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Japanese System in an Institutional Complementarity and its Probable Evolution¹

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An economy is an organic system consisting of several factor institutions which are in a relationship of more or less mutual complementarity. The recently developed economics of "comparative institutional analysis," defines this mutual relationship of factor institution as "institutional complementarity."

This paper seeks, first, to clarify these factor institutions with regard to Japanese economy and, second, to analyze relationships of institutional complementarity among such institutions. Finally, this paper seeks to discuss the capacity for change of the system as a whole, partly by making use of a method called "the evolutionary game."

1. Introduction

The Japanese system, which refers both to the economic structure at macro-economic level and to the business structure at the micro-economic level, is widely understood to incorporate some outstanding peculiarities, at least when compared with most Western economies.

As is true with any other system of this kind, however, the Japanese system is not a mere incidental combination of various peculiar phenomena. On the contrary, it should be seen as a holistic organism combining various factor institutions in a relationship of close mutual complementarity.

Studies on the Japanese system so far have achieved much toward clarifying the details of each factor institution. However, very few of them have successfully analysed the organic relations of factors which are in a network of intimate complementarity.

Also, these studies did not analyze the possibility of changes in the system adequately with sufficient scientific rigor; indeed some go to exaggerated probable changes overlooking the stubborn nature of the holistic network or by basing themselves on an overly optimistic outlook.

This paper first focuses on the representative factors forming the Japanese system, factors which have been taken up in previous studies. However,

1) This paper is an expansion of the same author's "The Japanese System and Its Changeability." (Tominomori 1995) The two papers' principal differences are the further revision of factor-institution learning based on recent results of other relevant research, and the use of game theory.

attempts are also made to clarify their relations of complementarity as much as possible. This part of description is given in Section 1 of the paper.

So as to enable a more rigorously scientific approach regarding future forecasts of the changeability of the system, we take up evolutionary game theory in Section 2, drawing on recent research in the field. From such study, a valuable theoretical suggestion for consideration of the changeability of the system will be induced.

Section 3 is devoted to more concrete discussion of probable changes in the Japanese system, taking into consideration contemporary circumstance of change bearing on the Japanese economy.

A brief summary and conclusion is given in the final section.

2. Factor Institutions

2.1. Groupistic Job Allocation Based on "Contextual Skills" and "Assimilated Information Systems" ($Gp-C$)

In the Western style of business, ordinarily an employee is hired for a defined job described in the employment contract. Thus, the person is required to engage in this individually given job and eventually is evaluated according to clearly described assessment criteria.

The practice in Japan, unlike that in the West, is for the employee to be hired on a general basis without being given any specific job description, except in rare cases. The person is required to engage in various kinds of work throughout his/her working life in the company, belonging to a small group whose job area is more clearly defined. Although the employee engages in a definite job for some extent of time (from several months to several years), the borders of his/her job are more or less flexible. Workers are usually expected to cooperate with each other whenever necessary. In addition, the person is rotated to other positions in other small groups, the work sometimes being of an entirely different kind from the former job.

In short, "groupistic job allocation," in contrast to the "individual job allocation" of the West, is universal in Japanese business.

Due to such job allocation, "contextual skills,"² as defined and analyzed by Aoki (Aoki, 1995) naturally are expected of an employee. On this point, too, the Japanese system can be distinguished from that of the West, in which "func-

2) Aoki defines contextual skills as skills useful only in a certain organizational context. For this reason of context, the skills can be acquired only after working in a certain organization for some time. However, in order to acquire the skills as quickly as possible, an employee is expected to have "malleability skills" from the outset. Expressed more directly, contextual skills are sometimes described as "a firm-specific skills" (Aoki, Okuno 1996).

tional skills” are expected of an employee.

As an “assimilated information system,” the Japanese system can be further distinguished from the Western “differentiated information system, if we view each of business organization as a system of information among organization members. This enlightening contrast between the two systems is also given by Aoki (Aoki 1995). However, focusing only on the aspect of information is considered to yield a distorted view, since a business organization is above all an organization of jobs, rather than an information system. Thus, here characterizing the Japanese system from this aspect is given as an additional factor.

2.2. Long-term Employment Under the Rotation System (*L-R*)

Since the Japanese system requires employees to have contextual skills which can hardly be acquired under short-term employment in a company, the system naturally results in long-term employment. Contextual skills, by their nature, cannot be acquired if the employee lacks a wider range of job experience and information within the company. The rotation system thus becomes indispensable in the Japanese system. Rotation is also established to reduce the dangers of excessive factionalism and the moral hazard problem induced by a certain group of employees who may have been presiding over a specific area for too long.

Once contextual skills are acquired, leaving the company, for the employee, would signify losing the skills and requiring additional time and effort to acquire other contextual skills. Also, for an employer to lose an employee who already has acquired contextual skills would mean making another investment in the training of another employee. The employer, if once making layoffs, is very likely to jeopardize its reputation in the labor market, which is likely to result in subsequent difficulty in finding employees gifted with malleability skills. In such a way, contextual skills themselves can work as an effective incentive system for long-term employment from the point of view of both employer and employee.

For the reasons mentioned above, the factor *L-R* is understood to be in a close relationship of complementarity with *Gp-C* discussed in (1). Not only is *L-R* an inevitable result of *Gp-C*, it also sustains effective operation of the latter.

2.3. Closed Labor Market (*C-L*)

An idealistic way of maintaining long-term employment is for the employer to recruit graduates directly and to put them to work hopefully until the retirement age of about 60. Naturally, this makes the Japanese labor market basically closed.

However, it is not always possible to satisfy labor demand exclusively with

recent graduates, nor to put them to work quickly. This is particularly true for smaller companies, so that small or mid-size companies become more dependent on the “secondary labor market” of workers who have left their companies at least once.

However, in contrast to the mainstream labor market mentioned above, the wage level in the secondary labor market is generally low. Statistics show the average wage level of the secondary labor market to be 70% of that of the primary labor market (Suzuki, 1994). Consequently, workers who leave their company are usually forced to risk great disadvantage in their working lives.

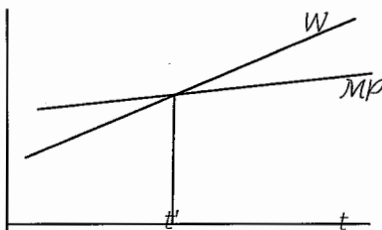
Due to this feature of the labor market that arises from long-term employment, even a slight implicit threat of probable dismissal can be a quite effective means of preventing individual employees from falling into the moral hazard situation such as becoming “free-riders” at the expense of the group. Thus, $C-L$ is not only a necessary outcome of long-term employment but also works as a factor sustaining the effective functioning of $Gp-C$.

2.4. System of Service-length-related Wage and of Gradual Promotion through Competition ($SW-P$)

Unlike the seniority-based wage system, for which it is sometimes mistaken, the service-length-related wage system usually operates within the Japanese system. $Gp-C$, where individual performance of a job is ambiguous, explains another background of it.

A wage curve that depends on length of service (t), however, is understood to be even steeper than a marginal productivity curve also dependent on t . (See Figure 1).

Figure 1 Marginal Productivity and Wage



On the left side of the figure, where marginal productivity is higher than wage, an employee under t' pays a certain amount as investment —so-called Williamson’s “hostage”— (Williamson, 1983) that will be refunded when the employee exceeds t' . In order to receive the largest possible refund, it is hoped that the employee will stay with the company until retirement, when he/she will be given an additional refunded sum as retirement allowance. It is also true that

the more the company grows, the greater will be the refund. Thus, the wage system can be an effective incentive toward an employee's longer service in the company, as well as for his/her greater possible contribution to the company and for mutual monitoring among employees to prevent the moral hazard problem.

The system of gradual promotion through competition, which obviously brings about wage differences among employees having the same length of service, offers another incentive function for employees to contribute more to the company, because it is clear that the employee can be more greatly refunded by being promoted more rapidly.

For these reasons, *SW-P* is in a relationship of close mutual complementarity with *Gp-C* and *L-R*. This makes the labor market further closed and management strategy more growth oriented (*Gr-S*).

2.5. Growth-oriented Strategy (*Gr-S*)

In a system in which *L-R*, *C-L* and *SW-P* function, it is inevitable for management to follow a growth-oriented strategy as much as possible. This is because expansion of the company is indispensable for the maintenance of the promotion system, since employee of growing companies are less likely to leave. Making promotion a stronger incentive naturally requires the creation of more positions.

Figure 2 Breakdown of Employee by Length of Service

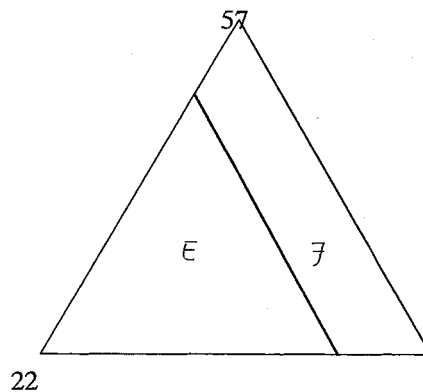


Figure 2 displays a breakdown of employees by length of service. The length of the bottom line indicates the number of new recruits. The width of the upper part of the triangle shows the number of employees having longer length of service and those already promoted. (Promotion is considered on average level here, neglecting its difference among employees.) The size of the triangle is nothing more than the overall size of the company.

It may be obvious that without expanding the triangle itself, it becomes im-

possible for management to meet the promotion expectations of the employees. The only way of doing so is to expand the triangle to that shown by F .

Additionally, as discussed in the above (4), $SW-P$ provides incentives for employees to contribute to the growth of the company.

Thus we find that $Gr-S$ is also in a relationship of close mutual complementarity with $L-R$, $C-L$ and $SW-P$.

2.6. Business Groupings with Relationships of Reciprocal Share-holding ($Bg-Sh$)

Under the Western business circumstance in which shareholders apply strong pressure for profits, business strategy is likely to become profit-oriented. The Japanese system, on the contrary, allows business to be exempt from such pressure due to the relationships of mutual share-holding among firms forming business groupings. This is because, given that the majority of shareholders are such companies in such relationships, management is never required to pay the greatest possible dividend and thus is able to use residual funds mainly for expanding investment.

Thus it is clear that $Bg-Sh$ works as a factor sustaining $Gr-S$. It also functions as a factor complementary to $L-R$, since a group of firms occasionally provides a wider realm of rotation over different businesses in the same group.

2.7. Main Bank System (MB)

Although the main bank system is an aspect of business groupings, it needs to be considered separately, as it has a particularly important and distinct function in the Japanese system. (For details about the system, Aoki & Patrick, 1994)

First, it should be remarked that ($Gr-S$) is not possible without a system whereby main banks take significant initiatives in supplying funds sufficient for company growth. Second, main banks work as effective monitors for business, by means of contingent governance over them, as analyzed by Aoki and others (Aoki & Patrick, 1994). It should be remarked that this monitoring function by main banks, as Aoki described, effectively defends businesses from the moral hazards problem.

One point, however, should be added here: that is, although the main bank system has a supplemental function in defending the moral hazards problem, other institutions such as $L-R$, $C-L$ or $SW-P$ do have a similar function in a stronger sense. This must be well understood from our analysis developed above.³

Figure 3 Institutional Complementarity Relationship of J-System

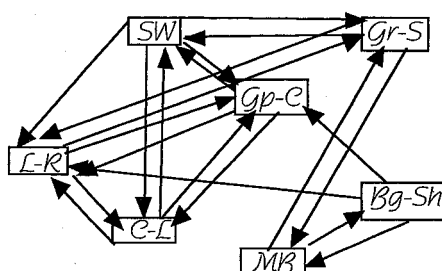


Table 1 Institutional Complementarity Relationship of J-System

	<i>Gp-C</i>	<i>L-R</i>	<i>C-L</i>	<i>SW</i>	<i>Gr-S</i>	<i>Bg-Sh</i>	<i>MB</i>
<i>Gp-C</i>		+		+			
<i>L-R</i>	+		+		+		
<i>C-L</i>	+	+		+	+		
<i>SW</i>	+	+	+		+		
<i>Gr-S</i>		+		+			+
<i>Bg-Sh</i>	+	+					+
<i>MB</i>	+				+	+	

3. Relationships of Institutional Complementarity in the Japanese System, and the Capacity for Change of that System

3.1. Institutional complementarity of the J-system and the A-system.

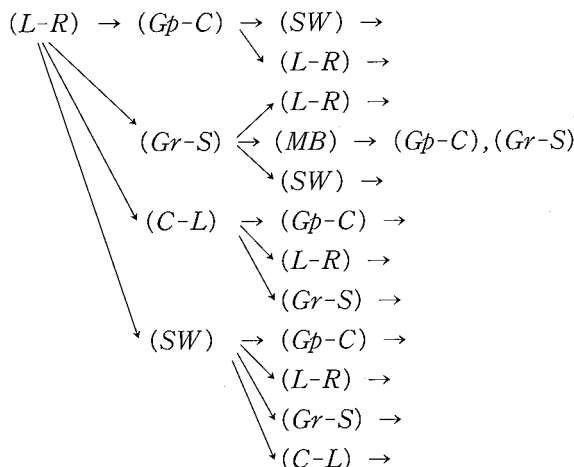
The preceding chapter described the relationship of institutional complementarity among seven factor institutions. This can be summarized in matrix table (Table 1) and a figure (Figure 3). Here, + in the table indicate a direct complementary relationship from vertically shown institution to horizontally shown institution. In addition to such direct relation, there can be an indirect relation among factors. For example, *Gp-C* can affect *C-L* through the intermediary of *L-R*. Such indirect relationships, however, are omitted here. Now the capacity for change of the system can be conceived according to those tables or the figures.

- 3) It is known that the industrial policy of the government has played a significant role in the Japanese system. It could be argued that it is necessary to include it in a factor institution list of the system. However it is excluded here to confine the analysis to the principally private elements of the system. Although it is better to be included for a more detail analysis of the Japanese system itself, for the purpose of the present study, which is mainly to analyze the possibility of change in the system under continuously changing circumstance, confining the study only to the private level will be considered to be acceptable.

Some readers may think it also necessary to include Affiliate Subcontractors as another factor institution of the Japanese system. However it is not taken up separately here for two reasons: first because it is already included in (*Bg-Sh*) implicitly, secondly because present purpose of the study can be fulfilled without taking it up separately.

First, if any realizable change occurs in any one factor of the system, we can consider the probability of a change of the whole system by tracing + or $\rightarrow$.

For example, if $L-R$ became unadaptable by some meaningful percentage of firms for some reason, it would give negative impact to $Gp-C$, $Gr-S$, $C-L$ and $SW-P$, which then would negatively affect other factors, as follows:



A sort of cyclical impact relation is recognized here. However, what we can deduce cannot be any more than just realizing the above sort of cyclical shock giving relationship. The degree of the shock or inevitability of change toward another system can hardly be known from only the above analysis.

In general, it might be conceived that the greater the shock the more inevitably the system might move toward another system. However, two vital questions may still remain.

First, we need to have a substituting organic system, which consists of other factor institutions in complementary relationship.

Second, another system should be another equilibrium toward which the preceding system can move, at least once some alienation from the preceding system occurs.

The A -system, which is abstracted from the American system, could be one probable substituting system.

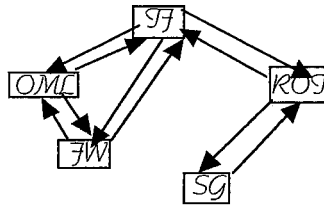
The system may have the following factor institutions, which are in a complementary relationship as shown in Table 2 and Figure 4.

1. Individualistic job allocation based on functional skills ($I-F$)
2. Open and mobile labor market (OML)
3. ROI-oriented strategy (ROI)
4. Function-based wage system (FW)
5. Shareholder governance (SG)

Table 2 Institutional Complementarity Relationship of A-System

	<i>JF</i>	<i>OML</i>	<i>ROJ</i>	<i>JW</i>	<i>SG</i>
<i>JF</i>		+	+	+	
<i>OML</i>	+			+	
<i>ROJ</i>	+				+
<i>JW</i>	+	+			
<i>SG</i>			+		

Figure 4 Institutional Complementarity Relationship of A-System



Although an answer to the first question may be given in this way, how to answer the second is not as easy.

Evolutionary game theory, developed recently by Aoki and other Comparative Institutional Analysis (C. I. A.) economists, however, gives us an enlightening suggestion regarding this point. We would like to paraphrase it and refer to its context in our discussion in the next section.

3.2. Evolutionary Game Theory and Its Implications

3.2.1. First we paraphrase the theory according to Aoki's model (Aoki, Okuno 1996), using a slightly different numerical assumption.

Assumptions given here and deductions from them are as follows.

1. What exist are two systems and two industries. One system is based on contextual skills (*c*) and the other on functional skills (*f*). One industry is *V*-type and the other is *M*-type.
2. One industry has one employer and one employee, each of whom has a strategy for investing in either contextual or functional skills. If two people who have chosen the same skill work in the same industry, its efficiency improves compared to the case of had the two people chosen different skills. Additionally, *V*-type industry becomes more efficient if it gets two who have chosen *c*, whereas *M*-type becomes more efficient if it gets those who have chosen *f*.

The resulting cost structure would be :

$$Vcf = Vfc = Mfc = Mfc > Vff = Mcc > Vcc = Mff$$

where Vcf is the cost of *V*-type industry having a *c* employer and an *f* employee. Also, we assume here that $Vcf=0.4$, $Vff=0.2$ and $Vcc=0.1$.

3. A population having the strategy of choosing i skill and j industry is indicated as S_{ij} , and the total of the population

$$Scm + Scv + Sfm + Sfv = 1.$$

4. Two people choosing the same industry are matched together at random to form one firm producing 1 unit of production. The production sum of V and M industry (Xv and Xm) would be:

$$Xv = (Scv + Sfv) / 2$$

$$Xm = (Scm + Sfm) / 2.$$

Here also, on the demand side, α % of income is assumed to be paid for v whereas β % is so assumed for M . The price of each unit produced would be:

$$Pv = 2\alpha / (Scv + Sfv), \quad Pm = 2\beta / (Scm + Sfm).$$

5. Assuming that two people in one industry share the revenue equally, then the expected income of each (we described it as expected utility: $Ucv...$) would be gained as a reduction of cost from half of income ($1/2$ of the price) as follows.

$$Ucv = (\alpha - ScvVcc - SfvVcf) / (Scv + Sfv)$$

$$Ucm = (\beta - ScmMcc - SfmMcf) / (Scm + Sfm)$$

$$Ufv = (\alpha - ScvVfc - SfvVff) / (Scv + Sfv)$$

$$Ufm = (\beta - ScmMfc - SfmMff) / (Scm + Sfm)$$

6. It is also assumed that if the expected utility of investing in one strategy is smaller than for the other strategy, the percentage of those investing in the former will surely decrease gradually. Also, it is understood that those who invest in functional skills are transferable from one industry to another according to the difference of the expected utility due to the nature of functional skills, whereas those who invest in contextual skills are not transferable for the length of time necessary to train themselves in different skills since contextual skills are skills useful only in a certain company. From the former understanding, it is also clear that whenever $Ufm > Ufv$ or $Ufm < Ufv$, nobody investing in functional skills will choose V or M industry (that is, Sfv or $Sfm = 0$).

3.2.2. More Important for Us than Just Paraphrasing the Model Should Be Its Implications.

The model, indeed, does have theoretical connotations that are highly valuable to our discussion.

In particular, it gives us one very suggestive point regarding the probability of the Japanese system to change to some other equilibrium, although it gives us this in a very abstract way.

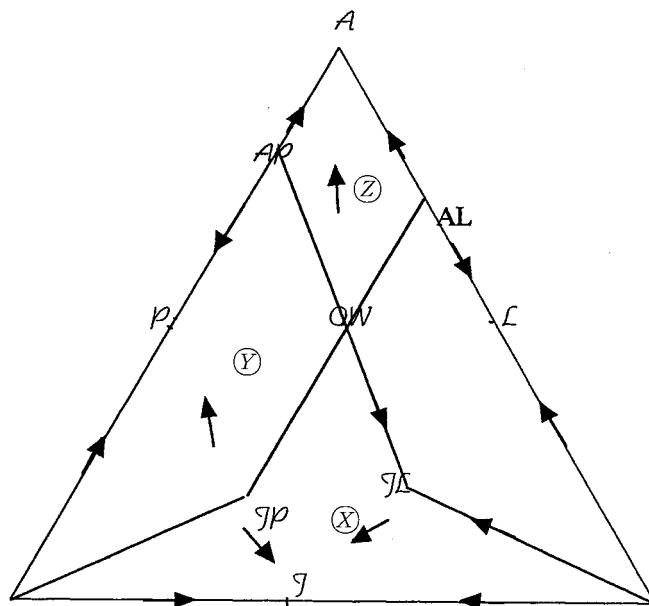
As is easily seen, equilibrium J represents the Japanese system in a highly abstract way, since this system is based on people's strategy of choosing contextual skills. As in any other society, however, there may be some, for some rea-

son, who dare to have another strategy of investing in functional skills. Even in such cases, if the percentage of those people is less than a certain figure (in the rectangular triangle in Figure 5, within realm $\textcircled{X}$), then the expected utility of choosing this strategy would still be smaller than the expected utility of choosing contextual skills and, now that we assume people act within bounded rationality⁴, there works a significant enough pressure to call them back to J equilibrium. However, once the percentage of those people becomes great enough to move from realm $\textcircled{X}$ to realm $\textcircled{Y}$ (in this case moving to $\textcircled{Y}$ from $\textcircled{X}$ is clearly less costly than moving to $\textcircled{Z}$), then the expected utility of investing in functional skills (U_{fm}) becomes greater than U_{cm} , making the point evolve to a new equilibrium, P . (Here, V industry has only people of contextual skills, whereas M industry has only those of functional skills.) Numerical examples of equilibria is given in Table 3.

The connotations of this deduction are now quite apparent.

That is, the question of the Japanese system with regard to its capacity for change depends wholly on whether there would arise some change in circumstances to increase the percentage of "persons of functional skills" enough to

Figure 5 Evolutionary Equilibria



The height of the regular triangle here drawn is just 1, which signifies the total of distance from a point within the triangle to each line is everywhere just one. The distance from the point to the left line indicates S_{cm} , whereas that to the right line does S_{cv} and that to the bottom line does $S_{fc} + S_{fv}$.

4) The definition of "bounded rationality" is given in (Aoki & Okuno 1996, p. 279).

Table 3 Numerical Examples of Equibria

	<i>Scm</i>	<i>Scv</i>	<i>Sfm</i>	<i>Sfv</i>	<i>Ucm</i>	<i>Ucv</i>	<i>Ufm</i>	<i>Ufv</i>
<i>p</i>	0	0.5	0	0	0.6	0.9	0.9	0.6
<i>A</i>	0	0	0.52494	0.47506	0.55249	0.65249	0.85249	0.85249
<i>J</i>	0.47507	0.52494	0	0	0.85249	0.85249	0.65249	0.55249
<i>AP</i>	0	0.18214	0.54464	0.27321	0.51804	0.81804	0.81804	0.81804
<i>AL</i>	0.28804	0	0.19201	0.51997	0.76157	0.56160	0.76160	0.76157
<i>JP</i>	0.27322	0.54464	0.18214	0	0.8180	0.81804	0.81804	0.51804
<i>JL</i>	0.51997	0.19201	0	0.28802	0.76160	0.76160	0.56160	0.76160
<i>L</i>	0.5	0	0	0.5	0.8	0.6	0.6	0.8
<i>OW</i>	0.3	0.2	0.2	0.3	0.72	0.72	0.72	0.72

reach realm y .

In the final chapter, we will take up this question, starting by pointing out actual changes in circumstances now facing the Japanese economy and, next, analyzing probable strategy changes of people to move society to another equilibrium, P .

4. Changes in Circumstances and Their Effects on System Change

In recent years, the circumstances of the Japanese economy have undergone remarkable change, at least relative to the period of rapid economic growth (1955-1973).

Although sometimes its effect on the Japanese system is in some ways exaggerated, the question of the probability of system change still deserves serious consideration. In particular, the following three points seem to be highly important in this respect: stagnant economic growth, remarkable changes in the global economy, and changes in circumstances regarding technological innovation. We now consider them one by one to discuss their probable influence on system change.

4.1. Stagnant Economic Growth

In the relationship of institutional complementarity of the Japanese system, the growth-oriented business strategy is deeply ingrained in the system, as we have already illustrated.

However, it has been becoming increasingly difficult for most Japanese businesses to pursue this strategy since the Japanese economy reached some saturation point finishing its process of "catching up."

Such a phenomenon seems to have arisen first after the oil shock of 1973, although it turned out to be less conspicuous in the '80s for some peculiar and temporary reasons including Reaganomics or the "bubble economy." As is well acknowledged, this tide is becoming an undeniable fact in the '90s and is already

beginning to affect the Japanese system. First it is observed in recent trials by many firms to introduce new employment systems. In reality various different trials of this kind are found. Theoretically, however, it can be explained as follows.

Let us assume that a firm now has a breakdown of employees as shown in the regular triangle of Figure 2. Here, the bottom line indicates the number of the youngest (e. g., age 22, just graduated from college) and other horizontal lines above it indicate the number of older employees as one reads from the bottom up⁵.

In the usual system of "long-term employment with rotation" (*L-R*), upper-level employees are not only older, but also occupy higher positions. In order to sustain the system in the future (say, for five years), the firm needs to expand from triangle *E* to triangle *F*, since every age level of employees, who are supposed not to leave the firm under the system, should be promoted while staff is newly recruited at the bottom. Pursuing growth-oriented strategy thus becomes inevitable.

However, in the current low-growth economy, it is becoming difficult to implement the strategy. This means that the firm needs to have room for promotion at least regarding mainstream employees still working in the "long-term employment" track, while keeping the size of the firm unchanged. As is easily understood, this kind of strategy is not possible without squeezing down the mainstream portion of the employees. In the triangle, it is a situation in which a firm of size scale *F* depends on the mainstream of employees of size *E* for *L-R* employment, while depending on the other portion (*F-E*) for the more mobile labor market.

The question here is nothing but the characteristics of those workers in the "more mobile labor market."

At least we can say that they are not required to have contextual skills as rigorous as those of mainstream workers, since the former workers are not supposed to stay with the firm for so many years. However, it does not necessarily mean that they are required to have functional skills. It may depend heavily on the quality of the demand for such workers, in other words, on how much important or urgent demand there exists for those workers. If the required quality is high enough and the urgency is strong enough, the market is more likely to become one that demands functional skill. In the contrary case, the market is more likely to become one that demands unskilled workers.

The general condition of the labor market becomes important in deciding

5) For the sake of simplicity, we consider the seniority system in pure biological sense. Most Japanese firms actually combine age and length of service.

which direction is more likely. It is considered that under conditions of labor shortage the former situation is more likely, whereas under demand shortage the latter is more likely.

The predicted impending graying of society may explain the higher probability of the former case. Excessively low economic growth, on the other hand, could result in a higher probability of the latter. Long working hours, which is also ingrained in the Japanese system⁶, may result in the latter possibility from another angle.

It is hardly predictable what will be the case in the future, since it all depends on the combination of the above factors. However, it can be said that if some significant policy step were taken regarding regulation of overly long working hours, it would surely foster a favorable background for the former case becoming more likely.

It is also conceived that the probability of the latter case may generally be higher in *M*-type industry than in *V*-type industry, since *M*-type is the industry where a combination of functional skills can make the industry more efficient, as already outlined.

When a firm becomes overly dependent on functional skills, it may lead to a situation where a function to check the moral hazard problem by *L-R* would be jeopardized. In this case, the establishment of a stronger monitoring system by the main bank or any other institution including a share holding company may become indispensable⁷.

4.2. Changes in the Global Economy

In this concern, two points in particular should be remarked. One is the recent astonishing growth of Asian economies. As already has been observed, in many industrial fields other Asian economies are becoming powerful enough to be threatening competitors to Japan, given which Japanese businesses in this nation's advanced economy are increasingly called on to seek niche strategies. This means that they need to become suppliers of higher quality goods or products that incorporate outstanding features. Different from ordinary goods of the mass-production system, these goods require that firms establish more functional-skill-based organization.

The other point is that the present floating system, under which the value of the yen is always quite unstable, is calling for business to take a more currency-

6) The point, which is not considered explicitly in Chapter I, is more developed in Tominomori 1994)

7) Aoki proposes this, taking into consideration that the function of main banks as monitors is weakening due to lower economic growth where firms become less dependent on bank loans (Aoki, 1995).

free strategy. This means that it is getting increasingly important for firms to have production fronts worldwide. In order more successfully to accomplish this, it naturally becomes indispensable for them to introduce a different system that is more adaptable to employees of different cultures. Although the extent is quite uncertain, some level of feedback to the domestic system is conceived.

These two aspects of recent changes in global economic circumstances may work as a relatively long-term pressure toward changing the Japanese system toward *P* equilibrium.

4.3. Circumstances Regarding Technological Innovation

The Japanese way of innovation has its own outstanding peculiarities and merits, such that many analysts in this field have attempted several appellation, such as the "Sashimi Slice Model" (Imai, 1985) or the "Rugby Approach" (Takeuchi & Nonaka, 1986). There are also valuable empirical analyses of actual innovations (Nonaka and Nagata, 1995), (Shintaku, 1994).

A summary of the preceding research is as follows.

1. Successful Japanese innovation has, more or less, inclined toward "architectural innovation" (Shintaku, 1994), in which some sort of technological leap was just about to be realized despite the fundamental concept of the commodities already having been established. Such cases were quite typical in the innovation of the TV, from the vacuum tube to the transistor, or in the case of the facsimile machine.
2. Japanese innovation has been particularly successful when a certain "trajectory" existed. For example, in the case of facsimile innovation, the target of the innovation had been sufficiently clear from the beginning: the sending of a picture as quickly and clearly as possible. Also, in the case of DRAM innovation, expansion of memory size while cutting production costs and maintaining quality had been a clear goal from the start.
3. Fast-growing markets were chosen for the field of innovation. Competition for innovation of a similar technology was fierce and oligopolistic between several firms of similar scale.
4. Tightly organized teamwork between engineers was always found. Due to such cooperation, the careers of the engineers were usually managed by corporations rather than by the individuals themselves. This frequently caused not a little frustration in those highly educated people (Sakakibara, 1995).

From the above, especially from point 4, it is known that technological innovation in Japan has also been based on contextual skills, though at a high level.

The recent circumstances surrounding innovation, however, seem to be changing to make it harder to continue such an innovation strategy with the same success.

Above all is the fact that the Japanese economy now is too developed to discover new technological frontiers of the kind mentioned above (that is, a frontier where the fundamental concept already has been established but where an architectural leap is still possible). In other words, innovation not based on contextual skill but rather on functional skill is in increasing demand.

Actually, as Okimoto pointed out (Okimoto, 1995), the Japanese system of innovation, even if confined solely to the computer industry, has shown some disadvantages in such fields as CPUs, MPUs, system software and application software, although it has shown advantages in DRAMs, SRAMs, floppy disks, and discrete elements.

The question is whether such new circumstances would compel a Japanese firm to change its system of innovation. It is sometimes heard that some business executives speak of the necessity of having a new system of innovation, one that enables breakthroughs.

However, it is highly difficult for a Japanese firm to change its traditional system of innovation. The advantage of the system has been too great to dare to change the system, a change that might be too costly. Additionally, there is another way for firm to rely on some other outside institution for this part of innovation. One is to rely on government-sponsored development projects, in which a company would participate. The other is to pursue technical alliance contracts with foreign companies, relying on the partner for the breakthroughs and then supplying the architectural innovation themselves.

In short, although it is recognized that some change is necessary, the impact on system change from this factor seems to be a little smaller than the impact concerning the former two factors.

5. Conclusion

Our discussion so far can be summarized as follows.

1. The Japanese system is an organic system consisting of seven factor institutions, which are in a relationship of mutual, institutional complementarity.
2. As can any other organic system, the Japanese system can hardly change without there being an alternative system into which it can be transformed. Otherwise, any shock to shake the system would only work as a disruptive or negative force that would not lead to a new system.

3. A recently developed trial that applies evolutionary game theory in the consideration of economic change, in particular the model of Aoki, provides enlightening insights on this question. According to the model, it is clear that under certain conditions (in which a percentage of the population who follow the strategy of investing in functional instead of contextual skills exceeds a certain level), another system which is a combination of the *J*-system and the *A*-system can achieve another equilibrium into which the traditional system can be transformed.
4. Actually, there have been observed some significant changes of circumstances that would make functional skills more attractive for a part of the population. Therefore, it is conceivable that the Japanese system could be transformed into a “*P* system” (*V*-type industry based on contextual skills, versus *M*-type based on functional skills) in the near future.
5. Two caveats, however, are necessary. One is that it is impossible to speak about precise percentage numbers within a model analysis, since a model is merely an abstraction. The other is that the model was based on another assumption to which we have yet to refer. That is, it is assumed that any economy needs to have above two industries, *V* and *M*, within itself. In reality, however, it is probable that through international competition and international division of work as its result, either of these two industries could vanish from one country. In our context, it is probable that Japan will confine herself only to *V*-type industry in the future. This sort of probability, though we can hardly think about such a case in the extreme sense, would work as a counterbalancing power for the transformation mentioned in (4.).

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List of Symbols

E: Smaller size of employee's number in a firm stratified according to age category

F: Bigger size of employee's number in a firm according to age category

Gp-C: Groupistic job allocation based on "contextual skills"

L-R: Long-term employment under the rotation system

C-L: Closed labor market

SW-P: System of service-length-related wage and of gradual promotion

Gr-S: Growth-oriented strategy

Bg-Sh: Business groupings with relationships of reciprocal shareholding

MB: Main bank system

I-F: Individualistic job allocation based on functional skill

OML: Open and mobile labor market

ROI: ROI-oriented strategy

FW: Function-based wage system

SG: Shareholder governance

t : Length of service (employment)

W : Wage

MP: Marginal productivity of an employee

V : an industry where contextual skill is more adapted

M : an industry where functional skill is more adapted

c : contextual skill

f : functional skill

V_{cf} : the cost of V-type industry having c employer and f employee

V_{fc} : the cost of V-type industry having f employer and c employee

M_{cf} : the cost of M-type industry having c employer and f employee

M_{fc} : the cost of M-type industry having f employer and c employee

V_{ff} : the cost of V-type industry having f employer and f employee

V_{cc} : the cost of V-type industry having c employer and c employee

M_{ff} : the cost of M-type industry having f employer and f employee

M_{cc} : the cost of M-type industry having c employer and c employee

S_{ij} : A population having the strategy of choosing i skill and j industry

X_v : Population sum of V industry

X_m : Population sum of M industry

U_{ij} : Expected utility choosing i skill in j industry

P : Pareto equilibrium

J : Japanese type equilibrium

A : American type equilibrium

AP, AL, TP, TL, L, QW : Other equilibria

X : An area moving toward J-equilibrium

Y : An area moving toward P-equilibrium

Z : An area moving toward A-equilibrium