

An Analysis of the Employment Adjustment Behavior of Japanese Firms in the 1990s Using Financial Data*

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Abstract

In this paper, we analyze the structural changes in Japanese firms' employment adjustment behavior during the recession that occurred after the bubble economy collapsed. The negative profit employment adjustment hypothesis is a popular hypothesis for explaining Japanese firms' employment adjustment behavior. We verify the hypothesis using financial data. We use a model in which the deficit can influence the adjustment behavior through two effects. One is the cost of adjustment, and the other the desired amount of employment. We also analyze the influence of the structural changes on the employment adjustment behavior of large Japanese firms beginning in the mid-1990s. The main results are as follows. 1) The speed of adjustment in deficit years increases until the first half of the 1990s, except for the period of the bubble economy. 2) From the late 1990s, the effect of the deficit becomes insignificant. This result suggests a structural change. 3) The deficit influences the employment adjustment behavior through not only the adjustment cost, but also the desired amount of employment. This result suggests the existence of liquidity constraints, which force firms to reduce employment.

JEL Classification Codes: D21, J23

Keywords: Employment adjustment, Dynamic panel data analysis, Negative profit adjustment hypothesis

1 Introduction

The negative profit employment adjustment hypothesis is a popular hypothesis for explaining the employment adjustment behavior of Japanese firms. Under this hypothesis, rapid reduction is done when the firm experiences a large deficit or deficits in 2 successive years. This can be explained as follows. The firm is pressured into reducing employment by the capital market, and the workers weakens their resistance in such a situation.

An economic recession persisted for over a decade after the collapse of the bubble economy in 1991. However, the recession began having a serious impact on the labor market in the late 1990s, rather than immediately after the bubble's collapse. In a study on the recession, Chuma (2002) examines macro data and micro data. He argues that the recession following the collapse of the bubble was as serious as the recessions that occurred after the first oil crisis in the 1970s. Nitta (2003) suggests that the adjustment behavior in the period immediately after the bubble's collapse can be explained by the negative profit adjustment hypothesis. He suggests that this structure of adjustment was not different from either the recession after the first oil crisis in the 1970s, or the recession caused by a strong yen in the 1980s. However, after the financial crisis of 1997–98, he found a sharp increase not only in the adjustment of working hours, but also in the adjustment of the number of employees. For example, the rate of involuntary separation increased. He argues that the structural change of the employment adjustment system must be examined. Muramatsu (1999) suggests that such a change could occur because the function of the employment buffer played by small and medium-sized businesses and by construction businesses was lost. It is necessary to examine empirically whether the firm's employment behavior changed after the financial crisis of the 1990s. If there is a structural change, we also need to verify the negative profit adjustment hypothesis.

The partial adjustment model is widely used in studies of employment adjustment behavior because it is easy to interpret. When a firm adjusts employment, it may not achieve the instantaneous optimal amount of employment because there is an adjustment cost, and both revenue and cost must be considered to determine the amount of employment. The ratio between the actual and optimal amount of employments affects the speed of adjustment. Losing expert workers, bargaining with workers, and damage to the morale of remaining workers are examples of employment adjustment costs. Numerous empirical studies in Japan have applied the partial adjustment model to aggregated data in Japan (Shinotsuka and Ishihara, 1977; Shinotsuka, 1989; Muramatsu, 1983). In those studies, the speed of adjust-

ment is compared among different countries, different firm sizes and different periods. Hamermesh (1989) raises an objection against such analyses as follows. We observe smooth employment adjustment as described in the partial adjustment model when we use aggregated data. This happens even if each plant adjusts labor input in a lump sum, because data are aggregated among many plants where the timing of adjustment is different. Therefore, empirical analyses applying the partial adjustment model to aggregated data does not reveal the behavior of individual firms. Hamermesh proposes a switching model where the adjustment is done only when the desired amount of adjustment becomes large enough. He shows that his model, by using the plant-level data, is better than the partial adjustment model, for analyzing micro data. On the other hand, Hildreth and Ohtake (1998) find that the partial adjustment model is better than Hamermesh's model when applied to the plant-level data of a Japanese firm.

Recently, studies using firm-level financial data of Japanese firms have been conducted in order to analyze firm behavior that cannot be captured by aggregated data. In particular, there are a large number of studies that examine the effects of a firm's governance structure on its employment adjustment behavior (Noda, 1998 and Tomiyama, 2001). Indices of firm's financial status are other variables that affect the firm behavior. As the model proposed by Hamermesh, the adjustment cost changes if periods are different, even in the same firm. Suruga (1997, 1998) is a representative study of the employment adjustment behavior in Japan that uses such a model. He empirically shows the characteristic that rapid adjustments occur after a large deficit or two consecutive deficit years, as suggested by Koike (1983), Muramatsu (1986) and Kagono (1995).

While Hamermesh (1989) assumes that employment adjustment is done when the desired amount of adjustment becomes large enough, Suruga uses the partial adjustment model where the speed of adjustment changes in deficit years. He empirically shows that the employment adjustment is not executed in a business depression unless the depression is serious, but it is executed in a lump sum in deficit years. We can interpret this as follows. The adjustment costs, such as bargaining with workers and damage to workers' morale, will be reduced when the firm faces a bankruptcy because the workers' resistance to dismissals is weakened by the threat of bankruptcy. In addition, the possibility of bankruptcy makes the financing costs increase. As a result, the cost of adjustment decreases.

In this paper, we examine the negative profit employment adjustment model, which is a popular model describing the employment structure in Japan. We also investigate the structural change of the firm's employment adjustment behavior around the financial crisis of the 1990s. Statistical inferences are done by apply-

ing a modified partial adjustment model to the financial data of individual firms. There are two problems with many studies using the partial adjustment model. One is that in these models, the governance structure and financial situations affect only the speed of adjustment. Yasui (2005) points out that it is necessary to consider other effects on the desired level of employment. However, he did not use a model which considers other effects. In this paper, we introduce a dummy variable that indicates the firm is in a difficult profit situation. The variable indicates whether or not the firm has experienced losses in two consecutive years until the end of the previous year. This variable affects the employment adjustment behavior through both effects. Thus, we can measure the effects on not only the adjustment speed, but also the financing cost. The other problem with many studies using the partial adjustment model is that restrictions on the parameters are ignored. The model becomes nonlinear, even if we consider only the effect on the adjustment speed. In previous studies, the restrictions on the parameters derived from the nonlinearity of the model were ignored and the parameters estimated by a linear model. The parameters are difficult to interpret if the estimation is done ignoring the restrictions. We resolve this problem by using the nonlinear Generalized Method of Moments (GMM) estimation.

We use data for 4 periods, 1978–1983, 1984–1990, 1991–1997 and 1998–2004, and analyze the panel data for each period. These periods respectively include the second oil crisis, a recession caused by the strong yen, the bubble’s collapse and the recession after the financial crisis. We specifically examine whether or not the adjustment behavior is consistent with the negative profit adjustment hypothesis in the fourth period. Since the hypothesis considers regular (permanent or full-time) workers of large firms, we focus on large Japanese manufacturing firms. In addition, we investigate the employment structure and its change in a more general way by modeling the two effects of deficit.

This paper is constructed as follows. Section 2 presents a summary of the conventional partial adjustment model, introduces our model, and explains the estimation method. In Section 3, the data is explained. In Section 4, the results of the estimation are reported and discussions given. In Section 5, concluding remarks are presented.

2 Model and Estimation Method

In this section, we first explain the conventional partial adjustment model. We propose a modified model which allows for the two effects in 2.2.

2.1 Partial Adjustment Model

We explain the conventional partial adjustment model. We assume that the firm maximizes the present value of the total profit in the future. We consider the adjustment costs mentioned in the previous section. The logarithm of the firm's employment in year t , L_t is obtained as (Gould, 1968; Muramatsu, 1983 and Nickel, 1986),

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

where L_t^* denotes the optimal (logarithm of) employment at the equilibrium. λ is the coefficient of adjustment and indicates the speed of adjustment. λ usually satisfies the condition of $0 \leq \lambda \leq 1$, and a larger value of λ means a higher speed of adjustment. Since it is easy to interpret, this model is used in many empirical analyses of employment adjustment (Hamermesh, 1993 and Muramatsu, 1995). This model does not assume that different types of workers, such as regular and non-regular employees, exist. However, this model is suitable for our purposes because we obtain it from a dynamic profit maximization problem which account for the two types of the employees, under an appropriate assumption. The assumption is that the adjustment of regular employees costs the firm while that of non-regular employees does not.

In many studies on the firm behavior in Japan, the vector v has been introduced as shown in the following equation to analyze the factors that affect the coefficient of adjustment.

$$L_t - L_{t-1} = (\lambda_0 + \lambda_1 v)(L_t^* - L_{t-1}). \quad (2)$$

As v , indicators of the governance structure of the firm such as the existence of unions, relations to banks are used. Noda (1998) shows that the existence of unions reduces the speed of employment adjustment using the data of unlisted companies from the period 1988–1994. Tomiyama (2001) takes notice of the relations to the *main bank*. She analyzes the variables that characterize the corporate alliances and the main bank system using the data of 644 firms from the period 1980–1996. She finds that the firms which are strongly related to their main banks have small coefficients of adjustment. She also finds that such a characteristic does not change in deficit years. In addition, she found that the financing cost affects the speed of adjustment. Urasaka and Noda (2001) show that employment adjustment is slow if an employee is promoted to a manager and is fast if the manager or his family member is a large shareholder. They also indicate that this difference between two cases became small during the recession period (1991–1994).

Suppose that the speed of adjustment changes in years. Financial indices are

introduced as variables that influence the employment adjustment behavior in previous studies. As noted in the previous section, Suruga (1997) is one of the representative studies that consider the negative profit adjustment hypothesis. He shows that a deficit accelerates employment adjustment by choosing v as a dummy variable that indicates deficit years. The statement that the speed of adjustment increases in deficit years is also considered in many studies that mainly focus on the governance structures as presented above.

Komaki (1998) analyzes the panel data constructed from the data of 1316 firms in the period 1981–1996, while Suruga uses the data of only 5 firms and does not do a panel analysis. He finds that two consecutive deficit-years significantly make the speed of adjustment increase in the non-manufacturing industry and in 9 out of 19 sectors of the manufacturing industry. While Suruga explains the behavior of firms that experience a large adjustment of employment by the deficit, Komaki examines whether or not the deficit triggers employment adjustment in listed companies. On the other hand, from Komaki's result, Nakata and Takehiro (2001) argue that the negative profit hypothesis is not supported in some sectors. They analyze the data of 42 firms of 4 sectors during the period 1974–1999 and find that this hypothesis is not appropriate to many firms. They argue that this hypothesis cannot apply to some types of industry. Okui (2004) analyzes the data of the period 1990–1999. She shows that the adjustment speed of listed firms in the information service industry is greater than that of electric machinery firms. She shows that the adjustment speed becomes greater as the absolute value of the change rate of outsourcing expenses is greater. This indicates the trade-off between outsourcing and employment. In addition, she finds no evidence of an increase in the adjustment speed when the firm faces two consecutive deficit years. She argues that the inconsistency between this result and the hypothesis that the adjustment speed increases in deficit years as indicated by the previous studies is due to the period of the data. Yasui (2005) analyzes the data of the firms which belong to 6 manufacturing sectors and confirms that uncertainty affects not only investment behavior, but also the employment adjustment behavior of the firms. He assumes that the firm uses an AR(1) model to predict the production of the next year with the growth rate of the previous 10 years. He uses the standard error of the AR(1) model as the index of uncertainty, and confirms that the uncertainty slows the speed of adjustment down for 5 out of 6 sectors. Ogawa (2007) analyzes the panel data that include not only the data of large firms, but also the data of unlisted small and medium-sized firms constructed from the micro data of the Financial Statements Statistics of Corporations of Ministry of Finance. He finds that the employment adjustment behavior of small and medium-sized firms are

affected not only by excessive debt of the firm, but also by the attitude of the financial institutions towards lending.

2.2 Model Allowing for the Two Effects

In the previous subsection, we reviewed the previous studies. They expand the partial adjustment model of Equation (2) in order to evaluate the influence of the focused variable v on the adjustment coefficient. However, indices that are related to the attributes or management of the firm can have an effect not only through the coefficient of adjustment, but also through the desired level of employment L_t^* . Therefore, we propose a model that allows for effects both through L_t^* and through the coefficient of adjustment. These two effects were explicitly considered by Yasui (2005) for the first time. Although he suggests that the two effects are important, he does not use the model containing both effects. The model proposed in this subsection includes these two effects.

To analyze the panel data, we represent the firm and time by the indices $i(= 1, \dots, I)$ and $t(= 1, \dots, T)$ respectively. We express the simplest partial adjustment model as

$$L_{it} - L_{i,t-1} = \lambda(L_{it}^* - L_{i,t-1}) + \eta_i + v_{it}, \quad (3)$$

where η_i is the individual factor and v_{it} is the error term. Here, following the Noda and Yasui, we define L_{it}^* as

$$L_{it}^* = \alpha_0 + \alpha_1 Y_{it} + \alpha_2 W_{it}. \quad (4)$$

The variables are defined from the annual financial data as follows:

$$L_{it} = \log N_{it},$$

$$Y_{it} = \log y_{it},$$

$$W_{it} = \log(w_{it}/r_{it}),$$

$$N_{it} = \text{number of employees},$$

$$y_{it} = \text{production}$$

$$= \text{sales and operating revenue} - \text{inventory for sale at the beginning of the year} \\ + \text{inventory for sale at the end of the year},$$

$$w_{it} = \text{labor cost per capita}$$

$$= (\text{labor expenses and employees welfare expenses} + \text{labor and welfare expenses}) \\ / \text{number of employees}^1, \quad \text{and}$$

$$r_{it} = \text{interest rate} = \text{interest expense and discount premium} / \text{total liability}.$$

Although variables such as y_{it} are predicted values by the firm, this paper assumes perfect foresight. The definitions of N_{it} , X_{it} and w_{it} are the same as those in previous studies. The definition of the interest rate r_{it} follows that of Nakao (2004).

In order to examine the negative profit adjustment hypothesis, we define the index that expresses deficit years in a similar way to previous studies. We define the dummy variable $M_{i,t-1}$ that implies negative values of the ordinary gain m_{it} in two successive years as

$$M_{i,t-1} = \begin{cases} 1 & \text{if ordinary gain is negative in year } t-2 \text{ and } t-1 \\ & (m_{i,t-1} < 0, m_{i,t-2} < 0), \\ 0 & \text{otherwise.} \end{cases}$$

Here, on the basis of the negative profit adjustment hypothesis, we formalize the effects of this variable on employment adjustment. First, let us consider one effect that changes the coefficient of adjustment as $\lambda = \lambda_0 + \lambda_1 M_{i,t-1}$. From equation (2), we have:

$$\begin{aligned} L_{it} - L_{i,t-1} &= (\lambda_0 + \lambda_1 M_{i,t-1})(L_{it}^* - L_{i,t-1}) + \eta_i + v_{it}, \quad \text{and} \\ L_{it}^* &= \alpha_0 + \alpha_1 Y_{it} + \alpha_2 W_{it}. \end{aligned}$$

Therefore, the model can be written as

$$\begin{aligned} L_{it} &= (1 - \lambda_0)L_{i,t-1} - \lambda_1 M_{i,t-1}L_{i,t-1} + \lambda_0 \alpha_0 + \lambda_1 \alpha_0 M_{i,t-1} + \lambda_0 \alpha_1 Y_{it} \\ &\quad + \lambda_1 \alpha_1 M_{i,t-1}Y_{it} + \lambda_0 \alpha_2 W_{it} + \lambda_1 \alpha_2 M_{i,t-1}W_{it} + \eta_i + v_{it}. \end{aligned} \quad (5)$$

Next, we consider the other effect that change the desired employment L_{it}^* through the financing cost. This model is written as

$$\begin{aligned} L_{it} - L_{i,t-1} &= \lambda_0(L_{it}^* - L_{i,t-1}) + \eta_i + v_{it}, \quad \text{and} \\ L_{it}^* &= \alpha_0 + \alpha_1 Y_{it} + \alpha_2 W_{it} + \alpha_3 M_{i,t-1} \end{aligned}$$

by introducing $M_{i,t-1}$ into the equation of L_{it}^* . The estimation equation is written as

$$L_{it} = (1 - \lambda_0)L_{i,t-1} + \lambda_0 \alpha_0 + \lambda_0 \alpha_1 Y_{it} + \lambda_0 \alpha_2 W_{it} + \lambda_0 \alpha_3 M_{i,t-1} + \eta_i + v_{it}.$$

¹We must be careful to interpret the estimation result, because this definition of labor cost may produce a mismatch between the total labor cost and the number of employees, as pointed out by Nakata and Takehiro (2001). The definition of the number of employees can be different among firms. Nevertheless, our data provided by Nikkei NEEDS is based on the ordinary financial data, but is improved by Nikkei's own investigation and processing. See the NEEDS-FinancialQUEST code book by Nihon Keizai Shinbunsha for details.

As the financing cost noted above, we consider pressure from investors to reduce the level of employment through the financing cost. The attitudes of the financial institutions towards lending is one example (Ogawa, 2007). In other words, investors' intentions may not be fully expressed only in the interest rate of lending. The desired amount of employment may be reduced by decisions made by the investors, such as the decision not to lend, or by a damage caused by a negative evaluation of the firm in the capital market. Generally, it is not reasonable to assume that only one of these two effects is valid at a time. In this paper, we consider both effects and write the model as:

$$\begin{aligned} L_{it} - L_{i,t-1} &= (\lambda_0 + \lambda_1 M_{i,t-1})(L_{it}^* - L_{i,t-1}) + \eta_i + v_{it}, \quad \text{and} \\ L_{it}^* &= \alpha_0 + \alpha_1 Y_{it} + \alpha_2 W_{it} + \alpha_3 M_{i,t-1}. \end{aligned} \quad (6)$$

We combine these equations and rewrite them as

$$\begin{aligned} L_{it} &= (1 - \lambda_0)L_{i,t-1} - \lambda_1 M_{i,t-1}L_{i,t-1} + \lambda_0 \alpha_0 + \lambda_1 \alpha_0 M_{i,t-1} + \lambda_0 \alpha_1 Y_{it} \\ &\quad + \lambda_1 \alpha_1 M_{i,t-1}Y_{it} + \lambda_0 \alpha_2 W_{it} + \lambda_1 \alpha_2 M_{i,t-1}W_{it} + \lambda_0 \alpha_3 M_{i,t-1} + \lambda_1 \alpha_3 M_{i,t-1} \\ &\quad + \eta_i + v_{it} \\ &\equiv h(x_{it}, \theta) + u_{it} \end{aligned} \quad (7)$$

where

$$\begin{aligned} x_{it} &= (L_{i,t-1}, Y_{it}, W_{it}, M_{i,t-1})', \\ \theta &= (\lambda_0, \lambda_1, \alpha_0, \alpha_1, \alpha_2, \alpha_3)', \quad \text{and} \\ u_{it} &= \eta_i + v_{it}. \end{aligned}$$

$M_{i,t-1}$ in the first and second equations in (6) implies the effect of deficit through the adjustment cost and through the desired level of employment, respectively. This model includes the two models above, and can represent both effects.

Many studies estimated Equation (5) regarding it as linear with no restrictions. Ignoring restrictions may cause some problems. For instance, if the signs for the terms Y_{it} , $M_{i,t-1}Y_{it}$, W_{it} in (5) are all positive, the sign for the term $M_{i,t-1}W_{it}$ must be positive. In this paper, we estimate the nonlinear estimation equation (7), which includes Equation (5) by the nonlinear GMM. Since Equation (7) includes a lag of the dependent variable and the individual effect η_i on the right hand side, we use the orthogonality conditions per Arellano and Bond (1991)². We assume that the

²The panel data model that include a lag of the dependent variable in the explanatory variables is called a dynamic panel data model. The model has been actively investigated in recent years (Arellano and Bover, 1995; Ahn and Schmidt, 1995, 1997; Blundell and Bond, 1998; Baltagi, 2005; Kitamura, 2005 and Hayakawa, 2007).

term that is not correlated to η_i is the constant term and that the others variables are all predetermined.

3 Data

We use the financial data of individual firms provided by Nikkei NEEDS-FQ (unconsolidated accounts³). The NEEDS-FQ is based on the annual financial reports of the firms, and is improved by Nikkei's own investigation. It includes firms that submit financial reports as well as leading unlisted firms. The definition of the number of employees can be different among respondent firms since there are no formal definitions used for the annual financial data. In principle, the number of employees is defined as the number of regular employees that require adjustment costs⁴.

We use the data of the manufacturing firms where (i) the average number of employees in the periods are greater than or equal to 300, (ii) the settling months do not change during the periods, and (iii) no necessary items are missing in the periods. In order to measure and compare the effect of the financial index on the employment adjustment behavior, we collected data for these four periods: 1978–1983, 1984–1990, 1991–1997 and 1998–2004. Between 1978 and 1983, the second oil crisis was experienced and there was an upward trend in the unemployment rate. The period 1984–1990 includes a recession caused by a strong yen around 1986, and the successive bubble economy until the end of 1990. The period 1991–1997 includes the recession following the bubble's collapse, and the weak recovery after that. The Hyogoken-Nambu earthquake occurred in 1995. The rate of the consumption tax was raised, and large financial institutions went bankrupt in 1997. The unemployment rate fluctuated around the 2% level until 1990, rose moderately beginning in 1991, and increased rapidly in the period 1998–1999. In the period 1998–2004, the unemployment rate was always above 4% and was above 5% for about 2 years. As suggested in the previous studies, we expect that the result is consistent with the negative profit hypothesis with respect to the first 3 periods, 1978–1983, 1984–1990 and 1991–1997, and is somewhat

³Nakata and Takehiro (2000) attempt to examine transfers among the group firms by using consolidated accounts data. However, they just indirectly suggests the possibility of transfers since the number of employees is not recorded in consolidated accounts.

⁴Some firms may consider part time workers to be regular employees. However, it was not possible to distinguish which firms these were.

different from those periods in the last period, 1998–2004⁵. There are firms that became pure holding companies motivated by the revision of the anti-trust regulations in 1997. Hence, we looked for firms whose employment fell below 50% in one year, checked their history, and omitted them from the sample of the period 1998–2004. As a result, the numbers of firms are 880, 792, 986 and 985 for the sample periods 1978–1983, 1984–1990, 1991–1997 and 1998–2004, respectively. Monetary values are all adjusted by the GDP deflator for each year reported by the Department of National Accounts, Economic and Social Research Institute (ESRI), Cabinet Office of the Japanese government. The summary of the data is given in Table 1. There is a downward trend in the average number of employees (N_{it}), from 2,882 in 1978–1983 to 2,157 in 1998–2004. Its rate of change ($N_{it}/N_{i,t-1}$) increases once from 1.00 in 1978–1983 to 1.01 in 1984–1990, then decreases to 0.99 and 0.97. The amount of production (y_{it}) and the wage (w_{it}) are in an upward trend, and the interest rate (r_{it}) is in a downward trend. The ratio of ordinary gain to production ($m_{i,t-1}/y_{i,t-1}$) increases to 0.0471 once, then falls to 0.0371 and slightly rises to 0.0391 in 1998–2004.

The total number of employees for each period are given in Figures 1 (a)–(d). Note that the levels are different among the periods because the number of firms included in each period are different. In (a) and (b), the number of employees declines in 1976–1979 and 1985–1988 by roughly 170,000 and 70,000, respectively. After the bubble’s collapse, it declines by about 260,000 in 1992–1997 in (c). The number of employees declines steadily in the period 1996–2004 and the amount of the decline reaches approximately 640,000. The amount of production does not show any noticeable fluctuation until 1990, except for 1979, the year the second oil crisis occurred. On the other hand, it increases between 1994 and 2004 in contrast to the reduction in the employment.

⁵Muramatsu (1999) and Nitta (2003) suggest that the structure of employment changed in 1997–1998. However, Kobayashi (1995) suggests the structure of employment changed in 1993–1994. He traces the change back to the first oil crisis and compares the employment adjustment behaviors of several large firms in the iron and steel industry. He suggests that the structure of employment changed during this earlier period because not only blue-collar workers of the affiliate firms became the targets of employment adjustment, but also directly hired blue-collar workers and white-collar workers became the targets of employment adjustment beginning in 1993–1994. Since our data do not record the attributes of workers that may be related to the selection of the targets, we consider the structural change to have occurred in 1997–1998.

Table 1: Summary of Financial Data of Firms

Variable	Average	Standard Deviation	Median	Min.	Max
1978 (1975)–1983					
N_{it}	2882.4	6548.8	1116.5	169	75549
$N_{it}/N_{i,t-1}$	1.00	0.08	1.00	0.40	2.97
y_{it}	99631.1	380500.3	23005.7	490.7	12017883.9
w_{it}	3.6	2.6	3.4	0.2	33.7
r_{it}	3.4	2.6	3.0	0.0	30.6
w_{it}/r_{it}	171.2	363.9	103.2	21.9	8627.0
$m_{i,t-1}/y_{i,t-1}$	0.0413	0.0544	0.0352	-0.4706	0.3576
I	880				
1984 (1981)–1990					
N_{it}	2732.6	6698.6	1051.0	209	79801
$N_{it}/N_{i,t-1}$	1.01	0.07	1.01	0.48	1.77
y_{it}	111630.6	335286.8	30959.9	619.9	7605425.5
w_{it}	4.8	2.2	5.0	0.3	17.5
r_{it}	2.4	1.6	2.2	0.0	18.7
w_{it}/r_{it}	427.9	2230.9	208.7	33.6	92461.6
$m_{i,t-1}/y_{i,t-1}$	0.0471	0.0512	0.0404	-0.3143	0.3818
I	792				
1991 (1988)–1997					
N_{it}	2487.6	5712.4	1022.0	177	81488
$N_{it}/N_{i,t-1}$	0.99	0.09	0.99	0.21	4.81
y_{it}	120946.5	304883.1	36259.9	789.2	3943718.5
w_{it}	6.1	2.1	6.2	0.3	24.1
r_{it}	1.7	1.2	1.5	0.0	11.5
w_{it}/r_{it}	1045.3	6933.7	397.7	29.7	477408.2
$m_{i,t-1}/y_{i,t-1}$	0.0371	0.0558	0.0319	-0.5592	0.4011
I	986				
1998 (1995)–2004					
N_{it}	2156.7	5015.9	832.0	134	67912
$N_{it}/N_{i,t-1}$	0.97	0.10	0.98	0.15	3.06
y_{it}	158746.3	502731.3	38900.2	622.3	9273470.9
w_{it}	7.9	2.9	7.7	0.4	36.8
r_{it}	0.8	0.7	0.7	0.0	16.3
w_{it}/r_{it}	3257.4	11607.8	1069.2	54.6	246465.9
$m_{i,t-1}/y_{i,t-1}$	0.0391	0.0547	0.0320	-0.5002	0.4938
I	985				

y_{it} , w_{it} : million yen. r_{it} : %

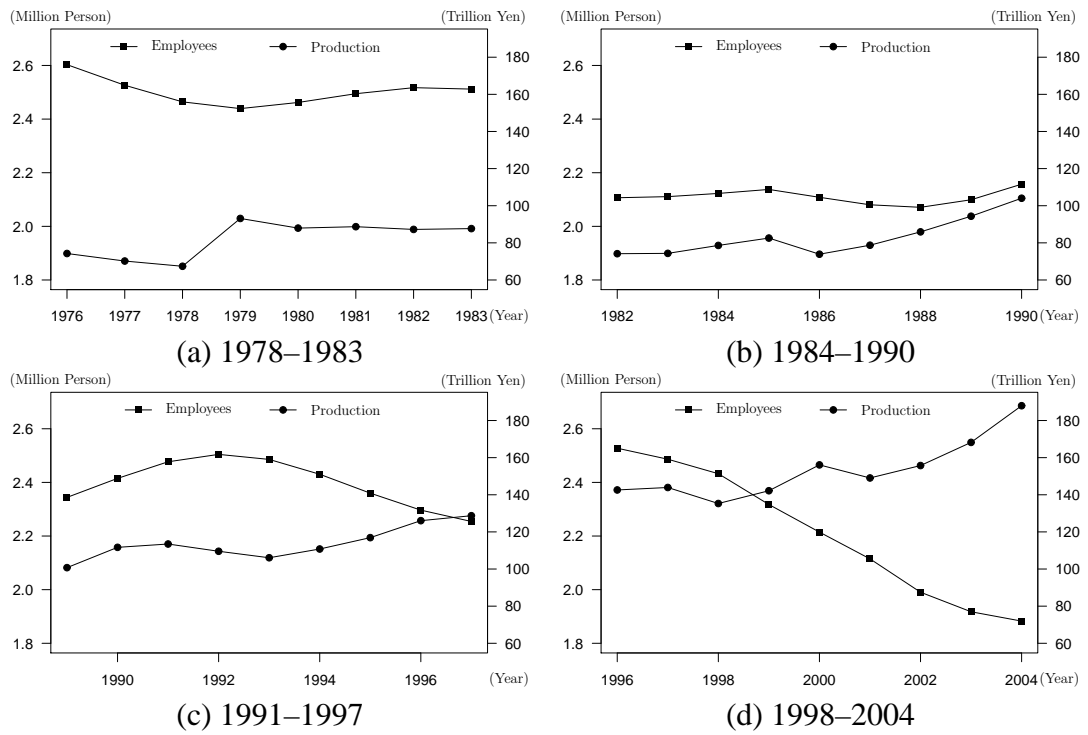


Figure 1: Fluctuations in Total Number of Employees and Production

Table 2: Estimation Result for Adjustment Model with Dummy Variable ($M_{i,t-1}$) Indicating Two Consecutive Deficit Years

	1978–1983	1984–1990	1991–1997	1998–2004
λ_0	0.268*** (0.019)	0.361*** (0.018)	0.318*** (0.017)	0.385*** (0.023)
λ_1	0.037** (0.016)	−0.047** (0.022)	0.485*** (0.039)	0.058 (0.043)
α_0	5.864*** (0.176)	5.243*** (0.150)	5.229*** (0.353)	5.255*** (0.363)
α_1	0.167*** (0.019)	0.228*** (0.015)	0.274*** (0.036)	0.364*** (0.037)
α_2	−0.065*** (0.014)	−0.085*** (0.008)	−0.173*** (0.010)	−0.318*** (0.016)
α_3	−0.139*** (0.027)	0.022 (0.023)	−0.105*** (0.034)	0.006 (0.022)

* Significant at 10% level.

** Significant at 5% level.

*** Significant at 1% level.

Robust standard errors are given in parentheses.

4 Results and Discussion

Table 2 shows the estimation results for model (7). $M_{i,t-1}$ is the dummy variable that indicates two consecutive deficit years. Under the negative profit hypothesis, the adjustment cost is reduced in deficit years. Hence the sign for parameter λ_1 is expected to be positive. The hypothesis also implies that deterioration of the profit situation reduces the desired employment L_{it}^* through the increase of the financing cost. That is, the sign for parameter α_3 is expected to be negative.

In this paper, we divided the whole data into four periods: 1978–1983, 1984–1990, 1991–1997 and 1998–2004. First, we investigated the estimation results of each period. The result for 1978–1983 is as follows. The adjustment coefficient of the ordinary years, λ_0 , is 0.268 and that of the deficit years, $\lambda_0 + \lambda_1$, is 0.305. Hence, both figures are in the range between 0 and 1. λ_1 is significant at the 5% level and its sign is consistent to the expectation of the negative profit hypothesis. However, its absolute value is small, and we can state that the rise of the speed of

adjustment due to the deficit is not high in this sample period. α_3 , the effect on the desired employment L_{it}^* , is estimated to be -0.139 and significant at the 1% level. This means that the desired amount of employment declines by approximately 13% in the deficit period. Furthermore, λ_1 is as small as 0.037. Therefore, according to the negative profit adjustment model, this result implies that the acceleration of adjustment is due to the reduction of the desired employment L_{it}^* rather than to the reduction of the adjustment cost. We previously mentioned that employment adjustment can be accelerated in deficit years because the workers' resistance to dismissals becomes smaller and the adjustment cost is reduced when the firm is in financial difficulties. However, the result implies that such an effect was not large.

The reduction of the desired employment in deficit years can be explained as follows. In principle, the demands for input factors such as the labor force are determined by the demand for production, the factor prices, and the production technology, regardless of the past profits. On the other hand, as revealed by Tomiyama (2001) and Ogawa (2007), relations between the firm and the financial institutions are significantly correlated with the demand for labor input. In the estimation equation (7), the interest rate, reflected by W_{it} , is the only factor that affects the financing cost. However, the attitude of investors also affects financing costs, but is not observable from our data. Tomiyama shows that the adjustment is slow for those firms which have close relationships with their main banks. She points out the existence of liquidity constraints that comes from asymmetry of information⁶. Liquidity constraints are financing difficulties of payment in the short term. Tomiyama implies that they are relaxed because the main bank has more information about the firms than the other investors. Under liquidity constraints, deterioration of the profit situation decreases the desired employment through a rise of the financing cost. In other words, signaling employment reduction improves the evaluation of the firm in the capital market and moderate the increase in the financing cost. Based on the discussions above, we can obtain the following interpretation. The positive estimate of α_3 means that the deficit increases the financing cost to reduce the desired employment L_{it} . This is consistent with the suggestion of Tomiyama. The parameter for production, α_1 , and the parameter for the ratio of the interest rate to the wage, α_2 , are estimated as 0.167 and -0.065 . They are consistent with the expected signs of Equation (7).

⁶Tomiyama also notes that the possibility of institutional complementarity cannot be ruled out since the quantity of human capital cannot be captured from the data. Under the institutional complementarity hypothesis, monitoring by the main bank slows the employment adjustment of the firms with large human capital and accelerates that of the firms with small human capital.

The period 1984–1990 includes a recession caused by the strong yen, and the bubble economy. While λ_0 , the adjustment coefficient of ordinary years is 0.361, λ_1 is -0.047 and significant at the 5% level, indicating the sign opposite to that expected from the negative profit adjustment hypothesis. We can see from Figure 1 (b) that the employment reduction after the recession, caused by the strong yen, is smaller than those of the other three periods. We can see that the total number of employees is in an upward trend during the bubble economy, and slightly increases throughout this period. It is quite likely that the sign of the estimates is opposite to our expectation because there was an excessive demand for labor during this period, while the negative profit adjustment model assumes employment reduction⁷. On the other hand, α_3 is not significant at the 5% level. This is explained as follows. A negative profit caused by capital investment was different from one caused by deterioration of the profit situation. Because excessive land speculation is a noticeable feature of the bubble economy, it is natural to consider that capital investments were actively done.

1991–1997 was the period immediately after the bubble’s collapse. The adjustment coefficient of ordinary years is 0.318, which is close to the prior periods. However, λ_1 and the coefficient of negative profit years ($\lambda_0 + \lambda_1$) increases to as much as 0.679. This increase is expected by the negative profit hypothesis. We can say that the hypothesis explains the employment adjustment behavior of the large Japanese firms in this period. α_3 is -0.105 , which implies that the desired employment decreases approximately 10% in the deficit years. This means that the effect through the financing cost is also large. We can say that the firms in difficult profit situations performed large employment adjustments in this period.

In 1998–2004, while the adjustment coefficient of ordinary years is 0.385, the largest among four periods, λ_1 is not significant. Since α_3 is not significant either, the negative profit hypothesis cannot be supported in this period. Under the negative profit hypothesis, we explain that the speed of adjustment increases because the deficit lets the workers and capital market know that the firm may be close to bankruptcy. The fact that the knowledge of the deficit does not affect the speed of adjustment is interpreted as follows. In this period, there was other information besides that about the deficit. That information may consist of the fact that the firm will be in difficulty because of the recession of the entire Japanese economy⁸.

⁷We are not concerned with generalization that introduces asymmetry between employment expanding and contracting processes. For such discussions, see, for example, Hamermesh (1993) and Hamermesh and Pfann (1996).

⁸Ogawa (2007) also suggests that the financial situations of the banks affect their lending atti-

In the rest of this section, we analyze the transitions of the parameters as a time series. λ_0 , the adjustment coefficient of ordinary periods, does not show any noticeable move. λ_1 , the change of the adjustment coefficient, is significant until 1997 except for the period of the bubble economy. It is consistent with the negative profit hypothesis. On the other hand, it is not significant for the period 1998–2004 and a change of employment structure is suggested. α_3 is not significant for the periods 1984–1990 and 1998–2004, while the sign is expected. The significance of this parameter implies that the deficit changes the desired amount of employment. Therefore, except for the period of the bubble and 1998–2004, employment reduction was done regardless of the firm’s situation. The firm’s employment adjustment behavior is highly affected not only by the production technology, but also by the pressure from the capital market.

α_1 , the parameters for the production, increases as 0.167, 0.228, 0.274 and 0.364. α_2 , the parameters for the ratio of the interest rate to the wage, decreases as -0.065 , -0.085 , -0.173 and -0.318 . In particular, α_2 significantly increases in the last period. These are explained as follows. Adjustment of working hours, which is another important feature of the Japanese employment adjustment behavior, was widely done in the period. Consequently, the differences of this parameter became large among firms that needed to adjust employment. Thus, the value of this parameter became large. Nitta (2003) suggests that the structure of employment changed around 1998. Changing working hours has been a major method of employment adjustment. He argues that many firms began to reduce their numbers of employees when the adjustments of labor input by this method reached their limits. The estimates of α_2 increased, consistent with Nitta.

The estimation results indicate that the two effects of the deficit on the employment adjustment behavior changed around the financial crisis in 1997–1998. Muramatsu (1999) also discusses how the employment structure changed after the financial crisis rather than immediately after the bubble’s collapse⁹. As we discussed in the early part of Section 1, Muramatsu argues that the function of the employment buffer by small, medium-sized and construction businesses had been weakened¹⁰. We also found that the employment adjustment behavior of the large

tudes towards some firms.

⁹We do not consider the attributes of workers, the employment contract and the methods of employment reduction. Thus, as Kobayashi (1995) points out, the structural change in the targets of employment adjustments might have been started immediately after the bubble’s collapse. Since analyzing such a change requires more precise data than ours, we could not examine them.

¹⁰Data that indicates such a function by small and medium-sized firms has been observed regarding the employment adjustment after the first oil crisis (Shinotsuka and Ishihara, 1977).

manufacturing firms had changed around that time.

5 Concluding Remarks

In this paper, we analyzed the validity of the negative profit adjustment hypothesis and structural change of the employment adjustment behavior using the newly developed modified partial adjustment model. We used the orthogonality conditions of Arellano and Bond (1991) and calculated the consistent estimators by applying the nonlinear GMM. Thus, we resolved the problem of inconsistency among the signs of the parameters which arise when we estimate the model as a linear model. As an index of the deficit years, we used the dummy variable that indicates two consecutive negative values of the ordinary gain. We obtained the following results by analyzing the panel data on the large manufacturing firms for four periods. Except for the period of the bubble economy, we confirmed that the negative profit adjustment hypothesis was valid. In contrast, there was no evidence that the deficit affected the employment adjustment behavior after 1998. Until 1997, the deficit reduced the adjustment cost and the desired amount of employment. We found a relatively large change in the latter effect. This was shown by the model where the deficit affects the employment adjustment behavior through two effects. This suggests that the existence of liquidity constraints and the deficit forces firms to reduce employment by the higher financing cost. Therefore, the results of this paper suggest that firm employment behavior changed around 1997–1998, and that this change was such that employment reduction was performed independently of the information about negative profit. This is possibly because an expectation of the firm's future deficits and the behavior of investors, instead of the past deficits after the change, influenced the employment adjustment behavior. We could not examine another structural change of employment adjustment, the change in the targets of layoffs and dismissals, which is suggested by Kobayashi (1995). We need data that enable us to identify what attributes of workers affect the selection of the target of employment adjustment in a future study.

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