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1. Introduction

In the first half of the 1980's Japanese export industries exhibited a phenomenal competitive strength. During this period (1980 - 1985), the amount of Japan's exports grew at the average annual rate of 6.4 percent, exceeding the average rate of growth of OECD countries' gross national products by x.x per cent. Meanwhile, after reaching its peak in 1982 ($ 129 billion), Japan's import remained below that level since then ($ 119 billion in 1985). As a result, Japan's current surplus amounted to $ 55.1 billion in 1985 and its foreign assets climbed to $129.8 billion at the end of 1985, making Japan the largest capital exporting country. What is the basic driving force of this salient external imbalance? Is the imbalance curable by appropriately designed domestic and/or internationally coordinated policy measures? Or is the Japanese competitive strength due to the development of a new paradigm of industrial organization which is noticeably more efficient than the one dominating Western industry in the last half century or so?

Political spokesmen for hard hit foreign industries tend to regard the imbalance primarily as a result of "unfair" trade practice on the side of Japan. They argue that the Japanese government bureaucracy, in collusion with industry, erects diverse networks of regulation which put foreign competitors considerably at disadvantage in competing in domestic markets in Japan. Also it is often claimed that Japanese companies are tied to each other through the practice of long-term business relationships, excluding outsiders from

competitive business opportunities. According to this view, the external balance may be effectively removed by more liberal political actions and modernizing business practices.

Another view concurrently prevailing among political and industrial, as well as academic, circles pinpoints the source of external imbalance at persistent twin macro imbalances of the Japanese and American economies. In the first half of the 1980s, there was a considerable excess of savings over investments by the household sector in Japan, amounting on average to ten percent of its national income. The business sector and the government sector absorbed only a portion of this excess. As a result, the excess domestic savings, amounting to about 3 percent of national income in 1984 and 3.5 percent in 1985, were channeled into the international capital markets. Sizable capital exports from Japan have been directed to the U.S., financing the persistent government deficit as well as the direct investment in corporate assets by Japanese manufacturers. According to this view, the realignment of the exchange rate beginning with the intervention of G-5 in September 1985 would not ease the external imbalance, if contemporaneous measures be not employed to absorb more savings domestically in Japan and to reduce government deficit in the United States.

There are possibly some elements of truth in these views. However, I will argue in this paper that, lying behind the growing external imbalance, there also exist competitive strength of Japanese manufacturers in some export-oriented industries which cannot be

reduced to political, traditional, and macro factors. Specifically I will argue that Japanese manufacturers which have been growing into global firms have been developing an intra-firm work organization and a coordination mechanism which are somewhat different in its operating and controlling characteristics from the ones prevailing in the Western firm. In short, the developing Japanese system is the one which relies more on semi-autonomous problem-solving capability (information processing capacity) of workers, thus making the intra-firm demarcation between control and operating tasks rather ambiguous. In contrast, the prevalent Western system seems to aim at the pursuit of economic efficiencies realizable through the professional control over specialized operational tasks.

I will discuss below how the developing Japanese system may perform well in coordinating intra-firm operations in response to evolving market circumstances of certain characteristics. I will also argue that the problem-solving capability of workers enables them to participate in the sharing of rents accruable to the efficient operation of the intra-firm coordination mechanism, but this sharing opportunities entail the hierarchical layering of workers' benefits depending on the size of employing firms: the phenomena which I will refer to as the "dilemma of industrial democracy."

Whatever the relative merit and demerit of the Japanese system may be, its development suggests a possibility of a new paradigm of work organization and an intra-firm coordination mechanism which may be an alternative to the traditional Western paradigm of hierarchies

based on the separation of control and operation. Then a question may be raised as to whether the Japanese system is culturally unique or can be reconciled with some elements of the traditional Western system to form a more efficient and fair hybrid system. This question is of vital importance in contemplating on the future of post-industrial, informational society. Although a through inquiry into the question is far beyond the scope of this essay, at least some relevant issues may be referred to in the concluding section in order to prepare for a future study.

2. The Traditional Paradigm of Hierarchy

In order to make the comparative assessment of the Western and Japanese work organizations and intra-firm coordination mechanisms from the decision-making systematic (information-systematic) perspective, let us first distinguish the strategic decision-making and the operational decision-making. The former is concerned with those decisions of the firm (corporate organization) which would structure the basic framework of its operation. Decisions regarding investments in new equipments and buildings, the direction of research and development, diversification, acquisition and divestiture, etc. fall in this category. Given these strategic decisions, the firm needs to adapt its operating tasks to evolving technical and human emergencies (the malfunction of machines,

defective products, absenteeism of workers, etc.) and changing market circumstances sequentially. Such adaptation involves assignments of specific tasks to each member of work organization, operational coordinations among functional work units (such as teams, shops, etc.), piecemeal improvements on work process, etc., and I will subsume this type of decision-making under the second heading. In this and next sections, I assume strategic decision-making as given and focus attention on the operating and adaptive attributes of the highly stylized Western and Japanese firms. In section 4, I will consider interactive relations between the operating and strategic attributes of the two.

The stylized nature of operational coordination in the Westen unionized firm may be captured by a simple traditional model of hierarchy characterized by the follwoing three basic attributes: (1) every constituent unit is chrystallized around a well-defied specialized function; and (2) each constituent unit has one and only one immediate superordinate to which it reports and coordination between any two (or more than two) constituent units are performed by the lowest superordinate common to them; and (3) there is only one unit (the central office) which is superordinate to any other unit. In particular, the manufacturing department may be conceived of being composed of several operating units, which I will call shop for simplicity's sake. The shop is further comprised of a group of workers, each of whom is assigned to a specific job according to an articulated job classification scheme as stipulated in the collective

agreement with the union (assuming that the shop is unionized). Within the limit set forth in the collective agreement, the foreman of a shop has a discretionary power to specify concrete operating tasks for each job and direct coordination among different jobs in response to local shocks, or unusual events within the shop, such as work stoppage due to machine malfunction, the absenteeism of workers, an unusual increase in defective outputs, etc. There is a clear demarcation between operating jobs and jobs coping with such local shocks. The latter is performed by specialists such as repairmen, reliefmen, product inspectors and the like. The remuneration to workers on the shop is made according to job titles.

For simplicity's sake, let us imagine that the adjustment of output levels of various final outputs in response to system shocks (e.g., changing market demands or supply shocks), as well as accommodating adjustments of the flow of intermediate products, materials, parts, etc. between shops and as the amounts of buffer inventories to be held at each shop, are directed from the centralized office of production planning (possibly through intermediate administrative office).

It is O. E. Williamson (chapter 9, [1985]) who has advanced a most comprehensive argument in defense of hierarchy on the efficiency ground.[1] According to him, the hierarchical organization of work and coordination would save transaction costs by the following reasons:

1. Saving of transaction cost: Hierarchy can economize on buffer

inventories and expenses involved in inter-shop transportations by the centralized coordination of material requirement planning by the expediter. It also discourages embezzlement and deter the disguise of true quality attributes of intermediate products by centralized monitoring.

2. Economies of specialization: The talents of employees will be most effectively utilized by the specialized assignment of different operating tasks as well as the separation between managerial and operating tasks.

3. Economies of centralized handling of shocks: Hierarchies have the best responsiveness to system shocks because of the centralization of market and other environmental information and decision-making. Also the capacity to recognize and implement system innovations are high because of specialized contributions of engineers.

However, he admits that hierarchy may have a certain negative incentive attribute:

4. Lack of responsiveness to local shocks: Employees working under hierarchies may not be motivated to work intensively because the link between reward and effort is not direct (the payment to employees is normally made according to job titles). They may be

also less responsive to local shocks because they are not authorized to do so under the job classification scheme. But this disadvantage (4) may be outweighed by gains from the specialization of jobs and the centralization (hierarchical ordering) of decision-making listed under (1) through (3) above. Counterarguing He concludes: "Hostility to hierarchy thus lacks a comparative institutional foundation." (p.231.)

His comparative analysis may appear undisputable from the efficiency point of view. However, comparative alternatives in his analysis are primitive production organizations, such as putting out system and inside contracting, historically preceding to and replaced by the emergence of hierarchical system, or idealized utopian systems, such as the commune in which workers rotate among various jobs regularly on the basis of common ownership of capital, which have never become viable on recognizable scale. Tacit in his comparative analysis seems to be the assumption of market and technological environments in which scale economies are favored. Suppose that production is for mass markets in which relatively standardized commodities are demanded by numerous anonymous consumers. In order to exploit economies of scale, production process may be subdivided into multiple tasks, each of which may be performed by the aid of special purpose machines (the attribute (2) is relevant here). Also demands in these markets are more or less predictable thanks to the law of large number, and adaptation to changing market circumstance may be adequately made by regularly revised centralized

production planning. Interim adaptation may be coped with by the adjustment of buffer inventories without overall production rescheduling (the attributes (1) and (3) are relevant here).

However, if scale merit is lost by some reason and if flexible and quick adaptation to local and systematic shocks become imperative for competitive efficiency, the efficiency of hierarchical decision-making and coordination may become problematical. This point may be illustrated by an example. It is becoming the case that modern assembly lines of passenger cars specifically designed for the production of a particular model turn out literally tens of thousand of varieties of cars, distinguished by different combinations of engine and transmission, color, body type, options, etc. At an assembly factory of a Japanese manufacturer, 32,100 varieties of cars were produced and the average amount of output per variety was only 11 in three months period in 1978 (This factory only produced 500 varieities in the mid 1960s.). This kind of intensive product diversification is becoming an important feature of modern factories ranging from consumer products, such as automotive and home entertainment electronics, to material products such as steel products. Through intensifying competition among producers of different national origins on global scale, national markets are becoming more integrated into the single global markets, and in order to capture a larger market share each producer is forced to treat these markets more like "fashion markets", where product life cycles are short, demand shift from one variety of product to another is

volatile, the batch of production is small, and the shortening of lead time from order to delivery are imperative. It seems that economies of scale so effective in mass production are losing ground in this trend. The trend also seems to cast doubt on economies available from the hierarchical integration of specialization by the reason listed below:

(1) As product diversification within a single manufacturing department is intensified, production coordination through buffer inventories may become very costly, as the number of parts, materials, half products, etc. to be integrated soar. [high inventory costs]

(2) In order to adapt work organization to meet diverse and volatile market demands quickly and flexibly, rigid specialization based on an articulated job classification scheme may not be conducive to the efficient utilization of work force. It may become necessary to assign diverse tasks to workers flexibly, responding to evolving circumstances. Also it may become necessary to cope with local shocks (such as the malfunction of machines and absenteeism) quickly without calling in specialized helps (such as by engineer, servicemen and reliefmen) from outside the shop. But doing so may require more versatile skills of workers. [the rigidity of specialization]

(3) The centralization of information and decisionmaking may be subject to noise disturbance in the process of communications and time-lag from the perception of shocks to the implementation of operational response. (Information concerning volatile market conditions is first screened by the marketing department, and then transmitted to and transformed into production plan by the centralized office of planning. The production plan is then instructed to each constituent units.) Also if intermediate product flow is controlled centrally by the expediter's office, valuable on-the-spot information available at interfaces of constituent units, such as on the quality of intermediate products and emergent events affecting timing of delivery, etc. may remain unutilized. [communication costs in the hierarchy]

(4) The negative incentive attribute of hierarchy referred to may be aggravated in the increasing needs of flexible adaptation. The cooperative participation in the problem-identification and problem-solving by workers may be motivated only if they participate in the sharing of outcome as well. [the lack of incentive to respond to local shocks]

Thus hierarchical decision-making and coordination based on the separation of control and specialized tasks may be losing its efficient characteristics attributed by Williamson in the emerging market conditions. But are there any alternative mode of work

organization and coordination mechanism which can respond to increasingly volatile market conditions and complex technological conditions more effectively?

3. A New Paradigm? --- the Japanese System

The Japanese firm has a legal corporate structure and the formal internal organization similar to the Western firm. However, the operating and adaptive decision-making structure is somewhat different from the stylized model of the Western system as described in the last section. Let us illustrate this point by describing the essential characteristics of the well publicized "kanban" system which is used to adapt the production process to changing market demands at Japanese automobile manufacturers.

The production process of automobile may be visualized as a river-like structure in the following sense: The final assembly line is analogous to the mouth of a river through which the stream of final output run to the ocean of "market". If one travels one step backward, the river (production process) divides itself into many branch streams (parts production process), each of which is in turn formed by merging still smaller brooks, etc. Let us imagine that flow controlling stations (shops) are set up at every points of branching. One way of controlling the flow of stream at the mouth of the river is to set up a central controlling office which monitors the difference between the desired and actual levels of the final flow

and, depending on the difference, dispatch the central directions of water control to each station at a regular interval. Meanwhile the need for the fine tuning of water control at each station responding to unexpected local emergencies may be dealt with by adjusting the level of resevoir (inventory) at each station.

Needless to say, controlling the production flow of automobile is much more complicated than controlling homogeneous flow of water, as the former involves the production of thousand varieties of final outputs distinguished by specific combinations of thousands of parts as noted already. But the crude analogy of water control along the river suffices for our immediate purpose. It is to be noted, however, that in the centralized control system, production of final outputs is made according to the centralized plan and that the demand and supply of each variety within a certain planning period may be matched by the use of the price mechanism (i.e., by the uses of rebates, discounts, and undesired option premiums, etc.)

The essence of "kanban" system may be visualized as that the entire communications needed for the control of water flow emancipates from the mouth of river station and flow in the exactly reverse direction (upstream direction) as water flow throughout the entire system. More concretely, it runs as follows: tentative production schedule may be worked out by the central planning office at a regular interval, say once every two weeks, just as in the hierarchical system. But this centralized schedule only provides with each shop a general guideline of production for that period.

Information regarding actual demands for varieties of cars monitored by the marketing department is utilized to fine-tune the production schedule in a shorter period and this schedule is directly fed into the final assembly line a few days before actual production takes place. In implementing the production schedule, the final assembly line dispatches a "kanban" (an order form placed in a vinyl envelop) to each shop located at an immediately upstream location specifying the amount and timing of delivery of each type of parts or in-process goods (as engine, transmission, body, etc.) to be supplied. A kanban is dispatched normally a few times a day to each upstream shop and is returned to the final assembly line together with actual delivery as specified. Thus the kanban plays a dual roles of order form and delivery notice. The shop which receives "kanban" from the final assembly line in turn dispatches its own "kanban" to each shop located at an immediate upstream position at a similar interval, and the chain of this bilateral order-delivery link between immediately neighboring shops intermediated by the circular flow of "kanban" extends as far as to outside suppliers which have long-term relations with the final assembly manufacturer.

This "kanban" system appears to be rather a crude information system, but it turns out to be effective to reduce the amount of inventory when a multitude of parts assemblage is involved to produce final outputs. The upstream shops are supposed to adapt their productions according to the order of downstream shops specified in the "kanban" and not to respond by the adjustment of inventories.

In fact, the "kanban" system is also called as "zero inventory" method or "just-in-time" method to capture this attribute. In contrasting to the vertical hierarchical control, let us conceptualize the essential feature of the "kanban' system as "semi-horizontal operational coordination", where "semi" refers to the fact that preliminary centralized planning needs to proceed for providing a general framework for horizontal informational flow. We assert that:

(1) The reduction of inventory cost: The semi-horizontal operational coordination is effective to reduce the amount of inventories, when the production process involves the flow of a multitude of intermediate goods.

As already clear, the essence of the semi-horizontal operational coordination is to feed information concerning the changing market demands directly to the production system and dissipate it throughout constituent bodies, as needed, without the intermediary of the centralized office. By this way, the entire production system may be able to respond to diverse market demands quickly and precisely. When a multitude of intermediate products (parts) are involved, this adaptation of the production system may require a considerable degree of flexibility and speed on the side of each constituent shop in adjusting the amount, kinds, timing of production of its in-process products. Also the "zero-inventory" requirement necessitates the

effective control of local emergencies, such as the malfunction of machine, absenteeism of workers, quality defects, etc. in order to minimize their effects on the smooth operation of semi-horizontal coordination.

Another important element of the Japanese system which meets these needs is the characteristics of work organization in which the job demarcation is ambiguous and fluid. The widely prevailing shopfloor practice at Japanese factories is the regular rotation of workers. The team of workers led by the subforeman is assigned to a cluster of interconnected jobs on the shopfloor and they rotate jobs among themselves in an egalitarian way. The size of team and the frequency of rotation normally depends on the nature of work involved as well as the shop convention. In typical cases the size may range from seven to fifteen workers and the rotation may be made as frequently as every few hours. Even the most inexperienced workers may be assigned a very difficult job, in which case the most experienced workers may assist in a side by side position. This rotation scheme seems to sacrifice economies of specialization.

But the possible short-term inefficiency may be compensated by the following dynamic efficiency: first, through rotation, workers are nurtured to be skilled in a relatively wider range of jobs. The multi-functionality of workers may enable each shop adapt its work organization flexibly to the requirement of changing composition and speed of its products specified in the "kanban" which is sent in from the downstream shop. The assignment of a worker to a set of different

types of machines, say lathe, drilling and milling machines laid out in a linear sequence, instead of multiple machines of a single type arranged around the operator, can save time necessary for the transport and loading of in-process products, as well as the amount of in-shop inventories. Also multi-functional workers are more effective in operating multi-purpose machines which are beginning to take over single-purpose machine as the emphasis shift from economies of scale to economies of timing in producing varieties of products. This follows Adam Smith's dictum: "the extent of specialization is limited by the size of market". When demands from downstream shop slackens, idle workers may be deployed in the maintenance of machines and cleaning up of shops, etc.

A more subtle, yet probably even more significant reason for the dynamic efficiency of rotational scheme is the one emphasized by Kazuo Koike.[2] According to him, the rotation scheme is effective to make workers familiar with the whole work process involved in the shop not readily acquired under the work organization based on clear and unambiguous job demarcation. This familiarity or knowledge may be tacit and not readily transferable in the form of formal language, but quite useful to identify on-the-spot, and solve semi-autonomously, the local emergencies, such as breakdown of machines and product defects, and to improve on quality control. Those workers nurtured to be skilled in a wide range of skills may be able to understand, for instance, why defective products have increased, and to device and implement measures to cope with the situation, and

prevent the recurrence of the problem without so much, if any, help from the "outside" service. It is important for the smooth operation of semihorizontal operational coordination that product defects can be spotted not at the final inspection station, but at the very place where the problem occurs and that remedial measures can be taken immediately. Thus the semi-horizontal coordination mechanism crucially depends on the skills, judgment, and cooperation of versatile and autonomous work force on the shopfloor. Koike has called such system as "integrative system" in that operating tasks and tasks coping with emergencies are integrated and not specialized.

Not only the job demarcation among workers on the shop floor is ambiguous, the extent of workers participation in local problem-solving and responses to local shocks may also entail a certain degree of blurring of job teritoriality between workers on the one hand and foremen, engineers, programmers, etc., on the other. This blurring of function is also reflected in the status differentiation of employees within the firm. The foreman is regarded more like the leader of the work group and its position represents often the most advanced career opportunity for blue color workers rather than the lowest end of managerial hierarchy who exercise the authority control over workers. It is taken for granted that foremen belong to the same enterprise union as workers who they they lead and its legitimacy is never questioned. Blue color workers are also paid by monthly salaries not by hourly wages, and fringe benefits available to blue and white color employees are not different at least in coverage.

We summarize:

(2) Integration of operating and problem-solving tasks: The fluid job demarcation and the job rotation system on the shop level may sacrifice static efficiency available in the specialization scheme, but may contribute to dynamic efficiency of the semi-horizontal operational coordination by fostering collective learning of workers and encouraging semi-autonomous problem-solving and adaptation to local shocks by the group of versatile workers at the shop floor.

Relative costs of sacrificing static inefficiency available in the specialization scheme vis-a-vis gains from dynamic efficiency obtained in the rotation scheme depends on various parameters, such as the speed of learning relative to the rate of obsolescence of technology instituted, the nature of stochastic elements and interdependence of jobs involved in shop technology, etc. In a recent paper, I constructed a formal comparative model to analyze the relative efficiency of the two system.[3] One of the interesting conclusions drawn from the analysis was that, in order for the system relying on collective learning to be relatively efficient, learning alone is not sufficient, but the initial level of workers' knowledge about the nature of technology involved and their capability to identify and solve local problems seems to be also essential. In fact, the Japanese firms come to emphasize, together with the

importance of learning-by-doing on the shop level, more and more the importance of formal education of workers on relevant engineering and technological knowledge given in a classroom environment at regular interval during work career.[4]

Admitting that an essential element of the semi-horizontal operational coordination is the institutionalization of effective learning-by-doing, an aspect of the well publicized practice of "seniority" and "life-time" employment system at Japanese firms may be understood as an incentive device for fostering such learning-by-doing. In this practice, the salary of a worker is determined not by his job (what is his job may not be clear), but by his grade related to the number of years of his service to the employing firm as well as to the degree of his skills more or less generally conceived. There is no formal contractual agreement for the life-time employment, but there is a general understanding between the employer and the employee that the employment relation will continue up to the time of mandatory retirement unless unexpected emergency on either side may necessitate the termination. Actually the non-neglible rate of turnover of workers, particularly at early stage of work life, is observed even in Japanese labor market. But mid-career quit penalizes workers financially, as the mandatory retirement carries a substantial amount of lump-sum payment of taishokukin (retirement compensation).

The theory of human capital has made it clear that a rising age profile of earnings functions as a scheme to have workers bear the

partial cost of on-the-job training at the early stage of work life and to preserve the acquired firm-specific skills by discouraging mid-career quit. Also the recent development of contract theory points that the rank-ordering of workers by the degree of learning acquired would provide an incentive for a worker to maximize its learning potentiality over working life.[5] Further the disassociation of the level of individual compensation from specific job category may facilitate, or at least not hinder, the acquisition of wide ranged skills through the rotation scheme, while the seniority aspects of the compensation scheme may promote inter-generational transmission of skills through teaching of junior workers by senior workers in the group.

As already indicated, the semi-horizontal operational coordination is a way to adapt to changing market circumstances quickly without accumulating costly buffer inventories when many varieties of outputs integrating a large number of parts are involved. On the other hand, it is observed that hierarchical control of production system performs well and there is no merit of introducing the semi-horizontal coordination from the operational efficiency point of view, when the system produces a relatively small number of homogeneous outputs involving a relatively small number of parts at a relatively steady rate.[6] On the other hand, the reduction of buffer inventories may make the system vulnerable to "large" or drastic change. The "kanban" system connects not only shops within a factory, but also between the prime manufacturer and many suppliers

geographically dispersed. If the transportation of materials and parts from a supplier to the prime manufacturers is disrupted by a large shock such as natural disaster, then the smooth operation of the whole system operated on the minimal inventories may become problematical.[7] Also the capacities of workers to cope with changes in product compositions as well as local emergencies may be specific to the global framework set out in strategic decisionmaking of the firm. Such capacities may be effective to cope with continual and incremental changes within that framework, but not with drastic changes in market and other environmental state.

(3) Response to continual changes in system environment: The semi-horizontal operational coordination may be effective in response to continual and incremental changes in system environment, but neither to drastic system shocks nor fairly regular system environment.

Finally let us turn to an incentive aspect of the Japanese system. My starting hypothesis is that worker's life-time earnings involves an element of sharing of quasi rents made possible through the efficient operation of the semi-horizontal operational coordination. As is clear by now, the efficient operation of the entire coordination crucially depends on workers' collective capacity to identify and solve emergent local problems and, in the sense that such capacity can be only nurtured through collective learning on the

shopfloor, it becomes truly firm-specific which is not marketable. Then the workers as a collectivity can possibly exercise effective bargaining power over the disposition of rent.

If workers have a reasonable ground to expect, from repeated bargaining with management, that a fair share in forthcoming rent is assured for them, it would be rational for them to make effort to contribute the maximization of rents. Particularly, under the situation that the delay of response to system and local shocks make it possible for competitors to snatch away potential rents, workers may be motivated to find an efficient solution to shocks without delay in cooperation with management. By relegating the discussions of possible free-rider problem (shirking of workers at the expense of efforts of others) and other related questions to other works,[8] let us hypothetically summarize the above argument as follows:

(4) Sharing of responsibility and outcome: Workers are likely to participate in the sharing of rents available from the efficient working of semi-horizontal operational coordination and thus be motivated to contribute to and be responsible for local problem-solving and quick response to local as well as system shocks which would enhance the amount of rent.

On the other hand, under the remuneration scheme accompanying job hierarchy in which a hourly wage rate is fixed in relation to a particular job there is not only no incentive for workers to

contribute to local problem-solving and response to local shocks (furthermore they are not allowed to do so under a job classification scheme), but also there may be a positive incentive for them to shirk in the performance of their job (as their wage rate is guaranteed for at least for the period of contract provided that his shirking is not detected). Being aware of this possibility, management is interested in retaining controlling power as much as possible in their hand and, further, is interested in developing technology to deprive from workers the capability to set the pace and intensity of works. A fascinating social historical account by Noble shows how the developmental path of automatic tool machines in the United states are conditioned by such managerial interests.[9]

4. The Nature of the Japanese Sharing Scheme

In the last section, we hypothesized the essential aspect of Japanese remuneration scheme as a sharing scheme. Martin Weitzman also regarded the Japanese economy as "the only industrial economy in the world with anything remotely resembling a share system" in his widely discussed book, The Share Economy.[10] Later in his preface to the Japanese edition, he added Korea and Taiwan as belonging to the profit-sharing variety and proclaimed that "because of the flexible compensation scheme, these countries have been able to maintain high, stable rates of employment and production, while steering through

business cycles. In these countries, governments were able to afford to combat unemployment without abandoning the employment goal."[11] economic problems of our day have at their core not macro but profoundly micro behaviors, institutions, and politics. The war against stagflation cannot be won at the lofty anticeptic plane of pure macroeconomic management. ... What is most desperately needed is an improved framework of incentives to induce better output, employment, and pricing decisions at the level of the firm"(p.3)[12] Having concurred with his basic premise, however, I would submit below that the "resemblance" between his model of of the share system of purely theoretical construct and the Japanese system is rather superficial. Yet contrasting the two may help clarify the nature of Japanese sharing scheme, as I conceive it, and its implications to macro performance of the Japanese economy.

The essence of the Weitzman's share system is that the employer and the union, representing employees, agree on a share parameter (or possibly the employer unilaterally announce the parameter) according to which revenue (net of material costs and depreciation charges) of the firm can be divided between the firm and the body of employees. This parameter is fixed for a certain period of time, during which the employer has the unilateral power to set the level of employment according to the profit maximizing motive. Under this scheme, the marginal cost of additional labor is always smaller than the marginal revenue product of additional labor, as the former equals to the share parameter fraction of the latter, and, therefore, the employer

is always motivated to expand the output and employment, as far as the the elasticity of demand exceeding unity. Within the monopolistic competition framework a a Chamberlain, given a demand function of firm's output, revenue per worker declines as the amount of employment increases. Therefore, the firm would reduce the level of remuneration to workers in the short run by expanding the output. In essence, "[a] share contract, then, can generally be defined as any payment mechanism where, throughout the life of the contract, worker remuneration varies inversely with firm's employment level, all other things being held constant"(p.84).

If one accept the Weitzman's design of a share contract, then the perpetual short run demands for additional employment may appear an inescapable logical conclusion. However, it seems to me quite unrealistic to assume that the union will fail to recognize the subsequent outcome of agreeing with the Weitzman's share contract, that is, the loss of control over remuneration per worker. Weitzman is careful enough to qualify his argument by referring to the eventual long-run macro outcome. "As each firm expands, its new worker spend their wages on the products of other firms, creating new demands"(p.5) and this multiplier effect would bring up workers compensation to the level consistent with the optimal allocation of resources. But I am doubtful that the union, or at least the Japanese enterprise union, is so far-sighted. Also I am uncertain that the union is altruistic enough to accept the managerial discretionary power to add new employment at the sacrifice of the level of

remuneration to incumbent employees even in the short run.

The controversy regarding whether or not the Weitzman's share model captures the essential feature of the Japanese system has been centering around the issue of whether the Japanese bonus system is a variant of profit sharing scheme or a disguised wage system. This issue is yet to be settled empirically, and at this moment I am willing to accept as a working hypothesis the view that there is an element of sharing in the Japanese remuneration scheme although the adjustment of workers remuneration in response to the fluctuation of firm's revenue may be made only with a considerable degree of inertia.[13] My point is rather that the Weitzman's system does not live up to the full expectation suggested by the attractive naming "share." Decision-making on strategic variables of high relevance to the well-being of employees, such as employment and working hours, is not shared between the employer and employees, either explicitly or imlicitly, in his system and belongs exclusively to the managerial prerogatives. In contrast, I would submit that the Japanese employees acquire the bargaining power over such strategic issues, as employment and relocation, which are of vital concern to them. The implicit or explicit sharing of decision-making over those strategic issues may not necessarily lead to outcomes pleasant to "outsiders", as we will see later. But this alternative paradigm seems to explain some industrial organizational and macro economic features of the Japanese economy better than the Weitzman's papradigm.

As we have seen, in the Japanese firm the employees are given

incentives to develop skills relevant to the effective working of semi-horizontal operational coordination through learning by doing over time. If their career development is suspended because of lay-off or discharges necessitated by the loss of competitiveness of the employing firm, the cost in terms of sacrifice of otherwise available future returns to learning in the form of seniority premium and retirement compensation would be great. On the other hand, if the firm keep expanding, it would open better career prospective for its incumbent employees in the form of better chances of future promotions and increasing earnings accompanying with them. Thus one may conceive that the utility function of the representative incumbent worker includes not only the conventional variable of the current level of earnings but also such strategic variables of the firm, as employment, growth rate of the firm, etc. If that is the case, it is not internally efficient from the view point of the profit earner (stockholders) and the incumbent employees that only the earnings level is co-determined between them (possibly through collective bargaining) and then decisions on those strategic variables relevant to the well-being of employees are unilaterally made by management, as in the case of the Weitzman system, who strives to maximize profit, regarding bargained wage as data for this decision-making. In this decision-making procedure, outcome would always be off the contract curve on which the efficient bargaining should settle. Both the earning level and those strategic variables need to be cojunctionally determined.

Suppose that the both parties are "time-impatient" in the sense that they are fully aware of the risk that potential rent accruable to the firm may be lost if an efficient adjustment of the firm's strategic market variables and the mutual cooperation for its implementation is delayed. Then the both parties may be motivated to reach a combined agreement, implicit or explicit, both on strategic market decision and distribution without delay. A recent contribution of bargaining game theory shows that, if bargaining on these matters can be proceeded in a time-efficient manner (in the technical sense that the time interval elapsing between alternating proposals and counter proposals becomes infinitesimally small), an outcome known as the "Nash bargaining solution" is likely to emerge as the "perfect equilibrium" in which the both party cannot expect to do better. [14] At this equilibrium, the percentage utility gain from marginal change in any variable (distributional or strategic) relative to the total utility gain from cooperation is equalized and maximized for the both parties. [15]

In an analysis of the nature of the Nash bargaining solution involving strategic variables of the firm, I derived the following interesting property of the solution: under a certain regularity condition, the share parameter which determines the distribution of rent between the both parties may be fixed once for all, independent of changing market environment, reflecting the relative bargaining power of the both party; and the equilibrium choice of strategic variables can be made, responding to changing market environment, by

weighting the optimal choices by respective parties by the share parameter as weights. One may call this the dual parametric rule.[16] In another word, the equilibrium market policy of the sharing firm would be the weighted average of the optimal policy of stockholder controlled firm (the profit maximizing firm) and the worker-controlled firm a la Ward and Domar. According to this theory, if the Japanese firm chooses a lower lay-off rate than the one which the neoclassical paradigm of profit maximization under the hourly wage system would predict, it is not because management can, as in the Weitzman's system, unilaterally reduce worker's compensation while expanding the employment level, but because the worker's preference for the job security and worksharing is duly reflected in the managerial policymaking possibly in exchange for a lower wage level.

The equilibrium property of the dual parametric rule suggests that strategic managerial variables need not be subject to explicit bargaining as market environment changes, once a proper share parameter is specified (as long as the relative bargaining power between the stockholders and the workers is stabilized). The adjustment of managerial policy may be delegated and entrusted to management, yet if management follows the weighting rule in formulating and adjusting strategic managerial variables, the essence of the sharing of decisionmaking would not be lost. I phrased the role of management following the weighting rule as that of "referee" of the bargaining game, but one may put it as the "principal" in the Meyerson's sense which makes a particular efficient point (the Nash

solution) as a focal point for bargaining partners.[17] I conceive the role of management of the Japanese firm essentially similar to that of the referee (or the Meyersonian principal) rather than the sole agent of the stockholder as in the neoclassical theory or the maximizer of its own utility as in the managerialist theory.

There are two important macro-economic implications of micro behavior derived from the dual parametric rule. The first is concerned with the comparison of behavior derived from the dual parametric rule and that derived from the neoclassical rule of profit maximization. The second is concerned with how the microeconomic behavior of the firm would change when share parameters change reflecting the strengthening of worker's relative bargaining power.

First, suppose an equilibrium set of internal distribution and strategic decisionmaking, such as on lay-off or the rate of expansion of the firm, derived from the application of the dual parametric rule. Then fix only the internal distribution at the equilibrium value and make managerial strategic variables changeable. Let us specifically choose the profit maximizing managerial strategic variables and compare the values with the equilibrium values chosen under the dual parametric rule. If the increased value of strategic managerial valuable enhance the well-being of the worker with other conditions being constant, then the profit maximizing value is generally lower than the equilibrium value chosen under the dual parametric rule. This is so, because the applied profit-maximizing rule is equivalent to the weighting rule in which zero weight is

given to the worker (the worker is shunned from the sharing of decision making), while the weight given to the profit earners remains to be the lees-than-one fraction used in the dual parametric rule.

Therefore even though potential relative bargaining powers between profit earner and employees remains constant, whether the workers' preference is duly reflected in the strategic decision-making matters for the micro behavior of the firm. In general, if the collective preference of workers as represented by the enterprise-based union is such that the marginal rate of substitution of job-security (or promotional chance) for the current level of earnings is positive, one can expect that management which would absorb such workers preference would set the level of employment (or the rate of growth of the firm) higher than the profit-maximizing level. The neoclassical view that management should always maximize profit is based on the assumption that the preference of workers can be duly dealt with either in bargaining with worker in the marginal unit or by collective bargaining with the union. But this assumption is erroneous in the modern context in which the emergence of internal organization and the associated long-term attachment of workers to the employing firm makes their well-being dependent on a wider range of strategic decision-making of the firm other than the current earning level, unless the scope of bargaining do cover the issues of strategic decision-making of the firm (which is most unlikely in the case of bargaining in the marginal unit).

Secondly, consider the relative changes of internal bargaining power between the profit earners and the workers as reflected in the corresponding change in share parameters. The dual parametric rule suggests that, since the equilibrium strategic decision-making is the weighted average of optimal strategic decision-makings corresponding to bargaining partners, the result of parametric changes can be easily predicted by examining qualitative and quantitative differences of optimal strategic decision-makings to the both parties.

Let us compare first the preferences for the growth of the firm by the both constituents. Even if the workers can benefit from the growth of the firm through better chances of promotion brought about by it, their preferences for the growth may not be as high as the profit earners. This can be seen as follows: First assume the firm which is controlled by stockholders. The stockholders can opt for monopolizing gains from growth, if they wish, among existing stockholders in the form of capital gains while they bear all the cost of growth among themselves in the form of the retention of the profit. (When they opt for making new members bear a part of growth cost in the form of new equity share, capital gains accruing to themselves is reduced exactly in the same amount as the value of new equity issue under the assumption of perfectly competitive financial market and no taxes.)

Imagine next the twin firm which is controlled fully by the workers, but otherwise identical. Suppose that, in order to finance

the growth, the incumbent workers have to sacrifice the current earnings in the form of retention of revenue of the firm. The growth would normally entail the expansion of new work force, unless labor saving technological progress is involved. Even if status differentiation is created concurrently between the senior workers and the new coming workers, the on-going organization would normally sustain the basic feature of current structure over time so that at least some of incoming workers would eventually participate in the sharing of benefits from the growth in the form of promotions, etc. In other words, the incumbent workers cannot monopolize the benefits from growth, as the stockholders does, even if they bear the cost of growth. The possibility of external debt financing would mitigate this effect to some extent as it would shift some portion of growth cost to incoming workers, but not completely.

From this thought experiment, one can predict that the firm would choose slower growth or, when it does, it would choose more labor-saving technology, if the relative bargaining power is tilted in favor of workers. Also when the future risk of lay off is involved, the firm would choose the lower level of employment so that the probability of lay-off would be reduced.[18] Thus the increasing power of workers within the firm may have the adverse effect on the demand for new employment. I called this adversarial effect the "dilemma of industrial democracy".[19]

An evidence suggests that the Japanese firm has not escaped this dilemma. Since 1973-4 depression in the aftermath of Oil Shocks,

Japanese large firms has considerably limited the expansion of workforce through the restraint of new employment, the increasing use of "part-time workers", the acceleration of labor-saving technology and organizational innovation through the promotion of efficient semi-horizontal operational coordination, etc. Also the simplification of hierarchical layers and the reduction of blue color workers were achieved through the increasing hiving-off of subsidiaries. In my estimation, the subsidiarization alone contributed to 3.5-4.5 percent reduction in the employment/sales ratio (in real term) in the electric machinery and electronics industry over the period of 973-82, controlling the effect of labor saving technological and organizational innovation and scale effect. The autonomous rate of labor savings per sales due to internal organizational and technological innovation is estimated to be as high as about 10.0 percent per annum.[20]

The Japanese firms have thus been fiercely trying to reduce the work force size in order to protect the benefits of incumbent workers rather than wooing new workers exploiting the liberty of reducing the earning level of incumbent workers. Also the dual parametric rule is not inconsistent with the fact that Japanese firms appears eager to grow in terms of sales and revenues, while restraining new employment, than to pursue the profit maximizing objective. If this casual empiricism is in fact verifiable, it is explainable, without invoking the ad hoc assumption of share maximization hypothesis, by the presumption that the management of Japanese firms reflect and

give a positive weight to the preference of incumbent employees rather than act as the sole agent of stockholder.

5. The Dual Structure Reemerging?

If Japanese firms restrain new employment relative to sales, why does the dilemma of industrial democracy not manifest itself in the macro level as a conspicuous phenomena of unemployment? The unemployment in Japan has been lingering at a rather low level not exceeding three percent in the 1980's. Some, like K. Taira, attributed the Japan's low level as a statistical artifact, but the realignment of statistics according to the re-definition of unemployment as consistent with the American definition does not seem to narrow down the difference between the two countries substantially.[21]

One reason for the restraint of employment at large firms not to entail massive unemployment in the labor market is that there are alternative absorbents of employment. One is a relative increase in employment in the category of the so-called "part-time" workers. Second, the restraint of unemployment at large firms is at large extent made possible by the hiving off of subsidiaries, increase use of subcontractors, and transfer of employees to those relatively smaller, satellite companies at inferior employment condition.

In the great surges of growth after 1955 large firms hired many

of their new workers with temporary contracts of 3 months to one year renewable at management discretion. While regular workers were provided a considerable degree of job-securities and other benefits such as retirement compensation, bonuses , etc., the status of temporary workers was potentially vulnerable and underprivileged one, although they were actually employed more or less permanent basis as far as business condition of employing firm permitted. Around 1960's these temporary workers reached their peak, accounting for roughly 12 percent of workers employed by firms of 500 or more workers in manufacturing industries. Income Doubling Plan of 1960 declared that the removal of this dual employment structure should be one of the most urgent modernization agenda. During the era of high growth of 1960's the shortage of labor supply became acute and even the enterprise unionism based on incumbent regular workers was able to absorb the aspiration of temporary workers to attain more secured membership in employing firms without the sacrifice on the part of regular workers. Many temporary workers at large firms were either promoted to the status of regular workers or quit voluntarily to seek for relatively better paid jobs at other firms (not rarely at smaller firms)[22]. By the early 1970's, temporary workers as a ploy to maintain a buffer group of long-term but lower paid workers largely disappeared.

Recently two new categories of workers characterized by relatively shorter job durations has surged: the part-time workers, dominantly female, and dispatch workers (haken rodosha). When the

former category was first mentioned in the yearly Labor Ministry White Paper series in 1967, the main reason cited for the employment of part-timers was the scarcity of people willing to work full time. However, since the mid 1970's this category of workers begun to be used in larger scale particularly in relatively smaller firms in the service industry because of the low cost and the relative easiness of firing. Although there are some evidences that the use of "part-timers" are recently spreading to manufacturing industries and to relatively larger firms, larger firms seem to still largely rely on hiring freeze and transfers or dispatches of regular workers to relatively smaller related firms for the restraint of employment.[23]

This leads us to a re-examination of an aspect of relationship between prime manufacturers and their related firms. As already mentioned, it is a conspicuous phenomena since the mid 1975's that large Japanese firms have been spinning off many fully owned or partially owned subsidiaries as well as relying on extensive uses of subcontractors in which prime manufacturers have often minority holding.[24] These firms related to prime manufacturers in long-term business relations in a more or less systematic manner. For an example, in the automobile industry in which these relations are most systematized, prime manufacturers normally maintain direct first-tier relations with hundred odds suppliers, normally organized into exclusive associations of firms cooperating with prime manufacturers, which in turn have second-tier relations with still smaller subcontractors, etc. According to a survey by the Agency for Small

and Medium Sized Enterprises conducted in 1977, a auto prime manufacturer had direct relations with 122 first-tier suppliers, and indirect relations with 5,437 second-tier suppliers and 41,703 third tier suppliers. Adjusting for double-counting, this manufacture stood at the apex of corporate grouping fabricated by hierarchical transactional relations whose number amounted to 35,768.[25]

The long standing folklore dictates that large firms in Japan are using those relatively smaller related firms as a business cycle buffer of permanent employment at larger firms. However, the relationship nowadays are much more subtle. Many first tier supplier firms supply essential components, such as electronic parts, brakes, etc., on which the prime manufacturer do not have comparable technological expertises; or are subcontracted for the assembly of particular models of final products, while producing specific bodies, etc. The transactional contracts between the prime manufacturer and those first-tier suppliers normally extend for the period of life cycle of a particular model and renewable unless the latter did not meet the quality and cost standards of the prime manufacturer in the prior contractual period. For example, between the period of 1973 - 1984, only three firms exited from the Association of Toyota Cooperating Firms composed of first-tier suppliers, and 21 firms made new entry.[26]

The prime manufacturer thus do not vary their dependence on first tier supplier firms in response to business cycle conditions. The semi-exclusive reliance of the prime manufacturer on first-tier

related firms for the supply of certain parts and components and the clear demarcation of works performed between the prime and first-tier supplier firms make it imperative for the prime manufacturers to maintain the perpetual transactional relations with the latter. A recent econometric studies on the subcontracting group also indicates that there is the sharing of income fluctuations among prime contracting firms and subcontracting suppliers, normally with the former absorbing more risks than the latter.[27] Since the prime contracting firm is normally capable of absorbing more business risks than the smaller subcontracting supplier by the diversification of product portfolio and the accumulation of financial assets, it is an efficient arrangement that the former absorbs more risk in exchange for risk premium in the form of monopsonic gain.[28]

The terms of transaction is bilaterally negotiated between the prime manufacturers and each member of the first-tier group regularly, normally twice a year coinciding with the time of collective bargaining with the union regarding bi-annual bonuses. Prime manufacturers guarantee the amortization charges for the transaction specific equipments and tools committed by supplies, and on the top of it shares of rents accrued to the group is negotiated.[29]

Because of these transactional and distributional arrangements, the first-tier firms relate to the prime manufacturer in a much similar way as in-house divisions of an integrated firms. Even workers of some of those first-tier firms are often organized into a

single "enterpise-group" union, together with workers of the prime manufacturer. But, on the otherhand, in spite of minority holdings of first-tier suppliers by the prime manufacturer, the former retains a considerable autonomy in operational control. Also many first-tier supplier firms are very active in pursuing their own efforts in research and development, because the development of new technology would endow them considerable bargaining power over the disposition of group specific rents vis-a-vis the prime manufacturer. It is also not rare that technologically advanced suppliers have simultaneous transactional relations with multiple prime manufacturers.[30]

Economies of quasi-disintegration in the form of semi-autonomous grouping come partly from the efficiency of the operational coordination mechanism which is very similar in its functioning to the semi-horizontal operational coordination among in-house shops which we have already discussed in section 3. In fact, the "kanban" system normally applies to communications between first-tier suppliers and the prime manufacturer, and often extends even to transactions between first-tier suppliers and second-tier suppliers. Response to system shocks, such as fluctuating final demands, is initiated from the final assembly lines of the prime manufacturer and dissipated beyond the corporate boundary of the prime manufacturer throughout the whole group by the medium of "kanban" without the intervention of a single controlling tower, although pressure to respond to local shocks such as quality defects and machine malfunction, etc., are placed sternly on each supplier. This semi-

horizontal operational coordination beyond corporate boundaries which dispense with a single corporate control may be regarded as having the same transaction cost savings features as attributable to the intra-firm mechanism. This saving dramatically manifests itself in that the management hierarchy of the prime manufacturer in Japan is much flatter as compared with large American integrated firm. In American auto manufacturers, the chief executive officers are normally six or seven management layers away from a typical plant manager, whereas in Japanese auto manufacturers main plant managers are often appointed to the companies' boards of directors (which are overwhelmingly "inside" boards) and at most two levels below the chief executive officer.

Employees of first tier suppliers normally enjoy comparable benefits as the workers at prime manufacturers. Thus, although the pressure on the first-tier suppliers and their workers for the efficient functioning of operational coordination to cope with system- as well as local shocks is hard and keen, one of the primary economic reason of the existence of first-tier semi-autonomous suppliers stems from informational efficiency made possible by avoiding the high degree of integration.

But it seems true that the quasi-disintegration is also a way to secure the benefit of incumbent workers at the prime manufacturer and strong first-tier suppliers by restraining the expansion of workers at those levels. By doing so, the prime manufacture and strong first-tier suppliers can spin-off the potential problem of securing jobs

and other benefits for workers to smaller satellite firms. As one goes downwards hierarchical tiers in the supplier group, technological expertise owned by lower tier supplies becomes less and less unique. The fact that their supplies may be easily replaceable by other competitors makes their bargaining power over the participation in rent accruable to the whole group extremely weak.

A look at Table 1 reveals that scale differential in the rate of increase in value-added productivity began to widen after 1975 in favor of larger establishments, and some portion of its slower growth at small establishments is absorbed in the relatively lower rate of increase in wage there. However, if one compare wages of workers in the same age category and the same job tenure category, the differentials according to establishment size are not so great. For instance, regularly paid wages to male workers of establishments with 10-99 employees in manufacturing industries in the age categories 20-24 and 25-29 were 98.6 percent and 94.5 percent, respectively, of those paid to workers of establishments with 1,000 or more in 1983.[31]

Table 1 about here

Such equalization of standard wages probably accounts for the fact that the widening of scale differential in wages is not as much pronounced as that in value-added productivity. However, if one compares benefits paid in the form of non-standard wages, such as

bonuses, pensions, and lump-sum retirement compensations, there are evidences of widening of differentials among larger and smaller firms (see Table 2). It is also at these smaller firms that one can find a larger proportion of employment of "part-timers" who are underpaid and deprived of various benefits such as job security, bonuses, pensions, etc.

Table 2 about here

One may then conjecture, conditional on further empirical verification/falsification, that larger firms in the corporate group gained increasingly larger shares in group specific rent with possible workers' participation in rents in the form of non-standard wage benefit, while bargaining power of smaller firms within the group have been adversely affected, with workers there gaining only the near-competitive wages. This appears reminiscent of the old folklore of the dual market hypothesis, but the current structure is characterized more by fine gradation from the cooperative game system at large firms at the apex of the group through relatively well-to-do supplier firms at the relatively upper tier of supplier hierarchy to the competitive system at the lowest tier. Also in the early 1960s, there was differential in regularly paid wages (standard wages) according to size, but such differential was narrowed and almost disappeared in the period of high growth, and does not seem to have reemerged since. Scale differentials appear in the form of non-

standard wage benefits, a part of which may be understood as participation in rent.

This gradational structure seems to begin facing a turning point, however. Since the realignment of exchange ratio starting from the intervention of G-5 and accelerated by the reverse Oil Shock, the merit of the low cost production of lower tier suppliers are being lost in comparison to the potentiality of lower valued supply abroad. Thus the prime manufacture has began to weigh the relative merit of supply source abroad either through foreign suppliers and/or their own subsidiaries. Also most of strong first-tier suppliers are looking for foreign basis of operation. Thus the substitution of foreign suppliers (or Japanese subsidiaries in foreign countries) for Japanese suppliers may not reach the first tier supplier immediately in a way to spoil the efficiency of close networking of semi-horizontal coordination, but it may well have the effect of hitting hard employment opportunities at the lower end of industrial grouping.

6. Concluding remarks: Is the Japanese system culturally unique?

In section 3, I have discussed that the semihorizontal operational coordination, coupled with the integrative approach to operating and problem-solving tasks at the shop floor, may contribute to the dynamic efficiency of firms in certain industries which would

surpass that of specialism cum hierarchical coordination. Those industries for which the Japanese method may operate dynamically more efficiently would be the ones, of which market conditions are characterized by continual and incremental changes and of which technological process involves many steps. But it may not be particularly dynamically efficient in industries where market conditions are relatively stable and/or production process involves comparatively simpler steps. The mass production method utilizing economies of specialization and centralized coordination may operate more efficiently for those industries.

Also a production process may not necessarily have simple "river-like" structure as described in section 4, the structure for which the "kanban"-like horizontal communications can be instituted. For example, modern integrated steel plants produce thousand varieties of final outputs, differentiated by size, shape, the amounts and kinds of other minerals to be blended, coating, etc., but the entire process starts with the production of uniform steel ingot which may be gradually differentiated in the following downstream processes, such as ballet casting, rolling, coating, etc., to specified products. In this case sequential backward transmission of demand-responsive information along the production process beginning at the final work station can not be organized to coordinate the whole production process and elements of centralized coordination would be expected. The petrochemical industry is another example of such continuous production process of non-river structure.

In section 4, I have also hinted that it is extremely costly to develop integrative skills of workers to cope with drastically changing system environments (market or technological). Further, in such an environment, entrepreneurial leadership to perceive market and engineering potentials and initiate a new design of products may be more crucial to the viability of the firm, in comparison to the capability to respond quickly to demands for existing products

Then one may expect that the "Japanese-type", less hierarchical and less specialized system would be found more frequently in industries characterized by medium batch production, while more hierarchical and more specialized system may be found in industries characterized by continuous or mass production methods. The latter may be also found in industries characterized by customized production or drastically changing market environments. Such is indeed what the "contingency" theory predicts and in the U.S. there seems to be empirical supports for this hypothesis. In Japan, however, this theory does not seem to be hold. For example, in a recent statistical studies comparing samples of 50 odds companies selected from in each cell of a size-by-industry classification both in the central Indiana and the Atsugi region in the vicinity of Tokyo, J.Lincoln et al has found that the Japanese companies have less specialized job classifications and lower levels of de facto decisionmaking, regardless of industrial characteristics.[32] This finding is consistent with often-made claims in business economics that the Japanese is comparatively stronger in industries

characterized by medium-ranged market volatility and many-stepwise manufacturing processes, such as automobile, and electric and precision machinery industries, whereas weak in industries characterized by stable markets or continuous manufacturing process, such as food-processing, paper, and petro-chemical.[33]

One may conjecture that, if the less specialized cum less-hierarchical (in the sense that de facto decision-making level is comparatively lower) method is consistently chosen in Japan regardless of its economic efficiency, it must be rooted in Japanese culture. One may continue to argue further that if the Japanese method is cultural, then it is unique to Japan and not exportable. But we ought to be careful about making such sequential assertions.

First of all, it may be probably agreed that the less clear demarcation of jobs within a small work group is a distinctive characterisitcs of the Japanese and that this organizational orientation may be culturally conditioned by the collective memory of agrarian village life where the condition of rice production required cooperative works involving rotation of tasks, ad hoc and flexible collective responses to continual and incremental environmental changes, etc. But the team approach to work does not automatically assure an efficient work system in the context of large organization characterizing modern firms. If the task of a functional unit is carried out by the relatively egalitarian and cohesive work team, the work team may tend to become autonomous and assert its own localized interests by taking advantage of its monopolistic position within the

organization. The coordination between functional units then become problematical.

This problem was not indeed foreign in the pre-industrial period. Villages in the Edo period, which were organized as coherent, relatively homogeneous user units of the irrigation system and autonomous from the control of castle-towns, often engaged in fierce disputes among themselves over the distribution of water resources. those disputes, known as mizu-arasoi (water-disputes), sometimes lead to bloody clashes among neighboring villages in time of water scarcity. Elaborate arbitration schemes had to be developed in the Edo period along the irrigation system to cope with such social conflict. Great names of agrarian leaders at that time, like Ninomiya Kinjiro and Mutsugawa Chiyozaburo, were associated with the organization and effective management of such arbitrative scheme.

The need for inter-group coordination and conflict resolution is not less important for modern Japanese firms. As Thomas Rohlen has put it in the criticism of Chie Nakane: "The total company situation is more complicated. While the nature of work groups is best approached from the question of their fundamental conceptualization, it is less likely that an ideology emphasizing small-group values will have same significance for large organizations. Company leaders may be devoted to such values, but they are not in a position to unite the personnel of a company in the same immediate way group leaders are, and the best they can accomplish is to make success of the directors' and other high level small groups. Companies have been

able to elaborate a wide manner of activities of symbolic participation (such as ceremonies, gatherings of representatives, company-wide outings, and civic and charitable programs), but none of this will be sufficient to secure the sense of connectedness of individuals to the whole, a crucial matter to Japanese companies."[34]

From this perspective, it would not be too difficult to recognize that some elements of the "semihorizontal" operational coordination in the context of modern firm are rather the product of conscious management design. For example, the "kanban" system was developed by the ingenious effort of industrial engineers at an automobile manufacturing firm who imported the method of replenishing on-shelf stocks of American supermarket system and adapt it to the requirement of manufacturing coordination and inventory control.

The practice of rotation of personnel beyond the functional units is also a device to facilitate communications between units and to restrain the development of unit-specific interests. Such rotation is found, for example, among engineers in the manufacturing division, who may be transferred to the central research laboratory to participate in the development of analytic design of a new product as well as to the production site for leading a value engineering group or supervising setting up of a new manufacturing process. It may facilitate the formation of feedback loops between the downstream and upstream phases of design as well as between the manufacturing process and the preceding design process. The utilization of such feedback loop provides a distinctive feature to the R&D process at

the Japanese firm, in which the interactive development of in-house engineering knowledge basis is emphasized as opposed to the purely scientific approach to innovation.[35]

Inter-functional unit rotation may be considered as the magnified version of job rotation within the small group. But while the job rotation on the shopfloor began rather autonomously with the initiative of foreman and subforeman on the shop floor,[36] the practice of inter-units rotation has been cultivated by management and centrally administered by the personnel department of the firm. Although the Japanese firm has come to rely on less hierarchical control over operating tasks, in order to make sure that the functional units, and member of each work group therein, are compliant with the organizational goal, the personnel administration of the Japanese firm has thus become much more centralized in comparison to the Western firm. Decentralization in one dimension seems to be compensated by centralization in another dimension.

Even though the development of semihorizontal coordination in Japan is a rational management response to the "culture" of small group values, if it turns out to be more responsive to market and other environmental changes of incremental nature and thus can avoid the rigidity of hierarchical coordination, it may be much worth considering the implementability of the mechanism elsewhere as alternative to hierarchical coordination. But it is to be reminded that the semihorizontal operational coordination in Japanese firms which has developed as a response to small group values in turn

relies on the problem-solving capacity of each functional unit (shops). This localized approach aims at the effective utilization of on-the-spot information that may be tacit, subtle, unprogrammable, yet economically valuable for problem-solving.[37] And such utilization would be made possible by enhancing job experiences of workers, knowledge sharing among workers, and cross jurisdictional communications at the operating level. But is less rigid, flexible job demarcation, which would facilitate the formation of integrative skills of workers, possible in the cultural tradition of specialism?[38] This question may be answered only after painstaking efforts in that direction both on the sides of labor and management rather than by intellectual exercise of scholars. Once the efficient and humanistic aspects of integrative approach are understood, however, such effort seems to be painsworth.[39]

No doubt learning by doing, sharing of knowledge and inter-disciplinary communications useful for localized problem-solving and semihorizontal coordination will be aided more and more by the development of communication technology. But I would emphasize again that the human element cannot be dispensed with altogether. Significant effort at many Western firms has lately been given to reduce layers of hierarchy by the use of developing communication technology. Also some regard the kanban system as means simply to reduce hierarchical layers and buffer inventories. If the purpose of the simplification of hierarchy is only the realization of simpler centralized coordination by allowing top management easier access to

lower level information, however, it may be expected that management can have additional leverage for controlling the shopfloor event by the aid of robotics technology as well. It is in fact the long standing fancy of many engineers to realize the integrated computer-aided control system of the factory in which all the operating tasks are performed by robots and are coordinated by the computer network. There is no room for human element in such a centralized system except for the engineer's sovereignty. Managements who feel insecure about workers' capability to set the pace and intensity of work may try to retain or regain its control over the shopfloor by implementing such a system.

But paradoxically it has been in Japan that robotics technology has spread at a faster rate. According to surveys by the Japan Industrial Robot Association and the Robotics Institute of America, the numbers of operating industrial robots (excluding fixed sequence robots) at the end of 1980 were 14,250 for Japan and 4,100 for the U.S. In the end of 1984, they were 67,300 for Japan and 14,500 for the U.S.[40] Why is the rate of diffusion of robots higher in Japan where integrative learning by the worker is relatively more emphasized ?

One type of robot which spread quite extensively throughout Japan is the one designed with record-playback programming. This is the type for which operators on the shopfloor can teach the robot arms by manually guiding them through the desired motions while these motions are automatically recorded and played back. It is obvious

that the effectiveness of this type of machines depends on acquired skills and the judgment of workers. In Japanese factories, this type of robot is widely adopted in such tasks as spray painting and spot and arc welding of car bodies where the control of three dimensional movement is involved. In the United States, robots of the recording/playback type had not been commercially promoted in spite of its technological potential, however, precisely because of managerial interests in retaining control of production and skepticism over workers' control.[41] It is only after the Japanese had emerged as a challenger in the sphere of robotics technology that American management started to adopt this type of robot on a large scale.

Also relatively easy-to-use, yet sophisticated numerical control for lathes, milling machines, and machining centers are being introduced at a much faster rate by large as well as medium to small sized firms in Japan.[42] These microprocessor-based machines are featured with programmable controllers and manual data input, and operators on the shop floor are able to program while machining a first part by simply storing instructions in the machine's memory as he proceeds. Even if more sophisticated numerical control machines are deployed, the programming of machines is not exclusively the job of programmers off the shop floor at the J-firm. In order to program machines in an efficient way, skilled workers are consulted by and cooperate with programmers who lack shopfloor experience. Operators are also encouraged to debug and edit programs, whenever they can,

responding to programming errors, the wear of tools, subtle quality difference of operating objects, etc. The speedy diffusion of robots in general in Japan may thus be largely explained by the cooperative participation of robot operators in programming and the resulting reduction of programming costs, as well as prospective improvements in the operational efficiency over time through operator's learning.

It is widely believed that production processes with job structures of finer specialization are likely to be more automated, and that the introduction of new technology reinforces the tendency toward greater specialization. However, recent case studies in the U.S. have suggested that a greater specialization is not necessarily the outcome of automation. In a case study of the banking industry, Paul Adler finds that the introduction of the computer requires a broader knowledge of banking procedures. Barbara Baran's research on insurance companies reveals that computerization requires the expanded job jurisdiction at the bottom of hierarchies in some companies.[43]

Implications of these studies may be as follows: To imagine the modern technology of robotics and communications as complete substitutes for human skills may not be warranted and there may always remain useful unprogrammable knowledge on the operating level which can be utilized effectively in conjunction with modern technology. Even the most sophisticated computer-aided coordination system would not be able to cope with all possible evolving events and there may always a room for human skills and wisdom. And paying

sufficient regards to these human elements may also serve as the way to utilize modern technology in the most effective way.

Table 1

The rates of increase in wage and value added productivity by establishment size and period (percent)

wage

no. of employees	500 or more	100-499	30-99	5-29
1960-65	8.1	11.0	12.2	15.0
1965-70	14.7	14.9	14.4	14.2
1970-75	18.1	18.2	17.3	17.3
1975-83	7.5	6.9	6.7	6.7

value added productivity

no. of employees	500 or more	100-499	30-99	5-29
1960-65	6.9	10.0	11.9	14.5
1965-70	17.2	16.8	16.5	16.3
1970-75	10.8	13.8	13.1	13.8
1975-83	11.6	9.2	8.6	8.2

Source: Ministry of Labor, Monthly Labor Survey. Ministry of International Trade and Industry, Industrial Statistics.

Table 2

Size Differential in Welfare-related Labor Costs

(the relative ratio for establishments with 30-99 employees. establishments with 1,000 or more employees = 100)

	welfare costs legally required	welfare costs legally not-required	costs for retirement compensation
1973-75	76.1	44.8	32.2
1976-79	70.1	34.8	33.9
1980-82	72.0	29.4	29.2

Source: Ministry of Labor, Analysis of Labor Economy, 1983.

NOTES

1. Oliver, E. Williamson, Chapter 9 of The Economic Institutions of Capitalism, "The Organization of Work", Free Press, 1985.

2. Kazuo Koike, "Skill formation system in the U.S. and Japan," in M.Aoki (ed.), The Economic Analysis of the Japanese Firm, North-Holland, 1984, pp.44-75; "Skill formation in mass production: A Thai-Japan comparison," Journal of the Japanese and International Economies, forthcoming.

3. See M. Aoki, "Horizontal vs. vertical structures of the firm," American Economic Review, (December 1987).
forthcoming. Also Kurt Lundgren built an interesting model to investigate under what condition the switch of a work organization based on functional specialization to the one relied on versatile skills become optimal. A paper presented to the International Conference on Property Rights, Economic Organization and Behavior, Swedish Collegium in Advanced Studies in Social Sciences, June 1986, Uppsala.

4. Kazuo Koike, "Human resource development in the Japanese industry," in Kozo Yamamura and Yasukichi Yasuba (ed.),the Japanese Political Economy, volume 1, Stanford University Press, 1987.
"

5. This assertion is based on the re-interpretation of an excellent paper by W.Bentley McLeod and James M.Malcomson, "Reputation and hierarchy in dynamic models of employment," Journal of Political

Economy, forthcoming. See chapter 2.2 of my A Microtheory of the Japanese Economy: Information, Incentives and Bargaining Games, Cambridge University Press, in process.

6. See James Abbeglen and George Stalk Jr., Kaisha: Japanese Corporation, Chapter 5.

7. On July 11, 1979, large fire triggered by the collision of hundred of cars in Nihonzaka Tunnel forced the Tomei Highway, the major highway connecting Tokyo and Nagoya, closed for more than two days. Some body assembly lines of a car manufacturer in the Nagoya region were shut down in the afternoon of July 12 because of the delay of delivery of parts from suppliers located in Tokyo.

8. Where job demarcation is not clear and team approach to local problem solving production is emphasized, mutual monitoring by workers in the team may be most effective to prevent individual shirking.

9. David E. Noble, Forces of Production: A Social History of Industrial Automation, Oxford University Press, 1984.

10. Published by Harvard University Press, 1984, p.76.

11. Translation of the Japanese preface to Shea Ekonomi, Iwanami Shoten, 1985, p.vii.

12. In my book (The Cooperative Game Theory of the Firm, Oxford University Press) published in the same year as the Weitzman's book, I stated that "In my assessment, an out-of-proportional attention has been given to the monetary aspect of the recent stagflationary phenomenon. However, it is at the level of enterprises that prices of

products, wages of various jobs, amount of employment, and so on are actually determined. Is there not an internal driving force within the firm to generate such a phenomena?" (p.6) From this perspective, I tried to offer a micro economic explanation of stagflation in the cooperative-game (bargaining-game) theoretic framework. See chapters 5 and 7.

13. See for instance K.Koshiro, "Labor market flexibility in Japan with special reference to wage flexibility," Journal of the Japanese and International Economies, forthcoming.

14. K. Binmore, A. Rubinstein and A. Wolinsky, "The Nash solution in economic modeling", Rand Journal of Economics, 1986.

15. See M. Aoki, "The Nash Bargaining Solution and the Theory of the Coalitional Firm," mimeo., presented to International Symposium on Property Rights, Organizational Forms and Economic Behavior, Swedish Collegium for Advanced Study in the Social Science, Uppsala, 1986.

16. M. Aoki, The Cooperative-Game ...., Chapter 5. There I call the second part of the dual rule as the weighting rule (pp. 74-80)

17. M. Aoki, The Cooperative-Game...., chapter 6. Roger Meyerson, ".....", mimeo.,1985.

18. See Hajime Miyazaki, "Internal bargaining, labor contracts, and a Marshallian theory of the firm," American Economic Review, (June 1984), pp.381-93.

19. See M.aoki,ibid.

20. M.Aoki, " Innovative adaptation through quasi-tree structure: an emerging aspect of Japanese entrepreneurship," Zeitschrift fur

Statistical Artcraft," Monthly Labor Review, July 1983, pp.3-10.
T.Ito, "why is the Unemployment Rate So Much Lower in Japan than in the U.S.?" mimeo, University of Minnesota, 1984.

22. See Table 2. In the early 1960s, the wage differential between large and smaller firms was considerably reduced.

23. Dispatch workers are entirely new category of workers. They are employed by firms registered at the Employment Security Office, but dispatched by them to other firms for services of particular skills for certain contractual periods. They are largely composed of redundant employees at large firms and the institutionalization of this system may be considered as a way of reconciling the practice of long-term employment contract with emergent necessity of lubricating the competitive mobility of standardized jobs.

24. See M.Aoki "Aspects of the Japanese Firm," in M.Aoki(ed.), The Economic Analysis of the Japanese Firm, North-Holland, 1984, and "Innovative Adaptation ....", ibid.

25. The Agency for Small and Medium Sized Enterprises, A Survey of Divison of Labor Structure (Automobile), 1977.

26. See Kazuichi Sakamoto, Technological Innovation and the Structure of the Firm, (in Japanese), Minerva, 1985, Chapter 3.

27. S.Kawasaki and J.Macmillan, "The design of contracts: evidence from Japanese subcontracting," Journal of the Japanese and International Economies, forthcoming.

28. See M.Aoki, "Aspects of the Japanese firm," ibid.

29. Banri Asanuma, "The Organization of Parts Purchases in the

Japanese Automotive Industry," Japanese Economic Studies, Summer 1985, 32-53.

30. For an example, Toyota corporate group owns about 28% of the stock of Nihon Denso which supplies car electronic equipments, but the latter is also a member of the Associations of Cooperating Firms for Mitsubishi Auto Industry, Ltd., Fuji Heavy Industry Co. and Isuzu Motor Co.

31. Ministry of Labor, Basic Survey of Wage Structure.

32. James Lincoln, Mitsuyo Hanada and Kerry McBride, " Organizational structures in Japanese and U.S. manufacturing," Administrative Science Quarterly, (1986), pp.338-64.

33. For example, J.Abbeglen and G.Stalk, jr., Kaisha: The Japanese Corporation, Basic Books, 1986; T.Kagono, Y.Nonaka, K.Sakakibara and A.Okumura, Strategic vs. Evolutionary Management: A U.S. - Japan Comparison of Strategy and Organization, North-Holland, 1985.

34. T.Rohlen, "The company work group," in E.Vogel (ed.),Modern Japanese Organization and Decision-making, University of California Press, 1975, pp.208-9.

35. For more on this, see chapter 6.3 of my A Microtheory of the Japanese Economy: Information, Incentives and Bargaining Games, Cambridge University Press, in process.

36. See Kazuo Koike, "Skill formation systems: Japan and U.S.", in M.Aoki (ed.), The Economic analysis of the Japanese firm, North-Holland, 1984, p.63.

37. The emphasis on the integrative approach is also exactly the

point that Swedish management and labor unions have agreed to aim at as a key to productivity growth and the enhancement of the quality of work. In Sweden, in the 1970s the increasing incorporation of the voice of employees in the affairs of the employing firm was sought through the employees' participation in the corporate governance structure as in other continental European countries (the so-called codetermination or co-management). In the 1980s, however, the focus of participation has clearly shifted to the shopfloor level. The need for decentralized and semiautonomous problem-solving with the workers' participation are formally agreed to in the historical Development Contract signed between SAF (Swedish Employers' Confederation), LO (Labor Union Association) and TCO (White-Collar Central Union) and subsequent Development Contracts at the enterprise level. One of those enterprise level contacts at Volvo states that "development of work organization .. creates opportunities for making better use of the employees' experience and knowledge. Jobs, management practices, and control systems which stimulate and involve the employees shall be the goal in this respect." Also for that purpose, "responsibility and decision-making can be delegated, within an organizational unit and within well defined sections, to groups of employees who organize their work together themselves". This contract is noteworthy in that the powerful Swedish unions have came to recognize that participation in semihorizontal, semiautonomous coordination is more effective than participation in vertical control over management (i.e., co-management) for enhancing the quality of

work in the factory. see M.Aoki The Cooperative Game Theory of The Firm, chapter 10, Oxford University Press, 1984 for codetermination.

38. See Robert Cole, Work, Mobility and Participation: A Comparative Study of American and Japanese Industry, University of California Press, 1979 for the cultural aspect of the development of spcialism in the U.S.

39. There are many anecdotal experiments of more flexible job classification scheme in the U.S. recently, but a true hybrid of the two Japanese and American giant firms, New United Motor Manufacturing Incorporated (NUMMI) founded in 1983 at Fremont, California, provides a particularly interesting example in showing that the Japanese rotation scheme may be a viable alternative even in the U.S union setting. Prior to the start of actual production in the beginning of 1984, management of NUMMI and the UAW Local 2244 exchanged a letter of intent and completed their first collective bargaining agreement in June 1985,, in which the job categories for hourly workers were reduced to three: general maintenance, tool and die, and assembly line, from traditional 200 or more categories at a comparable unionized factory of the same size. All blue-collar workers are now organized into egalitarian teams, each composed of seven members among whom jobs are rotated under the direction of a team leader. There are two pay levels, skilled and unskilled, with annual bonuses. Team leaders make 50 cents more per hour in 1986, but there are no "pay-for-knowledge" differentials as in the GM's operating work team system mentioned before.

Through this team system, together with the application of a kanban system adapted for the geographical distances of supply sources in Japan and the Midwest, NUMMI was able to eliminate such specialized jobs as reliefmen (normally 500 workers at the comparable unionized), quality inspectors (250), material handlers (250), repairmen (250), and non-working union representatives on payroll (40). Combined with an on-site stamping plant, which not only allows for just-in-time deliveries, but also increases time efficiency through the Toyota "quick-die" process, the work-team approach has been able to reduce the work force at NUMMI by about one-third relative to comparable North American factories. The labor accord at the Fremont plant is expected to have a impact on the shaping of future industrial relations, particularly in newly built plants, in the American auto industry. According to an interview with a NUMMI manager, 1500 GM managers from 50 different plants and 40 local unions have visited the NUMMI plant by the end of 1985. The design of a new GM assembly plant now being built in Kansas has adopted many ideas influenced by NUMMI. At GM's plant in Van Nuys, California, a new collective agreement closely resembling the NUMMI agreement was ratified in 1986.

40. According to a survey by the Belgian Institute for Regulation and Automation, the number at the end of 1984 for West Germany, France, Sweden and U.K. was 6,600, 3,380, 2,400 and 2,623 respectively.

41. David E. Noble, Forces of Production: A Social History of

Industrial Automation, Oxford University Press, 1984.

42. In 1981, only about one out of every five NC tools made in Japan was sold to large firms. More than twenty five percent were sold to shops with fewer than ten employees. (Interview with the Robot Industrial Association). In the U.S., vast majority of NC machine tools are made by large size firms. American Machinist, 1983,pp.120-1.

43. P. Adler, "New technologies, new skills," Working Paper No. 1-784-076. Division of Research, Graduate School of Business, Harvard University (May 1984). B.Baran, "Office Automation and Women's Work: The Technological Transformation of the Insurance Industry," in Manuel Castells (ed.): High Technology, Space, and Society, Sage, 1984.

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