability) and (High Authority, Low Accountability). If we find $\alpha_1 > 0$ and $\alpha_2 > 0$ in this estimation, it supports the stronger property (ACH) and (ACL).

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

		Accountability		
		<i>L</i>	<i>M</i>	<i>H</i>
Authority	<i>L</i>	$I_L^{ai} \times I_L^c$	drop	
	<i>M</i>	drop	drop	drop
	<i>H</i>		drop	$I_H^{ai} \times I_H^c$

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 $AUT_i = M$ or $ACC = M$ are dropped in Panel (b) as in Figure 3. First, the coefficient of (Low Authority, Low Accountability) and that of (High Authority, High Accountability) satisfy $-\alpha_1 \leq \alpha_2$ for 11 out of 12 cases. We conduct one-sided *t* tests whether $-\alpha_1$ is significantly less than α_2 . We find that in all the AUT3 models $-\alpha_1$ is significantly less than α_2 at the 10% level (for low monitoring) or 5% level (for high monitoring) while in the rest of the models the coefficients are not significantly different. These results are weakly consistent with the complementarity hypothesis between authority and accountability (AC).

Furthermore, when monitoring intensity is high, both coefficients are always positive, and the coefficients of (High Authority, High Accountability) are significant for AUT3. These results are consistent with (ACL) and especially (ACH) that firms with (Low Authority, Low Accountability) or (High Authority, High Accountability) perform better than those with the “mix and match” combinations.

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

5.2 Effects of Monitoring on Authority and Accountability

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

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

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

The results are reported in Table 6. The coefficients of (High Authority, High Accountability, High Monitoring) are positive and mostly significant, supporting (AC-MH) for (High Authority, High Accountability). On the other hand, although the coefficients of (Low Authority, Low Accountability) are often positive and significant, monitoring intensity does not reinforce this effect: The coefficients of (Low Authority, Low Accountability, High Monitoring) are mostly negative, and sometimes significantly so, again consistent with (AC-ML).

Note that controlling for the interaction terms, we find that delegated authority or accountability alone is not likely to contribute to performance. And the coefficient of High Monitoring is significantly negative, suggesting that more frequent monitoring alone actually hurts the performance of the firm. This result may be due to reverse causality: There may be an endogeneity problem between performance and (especially) monitoring. It is true that a poorly performing affiliate firm is more likely to be monitored more closely by its parent. It might also be true that poor performance will cause the parent to reduce the authority granted to the affiliate. Unfortunately, we cannot test which direction of causality is relevant, because we only have cross-sectional data.

Second, we test complementarities among three variables, that is, (AC), (AM), and (CM), by estimating the following equation.

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

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 Accountability) and (High Authority, High Accountability) are similar to those in the previous estimation results in terms of magnitude, sign, and significance, and are consistent with complementarity between authority and accountability.²⁴ And the coefficients of (High Accountability, High Monitoring) are positive and mostly significant, consistent with complementarity between accountability and monitoring. The coefficients of (High Authority, High Monitoring) are positive except for the case of AUT2 in Panel (a), but none is significantly different from zero.

5.3 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 error terms 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 8, 9, and 10, which correspond to Tables 5, 6, and 7, respectively. Note that the coefficients are not altered with this alternative method, but the standard errors (and hence t -values) change.

In Table 8, the coefficients of the interaction terms are no longer significant for the low monitoring case, whereas one coefficient of (High Authority, High Accountability) in the AUT2 case with high monitoring becomes significant. In Table 9, although the coefficients of (Low Authority, Low Accountability) become insignificant, those of (High Authority, High Accountability, High Monitoring) continue to be mostly significant. Moreover, many

²⁴The difference between $-\eta_6$ and η_7 is significant at the 1% level for two AUT3 models.

coefficients of the Authority and Accountability terms become significant or their levels of significance improve. The results are similar in Table 10.

Overall, levels of significance become worse for some variables, while they improve for other variables. However, the interaction terms in many models become no longer significant, which results suggest that the error terms are likely to be independent even across the affiliated firms with the same parent.

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, accountability, and monitoring. Our analysis offers some evidence for complementarities:

1. Increasing accountability raises the marginal return from increasing delegated authority.
2. Performance is likely to be higher under the combination of low authority and low accountability than the “mix and match” combinations.
3. The combination of high authority and high accountability 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 accountability is increasing in monitoring intensity, while the combination of low authority and low accountability does not perform better as monitoring intensity increases.
5. The marginal return from high authority and that from high accountability are increasing in monitoring intensity.

We are aware of the limitation that our analysis does not disentangle the interdependence of the governance activities from the impact of unobserved factors as pointed out by Athey and Stern (1998). But, according to them, it is a difficult task to find at least 3 instrumental variables. This is the first step toward an empirical understanding of the relationships among the fundamental organizational decisions: authority, accountability, and monitoring. 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)		Panel (b)	
Median years of operation (as of 2000)	13 years	Separated	29.41%
Publicly held	4.33%	Takeover	17.30%
More than 50% owned	91.18%	Newly established	40.31%
Wholly owned	69.72%	Joint venture	9.69%
		Manufacturing	50.69%
		Sales	13.32%
		Service	33.56%

Table 3: Distributions of the governance variables

	<i>L</i>	<i>M</i>	<i>H</i>
AUT1	21.60%	10.19%	68.21%
AUT2	15.43%	10.19%	74.38%
AUT3	14.20%	10.80%	75.00%
ACC	29.63%	27.16%	43.21%
MON	26.23%		73.77%

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

Table 4: Summary statistics 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 accountability

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

Panel (a): all the samples are included. Panel (b): samples with AUT_{*i*} = *M* or ACC = *M* are dropped. OLS regression with PPS (operation profit to sales ratio) as the dependent variable. AUT1 measures delegated 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 measuring 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 accountability

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

Panel (a): all the samples are included. Panel (b): samples with $AUT_i = M$ or $ACC = M$ are dropped. OLS regression with PPS (operation profit to sales ratio) as the dependent variable. AUT1 measures delegated 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 measuring 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, accountability, and monitoring

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

Panel (a): all the samples are included. Panel (b): samples with $AUT_i = M$ or $ACC = M$ are dropped. OLS regression with PPS (operation profit to sales ratio) as the dependent variable. AUT1 measures delegated 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 measuring 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: Performance effects of authority and accountability (regression with robust standard errors and parent firms as clusters)

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

Panel (a): all the samples are included. Panel (b): samples with AUT_{*i*} = *M* or ACC = *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 delegated 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 measuring 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 9: Effects of monitoring on authority and accountability (regression with robust standard errors and parent firms as clusters)

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

Panel (a): all the samples are included. Panel (b): samples with $AUT_i = M$ or $ACC = M$ 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 delegated 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 measuring 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: Authority, accountability, and monitoring (regression with robust standard errors and parent firms as clusters)

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

Panel (a): all the samples are included. Panel (b): samples with AUT_{*i*} = *M* or ACC = *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.