Does downsizing take a toll on retained staff? An analysis of increased working hours during recessions using Japanese micro data

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Abstract

Using official household micro data from the *Labour Force Survey*, this paper examines the increase in the working hours of regular male employees in Japan under recession from the late 1990s to the early 2000s. The most important findings of this paper are that working hours tended to be longer among male regular employees of firms in which (1) there was major employment adjustment, (2) substantial increase in proportion of non-regular workers, and (3) wide variance in regular wages. The results suggest that the existence of a large amount of fixed duties that are necessary to maintain internal organization and transition from the traditional employment system are the main factors that explain the increase in the working hours during the recession in Japan.

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Employees' working hours usually fluctuate with amounts of business, and employees generally work longer hours in periods of boom than in recession. However, in Japan, the exact opposite phenomenon has been observed: the average working hours of male regular employees largely increased from the late 1990s to early 2000s, when Japan's economy underwent a recession. According to the OECD *iLibrary*, there has been a steady decline in Japan's average annual working hours over the past several decades. However, since the data sample of the OECD includes part-time workers, the unusual fact that the working hours of Japanese full-time regular employees have increased under prolonged recession from the late 1990s to the early 2000s has not been noticed. To the best of our knowledge, this is the first analysis of the counter-cyclical phenomenon of an increase in working hours even under severe recession.

Long-term employment and seniority-based wage payments are well-known, unique characteristics of Japanese firms. One of the theoretical explanations of these characteristics is that it enables the accumulation of firm-specific human capital (Hashimoto and Raisian 1985, Mincer and Higuchi 1988). The other explanation is that rapid technological innovation and shortage of skilled workers led to the development of internal labor markets during the rapid growth era of the 1960s (Koike 1988). Both these theories predict that labor-hoarding behaviors during recessions may be prevalent among Japanese firms.

Due to the substantial cost of training as well as high hiring and firing costs, it is believed that Japanese firms avoid a reduction in the number of employees and attempt to cut personnel costs by reducing the working hours of incumbent employees when there is a recession in the economy. Such a labor hoarding practice is rational under the assumption that the negative unanticipated shock is believed to be temporary or minor. On the other hand, when the negative shock is expected to be persistent and substantial, even firms with a propensity to hoard labor are compelled to reduce the number of employees by freezing hiring and accelerating dismissals. Under such a situation, if there are certain fixed activities in a firm that are conducted almost independently of the production level, the workload on every remaining employee may increase in spite of recession. Consequently, the small number of employees who are retained by the downsizing company may need to work longer hours.

Furthermore, since the end of the 1990s, an increasing number of Japanese firms have introduced measures to reduce employment through policies such as payment of extra retirement allowances. In addition, certain studies emphasize that the Japanese employment system has been in transition since the end of the 1990s (for example, Genda 1998, Ono 2010, Morishima 2010). They suggest that employment has become

more flexible in Japanese firms as aspects of seniority such as age and tenure no longer play dominant roles in determining wages, and these firms are more likely to pay wages based on the short-term performances of individual workers. The increasing possibilities of dismissal along with transition of the wage payment system during this period may have induced workers to work longer hours. In addition, since the late 1990s, a large number of non-regular workers are being employed as a more effective method to secure the flexibility of wage and employment. According to the *Labour Force Survey*, in 2010, 34.3 percent of the total Japanese employees were non-regular staff such as part-time, dispatched, and contract workers. Thus, the increase in the number of untrained non-regular employees may increase the job burden of regular permanent workers who manage these non-regular workers in terms of managing teams and adjusting team production.

Overview

Japan's employment system is characterized by long-term employment that begins immediately after the completion of education and lasts until the age of mandatory retirement is attained.[1] An obvious consequence of this so-called "lifetime" employment system is a long job tenure and high job-retention rates for prime-aged male workers. A "seishain," or a regular employee, works full-time and is on an employment contract that does not specify the date of termination; such an employee is usually believed to be on the lifetime employment track.[2] In this section, we describe the manner in which the number of working hours for male regular employees has changed during the prolonged recession since the early 1990s (the so-called "Japan's lost decade").

Figure 1 presents the series of average weekly number of working hours of prime-age (25–49) male regular employees and the male unemployment rate from 1986 to 2007. Both series have been adapted from The *Special Survey of the Labour Force Survey* (*Roudouryoku Chousa Tokubetsu Chousa*, 1986–2001) and the data obtained

[1] Contrary to public belief, Kato (2001) emphasizes the enduring nature of the lifetime employment practice in Japan, using data until 1997. Further, Kambayashi and Kato (2011) also find that job stability of regular employees did not fall much in particular during the first five years of Japan's lost decade. However, they also suggest that the job stability of regular employees eventually fell slightly from the end of the 1990s to early 2000. Further data accumulation is necessary to test whether the traditional Japanese employment system has undergone a complete transformation in response to prolonged recessions.

[2] In certain occasions, even if an employee satisfies the two conditions, he/she is not considered as a "regular" employee. Thus, numerous surveys, including the *Labour Force Survey*, directly ask what the respondent is called by the employer in order to clearly classify regular and non-regular workers.

from the special questionnaire of *the Labour Force Survey* (*Roudouryoku Chousa Tokutei Chosahyo*, 2002–2007).[3] Both surveys are conducted by the Statistics Bureau, Ministry of Internal Affairs and Communications, Japan.

It is evident from Figure 1 that the number of working hours of prime-age male regular employees declined rapidly from the end of the 1980s to early 1990s. This reflects a reduction of the (straight-hour) workweek from 48 hours to 40 hours as mandated by the 1988 amendment to the Labor Standards Act and the effect of the economic recession that occurred in the early 1990s. After the sharp decline in the early 1990s, the number of working hours remained around 48 hours per week until 1997. However, after 1998 when the recession worsened, the number of working hours surged close to the number of working hours during the economic boom in the end of the 1980s. In other words, the number of working hours per week surged from 47.7 hours in 1998 to 50.2 hours in 2004, which is close to the level recorded in 1988 (51.1 hours).[4] Together with the domestic recession that began in the early 1990s, 1998 was the year when the Asian financial crisis hit the entire area of Asia, including Japan, which further dampened the economy. This was the time when Yamaichi Securities, one of the leading financial firms at the time went bankrupt and the Bank of Japan introduced a zero-interest rate policy to prevent the economy from falling into further recession. However, the recession had deepened after 1998 until the early 2000s and the unemployment rate rose rapidly to an unprecedented level during the period, as shown in Figure 1.

Further, Figure 2 presents the divergence in the working hours among certain male regular employee groups for two specific years in which the working hours peaked—1988 and 2004. Although the average number of working hours is relatively the same for both 1988 and 2004, several other different features are evident from Figure 2. First, in 1988, employees in their 20s were the group with the longest working hours among all the age groups: the younger an employee is, the longer he/she works. However, in 2004, the group with the longest working hours was employees in their 30s. Moreover, employees in their 40s who used to work relatively lesser number of hours in the 1980s began working longer hours to equal those in their 20s. Second, in 1988,

[3] Unless noted otherwise, all analyses from this point forward are based on calculations using weights provided by the Statistics Bureau, Ministry of Internal Affairs and Communications, Japan.

[4] Although not shown in the figure, even after controlling for demographic and compositional changes that occurred during the two decades, such as a rising proportion of elderly persons, lower fertility rates, increasing number of years in education, and decline in marriage rate, the series presented in the figure remains almost the same. Using a rich time-use survey, Kuroda (2010) reports similar trends for full-time Japanese workers.

highly educated employees worked lesser number of hours than less-educated ones. However, in 2004, there was an increase in the number of working hours of highly educated employees. Lastly, white-collar employees worked for greater number of hours than blue-collar employees did in 1988; this tendency increased further in 2004.

Two aspects may be emphasized from the casual observations above. First, it appears that the number of working hours changed counter-cyclically from the end of the 1990s to early 2000s. This may be regarded as a rather unique phenomenon, in particular since the typical practice adopted in Japanese firms during previous recessions was to reduce the number of working hours as much as possible in order to protect employees from dismissal[5]; therefore, the number of working hours changed pro-cyclically in the past. Second, during this period there was a change in the characteristics of male employees who worked relatively longer hours. The employees whose number of working hours increased during this period were in their 30s, highly educated, and white-collar workers. What has led to these changes during this period? In order to investigate the reasons for this increase in the number of working hours, in the next section we introduce four possible effects that may explain the reasons for the counter-cyclicality in number of working hours.

Underlying Mechanisms

In this section, several hypothetical effects are presented in order to explain why working hours of prime-age male regular employees tended to be longer during the recession. As already indicated, until Japan underwent the long recession in the 1990s, the employment adjustment in Japanese firms was characterized by "labor hoarding" in which, during recession, there was a gradual adjustment in the number of employees; however, there was a sharp decrease in the number of working hours. The following two factors are considered to have contributed to this phenomenon.

One is the fact that since training employees is a rather time-consuming process, firms are required to recruit a certain proportion of employees required in the future much ahead of time. This implies that firms are unable to adjust their labor input freely

[5] There is a strand of literature that studies the speed of employment and adjustment of working hours adjustment for Japan and other countries using both aggregate and industry-level data (for example, Shinozuka and Ishihara 1976, Tachibanaki 1987, Hashimoto and Raisian 1988, Abraham and Houseman 1989). A large number of these literatures suggest that the adjustment of employment is significantly slower in Japan than in other countries. Further, Hildreth and Ohtake (1998) conducted a detailed examination using plant-level data and found that Japanese firms respond to negative shocks in a slightly different manner than US firms, for example by transferring employees within firms.

when faced with fluctuations in product demand. Since Japanese firms tend to invest actively in firm-specific human capital, the speed of employment adjustment in terms of the number of employees is likely to become slow. Instead, they control the number of working hours of the employees in order to cope with changes in optimal labor input.

The other factor is that large costs are incurred in labor adjustment. In order to invest intensively in firm-specific human capital, Japanese firms had to assure long-term employment to their employees in an implicit manner. In order to support such an employment policy of Japanese firms, several Japanese labor case laws also place high priority on maintaining employment levels in firms.

Hence, we first present a rather simple model that considers the abovementioned factors. Thereafter, we will consider the manner in which changes in the Japanese economy during the 1990s have brought about the changes in the premises for this model.

Basic Model

In this model, we assume that a firm exists forever but its employees exist only for two periods. The first period is the "training period" and the second one is the "production period." For the sake of simplicity, the first period is purely for training and the contribution of employees to production is present only in the second period. The input factors of the second period, that is the production period, include "number of employees" and "working hours." The production function depends only on labor; therefore, the production level at time *t* can be expressed by $y_t = F(h_t, N_{t-1})$, where h_t denotes the working hours used for production during the second period and N_{t-1} denotes the number of workers hired in the previous period ($F_1 > 0$, $F_2 > 0$). In other words, the number of workers in period *t* is determined in period *t - 1* on the basis of the expectation of the production level in period *t* and thereafter.

This implies that the layoff cost is infinite and that the firm cannot adjust the number of workers at all after they have been hired by the firm. On the other hand, let us assume that the number of working hours necessary for production in period *t* can be ascertained after the realization of the demand level in period *t*, given that the number of workers has already been determined in the previous period.

Further, we assume the following situation regarding the wages. The wages are to be paid at the end of the second period. The wage level depends only on the number of working hours in the second period and is independent of the training hours in the first period. Therefore, the longer the production hours in the second period, the higher the

total wage. Following Hamermesh (1993), the wage level paid in the second period is expressed by $w(h_t)$; in other words, the wage level is a function of the number of working hours. No wage is paid during the first period because there is no contribution to production. However, this assumption for simplification also reflects the seniority-based wage system prevalent in large Japanese firms.[6]

Firms face uncertainty regarding the product price *p* in the future. Firms are aware of the current price but only know the distribution of the future price. Based on all these assumptions, firms attempt to maximize the expected profit function given below in terms of the number of working hours and workers.

$$\Pi = \mathrm{E}\left\{\sum_{s=t}^{\infty}(1+r)^{t-s}[p_s F(h_s, N_{s-1}) - w(h_s)N_{s-1}] \,\middle|\, \Omega_t\right\} \tag{1}$$

where *r* is the interest rate[7], *E* is the expectations operator, and Ω_t is the information set available to firms in period *t*.

The first-order necessary conditions for profit maximization are

$$\mathrm{E}\{p_{t+1}F_2(h_{t+1}, N_t) - w(h_{t+1})|\Omega_t\} = 0 \tag{2}$$

and

$$p_{t+1}F_1(h_{t+1}, N_t) - w'(h_{t+1})N_t = 0, \tag{3}$$

where (3) indicates that the number of working hours in period *t + 1* are a function of the price level in period *t + 1* and the number of employees determined in period *t*. Substituting (3) into (2) determines the number of employees hired in period *t*. The labor-hoarding behavior of the firm is evident from the above two equations. The number of employees hired in period *t* is determined completely independently of the price level at that time, and the number of working hours necessary for production in period *t* is determined only by the number of workers hired in the previous period and

[6] A trend in Japan is that wages rise until workers attain around the age of 50. This phenomenon is termed the seniority-based wage system. Although wage-setting policies differ from firm to firm, the actual wage curve reveals that salaries rise as seniority increases. This reflects that in numerous firms, greater priority is given to age and tenure than to other criteria since human capital (or skills) is believed to accumulate with age and tenure. For a more rigorous discussion on the human capital theory, see Becker (1964).

[7] The interest rate is assumed to be constant over the entire period.

the price level of the current period *t*. This implies that if the price level in period *t* were to become temporarily low, firms would decrease the number of working hours but retain the number of employees.

However, during the recession of the 1990s there was a reduction in the number of employees in Japanese firms and an increase in the number of working hours of these employees. How can this phenomenon be explained? Several possible hypotheses are presented below.

The fixed-duty effect

The model developed above indicates that the shifts in the price distribution in period t + 1 affect the number of workers in period *t*. For example, when firms expect a decrease in future prices (the price distribution shifts to the left), the current number of workers will be reduced. In other words, if a negative shock is expected in the long-term forecast, employment will be reduced. In addition, if there are certain activities in a firm that are conducted independently of the production level, the number of working hours of each retained employee will increase as a result of the large-scale reduction in the number of employees.

Now it is assumed that employees who underwent training in the first period are not only engaged in ordinary production activities but also in activities that are not prone to change on the basis of changes in demand for their products or services. The existence of such fixed duties may be easily understood if the actual operations of a firm are considered. For example, "internal control" jobs such as accounting, planning and human resources, and activities in the factory to prepare for production such as overhauling and repair of machinery are necessary for the business operation of a firm and are independent of the demand level. Therefore, in the following discussion, we assume the existence of such "fixed" duties that are independent of the production level, and that these duties always require D number of hours to be invested by all employees in the second period as a whole. Assuming that h_t^d is the average working hours per worker for such duties in period *t*, the relation $h_t^d N_{t-1} = D$ holds. If we assume that the average total number of working hours of workers in the second period are represented by $\hat{h}_t$, where $\hat{h}_t = h_t + h_t^d$ holds, then the profit function of (1) can be modified in the following manner.

$$\Pi = E\left\{\sum_{s=t}^{\infty}(1+r)^{t-s}\left[p_s F(h_s, N_{s-1}) - w\left(h_s + \frac{D}{N_{s-1}}\right)N_{s-1}\right]\middle|\Omega_t\right\} \tag{4}$$

Further, we suppose, for the sake of simplicity, that hourly wage rate is constant; in other words, $w(\hat{h}_t) = \bar{w}\hat{h}_t$,. Then, the total labor cost can be denoted in the following manner: $w(\hat{h}_t)N_{t-1} = \bar{w}\left(h_t + \frac{D}{N_{t-1}}\right)N_{t-1} = \bar{w}h_tN_{t-1} + \bar{w}D$. If there is a fall in the expected price in period *t*, the number of workers hired in the period *t - 1* will decrease and the number of working hours utilized for production, which are determined in period *t*, will also decrease. On the other hand, the number of working hours for the fixed duties per worker will increase according to the overall reduction in the number of workers. It must be noted that if the reduction in both price and the number of workers due to recession is significantly large, then the increase in number of working hours for fixed duties may overtake the decrease in the number of working hours caused due to reduction in production. As a result, it is possible that there is an overall increase in the number of working hours.

This situation can occur during recession in firms that require the fulfillment of a large amount of fixed duties for managing internal labor markets. Specifically, we can find that the total number of working hours per employee $h_t + D/N_{t-1}$ increase with a decline in the number of employees N_{t-1} if $dlnh_t/dlnN_{t-1} < D/h_tN_{t-1}$. In other words, the smaller number of total employees need to work for longer hours when working hours required to fulfill fixed duties D are sufficiently large as compared with the total production hours (h_tN_{t-1}) and its ratio is larger than the relative elasticity of production hours to employment.

The worker-replacement effect

An important feature of Japan's lifetime employment system is the two-tier structure within a firm. In other words, in order to protect regular employees from recessions, numerous Japanese firms hire non-regular employees (fixed-term contracts or part-time workers) on a regular basis as a buffer for contingency. Therefore, a typical practice in numerous Japanese firms was to reduce the number of non-regular workers during a recession by ceasing contract renewal while hoarding regular workers as much as possible. This practice is closely related with the strict employment protection legislation for regular employees in Japan, which has been established by the accumulation of case laws over the past several decades. In such an environment, firms invest considerable resources for regular employees to accumulate job-related skills, while investment on non-regular employees remains relatively small.

During the 1990s, under a considerably uncertain economic environment, numerous firms changed the proportion of regular and non-regular workers by

increasing the ratio of non-regular workers in order to prepare for the impending downturn. According to the *Labour Force Survey*, the proportion of non-regular workers was 16.4 percent in 1985, but grew rapidly to 20.9 percent in 1995, and 32.6 percent in 2005. In other words, the ratio of non-regular workers almost doubled during the prolonged recession and non-regular employees replaced regular employees in numerous jobs.[8]

Our next explanation for the increased working hours of male regular employees comes from this rapid increase in the number of non-regular workers during the prolonged recession. If regular and non-regular employees are not perfect substitutes, which is a reasonable assumption since the investment on regular employees is much larger than that on non-regular employees, the increase in the number of non-skilled workers at the workplace may have shifted the burden of fulfilling fixed duties and supervision to the retained regular employees. If this is the case, the greater the ratio of non-regular employees at the workplace, the greater the burden that shifts on to regular employees; this increases their number of working hours.

This concept can be introduced into our model as follows. The assumption here is that firms, as before, cannot adjust the number of regular employees after an economic shock, but they can adjust the number of non-regular employees. Then, let us assume that the production level is a function of three factors: the working hours of regular employees, number of regular employees, and number of non-regular employees. In other words, if the number of non-regular employees is denoted by M, then $y_t = F(h_t, M_t, N_{t-1})$. For the sake of simplicity, it is assumed that the number of working hours of non-regular workers and wage level are fixed.

Further, we assume that regular workers have to supervise non-regular workers, and the total hours necessary for the fulfillment of fixed duties are given by

$$D = D(M), D'(M) > 0. \tag{5}$$

Then, this value divided by the number of regular workers, as discussed in the previous section, yields the number of hours spent in the management of non-regular workers per regular worker. By applying these modifications to (4), we can formulate the profit

[8] Note that even though we used the term "replacement," it does not necessarily imply firing incumbent regular employees and replacing them with non-regular employees. Rather, the replacement of regular workers with non-regular workers occurred among new hires, i.e., hiring non-regular employees instead of regular-employees. Genda, Kondo, and Ohta (2010) found that the unique school-based hiring system in Japan leaves the youths in non-regular employment for a longer period than in the United States if they fail to obtain regular jobs soon after graduation.

optimization problem.

On the basis of this modified model, it may be indicated that when Japanese firms face an unstable economic environment, they attempt to restrain the employment of regular workers and increase the number of non-regular workers. However, this, in return, may increase the total working hours spent in team management, coupled with the likely reduction in the number of regular workers, prolong the working hours of regular workers.

The dismissal-threat effect

Although retaining regular workers was the typical practice adopted by Japanese firms, the Japanese labor market underwent an unprecedented huge employment adjustment pressure due to the large and persistent negative economic shocks that occurred in the late 1990s. Under such an environment, certain firms were compelled to reduce the number of employees. The dismissal-threat effect describes the phenomenon that the greater possibility of dismissal in such an economic scenario induced workers to work longer in order to avoid being laid off. This may be particularly true for white-collar workers, who work long and hard in an attempt to prove to one's employer that he/she is rather hardworking and thus must not be the one to be laid off.

Suppose, for example, that there exits asymmetric information about productivity or performance level between employers and employees: workers know the precise level of their productivity; however, employers only know the value that contains the measurement error. This can happen particularly when the workers are involved in team production or projects that require a long time for the firm to evaluate workers' actual contribution to them. Further, suppose that both parties know that long working hours can raise the workers' observed performance level. If the firm uses such observed performance level as an important criterion for layoff, workers are induced to work longer hours simply to influence the firm's evaluation of productivity.[9]

The wage-incentive effect

Our final hypothesis is centered on the concept that larger earnings inequality would induce workers to work longer since extra number of working hours would imply greater wages if there is a larger inequality in earnings among workers. The original

[9] This explanation is rather close in spirit to the one discussed in Landers, Rebitzer and Taylor (1996), which argues that large law firms use number of hours worked as an indicator of associates' propensity to work hard. Their paper indicates that reliance upon number of working hours as an indicator of performance leads to a rat-race equilibrium in which associates work long hours.

concept has been given by Bell and Freeman (2001), who find that the large differences in the number of working hours between the United States and Germany can be explained by the earnings inequality. They indicate that since inequality is much larger in the United States, the workers in US are more likely to work longer hours to seek higher wages.

During the late 1990s, inequality in earnings expanded particularly among highly educated male employees.[10] This may have been induced by the introduction of the performance-based pay system, which was widely spread out in Japan during this period. Since the performance-based pay system is a wage system whereby the wage is paid on the basis of the short-term explicit performance of the worker, the marginal benefit from making greater effort is likely to increase if such a system is introduced. Therefore, employees tend to work longer hours in order to achieve better production performance.

Data and Methodology

Data

The primary sources of data for this study are the *Special Survey of the Labour Force Survey* and the data obtained from the special questionnaire of *the Labour Force Survey*.

The *Special Survey of the Labour Force Survey* was conducted annually in February from the early 1980s until 2001, and each year's sample comprised approximately 90,000 individuals over the age of 15 in approximately 40,000 randomly selected households. In 2002, the annual *Special Survey* was replaced with the monthly *Labour Force Survey* that incorporated a special questionnaire with a sample size of 23,000 individuals each month. For this study, in order to avoid the seasonality bias, only the February samples must be used; however, due to lack of an adequate sample size, we combined the surveys taken from January to March. Both surveys are cross-sectional and include the same questions pertaining to annual earnings, detailed employment status, employer characteristics, and basic demographic characteristics, thereby making both surveys inter-related. We limit our samples to prime-age male regular employees aged from 25 to 49 years who work for private firms. Table 1 presents the summary statistics.

[10] Kambayashi, Kawaguchi, and Yokoyama (2008) report that the wage variance among Japanese males expanded after 1997, and find that this expansion can mostly be explained by an increase in variance within groups. Moreover, Rebick (2005) also finds that dispersion in earnings among middle-aged university-educated men has increased particularly in large firms, and argues that there may be certain effects of new compensation schemes.

Methodology

We estimate the following nested reduced form model that incorporates possible explanations that reflect the fours effects mentioned in the previous section for the increase in number of working hours during the severe recession.

$$\ln h_{i,t} = \sum_j X_{ij,t}\alpha_{j,t} + \sum_k Y_{ik,t}\beta_{k,t} + \sum_l m_{l,t}\gamma_{l,t} + u_{i,t} \quad , \qquad (6)$$

where $\ln h_i$ is log weekly number of working hours of individual i, X_{ij} represents the possible factors j (j = 1,2,3,4) that describe the four effects described in the previous section, Y_{ik} represents the observed individual characteristics, m_l represents other control variables, u_i is an error term, and subscript t represents time. Each variable is explained in the following manner.

Possible factors

First, for the *fixed-duty effect*, we included the rate of change in the total number of workers (including regular and non-regular employees, males and females) using data from *the Labour Force Survey*. The total number of workers were first grouped by industry ("construction," "manufacturing," "transport and postal activities," "wholesale and retail trade," "finance, insurance, and real estate," and "other service industries") multiplied by firm size (500 and over, 30–499, and less than 30 employees). Thereafter, we calculated the rate of change by subtracting the current number of employees from the number of employees in the same group five years earlier. The rate of change in the number of employees reflects the magnitude of labor adjustment that occurred during the period under study.

Second, for the *worker-replacement effect*, we calculated the number of non-regular workers grouped by industry ("construction," "manufacturing," "transport and postal activities," "wholesale and retail trade," "finance, insurance, and real estate," and "other service industries") multiplied by firm size (500 and over, 30–499, and less than 30 employees) and divided it by the total number of employees in the same group. This non-regular worker ratio is incorporated as a proxy for the magnitude of worker replacement. In order to capture the effect of rapid increase in the worker replacement ratio, we also subtracted the non-regular worker ratio from the ratio calculated five years ago for the same group and included the rate of change in the estimation.

Third, for the *dismissal-threat effect*, we calculated the possibility of dismissal in the following manner. First, we grouped the number of male regular employees N_z (z denotes group) by firm size (500 and over, 30–499, and less than 30 employees)

multiplied by cohort (grouped by five years) and education (high school diploma or less, junior or technical college (2 years) diplomas, university diploma or more). Then, we subtracted N_z from the number of male employees present five years ago for the same group z in order to calculate the dismissal rate for each group $(N_{z,t-5} - N_{z,t})/ N_{z,t-5}*100$. The higher the dismissal rate, the higher the possibility of the corresponding group to be dismissed from employment.[11]

Finally, for the *wage-incentive effect*, we cannot directly use information that identifies whether each individual is hired in a firm using the performance-based pay system. Instead, we examine the effect by incorporating a divergence of wages to the estimation equation, following Bell and Freeman (2001). Specifically, we use data from the *Basic Survey on Wage Structure* (Chingin Kouzou Kihon Toukei Chousa) conducted by the Ministry of Health, Labour, and Welfare of Japan, which is the most trusted official survey on wages in Japan. These data are collected annually on establishments that have 10 or more regular employees; the sample size of the survey is almost 80,000 establishments. From this survey, we employ the "Decile dispersion coefficient (=[9th Decile - 1st Decile]/2 × Median)" as a proxy for the wage dispersion, grouped by firm sizes (1,000 and over, 100–999, and 10–99 employees)[12] multiplied by age group (25–29, 30–34, 35–39, 40–44, 45–49) and education (high school diploma or less, junior or technical college (2 years) diplomas, university diploma or more).

Individual characteristics and control variables

With regard to individual characteristics, we included age, age-squared, education dummies, firm-size dummies, industry dummies, occupation dummies, marital status dummy (married = 1), child dummy (having a child under six = 1), working spouse dummy (working spouse = 1), residential prefecture dummies, and cohort dummies.

Further, with regard to control variables, we incorporate the regional male unemployment rate grouped by 10 regional blocks (Hokkaido, Tohoku, Southern Kanto, Northern-Kanoto and Koshin, Hokuriku, Toukai, Kinki, Chugoku, Shikoku, and Kyusyu) in order to control for the differences in demand by region. In addition, we include monthly scheduled cash earnings (amount of contractual cash earnings, not including overtime allowance) from the *Basic Survey on Wage Structure* categorized by

[11] Since the change in the number of regular workers also includes factors such as inflows to and outflows of non-regular workers, self-employed, and out-of-labor force, this variable is not necessarily the best proxy of dismissal rate.

[12] Since the *Basic Survey on Wage Structure* does not include wage information on firms with less than 10 employees, we use information of firms with 10–99 employees to those who work in firms that hire less than 10 employees for the approximation.

industry ("construction," "manufacturing," "transport and postal activities," "wholesale and retail trade," "finance, insurance, and real estate," and "other service industries") multiplied by firm sizes (1,000 and over, 100–999, and 10–99 employees), age group (25–29, 30–34, 35–39, 40–44, and 45–49), and education (high school diploma or less, junior or technical college (2 years) diplomas, university diploma or more). Further, the monthly scheduled cash earnings were converted into log in real term using information from the *Consumer Price Index* by prefecture level.[13] This is done in order to control the change in wages since the end of 1990s.

Finally, we added a variable to control for the difference in the age structure among regular employees. This was done by calculating the ratio of the number of regular employees in a certain age group to that of employees who are five years younger: $N_{z\text{-}1,t} / N_{z,t}$, where $N_{z,t}$ is the number of regular employees in age group z in period t. If the ratio is equal to one, it implies that the number of regular employees who are five years younger is same as the number of employees in the selected age group. If the ratio is over 1, it implies that the number of younger employees are greater; if the ration is lower than 1, it implies that the number of younger employees are less than the selected age group.

Using the above variables, we estimate equation (6) for the following three periods: (a) 1998–1999, (b) 2002–2004, and (c) 2006–2007. [14] The years 1998 and 1999 are the first two years when the Japanese economy underwent further recession. The period 2002–2004 is when the average number of working hours and unemployment rate both recorded their peak since 1998. The years 2006 and 2007 are those of mild economic recovery before the global financial crisis hit the economy again in 2008.

We first estimate the weighted least squares for each period using sampling weights provided by the statistical bureau. In Japan, there is a government policy measure to provide subsidies to a firm that undergoes a severe downturn in business in order to protect regular workers' employment. All the employees hired by firms that receive such subsidies must either take one day off per month or shorten work hours

[13] Monthly cash earning is determined on the basis of the statutory work week; therefore, it is independent of actual working hours. We use this variable in order to avoid negative correlation that may occur when hourly wage is calculated as the individual's annual income divided by annual work hours (= weekly hours worked multiplied by 52 weeks). However, when we used instrumented hourly wages calculated from this hourly wage, we obtained similar results.

[14] While the left-hand side of our estimation is the number of weekly hours worked by individual employees, the explanatory variables we incorporated as possible factors to test the above effects are all calculated using aggregated data. There is no simultaneous bias for estimation as we assume that employees decide their individual working hours, given the aggregate working conditions that they encounter.

below the legal workweek (40 hours per week). In order to avoid the effect of such a policy, we limit our samples only to those who work for over 40 hours per week.[15] In addition, we also estimate the Tobit model (censored below 40 hours) using sampling weights.

Estimation Results

Results regarding possible factors

The estimation results are presented in Tables 2 (weighted least squares: WLS) and 3 (Tobit model). It is evident that both tables present similar results.

With regard to the fixed-duty effect, the *changes in the number of workers* has a significantly negative sign during the period 2002–2004, thereby suggesting that this effect was present during this period. This is the period when the number of working hours recorded its peak, thereby implying that the huge reduction in the number of employees due to prolonged recession resulted in an increase in the working hours of retained regular employees.

Further, the results reveal that the worker-replacement effect also holds during the prolonged recession. Specifically, the *ratio of non-regular workers* has a significantly positive trend for the periods 1998–1999 and 2002–2004. Furthermore, the rapid increase in the *ratio of non-regular workers* also caused the number of working hours to increase during the period 2002–2004.

With regard to the dismissal-threat effect, the *probability of dismissal effect* is significantly positive for 1998–1999, although for the periods 2002–2004 and 2006–2007 this probability is insignificant. This implies that this effect was only present at the beginning of the severe recession.

With regard to the wage incentive effect, our estimation results reveal that *wage dispersion* is statistically significant in all periods, thereby implying that the performance-based pay system, which was widespread in Japan during these periods, may have pressurized employees to work for longer hours.

In Table 4, the samples are limited to workers in their 30s and 40s, while other control variables are the same as those in Tables 2 and 3. The results are almost the same as those presented in Table 2. Further, in Table 5, the results of the Probit model estimation in which the variable in the left-hand side takes 1 if an employee works for over 60 hours per week, and 0 otherwise. In other words, Table 5 indicates which of the four effects is most relevant for employees who work for extremely long hours. It is

[15] Note that even when we include samples of those working for 40 hours or less, however, our overall estimation results did not change.

evident from Table 5 that the fixed-duty and worker-replacement effects are the two main factors that drove employees to work rather long hours during this period.

It is possible that the results obtained in Tables 2 to 5 are due to the high correlation among possible factors. As a robustness check for the multicollinearity, we check whether the same implications that are evident from these tables hold even if one or more factors are excluded. The Appendix Table presents the estimation results using the Tobit model. It is evident from the table that overall the statistical significance as well as the sign and size of the coefficient are almost the same, which endorses the results presented in Tables 2 to 5.

Now we examine the results related to other control variables by examining Table 2. With regard to the years of education, it is evident that those who have longer years of education tend to work longer during the period under consideration, and this trend seems to be particularly prevalent during 2002–2004. With regard to occupation dummies, highly skilled white-collar workers such as professionals and managers tend to work longer than clerical workers (base) or laborers (blue-collar workers). However, workers in sales, protective services, transportation and communication, which do not necessarily require high skills, also appeared to work longer in these periods.

Moreover, one of the other important findings is that the real monthly scheduled income has a significant negative impact on working hours in the periods 2002–2004 and 2006–2007. This may suggest the income effect on labor supply during these periods; in other words, if the real wage income had fallen, employees would have avoided consuming normal goods like leisure and preferred to work more. It is evident from Table 1 that the average nominal wage could indeed be calculated to be lower by 2.7 percent in 2002–2004 than that in 1998–1999. However, there was a serious deflation in the Japanese economy at the same time; thus, the average consumer price index fell by 2.9 percent on average between the abovementioned periods. As a result, the average real wages of regular male employees remained stable or rather increased slightly during these recession periods. This implies that the income effect could not explain the increase in number of working hours.

With regard to marital and child dummies, both variables indicate positively significant results during the three periods. In standard labor supply studies, results that indicate that a worker who is responsible for housework and childcare tends to work less are rather usual; however, our estimation reveals the opposite results. The reason for this is not clear. It may be because prime-age Japanese males—who our study focuses on—spend very little time, on average, on housework and child-related (non-market) work. This is an area for further study.

Which factor most influenced the number of working hours?

The above discussion indicates that the counter-cyclicality of number of working hours observed from the end of the 1990s to early 2000s in Japan can be explained by a mixture of several factors. For the period from 1998 to 1999, when there was immense pressure on employment adjustment, increasing risk of dismissal induced employees to work longer hours in order to avoid being laid off. However, in the period 2002–2004, when both the number of working hours and unemployment rate reached their peaks, the large-scale reduction in the total number of employees at the workplace induced the retained regular employees to work longer hours. Further, the increase in the number of non-regular employees during this period also appeared to increase the number of working hours of regular employees. In addition, the widespread performance-based pay system also pressurized workers to work longer hours in order to improve their performance.

Then, which of the four factors contributed most to the increase in the number of working hours in the period 2002–2004 during the severe recession? Table 6 presents the simulation results that indicate the contribution of each factor toward increasing the number of working hours using the results obtained in Table 2.[16] It is evident from Table 6 that the large adjustment of the total number of employees (the fixed-duty effect) and the increase in the number of non-regular employees (the worker replacement effect) are the two main factors responsible for the increase in the number of working hours of male regular employees in Japan. [17]

Discussion and Conclusion

This paper addressed the confounding issue of why there was an increase in the number of working hours of Japanese male regular employees in spite of serious recession from the late 1990s to the early 2000s. It has long been said that a typical feature of Japanese firms under recession is labor hoarding, which implies the maintenance of a certain

[16] This simulation was conducted in the following manner. Taking the wage incentive effect as an example, we obtained the following result in Table 2: log(*hour*) = const + 0.208(*var*) + other terms, where *var* is the wage variance. This implies that one unit of increase in wage variance would increase working hours by 20.8%, other things being equal. It is evident from the summary statistics presented in Table 1 that the change in the average wage dispersion from 1998–1999 to 2002–2004 was (Δvar = 0.241–0.236). Therefore, we calculate that the average working hours derived from the constant term in 2002–2004 was pushed upward by 20.8% × Δvar, which is 0.035 hours.

[17] When we calculate the contribution of the slight increase in real wages on the number of working hours during the period 2002–2004, we obtained a rather small value of -0.00002 hours.

level of employment in firms to the furthest extent possible. In economic downturns of the past, such a practice was common particularly when a negative shock was considered temporary and firms reduced employees' working hours in order to reduce personnel costs. However, when the shock is predicted to be persistent and substantial, firms in which the internal labor market has developed and firm specific skills have been accumulated can reduce employment. Under such circumstances, our empirical examination using micro data revealed that there was an increase in the number of working hours among employees of firms that greatly reduced the number of regular employees since the retained employees were required to fulfill fixed duties that are necessary for the maintenance of internal organization.

Furthermore, we also found two other reasons to explain the increase in number of working hours during the recession. The Japanese system of wages and employment practices has been substantially in transition since the 1990s. The seniority-based wage rule has weakened, and an increasing number of firms are employing the performance-based one, thereby enlarging the wage disparity as compared to that in the past. In this paper, we indicated that the working hours of male regular employees tended to increase in firms where there has been a steady increase in the wage variance on the basis of performance. In addition, the number of non-regular employees has increased rapidly in Japan as well as in other developed countries. In this paper, we found an increase in the number of working hours of Japanese male regular employees who work in firms that drastically increased the ratio of non-regular workers.

In conclusion, two important remarks of these results must be noted. First, the effect of the transitions in the wage and employment practices in Japan may not be continuous but transient, as they occurred just in the beginning of the 2000s. For example, the effect of increasing non-regular workers on the increase in the number of working hours disappeared in the latter half of the 2000s, as is evident from the results of our paper. According to Genda, Kuroda, and Ohta (2010a), the ratio of regular employees who work for extremely long hours (over 60 hours per week) has decreased since 2005, and this phenomenon was particularly prevalent among employees in the service and production occupations. This is because non-regular employees such as dispatched workers were rapidly introduced in these occupations.[18] In our casual observation, it appears that in period of economic recovery after 2005, firms chose to increase such non-regular workers as a buffer for unexpected contingencies rather than

[18] Until 2004, the Labor Dispatched Law prohibited manufacturing factories from using dispatched production workers in Japan. Due to the deregulation in 2004, which permitted the factories to hire these dispatched workers, the proportion of such workers has increased rapidly in the industry.

asking regular workers to increase overtime work. Further examination will be required to study the long-term effect of including non-regular workers on regular working conditions.

Second, it is also noteworthy to examine the number of working hours of female employees. Genda, Kuroda, and Ohta (2010b) revealed the polarization of working hours among female regular employees, while their average working hours tended to fall. Their study suggests that a certain amount of female regular employees also increased the number of working hours from the late 1990s to the early 2000s, while other female regular employees worked for shorter hours. Our tentative analysis suggests that females who were employed in firms that introduced the meritocratic performance-based wage system as well as those that underwent a change in their employment and wage policies drastically tended to increase working hours, which is feature that we have observed for male employees. However, a detailed analysis is required to consider the trend of inequality of number of working hours among regular female employees in the future.

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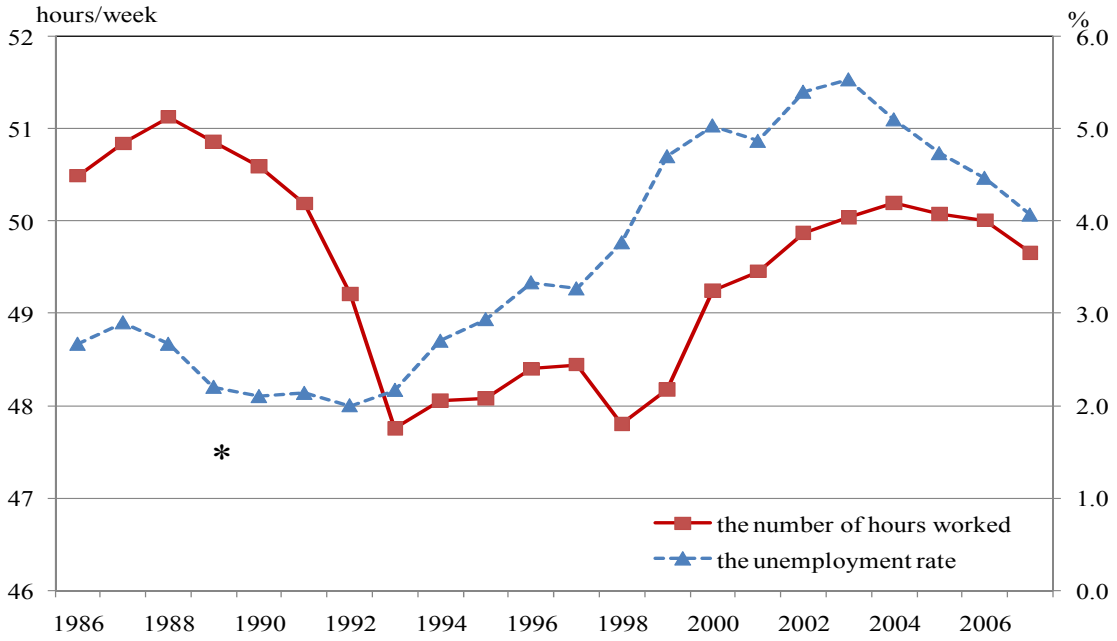
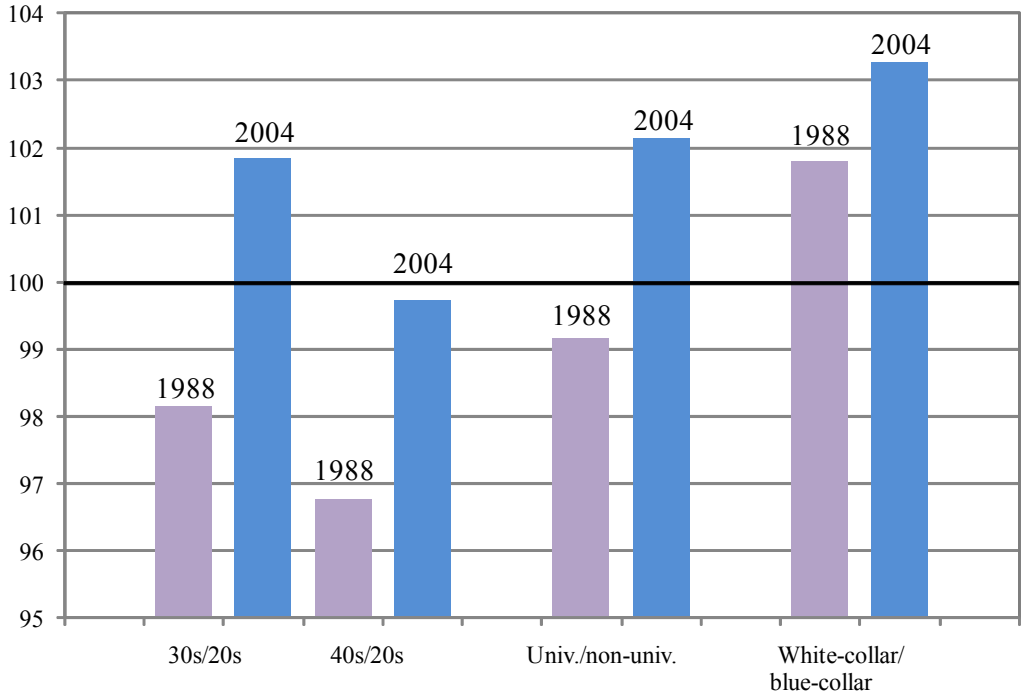
Figure 1. Average weekly working hours of prime-aged regular male employees in Japan



Sources: The *Special Survey of the Labour Force Survey* (1986–2001) and data obtained from the special questionnaire of *the Labour Force Survey* (2002–2007).

Notes: Prime-aged regular male employees exclude self-employed, part-time employees, non-regular employees, and students. The unemployment rate is the national average for male employees. * indicates the actual number of working hours in 1989 that are reported in the statistics. The large drop in this year is due to *taiso-no-rei* (the ritual of the Showa emperor's demise), which took place during the last week of February 1989, when numerous Japanese workers took a day off to offer condolences. Since this was a special occasion, we conducted a linear interpolation from 1988 and 1990 in this figure.

Figure 2. Divergence in working hours among different groups of employees



Notes: "30s/20s" and "40s/20s" indicate the average number of working hours of employees in their 30s and 40s respectively, when the average number of working hours of employees in their 20s equals 100. "Univ./Non-univ." indicates the average number of working hours of university graduates when the average number of working hours of non-university graduates equals 100. "White-collar/blue-collar" indicates the average number of working hours of white-collar workers when the average number of working hours of blue-collar workers equals 100. Further, "White-collar" includes professional and technical workers, managers and officials, clerical and related workers, and sales workers. "Blue-collar" includes protective service workers, workers in transportation and communication, production process workers, and laborers.

Table 1. Summary Statistics

		1998-1999		2002-2004		2006-2007	
Age		34.980	(8.36)	34.949	(7.79)	35.343	(7.57)
Educational background	high school and junior high school diploma	0.592	(0.49)	0.534	(0.50)	0.500	(0.50)
	junior or technical college (2 years) diploma	0.098	(0.30)	0.126	(0.33)	0.131	(0.34)
	university diploma or more	0.308	(0.46)	0.337	(0.47)	0.365	(0.48)
Firm size	less than 30 employees	0.267	(0.44)	0.272	(0.44)	0.255	(0.44)
(the number of	30 to 499 employees	0.382	(0.49)	0.403	(0.49)	0.407	(0.49)
employees)	500 employees and over	0.351	(0.48)	0.325	(0.47)	0.338	(0.47)
Industry	Construction	0.147	(0.35)	0.134	(0.34)	0.122	(0.33)
	Manufacturing	0.315	(0.46)	0.306	(0.46)	0.305	(0.46)
	Transport and postal activites	0.099	(0.30)	0.127	(0.33)	0.151	(0.36)
	Wholesale and retail trade	0.196	(0.40)	0.202	(0.40)	0.199	(0.40)
	Finance, insurance, and real estate	0.047	(0.21)	0.041	(0.20)	0.043	(0.20)
	Other service industries	0.196	(0.40)	0.189	(0.39)	0.180	(0.38)
Occupation	Professional and technical workers	0.147	(0.35)	0.146	(0.35)	0.154	(0.36)
	Managers and officials	0.010	(0.10)	0.012	(0.11)	0.013	(0.11)
	Clerical and related workers	0.135	(0.34)	0.133	(0.34)	0.137	(0.34)
	Sales workers	0.192	(0.39)	0.197	(0.40)	0.188	(0.39)
	Protective service workers	0.048	(0.21)	0.053	(0.22)	0.057	(0.23)
	Workers in transport and communication	0.062	(0.24)	0.055	(0.23)	0.054	(0.23)
	Production process workers	0.356	(0.48)	0.355	(0.48)	0.349	(0.48)
	Labourers	0.049	(0.22)	0.048	(0.21)	0.048	(0.21)
Marrital status	(married = 1)	0.603	(0.49)	0.602	(0.49)	0.605	(0.49)
Having a child	(having a child less than 6 years old = 1)	0.213	(0.41)	0.243	(0.43)	0.248	(0.43)
Spouse's work status	(wife working = 1)	0.300	(0.46)	0.299	(0.46)	0.307	(0.46)
Nomial monthly wage	(contractual Cash Earnings; 1,000yen)	319.758	(90.64)	311.006	(87.58)	316.029	(92.42)
Regional unemployment rate (%)		5.070	(0.88)	6.279	(1.31)	5.008	(0.97)
Composition of age structure		0.919	(0.28)	0.934	(0.31)	0.927	(0.32)
Possible factors	changes in the no. of workers	1.632	(11.44)	-3.361	(13.59)	1.800	(11.10)
	ratio of non-regular workers	19.096	(11.03)	23.634	(12.01)	25.505	(13.69)
	changes in the ratio of non-regular workers	18.706	(17.25)	24.639	(16.26)	7.604	(11.25)
	probability of dismissal	-10.445	(26.73)	-14.995	(45.10)	-16.901	(47.95)
	wage dispersion	0.236	(0.05)	0.241	(0.04)	0.271	(0.05)
Sample sizes		21943		21396		12549	

Note: Values given in parentheses denote standard deviation.

Table 2. Estimation results from weighted least squares

	1998-1999		2002-2004		2006-2007	
Age	0.002	(0.36)	0.011	(1.51)	0.014	(1.24)
Age^2	0.000	(-0.71)	0.000	(-1.41)	0.000	(-0.91)
Educational background						
(base = high school and junior high deploma)						
junior or technical college (2 years) diploma	0.025	(3.90) ***	0.019	(2.76) ***	0.024	(3.13) ***
university diploma or more	0.022	(3.46) ***	0.037	(5.17) ***	0.022	(2.48) **
Firm size (base = less than 30)						
30 to 499 employees	0.012	(1.20)	0.036	(4.47) ***	0.005	(0.58)
500 employees and over	0.002	(0.15)	-0.011	(-0.85)	0.001	(0.07)
Industry (base = construction)						
Manufacturing	-0.052	(-4.38) ***	-0.064	(-7.48) ***	-0.052	(-5.76) ***
Transport and postal activites	-0.026	(-1.35)	0.071	(2.48) **	-0.048	(-2.45) **
Wholesale and retail trade	-0.021	(-1.08)	-0.030	(-1.57)	-0.005	(-0.25)
Finance, insurance, and real estate	-0.007	(-0.46)	-0.024	(-1.62)	-0.040	(-2.68) ***
Other service industries	-0.058	(-5.18) ***	-0.079	(-5.47) ***	-0.049	(-2.47) **
Occupation (base = clerical)						
Professional and technical workers	0.029	(4.02) ***	0.033	(4.64) ***	0.026	(2.86) ***
Managers and officials	0.075	(4.48) ***	0.036	(1.79) *	0.052	(2.87) ***
Sales workers	0.049	(7.93) ***	0.048	(7.08) ***	0.046	(5.44) ***
Protective service workers	0.075	(6.93) ***	0.083	(7.50) ***	0.045	(3.03) ***
Workers in transport and communication	0.072	(6.52) ***	0.097	(8.83) ***	0.098	(6.39) ***
Production process workers	0.004	(0.64)	-0.002	(-0.31)	-0.004	(-0.46)
Labourers	0.034	(3.66) ***	0.038	(3.49) ***	0.041	(3.12) ***
Other control variables						
Marital status (married = 1)	0.029	(5.32) ***	0.035	(5.97) ***	0.031	(4.14) ***
Child (less than 6 years old = 1)	0.017	(3.24) ***	0.011	(2.02) **	0.024	(3.47) ***
Spouse works (work = 1)	0.002	(0.44)	0.000	(-0.06)	-0.010	(-1.55)
log real monthly wage	-0.035	(-1.38)	-0.070	(-2.52) **	-0.054	(-1.93) *
regional unemployment rate	0.004	(1.32)	-0.001	(-0.10)	-0.021	(-1.81) *
composition of age structure	-0.018	(-1.31)	-0.006	(-0.44)	-0.037	(-2.61) ***
Possible factors						
changes in the no. of workers	0.000	(-0.24)	-0.004	(-4.47) ***	0.000	(0.31)
ratio of non-regular workers	0.001	(2.08) **	0.003	(3.87) ***	0.000	(-0.19)
changes in the ratio of non-regular wkrs	0.000	(-0.60)	0.001	(1.97) **	-0.001	(-1.75) *
probability of dismissal	0.000	(2.48) **	0.000	(-0.69)	0.000	(-0.27)
wage dispersion	0.124	(2.04) **	0.208	(3.16) ***	0.125	(1.71) *
Constant	3.822	(32.60) ***	3.591	(26.08) ***	3.746	(17.66) ***
prefecture and cohort dummies	yes		yes		yes	
R2-adj.	0.0446		0.0495		0.0421	
Sample sizes	21943		21396		12549	

Notes: Values in parentheses denote *t*-statistics. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels respectively.

Table 3. Estimation results from the Tobit model

Possible factors	1998-1999			2002-2004			2006-2007		
changes in the no. of workers	0.000	(-0.65)		-0.004	(-5.37)	***	0.000	(0.80)	
ratio of non-regular workers	0.002	(2.47)	**	0.003	(4.61)	***	0.000	(-0.62)	
changes in the ratio of non-regular workers	0.000	(-0.73)		0.001	(2.69)	***	-0.001	(-1.72)	*
probability of dismissal	0.000	(2.60)	***	0.000	(-0.61)		0.000	(-0.13)	
wage dispersion	0.133	(2.13)	**	0.238	(3.95)	***	0.156	(2.18)	**
Pseudo R2	0.0819			0.0975			0.0942		
Log likelihood	-7551.57			-6586.30			-3477.66		
Sample sizes	21943			21396			12549		

Notes: Values given in parentheses denote *t*-statistics. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels respectively. The same control variables as those in table 2 are used for this estimation.

Table 4. Estimation results from the Tobit model by age

(1) 30s

Possible factors	1998-1999			2002-2004			2006-2007		
changes in the no. of workers	-0.001	(-0.88)		-0.003	(-2.49)	**	0.001	(0.87)	
ratio of non-regular workers	0.002	(1.67)	*	0.004	(3.11)	***	0.000	(-0.35)	
changes in the ratio of non-regular workers	0.000	(0.14)		0.001	(1.29)		0.000	(-0.67)	
probability of dismissal	0.000	(0.84)		0.000	(-0.61)		0.001	(2.55)	**
wage dispersion	0.239	(1.85)	*	0.167	(1.63)		0.189	(1.66)	*
Pseudo R2	0.0878			0.1137			0.0993		
Log likelihood	-2772.56			-2662.10			-1570.8		
Sample sizes	8194			9013			5620		

(2) 40s

Possible factors	1998-1999			2002-2004			2006-2007		
changes in the no. of workers	-0.001	(-1.40)		-0.004	(-2.66)	***	0.002	(2.40)	**
ratio of non-regular workers	0.001	(0.59)		0.003	(2.17)	**	-0.002	(-1.80)	*
changes in the ratio of non-regular workers	-0.001	(-1.88)	*	0.001	(2.30)	**	-0.001	(-1.65)	
probability of dismissal	-0.001	(-1.51)		0.000	(-0.03)		0.000	(-0.90)	
wage dispersion	0.111	(1.03)		0.349	(3.43)	***	0.287	(2.32)	**
Pseudo R2	0.0807			0.0907			0.1474		
Log likelihood	-3068.6			-2454.54			-1181.85		
Sample sizes	8865			7873			4731		

Notes: Same as Table 3.

Table 5. Estimation results from the Probit model

Possible factors	1998-1999			2002-2004			2006-2007		
changes in the no. of workers	-0.001	(-1.91)	*	-0.006	(-5.03)	***	-0.001	(-1.39)	
ratio of non-regular workers	0.002	(2.30)	**	0.005	(4.80)	***	0.000	(0.26)	
changes in the ratio of non-regular workers	0.000	(0.37)		0.001	(2.51)	**	0.000	(-0.43)	
probability of dismissal	0.000	(-0.16)		0.000	(-0.36)		0.000	(-1.05)	
wage dispersion	-0.053	(-0.75)		0.010	(0.11)		0.100	(1.00)	
Pseudo R2	0.0450			0.0418			0.0445		
Log likelihood	-6580.164			-8713.918			-4787.799		
Sample sizes	21943			21396			12549		

Notes: Same as Table 3. The left-hand side variable takes 1 if an employee works for over 60 hours per week, and 0 otherwise. The figures represent marginal effects.

Table 6. Estimated value of each factor that led to an increase in working hours during the period 2002–2004

Possible factors	
changes in the no. of workers	0.686
ratio of non-regular workers	0.485
changes in the ratio of non-regular workers	0.150
probability of dismissal	-
wage dispersion	0.035

Notes: The unit used is hours. The estimated values are calculated from the results obtained in Table 2.

Appendix Table. Robustness check (Tobit model)

Possible factors	1998-1999							
changes in the no. of workers	0.000	(-0.22)	0.000	(-0.68)				
ratio of non-regular workers			0.002	(2.37) **	0.001	(2.06) **		
changes in the ratio of non-regular workers					0.000	(-1.00)		
probability of dismissal	0.000	(2.46) **	0.000	(2.65) ***			0.000	(2.49) **
wage dispersion	0.137	(2.18) **	0.135	(2.16) **	0.105	(1.70) *	0.134	(2.15) **
Pseudo R2	0.0816		0.0819		0.0814		0.0815	
Log likelihood	-7554.63		-7551.00		-7556.10		-7555.20	
Sample sizes	21943							

Possible factors	2002-2004							
changes in the no. of workers	-0.001	(-2.96) ***	-0.003	(-4.76) ***				
ratio of non-regular workers			0.003	(3.91) ***	0.001	(1.47)		
changes in the ratio of non-regular workers					0.000	(-0.96)		
probability of dismissal	0.000	(-1.44)	0.000	(-0.95)			0.000	(-1.42)
wage dispersion	0.249	(4.14) ***	0.232	(3.85) ***	0.227	(3.77) ***	0.239	(3.98) ***
Pseudo R2	0.096		0.097		0.0955		0.0954	
Log likelihood	-6597.55		-6589.92		-6601.30		-6602.00	
Sample sizes	21396							

Possible factors	2006-2007							
changes in the no. of workers	0.000	(-0.11)	0.000	(0.08)				
ratio of non-regular workers			0.000	(-0.35)	0.000	(-0.25)		
changes in the ratio of non-regular workers					-0.001	(-1.52)		
probability of dismissal	0.000	(-0.18)	0.000	(-0.18)			0.000	(-1.55)
wage dispersion	0.163	(2.29) **	0.164	(2.29) **	0.157	(2.20) **	0.121	(1.74) *
Pseudo R2	0.0938		0.0938		0.0941		0.0926	
Log likelihood	-3479.19		-3479.1		-3477.99		-3483.9	
Sample sizes	21396							

Note: Same as Table 3.