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Evidence of a Growing Inequality in Work Timing Using a Japanese Time-Use Survey*

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Abstract

Using data from a Japanese time use survey, we show a noteworthy increase in the share of employees working unusual hours (late night and early morning) over a period of a decade since the mid 1990s. When controlling for changes in hours worked, however, we find that the notable increase in the fraction of people working unusual hours was for low-income nonregular employees (part time, temporary and contract workers), while relatively higher-income regular employees' work timing remains stable. These observations imply that there is a trend of diversification of work timing in Japan between regular and nonregular employees. A possible explanation is that the increase in the average hours worked per weekday by regular employees, possibly because of the spread of the five-day workweek since the 1990s, increased the demand for services and goods during unusual hours, as they returned home. An Oaxaca–Blinder type decomposition suggests that such an increase in the average hours worked by regular employees explains partially the rise in the employment rate of nonregular employees at unusual times. We also suggest that the negative income effect induced low-wage nonregular employees to take jobs at night to earn a wage premium.

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I. Introduction

The 24-hour lifestyle has become deeply rooted in some societies around the world. Japan is a prime example. Nowadays, many businesses such as evening and weekend banking, 24-hour customer services, convenience stores, and all-night movie theatres operate outside standard hours in Japan. The 24/7 convenience stores, for example, have increased tremendously in number within Japan in recent decades. According to a report issued by the Japan Franchise Association, there were 6308 convenience store outlets in Japan in 1983, and rapid growth since then has increased the total to 42 629 stores in 2009.[1] In Metro Tokyo, there are some areas where it is impossible to walk 30–40 meters without passing a convenience store. From the consumer's point of view, such 24-hour businesses offer a high degree of convenience especially for two-income families with little time to spare during the workday. However, longer and nonstandard hours in such businesses are required by the workers who work at those hours, which reflects the main characteristics of the service: simultaneity. This implies that the number of people who work at unusual hours is also growing.

There are legitimate questions, however, as to what extent people actually work unusual hours, how far has employment shifted toward unusual hours, and also, the main reason behind the expansion in operating hours. Is it globalization, the advent of technology such as mobile phones and the internet, changes in open-hour legislation or labor market regulation, or a huge negative demand shock that hit the economy from the early 1990s changed Japanese lifestyles? Detailed answers to these questions remain elusive. This paper uses a Japanese time use survey to examine how the timing of work in Japan has changed since the 1990s and attempts to identify the driving forces behind the 24-hour society.

[1] Among them, 7-eleven leads the market with 12 743 stores (as of March 2010) in Japan, compared with only 6547 stores in the US.

There is little research that focuses on the timing aspect.[2] The exceptions are pioneering studies by Hamermesh (1999a, b, 2002) that focused on US workers. Using the *Current Population Survey* (CPS) for 1973–1991, Hamermesh (1999a) found that the share of US workers working late-night hours declined gradually over time.[3] Given the anecdotal evidence above, Japan seems to be heading in the opposite direction from that of the US. This paper uses detailed Japanese time use micro data to assess empirically whether this conjecture is correct. Specifically, the data we use are from the *Survey on Time use and Leisure Activities*, a time use survey conducted by the Japanese government's Statistics Bureau within the Ministry of Internal Affairs and Communications (MIAC) since 1976. Respondents to the survey, nearly 200,000 Japanese citizens, annotate their activities in 15-minute increments over two consecutive 24-hour periods. This paper uses data from the 1996, 2001, and 2006 surveys.

The results of this paper are as follows. First, we show that Japan experienced a noteworthy increase in the share of workers working at unusual times (late night and early morning) over the period of a decade from the mid 1990s. Second, when controlling for changes in hours worked, however, we found that a notable increase in the fraction of people at work at such unusual times was evident for low-income nonregular employees (part time, temporary and contract workers) while relatively higher-income regular employees' work timing remains stable. These observations imply that there is a trend of diversification of work timing in Japan between regular and nonregular employees. Third, the increase in the average hours worked per weekday by regular employees, possibly because of the spread of the five-day workweek since

[2] Much of the literature in economics that makes use of time use surveys is based on analysis that measures an aggregate of work time and leisure time. Sociology, however, has a longer history of literature analyzing activities by time of the day. For example, Szalai (1972) showed that in the US, activities for each time slot differ depending on the city, while Presser (1987) analyzed the timing of the work of spouses. The survey by Gershuny and Sullivan (1996) is also of interest.

[3] The series of papers by Hamermesh do not use time use surveys but rather information on the usual start and end times of working hours extracted from questions in the CPS.

the 1990s, increased services and goods demands at later hours as workers returned home. An Oaxaca–Blinder type decomposition suggests that such an increase in the average hours worked by regular employees explains partially the rise in the employment rate of nonregular employees at unusual times. We also suggest that the negative income effect induced low-wage nonregular employees to take jobs at night to earn a wage premium.

This paper is organized as follows. In Section II, we explain the theoretical underpinnings of our analysis, and in Section III, we provide an overview of our data. In Section IV, we examine how the timing of work in Japan has changed over the period of a decade from the mid 1990s. In Section V, we further analyze the data to identify the main factors that lead people to work at unusual hours. We end with our conclusions in Section VI.

II. Theoretical Underpinnings

Following Winston (1982) and Hamermesh (1999a), we assume that individual *i* chooses daily the timing of work so as to maximize the following utility function

$$V_i = \sum U_{it}(1 - L_{it}, C_{it}), \quad \textit{subject to } \sum (w_{it}L_{it} - C_{it}) = 0, \quad t = 1, \cdots, 24 \qquad (1)$$

where L_{it} is an index function that takes the value 1 if individual *i* is working at time *t* (an hour block of time within the 24-hour day), and 0 otherwise; w_{it} is the wage rate if individual *i* is working at time *t*, C_{it} is consumption at time *t*, and the consumer goods price is 1 for simplicity. We assume here that leisure and consumption are intertemporally additively separable, and thus that leisure and consumption are separable at each *t*. Because we are considering a utility function for one day only, we do not use a discount rate. We also assume that fatigue does not impact the choice between consumption and leisure for individual *i* at time *t*, because we are addressing decisions for each time block. When the following equation is satisfied, individual *i* works at time *t*.

$$(-\Delta U_{it} / \Delta L_{it}) / (\Delta U_{it} / \Delta C_{it}) \leq w_{it} \qquad (2)$$

The above equation is based on the same logic as the corner solution in a standard labor supply model for an individual's decision on whether to participate in the labor market (whether to work or not work), with the only difference being that the decision is on whether to work at time *t*. The left-hand-side term in equation (2) is the reservation wage of individual *i* at time *t*. Just as each individual has a different reservation wage, each time *t* has a different reservation wage, even for the same individual. In other words, the perceived disutility of an individual will differ depending on the work timing.

We next consider the demand side. We assume that the firm engages in profitable production activity during various blocks of time throughout the day. The profit function of firm *j* is given by

$$\Pi_j = \Pi_j(a_{j1}N_1, \cdots, a_{j24}N_{24}; w) \tag{3}$$

where N_t is the number of workers at time *t*, a_{jt} is labor's contribution to firm *j*'s profit at time *t*, and *w* is the average wage of workers employed by firm *j*.

The equilibrium is shown by the standard implicit contract model of Rosen (1986). That is, the labor demanded by firm *j* at time *t*, holding other conditions constant, is supplied by the worker, out of those with the lowest reservation wages at time *t*, with the highest a_{jt}.

The labor market's wage premium θ_t at time *t* is determined by the distribution of workers' reservation wages at time *t* and by the distribution of a_{jt}. The wage at each *t* is given by $w_{it} = w_i(1+\theta_t)$. Like Hamermesh (1999a), we assume that there are time periods *t* where firms cannot fully meet their demand for labor when $\theta_t = 0$. In other words, there are time periods that are undesirable as a time to work for a large number of workers although firms can profit from operating at those times, and the wage premium ($\theta_{t'} > 0$) then serves to motivate workers to supply labor at those times.[4]

[4] Here, we assume that θ_t is determined by the labor market, although the overtime premium that applies to hours worked beyond the legal workweek is actually prescribed by law in many countries, and Japan is no exception to this. According to Japan's Labor Standards Act, legal work hours are eight hours per day and 40 hours per week, and firms must pay an overtime premium of at least

Holding other conditions constant, it is lower-income workers who will be motivated by a wage premium to work at times when the marginal disutility of labor is high, i.e., at undesirable work times.

Using this model, Hamermesh (1999a) made the following three assumptions: (1) workers' preferences do not change over time; (2) the higher the proportion of workers with relatively low human capital endowment working at a given time, the less desirable is that time for workers as a time to work; and (3) technical innovations have a uniform impact on the average productivity of workers across different time blocks, and impact the productivity of workers in various time blocks. Under these assumptions, when average real wages increase (decrease) within an economy, the share of workers who work at undesirable times should decrease (increase) because of the income effect. Moreover, when income inequality increases, higher income workers take work at desirable times while low-income workers are likely to take work at undesirable times (to earn a wage premium), and this would lead to a widening discrepancy in work timing across income levels. Hamermesh (1999a) found a decline in the number of workers who worked during the undesirable times with a high marginal disutility of labor,[5] along with an increase in average real wages and also suggested that this trend is stronger for individuals with higher incomes, consequently suggesting a widening discrepancy in the timing of work based on income level.

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25 % for any hours that exceed this. If this overtime work is done during late-night hours (defined as from 10:00 pm to 5:00 am), the required premium is at least 50 % (a 25 % premium for late-night work and a 25 % premium for overtime work). Kawaguchi, Naito, and Yokoyama (2009) showed that nearly all of the wage premia actually paid in Japan were above the 25 % level. It is unclear whether the legally prescribed wage premium is higher than that determined by the labor market (i.e., than the potential wage premium).

[5] Using the CPS and data from the FBI crime report on the number of murders by region, Hamermesh (1999b) showed that the fraction of people at work late at night was lower for regions with higher murder rates. This could be interpreted as corroboration that late-night work has a high marginal disutility of labor. Additional trials in Hamermesh (2002), which extended the CPS data set to 1997, also showed a decline in late-night work by US males.

This paper focuses on the growing number of nonregular employees with relatively lower wages in the Japanese labor market. We here define nonregular employees as nonstandard workers, consisting of part time, temporary and contract workers. From the early 1990s, Japan experienced a long-term economic slump, Japan's so-called 'lost decade and a half'. During this period, average real hourly wages have declined. Moreover, many firms reduced personnel expenses by cutting back in hiring regular employees representing high fixed costs and hiring instead inexpensive nonregular employees with relatively low skills. This practice was particularly common for new hires, especially among new graduates who entered the labor market during the prolonged recession looking for regular full-time jobs. Accordingly, the share of nonregular male employees has expanded significantly; from 8.9 % in 1996 to 18.59 % in 2006 (figures are from the *Labor Force Survey* and the *Special Survey of the Labour Force Survey*, MIAC). For those aged under 34, the share of nonregular male employees has grown from 10.1 % to 22.1 % during the same period, partly as a consequence of having no choice but to be hired as a nonregular employee, or otherwise be unemployed.

Under these circumstances, we expect more nonregular workers have taken late-night work because of negative income effects. This is because, in general, workers who face real wage declines would either work longer hours or take jobs at undesirable times with a wage premium (or both) in order to compensate for the (potential) income losses. We expect this may be more likely to occur for nonregular employees, because the average hourly wage of nonregular employees is roughly two-thirds of that of regular employees and the wage gap has been widening during this period (see Ohta 2005 for example)[6]. For nonregular employees who desire to work as a regular employee, the current wages must be much lower than their desirable level, which consequently would induce a negative income effect. We take a closer look at this below, by separating our samples into regular and nonregular employees.

[6] Since there is no 'equal pay for equal job' type regulation in Japan, the average hourly wage of nonregular employees is considerably lower than that of regular employees.

III. Data

Our data come from the *Survey on Time use and Leisure Activities* (STULA), a Japanese time use survey conducted by MIAC. STULA has been conducted every five years since 1976, in the year following the *Population Census*. It is a large-scale survey that first selects approximately 6000 survey districts from those established for the *Population Census*, out of which it selects approximately 70 000 to 100 000 households, in which live about 200 000 to 270 000 household members who are at least 10 years old. The sample size (number of households and household members) varies each survey year. The survey is based on answers from individuals regarding a consecutive two-day period that is set for each survey district, and thus the sample size is approximately twice the number of household members surveyed. The survey covers every day of the week during a nine-day period from late September to early October. We use the latest three surveys conducted in 1996, 2001, and 2006.

The survey respondents recorded their activities, chosen from a list of 20 possibilities, for each 15-minute increment within the 24-hour day. Our measure of hours worked corresponds to the category called *work* in STULA. The respondents are given a detailed definition of work, which states that '*work* includes various types of work, such as regular work, preparatory work and clean-up work, overtime, take-home work, part-time work, moonlighting, and help with the family business'. It does not include time taken for rest breaks or meals during the workday. In addition to their activities, respondents are asked other basic information such as age, level of education, marital status, whether they have children, number of persons in the household, household annual income, number of employees in the workplace, and length of usual workweek. For more information about STULA, see Kuroda (2010).

We limit our analysis to male employees, and exclude the self-employed.[7] The basic statistics for our sample are shown in Table 1.[8]

[7] Students are included in our samples. Because they are small in number, however, excluding them would not change the findings of our paper.

IV. Timing of Work

Changes from 1996 to 2006

Figs 1(1) and 1(2) show the employment rate during the day, that is, the fraction of people at work (employment rate) for each 15-minute intervals in a 24-hour day in 1996 and 2006 using weekday samples (from Monday through Friday). First, looking at Fig. 1(1) for regular employees, the overall shape of the distribution shows the employment rate is over 50 % from 8:00 am to 9:00 am, and rises to close to 85 % after 9:00 am. It then drops to about 30 % around noon (lunchtime), returns to nearly 85 % from 1:00 pm to 5:00 pm, and then gradually declines from the early evening. The slight declines around 10:00 am and 3:00 pm can probably be attributed to the large number of employees who take a break around those times. Looking next at Fig. 1(2) for nonregular employees, we find the overall shape of the distribution relatively similar to that of regular employees. That is, the employment rate rises from morning and reaches its peak before and after noon, and gradually declines from the early evening.

Changes in these employment rates by time of day also show a common trend for both regular and nonregular employees. That is, the tails at both ends of the distribution became fatter, as the employment rate from 6:00 pm until 6:00 am (evening, late night, and early morning) increase. This is the opposite of findings in Hamermesh (1999a), which show a decline in nighttime work in the US.

The extent of the change in the employment rates, however, is quite different between regular and nonregular employees. For example, the fraction of people working at midnight in 1996 was not very different between the two groups. In 2006, however, the employment rate seems to be double for nonregular employees at midnight, while that of regular employees remains stable. A significant rise in employment rates during unusual periods (especially from about 10:00 pm to 5:00 am) can be observed for the nonregular employees. Another notable feature that can be seen only for nonregular

[8] Unless noted otherwise, all analysis from this point forward is based on calculations using weights provided by the Statistics Bureau of the MIAC.

employees is that the employment rates during daytime show a significant drop over this decade.

To examine this more closely, Table 2 shows the employment rate for seven times of the day in 1996, 2001, and 2006 for weekdays. The employment rate at 11:00 am declined 5.6 % for nonregular employees while the rate has not changed for regular employees as seen in Fig. 1. Furthermore, the fraction of employees working at midnight, very early morning (3:00 am and 5:00 am), evening (7:00 pm), and late night (10:00 pm to midnight) has risen over the 10-year period. In particular, those of nonregular employees have shown substantial increases during late night and very early morning hours. The results of significance tests for differences between 1996 and 2006 are reported at the bottom of each row.

It is striking that the employment rate at 7:00 pm on weekdays has risen to 35.6 % for regular employees in 2006. This implies that more than one-third of regular male employees are working at 7:00 pm. It is important to note that Japan's Labor Standards Act was amended in 1988, and the legal workweek was shortened from 48 hours to 40 hours. This has led to wider adoption of the five-day workweek since the 1990s, which has resulted in a substantial change in the allocation of work hours between weekdays and weekends (Saturday). Kuroda (2010) found that the ratio of full-time workers working more than 10 hours per day during weekdays has increased from 35 % in 1996 to 43 % in 2006, because many people have begun to squeeze their work into five days. The increasing fraction of people working at night may have something to do with the longer work hours within the day. Table 3 shows that the average hours worked per day during weekdays has increased for regular employees while that of Saturday has decreased from 1996 to 2006. Specifically, the hours worked per weekday from Monday through Friday averaged 8.86 hours for regular employees in 1996, but increased to 9.21 hours in 2006. In contrast, there was a decline in the hours worked on Saturday, because of the fact that more people are taking Saturday off. Thus, one may argue that the observed change in the timing of work for regular

employees was because of the change in the number of hours worked resulting from regulatory changes (and/or business cycles).

For nonregular employees, however, there is no trend in average work hours except that a slight decline can be seen for Saturdays. As stated in the previous section, workers who faced real wage declines are likely either to work longer hours or to take work at undesirable times with a wage premium to compensate for the income losses. It seems, however, that the former effect cannot be seen for nonregular employees on average. We further consider this point below. However, we first check to see if there were any changes in the timing of work even after adjusting for the number of hours worked in the next section.

Adjustment of the number of hours worked

We conduct an Oaxaca–Blinder type decomposition to compare the employment rates between 1996 and 2006, which are adjusted for the difference in hours worked. We first estimate the following probit model

$$\Pr(L_{its}) = \alpha_{ts} H_{is} + e_{its}, \quad t = 1, ..., 24, \quad s = 1996,\ 2006 \tag{4}$$

where L_{its} indicates whether individual i is working at time t, taking a value of 1 for working and 0 for not working, s is the survey year, H_{is} is the daily work hours of individual i in year s, and e_{its} is the error term. Then, we decompose the changes in the employment rate from 1996 to 2006 into explained and unexplained factors based on Fairlie (2005) and Jahn (2008), as in equation (5). The explained factor F^{e} represents the changes in the employment rate brought about by changes in the number of hours worked. The unexplained factor F^{u} represents the rest of the factors that increased the employment rate even when hours worked were fixed at the 1996 level.

$$\overline{L}_{t,06} - \overline{L}_{t,96} = F^{e}(\overline{H}_{06}, \overline{H}_{96} \mid \hat{\alpha}_{t,06}) + F^{u}(\hat{\alpha}_{t,06}, \hat{\alpha}_{t,96} \mid \overline{H}_{96}) \tag{5}$$

Table 4 shows employment rates by time after adjusting for hours worked. The table suggests that most of the changes in the fraction of regular employees in each time period can be explained by the ‘explained factor’, that is, the changes in the number of

working hours. As for nonregular employees, however, the changes in the fraction in each time period cannot be explained by the changes in the number of work hours. This implies that the cause of the increasing fraction of nonregular employees working at unusual times is due to other factors besides the changes in the length of hours worked. In the next section, we focus on nonregular employees and look for the causes of the increased fraction of employment at unusual hours.

V. Causes of Increased Employment Rates at Unusual Hours

Demographic change and possible causes

In addition to the number of working hours, the change in the timing of work could also be caused by other factors, such as demographic changes in which people marry later in life and have fewer children (which leads to an ageing society), or changes in the occupational mix resulting from growth in the service industry. For example, if there were a tendency for single workers to work late-night hours and elderly workers to work early-morning hours, the demographic changes associated with population ageing and marrying later in life could possibly cause the late night and early-morning employment rates to increase, even without any change in individuals' lifestyles. It is also conceivable that an increase in the crime rate could necessitate more late-night workers such as security guards, thereby raising the late-night employment rate. We therefore check below to see if the trends seen in the previous section still hold even after holding such changes constant.

We follow the same method taken in the previous section. Here, we modify equation (4) as follows

$$\Pr(L_{its}) = \beta_{ts}^{'} X_{is} + e_{its}, \quad t = 1, ..., 24, \quad s = 1996,\ 2006 \tag{6}$$

where X_{is} is a set of variables that affect the employment decision of individual *i* at time *t*, and β_{is} is its coefficient vector. The variables we include in X_{is} are *hours of work per day*, *age*, *education* (university graduates = 1), *marital status* (married = 1), *having a child less than six years old* (having child = 1), and *occupations* (professional and

technical, managerial, sales, and blue collar; base = clerical). Because STULA does not contain industry information, we also add *the share of the service industry* by prefecture calculated from the *Basic Survey on Wage Structure* (Ministry of Health, Labour and Welfare) in order to control for structural changes in industries. STULA has information on residential location by prefecture level; thus, we are able to match the data for each sample.

Besides controlling for demographic and compositional changes, we add three variables into X_{is} to identify the causes of the increased fraction of employment at unusual hours: (a) the average number of hours worked by regular employees by prefecture, (b) the percentage of people who shop outside the hours of 8:00 am to 8:00 pm by prefecture, and (c) the male unemployment rate by region.

The average number of hours worked by regular employees is included in order to capture long-working regular employees' demand for services and goods on their way home. As explained in the previous section, the average hours worked per weekday by regular employees has increased in these years, possibly as a result of the spread of the five-day workweek. This might have delayed the timing of leaving office on weekdays, which implies that there should be plenty of demand for services and goods at later hours, such as trains, buses, taxies, convenience stores, bars, restaurants, fast food shops, and coffee shops. To motivate enough nonregular employees to work at those times and meet this demand, firms would need to raise the late-night wage premium.

Second, *the percentage of people who shop outside the hours of 8:00 am to 8:00 pm* is included to control for the effect of the open-hour legislation for large stores that was abolished in 2000. Before 2000, large stores of more than 500 square meters were under stringent control over opening hours by the Japanese government in order to protect local small shops, and thus large stores were unable to operate after 8:00 pm. After 2000, the legislation was deregulated, which enabled large stores to operate 24 hours per day in principle. To account for the effect of this deregulation, we calculate the percentage of people who shop during the period from 8:00 pm to 8:00 am using

STULA, as a proxy for the needs of consumers shopping at night. In STULA, there is an activity called *shopping* among 20 possible activities. We use 1 to indicate an individual who did shopping for at least 15 minutes from 8:00 pm to 8:00 am and 0 otherwise, and calculate the percentage of people who shop during the period by prefecture. In order to capture the effect of the changes in the legislation only, we use only nonworker samples to calculate the shopping rate.

Lastly, we include *regional male unemployment rates* in order to control for the tightness of the local labor market.

Adjusted Timing of Work

Tables 5(1) to 5(4) show the results of the Oaxaca–Blinder decomposition of nonregular employee's employment rates for four undesirable times: (1) midnight, (2) 3:00 am, (3) 10:00 pm and (4) 11:00 pm. First, looking at midnight in Table 5(1) when the employment rate increased by 4 % from 1996 to 2006, *age* is the only component that significantly explains the increase in the employment rate. Because the average age decreased from 45.6 to 42.3, the growing number of younger employees is one of the factors explaining the rise in the employment rate of nonregular employees at midnight. Otherwise, however, the table confirms that there is virtually no change even after controlling for changes in demography and the occupational mix.

Table 5(2) for 3:00 am also shows that even after controlling for various factors, two-thirds of the increase in the employment rate at this time is still unexplained. The increase in the number of single workers is the only explained factor at this time, while the *blue-collar* dummy shows a significantly negative contribution in the unexplained factor.

Next, the results shown in Table 5(3) for 10:00 pm provide a somewhat different picture in that most of the increase in the employment rate is explained by the changes in the control variables. Increases in the percentage of young and single employees are again significant at the 5 % level. Furthermore, the increase in *the average hours worked by regular employees* explains almost three-quarters of the total change in the

employment rate. We interpret this finding to imply that there have been increases in the demand for services and goods at later hours on the way home by regular employees who work until night. It is inferred that the late night wage premium to meet this demand consequently induced nonregular employees' labor supply at this time.

However, when we look at the result for 11:00 pm, *age* is the only variable that is significant as the explained factor. Instead, *the share of the service industry*, *percentage of people shopping from 8:00 pm to 8:00 am*, and *regional unemployment rate* are significant as the unexplained factor.

Interpreting the increase in night work of nonregular employees

To summarize, the Oaxaca–Blinder type decomposition of the changes in nonregular employee's employment rates during undesirable times in Tables 5(1) to 5(4) show that most of the increases are not explained by changes in demographic, occupational, or industrial composition, as well as other factors such as deregulation of operating hours for large retailers. The exception is the regular employee's working hours that have a positive effect on the nonregular employee's employment rate at 10 pm. How should we interpret these results?

One possibility is that the large unexplained factor leading to the increase in nighttime employment rates is the negative income effects of nonregular employees, which is the opposite of the phenomenon observed in the US. As we explained, Hamermesh (1999a) found a decline in US employment rates at night along with an increase in the average real wages. Conversely, the Japanese labor market experienced declining real wages after the bursting of the bubble economy, which would have induced negative income effects on the timing of work especially for the low wage earners such as nonregular employees. That is, the more the workers' potential market wages decline, the more they tend to take jobs at undesirable hours to compensate for the (potential) income loss.

Another interpretation is related to the sustained recession in post-bubble Japan that reduced the number of regular employees working daytime hours, while there was a

trend among businesses, particularly in the service industry, to greatly expand operating hours in the hope of sparking at least some demand. This may have resulted in the more highly educated, higher income employees working during the desirable daytime hours as regular employees, while the other workers, having been squeezed out, had no choice but to work at other times.[9] We assume these factors, coming both from the labor supply and demand sides, brought about the increase in the employment rate of nonregular employees at undesirable times.

Then, how should we evaluate these increases in employment rates of nonregular employees at undesirable hours? As far as consumers who work overtime are able to purchase services and goods on their way home, or the workers who fail to find a job during daytime are able to get nonregular jobs at night, it may be a better outcome for all workers. However, issues such as health problems caused by nighttime work also cannot be ignored. It is sometimes argued that night work as well as long working hours could adversely affect one's health.

In fact, we can observe that the increase in the nighttime employment rate is accompanied by longer working hours. Fig. 2 is a radar chart where we plot the average daily work hours for those who work at each time of the day. It is found that the solid line (the average hours worked in 2006) expands to the northeast direction from the dotted line (those in 1996), which indicates the increasing average hours worked for those who work from midnight to 6:00 am. This indicates that the average hours worked for those working from midnight to early morning increased in 2006. Furthermore, Fig. 2 suggests that the average hours worked by nonregular employees who work from midnight to early morning in 2006 is almost the same length as that of daytime regular employees in 1996 (shown using triangle dots). It is important to note that we have shown in Table 2 that the average hours worked by all nonregular employees is much shorter than that of regular employees, and has not changed during the decade. However, Fig. 2 indicates that nonregular employees who work during undesirable night hours

[9] An increase in the fraction of workers working at unusual times as a result of wider use of the internet could be another possibility. This is an area for further study.

began to work as many hours in 2006 as that of daytime regular employees. This finding may also be evidence of the negative income effect for those who work during undesirable times as described in Section II. That is, workers who need to earn more at low wage rates tend to work longer hours to earn more income.

VI. Conclusion

This paper aimed to understand Japanese worker's recent lifestyle changes by observing the timing of work during the day, using a Japanese time use survey from 1996 to 2006.

We showed that Japan had a noteworthy increase in the share of employees working at unusual times (late night and early morning) over a decade starting in the mid 1990s. When controlling for changes in hours worked, however, we found that the notable increase in the fraction of people at work at such unusual times was evident for low-income nonregular employees while relatively higher-income regular employees' work timing remained stable. These observations imply that there is a trend of diversification of work timing in Japan between regular and nonregular employees, suggesting another aspect of inequality.[10] The increase in the employment rate during late night and early-morning hours, which are generally thought of as undesirable hours with a high marginal disutility of work, is an interesting result, because Hamermesh (1999a) found opposite results: a decline in the late night and early-morning employment rate in the US.

Why has the employment rate for nonregular employees during late night and early-morning hours increased in Japan? We pointed out a possible explanation in that the increase in the average hours worked per weekday by regular employees possibly because of the spread of the five-day work week increased the demand for services and goods at later hours as workers returned home. An Oaxaca–Blinder type decomposition

[10] Kuroda and Yamamoto (2010) showed that notable increases in the late night and very early-morning employment rates since the mid 1980s was evident among full-time workers with low levels of both education and income in Japan.

suggested that such increases in the average hours worked by regular employees explains partially the rise in the employment rate of nonregular employees at unusual times. However, unexplained factors remain. We conclude that the remaining factor relates to the negative income effect, which induces low-wage nonregular employees to take jobs at night to earn a wage premium. Another interpretation is that the job opportunities are limited to nonregular work at night, thus people have no choice but to accept jobs at those undesirable times because of the prolonged recession.

This growth in work timing differences during a sustained economic slump could probably be interpreted as evidence that people were happy just to have the opportunity to work, even at undesirable times. If that is the case, income inequality is lower than it would have been with absolutely no change in the work timing gap. In other words, another way to frame these phenomena is that although gaps in the timing of work arose during Japan's lost decade, this was a successful way to avoid unemployment and brought the added benefit of suppressing the increase in income inequality.

There has been an increase in health problems related to overworking and stress in Japan in the last several years; however, this may be related to the rising number of people working late night and early-morning hours. Some interesting issues for further study are the causes of differences in the timing of work and whether late-night work has anything to do with Japan's increase in overworking and stress-related health problems.

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Table 1: Basic statistics

		Regular employees		Nonregular employees	
Age		41.12	(10.98)	43.28	(15.18)
Education (university graduates = 1)		0.34	(0.47)	0.19	(0.39)
Marital status (married = 1)		0.72	(0.45)	0.49	(0.50)
Child (having child = 1)		0.18	(0.38)	0.04	(0.19)
Occupations	Professional + technical	0.16	(0.36)	0.10	(0.29)
	Managerial	0.04	(0.19)	0.00	(0.06)
	Clerical	0.18	(0.38)	0.10	(0.30)
	Sales	0.15	(0.36)	0.08	(0.28)
	Blue collar	0.48	(0.50)	0.72	(0.45)
Average hours worked per day		8.98	(3.28)	6.75	(3.75)
Sample sizes		88801		8052	

Notes: Weekday (Monday through Friday) respondents.

Standard deviations are given in parentheses.

Table 2: Employment Rate by Time

	midnight	3:00 am	5:00 am	11:00 am	7:00 pm	10:00 pm	11:00 pm
Regular employees							
1996	0.036	0.024	0.032	0.853	0.305	0.077	0.054
2001	0.042	0.025	0.032	0.841	0.340	0.092	0.063
2006	0.042	0.029	0.035	0.853	0.359	0.094	0.062
96 --> 06	0.006 **	0.004 **	0.003 *	0.000	0.054 **	0.017 **	0.008 **
Nonregular employees							
1996	0.041	0.025	0.038	0.691	0.151	0.070	0.053
2001	0.062	0.045	0.056	0.620	0.167	0.084	0.074
2006	0.084	0.057	0.066	0.635	0.210	0.097	0.083
96 --> 06	0.043 **	0.032 **	0.028 **	-0.056 **	0.059 **	0.027 **	0.030 **

Note: $^{+}$, *, ** indicate 10, 5, 1 % statistical significance, respectively.

Table 3: Average Hours Worked Per Day

	Regular employees			change	Nonregular employees			change
	1996	2001	2006	96->06	1996	2001	2006	96->06
Weekday	8.86	8.87	9.21	0.34 **	6.76	6.58	6.86	0.10
Saturday	4.97	4.58	4.47	-0.49 **	4.98	4.64	4.70	-0.28 *
Sunday	2.16	2.16	2.23	0.07 *	2.52	2.36	2.58	0.07

Note: $^{+}$, *, ** indicate 10, 5, 1 % statistical significance, respectively.

Table 4: Employment Rate Decomposition (Adjusting the Number of Hours Worked)

	midnight	3:00 am	5:00 am	11:00 am	7:00 pm	10:00 pm	11:00 pm
Regular employees							
difference	0.006	0.004	0.003	0.000	0.054	0.017	0.008
(explained)	0.002 **	0.002 **	0.003 **	0.012 **	0.046 **	0.015 **	0.007 **
(unexplained)	0.004 +	0.002	0.002	-0.012 **	0.009 +	0.003	0.001
Nonregular employees							
difference	0.043	0.032	0.028	-0.056	0.059	0.027	0.030
(explained)	0.003	0.003	0.003	0.002	0.011	0.003	0.003
(unexplained)	0.040 **	0.030 **	0.026 **	-0.059 **	0.049 **	0.024 *	0.027 **

Notes: 'difference' = employment rate at time t in 2006 – employment rate at time t in 1996.

+, *, ** indicate 10, 5, 1 % statistical significance, respectively.

Table 5: Employment Rate Decomposition (Adjusting for Demography and Other Possible Changes)

(1) Midnight

	Mean		Estimated coefficients		Oaxaca decomposition	
	Year 2006	Year 1996	Year 2006	Year 1996	Explained	Unexplained
Dependent variable	0.084	0.041	-	-	0.0089	0.0336+
Employment rate at midnight	(0.277)	(0.198)	-	-	(0.015)	(0.018)
Control variables						
The number of hours worked	6.861	6.762	0.1131**	0.0935**	0.0016	0.0178
	(3.829)	(3.647)	(0.021)	(0.019)	(0.003)	(0.030)
Age	42.297	45.645	-0.0112*	-0.0132*	0.0059+	0.0117
	(14.825)	(15.180)	(0.005)	(0.006)	(0.003)	(0.044)
Education (university graduates = 1)	0.203	0.174	0.0682	-0.1583	0.0002	0.0054
	(0.402)	(0.379)	(0.174)	(0.212)	(0.001)	(0.007)
Marital status (married = 1)	0.420	0.592	-0.2298	-0.1431	0.0055	-0.0063
	(0.494)	(0.492)	(0.153)	(0.145)	(0.004)	(0.016)
Child (having child = 1)	0.035	0.045	-0.1396	-0.0646	0.0002	-0.0004
	(0.184)	(0.207)	(0.220)	(0.257)	(0.000)	(0.002)
Share of service industry in prefecture	0.623	0.578	1.1965	0.1708	0.0073	0.0804
	(0.098)	(0.091)	(0.773)	(0.808)	(0.007)	(0.094)
Occupations: (base = Clerical)						
Professional and technical	0.085	0.116	-0.8394*	-0.1160	0.0029	-0.0102
	(0.279)	(0.320)	(0.404)	(0.347)	(0.002)	(0.008)
Sales	0.081	0.080	0.0921	0.0774	0.0000	0.0002
	(0.272)	(0.271)	(0.402)	(0.355)	(0.000)	(0.006)
Blue collar	0.729	0.682	0.0901	0.1965	0.0008	-0.0100
	(0.444)	(0.466)	(0.373)	(0.299)	(0.002)	(0.044)
Averege hours worked by regular employees	9.203	8.854	-0.1886	0.1699	-0.0067	-0.4273
	(0.274)	(0.184)	(0.187)	(0.285)	(0.012)	(0.420)
Percentage of people shopping from 8 pm to 8 am	1.174	0.754	-0.0707	-0.3300*	-0.0106	0.0310
	(0.386)	(0.380)	(0.168)	(0.161)	(0.012)	(0.027)
Regional unemployment rate	4.859	3.845	0.0329	-0.0964	0.0020	0.0692
	(1.026)	(0.559)	(0.073)	(0.110)	(0.010)	(0.072)
Constant	-	-	-0.8985	-2.9353		0.2722
	-	-	(1.837)	(2.741)		(0.440)

Notes: Numbers in parentheses are robust standard errors.

+, *, ** indicate 10, 5, 1 % statistical significance, respectively.

The number of observations is 2,945 for year 2006 and 2,767 for year 1996.

Table 5: Employment Rate Decomposition (Adjusting for Demography and Other Possible Changes)

(2) 3:00 am

	Mean		Estimated coefficients		Oaxaca decomposition	
	Year 2006	Year 1996	Year 2006	Year 1996	Explained	Unexplained
Dependent variable	0.057	0.025	-	-	0.0101	0.0218+
Employment rate at midnight	(0.231)	(0.155)	-	-	(0.008)	(0.013)
Control variables						
The number of hours worked	6.861	6.762	0.1296**	0.0806**	0.0011	0.0234
	(3.829)	(3.647)	(0.031)	(0.018)	(0.002)	(0.025)
Age	42.297	45.645	-0.0011	-0.0092+	0.0013	0.0252
	(14.825)	(15.180)	(0.005)	(0.005)	(0.001)	(0.022)
Education (university graduates = 1)	0.203	0.174	-0.0005	0.2219	0.0002	-0.0029
	(0.402)	(0.379)	(0.213)	(0.228)	(0.001)	(0.004)
Marital status (married = 1)	0.420	0.592	-0.3075*	-0.4235*	0.0055*	0.0046
	(0.494)	(0.492)	(0.142)	(0.177)	(0.002)	(0.008)
Child (having child = 1)	0.035	0.045	0.3496	0.2631	-0.0004	0.0003
	(0.184)	(0.207)	(0.234)	(0.284)	(0.000)	(0.001)
Share of service industry in prefecture	0.623	0.578	-0.2561	-2.9355**	-0.0036	0.1104
	(0.098)	(0.091)	(0.795)	(0.754)	(0.003)	(0.069)
Occupations: (base = Clerical)						
Professional and technical	0.085	0.116	-1.4876**	0.1691	0.0033	-0.0126
	(0.279)	(0.320)	(0.517)	(0.405)	(0.002)	(0.008)
Sales	0.081	0.080	-0.3862	0.3849	-0.0000	-0.0044
	(0.272)	(0.271)	(0.445)	(0.296)	(0.000)	(0.004)
Blue collar	0.729	0.682	-0.1431	0.9118**	0.0001	-0.0516+
	(0.444)	(0.466)	(0.406)	(0.248)	(0.001)	(0.029)
Averege hours worked by regular employees	9.203	8.854	0.0072	-0.0054	0.0003	0.0078
	(0.274)	(0.184)	(0.188)	(0.329)	(0.006)	(0.236)
Percentage of people shopping from 8 pm to 8 am	1.174	0.754	-0.0560	-0.0863	-0.0019	0.0013
	(0.386)	(0.380)	(0.190)	(0.174)	(0.007)	(0.016)
Regional unemployment rate	4.859	3.845	0.0163	0.2030*	0.0042	-0.0520
	(1.026)	(0.559)	(0.069)	(0.102)	(0.006)	(0.045)
Constant	-	-	-2.2286	-1.8350		-0.0276
	-	-	(1.755)	(3.069)		(0.247)

Note: See Table 5(1).

Table 5: Employment Rate Decomposition (Adjusting for Demography and Other Possible Changes)

(3) 10:00 pm

	Mean		Estimated coefficients		Oaxaca decomposition	
	Year 2006	Year 1996	Year 2006	Year 1996	Explained	Unexplained
Dependent variable	0.097	0.070	-	-	0.0235+	0.0027
Employment rate at midnight	(0.297)	(0.256)	-	-	(0.013)	(0.015)
Control variables						
The number of hours worked	6.861	6.762	0.1092**	0.1219**	0.0017	-0.0098
	(3.829)	(3.647)	(0.018)	(0.017)	(0.003)	(0.012)
Age	42.297	45.645	-0.0101*	-0.0104*	0.0049*	0.0013
	(14.825)	(15.180)	(0.005)	(0.004)	(0.002)	(0.032)
Education (university graduates = 1)	0.203	0.174	-0.0127	-0.3979*	-0.0005	0.0079
	(0.402)	(0.379)	(0.152)	(0.159)	(0.001)	(0.018)
Marital status (married = 1)	0.420	0.592	-0.3148**	-0.0513	0.0061*	-0.0160
	(0.494)	(0.492)	(0.121)	(0.116)	(0.003)	(0.040)
Child (having child = 1)	0.035	0.045	0.2802	-0.0609	-0.0002	0.0016
	(0.184)	(0.207)	(0.185)	(0.229)	(0.000)	(0.004)
Share of service industry in prefecture	0.623	0.578	-1.1384+	0.8170	-0.0034	-0.1322
	(0.098)	(0.091)	(0.659)	(0.680)	(0.004)	(0.297)
Occupations: (base = Clerical)			(0.237)	(0.166)	(0.001)	(0.010)
Professional and technical	0.085	0.116	0.3420	0.2932	-0.0015	0.0005
	(0.279)	(0.320)	(0.231)	(0.244)	(0.001)	(0.004)
Sales	0.081	0.080	0.2265	-0.1037	0.0000	0.0030
	(0.272)	(0.271)	(0.217)	(0.255)	(0.000)	(0.008)
Blue collar	0.729	0.682	0.0725	-0.0908	0.0000	0.0132
	(0.444)	(0.466)	(0.176)	(0.187)	(0.001)	(0.037)
Averege hours worked by regular employees	9.203	8.854	0.2688	0.1031	0.0144*	0.1675
	(0.274)	(0.184)	(0.175)	(0.244)	(0.007)	(0.501)
Percentage of people shopping from 8 pm to 8 am	1.174	0.754	0.0398	-0.2724*	-0.0069	0.0336
	(0.386)	(0.380)	(0.128)	(0.129)	(0.007)	(0.076)
Regional unemployment rate	4.859	3.845	0.1224*	-0.2127*	0.0090	0.1544
	(1.026)	(0.559)	(0.060)	(0.096)	(0.007)	(0.348)
Constant	-	-	-4.1655*	-2.2136		-0.2223
	-	-	(1.691)	(2.333)		(0.624)

Note: See Table 5(1).

Table 5: Employment Rate Decomposition (Adjusting for Demography and Other Possible Changes)

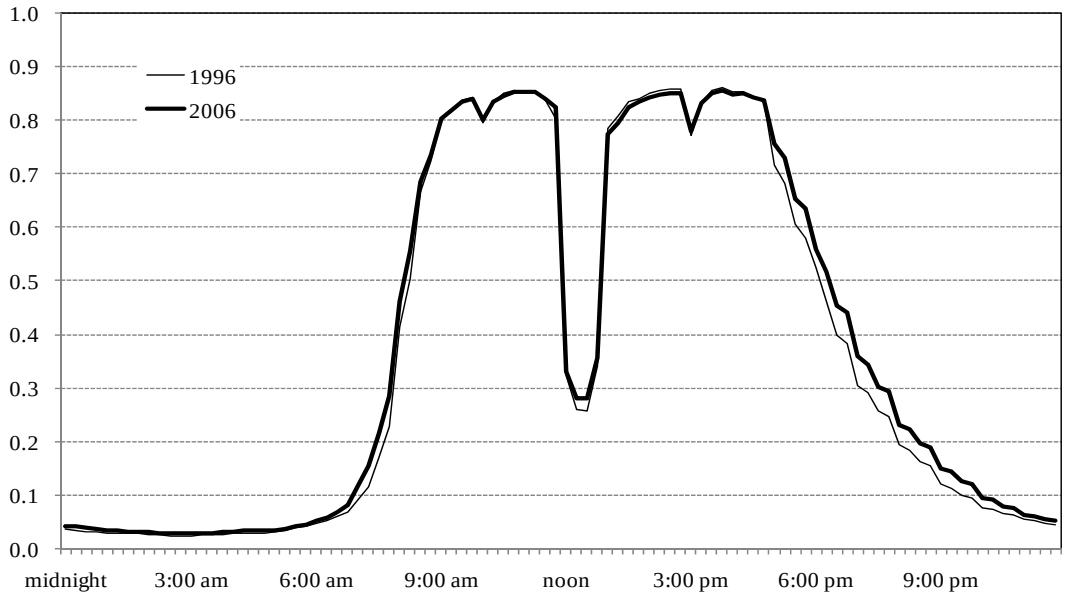
(4) 11:00 pm

	Mean		Estimated coefficients		Oaxaca decomposition	
	Year 2006	Year 1996	Year 2006	Year 1996	Explained	Unexplained
Dependent variable	0.083	0.053	-	-	0.0165	0.0130
Employment rate at midnight	(0.276)	(0.224)	-	-	(0.013)	(0.014)
Control variables						
The number of hours worked	6.861	6.762	0.0941**	0.1187**	0.0014	-0.0147
	(3.829)	(3.647)	(0.018)	(0.021)	(0.002)	(0.012)
Age	42.297	45.645	-0.0082+	-0.0151**	0.0044*	0.0272
	(14.825)	(15.180)	(0.005)	(0.005)	(0.002)	(0.028)
Education (university graduates = 1)	0.203	0.174	0.1081	-0.5359**	-0.0002	0.0102
	(0.402)	(0.379)	(0.154)	(0.203)	(0.001)	(0.006)
Marital status (married = 1)	0.420	0.592	-0.2660*	0.1144	0.0039	-0.0181
	(0.494)	(0.492)	(0.121)	(0.126)	(0.002)	(0.013)
Child (having child = 1)	0.035	0.045	0.2389	-0.1680	-0.0001	0.0015
	(0.184)	(0.207)	(0.185)	(0.220)	(0.000)	(0.001)
Share of service industry in prefecture	0.623	0.578	-1.0186	1.4134+	-0.0016	-0.1270+
	(0.098)	(0.091)	(0.671)	(0.778)	(0.003)	(0.067)
Occupations: (base = Clerical)						
Professional and technical	0.085	0.116	0.6336*	0.1167	-0.0019	0.0047
	(0.279)	(0.320)	(0.290)	(0.318)	(0.001)	(0.005)
Sales	0.081	0.080	0.6917*	-0.1747	0.0000	0.0062
	(0.272)	(0.271)	(0.270)	(0.308)	(0.001)	(0.004)
Blue collar	0.729	0.682	0.6852**	-0.0225	0.0023	0.0440
	(0.444)	(0.466)	(0.225)	(0.228)	(0.001)	(0.033)
Averege hours worked by regular employees	9.203	8.854	0.0742	-0.2363	0.0026	0.2429
	(0.274)	(0.184)	(0.178)	(0.250)	(0.008)	(0.255)
Percentage of people shopping from 8 pm to 8 am	1.174	0.754	0.0945	-0.3320*	-0.0044	0.0345+
	(0.386)	(0.380)	(0.133)	(0.144)	(0.007)	(0.020)
Regional unemployment rate	4.859	3.845	0.1452*	-0.2566*	0.0102	0.1429*
	(1.026)	(0.559)	(0.062)	(0.109)	(0.007)	(0.069)
Constant	-	-	-3.2396+	0.6348		-0.3414
	-	-	(1.771)	(2.414)		(0.301)

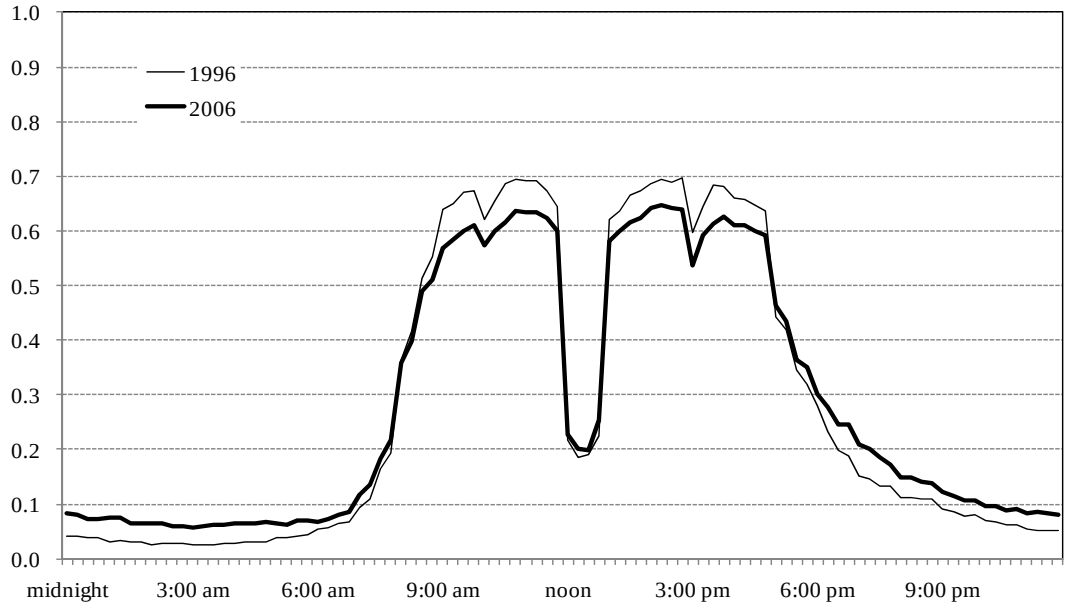
Note: See Table 5(1).

Fig. 1: Employment rate by time on weekdays (all male employees)

(1) Regular Employees



(2) Nonregular Employees



Note: Regular and nonregular employees (including students) aged 23 to 64. Self-employed are excluded.

Fig. 2: Average daily work hours by time of the day