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Employment Adjustment, Wage Cut and Shutdown: An Empirical Analysis Based on the Micro-data of Manufacturing Industry

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Abstract

This paper conducts empirical analysis on changes in employment and wages in Japanese manufacturing industry using micro data from the "Census of Manufacturers". Features of the paper are that: 1) an analysis was made of the characteristics of business establishments and industries that affect employment variability, using micro-data at a business establishment level, instead of aggregate data; 2) an analysis was made by explicitly taking the impact of shutdown into consideration; and 3) an analysis was made of the trade-off between employment and wage adjustments.

Major results are as follows: 1) Larger plants or older plants have a higher probability of survival. Plants with a higher diversification rates or higher average wages have a higher probability of survival. 2) The elasticity of employment variability to shipment amount variability is as small as about 0.1. Plants with higher wages or a higher ratio of male employees tend to have a lower employment reduction rate. 3) The elasticity of wage variability to shipment amount variability is about 0.2 to 0.4, and thus wages or working hours are more often adjusted, than the number of employees is changed. Plants with a higher ratio of male employees or a higher capital intensity tend to have a smaller wage adjustment, and plants with higher wages tend to have a higher rate of wage variability. 4) A trade-off exists between employment and wage adjustments. This trade-off holds if employment and wage variabilities are simultaneously treated in an analysis. Other things being equal, if wages are restrained by 1%, the number of employees will increase (or the employment reduction will be softened) by 0.05% to 0.21%. 5) The possibility is that an analysis of employment and wage adjustments without regard to shutdown will be biased, though the degree of such bias is not large.

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1. Introduction [*1]

Recently, the expression 'the worst unemployment since the end of World War II' has been repeatedly used. The unemployment rate for the whole of 1998 stood at 4.1%, the worst since this survey began (in 1953). The unemployment rate in 1999 will be higher than in 1998. The job offers to applicants ratio fell to a record low, well below that recorded at the time of the high yen-caused recession immediately after the Plaza Accord in 1985. Retirement due to the convenience of employers, namely dismissal, is on the increase and the unemployment rate of householders has increased. The number of bankrupt companies amounted to 18,988 in 1998.[*2] Needless to say, such bankruptcies generate increased numbers of unemployed persons.

For a long time the labor market in Japan has continued to demonstrate a better performance than labor market in other advanced countries. Since the oil crisis in particular, the low unemployment rate of Japan has attracted attention from many countries and various contributing factors, such as a stable employment system based on long-term employment practices, wage flexibility due to the bonus system, legal limitations on dismissal (interpretation of laws by the judiciary), etc., were identified. Recently, the labor market of Japan has been greatly changed as demonstrated by the rise in dismissals as a result of bankruptcies of companies and restructuring efforts by leading companies, the labor market of Japan has been greatly changed. Seniority-based wages continue to be a key characteristic of the wage structure in Japan, although many companies have increasingly adopted merit-based wages, such as the 'annual salary system.' Their objective seems to be to streamline the wage system and restrain overall wages. In the prolonged recession Japanese companies are making restructuring efforts through employment and wage adjustments.

In view of these conditions, this paper conducts empirical analysis on changes in employment and wage by business establishments in manufacturing industries of Japan using micro data from the "Census of Manufacturers" by the Ministry of International Trade and Industry (MITI). This article is mainly interested in which business establishments create employment and generate unemployment and whether or not it is possible to restrain the deterioration of employment through a wage curb or cut. There are many companies which must discontinue business even after they adjusted employment or wages. This paper is interested in how an analysis of corporate efforts to adjust employment or wages is affected if there is an option to discontinue business. The employment adjustment subsidy scheme under the Employment Insurance Law has been considered to function as an incentive for companies to retain employees and prevent the outflow of unemployed persons into the external labor market. In this connection, the paper aims to analyze how the scheme functions in reality.[*3]

This paper has the following features: 1) characteristics of business establishments and industries that affect job creation and destruction are analyzed using the extensive micro data of business establishment level instead of aggregate data; 2) an analysis is made in consideration of the effects of the discontinuation of business; and 3) the paper considers simultaneous determination of employment and wage adjustments.

In Section 2, the relationship between preceding related studies and this paper is explained. Section 3, details the data and estimation methods used in this paper. The results of the analysis are indicated and their interpretation is given in the following section. Conclusions and policy implications are then given.

The essence of the analytical results of the paper is as follows.

1) If plants are larger in size or older or more diversified, or if the average wage level is higher, the probability of survival is higher;
2) Value of elasticity of employment variability to shipment amount variability is small. If a factory's wage is the higher, or if the ratio of male employees is the higher, job destruction tends to be the smaller;
3) In response to changes in the shipment amount, adjustment of wages or working hours is more often made than an adjustment in the number of employees. If the ratio of male employees in a factory is higher, or a factory's capital intensity is higher, or a factory's wage level is lower, wage adjustment tends to be smaller;
4) There is a tradeoff between employment adjustments and wage adjustments. This relationship was verified by controlling for the effects of the shutdown of business and by assuming that employment and wage adjustments are simultaneously determined; and
5) If samples of shutdown businesses are not taken into consideration explicitly, the estimation results are likely to be biased.

2. Preceding studies

Preceding studies related to the analysis made in this paper are broadly classified into the following four groups: 1) analysis on the shutdown of companies or business establishments (exit behavior); 2) analysis of job creation and destruction; 3) analysis of employment adjustment; and 4) analysis of wage adjustment.

Although theoretical models or empirical studies concerning the exit of companies or business establishments or plant shutdown are surveyed in detail in Morikawa[1996], we would like to briefly mention empirical studies related to an analysis made in this paper.[*4] According to analyses of so-called 'post entry performance' using the micro data of business establishments or companies, the common results are that if a business establishment is smaller, or a business establishment is younger, the probability of shutdown is higher (Evans[1987a, b], Dunne et al. [1989b], Geroski [1991], Small and Medium Enterprise Agency[1999][*5], etc.). Others include a study indicating that the possibility of closure of plants (hazard rate) is higher for a company which has more than one plants (Audretsch and Mahmood[1995]) and a study indicating the relationship between diversification and exit (Dunne et al.[1989a]).[*6]

This paper conducts an analysis on decision making on shutdown or the continuance of business (probability of survival) as dependent variables in the first phase of the estimation work. The analysis is made using a few additional variables with explanatory variables used in preceding studies as mentioned above.

Although job creation and destruction are surveyed in Morikawa and Tachibanaki [1999], the most representative literature is Davis et al.[1996]. Although analyses of business establishments in Japan have been begun only recently, these include Morikawa and Tachibanaki [1999] using the "Census of Manufacturers", Higuchi and Shinbo[1998] and Genda[1998] using the "Employment Trend Survey". The analysis made in this paper is intended to identify corporate and industrial characteristics which regulate job creation and destruction on a business establishment (plant) basis, and in a sense the analysis is a development of the preceding studies.

Concerning employment adjustment, many empirical studies have been conducted and Hamermesh[1993] made a comprehensive survey of Western studies in particular. As for the studies on employment adjustment in Japan, Tachibanaki[1987] and Muramatsu[1995a, b] conducted surveys. Most of the past empirical studies in Japan use a "partial adjustment model" with estimations using time series data.*7 These studies are based on the concept that employment volume is adjusted to bridge a certain part of gap between optimal and real employment volumes, and the concept of a labor demand function based on optimal behavior (cost minimization) by companies. The simplest model assumes the following employment adjustment function (λ means employment adjustment speed, and L_t^* means optimal employment volume):

$$\Delta L_t = \lambda (L_t^* - L_{t-1})$$

And an estimation is made after converting the above function into the following equation (λ as employment adjustment coefficient = $1 - \alpha_3$):

$$L_t = \alpha_0 + \alpha_1 X_t + \alpha_2 w_t + \alpha_3 L_{t-1}$$

Analyses using macro-data or time series data by industry in Japan include Shinozuka and Ishihara[1977], Shinozuka[1979, 1986], Muramatsu[1981, 1991], Shimada et al.[1981], Shimada et al.[1982], Mizuno[1986], Kurosaka[1988] (Chapter 6), Abraham and Houseman [1989], Hashimoto[1993], Economic Planning Agency[1994], etc. In many of these analyses, comparison with other countries including the U.S. is made, and many analyses conclude that adjustment of "the number of employees" in Japan is slower as compared with the U.S. (except adjustment on a man-hour basis where working hours are taken into consideration).

However, these analyses focus on net employment change based on the aggregated data. Therefore, these analyses are different from the analysis made in this paper which targets job creation and destruction in gross terms for individual companies or business establishments. So far, very few analyses have targeted employment adjustment using the micro data of individual companies or business establishments.*8

Recently, a non-linear employment adjustment function, has been estimated using the time series data of individual companies or business establishments (Hamermesh[1989], Suruga [1997] and others) which indicate that employment adjustment against a small shock is slow but employment adjustment against a large shock is rapid. Data used in this paper are not long-term time series data but cross section data covering three temporal points. Although the analysis made in this paper is different in nature from preceding analyses, the purpose of each analysis is similar because factors to determine employment adjustment are analyzed in all cases.

As for wage adjustment, several studies including the estimation of a wage function has been made on the expectation that the low unemployment rate in macro terms in Japan is attributable to the flexibility of wage variability.[*9] Although many studies -- Gordon[1982], Grubb et al.[1983] and Ono[1989] (Chapter 12) -- concluded that wages flexibly changed in Japan, some studies -- Otake[1988], Kurosaka[1988] and Nakamura[1995] -- concluded that the speed or the flexibility of wage adjustment in Japan is not necessarily rapid or large.

In some analyses of Otake[1988], Teruyama[1993] and Nakamura[1995], employment adjustment and wage adjustment (endogenous changes of wage) are simultaneously taken into consideration, although these analyses are small in number.[*10] However, time series data at an aggregate level is used in these analyses, in contrast with this paper which uses micro data of individual business establishments. In a recent study made by Higuchi and Shinbo[1998], the relationship between job creation and destruction and wage level on an industry basis is analyzed, and some interesting results -- job destruction in a low wage industry is large -- were indicated. In their study employment and wage adjustments are not simultaneously analyzed however and are neither treated as endogenous variables nor simultaneously analyzed.

Preceding studies concerning employment and wage adjustments targeted surviving companies (business establishments), and only a few empirical analyses took births and deaths of companies (business establishments) into consideration.[*11]

3. Data and analytical methods

(1) Data and outline of start-up/shutdown /employment change

The basic data used for an analysis in this paper comes from the individual slip data for "Census of Manufacturers" made by MITI. The "Census of Manufacturers" is conducted once a year, and a complete survey, including business establishments with 1-3 employees, is conducted once in every two or three years. The so-called "trimmed survey" targeting only business establishments with 4 employees or more except certain industries is conducted in other years. This paper used data for 1988, 1990 and 1993 where a complete survey was conducted. However, since individual slip data of business establishments (plants) with 1-3 employees are maintained by prefectural governments and the time limit for the storage of data was over, such data were not available. Therefore, an analysis as mentioned below targets business establishments with 4 employees or more.[*12] An advantage of using the data of complete survey years, despite the unavailability of data of business establishments with 1-3 employees, is that there is no statistical bias for small business establishments as samples. The number of sampled business establishments (plants) is a little more than 400,000, although the number differs from year to year.

Based on this census data for 1988, 1990 and 1993 were collated for each business establishment, and for the periods 1988-1990 and 1990-1993. Business establishments were grouped into three types: A) start-up; B) surviving; and C) shut down business establishments. For each business establishment, employment changes were computed, and gross job creation

(increased job due to start-up + increased employment at existing business establishments) and gross job destruction (decreased employment due to shutdown + decreased employment at existing business establishments) were computed.

Actual situations of start-up/shutdown and job creation and destruction based on above mentioned data for this period are explained in detail in Morikawa and Tachibanaki[1999]. But we would like to mention the essence of the explanation as far as it is related to an analysis made in this paper. As for start-up/shutdown over the period 1988-1990, 47,809 plants started up, and 49,386 plants discontinued business. For the period 1990-1993, 52,002 plants started up, and 74,329 plants discontinued business (Table 1). The number of start-up/shutdown for each period was more than 10% of all sampled business establishments.* [13] According to a cross-industry analysis for the four-digit industrial classification, industrial characteristics, such as growth/decline of an industry, average number of employees per business establishment, capital intensity, business restrictions, functioned as factors to affect shutdown.

As for job creation and destruction, gross employment of about 2.06 million was created and gross employment of about 1.8 million was lost for all manufacturing industries in the period 1988-1990. Gross employment of about 2.17 million was created and gross employment of about 2.46 million was lost for all manufacturing industries in the period 1990-1993 (Table 2). In each period, gross employment creation or destruction represents more than 10% of total employees of all manufacturing industries, and employment variability at the level of business establishments is very large. Start-up accounts for about half of gross employment creation, and shutdown accounts for about half of gross employment destruction (increase or decrease of employment at existing (surviving) business establishments accounts for remaining half). This means that effects of start-up or shutdown cannot be disregarded in an analysis of employment variability. Furthermore, it was observed that female employees account for a higher portion in gross employment creation or destruction than male employees do. Also the effects of economic fluctuations on employment are more evident in gross employment creation in contrast with preceding studies made in the U.S.,* [14] while smaller business establishments experienced higher gross employment destruction.

Based on these observations, an analysis of the effects of characteristics of business establishments (plants) and industries to job creation and destruction is made in this paper by clearly taking 'shutdown' into consideration.

(2) Estimation methods and variables

In existing studies on employment and wage adjustments, analyses are generally made based on the data of surviving companies or business establishments. When faced with negative demand shock (decreased shipment amount), companies (business establishments) have various options, such as wage cut, employment reduction and shutdown. Therefore, there is a possibility that if wage and employment variabilities are analyzed based on the data of surviving companies (business establishments) only, the estimated value of elasticity of wage and employment to shipment amount variability may be biased. In this paper to overcome these problems decision

makings on the continuance or shutdown of business establishment are explicitly taken into consideration in the first phase, and an analysis of how employment and wage variabilities are determined is made in the second phase after controlling the continuance or shutdown of business establishments. For an estimation method, Heckamn's two-step method is basically used. In this paper, we are greatly interested in whether there is a difference between a case when the effects of shutdown are taken into consideration and a case when such effects are not taken into consideration. It is also of interest as to what difference will occur to estimates of various explanatory variables (in particular, values of elasticity of wage and employment variabilities to shipment amount variability).

In the Probit model of the first stage, a selection (y_i) of the continuance of business establishment (1) or shutdown (0) is explained by various plant characteristics (X_i) and industrial characteristics (Z_i).

$$y_i = \text{Prob}\,(X_i, Z_i) \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots [1]$$

In the second stage, analyses of two kinds -- 1) a case that a separate estimation is made for each equation using the OLS method and 2) a case that an estimation is made for both equations using the 2SLS method assuming that employment and wage adjustments are simultaneously determined -- are made for each of the following two equations which include estimates of probit ($\blacksquare$) in the first stage as explanatory variables.

$$\Delta E_i = \alpha_0 + \alpha_1 \Delta x_i + \alpha_2 \Delta w_i + \alpha_3 + \Sigma \alpha_k Z_{ki} \quad \cdots\cdots [2]$$

$$\Delta w_i = \beta_0 + \beta_1 \Delta x_i + \beta_2 \Delta E_i + \beta_3 + \Sigma \beta_k V_{ki} \quad \cdots\cdots [3]$$

In the second stage, as a matter of course, samples represent surviving business establishments only. ΔE_i means employment variability, Δw_i means variability of wage per employee, Δx_i means shipment amount variability, $\blacksquare$ means an estimate of y_i in the first equation, and Z_{ki} and V_{ki} mean characteristics of business establishments and industries respectively which are likely to affect employment and wage variability. α_1 and β_1 as coefficients of Δx_i may be interpreted to indicate values of elasticity of employment and wage variabilities to changes in production quantity. In this paper, the "partial adjustment" made in many preceding studies is not taken into consideration. This is because an analysis in this paper is a cross-section analysis for a period of 2-3 years, instead of an analysis based on time series data, and is intended to focus on the characteristics of business establishments or industries.
Some preceding studies analyzed the relationship between adjustment of working hours and adjustment of the number of employees. But the data used in this paper include no information on working hours. Therefore, attention should be paid to the fact that part of wage variability includes a reduced portion of overtime allowance, or a portion due to adjustment of working hours. Since the main objective of this paper is to know whether or not job destruction may be reduced by wage adjustment, the significance of the analysis will not be impaired, even if adjustment of working hours is included in part of wage variability.

The analysis was made for the two periods of 1988-1990 and 1990-1993 (the former and the latter fall in boom and recessionary periods respectively). Since there is a limitation that the data of preceding period (before 1988) are not available for some explanatory variables for a

period of 1988-1990, only the results for a period of 1990-1993 are, in principle, reported in this paper.

Since the total number of sampled business establishments for the "Census of Manufacturers" is as many as 400,000-500,000, actual estimation is made only for 1 percent of the total number of sampled business establishments selected on a random basis.* 15

Variables indicated in Table 3 are used as explanatory variables for the Probit model in the first stage. As variables of 'plant characteristics', plant size (the number of employees (E_i)), wage level per employee (w_i), dummy variables (O_{i1}, O_{i2}) indicating whether the plant is the single plant of a company or one of the plants of a company (multiplant)* 16 and product diversification rate (D_i : 1 - [shipment amount of a product with the largest shipment at the target plant / total shipment amounts] are used. Since information for the period 1988-1990 is available for an analysis of the period 1990-1993, a dummy variable indicating whether or not the target plant is newly established (N_i : a plant which existed in 1988 = 1, and a plant which was newly established in a period of 1988-1990 = 0) is added.

As variables of 'industry characteristics', shipment amount variability of the industry to which a target plant belongs (Δz_i, Δz_{i-1}: with lag)* 17, capital intensity (K_i) and business regulation dummy (R_i) are used.* 18

According to past studies, the smaller plants (business establishments) have a higher hazard rate, and the coefficient of plant size (the number of employees) (E_i) is expected to have a positive sign (as mentioned earlier, dependent variable are as follows: survival = 1 and shutdown = 0). Since the average wage level (wi) is a proxy for human resources and the target of analysis is manufacturing industries, the average wage level is expected to have a positive sign, assuming that industries with the larger ratio of knowledge workers have a comparative advantage. On the other hand, since there is a possibility that high wage level will make survival of a plant difficult, average wage level will have negative sign in that case. As for the dummy variable (O_i) indicating whether a plant is the single plant of a company or one of the plants of a company, a company with more than one plants is assumed to find it relatively easy to shut down an inefficient plant by transferring employees of the plant to other plant.* 19 Therefore, the coefficient of dummy variables (O_{i1}, O_{i2}) in the case of the single plant for one company = 1 is expected to have a positive sign. Although both O_{i1} and O_{i2} represent single plant for one company, the difference between them is that head office is located at a place other than a plant in the case of O_{i2}. It is likely that such a company conducts business other than manufacturing at its head office. Therefore, the coefficient of O_{i1} is expected to be larger positive figure than that of O_{i2}. Diversification rate of products (rate of shipment amount of non-core products (D_i)) shipped from a plant is expected to have positive sign, because it is considered to be easier for a plant to survive by changing the composition of products, if a factory is less dependent on a single product, on the condition that other terms are the same. A dummy variable (Ni) indicating whether a plant is newly established or an existing one, is used only in an analysis of the period 1990-1993 and is a proxy indicating 'age' after a plant started operation. According to recent studies made in Western countries, it is almost proved that the younger

plants tend to have higher hazard rates, and so it is expected that dummy variables of existing plants indicate positive signs. Variability of gross shipment amount (Δz_i) of an industry to which a certain plant belongs is a variable indicating demand shock. It is naturally expected that if an industry grows significantly, the probability of survival of plants belonging to the industry is high, and that if an industry declines, the shutdown risk of plants belonging to the industry is high. Therefore, the coefficient of variability of gross shipment amount should have a positive sign. Since capital intensity (K_i) and business regulation dummy (R_i) act as barriers to exit and are considered to restrain shutdown, they are expected to have positive signs.

In a regression equation which explains employment variability (ΔE_i), an explanatory variable as mentioned in Table 4 is used. In addition to ▪ (an estimate of y_i), variability of shipment amount of a plant (Δx_i), plant size (the number of employees (E_i)). initial wage level (w_i), the ratio of male employees (M_i), dummy variable of the single plant for one company (O_{i1}, O_{i2}), dummy variable for business transformation (T_i) and variability of wage per employee (Δw_i) are used as the data of plant characteristics. Furthermore, capital intensity (K_i) and the dummy variable for employment adjustment subsidy (A_i) are used as the data for industrial characteristics。 *[20]

The coefficient of variability of the shipment amount of a plant (Δx_i) means the value of elasticity of employment variability to shipment amount. Its sign should be positive, and so we are interested in the size of the coefficient. As for plant size (E_i), past literature indicates that smaller companies (business establishments) have a more rapid employment adjustment speed. If these studies are right, the coefficient of plant size (E_i) should have a positive sign (larger plants tend to have less employment adjustment).*[21] On the other hand, it is sometimes argued that 'small and medium-sized companies provide job opportunities in a recessionary period.' If this argument is right, the coefficient of plant size (E_i) should have a negative sign.*[22] With respect to dummy variables (O_{i1}, O_{i2}) of single plant/multiple plants, it is expected that the dummy variable of multiple plants will have a positive sign since reallocation of personnel among multiple plants is possible if a company has more than one plant (establishment). Average wage (w_i) is a proxy for labor quality, and employment adjustment is considered to be more difficult if average skill is higher. Therefore, (at least in a recessionary phase), against employment variability (these take negative value if employment is reduced) which are dependent variable here, w_i are expected to have positive sign.*[23] Dummy variable for business transformation (T_i) is likely to have positive sign, because it is a variable which indicates whether or not business was transformed under the four-digit industrial classification in a period subject to an analysis and employment may be maintained due to such business transformation. The coefficient of the ratio of male employees (M_i) is expected to have positive sign (in a recessionary phase) (employment adjustment occurs less for men than for women), because some past studies on employment adjustment indicate that employment adjustment speed is more rapid for women than for men.*[24] Variability of wage per employee (Δw_i) is one of the variables to be especially noted in this paper.*[25] When faced with negative demand shock, companies have to select either wage cut (restraint) or employment reduction. Companies have an alternative to reduced

working hours, and reduced working hours lead to reduced wages. In reality, companies will take a combination of various measures, and the method of combination may differ from company to company (plant to plant). If a shock of a certain size occurs, companies which can absorb the effect of the shock by cutting down on wage (or by restraining an increase in wage) are considered to reduce less employment, and companies whose wage level is rigid will have to reduce more employment. Therefore, the coefficient of wage variability is expected to have negative sign, but the size of the coefficient (how a reduction in employment will be softened by cutting down on wage by 1% on the assumption that a demand shock is given) should be noted. If the coefficient of an estimate in probit (▪) for probability of survival is significant, an analysis of employment adjustment without regard to shutdown will be biased. However, we cannot expect the sign of the coefficient in advance. As for capital intensity (K_i), preceding studies revealed that employment adjustment speed of heavy industries is slower than that of light industries (but the period covered by such studies is rather old).* [26] If these studies are right, the coefficient of capital intensity should have a positive sign. The employment adjustment subsidy scheme was introduced as a result of the revision of the Employment Insurance Law after the first oil crisis, and its aim was to prevent an outflow of workers to the external labor market. Recently, the scheme has been sometimes criticized for impairing the 'mobility of labor'. If the scheme functions as it was intended, the coefficient of dummy variable for employment adjustment subsidy (A_i) should have a positive sign.* [27]

In a regression equation which explains wage variability (Δw_i), explanatory variables in Table 5 are used. In addition to ▪ (an estimate of y_i), variables include variability of shipment amount of a plant (Δx_i), plant size (the number of employees (E_i)). initial level of wage per employee (w_i), the ratio of male employees (M_i), employment variability (ΔE_i) and capital intensity (K_i).

As in the case of employment variability, the coefficient of variability of shipment amount of a plant (Δx_i) is naturally expected to have a positive sign. The coefficient of plant size (E_i) is expected to have a positive sign (in a recessionary phase), since some preceding studies in Japan indicate that wage adjustment by large companies is slower than that by small and medium-sized companies.* [27] For the same reasons applicable to employment variability, coefficients of average wage (w_i), the ratio of male employees (M_i) and capital intensity (K_i) are expected to have positive signs. Coefficient of employment variability (ΔE_i) is expected to have negative sign, since tradeoff between wage and employment variabilities will occur as mentioned earlier. It is necessary to pay attention to the size of these coefficients.

Summary statistics and correlation matrixes (both represent figures of sampled existing business establishments) for variables related to employment and wage variabilities are shown in Tables 6 and 7. For explanatory variables, the correlation between the ratio of male employees (M_i) and average wages (w_i) is significantly strong, and the correlation between capital intensity (K_i) and average wages (w_i) is somewhat strong, but correlation between other explanatory variables is weak.

4. Analytical results

(1) Survival and shutdown

The estimation results of the Probit model in the first step concerning factors to decide survival or shutdown of plants in the period 1990-1993 are shown in Table 8. Out of 4,303 sample plants in this analysis, 3,577 plants survived and 726 plants were shut down.

The estimation results showed that plant size (E_i), diversification rate (D_i), shipment amount variability rate of an industry (Δz_i) and dummy variable for existing plant (N_i) reached a significant level in general, and all of their coefficients had positive signs as expected. Average wage level (w_i) also had a significant positive sign. A positive sign of shipment amount variability rate of an industry naturally means that plants in a growing industry have higher probability of survival and plants in a declining industry have higher risk of shutdown. This is valid as long as effects of variability of shipment amount in an industry in the same period are concerned. In a preceding period (1988-1990), the coefficient of shipment amount variability rate of an industry (Δz_{i-1}) is insignificant. A positive sign of the coefficient of plant size means that smaller plants have a higher risk, which is consistent with preceding studies made in Western countries. The dummy variable for existing plants has positive values at a highly significant level, which means that "young" plants which were recently established have higher risk. These results are also consistent with preceding studies made in Western countries. A positive sign of diversification rates of shipment composition of a plant means that plants with diversified products have higher probability of survival, even if an industry to which their core business belongs declines.* [29] The reason why the coefficient of the average wage level (w_i) is positive -- in other words, plants with higher wage have higher probability of survival -- is because unskilled-labor-intensive plants lost comparative advantage and such plants were often shut down (closed) in competition with Asian countries or as a result of overseas extension by Japanese companies. The significance level of capital intensity (K_i), dummy variable for business regulation (R_i) and dummy variable for the single plant (O_i) was low. These results mean that capital intensity and business regulation don't work as exit barriers.

(2) Employment variability

Now, let's examine the estimation results of employment variability rate (ΔE_i) after the effects of shutdown are controlled. Surviving plants are classified by employment variability in the period 1990-1993 as follows: 1) employment was increased at 1,018 plants; 2) employment remained unchanged at 997 plants; and 3) employment was reduced at 1,562 plants. Due to recessionary conditions immediately after the collapse of the bubble economy, employment was reduced at many plants.* [30]

The estimation results obtained using the OLS method for the second stage (Heckman's two-stage method) are shown in Table 9-1 (left side). Since the coefficient of shipment amount variability rate (Δx^i) of a plant is naturally positive figure with high significance, it is confirmed that if shipment amount increases, employment tends to grow, and if shipment amount

decreases, employment tends to shrink. Although the size of the coefficient is of interest to us, the value of elasticity of employment variability to shipment amount variability is as small as 0.1, which demonstrates that employment adjustment is small in Japan. Since the coefficient of wage level (w_i) is significantly positive, industries with lower wages have a larger employment adjustment. As in the case of the results of probability of survival, this fact indicates a possibility that products made by plants with low wage lost comparative advantage and are affected by a shift of production plants to Asian countries.[*31] Since the coefficient of the ratio of male employees (M_i) is significantly positive, plants with more male employees find it difficult to reduce employment (in other words, female employees tend to be the target of employment adjustment). Since the coefficient of wage variability rate (Δw_i) is a negative figure, with a high significance level, plants which reduced wages more deeply (or restrained wage increase more severely) tend to reduce less employment (due to tradeoff between wage and employment), even if they were faced with similar demand shock and had similar corporate or industrial characteristics. Since the size of coefficient is about -0.06, if average wage is reduced by 1% (or wage increase is restrained by 1%), employment to be reduced will be softened by 0.06%. As mentioned before, however, the average wage was obtained by dividing total wages including bonus and overtime allowances by the total number of employees. Hence the wage cut due to reduced working hours is reflected in the average wage.

Coefficients of capital intensity (K_i), plant size (E_i) and dummy variable of employment adjustment subsidy (A_i) were below normal significance level. From these results, it cannot be confirmed that the employment adjustment subsidy scheme has an effect to mitigate employment adjustment. As for the size of company, some preceding studies indicated that employment adjustment by large companies tend to be slow and employment adjustment by small companies tend to be rapid, although plant size was not the subject of these studies. The results of our study are different from those of such studies. This may be because recent environmental changes, such as drastic restructuring made by large companies, are reflected in the results.

Since the coefficient of an estimate (▪) of probability of survival is significantly negative, it can be noted that control of survival or shutdown will affect the estimation results of an equation to explain employment variability. In other words, it is indicated that the results obtained without regard to shutdown of plants are biased. When compared with the estimation results obtained without including ▪ (coefficient of Δx_i is 0.098742), coefficient of Δx_i including ▪ is somewhat smaller. Therefore, it can be noted that value of elasticity of employment variability to shipment amount variability in the case where shutdown is not taken into consideration is upwardly biased (see Figure 1). However, the difference is quantitatively not so large.

The results of an estimation of employment variability rate using two stage least squares method (2SLS) where wage variability rate (Δw_i) is treated as endogenous variable and an estimate (▪) of probability of survival is included are shown in Table 10-2 (right side). Since the number of employees (E_i), average wage (w_i) and the ratio of male employees (M_i) are used as instrumental variables of wage variability rate, these three variables are excluded from

explanatory variables of an estimation equation for employment variability, unlike the case of 1) (simple Heckman's two-step estimation).

Although most variables had the same signs as in the case of 1), the coefficient of capital intensity (K_i) had a positive figure of significance, and this indicated that capital-intensive industries increased employment (or had comparatively less reduction in employment). This may be because in the period 1990-1993, competition with products imported from Asian countries, etc. became intensified on the back of the strong yen and labor-intensive industries tended to lose comparative advantage. Although the coefficient of shipment amount variability rate (Δx_i) is 0.1177, a slightly larger than the corresponding figure in the case of 1), such difference is not essential. On the other hand, the coefficient of wage variability (Δw_i) is -0.21, which means that if wages are restrained by 1%, employment adjustment will be reduced by 0.21%. Since the coefficient is more than three times as large as the corresponding figure (-0.06) in the case of 1), we can conclude that tradeoff between wage and employment variabilities is stronger if wage variability is treated as endogenous variable. * 32

(3) Wage variability

The results of wage variability rate (Δw_i) for a period of 1990-1993 using Heckman's two-step estimation method are shown in Table 10 (left side). For surviving plants, average wages: 1) increased at 2,369 plants; 2) remained unchanged at 48 plants; and 3) decreased at 1,160 plants. The coefficients of shipment amount variability rate (Δx_i), the ratio of male employees (M_i) and capital intensity (K_i) were positive figures, and coefficients of initial wage level (w_i) and employment variability rate (ΔE_i) were negative figures, and all these figures were significant. The coefficient of plant size was not significant. The coefficient of an estimate (▪) of probability of survival was significantly negative, which indicates that it is necessary to take effects of shutdown into consideration in an analysis of wage variability.

The coefficient of shipment amount variability indicates the value of elasticity of wage variability to increased or decreased production, and the value of elasticity of about 0.18 is far larger than that of employment (the number of employees) variability to increased or decreased production. These results are consistent with the generally accepted idea that Japanese companies tend to absorb adverse effects of shocks, not by adjusting the number of employees but by adjusting wages or working hours. A positive coefficient of the ratio of male employees indicates that plants with comparatively more male employees find it difficult to reduce the number of employees and wage as mentioned earlier. It is indicated that plants with many regular employees find it difficult to restrain wages in order to maintain employment. Positive capital intensity is consistent with some preceding studies indicating that wage adjustment by companies in heavy industries is slow. A positive coefficient of initial wage level (w_i) indicates that plants with higher wage adjust wage more sharply in the same conditions. Considering that coefficient of average wage was a positive figure in the first-stage Probit analysis (plants with higher wages have a higher probability of survival) and coefficient of average wage was a positive figure (plants with the higher wage reduce less employment) in an estimation of employment

variability, plants with higher average wage can reduce the degree of employment adjustment or probability of shutdown by adjusting wages. A negative coefficient of employment variability rate (ΔE_i) is symmetrical to negative coefficient of wage variability in an estimation of employment variability, and this indicates the existence of a trade-off between employment and wage adjustments. The coefficient of ΔE_i is about -0.37, which means that if employees are reduced by 1%, a reduction in average wage (restraint of rate of increase) will be softened by 0.37%.

The results obtained by treating employment variability as endogenous variability in the second-stage estimation and by applying the two stage least squares method (2SLS) to estimation equations of employment and wage variabilities are shown in Table 10 (right side). Although signs of coefficients were the same as those obtained in the OLS method, coefficients of wage level (w_i) and employment variability rate (ΔE_i) were below normal significance level. On the other hand, coefficient of shipment amount variability (Δx_i) was about 0.36, and value of elasticity of wage variability when employment variability was treated as endogenous variable was more than twice as large as the value obtained in the OLS method. This fact may be considered to reinforce the above results that Japanese companies tend to make large adjustments focusing not on employment adjustment but on wage or working hours if they are faced with exogenous shocks.

5. Conclusions

In this paper, an empirical analysis was made for employment and wage variability at plant level for manufacturing industries in Japan using the micro data of the "Census of Manufacturers". Features of this paper are: 1) that an analysis was made for such characteristics of business establishments and industries that affect employment variability using the micro data of business establishment level instead of aggregate data; 2) that an analysis was made by explicitly taking effects of shutdown into consideration; and 3) that an analysis was made by paying attention to trade-offs between employment and wage adjustments.

The major results in this paper are as follows.

1) As in the case of preceding studies in Western countries, the larger plants or the older plants in Japan have the higher probability of survival. Plants with a higher diversification rates or a higher average wage have the higher probability of survival.
2) Value of elasticity of employment variability to shipment amount variability is as small as about 0.1. Plants with the higher wages or a higher ratio of male employees tend to have the lower employment reduction rate (job destruction rate).
3) Value of elasticity of wage variability to shipment amount variability is about 0.2-0.4, and thus wages or working hours are more often adjusted than the number of employees, if shipment amount is changed. Plants with a higher ratio of male employees, or higher capital intensity, tend to have a smaller wage adjustment, and plants with higher wage tend to have a higher wage variability rate.

4) A trade-off exists between employment and wage adjustments. This trade-off holds if employment and wage variabilities are simultaneously treated in an analysis. If other things are equal, if wages (overtime allowance is included) is restrained by 1%, the number of employees will be increased (or the employment reduction rate will be softened) by 0.05% to 0.21%.

5) The possibility is that an analysis of employment and wage adjustments without regard to the shutdown of plants will be biased, though the degree of such bias is quantitatively not so large.

The results of an analysis made in this paper have the following two policy implications:

1) When establishing and implementing labor policies, it is important to pay attention to the trade-off between employment and wages. In order to secure employment and restrain unemployment in a recessionary period, it is important to secure the flexibility of wage variability (at least from the viewpoint of micro economics).

2) The employment security function of the employment adjustment subsidy scheme should not be overvalued.

[Notes]

*1 This paper represents the results of research implemented as part of one of the research projects of Research Institute of International Trade and Industry, in the Ministry of International Trade and Industry, when the writers served as Special Research Fellows of the Institute. Before using the individual slip data of "Census of Manufacturers" for an analysis in this paper, we obtained approval from the Statistics Bureau, Management and Coordination Agency for using the micro data. We received various forms of cooperation and advice concerning the use of "Census of Manufacturers" from Industrial Statistics Division, Research and Statistics Department, the Ministry of International Trade and Industry. Dr.Roger Farrell helped to improve the article.

*2 This survey was conducted by Tokyo Shoko Research, Ltd. The survey only covered bankruptcy cases with total liabilities of ¥10 million or more. The number of bankruptcy cases is the third largest since World War II, following the years 1984 and 1983.

*3 The number of recipients of the employment adjustment subsidy continued to decline over the last three years, but began to increase at the end of 1997, and exceeded 10,000 again in December 1997 (Nihon Keizai Shimbun dated April 7, 1998). Recently, this scheme has been criticized for impairing labor market flexibility. As a result, the Ministry of Labour began to implement a partial modification, such as the introduction of a subsidy scheme for the benefit of business establishments which employed workers from recession-stricken industries.

*4 With respect to a comprehensive survey of entry/exit, please refer to Geroski[1995] and Caves[1998].

*5 As director for the Research Office of the Agency of Small and Medium Enterprise, I was in charge of writing the White Paper.

*6 There are few analyses of post entry performance which cover Japanese companies or business establishments. As an exception, Honjo[1998] analyzed factors of bankruptcy (insolvency) using company-level data.

*7 For a simpler analysis, there is an approach to measure the value of the elasticity of employment volume (labor input) relative to production variability (Greer and Rhoades[1977], etc.).

*8 Analyses of employment adjustment using the survey data of business establishment level include Fay and Medoff[1985] (the U.S.), Haskel et al.[1997] (the U.K.), etc. "Survey on Labor Economic Trends" of the Ministry of Labour in Japan is one of such surveys.

*9 Takagi[1996] is a shorthand survey.

*10 Mizuno[1985] is an analysis focused on relationship between wage variability (flexibility) and employment variability. But he did not estimate a model which assumes simultaneous decision.

*11 Hamermesh[1993] (Ch.4) indicated that few empirical studies were made, although labor demand pursuant to births or deaths of business establishments or companies is considered to be different from labor demand from existing establishments (companies). However, Doms et al. [1995], Evans[1987a,b], and Hall[1987] conducted analyses of corporate growth using a method in which sample selection bias was taken into consideration. Since the growth rate of the number of employees is used as an index of corporate growth, the results obtained in their studies are similar to those obtained in this paper.

*12 Therefore, attention should be paid to the fact that "start-ups" and "shutdowns" include business establishments which shifted from the classification of three employees or less to the classification of four employees or more and vice versa (figures of start-ups or shutdowns tend to become a little bit larger). For example, data of the U.S. manufacturing industries which are used by Davis et al.[1996] are those of business establishments with five employees or more. Since the "Census of Manufacturers" only covers business establishments in manufacturing industries, a business establishment which shifted from manufacturing to non-manufacturing industry is counted as 'shutdown', and the reversal case is counted as 'start-up'.

*13 Since the length of target period is two years in one case and three years in another case, it is impossible to simply compare the figures of two periods (for example, when a business establishment is shut down two and a half years after start-up, a figure on an annual basis will be undervalued, if target period is three years). The same thing can be said of gross job creation or destruction.

*14 This may be attributable to the fact that U.S. companies make layoffs as a response in a recessionary period, but Japanese companies mainly reduce the recruitment of new employees.

*15 Since some samples, for which some data are unavailable, were excluded the final number of business establishments covered by the estimation was 4,303 (out of this, the number of surviving business establishments was 3,577).

*16 O_{i1} and O_{i2} may be interpreted as control variables so that plant-level analysis may be interpreted as company-level analysis.

*17 Some business establishments may be grouped in different industry classifications if product composition at the beginning of a year changes by the end of the year. In this paper, shipment amount variability of an industry is used, classified at the beginning of a year.

*18 Capital intensity is generally considered to be an entry and exit barrier. Business regulation is expected to function as a barrier to entry or exit. Although capital intensity can be treated as a variable for plant characteristics, it was treated as the data of industry characteristics, because the data of tangible fixed assets were not collected for small plants in the "Census of Manufacturers".

*19 In addition, there is an analysis using a theoretical model of oligopolistic market (Ghemawat and Nalebuff[1990]) which indicates that companies with more than one plant in a declining industry are the first to close their plants. Genda[1998] indicates that intra-company 'job rotation' plays a significant role in terms of job creation or destruction on a business establishment basis.

*20 Since there are no data available to indicate whether individual business establishments are subject to business regulation or the employment adjustment subsidy, dummy variables for business regulation and employment adjustment subsidy indicate whether or not the industry under the four-digit classification, to which each business establishment belongs, is subject to business regulation or the employment adjustment subsidy. Since data on tangible fixed assets were not collected for small business establishments, capital intensity was treated as the data of industry characteristics instead of the data of characteristics of business establishments.

*21 Some analyses indicate that large companies are slower than small and medium-size companies in adjusting employment volume in Japan (Shinozuka and Ishihara[1977], Shinozuka [1979], Koshiro[1983], Muramatsu[1991,1995]. As an exception, Teruyama[1993] concluded that there are no differences among companies of various sizes in terms of labor adjustment speed).

*22 The Small and Medium Enterprise Agency[1999] has recently argued that large companies adjuste employment more sharply than small and medium-sized companies, but the difference in employment adjustments has decreased lately. Brunello[1988] indicated that large companies adjusted employment through intra-company job rotation using the corporate data of Japan, and Hassink[1996] obtained the same result using the corporate data of the Netherlands.

*23 Oi[1962] pointed out that labor is a quasi-inflexible production factor and jobs with higher wage are more inflexible.

*24 It has been confirmed in many empirical studies that the employment adjustment speed for women is more rapid than that for men in Japan (Shinozuka[1979], Muramatsu[1981], Abraham

and Houseman[1989], Hashimoto[1993]). Another study indicates that industries with lower average wages adjust employment more rapidly (Muramatsu[1981]). Most recently, Higuchi and Shinbo[1998] found that industries with lower wages have a higher job destruction ratio.

*25 Theoretically there should be a negative relationship between wage and employment variabilities, so long as a normal labor demand model is used (Hamermesh[1993]). It is generally accepted that there is a negative relationship between wage and employment variabilities so long as an empirical analysis using the macro time-series data is concerned (see Hamermesh [1986], Ono[1989], etc.).

*26 Shimada et al.[1981](Part 3) estimated an employment adjustment function using a two-digit industrial classification for manufacturing industries, indicating that adjustment by light industries, such as leather, textile, etc., is rapid and adjustment by heavy industries, such as steel, nonferrous metal, etc. is slow. In a cross-section analysis using two-digit industrial classification for manufacturing industries, Muramatsu[1991] indicated that there is a negative relationship between capital intensity and employment adjustment. In overseas countries, Greer and Rhoades [1977], for example, indicated that there is a negative relationship between the capital-labor ratio and the value of the elasticity of employment volume to production.

*27 Kurosaka[1988](Chapter 6) and Hashimoto[1993] indicated that employment adjustment speed has declined since the introduction of the employment adjustment subsidy scheme, as a result of the revision of the Employment Insurance Law. On the other hand, Morikawa and Tachibanaki[1999] concluded in a cross-industry regression analysis for periods of 1988-1990 and 1990-1993 that even if a certain industry became a designated industry under the employment adjustment subsidy scheme, job destruction was not significantly low (under the conditions that other things being equal).

*28 Otake[1988] and Teruyama[1993] indicated that large companies are slower than small and medium-size companies in adjusting wages.

*29 If an industry as a whole grows, diversified plants will have a higher probability of survival. However, since the target period is 1990-1993, a recessionary period after the collapse of the 'bubble economy', it can be argued more strongly that diversified plants are least affected by a reduction in the shipment amount of an industry.

*30 For all samples, employment increased at about 106,000 business establishments, with employment unchanged at about 104,000 establishments and employment decreased at about 152,000 establishments (Morikawa and Tachibanaki[1999]).

*31 These are the results obtained by controlling shipment variability, etc. Therefore, it is

necessary to understand that employment adjustment is not the direct result of reduced production (due to competition with developing countries, etc.) in the period, and that companies tend to reduce employment in anticipation of the least possibility of production recovery or growth in the future.

＊32 In addition to the analysis written the text, we analyzed decision makings concerning the adjustment of employment and shutdown using the Ordered Probit model. In the model, variables of (shut down plants = 0; surviving plants which reduced employment = 1; surviving plants which maintained employment = 2; surviving plants which increased employment = 3) were used as dependent variables and explanatory variables as mentioned above were used. This model is based on a concept that when faced with a reduction in demand, companies will try to survive by reducing employment, but they choose to shut down their plants if they cannot cope with reduced demand. We do not describe the details of the estimation results here, but it was indicated that if the effects of boom or bust in an industry as a whole are controlled, companies with larger plant size (E_i) and higher average wage (w_i) will be least likely to reduce employment or shut down their plants, and newly-established plants are highly likely to reduce employment or be forced to shut down their plants. These results are almost the same as those as mentioned earlier. In addition, it was confirmed in the Ordered-Probit model that dummy variable for the single plant (single plant where head office is also located) rarely led to employment reduction or shutdown.

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[Tables and Figure]

〔Table 1〕 Start-up/shutdown and net changes

	Number of plants	Number of start-ups	Number of shutdowns	Net changes
1988 - 90	436,786	47,809 (5.33%)	-49,386 (-5.82%)	-1,577 (-0.18%)
1990 - 93	424,834	52,002 (3.92%)	-74,329 (-6.21%)	-22,327 (-1.78%)

(Note) Number of plants means an average number of plants at the beginning and the end of the period. Figures in parenthesis mean rates on an annualized basis.

〔Table 2〕 Gross job creation, gross job destruction, and net job change

	Number of employees	Gross job creation	Gross job destruction	Net job change
1988 - 90	11,041,976	2,063,943 (6.16%)	-1,802,237 (-5.30%)	261,706 (1.18%)
1990 - 93	11,028,974	2,173,378 (4.23%)	-2,461,088 (-5.59%)	-287,710 (-0.88%)

(Note) Number of employees means an average of employees at the beginning and the end of the period. Figures in parenthesis mean rates on an annualized basis.

〔Table 3〕 Explanatory variables for survival/shutdown of plants

Plant characteristics	Plant size: The number of employees (E_i)	?
	Average wage (w_i):	
	Gross salary paid in cash / the total number of employees	?
	Dummy for the single plant:	
	Single plant and head office is located there = 1 (O_{i1})	+
	Single plant and head office is located at other place = 1 (O_{i2})	+
	Diversification rate of shipped products (D_i):	
	1-(sales of no.1 product / total shipment amount	+
	Dummy for existing plant (N_i):	
	Plants which were newly opened in a period of 1988 - 90 = 0	+
Industry characteristics	Variability rate of total shipment amount of an industry:	
	Variability rate in the period (Δz_i)	+
	Variability rate in the preceding period (Δz_{i-1})	+
	Capital intensity (K_i):	
	Tangible fixed assets / total number of employees	+
	Dummy for business regulation (R_i): Regulated industry = 1	+

(Note) Signs indicated in right column are those to be expected for 'survival ($y_i = 1$).

〔Table 4〕 Explanatory variables for employment variability

	Estimates of probablity of survival ($\cdot$)	?
Plant characterstics	Shipment amount variability rate of the plant (Δx_i)	+
	Plant size: The number of employees (E_i)	+
	Average wage (w_i):	
	Gross salary paid in cash / the total number of employees	+
	The ratio of male employees (M_i)	+
	Dummy for the single plant:	
	Single plant and head office is located there = 1 (O_{i1})	+
	Single plant and head office is located at other place = 1 (O_{i2})	+
	Dummy for business transformation (T_i):	
	Industrial classification by the 4-digit was changed = 1	+
	Average wage variability rate (Δw_i)	−
Industry Characteristics	Capital intensity (K_i):	
	Tangible fixed assets / total number of employees	+
	Dummy for an industry designated under the employment adjustment subsidy scheme (Ai)	+

(Note) Signs indicated in right column are those to be expected for 'survival ($y_i = 1$).

〔Table 5〕 Explanatory variables for wage variability

	Estimates of probablity of survival （▪）	?
Plant characterstics	Shipment amount variability rate of the plant（Δ x_i） Plant size: The number of employees（E_i） Average wage（w_i）: Gross salary paid in cash / the total number of employees The ratio of male employees（M_i） Employment variability rate（Δ E_i）	＋ ＋ ＋ ＋ －
Industry Characteristics	Capital intensity（K_i）: Tangible fixed assets / total number of employees	 ＋

（Note） Signs indicated in right column are those to be expected for 'survival（$y_i = 1$）.

〔Table 6〕 Summary statistics（1990 - 93, sample of surviving plants）

	Average	Standard deviation	Maximum	Minimum
Δ E_i	-0.01212	0.27148	4.5	-0.95402
Δ w_i	0.18674	0.67427	14.79374	-0.91162
Δ x_i	0.03373	0.78879	19.40816	-0.98188
E_i	28.934	139.200	4994	4
w_i	297.5783	157.0366	1232.8718	3.8
M_i	0.55972	0.25506	1	0
O_{i1}	0.74460	0.43609	1	0
O_{i2}	0.10526	0.30689	1	0
T_i	0.12576	0.33158	1	0
K_i	5.58086	3.51093	78.654	0.882
A_i	0.03989	0.19570	1	0

〔Table 7〕 Correlation matrix (1990 - 93, sample of surviving plants)

	ΔEi	Δwi	Δxi	Ei	wi	Mi	Oi1	Oi2	Ti	Ki	Ai
ΔEi	1.000										
Δwi	-0.105	1.000									
Δxi	0.251	0.197	1.000								
Ei	0.005	-0.016	0.004	1.000							
wi	0.098	-0.234	-0.089	0.145	1.000						
Mi	0.093	-0.034	-0.023	0.055	0.574	1.000					
Oi1	-0.018	-0.015	-0.033	-0.146	-0.153	-0.094	1.000				
Oi2	-0.003	0.019	-0.004	-0.008	0.064	0.058	-0.586	1.000			
Ti	0.004	0.012	0.031	-0.009	0.015	0.011	-0.025	-0.016	1.000		
Ki	0.043	-0.013	0.008	0.098	0.284	0.296	-0.116	0.036	0.007	1.000	
Ai	-0.015	-0.016	-0.012	-0.010	-0.052	-0.035	0.019	-0.015	-0.026	-0.068	1.000

〔Table 8〕 Estimation result of probablity of survival (1990 - 93)

Constant	-0.213432 (0.109811)	[0.052]
E_i	0.010955 (0.001527)	[0.000]
w_i	0.001113 (0.000172)	[0.000]
$O_{i\,1}$	0.095241 (0.074465)	[0.201]
$O_{i\,2}$	-0.011374 (0.098108)	[0.908]
D_i	0.295239 (0.141093)	[0.036]
N_i	0.63669 (0.065809)	[0.000]
Δz_i	0.389721 (0.177454)	[0.028]
Δz_{i-1}	-0.031035 (0.192589)	[0.872]
K_i	0.013576 (0.009862)	[0.169]
R_i	0.27197 (0.171883)	[0.114]
Log likelihood	-1802	
Number of observations	4,303	

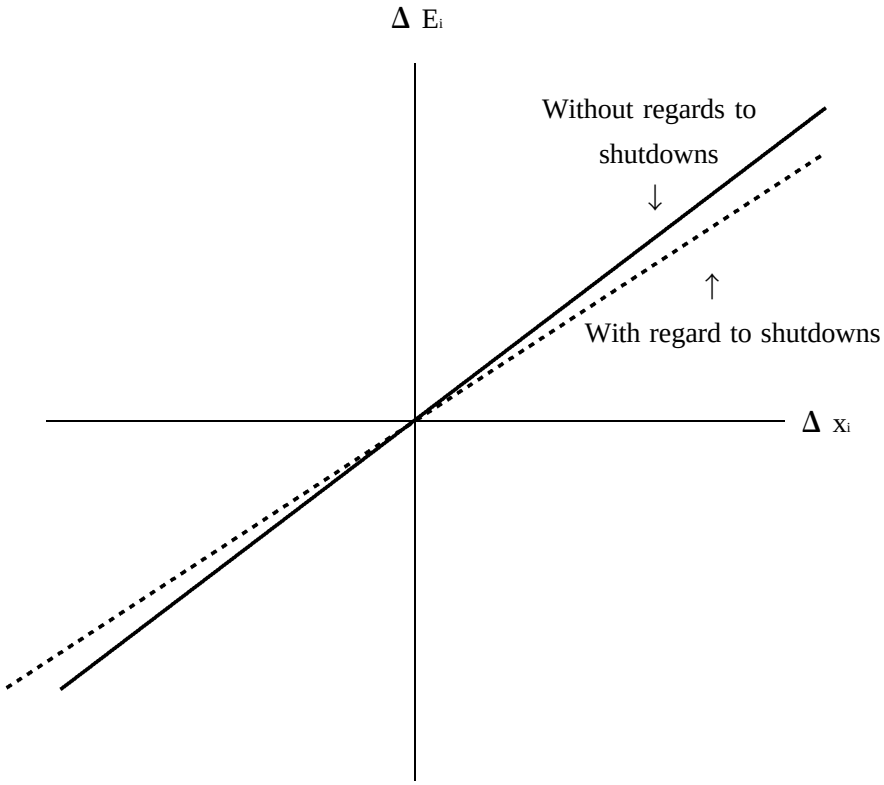
(Note) Number in the parenthesis mean standard error and those in square brackets mean p-values.

〔Table 9〕 Estimation results for employment variability(1990 - 93)

	① OLS	② 2SLS
Constant	0.194465 (0.04907) [0.000]	0.274731 (0.063892) [0.000]
▪	-0.346728 (0.060783) [0.000]	-0.310124 (0.069377) [0.000]
Δx_i	0.096096 (0.005590) [0.000]	0.117702 ($7.80*10^{-3}$) [0.000]
E_i	$6.37*10^{-6}$ ($3.20*10^{-5}$) [0.842]	
w_i	$2.00*10^{-4}$ ($4.02*10^{-5}$) [0.000]	
M_i	0.058347 (0.021194) [0.006]	
O_{i1}	$-2.92*10^{-3}$ (0.012523) [0.815]	-0.01345 (0.013266) [0.311]
O_{i2}	-0.014699 (0.017481) [0.401]	$-8.91*10^{-3}$ (0.018659) [0.633]
T_i	$-9.20*10^{-3}$ (0.013051) [0.481]	$-5.50*10^{-3}$ (0.013999) [0.694]
Δw_i (estimate)	-0.060725 ($6.73*10^{-3}$) [0.000]	-0.211918 (0.033841) [0.000]
K_i	$1.21*10^{-3}$ ($1.31*10^{-3}$) [0.355]	$4.19*10^{-3}$ ($1.37*10^{-3}$) [0.002]
A_i	-0.011458 (0.022314) [0.608]	-0.024463 (0.023981) [0.308]
Adjusted R^2	0.104591	0.06514
F value	38.9731	

(Note) Number in the parenthesis mean standard error and those in square brackets mean p-values.

〔Figure 1〕 Effects of shutdown samples on the elasticity of employment variability relative to shipment amount variability



〔Table 10〕 Determinants for wage variability

	① OLS	② 2SLS
Constant	0.702311 (0.115271) [0.000]	1.00337 (0.3715) [0.007]
▪	-0.527272 (0.149359) [0.000]	-1.1805 (0.761945) [0.121]
Δ xi	0.175983 (0.01399) [0.000]	0.356311 (0.204104) [0.081]
Ei	$1.18*10^{-4}$ ($7.79*10^{-5}$) [0.128]	$1.20*10^{-4}$ ($1.02*10^{-4}$) [0.240]
wi	$-1.11*10^{-3}$ ($9.69*10^{-5}$) [0.000]	$-5.52*10^{-4}$ ($6.47*10^{-4}$) [0.393]
Mi	0.373685 (0.051828) [0.000]	0.448119 (0.107967) [0.000]
Ki	$7.25*10^{-3}$ ($3.21*10^{-3}$) [0.024]	$8.94*10^{-3}$ ($4.62*10^{-3}$) [0.053]
Δ Ei (estimate)	-0.368683 (0.040749) [0.000]	-2.43227 (2.32683) [0.296]
Adjusted R^2 F value	0.121528 71.6721	0.05498

(Note) Number in the parenthesis mean standard error and those in square brackets mean p-values.