For RIETI Conference on Corporate Governance
January 8-9, 2003

Institutional Complementarities between Organizational Architecture and Corporate Governance

Masahiko Aoki

Stanford and RIETI

Introduction

We observe that different types of corporate governance structure tend to evolve across economies. Also for decades legal and economic scholars, as well as practitioners, have been debating regarding whether corporate governance ought to be, and will be, structured in the sole interests of investors or for a broader range of objectives including public and other stakeholders' interests. Some of them argue that the presence of different types of corporate governance structure is a sign of inefficient historical legacy and they ought to eventually converge according to the same standard of investor interests. Others argue that such convergence is not desirable or possible from ethical, political, historical and other reasons. But a difference in organizational premise in this debate has not necessarily been elucidated and its implication has not been analyzed. Above all, the corporate governance is about a way of governing the corporation which is an organization far complicated than a mere partnership of investors or a simple principal-agent relationship between the investors and the manager. Depending on type of organizational characteristics a proper governance structure may differ, and there can be different organizational architecture across industries, economies, regions, etc.

This paper considers a theoretical reason why a variety of Corporate Governance (CG) institutions can exist, using game-theoretic and information-theoretic tools. Specifically it start with identifying three generic modes of internal organizational architecture in terms of information connectedness among basic constituent units. They are hierarchical decomposition, information sharing (assimilation) and information encapsulation, each of which may be deemed as having familiar analogues in the actual economy. Then it analyzes how a different type of governance structure can evolve as a complementary institution responding to respective incentive and information problems unique to each architectural type. From a game-theoretic perspective we also consider possible linkages of these governance structures with distinctive institutions in other domains, such as financial markets, polity (political economy) and labor markets. In other words we try to understand different corporate governance structures as an instance of multiple equilibria that link games in the organizational domain and other domains of the economy. This analysis thus provides one theoretical reason why some organizational architecture, and thus respective governance structure as well, can become a convention in one economy but not in others.

A Comparative Institutional Analytic Approach

Following the comparative institutional analytic methodology as developed in Aoki [2001], institution may be conceptualized as beliefs among people in a relevant domain regarding ways how the game is repeatedly played. The reason why such beliefs can be generated, shared and sustained is that they reflect and summarily represent the essence of an equilibrium state of the game in that domain. Such equilibrium state may be consistent with laws as the formal rule of the game, but not necessarily so. Law can affect the expectations and thus incentives of the agents who act strategically, but an institution generated endogenously through the strategic interplays of the agents may be different from the original intention of the government who writes and enacts law.

We may define a corporate governance structure as an instance of institution thus conceptualized. Specifically, we consider the domain composed of the manager, workers and investors (the sole proprietor, shareholders, debt-holders, banks, venture capitalists, etc., depending on context). Then we regard a corporate governance structure as self-enforcing rules of the game regulating action choices of those players contingent on evolving states. In particular, its crucial element may lie in managers' beliefs regarding possible actions of other players in a critical contingency (a sub-game) such as corporate financial crisis. Such beliefs may, or may not, constrain manger's moral hazard behavior in other contingencies and as a result the actual occurrence of the critical contingency may, or may, not be observed with frequency. As we will see below, such beliefs may be conditional on ways how other institutions are structured in the economy, which we may refer to as institutional complementarities.

Three Generic Modes of Organizational Architecture as an Information System

As a basic premise for the emergence of diverse corporate governance structure, we start with identifying three generic modes of organizational architecture in terms of information connectedness among organizational constituents. For the sake of simplicity, consider an organization, of which objective is to produce or design a final product, say a computer, for the highest value (alternatively, at the lowest possible cost). Suppose that this product is a system that can be divided into two subsystems, say hardware and software, which may be called modules. Separate task agents are engaged in the production or design of these modules.

The organization must process two kinds of information to achieve its objective. One is "systemic information," and the other "idiosyncratic information." The latter kind is concerned with task environments idiosyncratic to the design/production of respective modules. Hence it can be hidden within each unit. On the other hand, the former kind of information is concerned with a systemic environment that affects the design/production of both modules simultaneously. A decision resulting from processing

this systemic information determines a connective mode among modules, i.e., the specification of the interfaces. Then we may need a third agent which is exclusively or non-exclusively engaged in processing and/or mediating the systemic information. We call this system-integrating agent the "helmsman," borrowing from the classical article on the design of economic systems by Arrow and Hurwitz (1960). The following three generic types and one derivative type are conceivable as generic procedures to process systemic information and formulate a connected rule out of it.

Hierarchical Decomposition: The helmsman is specialized in processing exclusively the systemic information and determines the connective rule *ex ante*, i.e., prior to the design or operation of each modular task agent. Even if something occurs in the systemic environment after activities in the respective module tasks begin, only the helmsman can decide changes in the connective rules. Thus the helmsman acts as a system designer. Each modular task agent is engaged in processing only idiosyncratic

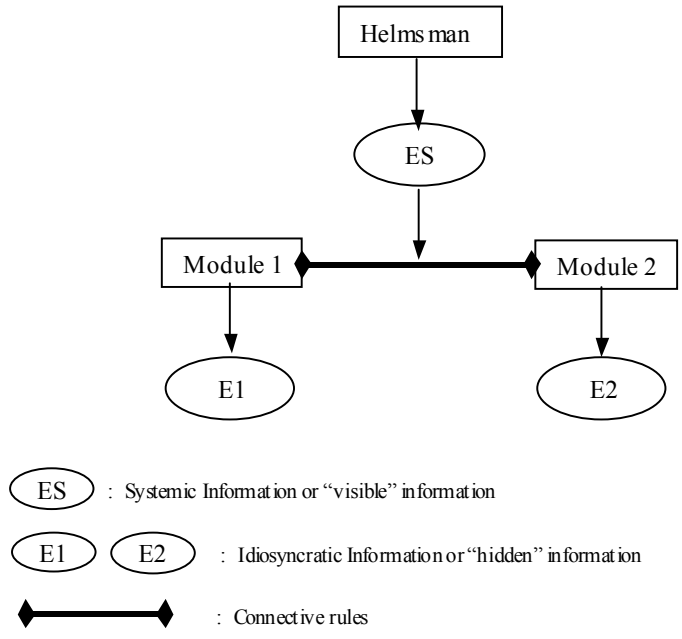

Figure 1: Hierarchical Decomposition

information required for its activity, given the visible systemic information transferred to it by the helmsman. This mode of information connectedness may capture the essential element of functional hierarchy, of which a classical example may be found in the design and production of IBM/ system 360 (Baldwin and Clark).

Information Sharing (Information Assimilation): Under the leadership of the helmsman, information regarding the changing systemic environment is processed by the modular task units as well and fed back to the helmsman. Thus, connective rules continue to be fine-tuned even after the activities in the respective modular task agent begin. A typical example of this mode may be found in the Toyota design team in which information feedback from component design teams to the "heavy-weight manager is a characteristics.

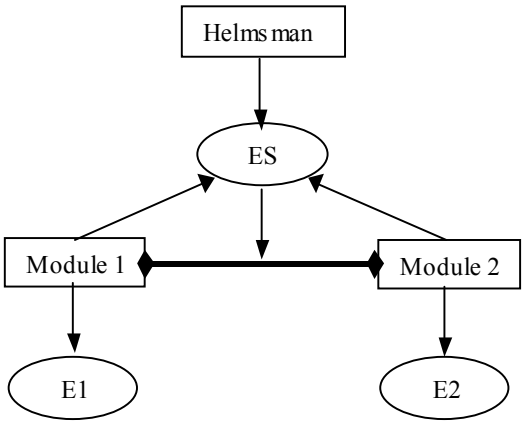

Figure 2: Information-Sharing

Information-Encapsulation and the "Silicon Valley model" :The third generic type is the one in which the modular task units process both systemic and idiosyncratic information independently of each other and a connected rule is determined *ex post* as a result of their decision-making based on their own information. In this type

information processing is encapsulated within each modular task agents and thus differentiated. In this type there is no role explicitly played by the helmsman.

A derivative type of this mode may be visualized as follows: Suppose that there are multiple independent agents, instead of only one, for each modular task who are engaged in encapsulated information processing. There can be also multiple helmsmen. Visible decisions (interface and performance characteristics of modules) by modular task agents are collected and mediated by the helmsmen. Thus multiple connective rules may emerge *ad interim* in a competitive way. The helmsmen select and combine modules that are compatible in the best way with the connective rule that they select to form a product system. The market finally evaluates which system will have the highest value and select it *ex post*. We may call this system the "Silicon Valley model" (Aoki, 1999; 2001) or the "modular cluster" (Baldwin and Clark, 2000).

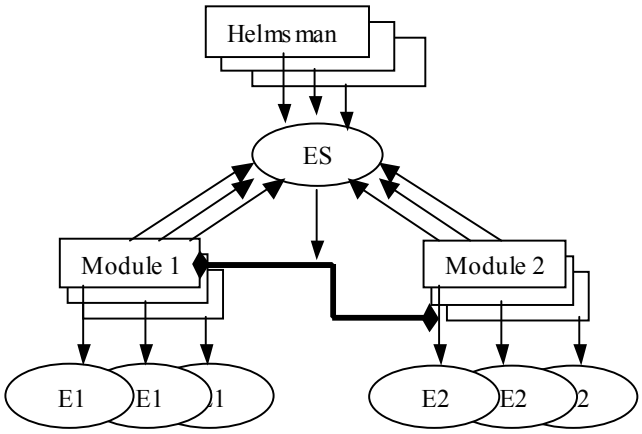

Figure 3: The Silicon Valley model as a derivative of information encapsulation

The above three modes (and one derivative mode) actually exhaust all possibilities of organizational architecture in terms of information connectedness. Before we relate these three modes to respectively distinct governance structures, we briefly note that

there is no absolute informational advantages among any of them independently of the nature of product system (in terms of the degree of attribute complementarities among modules) and the nature of technological environment (in terms of the relative importance of the systemic environment, vis-à-vis idiosyncratic environment). Resolving dependencies among all design specification of a complex system at one time can be very costly. The cost of processing and transmitting information will be greatly saved by dividing a complex system into modules and localizing coordination. This is the most primitive motive for modularizing a product system through hierarchical decomposition. Still another benefit of hierarchical decomposition may come from specialization, since an agent working on each modular task can be specialized in idiosyncratic information processing, while the processing of systemic information processing is exclusively performed by the helmsman specialized in that skill. However, the bounded-rational helmsman cannot foresee all the uncertainties, enumerating and resolving all possible dependencies among modules. But, once the connective rules are set, it may become costly to modify it in response to emergent information. The development of System/360 provided us with a good example here as well. Indeed, after design rules are centrally set, various problems arose in the course of designing respective modules and system testing (Baldwin and Clark). The more complex a system is, the more incomplete the *ex ante* design of connective rules among modules would be. Thus, hierarchical decomposition cannot escape from a trade-off between facilitating coordination by localization and sacrificing optimality in the whole system.

As the complexity of the product system increases, it may become desirable that a connective rule is fine tuned according as emergent systemic information becomes available. It will be informationally more efficient to do so by letting modular task agents participate in systemic information processing and pooling information fed back by them, when the information processing skills of the modular task agents become enhanced and their tasks and product attributes become closely inter-related. However, when their tasks become more independently performed in terms of product attributes

as well as technological interdependencies, the encapsulation of systemic information processing by modular task agents become informationally more efficient and the role of the helmsman may be reduced to the mediation of decision taken by them based on individual information. The Silicon Valley model adds another informational benefits at the costs of duplication of resource inputs by multiple agents in performing the same task. That is, it can create option value in that the complex system can be created evolutionarily by ex post selection of the best combination of modules from among many experiments performed by multiple agents in each modular task. We will discuss this merit later in more detail.

Product attribute complementarity	Technological correlation		
	low		High
High	encapsulation	sharing	hierarchical decomposition
Low	Encapsulation		

Figure 4. The Relative Informational Efficiency of the Three Modes

Thus the information advantage of each mode can be relative, dependent on technological environment and product attribute of the product system. There is no absolutely superior mode of organizational architecture. This indicates significant implications for the comparative assessment of corporate governance structure, as each mode may entail a unique structure of governance structure.

The Hartian Property Rights Approach as a Special Case

Let us first take up the celebrated contributions of the theory of the firm by Oliver Hart

and his associates. We re-interpret their major insights in the context of our framework. First, consider the simplest domain of organization in which the mode of hierarchical decomposition is established. Let us identify the helmsman with the manager and the modular task agents with the workers. Assume that they invest respectively in relation-specific (firm-specific) human investments, but that the skill of the former is "essential" in the Hartian sense, while the workers' are not. That is, the manager's task performance is indispensable to the productive use of physical assets used by herself as well as by the workers so that the workers cannot enhance their respective productivity without her intervention, even if they own the entire set of physical assets. On the other hand, the manager can (at least partially) realize her value even without the skilled workers if she owns the physical assets. In this case, the second-best solution is for the manager to acquire the ownership of the entire set of physical assets. Only in this way is the manager motivated to accumulate the essential human assets of her own. The essentiality of manager's skill may be thought of as composing of her ability to dictate the use of physical assets to the workers in a productive manner within the context of hierarchical organizational architecture, when contract is incomplete. Thus, *the manager's ownership of physical assets is institutionary complementary to the hierarchical production coordination by the manager*. In other words, proprietor's firms are expected to win out in competition vis-à-vis other forms of ownership arrangements, where the hierarchical mode is a convention of organizational architecture in the economy. However, as we have seen, there can be other modes of organizational architecture (production coordination) so that *the linkage of this type is to be regarded as a specific case, albeit an important one*, even if we limit our attention to generic CG arrangements.

When the manager cum owner becomes cash-constrained, she must then raise funds from outside investors through debt contracts (when cash constraint is moderate) or stockholders (when it is severe) through equity contracts. This situation can be analyzed as a three person repeated game between the investor, the manager and the worker(s). In this game, the investors control the supply of funds, the manager

invests/shirks in relation-specific human capital and is engaged in hierarchical coordination, and the worker invests/shirks in relation-specific human capital and is engaged in production using physical assets. One kind of such model can be obtained simply by augmenting the Tirole's *Econometrica* model (2001) with the explicit addition of the workers. One can derive the following implication from such model: "*value-enhancing takeover by a new stockholder may not necessarily be efficiency-enhancing, when the 'breach of trust' by a new manager is retaliated by the worker's non-cooperation* (*TCIA*, ch. 11.1).

Institutional Complementarities between Co-determination and Corporatism

In the hierarchical decomposition mode, it is assumed that the workers may be subjected to the efficiency wage discipline. That is, the workers invest in relation-specific human capital and use them in the second-best manner in the anticipation of employer's sharing of surplus with them as far as the manager has kept the promise to do so. Imagine, however, that a wage rate is fixed by a corporatist agreement between the trade union and the employers association on the national level and each management is obliged to comply with it.

Suppose that in order to elicit workers cooperation under this institutional environment, the employer (suppose for a while she is a manager cum owner just like the Hartian proprietor) allows the workers to participate in the "residual rights of control"(Grossman and Hart 1986) – the rights to decide on the use of human and physical assets in contractually unspecified events -- provided that the workers have always cooperated (made efforts in organizational skill development) in past periods (subgames). Otherwise she keeps the residual rights of control to herself and does not make any payment beyond what is determined in the corporatist agreement. In a symmetric way, the workers make reciprocating efforts, provided that the employer has always partially relinquished residual rights of control to the workers in the past periods, and otherwise shirk. Let us assume that the workers can reduce their effort

costs by participating in the residual rights of control, possibly because of improvements in working conditions, participation in work-place design, more autonomous control of their works, etc. This implies that the participation of the workers in the residual rights of control transforms the organizational architecture from a functional hierarchy to a participatory hierarchy. On the other hand, there may be some reduction in the employer's utility in the event of partial relinquishment of residual rights of control, for she may not any more implement the work plan that she likes the best. Still, it can become one possible equilibrium over periods that the reciprocating cooperative strategies are sustained by both parties. We cannot make a definite Pareto-ranking between this equilibrium and the Hartian equilibrium.

When the equity of the original owner of the firm is still too small relative to the required capital, it becomes inevitable that her ownership rights need to be abandoned. However, in this case the governance structure cannot be the same as the shareholder governance discussed in the previous section because the workers participate in the residual rights of control. Suppose that both the workers and investors (shareholders and creditors) are able to cast a veto vote vis-à-vis a management action that they prefer less than the status quo, or deny the reappointment of the manager for the next round of the game, depriving her of an opportunity to obtain an employment continuation value. Thus, the workers and investors can exercise separate control rights over the management. Let us call this governance arrangement *codetermination*. Then, any unilateral new action that would hurt the workers can be blocked by a workers veto and by the manager's career concerns.

On the other hand, assume that although the investors supply full financing, they have little useful information for facilitating the smooth operation of the participatory hierarchy within the firm, and thus are passive in formulating a business plan. The possibility of restructuring after initial financing can be perceived only by the manager who has invested in firm-specific human assets. However, the investors can threaten to withdraw financing and the workers can be noncooperative if they choose to do so. In

this setting, it can be proved that *the corporatist wage-setting is institutionally complementary to the linkage of participatory hierarchy and codetermination.* There may be a stock value-enhancing management plan that can be chosen under shareholder governance but not under co-determination, if it is expected to have a welfare-reducing impact on the workers and incite a retaliatory uncooperative choice of efforts by them. *The two governance mechanisms are thus not necessarily Pareto-rankable.* Also, it is interesting to note that under the codetermination external financing is made more in the form of long-term debt contracts, as the interests of debt holder and that of the worker are more congruent than under the functional hierarchy (*TCIA*, ch 11.2).

Information- Sharing and Relational Contingent Governance: Governance Dilemma

As already mentioned, there has been a persistent stream of thought in the CG literature that the corporation actually is, or at least ought to be, run in the interests of various stakeholders including the workers, but not in the sole interests of the shareholders. Even Adolph Berle, who was engaged in a harsh debate against such view in the early 1930s converted to it in his later career. Recently Jean Tirole, a sharp analytical economist, made the following comment in his Presidential Address to the Econometric Society, however: "The stake-holder society view has not been provided with a good theoretical perspective, as it is difficult to theoretically design multi-task incentives for the manager or an effective arrangement for the division of control rights among stakeholders"(2001). Even if that is so, it is possible to design a CG arrangement in which control rights *shift* (not be "divided") between stakeholders contingent on events on the corporate organizational domain, more specifically, between the insiders (the managers and workers) on one hand and a designated agent of the investors on the other, contingent on the (corporate financial) outcome of the stage game in a repeated game context. Thus, I call this governance arrangement the *relational-contingent governance*. I first derive this mechanism theoretically as a second best solution to a free-riding problem inherent to organizational architecture of

the information-sharing type and then discuss its inherent dilemma. .

Let us assume that the mode of information-sharing has been established as architectural mode in which the information processing activities of both manager (helmsman) and workers (modular task agents) are crucial inputs to each other to be productive. We may interpret this situation as that both the manger's skill and workers" skills become essential in the sense of Hart. That is, both the manager and the workers cannot generate surplus value without mutual cooperation, even if they own the entire (or relevant) set of physical assets. In this situation, an ownership arrangement cannot resolve the governance problem. Catching this essential aspect of the information-sharing mode in the simplest form, let us simply assume that they are symmetrical in their contribution to the organizational output but each of them cannot precisely observe the level of effort of the other. This type of production organization is referred to as the "team"(Alchian-Demsetz-Holmstrom). In it, the free riding on other members' efforts becomes an inherent moral-hazard problem that cannot be resolved by the sharing of outcome among the members alone. There must be an external discipline.

Suppose that this organization (let us refer to it as the *S-firm* and its manager and worker as the insiders) needs some outside financing for productive activity. It is provided by numerous investors who expect a certain level of financial returns. They cannot however observe even the aggregate output value of the S-firm *ex post,* but can observe only the court-verifiable event of its termination. They entrust the enforcement of financial contracts to a particular *relational monitor (R-monitor)* who can observe the aggregate output value of the S-firm at the end of each subgame and then exercise control rights contingent on it according to a contract agreed with the S-firm at the beginning of the repeated games. The R-monitor requires a certain expected level of income per subgame for this service payable from the current output of the S-firm.

In this setting, it can be proved that the following nexus of contingent contracts is the

second-best CG arrangement for the free-riding problem (*TCIA*, ch.11.3). It divides the entire range of the S-firm's possible output value at the end of each subgame into the following four regions in the order of the highest to the lowest, and specifies control rights to be exercised either by the insiders or the R-monitor on each of them. In the highest region, i*nsider-control region,* both investors and R-monitor get a fixed amount of returns and the residual output value is equally shared exclusively among the insiders. In the next highest *R-monitor-control region*, control rights to output shift to the R-monitor. The R-monitor pays the same rate of return to the investors as in the insider-control region, pays the agreed minimum income to the insiders, and acquires the non-negative residual. The S-firm continues to the next subgame. In the next lower *Bailing-out region*, the payment schedules are the same as the previous region except that the output value level is so low that the residual borne by the R-monitor becomes negative. However, the S-firm is still sustained to the next subgame. This corresponds to the case in which the R-monitor bails out the S-firm comprised of the wealth constrained insiders. In the lowest *termination region*, the R-monitor terminates the S-firm after making contractual payments of the minimum income to the insiders and a fixed rate of return to the investors lower than the expected investor' rate. Deficits after the termination are to be borne by the R-monitor.

The nexus of contracts just described defines a basic mechanism of governance regarding both the disposition of the S-firm's output and its continuation at the end of each period. Since control rights shift between the insiders and the R-monitor in a punctuated manner contingent on the value of the S-firm's output, we may call this arrangement the *relational-contingent governance*. In the insider-control region, the insiders become residual claimants, as in the case of an insider-controlled firm. However, if such a status were to extend over the entire range of output value, the moral hazard inherent to S-firms would become unavoidable. Further, if the value of output is very low, it may not be sufficient to guarantee the minimum required income of the insiders. For these two reasons, if the value of output falls below a certain level, the residual claimant status shifts to the R-monitor.

If the value of output falls even further to below the termination point, the S-firm is terminated and its members have to accept inferior outside options. This efficiency-wage-like discipline can provide incentives for the insiders not to shirk. The outside option value may be taken as a parameter by the insiders of an individual S-firm, but its lowering can be regarded as a (general equilibrium) outcome of the convention of information-sharing prevailing in the economy. Namely, if all firms are structured as S-firms relying on the context-oriented skills of their members and individuals' skills are geared toward a particular firm, they cannot freely move between the firms without suffering a loss in their employment continuation value. Thus, the effectiveness of the relational-contingent governance is enhanced when the information-sharing mode is established as a convention in the organizational field. Conversely, as we have discussed, the information-sharing mode can be run more efficiently when the relational contingent governance are institutionalized. Thus, *the convention of information-sharing mode and the contingent relational governance are mutually reinforcing and institutionally complementary.*

Since some costs of termination may be born by investors, in practice there may be incentives for the R-monitor to terminate a financially troubled S-firm, even when the S-firm should be bailed out. To counteract these incentives, there must be some intrinsic values -- rents -- available for the R-monitor for credibly committing to a bailing-out operation whenever it is appropriate to do so. We can then discern one important dilemma inherent in the mechanism of relational-contingent governance: On the one hand, if rents are not sufficiently high, the R-monitor may be motivated to terminate firms that should be bailed out. That is, valuable organization-specific assets may be destroyed even when mildly poor performance occurs due to uncontrollable stochastic events but not to the actions of insiders. On the other hand, if the rents made possible by bailing-out are too high, the monitoring agent may be motivated to bail out a firm that should not be bailed out. If such expectation prevails, the mechanism of relational-contingent governance fails to provide proper incentives *ex ante* for the

insiders of information-sharing firm to make sufficient efforts. The tendency is known to economists as the "soft-budget constraint" syndrome (Kornai).

Which syndrome prevails in a particular economy depends on the relative magnitudes of those costs and rents facing relational monitors. Explicit contracts of relational-contingent governance are hard to write in practice because of the complexity of the contractual environments. Further, the rents from bailing out may not be determinable in individual organization domains, but may be specified and generated only in a broader institutional context in which they are embedded. In actuality, one cannot assume therefore that costs and rents are arranged in such a way that the second-best solution can be implemented with precision in each organization domain. It is reasonable to expect that one or another of the syndromes may prevail. Yet, in environments where rents and costs remain fairly stable, if not balanced exactly in a second best way, expectations regarding the possible behavior of R-monitors, whoever they may be, may become predictable, and firms of the information-sharing architecture type may accordingly be disciplined while being able to accumulate and preserve organization-specific assets in a more or less steady fashion. However, when there is an environmental change that drastically transforms the parameter values defining the costs and rents of bailing-out, so that expectations regarding the monitoring agent's possible actions become uncertain, the provision of effective relational-contingent governance will become problematical.

My discussion above remained at a highly abstract level. In particular, I have been silent about who relational monitors can be and what their incentives are to bail out financially depressed firms. There are several institutional possibilities of contingent governance relationships: (i) between firms and their main bank; (ii) between subsidiary corporations and their holding/management company; (iii) between an entrepreneurial start-up firm and a venture capital company; (iv) between state-owned enterprises and the government; or (v) between banks and the government regulatory agency. These possibilities and their inherent syndromes are discussed in *TCIA*, pp.

300-5.

The Silicon Valley Model as a New Mode of Corporate Governance Structure

Now let us move on to discussion of governance issues of the derivative mode of information-encapsulation – the Silicon Valley model. The model assumed that multiple agents are competitively engaged in each of modular tasks, while multiple helmsmen take a mediating role in selecting *ex post* the optimal combination of completed tasks (modules). In a more concrete context, the former can be identified with entrepreneurs competing in the development of new modular products potentially constitutive of a new innovative product system. The function of the latter may be conceived of as being dispersed and fulfilled by various agents. They may include incumbent firms that have already established a leading position in a niche market and strives to consolidate the position by acquiring developmental results of start-up firms, or experienced venture capitalists who finance, and thus are engaged in the governance of, the start-up firms. The individual entrepreneurs are engaged in highly sophisticated information processing, encapsulating and hiding its contents from each other except for visible interface and performance characteristics.

This informational characteristic of the Silicon Valley phenomenon ought to be conceptually distinguished from "de-integration" in terms of the ownership of physical assets, however. Observing "a trend toward "de-integration [that] has occurred in the 1980s and 1990s," Hart commented that "because of advances in information technology, agents who were previously engaged in routine tasks need to be motivated to make wise decisions on the basis of the increasing amount of information at their disposal."(1955, p.53) This characterization is consistent with ours on the information encapsulation. However, Hart continues to argue that his theory predicts that the importance of individual initiative entails the decentralized ownership of physical assets among independent entrepreneurs. However, in Silicon Valley and other places of entrepreneurial clustering, such de-integration is not observable. In actuality,

start-up entrepreneurs are often devoid of initial capital and ought to be financed by the venture capitalists and others. Such arrangement provides a unique governance structure extended over the clustering of competing entrepreneurial firms, of which characteristics cannot be understood if an individual entrepreneurial firm is observed in isolation.

The information encapsulation in the Silicon Valley model allows that each module of a potentially innovative system can be developed independently of the design of other modules, as far as the interfaces and performance requirements among modules are standardized *ex ante* or *ad interim* and known to each entrepreneur. Then, an innovative system may be evolutionarily developed by combining the best-developed product of each module ex post. When system development is extremely complex, this process may have a superior innovative capacity in comparison to the case where system design is done in a hierarchical manner once for all, or design improvements may be done through intense information exchanges and sharing among a fixed set of modular task agents. This is so because the process can create *option values* (Baldwin and Clark) by allowing each module experimenting on diverse designs in the presence of high uncertainty. However, the option value cannot be obtained without costs. The costs are the duplication of development costs within each module. Further, if the cost of development by an entrepreneur has to be financed by outside investors so that possible returns are to be shared with them, entrepreneurial incentives may be compromised without a proper governance arrangement. How can these costs of development be controlled?

Let us consider a game played by the venture capitalist (VC) and two groups of entrepreneurs, each competing for the development of a modular product. These two modular products may be combined through standardized interfaces. The VC finances the initial development funds to multiple entrepreneurs in each module design and it then monitors their design development without necessarily observing their effort levels directly. It mediates a modicum of information sharing among entrepreneurs if

necessary for the ad interim modification of interface. Eventually the VC selects only one entrepreneur for each module for the completion of its project and realizes its values by bringing it to public offering or arranging an acquisition by an existing company. The realized values can be shared between the VC and the selected entrepreneurs according to ex ante share contracts, but other entrepreneurs do not get anything. It is essentially a tournament game played among entrepreneurs refereed by the VC and we may call this arrangement as *VC governance by tournament*. The VC is linked to other financial markets for raising funds, but I do not consider this aspect now

We can now take the balance. The arrangement can create option value with the cost of duplicated development efforts and financing (Baldwin and Clark). The tournament provides additional incentives for the entrepreneurs in contrast to the case of stand-alone development effort, because marginal benefits of additional effort are composed of marginal expected benefit obtained in case of winning plus marginal gains obtained from enhanced probability of winning (*TCIA*, ch 14). However, as the number of entrepreneurs competing in each modular design increases, this incentive effects are diluted so that there is an optimal number of entrepreneurs to compete in each module development, depending on the degree of uncertainty involved in development and the expected value of final products (Aoki and Takizawa 2002). Particularly interesting is the following proposition: *If total value of an innovative system is expected to be high, and if the VC's selection of winning entrepreneurs is believed to be precise by entrepreneurs, then it is possible that, even for the same share allocation between entrepreneurs and financiers, the VC governance by tournament can elicit higher development efforts from entrepreneurs than under arm's-length financing, and that its effect, together with the creation of option value, can compensate social costs of duplicated development efforts.*

Concluding Remark on the Role of Law

Using simple generic models I have shown that there may exist diverse CG arrangements associated with different modes of organizational architecture. Also, I have argued that those arrangements may be supported by respective complementary institutional arrangements in other domains (see *TCIA* for a more comprehensive treatment on this subject). This may indicate that a CG arrangement may have a robust property that may be hard to be changed in isolation, unless complementary changes occur in other domains. Also, a mode of organizational architecture tends to evolve as a convention, although conscious design elements are also involved. Thus a particular CG arrangement and a corresponding organizational architecture may co-evolve. Do all these indicate that an attempt to improve on a CG arrangement through the design of statutory law is bound to be futile? Obviously, this is not the case.

Statutory laws affect the pay-off functions of the game structure. In other words, they may provide information to the players about what could be the pay-off consequences of their actions, if laws are enforced, although whether they are actually enforced or not is a matter determined through the strategic interplays between the enforcer and other players. Thus laws affect the outcome of the game through the expectations of the players as well as their incentives. Thus statutory laws are not institutions per se in my conceptualization, but it can induce the evolution of an institution. In particular, codified rules of corporate governance, that is, the legal rights and duties afforded to various agents (particularly shareholders and employees) and the associated legal procedures, define the exogenous rules of the game in the corporate organization domain, and as such they may affect the beliefs and incentives of the agents and thereby corporate performance (La Porta *et al* 1998). However, legal rules that are inconsistent with equilibria in complementary domains, particularly with a prevailing convention of organizational architecture, may not yield the outcome intended by the legislature. For example, the Japanese Commercial Code provides minority shareholders with one of the strongest rights at stockholders' meeting. However, its governance arrangement is normally not considered to be stockholder-controlled (see *TCIA,* .Ch. 14)

On the other hand, sustainable legal rules for corporate governance may be understood as the codification of an equilibrium arrangement that evolved through a long history of complementary institutions (e.g., co-determination in Germany. See *TCIA* ch.6). A careful and systematic study is called for regarding the questions of how the initial institutional conditions, such as the legacies of old institutions and the prevailing informal rules (norms, social ethics, etc.), kinds and level of the existing stock of human competence, can affect subsequent legal evolution, and conversely, how formal rule-setting in the polity interacts with the evolution of the endogenous rules of the games (i.e., institutions) in CG and other domains.

References

Alchian, A. and H. Demsetz (1972), "Production, Information Costs, and Economic Organization," *American Economic Review* **62**: 777-795.

Aoki, M. (2001), *Towards a Comparative Institutional Analysis*, Cambridge, MA: MIT Press.

Aoki, M. and H. Takizawa (2002), "Information, Incentives and Option Value: The Silicon-Valley Model," *The Journal of Comparative Economics*, forthcoming.

Baldwin, C. Y. and K. B. Clark (2000), Design Rules: The Power of Modularity, vol.1, Cambridge, MA: MIT Press.

Grossman, S. and O. Hart (1986), "The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration," *Journal of Political Economy* **94**: 691-719.

Hart, O. (1995), *Firms, Contracts, and Financial Structure*. Oxford: Clarendon Press.

Hart, O. and J. Moore (1990), "Property Rights and the Nature of the Firm," *Journal of Political Economy* **98**: 1119-1158.

La Porta, R., F Lopez-de-Silanes, A.Shleifer and R. Vishny (1998), "Law and Finance," *Journal of Political Economy* **106**: 1113-1155.

Shleifer, A. and L. Summers (1988), "Breach of Trust in Hostile Takeovers," in A. J. Auerbach (ed.), *Corporate Takeovers: Causes and Consequence*: 65-88. Chicago: University of Chicago Press.

Tirole,J. (2001), "Corporate Governance," *Econometrica*.