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Business Cycles and Suicide Rate
- An Approach from Corporate Behavior -**

By

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Economic Analysis on Business Cycles and Suicide Rate¹ - An Approach from Corporate Behavior -

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Abstract

Japan has seen a sharp rise in the suicide rate since 1998, which has since been a major social problem. In addition, the number of those suffering mental disorders has been increasing in recent years. The paper argues that there exists economic rationality for corporations to motivate or force workers to resign and to raise the stress level at the workplace, when the consensus on the labor standards is altered drastically in response to the changing economic environment. The author believes that the increase in the number of workers exposed to larger stresses after the two-stage layoffs is a major factor for the increase of suicides following the currency/financial crisis.

1. Introduction

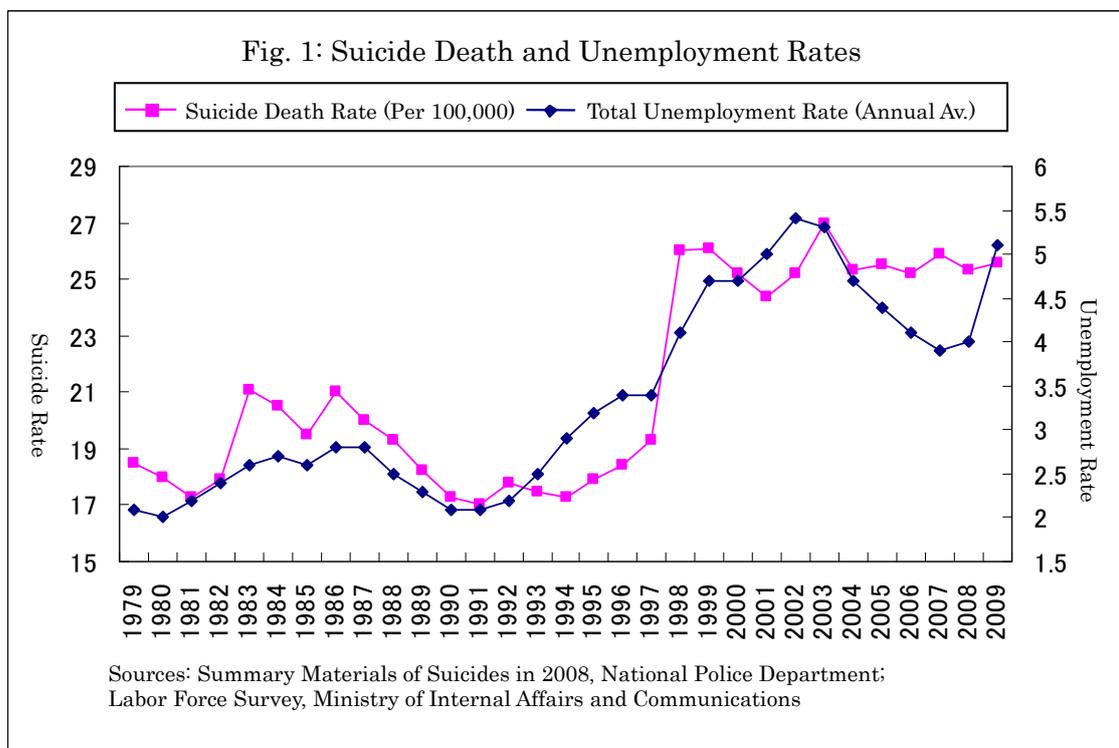
(1) Background

The change in the economic environment greatly affects the society in general, particularly in Japan. The unemployment rate rose drastically after the currency/financial crisis in the fall of 1997, and coincidentally, the suicide rate increased

¹ The paper is based on the study when the author was an associate professor of GRIPS. It is the revised version of the GRIPS Discussion Paper DP08-16 under the same title, with some additions and alterations including experimental studies, as well as articles published on Nikkei Business Online, in Japanese. The author expresses his thanks to readers who made comments on Nikkei Business Online. The author also expresses his thanks to Research Institute for Advancement of Living Standards for permitting citation of data from No. 15 Short-term Survey of Work and Life of Workers.

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sharply. The correlation coefficient between the unemployment and suicide rates (published by National Police Agency), as calculated from the annual data between 1980 and 2009, is 0.90. The causal relationship between unemployment and suicide is not self-evident. From the case studies, etc., however, it is known that unemployment often brings not only economic losses, but also disastrous life events³. A closer look at the data seems to indicate that the degree of correlation has been changing over time. In particular, the number of suicides, after having shot up in 1998, remained substantially unchanged, despite the improving unemployment rate since 2003. Therefore, it may be that a kind of regime switch was invoked in the relationship between the unemployment and suicide rates after the currency/financial crisis.



The statistics of National Police Agency shows the occupation of those who committed suicide in 2008 (Fig. 2). Accordingly, over half the suicide victims (56.7%) were unemployed. By reason, the largest cause was health, for about half the suicide victims, followed by economic and life hardships (over 7,000 victims.) (There may be two or more causes per suicide.)

³ Detailed case studies are found in “White Paper on Suicides,” Project Team for Analysis of Actual Conditions of Suicides (2008).

Fig. 2: No. of Suicide Victims by Occupation (2008)

| Occupation | No. of Suicides | Percent |
|-------------------------------|-----------------|---------|
| Total | 32,249 | 100% |
| Self-employed/domestic worker | 3,206 | 9.9% |
| Employee/corporate ranks | 8,997 | 27.9% |
| Students/pupils | 972 | 3.0% |
| Unemployed | 18,279 | 56.7% |
| Unknown | 795 | 2.5% |

Source: National Police Agency

Fig. 3 Cause of Suicide in 2008

(There may be multiple causes per suicide, except for Total)

| | |
|-------------------------|--------|
| Family problem | 3,912 |
| Health problem | 15,153 |
| Economic/life hardships | 7,404 |
| Job problem | 2,412 |
| Male-female problem | 1,115 |
| School problem | 387 |
| Other | 1,538 |
| Unknown | 8,759 |
| Total | 32,249 |

Source: National Police Agency

The data reflect situations at the time of suicide. For many suicides, however, there is a plurality of factors, with each victim having had varying biographical events. The data at the time of suicide alone will not fully reveal the issues surrounding the economy/society as a whole. The increase in the number of suicides coincided with the emergence of economic crisis, and possible causes consistent with the data characteristics are presumably economic issues, in particular, unemployment and bankruptcy.

In fact, situations surrounding work in Japan are believed to have changed drastically since 1998, including not only availability or non-availability of jobs (unemployment issues) but also workplace environment. The idea that the labor conditions in Japan has deteriorated beyond the level corresponding to the business cycle is presented, for instance, in the textbook “Text for Officers in Charge of Promotion

of Mental Health at Workplace,” published in 2008 by Japan Industrial Safety and Health Association, a private corporation established based on a special law. The text reads as follows (pages 98 - 99):

“Despite the economic upturn that has been going on for the longest period after World War II, surpassing that of the Izanagi economic boom, the number of suicides has not been decreasing at all. (new line) As the background, it is considered that some drastic changes in the society took place after the burst of the bubble economy, which has been persistent or entrenched to date. In addition to the long work hours, the work intensity (and hence work load) increased. On the other hand, the compensation decreased, and the workers today always feel worried that they may be urged to resign anytime. This has changed the workers’ consciousness about the work and workplace, which in turn forced workers to change their way of life. The situations surrounding workers are now completely different from when changes in the work conditions were generally attributed to the business cycle—some fundamental changes appear to have taken place in the society.”⁴

Measures have already been in place to fight the increases in suicides and changes in the society. In June 2006, the Basic Act on Suicide Prevention (Act No. 85 of 2006) was enforced for prevention of suicides and enhanced support for families of suicide victims through social measures, based on the idea that suicide is not merely a personal issue, but that it is a result of various social factors, including multiple indebtedness, long work hours, and unemployment. Further, based on the Act, the Outline of Comprehensive Suicide Measures was endorsed by the Cabinet meeting held on June 8, 2007, as a basic and general framework for measures against suicides to be promoted by the Government.

⁴ The article introducing the TV program “Depressions of Those in their 30’s—What Is Happening at Workplace?,” which was broadcast on NHK in June 2007, had similar descriptions, as quoted below: “There are numerous e-mail messages sent to NHK from workers suffering depressions in the prime of their life. From these messages and through news gathering activities has emerged the reality that rationalization and streamlining is taking toll on workers in their 30’s at workplace. With new working styles such as the performance-based compensation and discretionary labor system gaining popularity, workers in their prime are getting “isolated” at many companies. Furthermore, on them rest not only burdens of work but also burdens of household. With housing loans and children to look after, home is no longer a resting place.”

(2) Earlier Studies

Analysis of suicides has been performed mainly by sociological, psychological, and psychiatric approaches. In addition, there have been some economic approaches. According to Yang and Lester (1996), most economic models on suicides consider suicide as a rational behavior. Hamermesh and Soss (1974) established a model in which the suicide is committed when the expected utility of being alive turns negative, and verified the validity of the model using data of the US. Rosenthal (1993), on the other hand, considered suicide as a kind of signaling, and offered argument from the viewpoint of the theory of game. Dixit (1992) argued that the model of fixed cost of investment could be applied to suicide. For the socioeconomic factors of suicides in Japan, researchers at University of Kyoto (2006) carried out comprehensive survey researches combining various methodologies including economics, and concluded that suicides in Japan were likely to be the results of worsening employment circumstances or economic conditions, as witnessed by the higher unemployment rate.

However, views other than in the field of economics, as well as the government's official view, deny the idea that suicide is a rational selection. For example, in the No. 1 White Paper on Suicides, published in 2007, the Government of Japan expressed its view on decision to commit suicide as follows:

“As seen, suicide victims have not necessarily made the decision to commit suicide with sound judgment, but chosen an option, which can by no means be considered as the best choice objectively, because of unbearable emotional pain, in order to be free of the pain, and in many cases with impaired judgment due to depression and other mental disorders from the viewpoint of psychiatric medicine. The suicides can therefore be described as ‘mentally devastated death.’ Furthermore, only by understanding suicide as such, social measures against suicide can be taken.”⁵

The rationality on the side of the society or corporations is not necessarily well focused in the economic theories. If they let victims commit rational suicides, such an act is a murder and is out of question. However, such an act, if indirect, is widely observed in the society. In fact, the number of claims for work-related deaths with regard to suicides, as well as the number of legal actions, has been increasing sharply in

⁵ Excerpts from Section 1: Basic Perception of Suicide Prevention Measures, Chapter 1: Basic Perception and Concepts in Outline of Comprehensive Suicide Measures, Part 2: Suicide Prevention Measures Already in Place.

recent years.

As the suicide measures are rather addressed to the society and corporations, the paper focuses on the fact that the rational optimization on the side of corporations in response to the changing socioeconomic environment can increase mental disorders, and in the end, the suicide victims. From this viewpoint, the paper will theoretically clarify the logical path leading from economic changes to increases in suicides.

2. Impact of Stresses on Workers (Increases in Would-be Career Changers and Unhealthiness)

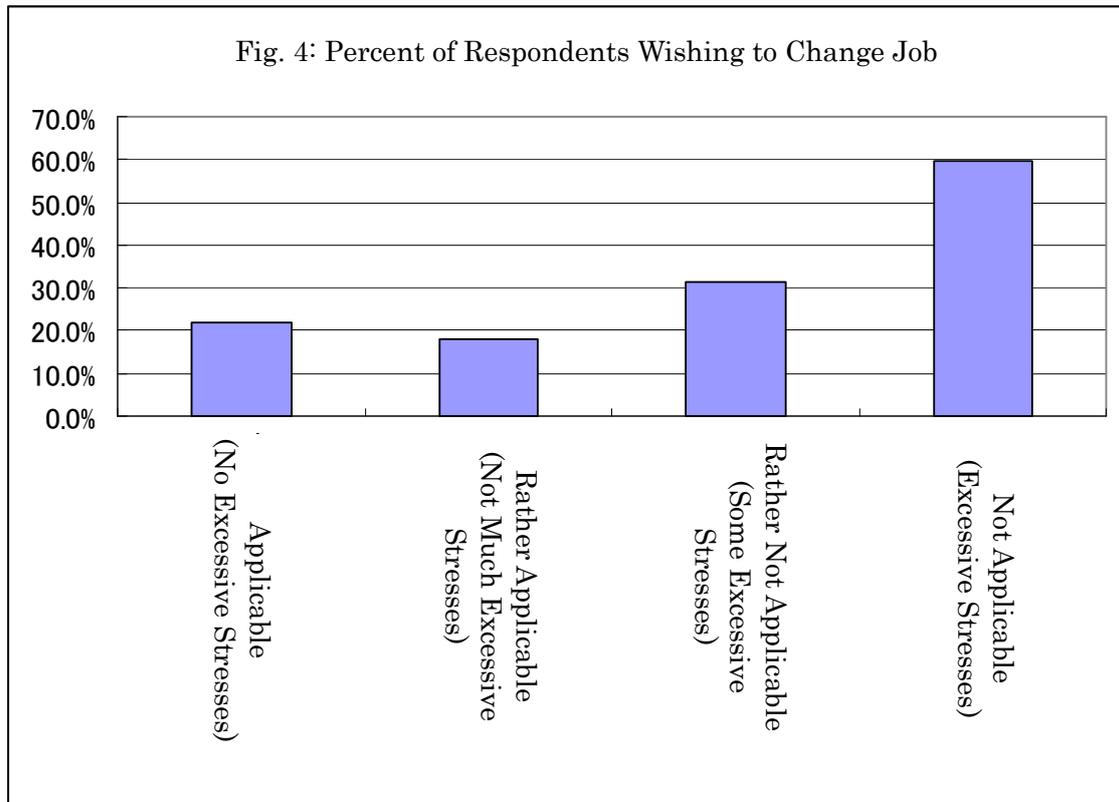
As a premise for analysis of corporate behaviors, the section analyzes the impact of excessive stresses on workers and then, the mechanism leading to suicides.

(1) Excessive Stresses Increase Would-be Career Changers

According to the No. 15 Questionnaire Survey on Work and Life of Workers⁶, answers to the question, “To what extent does the expression ‘there are no excessive mental stresses at the current workplace’ is applicable,” 12.1% of respondents answered as applicable, 36.3% as rather applicable, 31.0% as rather not applicable, and 20.3% as not applicable (no answers from 0.3% of respondents). About half the respondents think they feel excessive mental stresses at work. In the same survey, 33.7% answered yes, while 65.6% answered no, to the question “Do you want to change the current job” (no answers from 0.6% of respondents).

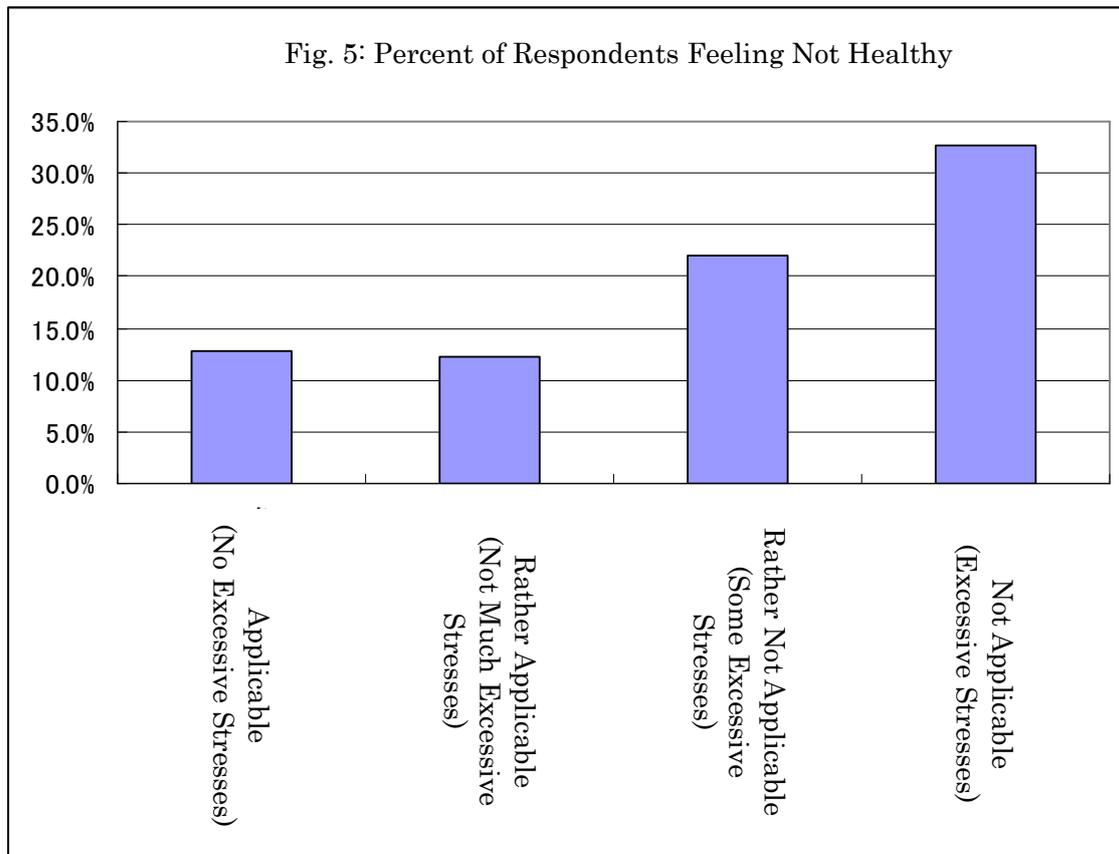
From answers to the two questions, the difference in attitudes towards career changes between stressed and unstressed workers can be observed. Fig. 4 shows the percentage of would-be career changers by stress level. It is clear that a higher percentage of those with strong stresses have stronger wishes to change their career. Answering “not applicable” to the question “there are no excessive mental stresses at the current workplace” means that the person has strong stresses, and as high as 60% of the respondents answering “not applicable” wish to change their job. Pearson’s test of goodness of fit was performed on the cross tabulation of the relationship between the wishes to change jobs and stresses, and independence of the wishes to change jobs from the stresses was rejected at a 1% level.

⁶ Please refer to Attachment for details.



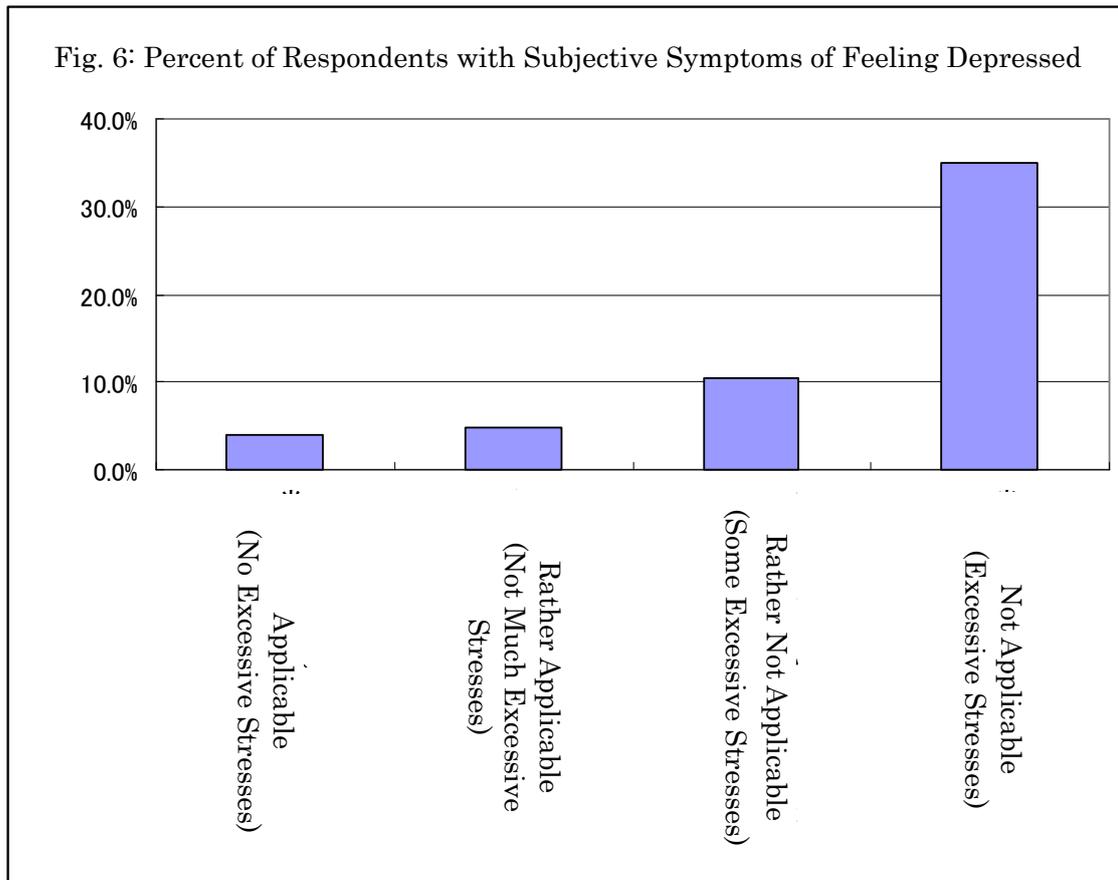
(2) Excessive Stresses Harm Health

In addition, the survey has questions about the current health condition. To the question “what is your current health condition,” 29.1% answered they are healthy, 51.2% rather healthy, 16.9% rather not healthy, and 2.8% not healthy. The cross tabulation of answers about health and stresses allows for analysis of relationship between the stresses and health. Fig. 5 shows the percentage of respondents feeling not healthy (sum of those answering “rather not healthy” and “not healthy”) by stress level. It is clear that higher percentage of those with stresses complain they are in bad shape. As with the case for the wishes to change the job, Pearson’s test of goodness of fit was performed on the cross tabulation of the relationship between the health and stresses, and independence of the health from the stresses was rejected at a 1% level.



(3) Excessive Stresses Also Worsen Mental Health

In order to identify the impact of stresses on mental health, let us see the answers to the question on subjective symptoms in the survey. To the question about the frequency of feeling depressed in the past one-month period, 13.4% answered “often,” 40.7% “sometimes,” and 45.6% “rarely.” (0.3% of respondents did not answer to the question.) The cross tabulation with stresses show that the percentage of those having the subjective symptoms of depression “often” increases clearly, as the stress level rises (Fig.6). As with the case for the wishes to change the job, Pearson’s test of goodness of fit was performed on the cross tabulation of the relationship between the depression and stresses, and independence of the depression from the stresses was rejected at a 1% level.



Summing up these analyses, it can be argued that workers, when exposed to excessive stresses, experience deteriorating physical and mental health, and increasingly wish to change the job. In Japan, job changes often result in poorer labor conditions, especially in monetary terms. The wish to change job despite inferior conditions tell how badly excessive stresses impact workers at the workplace.

(4) Suicide and Mental Health

The relationship between suicides and mental disorders is presented in many case reports. According to statistics of WHO, as high as 95% of suicide victims had some kind of mental disorders. Deterioration in mental health can thus be considered as one of direct factors for increases in suicides. From these analyses, the author believes it rational to conclude that excessive stresses deteriorate mental health, which in turn leads to suicides.

In fact, the instruction, issued by the Ministry of Health, Labour and Welfare and entitled “Rules about Mental Disease from Working Stress” (Ministerial Instruction No. 544 dated September 14, 1999, partially revised in April 2009) includes a guideline as

follows:

Patients of mental disorders, such as depressions and severe reactions to stresses, are generally considered to have a high likelihood of thinking of suicide. Accordingly, if a worker committed suicide who is recognized to have developed these mental disorders due to work-related psychological burdens, the worker shall be construed as having committed the suicide with significantly impaired cognitive ability and action selection capability or in a state with substantially impaired mental control to stop short of committing suicide, and the suicide shall be recognized as work-related death.

In the guideline, the cause is judged to be work-related or not by first evaluating mental stresses at the workplace through use of mental burden assessment tables, one for stresses at the workplace and another for stresses at outside the workplace, and then assessing and comparing the strengths of work-related and non work-related stresses. This implies that the criteria for work-related deaths/injuries in Japan are based on the idea that stresses can be numerically valued using the life event method⁷.

3. Socioeconomic Model for Determining Stress Level

(1) Outline

It is known that whether unemployment develops into a social problem is dependent on countries. In Europe, well-developed employment-related policies are in place, preventing escalation of unemployment to a social problem. On the other hand, unemployment easily grows into a social problem in Japan, presumably, the author believes, because such policies in Japan have shortcomings.

The paper will now focus on the job requirement level that employers can set up for workers. The job requirement level in a broader sense includes the workplace environment, and can substantially influence the stressor level. The job requirement level in a broader sense, in Japan in particular, varies significantly from company to company, widely fluctuates seasonally, and often depends on the personality of the manager and supervisor. The assumption made in the paper is that such job requirements are commonly observed in Japan that destroy workers, i.e., that not only waste their ability to perform the job, but also ruin their ability required to lead a life, such as excessively long work hours remaining uncontrolled, despite such acts are in

⁷ These tables are a kind of social readjustment rating scale, originally created by Thomas Holmes & Richard Rahe in 1967.

violation of the law. Moreover, the interpretation of the right of dismissal is altered, particularly during the economic slump, to be enormously in favor of employers. I argue this means that a regime switch could take place, in which workers have been motivated or forced to resign, stressors have been enhanced, and problems have become worse simultaneously. According to the doctrine of case law (Tokyo High Court Adjudication No. NE-1028 of 1976, dated October 29, 1979, etc.), the following conditions need to be met before workers may be dismissed for restructuring:

- (1) There are needs to reduce the size of workforce (needs to close a certain business segment);
- (2) There are needs to dismiss workers in order to reduce the size of workforce (there is no room to take other means, such as relocation, to avoid dismissals);
- (3) Selection of workers to be dismissed is appropriate (the selection criteria are objective and reasonable); and
- (4) The dismissal procedures are appropriate (labor-management consultations have been held, etc.).

Conversely, if these criteria are met, employers can legally dismiss workers. To the revised Labor Standards Act that came into effect in 2004 was added Article 18 Clause 2, which stipulated "A dismissal shall, where the dismissal lacks objectively reasonable grounds and is not considered to be appropriate in general societal terms, be treated as a misuse of that right and invalid." This is nothing more than the doctrine of case law put in the statutory form.

The background for the addition, however, reveals rather of a problem. According to the Ministry of Health, Labour and Welfare (comments published on the website), "Dismissal-related troubles have recently been increasing, and it is now necessary to clarify basic rules about dismissal in order to prevent and solve such troubles. Accordingly, 'the doctrine of case law on the right of dismissal,' which has been established through adjudication of the Supreme Court but little known to labor and management alike, was spelled out in the law." The Ministry thus asserted that the addition was due to increased cases of abuse of the right of dismissal.

Behind the establishment of the Labor Standards Act and other rules to protect workers, there is a consensus that employees have a strong incentive to leave destruction of workers unattended. Furthermore, if workers cannot appropriately evaluate the risk of themselves being destroyed due to the heightened level of job requirements, the employers will set the job requirements at a level that is more advantageous to them. In fact, evaluating such risks in advance is no easy task.

Moreover, there is concern that the destroyed workers may attribute the destruction to themselves. For example, those suffering depression tend to attribute the disease to themselves, rather than to the environment or people around them.

As the reason for the sharp rise in the suicide rate in and after 1998 to remain at a high level thereafter, the author believes that the regime switch, on interpretation of the right of dismissal, has persisted beyond the business cycle, that workers have been dismissed in a blatant manner, that the level of job requirements has been raised to the disadvantage of workers, and that more workers have been motivated or forced to resign⁸. The idea will now be described theoretically.

(2) Improvement in Productivity and Destruction of Workers due to Stressor

For the sake of simplicity, we assume that an employer produces products with labor alone. The production function assumes constant return to scale. Perfect competition is assumed for the labor as well as for product markets. Real wages, in accordance to marginal productivity of average workers, are assumed to be paid to all workers.

Also, we assume that the productivity of workers is dependent on the job requirement level established by the employer. For the sake of simplicity, the job requirement level is assumed to be represented with a single variable, stressor S . As an external criterion that substantially affects the job requirement level, there exist the labor standards. The rise in stressor S represents, for example, a tougher work environment, such as imposition of effectively prolonged work hours following adoption of the discretionary work system.

In organizational psychology, the Yerkes-Dodson Law (1908) is often quoted with regard to the relationship between the stress level and performance. Accordingly, rise in the stress level improves the performance to a certain point, and thereafter degrades it. For example, in a textbook on the theory of organizational behavior, Nelson & Quick (2006) described as follows:

The Yerkes-Dodson law, ..., indicates that stress leads to improved performance up to an optimum point. Beyond the optimum point, further stress and arousal have a detrimental effect on performance.

⁸ Such phenomena are observed not only in Japan, but also in the US. For example, Bridges (1994) said that the organization in today's world is no longer one in the past that combined many jobs into a beehive-like pattern, and that in place of jobs are work environments based on part-time and temporary workers" (quoted from page 23 of the Japanese translation).

It is also known that the relationship between the stressor and stress differs from a person to person—there are differences in stress tolerance. Nelson & Quick (2006) describes this in general terms as follows:

The same stressful events may lead to distress and strain for one person and to excitement and healthy results for another. Individual differences play a central role in the stress-strain relationship.

This means that some workers exhibit higher productivity at a higher job requirement level (stressor), while others are worn out at a weak stressor. Generally, the stress tolerance of people, not only of workers alone, changes substantially depending on existence or non-existence of other stressors at the time they are exposed to the stress in question, as well as on their characters. Stresses from job requirements, which a person can normally tolerate, may be intolerable when the person is suffering, for example, domestic conflicts or other diseases not related to stresses, or has had an accident. This can happen to anyone.

In order to comprehensively clarify the relationship in the workplace among the stressor, productivity and diseases, let us assume that the effects of stresses can be classified into two, and introduce two functions. (The relationship in question must be made clearer and the theoretical background more robust.)

The first effect is improvement in efficiency, and let us call the function a labor efficiency function, expressed as $E(S)$, where S is a value equal to or greater than 0. The value of the function $E(S)$ is assumed to increase when the value of S increases from the minimum value (assumed to be 0 here) to a certain value, and thereafter to start to decline. Accordingly, amount of effective labor input is expressed as labor input L multiplied by $E(S)$, or $E(S)L$. Further, we add an assumption that the second-order derivative of $E(S)$ with respect to S is negative. This means that, as the stressor becomes stronger, the effect of improvement in productivity becomes weaker, and that, beyond a certain point, productivity starts to decline. This is a representation of the Yerkes-Dodson Law⁹ as it is.

The second effect, as assumed, is that rises in S improves the productivity of workers

⁹ The reason the relationship between stresses and performance is invert U-shaped is described in Anderson et al. (1989), in which the relationship between stimuli from caffeine intake and performance is analyzed separately for the effect of improving and of deteriorating the performance, thus substantiating the Yerkes-Dodson Law.

but at the same time brings losses of the workers. Long work hours, beyond a certain level, not only bring about decreases in productivity, but also harm health of the workers. In other words, the assumption is that productivity improves for all workers when the stresses increase up to a certain level, but that, beyond that, some workers become unproductive. There are differences to stress tolerance, and the rise in S will, in some cases, result in an increased number of workers losing their ability to lead a life, no longer contributing to production, even assuming continued employment. The assumption is therefore not that workers develop depression as a result of job losses, but that they have already developed, or on the way to developing, depression prior to job losses. The author suspects that this is the reason for unemployment in a broad sense triggering suicides in Japan. For the sake of simplicity, the assumption, admittedly rather exaggerated, is that “living creatures adapt to stresses to some extent, but if excessive stresses persist, they will meet their death without exception.”¹⁰

With intensification or exacerbation of stressor S that represents the job requirement level, a certain percentage of workers are assumed to be destroyed, and the percentage of surviving workers is expressed with the function of S, or R(S), which is a monotonically decreasing function with respect to S. In other words, it is the remainder when loss rate of workers due to the stressor is subtracted from 1. The second-order derivative of R(S) with respect to S is also assumed to be negative. This means that the rate of surviving workers will decrease at an accelerating pace, as the stressor becomes severer.

Production Function:

$$Y = F(E(S)R(S)L) \dots \dots \dots (1)$$

Labor Efficiency Function

$$E = E(S), \quad \frac{\partial^2 E}{\partial S^2} < 0 \dots \dots \dots (2)$$

$$\frac{\partial E}{\partial S} > 0, \text{ when } S = 0$$

Worker Survival Function

$$R = R(S), \quad \frac{\partial R}{\partial S} < 0, \frac{\partial^2 R}{\partial S^2} < 0 \dots \dots \dots (3)$$

¹⁰ Quoted from Kanai (2004).

A further assumption is that, with regard the relationship between the two functions, the sum of the elasticity factor of $E(S)$ and that of $R(S)$, both with regard to S , is positive while S is small, and turns negative when S is above a certain value. Without this condition, the labor condition will be, for example, toughened infinitely. It is natural that employers demand certain efforts on the side of workers, and there will not be workers quitting the job immediately. Accordingly, the author believes that it is a realistic assumption. Specifically, it is assumed that there exists an S^* that meets the following equations:

$$\begin{aligned} \frac{\partial E(S)/\partial S}{E/S} + \frac{\partial R(S)/\partial S}{R/S} &> 0, \quad S < S^* \\ \frac{\partial E(S)/\partial S}{E/S} + \frac{\partial R(S)/\partial S}{R/S} &= 0, \quad S = S^* \dots \dots \dots (4) \\ \frac{\partial E(S)/\partial S}{E/S} + \frac{\partial R(S)/\partial S}{R/S} &< 0, \quad S > S^* \end{aligned}$$

Due to the asymmetry of information, we assume that the labor supply function is non-elastic with regard to the stressor. As this is true for the economy as a whole, we also assume that there is no unemployment that is voluntary on the part of workers. From these assumptions, the labor supply function is vertical.

(3) Long-term Employment Regime

The above section discussed the effect of stressor and labor supply. We will now move on to the regime of right of dismissal.

The first assumption is that wages are paid equally to all workers. In other words, workers destroyed are assumed to continue to remain on the payroll and to be paid equally. This is equivalent to the assumption that the rules of the Labor Standards Act¹¹ are thoroughly enforced, and is a corporate behavior of employers with the long-term

¹¹ Stipulations in the Labor Standards Act is as follows (Restriction on Dismissal of Workers):

Article 19: An employer shall not dismiss a worker during a period of absence from work for medical treatment with respect to injuries or illnesses suffered in the course of employment nor within 30 days thereafter, and shall not dismiss a woman during a period of absence from work before and after childbirth in accordance with the provisions of Article 65 nor within 30 days thereafter; provided, however, that this shall not apply in the event that the employer pays compensation for discontinuance in accordance with Article 81 nor when the continuance of the enterprise has been made impossible by a natural disaster or other unavoidable reason.

employment practice.

The maximization of corporate profits is given with the following equation:

$$\begin{aligned} \max Y - wL & \dots \dots \dots (5) \\ \text{s.t. } Y = F(E(S)R(S)L) & \end{aligned}$$

As no unemployment exists, maximization of corporate profits is equivalent to maximization of production by means of stressor, and the equilibrium value of the stressor can be derived from the following equation:

$$\frac{\partial}{\partial S} F = \frac{\partial F}{\partial E} \frac{\partial E}{\partial S} + \frac{\partial F}{\partial R} \frac{\partial R}{\partial S} = 0 \dots \dots \dots (6)$$

The first term of the right side of the equation represents the increase in production due to improvement in efficiency in response to the toughened stressor, while the second term represents loss in production due to destruction of workers, also in response to the toughened stressor. The level of stressor optimal for employers is the point where these two terms balance, which, as explained below, is equivalent to S*, the existence of which is assumed above.

The production function has a single input and is homogeneous of degree 1 with regard to the scale, and therefore is a linear function without the constant variable. Accordingly, if the productivity that is not dependent on S is expressed as A, the production function itself can be represented with the following equation:

$$Y = AE(S)R(S)L \dots \dots \dots (7)$$

From this equation, the differential coefficients of the production function, with regard to the efficiency and survival rate, respectively, are:

$$\frac{\partial F}{\partial E} = AR(S)L \dots \dots \dots (8)$$

$$\frac{\partial F}{\partial R} = AE(S)L \dots \dots \dots (9)$$

Accordingly, equation (6) is further equivalent to:

$$\frac{\partial F}{\partial S} = AL \left[R(S) \frac{\partial E}{\partial S} + E(S) \frac{\partial R}{\partial S} \right] \dots \dots \dots (10)$$

Accordingly, the first-order differential conditional equation for optimization with regard to S is:

$$\frac{\partial F}{\partial S} - w \frac{\partial R}{\partial S} L = 0 \dots \dots \dots (14)$$

From the assumption in equation (3), the second term on the left side of the equation (14) is positive. With the increase in S, the number of workers decreases to whom corporations must pay wages, and accordingly, the stressor can be toughened further to increase production. Accordingly, the equilibrium value S** is larger than S*. The real wages are paid only to workers inputted to production, and hence, wages per surviving worker multiplied by efficiency are:

$$w_E = \frac{\partial F}{\partial (E(S^{**})R(S^{**})L)} \dots \dots \dots (15)$$

$$= A$$

The relationship between wages paid to surviving workers multiplied by efficiency and wages per surviving worker meets the following equation:

$$w_E E(S^{**})R(S^{**})L = AE(S^{**})R(S^{**})L = wR(S^{**})L \dots \dots \dots (16)$$

The real wages per surviving worker R(S**)L is:

$$w = AE(S^{**}) \dots \dots \dots (17)$$

S, when in equilibrium, is shifted to the level where the efficiency per worker E is maximized.

(5) Comparison of Equilibrium Solutions

When the regime switch takes place so that consensus on the right of dismissal becomes advantageous for employers, the incentive arises to let workers go on the side of employers (the first dismissal effect). Then, the incentive to raise the stressor arises on the side of employers to compensate for the dismissed workers (the stress-increasing effect). As a result, there are secondary dismissals. The wages of surviving workers will increase, partly because there are no more burdens for destroyed workers, as is apparent from comparison with equation (11) (missing term R(s)), and partly because

the stresses increase so that workers can achieve the optimal productivity. Losers lose everything, while winners earn higher wages, although at a cost of severer stresses.

(6) Implications to Economy as a Whole

The regime switch, as discussed above, will help improve the average productivity for individual employers. During the economic slowdown since 1998, no increases in wages were observed in Japan. This, however, is attributed to a sharp decline in productivity represented by “A” due to the economic slump, and the regime switch can be considered as having prevented decreases in the real wages.

The dismissed workers, on the other hand, must recover and find another job, in order to gain an income. Some measures therefore needs to be taken for them. Another important point is the productivity for the economy as a whole. The economy-wide production is maximized in the long-term employment regime. The economy-wide production is smaller in the short-term employment regime than in the long-term employment regime, as there are excessive stresses (at a level where the worker survival rate declines faster than the efficiency improves), because the production has $R(S)$ as a component in the multiplication after all. Accordingly, from the standpoint of the production capacity in the economy as a whole, the regime is preferable in which the labor standards are complied with. (If costs to restore destroyed workers to health are taken into consideration, an even smaller S may be more preferable.) The regime that ignores the labor standards is not desirable to the society, even when only such indices as production capacity are taken into consideration.

The arguments above are basically applicable to regular employees. The increase in irregular employees, who are less protected by the Labor Standards Act, has an effect similar to the regime switch. With regard the impact of increases in irregular employment, Dooley and Prause (2004) defined employment in the poor labor conditions, such as irregular employment, as underemployment, and made detailed analyses on the adverse impacts, including psychological and health effects.

The rise in the worker loss ratio, as discussed above, is similar to the constant increase in the unemployment rate in the hysteresis¹² according to the efficiency wage hypothesis and insider-outsider model. The major differences are that the explanatory variable of productivity is stressor and not wages, and that problems arise even when workers are completely passive.

(7) Numerical Example

¹² Blanchard and Summers (1986).

In order to visually clarify the arguments above, a numerical example is presented below for explanation.

Production Function: $Y=L$

Labor Supply: $L=1$

Worker Efficiency Function (a simple quadratic function is employed here):

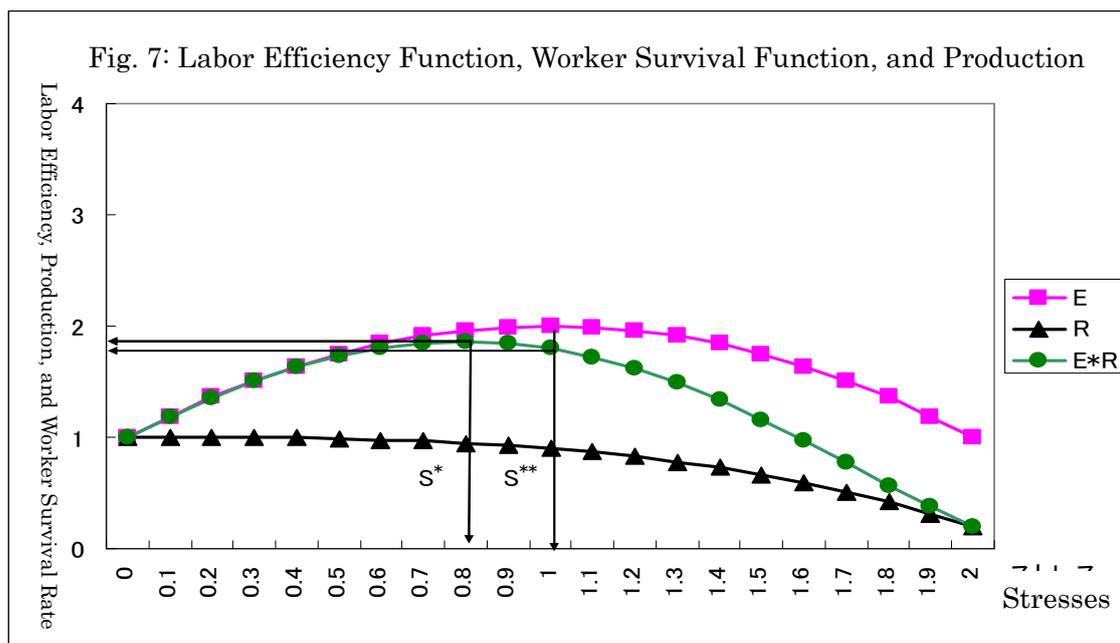
$$E(S)=-S^2+2x+1$$

Worker Survival Function (a simple cubic function is employed here):

$$R(S)=1-0.1S^3$$

Stressor: $S, 0 \leq S$

The assumptions above satisfy equations (1), (2), (3), and (4). A numerical example as calculated with these equations is plotted in Fig. 7 below. As shown in Fig. 7, the optimal S , when multiplied by the probability of survival, is about 0.8, and the maximum value, in terms of production volume, is about 1.86. At this point, the survival rate is about 0.95, i.e., about 5% of workers are lost. On the other hand, the maximum efficiency is 2 when S is 1. At this stressor level, the survival rate is about 0.9, i.e., about 10% of workers are lost. When compared with the initial equilibrium, first, the destroyed workers are pushed out of the labor market, then the stressor becomes severer, and the number of destroyed workers ends up doubled. The total production is 1.8, about 3% below the level achieved in the long-term employment regime.

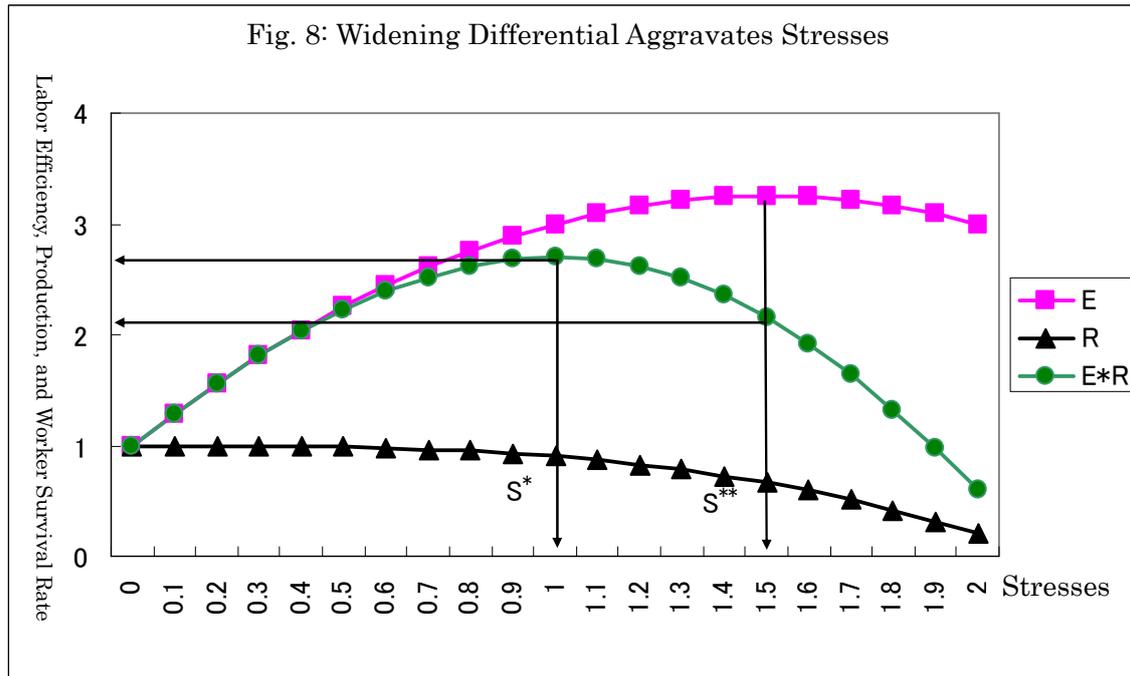


(8) Differential in Stress Tolerance and Social Pathology

Using the numerical example, an even more intriguing simulation can be performed. For example, suppose there is a technical innovation so that, while a worker can endure the stress, his productivity improves in accordance to the rise in the stresses (improvement in the labor efficiency against stresses). On the other hand, the percentage of workers losing productive capability (survival rate) remains unchanged, meaning that the percentage of workers suffering mental and physical disorders at any given job requirement level remains unchanged. What will then happen? Fig. 8 shows the shift in the equilibrium. In a society where employers can freely dismiss workers with low productivity, they can maximize their productivity solely by considering stress-tolerant workers, and a very severe job requirement level is established in the steady state of the markets, resulting in extreme restructuring. The stress level is further away from the point at which the productivity for the society as a whole is maximized¹³.

As demonstrated, the author believes that there exists a mechanism to aggravate the social pathology when the disparity among workers widens depending on whether their productivity improves with stresses, through optimization behavior of employers. Similarly, improvement in the stress tolerance, without accompanying reduction in the disparity, will not improve the mental health of the workers, but simply induce rises in the stresses and productivity. As there are various interactions among corporations and individuals, involvement of the entire society is essential in establishing measures to prevent suicides and measures to address the social malaise, that are designed to change the social structure itself.

¹³ Admittedly, the stress level, at which the productivity is maximized for the society as a whole, does shift somewhat to the right as well.



4. Paths to Social Problem

The model explains that, assuming that workers are destroyed with stresses, there exists a process that converts economic fluctuations into a social problem through occurrence of a regime switch transferring the burden of the destroyed workers to external parties.

There is a point that calls for more detailed analysis: destruction of workers leading to a social problem, including suicides. The paths that can be assumed are presented below as hypotheses.

(Hypothesis 1: Change in Attitude towards Human Resource Management and Disappearance of Sidetracked Employees)

In the long-term employment regime, workers suffering minor mental disorders with degraded performance might still remain on the payroll, be given some role at the workplace even if it may be marginal, and keep social contacts and functions, which prevented further aggravation of the disorders. In the short-term employment regime, however, these workers are no longer accepted at the workplace, have the disorders aggravated markedly, choose quitting the job, and, in extreme cases, may commit suicide, the author believes. This is presumably equivalent to the increase in suicides triggered by the effect of dismissal following the regime switch.

(Hypothesis 2: Large-scale Restructuring and Loss of Human Relationship at Workplace)

In line with the worsening management environment, employers promoted large-scale restructuring. In any countries, however, human relationship at workplace is an important part of the human relationship of the worker, and loss of it due to restructuring is considered to be a major stressor for the worker. In Japan, human relationship at workplace plays considerably more important role for many. Accordingly, the loss will be a substantially severer stressor. Shigeki Matsuda (2006), quoting results of covariance structural analysis based on a questionnaire¹⁴, stated as follows:

"The most important object of life-time employment is capacity development of employees over a long term. At the same time, it contributes to establishment of a workplace network for their close cooperation, which helps reduce stresses within the organization. Amidst the recent economic slump, many companies effectively scrapped the life-time employment system, which, presumably, weakened the workplace network and added to the stresses of the workers."

It can be pointed out that, with the practice of restructuring firmly established, the human relationship at workplace has weakened, that the stress level that workers face has elevated, and that such environment may have proliferated that easily induces mental disorders. This is equivalent to the increase in suicides triggered by the effect of aggravated stresses following the regime switch.

Overall, the author believes that the society has changed so that human resources with deteriorated performance, even if only slightly, can easily be discarded¹⁵. The rise in the suicide rate, according to the author, is the proof of such a change.

5. Relationship of Employment Norm, Stresses, and Mental Disorders

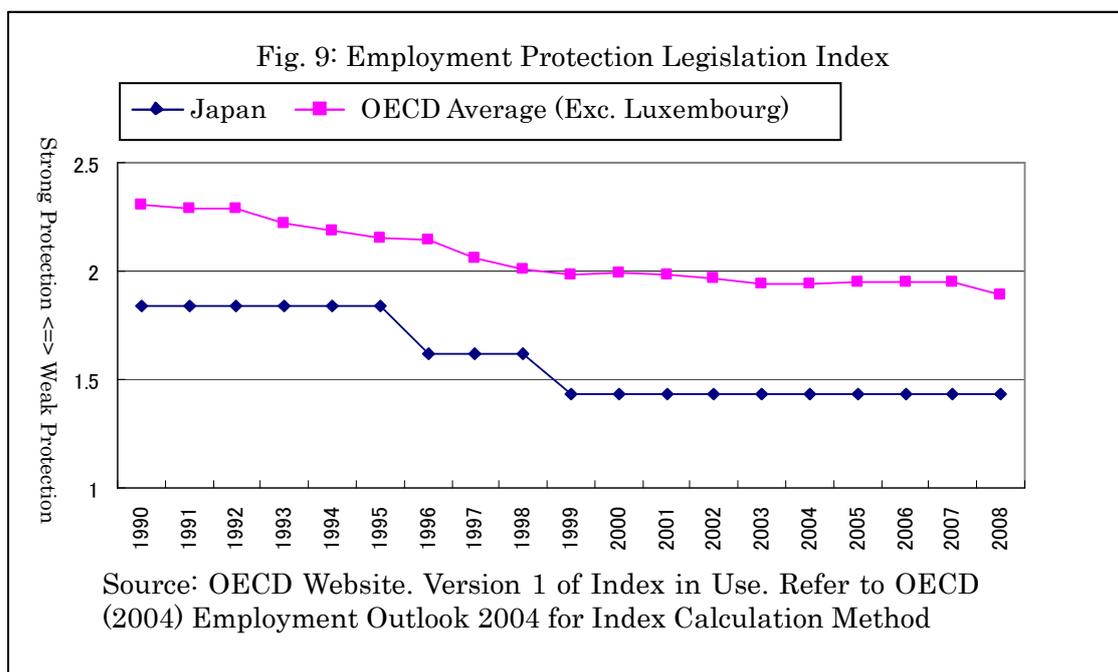
Japan's employment protection laws have also undergone a regime switch that can be analyzed statistically. According to the Employment Protection Legislation Index (see Fig. 9) that OECD developed for comparison of strength of legal systems for

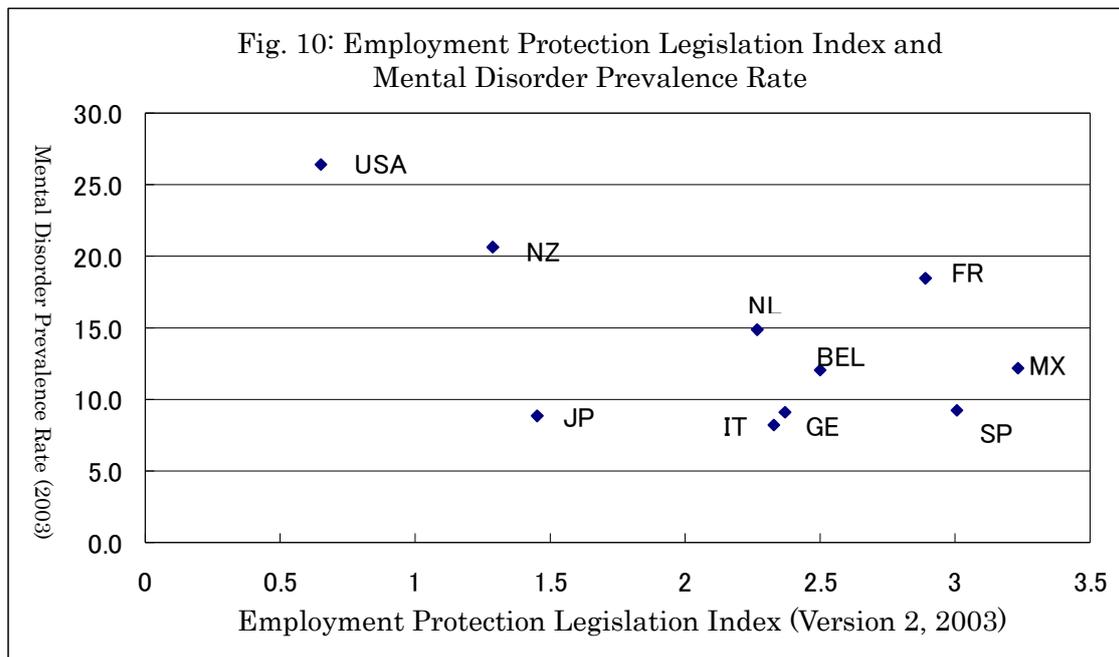
¹⁴ Matsuda (2003)

¹⁵ According to the National Personnel Authority (2008), among national government employees, too, the ratio of long-term sickness absentees rose sharply from 1.36% in 2001 to 2.04% in 2006. As many as 63% of them suffer "mental and/or behavioral disorders" in 2006.

employment protection between countries, Japan's employment protection laws were weakened in steps between 1995 and 2000. The characteristics of Japan's system are that, although individual workers are provided with strong protection, regulations on collective dismissal and on irregular employment are pointed out as weak. The regime switch on the employment norm took place not because of the economic downturn—it was partly because of the system changes beforehand.

Meanwhile, let us see the relationship between employment protection and mental health, by combining the study with the international epidemiological research promoted by WHO (which was conducted in Japan as "Epidemical Survey on Mental Health") (see Fig. 10). The simple regression analysis produced a negative slope, although not significant with regard to the parameter. The implication is that the decline in the Employment Protection Legislation Index leads to the rise in prevalence of mental diseases. As there are not many countries that conducted the epidemiological research, it may be difficult to derive any meaningful conclusion, but the author believes that it is one of the data supportive of the validity of the model.





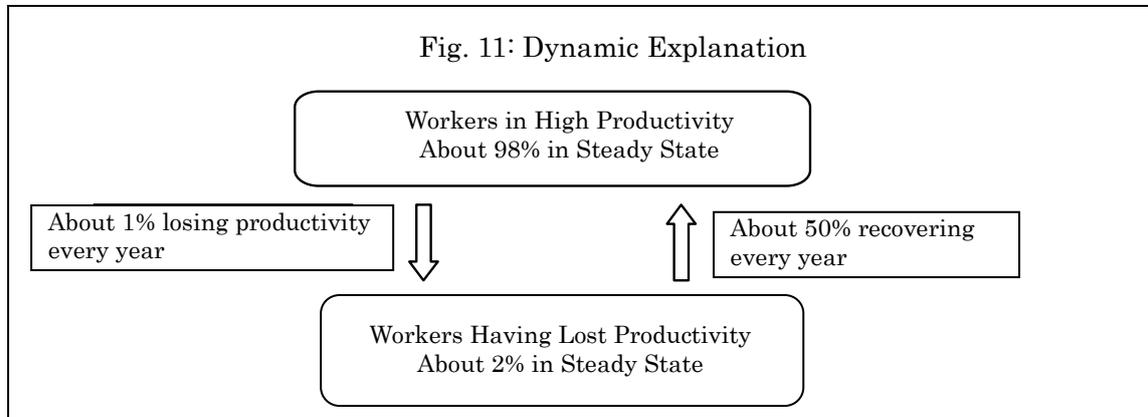
6. Policy Implications

Rise in the suicide rate due to economic hardship depends largely on countries and regions. Different national systems and traits give completely different meanings to economic fluctuations. Accordingly, the author believes it possible to prevent in Japan economic fluctuations from causing social problems, by changing the social systems and socially accepted norms. When economic slumps persist, or positioning of the right of dismissal changes throughout the economy and society, the equilibrium point of stresses will get shifted, not only for individual employers but also for the economy as a whole. The problem, therefore, cannot easily be addressed through efforts of individual employers. Policy responses are thus required.

(1) Importance of Prevention

When addressing the suicide problem, prevention is by far the most important. (If, unfortunately, already committed, mental care of the bereaved family members and other people around is important.) In order to prevent suicides, improvement in mental health is critical. The model above employed the methodology of "comparative statics," in which two points are compared that are apart in time—it is not of dynamics that follows the time course of changes. The mechanism for the progress of the two-stage dismissal, with the increase in stresses, can be considered as the decline in the probability of being able to remain productive (survival rate). On the other hand,

workers that once lost the productive capacity temporarily can, with time, recover to be productive again. The process can be illustrated as in Fig. 11.



Let us assume that the probability of remaining productive for a year is 99%. Also assume that the probability of workers, who once lost the productive capacity, restoring it is 50%. From these two figures, we can calculate what percentage of workers are in a productive condition.

In the steady state, about 98% of workers are productive, with some 2% having lost the capacity. As a set percentage of workers having low productivity accumulate every year, the probability at the steady state (98%) is lower than the probability of being able to remain productive every year (99%). What will happen if the probability of being able to remain productive every year is lowered by mere 0.5 percentage points, from 99% to 98.5%? The value at the steady state is reduced by as much as 0.9 percentage points, from 98% to 97.1%, and the percentage of workers in an unproductive state jumps from 2% to 2.9%. If there are 100 workers, the number of unproductive workers, which used to be around 2, is now up by 50% to around 3. What will then be the percentage of recovery required so that the steady state remains unchanged at 98%? A simple calculation reveals that the recovery rate must be raised from 50% to 75%.

According to the epidemiological research carried out between 2002 and 2006 ("Epidemical Survey on Mental Health"), the prevalence rate of mood disturbance in Japan is around 3%. At the same time, it is reported that the percentage of recovery from depressions is about 50% in one year¹⁶. The assumptions in the above argument are in fact based on the data on the mood disturbance and depressions in Japan in

¹⁶ Refer, for example, to page 607, Kaplan & Sadock's Synopsis of Psychiatry, Japanese translation (2004) under supervision of Reiichi Inoue et al., Second Edition. In case patients are treated in the first-time development of the disease.

recent years. In order to raise the one-year recovery rate of those suffering depressions from 50% to 75%, some major innovations will be required¹⁷. It will be next to impossible to raise the recovery rate in a short period of time. Accordingly, it is very important for the society to prevent depressions and other mental disorders in the first place, so that workers do not lose their productive capacity.

(2) An Approach from System Reform

(Measures: ① Strict Enforcement of Labor Standards Act)

For prevention, it is important so that the cost of worker destruction is borne by the responsible party. For this, the first step will be thorough enforcement of regulations on the right of dismissal. Also required are tight regulations on the job requirement level so that it will not destroy workers. For example, the perfunctory management of work hours and widespread practice of unpaid overtime work need to be addressed urgently. The Labor Standards Act should be thoroughly complied with in this regard, not only on the unpaid overtime. The situation in Japan is such that the Japanese word “karoshi,” meaning death from overwork, has made its way into English, as an occupational disease specific to Japan. Substantial efforts need to be made to improve the situation. In November 2007, the Nagoya High Court, in its adjudication, finally judged that time spent for productivity improvement activities is counted as work hours. It is important that the system is being improved to levy penalties for unpaid overtime work required in an unclear manner. Further advancement in this aspect is hoped for.

(Measure: ② Conversion of Social Insurance Premiums into Tax)

Saving workers, destroyed and pushed out of corporations, is another urgent issue. If bailout of a worker, who lost his job and impoverished without any insurance any longer, must wait until he is reduced to extreme poverty and qualify for welfare benefits, it aggravates not only his pain, but also the burden for the society as a whole. The lower the cost of destroyed workers, the better for employers, but that cannot be allowed for the society as a whole. Measures should be taken to address the problem of destroyed workers, by, for example, converting social insurance to be financed from tax payments.

(3) An Approach from Improvement of Socially Accepted Norms

(Measure: ③ Promotion of Education on Mental Health to Managers)

¹⁷ In addition to psychiatric treatments, there will be a wide variety of innovations in various fields, such as improvements in the return-to-work process or in the problem-solving ability in the community.

Although the Ministry of Health, Labour and Welfare has issued guidelines¹⁸, education of managers on mental health has not progressed much, and accelerated efforts are required. There still are many managers and supervisors who do not appreciate existence of differential in stress tolerance among workers for appropriate assessment.

The author has not, however, analyzed these arguments in detail so far, which is what the author intends to work on in the future.

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¹⁸ “Guideline for Mental Health of Workers at Workplace” (Ministerial Instruction No. 522-2 dated August 9, 2000), “Guideline for Maintenance and Improvement of Mental Health of Workers” (Public Notification No. 3, 2006, of Guideline for Maintenance and Improvement of Health), etc.

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Appendix: About No. 15 Questionnaire Survey on Work and Life of Workers

1. Outline

The “Questionnaire Survey on Work and Life of Workers” is conducted by Research Institute for Advancement of Living Standards, a think tank of Japanese Trade Union Confederation. The respondents are selected from among the monitors of Intage Inc. (about 240,000 monitors nationwide) who live in the Metropolitan and Kansai areas, to whom a self-filling survey sheet is mailed. By regularly identifying perception of workers on Japan’s economic conditions, work and daily life, the survey intends to clarify trends of Japan’s economy, employment and daily life, and to contribute to compilation of materials as the basis for reviewing various policy issues.

The first survey was conducted in April 2001, and thereafter, it has been conducted regularly in April and October every year. The respondents are those in their 20's to early 60's, who live in the Metropolitan or Kansai area and work at a private company.

The survey sheet, as well as the survey outline, is available from the website. Data for respective tables are deposited at the Center for Social Research and Data Archive, Institute of Social Science, University of Tokyo, and are available.

2. Survey Period, Distribution and Collection of Survey Slips, of No. 15 Questionnaire Survey Period: From Friday, April 4, 2008 to Monday, April 14, 2008

Distribution and Collection of Survey Slips

| Age | No. of Surveyees | Total Respondents | | Employee Respondents | |
|-----------|------------------|-------------------|---------------|----------------------|---------------|
| | | Valid Responses | Response Rate | Valid Responses | Response Rate |
| 20s – 50s | 900 | 895 | 89.4% | 774 | 86.0% |
| Early 60s | 200 | 190 | 95.0% | 170 | 85.0% |

3. Major Survey Items

- (1) Regular Survey Items: Perception on Business Climate, Prices, Work, and Living
- (2) Ad Hoc Survey Items: Safety and Security in Daily Life (Work Environment, Unemployment Unrest, Stresses and Fatigue, Eating Habits, and Global Environment Issues)