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The Impact of the Minimum Wage Increase on Subjective Wellbeing: Evidence from Japan

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The impact of the minimum wage increase on subjective wellbeing: Evidence from Japan [1]

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Abstract

This study examines the association between subjective wellbeing and minimum wage using the Japan Panel Survey of Consumers (JPSC). JPSC investigates Japanese young and middle-aged women with a relatively high proportion of low-paid, non-regular workers. Based on fixed-effects models, the estimated results revealed no significant effect of minimum wage when using the continuous variable of life satisfaction as the dependent variable. However, we found a significant positive association between the minimum wage and life satisfaction when a dummy variable indicating whether the respondent had a high life satisfaction was used as the independent variable. This positive association was robust against estimation methods and the change of the definition of the treatment group that was affected by the minimum wage and the control group that was not affected by the minimum wage but worked at wage levels near the minimum wage. The estimated results of this study are partially consistent with previous studies examining the effect of introducing the minimum wage in Germany.

Keywords: minimum wage, subjective wellbeing, fixed-effects model

JEL classification: I31, J31

[1]This study is conducted as a part of the Project"Research on Working-style Reform, Health and Productivity Management" undertaken at the Research Institute of Economy, Trade and Industry (RIETI). This study utilizes the micro data of the Japan Panel Survey of Consumers (JPSC), which is conducted by the Panel Data Research Center at Keio University. The author is grateful for helpful comments and suggestions provided by Daigo Nakata, Kotaro Tsuru, Makoto Yano, Masayuki Morikawa, Sagiri Kitao and participants at the RIETI discussion paper seminar.

1. Introduction

A minimum wage is instituted in many countries to protect workers' basic needs. However, excessively raising the minimum wage level could reduce employment. Many empirical analyses examine the negative effect of minimum wage on employment, particularly in the US, and provide mixed results (Neumark & Wascher, 2007; Neumark et al., 2014 for a review). For example, several studies demonstrate a negative employment effect (Neumark & Wascher, 1992; Burkhauser et al., 2000; Zavodny, 2000; Rama, 2001; Machin et al., 2003; Bossler & Gerner, 2016; Gittings & Schmutte, 2016; Lopresti & Mumford, 2016; Sabia et al., 2016; Schmitz, 2017; Sturn, 2018). However, other studies find no negative employment effect (Card, 1992; Katz & Krueger, 1992; Machin & Manning, 1994; Dickens et al., 1999; Dube et al., 2010; Dolton et al., 2015; Garloff, 2016). Based on these results, a definitive conclusion has not been reached yet.

Several studies have recently explored the association between minimum wage and subjective wellbeing (SWB) (Bossler & Broszeit, 2017; Gülal & Ayaita, 2019). These studies assume that raising the minimum wage can increase SWB in two ways. First, raising the minimum wage can increase the SWB of affected low earners as SWB is positively related to absolute income (Frijters et al., 2004; Gardner & Oswald, 2007). Second, raising the minimum wage can reduce income disparity and relative deprivation negatively associated with SWB (Boyce et al., 2010; Card et al., 2012). Thus, a minimum wage increase could be positively associated with SWB. Accordingly, Bossler and Broszeit (2017) and Gülal and Ayaita (2019) examine the relationship between minimum wage and SWB; they use the introduction of a new statutory minimum wage in Germany of €8.50 per hour as a quasi-experiment. Using the difference-in-differences approach, Bossler and Broszeit (2017) find that introducing a minimum wage increases job and pay satisfaction. They examined the effects of the minimum wage on work engagement and turnover intention and found no significant relationships. In addition, Gülal and Ayaita (2019) use the difference-in-differences approach and reveal a positive association between SWB and life, job, and pay satisfaction. They find that the positive effect of minimum wage continues to 1 year after the introduction of the minimum wage. The abovementioned two studies are interesting as they provide new empirical evidence regarding SWB and minimum wage, which has not been examined thus far. However, those studies focus on the case of Germany only. Therefore, whether the same results will be obtained using data from other countries with different minimum wage systems remains unclear.

The present study examines the association between SWB and minimum wage using the Japan Panel Survey of Consumers (JPSC). JPSC is one of the representative panel data that surveys young and middle-aged women in Japan. The statutory minimum wage has been established in Japan since its Minimum Wage Law was enacted in 1959. The regional minimum wage by prefectures plays a vital role in Japan and is revised every year considering the economic situation and the supply and demand of the labor market. This study provides new empirical evidence regarding minimum wage and SWB using annual changes in minimum wages by prefectures as a quasi-experiment.

This study has several contributions. First, this study is the first to examine the association between SWB and minimum wage using Asian data. Notably, we can analyze long-term data compared with Germany as the minimum wage was introduced decades ago in Japan. Second, this study controls time-invariant

individual heterogeneity by using the panel estimation method. The fixed-effects (FE) model examines the association between SWB and minimum wage. Third, we check the robustness of the estimated results by changing the definitions of the treatment and control groups, which are affected and not affected by the regional minimum wage, respectively. Nevertheless, the control group works at wage levels near the minimum wage.

The definition of the treatment and control groups is one of the issues in the analyses examining the effect of minimum wage. The present study defines the treatment group as workers whose wages in period $t-1$ are higher than the minimum wage in the same period but lower than in period t. The treatment groups are the low earners affected by minimum wage change in each period. The control group is workers whose wages in period $t-1$ are higher than those in period t. Additionally, the control group is restricted to workers whose wages in period $t-1$ are above the minimum wage threshold in period t; this limitation allows obtaining a sample with attributes close to those of the treatment group. The control group is restricted to workers whose wages in period $t-1$ are below 150% of the minimum wage in period t; this restriction is based on Bossler and Broszeit (2017) and Gülal and Ayaita (2019). The control group includes workers whose wage level is close to the minimum wage, although it is not affected by minimum wage changes.

This study uses life satisfaction as a measure of SWB. Life satisfaction is measured on a 5-point scale, where high values indicate high satisfaction. The analysis uses two types of dependent variables: the continuous and dummy variables of life satisfaction. The dummy variable of life satisfaction equals 1 if life satisfaction is rated as "very much satisfied" or "quite satisfied" and 0 otherwise. In addition, this variable indicates whether respondents have high life satisfaction. In the analysis, biographical, educational, and job-related attributes are controlled. The estimated FE model results show no significant association between the continuous variable of life satisfaction and minimum wage. However, the dummy variable of life satisfaction and minimum wage show a significant positive association. This positive relationship is robust regarding the estimation method and the definition of the treatment and control groups. Thus, minimum wage likely increases life satisfaction in Japan. This result is in line with Bossler and Broszeit (2017) and Gülal and Ayaita (2019) and shows that minimum wage improves wage level and SWB.

The remainder of this paper is organized as follows. Section 2 discusses previous studies, and Section 3 explains Japan's statutory minimum wage. Section 4 explains the data, and Section 5 shows the empirical strategy. Section 6 discusses the estimation results. Lastly, Section 7 provides the concluding remarks.

2. Literature Review

Empirical studies on minimum wage and SWB include Bossler and Broszeit (2017) and Gülal and Ayaita (2019). Using the German Linked Personnel Panel provided by the Institute for Employment Research, Bossler and Broszeit (2017) examine the effect of the introduction of minimum wage on pay and job satisfaction. In Germany, a new statutory minimum wage of €8.50 per hour was established on January 1, 2015. Bossler and Broszeit (2017) examine whether pay and job satisfaction differ between affected low-income workers and unaffected workers before and after introducing minimum wages. Their study defines treatment groups affected by the minimum wage and control groups as those whose wages in 2013 are

below and above €8.50, respectively.

Furthermore, they use the subjective treatment assignment to inquire respondents about whether they feel affected by the minimum wage in 2015. The estimated result using the difference-in-differences approach using data from 2013 to 2015 reveals a positive relationship between minimum wage and pay satisfaction. This result is generated using the treatment assignment based on hourly wage in 2013. Conversely, pay and job satisfaction positively associate with minimum wage when using the subjective treatment assignment.

Gülal and Ayaita (2019) also focus on introducing the minimum wage in Germany using the German Socio-Economic Panel. They define treatment and control groups as workers whose hourly wages in 2014 are below €8.50 and between €8.50 and €12.75 (50% higher), respectively. The result of the difference-in-differences analysis using data from 2014 to 2015 indicates that the introduction of minimum wage increases life, pay, and job satisfaction of affected low earners. The results are robust against the change in the definition of the treatment group. Additionally, Gülal and Ayaita (2019) find a difference in the effect among East and West Germany workers. The impact of minimum wage on workers' SWB is more substantial in East Germany than in West Germany.

In Japan, no study has examined the association between SWB and minimum wage. Nevertheless, certain studies investigate the effect of minimum wage on employment and earnings. Kawaguchi and Yamada (2007) discuss the unemployment effect of minimum wage using the JPSC. Their result demonstrates that minimum wage significantly negatively impacts affected low earners whose current wages are below the revised minimum wage. Kawaguchi and Mori (2009) use the micro-data of the Employment Structure Survey and demonstrate that the minimum wage has an unemployment effect on male teenagers and middle-aged married women. Their study reveals that most workers earning a minimum wage are non-household heads. Moreover, more than 70% of minimum wage workers are women, with a large proportion of those aged 30–59 years. Kambayashi et al. (2013) examine the impact of minimum wage on wage distribution using cross-sectional data from the Basic Survey on Wage Structure. They found that minimum wage increase compresses the lower tail of the wage distribution among women. Using the Keio Household Panel Survey, Higuchi (2013) demonstrates that raising the minimum wage increases wages of non-regular workers, particularly females, but does not have an unemployment effect.

In summary, previous studies based on German data present a positive association between SWB and minimum wage. In contrast, no study has examined the effect of minimum wage on SWB in Japan, whereas certain studies examine the relationship between minimum wage and employment and earnings. The present study provides new empirical evidence regarding the association between SWB and minimum wage in Japan and fill the studies' gap.

3. Statutory minimum wage in Japan

Japan's statutory minimum wage system sets a minimum wage based on the Minimum Wage Law and requires employers to pay wages above this minimum wage. The country has two minimum wage types: minimum wage by region and by industry. The present study focuses on regional minimum wage because

the industrial minimum wage has limited coverage and is gradually abolished (Kawaguchi & Mori, 2009). Regional minimum wages apply to all workers within a prefecture, regardless of industry and occupation. Japan has 47 prefectures, in which the minimum wage has been set since 1976. Regional minimum wages are revised annually.

The following steps determine regional minimum wages. First, the central minimum wage council discusses and presents the criteria for raising the minimum wage. The council comprises representatives of public interest, employees, and employers. Second, each prefecture's regional minimum wage council discusses and reports the minimum wage based on the region's actual situation according to the criteria of the increasing amount; the central minimum wage council indicates these criteria. Lastly, the prefectural labor bureau chief determines the regional minimum wage level based on the reports of the regional minimum wage council.

Figure 1 displays the average minimum wage level and its change rate in prefectures from 1993 to 2015, the analytical period of this study. The figure illustrates that the average minimum wage is rising moderately. In contrast, the minimum wage change rate declined until 2003. This decline was due to the long-term recession caused by the collapse of the bubble economy. After that, the economy has gradually recovered, and the minimum wage rate change rate has been increasing. The minimum wage will not be reduced and tends to remain unchanged, despite the recession period, to ensure workers' livelihood. Thus, the minimum wage change rate has not fallen below 0. This rate has increased since 2007 due to the revised Minimum Wage Law in 2007. The revision stipulates that the welfare received should be consistent to avoid exceeding the minimum wage income.

4. Data

This study uses data from JPSC, which surveys data on families, income, employment, wellbeing, and residential place and type in Japan. JPSC conducts its annual survey every October using a two-step, stratified sampling method. JPSC was first implemented in 1993, with 1500 female respondents aged 24–34 years. The data available for this study are from 1993 to 2015, with additional samples provided from 1997, 2003, and 2008. JPSC provides the data of the prefectural codes of each respondent. This study uses the prefectural codes to match regional minimum wage and respondents.

Using JPSC has the advantage of an extended data period, which allows us to obtain many samples compared with other panel data in Japan. Conversely, the disadvantage of using JPSC is that it only surveys women. However, the analyzed samples of JPSC are considered appropriate when examining the effect of the minimum wage because most minimum wage workers are women, as stated in Kawaguchi and Mori (2009).

This study analyzes women who continue to work in non-regular employment from the $t-1$ period to the t period. We restrict the sample to non-regular employment because regular and non-regular workers

have significantly different working conditions, and most minimum wage workers are non-regular[2] (Kawaguchi & Mori, 2009). Moreover, the analyzed samples are restricted to workers who continue to work at the same company to control the change in working conditions due to job changes. Furthermore, we remove the samples that move across prefectures to eliminate the impact of minimum wage level changes due to movement. After deleting missing variables used in the analysis, 5,392 observations were included in the analysis.

5. Empirical Method

This study examines the effect of minimum wage on SWB using Japanese panel data. We estimate two econometric models using panel estimation methods as follows:

$$LC_{it} = \alpha_0 + \alpha_1 Treat_{it} + \alpha_2 X_{it} + \alpha_3 \mu_i + \alpha_4 \theta_t + \varepsilon_{it} \quad (1)$$

where LC_{it} indicates the subjective rating of life satisfaction of women i at time t; $Treat_{it}$ indicates the dummy variable of the treatment group, which identifies whether women with non-regular employment are affected by minimum wage; X_{it} indicates the individual attributes; μ_i indicates time-invariant individual heterogeneity; θ_t indicates prefectural job opening ratio and year dummy; and ε_{it} indicates the error term. X_{it} includes educational attainment, age, age squared, marital status, child-related variables (number of children, with children under 3 years old, with children aged 4–12 years), household income, employment status, and working hours. θ_t are used to control the varying effects of macroeconomic conditions.

Life satisfaction is determined by the question, "Are you generally satisfied with your life?" Respondents select from the following five choices: "1 = very much," "2 = quite," "3 = moderately," "4 = a little," and "5 = not at all." These figures are reversed in the analysis, and the higher the number, the better life satisfaction. In the analysis, a z-standardized measure, with 0 mean and 1 standard deviation, is used to simplify interpreting the results.

Following Kawaguchi and Yamada (2007), the treatment group of minimum wage consists of workers who meet the following condition:

$$MW_{it-1} \leq W_{it-1} \leq MW_{it} \quad (2)$$

where MW_{it} indicates the regional minimum wage of women i at time t, and W_{it} indicates the hourly wage of women i at time t. Equation (2) indicates that women whose hourly wages at $t-1$ period are higher than the minimum wage at the same period and less than the minimum wage at t period are assigned

[2] In Japan, non-regular workers are generally composed of part-time workers, temporary workers, and contract workers. Among non-regular workers, the percentage of part-time workers is the largest, often accounting for 72% of the total (Labour Force Survey conducted by the Ministry of Internal Affairs and Communications from 2013 to 2019). We estimated the effect of minimum wage when restricting the sample to only part-time workers. The estimated results were almost the same as the findings, which restricted the sample to non-regular workers.

to the treatment group. This group is the workers affected by the minimum wage change.

The control group of the minimum wage is subject to the following condition:

$$MW_{it} \leq W_{it-1} \leq MW_{it} \times 1.50 \tag{3}$$

Equation (3) denotes that the control group comprises women whose hourly wages at the $t-1$ period are above the minimum wage at t period and below 150% of the minimum wage at t period. The control group includes workers who are unaffected by the minimum wage change but work at a wage close to the minimum wage. This restriction allows us to select low-wage workers whose attributes are close to those of the treatment group. Gülaland Ayaita (2019) has also restricted workers to those with wages less than 150% of the minimum wage. In the robustness section, the present study changes the upper limit of the minimum wage of the control group and confirms whether the effect of the minimum wage changes[3].

Equation (1) is estimated using FE OLS. To check the robustness of the estimated results, they are also estimated using the FE ordered logit model (Baetschmann et al., 2020). Using this model, only individuals with variations in their dependent variables are available in the estimate (Baetschmann et al., 2020). Therefore, the observations of the FE ordered logit are smaller than those of pooled ordered logit.

In addition to Equation (1), the following econometric model is estimated using FE OLS and FE logit model:

$$LD_{it} = \beta_0 + \beta_1 Treat_{it} + \beta_2 X_{it} + \beta_3 \mu_i + \beta_4 \theta_t + \varepsilon_{it} \tag{4}$$

Equations (1) and (4) differ in the dependent variable only. In Equation (4), the dummy variable of life satisfaction equals 1 if life satisfaction is rated "very much" or "quite" and 0 otherwise. Further, this dummy variable is the dependent variable. Previous studies reveal that married women, who comprise approximately 80% of the sample in this study, are likely to have higher happiness or life satisfaction and that the results tend to be skewed toward the positive side of the scale[4] (Helliwell, 2003; Dolan et al., 2008; Hamplová, 2019). Thus, whether minimum wage changes have resulted in changes in the proportion of the upper levels of life satisfaction may be important to be examined. Furthermore, the estimated result can be interpreted easily using the dummy variable of life satisfaction. Thus, a binary variable identifying women with high life satisfaction is used.

The linear probability model by FE OLS is employed in the estimation of Equation (4) because it can easily consider the time-invariant individual heterogeneity. In addition, we use the FE logit model to check the robustness of the linear probability model.

Table 1 presents the basic statistics of the variables used in the analysis. Column 1 displays the mean of

[3] The upper limits of the control group are changed to less than 120%, 130%, or 140% of the minimum wage at t period in the robustness section. The estimated results are robust against the change of the control group in most cases.

[4] In the sample of this study, about 49% of married women have higher life satisfaction. Meanwhile, about 39% of unmarried women have higher life satisfaction.

the variables in the total sample; column 2 indicates the mean of the variables in the treatment group; and column 3 shows the mean of the control group. As shown in column 1, only approximately 3% of the total sample is in the treatment group. Thus, the number of workers with minimum wage is small. Furthermore, the result of column 1 demonstrates that married and part-time workers have high employment. In terms of working hours, the percentage of workers who work 22–34 hours a week is high. Additionally, the analyzed sample's average age and the number of children are 39 years and 1.7, respectively. Similar trends within the total sample are observed in the treatment and control groups. It suggests that the differences between the treatment and control groups are minor in most variables. However, the ratio of part-time workers and workers who work less than 22 hours a week is slightly higher in the treatment group than in the control group.

6. Results

6.1 Effect of minimum wage on life satisfaction

Table 2 presents the estimated result of panel estimation. Columns (1) and (2) display the result of FE OLS and FE ordered logit model, respectively, using the continuous variable of life satisfaction as the dependent variable. Columns (3) and (4) indicate the estimated result of FE OLS and FE logit model, respectively, using the dummy variable of life satisfaction as the dependent variable. Columns (2) and (4) present the coefficients of estimated results.

The result of columns (1) and (2) in Table 2 demonstrates that the coefficients of the treatment group are positive but not statistically significant. Therefore, on average, a minimum wage increase does not significantly impact life satisfaction. This result differs from Bossler and Broszeit (2017) and Gülal and Ayaita (2019) findings, which demonstrate the positive effect of minimum wage on SWB in Germany. Nevertheless, all coefficients of the treatment group in columns (3) and (4) are positively significant. Therefore, women affected by minimum wage change are likely to have higher life satisfaction than non-affected women. Based on the results in columns (1) and (2), the effects of minimum wages in Japan are partially observed in the range of having high life satisfaction. Notably, this result is robust with respect to the estimation method.

Regarding the results of individual attributes in columns (1) and (2), the coefficients of age squared are positively significant. Thus, life satisfaction and age have a U-shaped relationship. The coefficient of the number of children is negatively significant. As the number of children increases, women's life satisfaction decreases. Household income is positively significant, demonstrating that women with high household income have high life satisfaction. In contrast, most of the coefficients in columns (3) and (4) are not statistically significant.

In summary, minimum wages are mainly observed on whether the respondents have high life satisfaction. This result is moderate compared with the minimum wage introduction in Germany (Bossler & Broszeit, 2017; Gülal & Ayaita, 2019). The difference between them may be due to the difference in the sample configuration. Bossler and Broszeit (2017) and Gülal and Ayaita (2019) examine men and women. However, this study focuses on women only due to data constraints. Particularly, approximately 80% of the women

analyzed in this study are married and are likely to be secondary earners rather than household heads. Thus, the impact of minimum wages may be relatively small because the husband's income is the primary source of household income, and the wife's income contributes a small part to the total family income.

6.2 Robustness check

Minimum wage impacts life satisfaction, particularly when using the dummy variable of life satisfaction as the dependent variable. However, further analysis of the robustness is indispensable because this result differs from previous studies. Thus, we conduct three additional estimates using the binary dependent variable. First, the definition of the control group is changed. Following Gülal and Ayaita (2019), Table 2 demonstrates that the upper limit of the control group is below 150% of the minimum wage at the period *t*. However, the upper limit of the said control group cannot be determined a priori whether the degree value is appropriate. Thus, it must be confirmed whether the minimum wage effect changes along with the changes in the upper limit value. Therefore, we change the upper limit of the control group to less than 120%, 130%, and 140% of the minimum wage at period *t*[5].

Table 3 indicates the estimated result of the FE OLS and FE logit model using the dummy variable of life satisfaction as the dependent variable and the estimated coefficients for each treatment group when changing the upper limit of the control group. The coefficients for columns (2) and (3) estimated by FE OLS are positively significant. Thus, the minimum wage is positively associated with life satisfaction. Additionally, all coefficients for columns (4)–(6) estimated by the FE logit model are also positively significant. These results suggest that the effect of minimum wage on female life satisfaction is robust, though changing the definition of the control group.

The second robustness check adds a restriction to the treatment group. As stated in Gülal and Ayaita (2019), if the wage increases excessively after the minimum wage change, it may be caused by factors in addition to minimum wage. To control this effect, we restrict the upper limit of wage of the treatment group sample at period *t* to less than 150%, 140%, 130%, and 120% of the minimum wage at period *t*. Table 4 presents the estimated result using FE OLS and FE logit model. All coefficients of the treatment group in Table 4 remain positively significant due to slight sample size changes with constraints. Therefore, the minimum wage effect on life satisfaction is robust to the definition of the treatment group.

The third robustness check uses alternative estimation methods: propensity score weighting (PSW) (Hirano & Imbens, 2001) and propensity score matching (PSM) (Heckman et al., 1997). The matching method allows us to compare life satisfaction between individuals affected by the minimum wage and those not affected by the minimum wage but have other similar attributes. The matching methods have the

[5] When the control group is restricted to less than 110% of the minimum wage at the t period, the sample size of the control group becomes 1388. It means that the sample size of the control group is reduced by 72% compared to the case where the upper limit of the control group is set at 150% of the minimum wage. To maintain a certain number of samples, we decide to analyze cases up to 120% of the minimum wage in period t in the robustness analysis.

advantage of matching samples through a statistical method. In the analysis, we use the dummy of the treatment group with the same definition as that in Table 2[6]. The propensity score estimated by the logit model uses covariates, including individual attributes and other control variables used in Table 2. The estimated results of the PSW and PSM analyses indicate the effect of minimum wage on female life satisfaction. They demonstrate an average treatment effect for the treated (ATT). In the PSM, kernel and nearest-neighbor matching are used to construct the control group[7]. Table 5 presents the estimated result. All coefficients of the treatment group are positively significant in any matching method. Therefore, minimum wage increases the proportion of women with high life satisfaction in Japan.

7. Conclusion

Many studies have examined the employment effect of minimum wage. However, research analyzing the association between minimum wage and SWB is scarce. The present study filled this gap by examining the effect of minimum wage on SWB using Japanese panel data. The estimated results based on the FE models demonstrated that minimum wage likely increases life satisfaction. This positive association was robust against estimation methods and changes in the definition of the treatment and control groups. The positive impact of minimum wage is due to the increase in absolute wage and decrease in wage disparity[8]. The result of this study is in line with previous studies examining the introduction of minimum wage in Germany[9] (Bossler & Broszeit, 2017; Gülal & Ayaita, 2019).

The analysis results of this study revealed that raising the minimum wage did not increase the average female life satisfaction but increased the proportion of women with high life satisfaction. This result is consistent with previous studies in that raising the minimum wage positively affects life satisfaction, though the effect is limited[10]. This result may be due to the analyzed sample of married women working part-time

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[6] The definition of the control group is the same in Table 2, which means that female workers whose hourly wages at the t-1 period are above the minimum wage at t period and below 150% of the minimum wage at t period.

[7] After conducting the matching models, we checked the mean differences of the covariates between the treatment and control groups. The means differences of all covariates were not statistically significant in the case of PSW and nearest-neighbor matching. However, in kernel matching, only mean differences in dummies of part-time and working more than 35 hours were statistically significant at the 10% level.

[8] The increase in minimum wage can improve SWB in two ways: increasing the wage level and decreasing the income disparity. We checked which one is more critical by adding the hourly wage rate in the independent variables. More specifically, we added the hourly wage rate at t and t-1 period or the change rate of the hourly wage to the independent variables and conducted FE OLS. In the analysis, we used the binary variable of life satisfaction as the dependent variable. If the estimated result of the treatment group is unchanged by adding the hourly wage rate, a reduction in the income disparity can be the cause of improvement of SWB. The statistical significance and magnitude of the coefficient of the treatment group were almost the same when adding the hourly wage rate to the independent variables. This result indicates that the increase in the minimum wage is likely to enhance SWB mainly through the decrease in income disparity.

[9] The analysis, including the sample that ceases working, is also conducted as in Gülal and Ayaita (2019). Binary variable of life satisfaction is used as dependent variable. The result of FE models that include the individuals who work in non-regular employment at the t-1 period and do not work at the t period shows that none of the coefficients of treatment group are significant. It indicates that the positive effect of minimum wage disappears when the sample that ceases working is added. This result is different from the finding of Gülal and Ayaita (2019) that showed the persistent positive effect of minimum wage even in a similar analysis. The difference in this result may be caused by the difference in the sample composition, including only women in JPSC, and the difference in the estimation method.

[10] We also conducted the analysis that used not the dummy of the treatment group but the log of minimum wage. In

and auxiliary earners. The positive effect of raising the minimum wage may be relatively small because most of the household income is earned by the husband[11].

The result of this study provides new empirical evidence on the effect of minimum wage on SWB. Moreover, this study is the first to use Asian data, particularly in Japan. The regional minimum wages set for each of the 47 prefectures are revised every year, making our analysis interesting. Furthermore, this study employs the FE model, which can control the time-invariant individual heterogeneity.

The estimated results of this study demonstrate that minimum wage is likely to improve female employees' SWB. This point has been overlooked; previous studies mainly focused on the negative effect of minimum wage on employment. Thus, policymakers will formulate future policies after understanding the negative effects of minimum wage and its positive effects on SWB.

Finally, remarkable issues should be noted. The present study examined female SWB only due to data restriction. Although most of the workers affected by the minimum wage comprise females, the association between minimum wage and SWB using data on men and women must be investigated to understand the overall effect of minimum wage. Furthermore, although previous research, including the present study, mainly focuses on SWB, minimum wage increase may be significantly related to health measures, such as the subjective rating of health and mental health. The number of research examining the effect of minimum wage on health has increased recently; these studies have obtained interesting results[12]. Minimum wage and health should be further conducted to reveal the broad range of minimum wage effects. Furthermore, empirical evidence on minimum wage and SWB is limited. The association between minimum wage and

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that analysis, we also added a log of hourly wage rate to the independent variables to check if there was a difference in the impact of the minimum wage and hourly wage on life satisfaction. However, the estimated result of FE OLS indicated that both variables were not statistically significant when the continuous and dummy variables of life satisfaction were used as the dependent variables. This result suggests that an increase in wage rate and minimum wage were not directly linked to improved life satisfaction, and it was important whether the workers were in the wage range affected by the minimum wage.

[11] We also conducted the analysis that limited the sample to unmarried women or married women who are the main earners. In the analysis, the sample size was significantly reduced from 4,976 to 1,330, and the number of treatment groups was also reduced from 142 to 32. The result of FE OLS showed that the coefficients of the treatment group were not statistically significant in either case of continuous and dummy of life satisfaction. This result means that when limiting the sample to unmarried women or married women who are the main earners, raising the minimum wage did not affect life satisfaction. However, we have to be careful when interpreting this result because the small number of the analyzed samples might be why the treatment group coefficients were not significant.

[12] Recent studies examining the effect of the minimum wage on health are Horn et al. (2017), Andreyeva and Ukert (2018), Lucas and Lochner (2019), and Chen (2021). Horn et al. (2017), which use the Behavioral Risk Factor Surveillance Surveys (BRFSS) of the United States, reveal that although the increase in the minimum wage harms some aspects of health among unemployed male workers, it reduces the mental strain among employed workers. Andreyeva and Ukert (2018), which also use the BRFSS, show that minimum wage has a positive association with being obese and has a negative relationship to the intake of daily fruit and vegetable. Additionally, their study shows that minimum wages are positively associated with self-reported health in non-whites, women, and married people. Hafner and Lochner (2019), which use data from the German panel study "Labour Market and Social Security" with administrative data from the Federal Employment Agency, indicate that minimum wage improves self-rated health. Chen (2021), which uses the 2014 and 2016 China Labor-force Dynamic Survey (CLDS), shows that raising the minimum wage improves several health measures, such as self-reported health status and the presence of health conditions. In addition, this study reveals that the impact of minimum wage is large for rural hukou workers and workers aged over 35.

SWB must be examined using data from other countries. Korea is an interesting example, raising the minimum wage by more than 10% in 2018 and 2019. Examining the effects of such a drastic minimum wage increase on employment and workers' SWB will contribute to the accumulation of research in the future. Lastly, the present study did not fully argue about the effect of the minimum wage increase on individuals who are currently unemployed. For these individuals, a minimum wage increase will raise wages at work. Thus, a positive effect on SWB is expected. However, a minimum wage increase may curb new employment. Therefore, all potential new workers will unlikely benefit from a minimum wage increase. The impact of this minimum wage increase on new workers is outside the scope of this study and thus needs to be considered in future studies.

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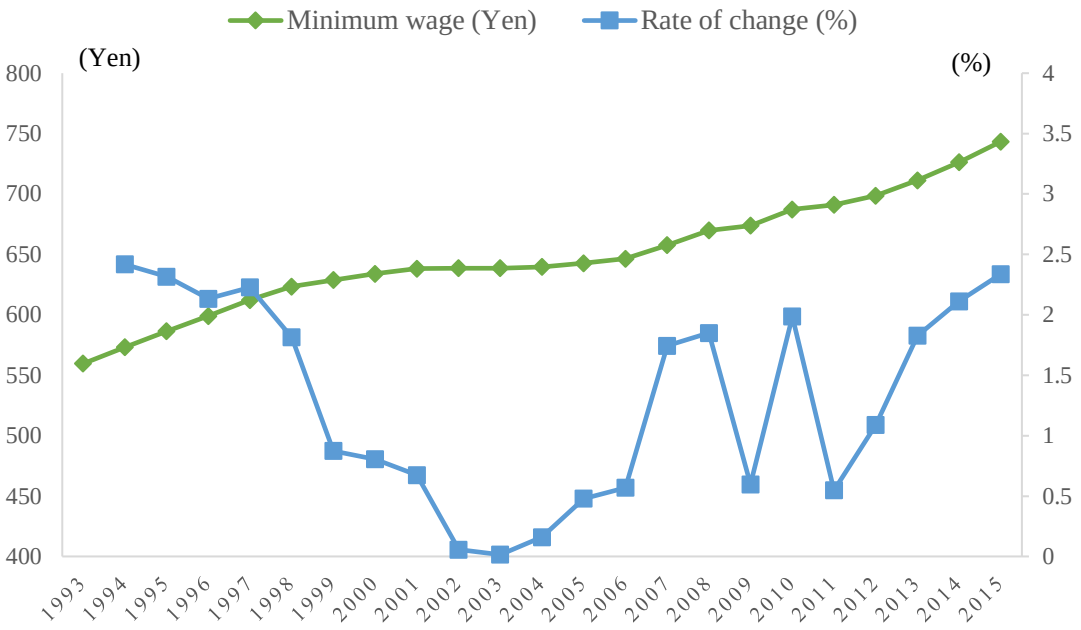
Figure 1 Average minimum wage rate and its change rate in prefectures from 1993 to 2015



Note: Regional minimum wages are obtained from the Pandect of Minimum Wage Determination (Japanese Ministry of Health, Labour and Welfare).

Table 1 Basic statistics

		Total Sample	Treatment group	Control group
		Mean	Mean	Mean
Life satisfaction	Continuous variable	3.247	3.324	3.245
	Dummy variable	0.470	0.556	0.468
Treatment group		0.029	1	0
Age		39.084	40.732	39.036
Marital status	Unmarried (Ref)	0.204	0.148	0.205
	Married	0.796	0.852	0.795
Child-related variables	Number of children	1.655	1.768	1.652
	Having children under 3 years old	0.079	0.092	0.078
	Having children aged 4-12 years old	0.377	0.352	0.377
Household income (Ten thousand yen)		552.988	517.082	554.043
Employment status	Temporary/contract worker (Ref)	0.085	0.021	0.087
	Part-time worker	0.915	0.979	0.913
Working hours	Less than 22 hours in a week	0.278	0.387	0.275
	22-34 hours in a week (Ref)	0.394	0.437	0.393
	over 35 hours in a week	0.325	0.169	0.329
Prefectural job opening ratio		0.830	0.918	0.827
Observations		4,976	142	4,834

NOTES: “Ref” indicates the reference category of the dummy variable.

Table 2 Effect of minimum wage on life satisfaction using the FE models

	Dependent variable	Life satisfaction (continuous)		Life satisfaction (dummy)	
		(1)	(2)	(3)	(4)
Treatment group		0.008	0.039	0.071**	0.646**
		(0.078)	(0.261)	(0.035)	(0.299)
Age		0.228	0.721*	0.173**	1.135
		(0.155)	(0.424)	(0.084)	(0.718)
Age squared		0.001**	0.003**	0.000	0.003
		(0.000)	(0.001)	(0.000)	(0.002)
Marital status	Married	0.050	0.112	-0.008	-0.055
		(0.103)	(0.295)	(0.048)	(0.396)
Child-related variables	Number of children	-0.115**	-0.278*	-0.040	-0.203
		(0.055)	(0.150)	(0.030)	(0.203)
	Having children under 3 years old	0.051	0.080	0.066	0.384
		(0.087)	(0.283)	(0.048)	(0.320)
	Having children aged 4-12 years old	0.037	0.107	0.012	0.108
		(0.052)	(0.161)	(0.027)	(0.198)
Household income		0.000*	0.001*	0.000	0.001
		(0.000)	(0.000)	(0.000)	(0.000)
Employment status	Part-time worker	0.035	0.088	0.026	0.187
		(0.078)	(0.255)	(0.040)	(0.356)
Working hours	Less than 22 hours in a week	0.035	0.092	-0.003	-0.053
		(0.039)	(0.133)	(0.020)	(0.148)
	over 35 hours in a week	0.018	0.072	0.007	0.056
		(0.043)	(0.135)	(0.024)	(0.205)
Prefectural job opening ratio		-0.042	-0.134	-0.056	-0.340
		(0.102)	(0.328)	(0.062)	(0.530)
Constant		-6.329		-4.155*	
		(4.062)		(2.190)	
Estimation method		FE OLS	FE Ologit	FE OLS	FE Logit
R-squared		0.029		0.025	
Log-likelihood			-2364.436		-1001.344
Observations		4,976	3,849	4,976	2,633

NOTES: *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. Heteroscedasticity robust standard errors are reported in parentheses in columns (1)–(3). The standard error in column (4) is calculated using the bootstrap method. Other independent variables used in the model are year dummies.

Table 3 Effect of minimum wage on the dummy variable of life satisfaction using

FE OLS and FE logit model: changing the definition of the control group

		Dependent variable: Life satisfaction (dummy)					
		(1)	(2)	(3)	(4)	(5)	(6)
	Definition of the control group						
Treatment group	$MW_t \leq W_{t-1} \leq MW_t * 1.20$	0.058			0.580*		
		(0.036)			(0.335)		
Treatment group	$MW_t \leq W_{t-1} \leq MW_t * 1.30$		0.077**			0.695*	
			(0.035)			(0.366)	
Treatment group	$MW_t \leq W_{t-1} \leq MW_t * 1.40$			0.072**			0.655*
				(0.035)			(0.354)
Estimation method		FE OLS	FE OLS	FE OLS	FE Logit	FE Logit	FE Logit
R-squared		0.035	0.029	0.026			
Log-likelihood					-490.271	-780.174	-932.232
Observations		2,996	4,121	4,628	1,397	2,093	2,460

NOTES: *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. Heteroscedasticity robust standard errors are reported in parentheses in columns (1)–(3). The standard error in columns (4)–(6) is calculated using the bootstrap method. All independent variables used in the model in Tables 2 and 3 are also used in these estimations.

Table 4 Effect of minimum wage on the dummy variable of life satisfaction using

FE OLS and FE logit model: changing the definition of the treatment group

		Dependent variable: Life satisfaction (dummy)							
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Newly added restriction to the treatment group								
Treatment group	$W_t \leq MW_t * 1.20$	0.069*				0.629**			
		(0.036)				(0.315)			
Treatment group	$W_t \leq MW_t * 1.30$		0.069*				0.629*		
			(0.036)				(0.324)		
Treatment group	$W_t \leq MW_t * 1.40$			0.071**				0.646*	
				(0.036)				(0.359)	
Treatment group	$W_t \leq MW_t * 1.50$				0.071**				0.646**
					(0.036)				(0.315)
Estimation method		FE OLS	FE OLS	FE OLS	FE OLS	FE Logit	FE Logit	FE Logit	FE Logit
R-squared		0.025	0.025	0.025	0.025				
Log-likelihood						-1001.181	-1001.181	-1001.344	-1001.344
Observations		4,973	4,973	4,974	4,974	2,632	2,632	2,633	2,633

NOTES: *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. Heteroscedasticity robust standard errors are reported in parentheses in columns (1)–(4). The standard error in columns (5)–(8) is calculated using the bootstrap method. All independent variables used in the model in Tables 2 and 3 are also used in these estimations.

Table 5 Effect of minimum wage on the dummy variable of life satisfaction using

PSW and PSM

	Dependent variable: Life satisfaction (dummy)		
	(1)	(2)	(3)
Treatment group	0.071*	0.120*	0.076*
	(0.041)	(0.072)	(0.043)
Estimation method	PSW	PSM (Nearest-neighbor)	PSM (Kernel)
Observations	4,976	284	4,976

NOTES: *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. Standard errors calculated by the bootstrap method are reported in parentheses in columns (1)–(3). The propensity score is estimated by the logit model using individual attributes and other control variables used in Table 2. In addition, educational background is newly added to other control variables for estimation.