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Gong, Haojun

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Gong Haojun

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Minimum wages, spousal tax exemption, and the labor supply of married women in Japan

Haojun Gong[12]

Abstract

Under Japan's spousal and spousal special exemption system, married women whose husbands earn less than a certain annual income are eligible for the spousal exemption. Additionally, the minimum wage is raised annually in Japan, and married women working as part-timers, who are vulnerable to the effects of minimum wage increases, may experience an increase in annual income if they do not adjust their working hours. Therefore, this study examines how the interaction between the spousal exemption and minimum wage systems affects the labor supply of married women engaged in part-time work using single women as a control group. This study particularly examines, under Japan's spousal exemption and spousal special system before 2018, whether married women who worked with annual earnings of 1.05 million yen or less (where the amount of the spousal exemption begins to decrease) or 1.41 million yen per year (where the exemption disappears) adjust their labor supply in response to an increase in the minimum wage. The results show that married women working with annual earnings lower than 1.05 million yen adjust their working hours more in response to the minimum wage increase than married women working with annual earnings lower than 1.41 million yen. For married women whose annual earnings were 1.05 million yen or less in the previous year, an increase of one yen in the minimum wage decreases their weekly work hours by 1.266 hours. The scale of adjustment in work hours is larger for married women whose annual earnings are close to 1.05 million yen, particularly in the subgroup of 0.9 million yen or more. These findings are robust even when controlling for heterogeneity in the selection of annual income groups.

Keywords: minimum wage, spousal exemption system, work hours

JEL Classification：J38; J20; H24

1. Introduction

In recent years, hourly wages for part-time workers have been rising because of labor shortages and higher minimum wages. However, this wage increase did not trigger an increase in annual

[1] Faculty of Economics, Kobe International University, 9-1-6 Koyocho-naka, Higashinada-ku, Kobe, 658-0032, Japan. E-mail: gonghaojun0310@gmail.com

[2] Research Fellow, Graduate School of Economics, Kobe University, 2-1 Rokkodai-cho, Nada-ku, Kobe-City,Hyogo 657-8501, Japan.

income due to their decreasing work hours. It is conceivable that under Japan's singular spousal exemption system, many married women working part-time may adjust their employment to qualify for tax exemption. This phenomenon shows how Japan's minimum wage and spousal exemption systems impact the work-hour supply choices of married women working part-time.

No prior study has examined how married women, especially married women working part-time who are likely to be affected by the minimum wage, make labor supply choices under these two systems. Existing studies have separately examined the impacts of the minimum wage system on employment and the spousal exemption system on employment choices for married women. Therefore, this study provides evidence for policymaking in an environment where labor shortages in Japan will become increasingly severe.

First, regarding the impact of the minimum wage system on employment from a demand side, a growing number of studies in various countries have examined the impact of minimum wage systems on work hours. When examining the short-term impact of minimum wages on labor demand, the cost of layoffs and substitution with other factors of production does not occur immediately; thus, per capita work hours are more easily adjusted. The results of studies examining the impact of minimum wages on work hours do not show a significant reduction in work hours (Allegretto et al, 2011; Connolly, and Gregory, 2002; Dickens et al, 1999; Hyslop and Stillman, 2007; Zavodny, 2000; Dickens et al., 2012). Machin et al. (2003) and Stewart and Swaffield (2008) who analyzed the minimum wage impact in the U.K., and Neumark and William (2004) and Neumark and Nizalova (2007), who analyzed the impact of the U.S. minimum wage, found that an increase in the minimum wage decreases work hours. More recent studies have also reported the negative effects of a minimum wage on work hours (Kamińska and Lewandowski, 2015; Wong, 2017).

In Japan, three studies have focused on the effect of minimum wage on work hours. Hguchi et al. (2011) examine the effect of the minimum wage on changes in average weekly work hours, including overtime, using individual unit panel data from the Keio Household Panel Survey (KHPS) from 2004–2010, targeting male and female part-time workers aged 15 and older. No significant effects were observed. Kawaguchi and Mori (2021) examine the effect of minimum wages on the average work hours (including overtime hours) of men and women aged 16–19 using regional-level panel data from the Labor Force Survey and Basic Survey on Wage Structure for the period 2006–2010. No statistically significant effect was observed on the work hours of the group in question. Akesaka et al. (2017) aggregated individual data from the Basic Survey on Employment Structure at five-year intervals since 1992 to a prefectural level to examine the impact on work hours by gender; they find that the decrease in work hours is particularly large for women. Few studies examine the impact of the minimum wage on employment from a labor supply side.

A growing number of studies have examined the impact of the spousal exemption system on the employment choices of married women. Under Japan's spousal exemption system before the 2018 revision, if the husband is a taxpayer, he is entitled to a spousal special exemption if his wife's annual earnings are 1.03 (1.41) million yen or less. The spousal special exemption decreases when the amount exceeds 1.03 (1.41) million yen. There has been a debate on whether this system hinders the labor supply of married women. Using inductive analysis methods, Abe and Ohtake (1995), Oishi (2003), and Yokoyama (2018) point out that the spousal exemption system inhibits the labor supply of married women. Akabayashi (2006), Takahashi (2010), Bessho and Hayashi (2014), and Adachi and Kaneda (2016) show that married women's work hours will increase if the spousal exemption is abolished. Examining the impact of abolishing exemptions in 2004, Yokoyama (2018) finds that partial abolishment boosts the labor supply of low-earning married women. Therefore, these studies show that married women in Japan adjust their labor supply under the spousal exemption system.

In recent years, it is conceivable that when married women with low earnings engage in labor supply behavior, they may increase their work hours in response to an increase in the minimum wage of at least 20 yen per hour, while simultaneously reducing their work hours to continue receiving spousal exemption. No existing research examines what happens to the employment choices of married women under minimum wage and spousal exemption systems, which have opposing effects on the labor supply of married women. Since married women who work part-time have flexible work hours, clarifying the intersectional effects of the minimum wage and spousal exemption systems have policy implications. In other words, it is necessary to find out how women adjust their labor supply when faced with the choice of reducing their work hours to continue to qualify for the spousal exemption or increasing their own work hours in response to an increase in the minimum wage.

This study examines how the interaction between the spousal exemption and minimum wage systems affects the labor supply of married women engaged in part-time work using panel data from the Japan Panel Survey of Employment Dynamics. This study's contribution is that it examines the impact of the minimum wage on work hours from both the supply and demand sides of the labor market. Furthermore, it focuses on the conflict between the minimum wage and the spousal exemption system in Japan. First, we use first difference estimation to calculate how married women in part-time with annual earnings below 1.05 (1.41) million yen ceiling who is potentially applicable for spousal exemption adjust work hours. During this analysis, we use single women with annual earnings over 1.05 (1.41) million yen as the control group to identify the labor supply effects of minimum wage on married women applicable to spousal exemption. Next, we control for heterogeneity probably brought by the selection of annual income groups to make a robustness analysis. The results show that married women whose annual earnings in the

previous year were less than 1.05 million yen significantly reduce their work hours in response to an increase in the minimum wage. The scale of adjustment in work hours is larger for married women whose annual earnings have a smaller distance to 1.05 million yen. These findings are robust even when controlling for heterogeneity in the selection of different earning groups. This suggests that when the minimum wage is high, work hours are adjusted so that annual earnings do not surpass 1.05 million yen to continue receiving spousal exemptions. This result supports the possibility that the effect of a higher minimum wage on work hours includes not only an adjustment of work hours on the demand side shown in previous studies but also a reduction in work hours on the supply side. This suggests that the minimum wage and spousal exemption systems in Japan have a conflicting impact on married women's labor supply choices.

The remainder of this paper is organized as follows: Section 2 presents an overview of the minimum wage and spousal exemption systems; Section 3 constructs an empirical model to examine the employment choices of married women in the interaction between the minimum wage and spousal exemption systems; Section 4 describes the data used in this study; Section 5 summarizes the estimation results; and, Section 6 provides a robustness check. Finally, Section 7 presents our conclusions.

2. Institutional background

2.1 Minimum wage system

Japan's Minimum Wage Act was passed in 1959. When determining the minimum wage amount, the Central Minimum Wages Council separates Japan's 47 prefectures into four ranks (A, B, C, and D) based mainly on an index that synthesizes the total indicators of economic conditions in each prefecture. Every year, it sets a rough level for an increase in minimum wages for each rank, which we refer to as the *meyasu* system. The current *meyasu* system for regional minimum wages is guided by minimum wage indicators based on the economic conditions of each region. The Local Minimum Wages Council in each prefecture determines the amount for the minimum wage increase based on the *meyasu* set for the prefecture's rank.

In 2007, the revision of the Minimum Wage Act conducted by the Japanese government aims to increase the prefectural minimum wage due to the gap between the minimum wage and amount of public assistance. The government has since adjusted the range of minimum wage increases to narrow the above gap in the corresponding region. Consequently, the hourly minimum wage for each prefecture has increased annually by approximately 20 yen or more compared with the previous increase of only one or two yen per hour. It is mandatory for all businesses to comply with a minimum wage.

Two types of minimum wages exist in Japan. One is regional wage, which applies to all workers in the corresponding prefecture. The other one is industrial wage, which only covers

specific industries. Since regional minimum wages cover a wider range of workers than industrial minimum wages to lead to a larger effect and all previous studies on minimum wages in Japan have also used regional minimum wages, we use the regional minimum wage in our study. The regional minimum wage in Japan is raised annually. As shown in Fig. 1, minimum wages increased considerably after 2007, causing low-wage workers' wages to increase considerably. Moreover, it has also affected wage increases for workers up to the 30th and 40th percentile of the wage distribution (Kambayashi et al., 2013; Kawaguchi and Mori, 2021).

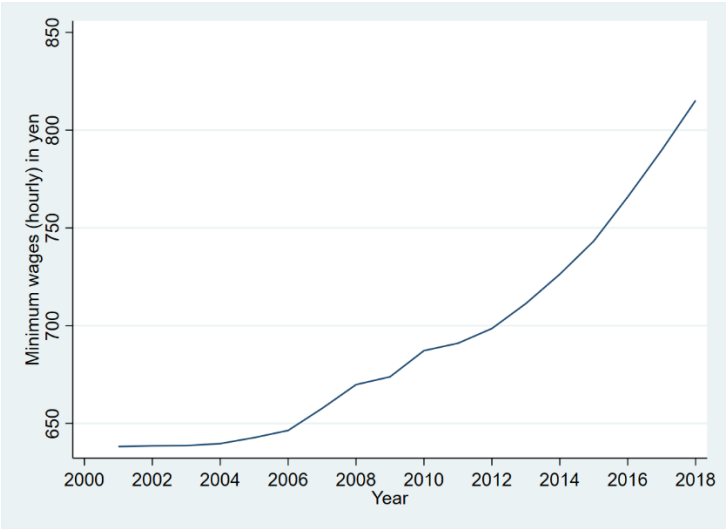


Fig. 1 Minimum wage: national average and hourly wage (yen)

Note: Data for national minimum wages, which are revised annually in October, are taken from the Ministry of Health, Labour and Welfare's "Revision of Regional Minimum Wages" for the years 2001 through 2018. Source: Calculations based on the Overview of Minimum Wage Determination (2000–2018).

2.2 The spousal and spousal special exemption system

A spousal special exemption system was established to reduce a taxpayer's personal tax burden by deducting a fixed amount from taxable earnings when the taxpayer's spouse earns below a certain amount. In Japan, the husband is the head of the household as well as the taxpayer in most cases. To simplify this study, we assume that the husband is the taxpayer. The structure of Japan's spousal exemption and spousal special exemption system is shown in Table 1. Regardless of the husband's annual earnings, if the spouse's annual earnings do not exceed 1.03 million yen, the spousal exemption is applied, and an exemption of 0.38 million yen is applied to the husband's taxable earnings. When the wife's annual earnings exceed 1.03 million yen, the spousal exemption ceases to apply, and a special spousal exemption is applied. Only taxpayers earning below 1.22 million yen are eligible for this special spousal exemption. The spousal special exemption is a vanishing exemption, as the amount decreases in accordance with the spouse's earnings. If the wife's annual earnings are below the 1.05 million yen threshold, the spousal special exemption of

0.38 million yen is applied to the husband. The spousal special exemption decreases in stages until annual earnings reach 1.41 million yen, and the special exemption ceases to apply once annual earnings exceed 1.41 million yen. Thus, in effect, the total (sum of exemption and special exemption) amount of the tax exemption applicable to the husband whose earnings are lower than 1.22 million yen decreases when the wife's annual earning exceeds 1.05 million yen, and the amount of tax exemption becomes zero when it exceeds 1.41 million yen.

Table 1. Exemptions for spouses before 2018 (unit: 10,000 yen)

Exemptions for spouse (Unit: 10,000 yen)			
Annual earnings	Exemption	Special exemption	Sum
~103	38	0	38
103-104.999…	0	38	38
105-109.999…	0	36	36
110-114.999…	0	31	31
115-119.999…	0	26	26
120-124.999…	0	21	21
125-129.999…	0	16	16
130-134.999…	0	11	11
135-139.999…	0	6	6
140-140.999…	0	3	3
141~	0	0	0

Note: Table 1 represents the number of spousal and special exemptions applicable to married women based on their annual earnings based on Yokoyama (2018). This table assumes that taxpayers earn below 1.22 million yen.

Additionally, when a wife's annual earnings are less than 1.03 million yen, she is not only exempted from income tax but also often receives a spousal allowance from her employer, which creates a ceiling of 1.03 million yen[3] (Abe, 2009). Therefore, married women who work part-time may adjust their work hours so that their annual earnings do not exceed 1.03 million yen. Additionally, since annual earnings that exceed 1.3 million yen are not exempted from social insurance, 1.3 million yen could be considered a factor that restrains female labor supply.

This study only focuses on the impact of the spousal exemption system on female labor supply. Under the system before 2018, for a husband who is entitled to both a spousal exemption

[3] The term of 1.03 million yen ceiling used in this paper follows Abe (2009), where the ceiling is the annual earnings threshold of 1.03 million yen that married women consider when they supply labor. This is because married women who earn more than 1.03 million yen do not qualify for the spousal exemption.

and a special spousal exemption, even if his wife's annual earnings exceed 1.03 million yen but not 1.05 million yen, a special spousal exemption of the same amount as the spousal exemption is applied. This has resulted in a kink in the wife's budget line at 1.05 million yen. Thus, the actual threshold at which the amount of the spousal special exemptions begins to decrease is at the point where annual earnings exceed 1.05 million yen. As mentioned previously, the spousal exemption becomes zero when it exceeds 1.41 million yen; thus, 1.41 million yen is another threshold.

In recent years, the hourly minimum wage for each prefecture has increased annually by around 20 yen. When these minimum wage increases lead to an increase in wages, workers have a theoretical incentive to work longer hours. In Japan, women and part-time workers are more sensitive to the impact on the minimum wage (Kawaguchi and Mori, 2009). In the case of married women who work part-time and are subject to the spousal exemption, there may be a conflict between the option to increase work hours in response to a minimum wage increase and the option to decrease work hours to avoid being excluded from the spousal exemption. Therefore, clarifying how married women make employment choices under these two systems that work against the labor supply is relevant.

This study focuses on the conflict between the spousal exemption and minimum wage systems. We examine whether married women who work part-time adjust their work hours so that their annual earnings do not exceed 1.05 million yen or 1.41 million yen when the minimum wage increases.

3. Econometric model

In this section, we use the following model to clarify how women's part-time work-hour decisions are affected by the interaction between the spousal exemption system and minimum wage. Since we assume potential eligibility for the special exemption for spouses, we restrict the sample of married women to those whose husbands earn less than 12.2 million yen per annum, which is the condition for applying for a spousal special exemption.

$$\Delta Hours_{ijt} = \Delta MW_{ijt}(\gamma_4 + \sum_{k=1}^{2}\varphi_k D_{ikt-1} + \gamma_5 Married_i + Married_i \times \sum_{k=1}^{2}\mu_k D_{ikt-1}) + \Delta X_{ijt}\beta' + \sum_{k=1}^{2}\gamma_k D_{ikt-1} + \gamma_3 Married_i + Married_i \times \sum_{k=1}^{2}\varepsilon_k D_{ikt-1} + u_{ijt} \quad (1)$$

where i denotes individuals, j denotes prefectures, and t denotes year. $\Delta Hours_{ijt}$ is the difference in women's average weekly work hours. Among the explanatory variables, $\sum_{k=1}^{2}\varphi_k D_{ikt-1}$ are two earnings dummies for the previous year, which include a woman's earnings in the previous year, less than 1.05 million yen and between 1.05 and 1.41 million yen, respectively, for which the base group is women whose previous year's earnings exceed 1.41 million yen. $Married_i$ is a married dummy that takes the value of 1 if the woman is married and 0 otherwise. Under the current spousal exemption system, the exemption amount begins to decrease when annual

earnings are over 1.05 million yen and continues to decline until earnings reach 1.41 million yen. The exemption disappears when annual earnings exceed 1.41 million yen. MW_{ijt} is the minimum wage for the year in region j where individual i lives. The other control variable vector, X_{ijt}, includes age, a dummy for living with parents, previous year's non-labor earnings, husband's earnings in the previous year, number of preschool children, occupation dummies, and unemployment rates. Following Takahashi (2010) and Yokoyama (2018), non-labor earnings, husband's income, and the number of preschool children may negatively impact the supply of work hours; therefore, the three variables are included in the control variables. u_{ijt} is the error term.

We identify the impact of the minimum wage on the determination of work hours of married women covered by the spousal exemption system using μ_k, a parameter of the intersection term of three variables: a marriage dummy variable, previous year's earning dummies, and minimum wage variables. In other words, μ_1 and μ_2 are the parameters of interest in this study. Married women with annual earnings of less than 1.41 million yen in the previous year qualify for spousal exemption, and we use μ_1 and μ_2 to identify the extent to which they reduce their work hours when they face a wage increase associated with an increase in the minimum wage.

We use μ_k to identify the effect of the minimum wage on the supply of work hours of married women covered by the spousal exemption system. This is because the Japan Panel Survey of Employment Dynamics used in this study does not include questions that would allow us to ascertain whether women are applying for or receiving a spousal exemption; however, like previous studies, we target women who potentially receive a spousal exemption based on their annual earnings.

This study seeks to identify whether married women with annual earnings of less than 1.05 million yen in the previous year show an adjustment in work hours with an increase in the minimum wage. We consider single women as the control group. Additionally, as the effect of an increase in the minimum wage on changes in work hours includes both demand- and supply-side effects, we should identify impacts on labor supply that are distinguishable from impacts on labor demand.

First, we consider the demand. Here, we assume that the labor force of married and single women is homogeneous, with other conditions held constant. Previous studies have shown that an increase in the minimum wage may cause firms to adjust their costs by reducing the work hours of low-wage workers. Specifically, low-wage earners earning less than 1.41 million yen per year are more likely to experience a larger wage increase from an increase in minimum wage than relatively high-wage earners earning more than 1.41 million yen per year. Therefore, firms are more likely to shorten low-wage earners' work hours. Thus, the difference in demand for work

hours triggered by a change in the minimum wage in annual earnings group is controlled by using single women in each earnings category as a control group.

Second, comparing single women with annual earnings of less than 1.41 million yen with the group with annual earnings of more than 1.41 million yen in the previous year, the impact of the minimum wage on women's supply of work hours appears to have a substitution effect rather than an income effect on the wage increase associated with the minimum wage increase. Thus, single women do not reduce their work hours. However, married women want to reduce their working hours to continue receiving spousal exemptions. Thus, the model allows us to control for the demand-side effects and fixed effects by annual earnings group and μ_k, a parameter of the intersection term of three variables: a marriage dummy variable, previous year's earning dummies, and the minimum wage variables; it identifies the effect of the minimum wage on the supply of work hours of those who apply the spousal exemption system.

4. Data

This study uses data drawn from the Japan Panel Survey of Employment Dynamics (hereafter JPSED). The main target of the analysis is married women who work part-time. Since this survey asks about employment status over a three-year period from 2015 to 2017, it will be used as panel data for the same individual over that period. The advantage of this survey over other household panel surveys in Japan is that it includes a larger sample of employed married women. Another advantage is that the panel data allow us to obtain the previous year's annual earnings of the same individual.

Next, we describe the characteristics of the JPSED data, its background, and strengths and limitations. We use JPSED data from 2016 to 2018. Since this survey investigates the situation in previous years, it captures the situation from 2015 to 2017. In 2018, Japan's spousal exemption system was revised regarding the annual earnings limit for receiving the exemption, which changed the treatment group when data from 2018 were used for identification; therefore, data up to 2018 were used in the analysis. This panel survey is conducted annually in January by the Recruit Works Research Institute using Internet monitors; moreover, it targets Japanese men and women aged 15 years and older nationwide. It contains questions on employment status, earnings, and living conditions during the previous year. The most significant advantage of the JPSED is its large sample size (approximately 50,000 individuals per year). However, its limitation is that it is conducted online; thus, the occupations and characteristics of the respondents may differ from those of the general Japanese population.

Among the survey questions, we use the average weekly work hours of the main job held as of December of the previous year and the annual earnings (including bonuses) from the main job during the previous year. The occupational classifications used in this survey follow the Basic

Japanese Standard Classification of Occupations. Since the survey provides information on the residential area of individuals, information on minimum wages and unemployment rates is matched by residential area. Data for regional minimum wages, which are revised annually in October, are taken from the Ministry of Health, Labour and Welfare's "Revision of Regional Minimum Wages" for the years 2014 through 2016. The annual average unemployment rate uses data from the Labor Force Survey, Statistics Bureau, and Ministry of Internal Affairs and Communications for 2015–2017.

As a sample restriction in the analysis, we exclude groups that receive public assistance. The presence of a group receiving welfare includes the possibility that they adjust their work hours in response to the minimum wage, making the effect of the spousal exemption system less pure.

Table 2 summarizes the descriptive statistics of the sample of married and single women used in the analysis. Compared with married women, single women work longer hours on average and have slightly higher earnings and non-labor income. The age ranges are about the same. The bottom part of Table 2 shows the sample sizes of married and single women by annual earnings group. The sample size of married women is about 1.5 times larger than that of single women. The sample of married women is dominated by a sample with annual earnings of less than 1.05 million yen, whereas that of single women is dominated by a sample with annual earnings of more than 1.41 million yen. Figure 2 shows a histogram of the previous year's annual earnings of married women who work part-time. The red line indicates, from left to right, 1.05 and 1.41 million yen, respectively. Figure 2 shows that the annual earnings of married women who work part-time spike around 1.05 million yen and 1.41 million yen, with the extent of the increase to 1.41 million yen being smaller than 1.05 million yen. The fact that the sample is not very large around 1.41 million yen is consistent with Yokoyama (2018). It also shows that 1.03 million yen is the upper limit of annual earnings for married women to obtain earning tax exemptions, spousal exemptions, and spousal benefits for their husbands. However, this study focuses on the impact of the 1.05-million-yen ceiling, where the actual exemption begins to decline for married women who are eligible for the spousal special exemption. The data used in this study also show that the annual earnings of married women increase to nearly 1.05 million yen. Since we do not observe a kink at 1.3 million yen owing to the social insurance ceiling, we are interested in whether women

behave with an awareness of the kinks at 1.05 million yen, where the spousal exemption begins to decrease, and at 1.41 million yen, where the exemption disappears completely.

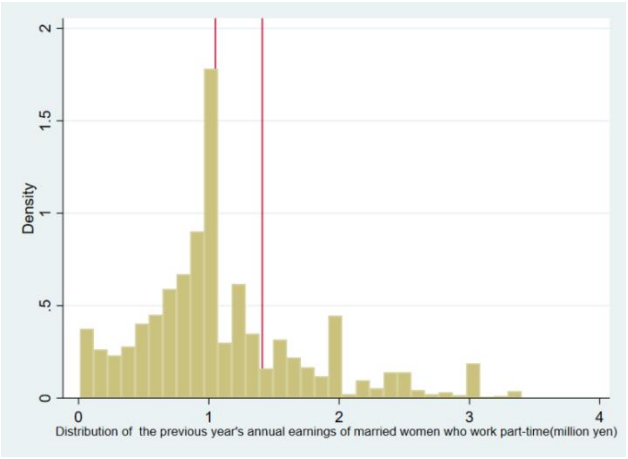


Fig. 2 Histogram of the annual earnings of married women working part-time

Note: The red line represents 105,141 points from left to right. The sample comprises married women in the JPSED from 2016 to 2018.

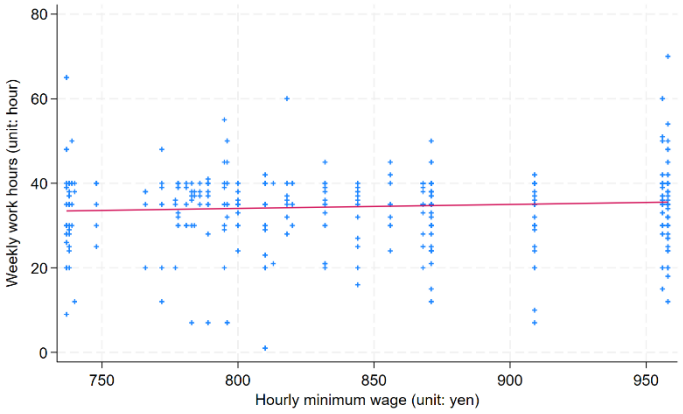
Table 2. Descriptive statistics

	Married Women					Single Women				
Variables	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
Weekly work hours	1,793	24.47	10.96	1	99	1,217	31.62	11.49	1	100
Minimum wage (yen)	1,793	843.78	71.58	737	958	1,217	847.33	74.50	737	958
Last year's income (10,000 yen)	1,793	116.67	82.36	1	1000	1,217	161.36	100.62	1	750
Household non-labor income in previous year (10,000 yen)	1,793	8.70	47.87	0	600	1,217	24.2	61.37	0	500
Husband's income in the previous year (10,000 yen)	1,793	529.29	237.19	150	1200	1,217	0	0	0	0
Age	1,793	49.22	9.26	21	78	1,217	44.49	13.40	19	77
Last year's income category										
D1	427					639				
D2	262					163				
D3	1,104					415				
Total	1,793					1,217				

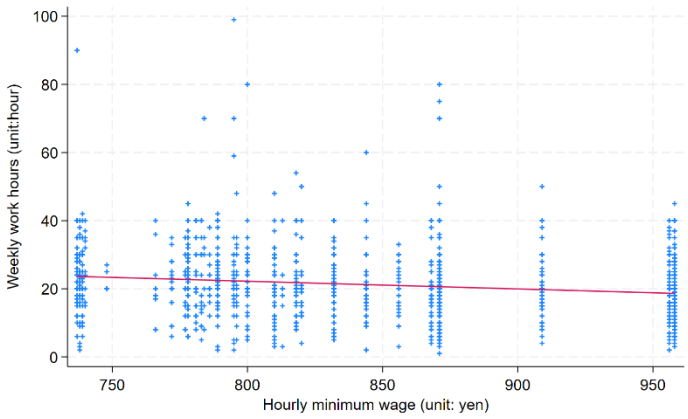
Note: D1 represents individuals whose earnings in the previous year were over 1.41 million yen. D2 represents individuals whose earnings in the previous year were between 1.05 and 1.41 million yen. D3 represents individuals whose earnings in the previous year were below 1.05 million yen.

Figure 3 plots the relationship between the minimum wage and work hours for married women with annual earnings less than and more than 1.41 million yen in the previous year. The slope of the graph for married women with annual earnings more than 1.41 million yen is more upward, whereas that of the graph for married women with annual earnings less than 1.41 million yen is downward.

This indicates that the response of working hours to the minimum wage differs depending on the marital status of female part-time workers whose annual earnings are less than 1.41 million yen. This finding suggests that the group potentially eligible for spousal exemption in the previous year may have adjusted their work hours in response to an increase in the minimum wage.



(a)



(b)

Fig 3. Plot of minimum wage and work hours for married women working part-time

Note: Panel (a) represents a sample of married women with annual earnings more than 1.41 million yen, and Panel (b) represents a sample of married women with annual earnings less than 1.41 million yen. The horizontal axis represents the minimum wage, and the vertical axis represents the weekly work hours.

5. Empirical results

Table 3 summarizes the estimation results. In Table 3, the control variables are added from left to right; since the column on the far right contains all the control variables, we explore the results here. The variables of interest are an intersection term consisting of three variables: a dummy for annual earnings of 1.05 million or less in the previous, a married dummy, and the minimum wage; moreover, there is an intersection term consisting of three variables: a 1.05–1.41-million-yen dummy, a married dummy, and the minimum wage. Both the coefficients of the two intersection terms are negative, but statistically significant in the case of the intersection term for annual earnings of 1.05 million yen or less in the previous year. For married women with annual earnings of less than 1.05 million yen, the coefficients indicate that an increase in minimum wage in the current year leads to a statistically significant decrease in work hours. The coefficient value indicates that for married women whose annual earnings were 1.05 million yen or less in the previous year, an increase of one yen in the minimum wage decreases their weekly work hours by 1.266 hours. Using the average values of minimum wage and weekly work hours presented in the descriptive statistics, we find that, since the minimum wage increases by 8 yen on average each year, married women who are potentially eligible for the spousal exemption reduce their weekly work hours by 10.128. This result is robust regardless of whether the year dummies or all the control variables are included. Therefore, married women adjust their work hours in response to the 1.05 million yen ceiling owing to the increase in the minimum wage under the spousal exemption system, while not responding to the 1.41 million yen ceiling. In the descriptive statistics, married women's annual earnings distribution also supports this result as they are not concentrated in the range of 1.05–1.41 million yen.

Table 3. First difference estimation: Effect of minimum wage increases on married women's work hour supply under the spousal exemption.

	First difference estimation					
	(1)	(2)	(3)	(4)	(5)	(6)
D2	0.967	1.129	1.128	1.036	1.001	0.979
	(14.852)	(14.860)	(14.863)	(14.872)	(14.873)	(14.877)
D3	-11.134	-10.962	-10.979	-10.925	-10.772	-10.795
	(11.433)	(11.445)	(11.455)	(11.452)	(11.454)	(11.468)
Marriage dummy	-19.528	-19.222	-19.243	-19.238	-19.480	-19.451
	(12.759)	(12.811)	(12.810)	(12.784)	(12.783)	(12.781)
D2×Marriage dummy	25.163	24.916	24.916	25.140	25.239	25.245
	(20.567)	(20.593)	(20.597)	(20.635)	(20.637)	(20.639)
D3×Marriage dummy	31.733*	31.369*	31.484*	31.449*	31.566*	31.592*
	(17.093)	(17.136)	(17.158)	(17.135)	(17.137)	(17.149)
ΔMinimum wage	0.184	0.191	0.191	0.193	0.193	0.195
	(0.208)	(0.209)	(0.209)	(0.208)	(0.208)	(0.208)
D2×ΔMinimum wage	-0.012	-0.018	-0.018	-0.015	-0.013	-0.012
	(0.596)	(0.596)	(0.597)	(0.597)	(0.597)	(0.597)
D3×ΔMinimum wage	0.493	0.486	0.487	0.485	0.478	0.479
	(0.463)	(0.463)	(0.464)	(0.464)	(0.464)	(0.464)
Marriage×ΔMinimum wage	0.772	0.760	0.761	0.761	0.770	0.769
	(0.504)	(0.506)	(0.506)	(0.505)	(0.505)	(0.505)
D2×Marriage dummy×ΔMinimum wage	-0.982	-0.972	-0.972	-0.981	-0.985	-0.986
	(0.823)	(0.824)	(0.824)	(0.826)	(0.826)	(0.826)
D3×Marriage dummy×ΔMinimum wage	-1.271*	-1.257*	-1.261*	-1.259*	-1.265*	-1.266*
	(0.683)	(0.685)	(0.686)	(0.685)	(0.685)	(0.685)
ΔAge	NO	YES	YES	YES	YES	YES
ΔNon-labor income	NO	NO	YES	YES	YES	YES
ΔHusband's income	NO	NO	NO	YES	YES	YES
ΔUnemployment rate	NO	NO	NO	NO	NO	YES
ΔNumber of preschool children	NO	NO	NO	NO	YES	YES
Adjusted R squared	0.003	0.003	0.003	0.003	0.003	0.003
Num. of Obs	3010	3010	3010	3010	3010	3010

Note: D2 is an earnings dummy that represents individuals whose earnings in the previous year were between 1.05 and 1.41 million yen. D3 is an earnings dummy that represents individuals whose earnings in the previous year were below 1.05 million yen. Robust standard errors are in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

Next, considering that married women with annual earnings under 1.05 million yen who earn closer to 1.05 million yen have a higher probability of exceeding the threshold of 1.05 million yen when there is an increase in the minimum wage, a larger decrease in work hours could exist in the group that earns close to 1.05 million yen. To confirm this, we divide the group below 1.05 million yen into two groups, one relatively close to the annual income barrier and the other relatively far from the annual income barrier. First, we divide the group below 1.05 million yen into two groups based on 0.9 million yen, and see how the adjustment of working hours supply

differs in response to an increase in the minimum wage between married women in the 0.9-1.05 million yen group and married women under 0.9 million yen. Next, we lower the 0.9 million yen dividing line to 0.8 million yen and 0.7 million yen to include annual income groups that are more distant from 1.05 million yen, and examine whether the average effect of the working hour adjustment is weaker in response to an increase in the minimum wage. We examine whether the same group below 1.05 million yen but closer to the annual income barrier adjust their working hours more in response to an increase in minimum wage. We estimate using the estimation equation (1). Change $\sum_{k=1}^{2}\mu_k D_{ikt-1}$ to $\sum_{k=1}^{3}\mu_k D_{ikt-1}$ which includes a 1.05-1.41 million yen dummy, a 0.90-1.05 million yen dummy and a below 0.90 million yen dummy (1.41 million yen or more is the base group). The same method is used for estimation when separating groups of 1.05 million yen or less with 0.8 million yen or 0.7 million yen as the boundary line. We plot the coefficients for the main variables of the above three estimation in Figures 4, 5, and 6 separately, and the results of the remaining variables are shown in the appendix (see Tables A.1, A.2, and A.3).

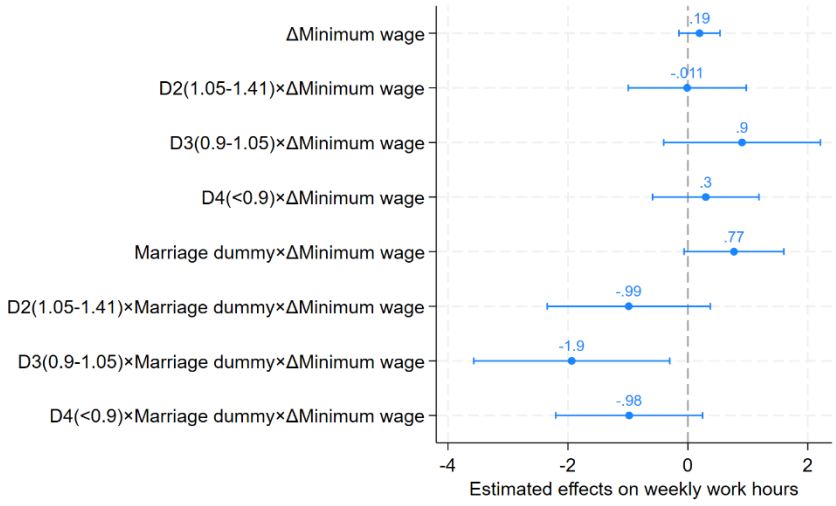


Figure 4. The plot of coefficients for the main variables in the first difference estimation with confidence intervals at the 90 percent significance intervals: Effects of minimum wage increases on work hours supply for married women under spousal exemption after subdividing the below 1.05 million yen earnings dummy variable into 0.9–1.05 million yen and <0.9 million yen subgroups

Note: D2 is an earnings dummy that represents individuals whose earnings in the previous year were between 1.05 and 1.41 million yen. D3 is an earnings dummy that represents individuals whose earnings in the previous year were between 0.9 and 1.05 million yen. D4 is an earnings dummy that represents individuals whose earnings in the previous year were below 0.9 million yen.

Figure 4 represents the plots of coefficients of intersection related to minimum wages after subdividing the below 1.05 million yen earnings dummy variable into 0.9–1.05 million yen and <0.9

million yen subgroups. The coefficients for $D_i \times Marriage\ dummy \times \Delta Minimum\ wage, where\ i = 2,3,4$, shows how part time married women with annual earnings of 1.05–1.41-million-yen, 90–1.05-million-yen and less than 0.9 million yen adjust their work hours under minimum wage increases, respectively. According to the coefficient values for $D_3 \times Marriage\ dummy \times \Delta Minimum\ wage$, an increase of one yen in the minimum wage in the 0.9–1.05 million yen group for the previous year's annual earnings decreases the weekly work hours of married women working part-time by 1.9 hours. The scale of the adjustment in working hours is larger when limited to the group earning 0.9–1.05 million yen in the previous year, which is closer to the 1.05 million yen threshold, than the scale of the adjustment in work hours for the group of married women with annual earnings of less than 1.05 million yen shown in Table 3. From the coefficient values for $D_4 \times Marriage\ dummy \times \Delta Minimum\ wage$, the group with annual earnings below 0.9 million yen, who are also potentially eligible for the spousal exemption, showed no statistically significant adjustment in their work hours and size of it is smaller than the that for 0.9–1.05 million yen group. This suggests that only the group that is most likely to exceed the 1.05 million yen threshold when the minimum wage increases will adjust their work hours.

Figure 5 shows the plots of coefficients of intersection related to minimum wages after subdividing the below 1.05 million yen earnings dummy variable into 0.8–1.05 million yen and <0.8 million yen subgroups. From the coefficient values for $D_3 \times Marriage\ dummy \times \Delta Minimum\ wage$, an increase of one yen in the minimum wage in the 0.8–1.05 million yen group for the previous year's annual earnings decreases the weekly work hours of married women working part-time by 1.6 hours. The results of this analysis show that the adjustment of work hours for married women in the 0.8–1.05 million yen group is smaller than the adjustment for women in the 0.9–1.05 million yen group shown in Figure 4, but larger than the adjustment for women in the 1.05 million yen or less group shown in Table 3. This is consistent with the hypothesis that in a situation where the deduction is expected to be eliminated with the increase in annual income brought about by an increase in the minimum wage, groups closer to 1.05

million yen, and thus more likely to exceed the annual income threshold for the deduction, are more likely to adjust their work hour supply.

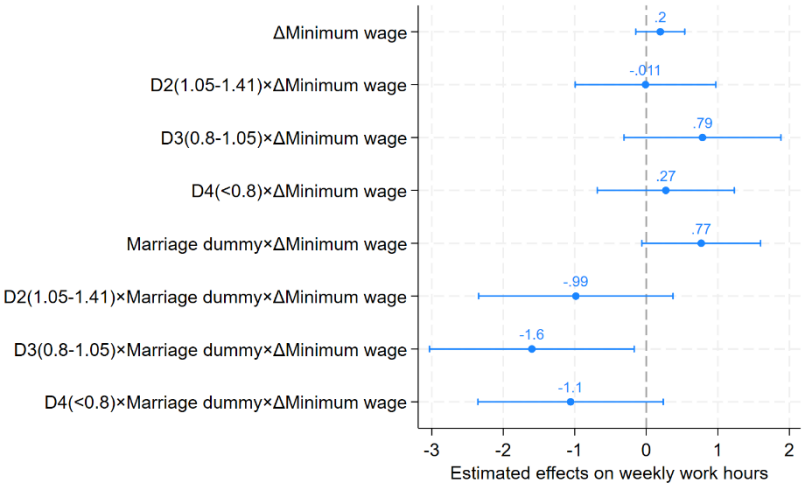


Figure 5. The plot of coefficients for the main variables in the first difference estimation with confidence intervals at the 90 percent significance intervals: Effects of minimum wage increases on work hours supply for married women under spousal exemption after subdividing the below 1.05 million yen earnings dummy variable into 0.8–1.05 million yen and <0.8 million yen subgroups

Note: D2 is an earnings dummy that represents individuals whose earnings in the previous year were between 1.05 and 1.41 million yen. D3 is an earnings dummy that represents individuals whose earnings in the previous year were between 0.8 and 1.05 million yen. D4 is an earnings dummy that represents individuals whose earnings in the previous year were below 0.8 million yen.

Figure 6 shows the plots of coefficients of the intersection related to minimum wages after subdividing the below 1.05 million yen earnings dummy variable into 0.7–1.05 million yen and <0.7 million yen subgroups. The adjustment of work hours for married women in the 0.7–1.05 million yen group is smaller than the adjustment for women in the 0.8–1.05 million yen group shown in Figure 5, but larger than the adjustment for all women in the 1.05 million yen or less group. These results are quite reasonable and indicate that the closer earnings are to the 1.05–million yen threshold, the larger the size of the adjustment in work hours for married women working part-time who are potentially eligible for spousal exemption as the minimum wage increases.

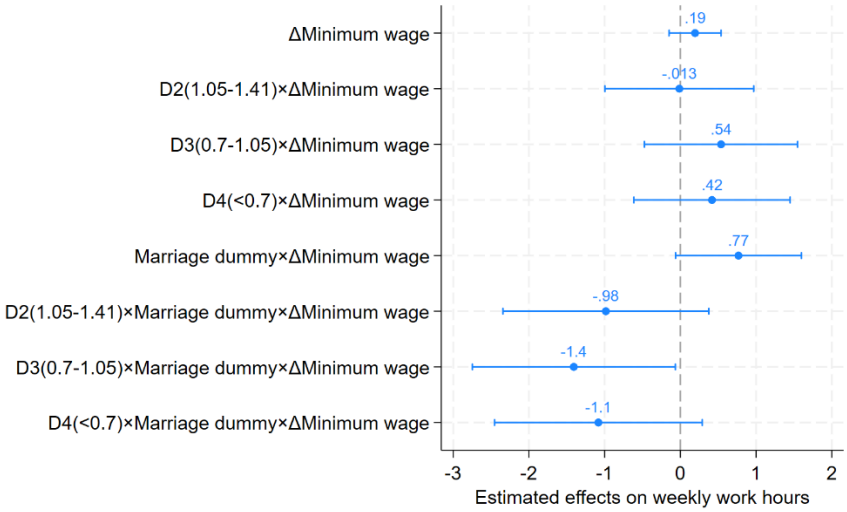


Figure 6. The coefficient plots for the main variables in the first difference estimation with confidence intervals at the 90 percent significance intervals: Effects of minimum wage increases on work hours supply for married women under spousal exemption after subdividing the 1.05 million yen earning dummy variable into 0.7–1.05 million yen and less than 0.7 million yen subgroups

Note: D2 is an earnings dummy that represents individuals whose earnings in the previous year were between 1.05 and 1.41 million yen. D3 is an earnings dummy that represents individuals whose earnings in the previous year were between 0.7 and 1.05 million yen. D4 is an earnings dummy that represents individuals whose earnings in the previous year were below 0.7 million yen.

6. Further check for unobserved heterogeneity

Since the above analysis may have included a selection bias in the annual earnings group, we perform a two-stage procedure following Origo and Pagani (2009). We estimate the probability of being in each annual earnings group (i.e., earning <0.8 million yen, from 0.8 to 1.05 million yen, earning from 1.05 to 1.41 million yen, and earning more than 1.41 million yen), and use these estimates to control for the earnings group selection bias in the work hours effect equation.[4]

In the first stage we estimate the following equation using a multinomial logit:

$$D_{ijt} = \gamma_{D'} X_{D_{ijt}} + \mu_{D_{ijt}} \quad (2)$$

[4] While the above analysis examines separate cases for groups with annual earnings of 1.05 million yen or less, and further divided by 0.7 million yen, 0.8 million yen, and 0.9 million yen, this section uses a case in which groups with annual earnings of 1.05 million yen or less are further divided by 0.8 million yen to perform robustness checks.

where D is a dummy variable for the four earnings groups. X is a vector of variables that may influence their choice of earnings group, γs is according to the parameters, and ε is the error term.

We obtain correction terms from the Eq. (2) as follows:

$$E(\mu/D = i) = \sum_{j \neq i}^{k} (\frac{P_j lnP_j}{1 - P_j} + lnP_j) \quad (3)$$

where P is estimated probabilities from Eq. (2).

Then, we add the above terms as controls in the work-hours equation, as follows:

$$\Delta Hours_{ijt} = \Delta MW_{ijt}(\gamma_4 + \sum_{k=1}^{2} \varphi_k D_{ikt-1} + \gamma_5 Married_i + Married_i \times \sum_{k=1}^{2} \mu_k D_{ikt-1}) + \Delta X_{ijt}\beta' + \sum_{k=1}^{2} \gamma_k D_{ikt-1} + \gamma_3 Married_i + Married_i \times \sum_{k=1}^{2} \varepsilon_k D_{ikt-1} + \lambda E\left(\mu_{ijt}/D_{ijt}\right) + u_{ijt} \quad (4)$$

where all the variables have the same meaning as in Eq. (1), and $E\left(\mu_{ijt}/D_{ijt}\right)$ is a function of the probabilities estimated from Eq. (3).

Table 7 summarizes the results. The results are presented here for the treatment groups of 1.05 million yen or less, separated by a 0.8 million yen dummy. Mills ratios 2, 3, and 4 are the probabilities of selecting 1.05–1.41, 0.8–1.05, and 0.8 million yen or less, respectively, when based on selecting the 1.41 million yen group. The Mills ratios are not statistically significant. The coefficient of the intersection term with the minimum wage and married dummies for the under 0.8 million yen dummies is larger than before controlling for the annual earnings group selection bias; however, they are still statistically significant. Thus, the results are robust after controlling for heterogeneity by annual earnings group.

Table 4. Robustness check: two-stage estimation after subdividing the below 1.05 million yen earnings dummy variable into 0.8–1.05 million yen and <0.8 million yen

	First difference estimation					
	(1)	(2)	(3)	(4)	(5)	(6)
D2	0.915 (16.472)	1.061 (14.629)	1.052 (15.107)	0.967 (14.227)	0.925 (15.532)	0.907 (15.258)
D3	-19.167 (17.109)	-19.019 (16.634)	-19.117 (16.097)	-19.057 (16.684)	-18.642 (16.203)	-18.683 (16.440)
D4	-5.876 (14.954)	-5.714 (15.124)	-5.699 (15.140)	-5.647 (13.749)	-5.704 (14.301)	-5.720 (15.073)
Marriage dummy	-20.171 (12.884)	-19.897 (12.256)	-19.928 (14.008)	-19.916* (11.932)	-20.139 (13.236)	-20.102 (12.749)
D2×Marriage dummy	25.559 (22.159)	25.336 (21.237)	25.343 (21.481)	25.546 (19.527)	25.640 (20.470)	25.642 (21.246)
D3×Marriage dummy	39.715* (21.970)	39.442* (20.974)	39.631* (21.911)	39.541* (21.831)	39.262* (21.428)	39.329* (21.976)
D4×Marriage dummy	28.012 (19.630)	27.626 (19.403)	27.815 (20.650)	27.817 (18.012)	28.226 (19.916)	28.230 (19.570)
ΔMinimum wage	0.175 (0.221)	0.181 (0.197)	0.181 (0.204)	0.183 (0.223)	0.184 (0.208)	0.185 (0.203)
D2×ΔMinimum wage	-0.009 (0.660)	-0.015 (0.585)	-0.014 (0.606)	-0.011 (0.572)	-0.009 (0.620)	-0.009 (0.614)
D3×ΔMinimum wage	0.828 (0.696)	0.822 (0.676)	0.826 (0.656)	0.824 (0.673)	0.806 (0.658)	0.808 (0.672)
D4×ΔMinimum wage	0.279 (0.607)	0.272 (0.611)	0.271 (0.612)	0.269 (0.553)	0.271 (0.579)	0.272 (0.604)
Marriage dummy×ΔMinimum wage	0.801 (0.508)	0.790 (0.486)	0.792 (0.555)	0.791* (0.472)	0.800 (0.525)	0.798 (0.505)
D2×Marriage dummy×ΔMinimum wage	-0.998 (0.888)	-0.989 (0.850)	-0.989 (0.861)	-0.997 (0.783)	-1.002 (0.820)	-1.002 (0.852)
D3×Marriage dummy×ΔMinimum wage	-1.638* (0.883)	-1.627* (0.846)	-1.635* (0.880)	-1.631* (0.873)	-1.619* (0.860)	-1.622* (0.885)
D4×Marriage dummy×ΔMinimum wage	-1.082 (0.790)	-1.067 (0.780)	-1.074 (0.829)	-1.074 (0.718)	-1.092 (0.799)	-1.092 (0.782)
E(μD=1.05-1.41 million yen group)	0.034 (0.066)	0.034 (0.072)	0.034 (0.068)	0.033 (0.068)	0.035 (0.069)	0.034 (0.061)
E(μD=0.8-1.05 million yen group)	0.087 (0.194)	0.086 (0.177)	0.089 (0.195)	0.089 (0.188)	0.090 (0.186)	0.087 (0.187)
E(μD=less than 0.8 million yen group)	-0.192 (0.186)	-0.191 (0.169)	-0.193 (0.193)	-0.192 (0.182)	-0.193 (0.175)	-0.191 (0.178)
ΔAge	NO	YES	YES	YES	YES	YES
ΔNon-labor income	NO	NO	YES	YES	YES	YES
ΔHusband's income	NO	NO	NO	YES	YES	YES
ΔUnemployment rate	NO	NO	NO	NO	NO	YES
ΔNumber of preschool children	NO	NO	NO	NO	YES	YES
Adjusted R2	0.005	0.005	0.005	0.004	0.005	0.005
Num. of Obs	3010	3010	3010	3010	3010	3010

Note: D2 is an earnings dummy that represents individuals whose earnings in the previous year were between 1.05 and 1.41 million yen. D3 is an earnings dummy that represents individuals whose earnings in the previous year were between 0.8 and 1.05 million yen. D4 is an earnings dummy that represents individuals whose earnings in the previous year were below 0.8 million yen. Bootstrapped standard errors (300 replications) are in parenthesis. ***p < 0.01, **p < 0.05, *p < 0.1.

These results indicate that those who originally received spousal exemptions adjusted their work hours themselves in response to the increase in the minimum wage under the minimum wage system and the spousal exemption system in Japan.

7. Conclusions

In recent years, the minimum wage in Japan has been raised by around 20 yen per hour each year, which should be an incentive to actively increase the supply of part-workers, especially women, who are more like to benefit from an increase in the minimum wage. Meanwhile, married women who work part-time and are eligible for the spousal exemption system may reduce their labor supply to avoid exceeding the annual earnings threshold, and continue to qualify for exemption in response to the wage increase triggered by the minimum wage increase. Therefore, it is important to clarify how married women working part-time perform labor supply under the minimum wage and spousal exemption systems, which have conflicting effects on the labor supply.

In this study, we use each annual earnings group of single women as a control group, and analyze how the supply of work hours of married women who potentially qualify for the spousal exemption system responds to an increase in the minimum wage by controlling for demand-side factors and fixed effects by annual earnings. The results indicate that married women with annual earnings of less than 1.05 million yen in the previous year statistically significantly reduce their work hours as the minimum wage increases in the current year. However, married women whose previous year's annual earnings were between 1.05 and 1.41 million yen do not reduce their working hours in the current year. In other words, while the increase in the minimum wage caused married women in the spousal exemption group to adjust their working hours in consideration of the 1.05 million yen ceiling, they do not react to the 1.41 million yen ceiling. The scale of adjustment in work hours is larger for married women whose annual earnings are close to 1.05 million yen, particularly in the subgroup 0.9 million yen or more. That is, we found that married women, who are potentially eligible for the spousal deduction, are adjusting their labor supply with an awareness of the annual income limit at which the real deduction amount begins to decline with rising wages. This is consistent with the fact that married women in the analyzed sample shown in the histogram in Figure 2 are concentrated around 1,050,000 yen. Furthermore, the results of the analysis after calculating the probability of selecting an annual earnings group are robust.

Previous studies focusing on Japan's spousal deduction system have analyzed the labor supply of married women based on changes in the "income barrier" for married women caused by policy changes, but few have analyzed cases where the "income barrier" itself remains fixed and other factors cause an increase in wages for married women, and then adjust the labor supply

so that it does not exceed the "income barrier" created by Japan's spousal deduction system. Additionally, most of the previous studies analyzing the minimum wage on labor supply have looked at it from the demand side (Akesaka et. al. 2017), and our study finds that it does, in fact, include some supply-side adjustments. In this study, married women who were subject to the annual income limit of application of the spousal deduction, especially those who worked below 1.05 million yen, showed an increase of one yen in the minimum wage decreasing their weekly work hours by 1.266 hours.

However, this study also contains the following limitations. The weekly work hours in this study use data on work hours as of December of each year. While this is a feature that makes it easy to capture adjustments in working hours in the sense that it is a time of year when there is a large potential for year-end adjustments, it does not measure the full scale of the working hour adjustment because it is not annual working hours. Since we are using weekly working hours and the adjustment is more on an annual basis, the actual effect could be much larger. Furthermore, since this study uses survey data from individuals, there is a certain potential for error. In the future, more accurate data on working hours should be obtained from company human resource data for the study.

This study's results provide insights into Japan's labor market, where labor shortages will become more severe in the future. It can be assumed that more married women who work part-time will adjust their employment levels after the hourly minimum wage was raised by 30 yen in 2022. The spousal exemption system has been revised since 2018, raising the annual earnings limit for the exemption to 1.5 million yen. Moreover, married women who work part-time may be less inclined to reduce their working hours in response to the wage increase brought about by the minimum wage hike. However, to improve labor shortages despite the continued increase in minimum wages in the future, it is important to design a system that considers the conflicting impacts of the two systems on the labor supply.

Appendix

Table. A.1.

	First difference estimation					
	(1)	(2)	(3)	(4)	(5)	(6)
D2	0.967 (14.862)	1.104 (14.870)	1.103 (14.873)	1.013 (14.883)	0.983 (14.884)	0.950 (14.888)
D3	-21.137 (19.204)	-21.000 (19.211)	-21.110 (19.227)	-21.052 (19.226)	-20.868 (19.237)	-20.941 (19.274)
D4	-6.763 (13.337)	-6.615 (13.348)	-6.598 (13.356)	-6.554 (13.355)	-6.447 (13.359)	-6.465 (13.363)
Marriage dummy	-19.528 (12.768)	-19.269 (12.819)	-19.297 (12.818)	-19.293 (12.793)	-19.502 (12.792)	-19.459 (12.791)
D2×Marriage dummy	25.163 (20.580)	24.954 (20.607)	24.954 (20.611)	25.172 (20.650)	25.258 (20.652)	25.267 (20.652)
D3×Marriage dummy	46.609* (24.415)	46.347* (24.444)	46.558* (24.459)	46.447* (24.444)	46.302* (24.448)	46.378* (24.493)
D4×Marriage dummy	25.326 (18.557)	24.989 (18.592)	25.130 (18.614)	25.151 (18.606)	25.384 (18.618)	25.408 (18.621)
ΔMinimum wage	0.184 (0.208)	0.190 (0.209)	0.190 (0.209)	0.192 (0.209)	0.192 (0.208)	0.195 (0.208)
D2×ΔMinimum wage	-0.012 (0.597)	-0.017 (0.597)	-0.017 (0.597)	-0.014 (0.597)	-0.012 (0.597)	-0.011 (0.598)
D3×ΔMinimum wage	0.911 (0.790)	0.906 (0.791)	0.910 (0.791)	0.908 (0.791)	0.900 (0.792)	0.903 (0.793)
D4×ΔMinimum wage	0.312 (0.538)	0.305 (0.538)	0.305 (0.539)	0.303 (0.539)	0.298 (0.539)	0.298 (0.539)
Marriage dummy×ΔMinimum wage	0.772 (0.504)	0.762 (0.506)	0.763 (0.506)	0.763 (0.505)	0.771 (0.505)	0.769 (0.505)
D2×Marriage dummy×ΔMinimum wage	-0.982 (0.824)	-0.974 (0.825)	-0.974 (0.825)	-0.982 (0.826)	-0.986 (0.826)	-0.986 (0.826)
D3×Marriage dummy×ΔMinimum wage	-1.947** (0.990)	-1.937* (0.991)	-1.945** (0.992)	-1.940* (0.991)	-1.934* (0.991)	-1.937* (0.993)
D4×Marriage dummy×ΔMinimum wage	-0.975 (0.742)	-0.962 (0.743)	-0.967 (0.744)	-0.967 (0.744)	-0.977 (0.744)	-0.978 (0.744)
ΔAge	NO	YES	YES	YES	YES	YES
ΔNon-labor income	NO	NO	YES	YES	YES	YES
ΔHusband's income	NO	NO	NO	YES	YES	YES
ΔUnemployment rate	NO	NO	NO	NO	NO	YES
ΔNumber of preschool children	NO	NO	NO	NO	YES	YES
Adjusted R2	0.008	0.008	0.008	0.007	0.008	0.008
Num. of Obs	3010	3010	3010	3010	3010	3010

Table. A.2.

	First difference estimation					
	(1)	(2)	(3)	(4)	(5)	(6)
D2	0.967 (14.862)	1.120 (14.870)	1.119 (14.873)	1.029 (14.883)	0.997 (14.884)	0.959 (14.887)
D3	-18.669 (16.342)	-18.515 (16.350)	-18.593 (16.365)	-18.534 (16.364)	-18.111 (16.378)	-18.179 (16.401)
D4	-6.029 (14.363)	-5.855 (14.376)	-5.843 (14.385)	-5.786 (14.384)	-5.844 (14.388)	-5.864 (14.392)
Marriage dummy	-19.528 (12.768)	-19.238 (12.820)	-19.265 (12.819)	-19.261 (12.793)	-19.482 (12.792)	-19.431 (12.792)
D2×Marriage dummy	25.163 (20.580)	24.929 (20.607)	24.929 (20.611)	25.148 (20.650)	25.239 (20.652)	25.249 (20.652)
D3×Marriage dummy	39.220* (21.568)	38.930* (21.601)	39.098* (21.616)	39.011* (21.596)	38.725* (21.597)	38.816* (21.627)
D4×Marriage dummy	27.247 (19.551)	26.843 (19.587)	27.004 (19.615)	27.013 (19.603)	27.421 (19.626)	27.428 (19.628)
ΔMinimum wage	0.184 (0.208)	0.190 (0.209)	0.190 (0.209)	0.193 (0.209)	0.193 (0.208)	0.196 (0.208)
D2×ΔMinimum wage	-0.012 (0.597)	-0.018 (0.597)	-0.018 (0.597)	-0.015 (0.597)	-0.013 (0.597)	-0.011 (0.598)
D3×ΔMinimum wage	0.806 (0.664)	0.800 (0.665)	0.803 (0.665)	0.801 (0.665)	0.782 (0.666)	0.785 (0.667)
D4×ΔMinimum wage	0.280 (0.582)	0.273 (0.582)	0.272 (0.582)	0.270 (0.582)	0.272 (0.583)	0.273 (0.583)
Marriage dummy×ΔMinimum wage	0.772 (0.504)	0.760 (0.506)	0.762 (0.506)	0.762 (0.505)	0.770 (0.505)	0.768 (0.505)
D2×Marriage dummy×ΔMinimum wage	-0.982 (0.824)	-0.973 (0.825)	-0.973 (0.825)	-0.981 (0.826)	-0.985 (0.826)	-0.986 (0.826)
D3×Marriage dummy×ΔMinimum wage	-1.618* (0.867)	-1.606* (0.868)	-1.613* (0.869)	-1.609* (0.868)	-1.596* (0.868)	-1.600* (0.870)
D4×Marriage dummy×ΔMinimum wage	-1.051 (0.784)	-1.035 (0.785)	-1.041 (0.787)	-1.041 (0.786)	-1.059 (0.787)	-1.059 (0.787)
ΔAge	NO	YES	YES	YES	YES	YES
ΔNon-labor income	NO	NO	YES	YES	YES	YES
ΔHusband's income	NO	NO	NO	YES	YES	YES
ΔUnemployment rate	NO	NO	NO	NO	NO	YES
ΔNumber of preschool children	NO	NO	NO	NO	YES	YES
Adjusted R2	0.006	0.005	0.005	0.005	0.005	0.005
Num. of Obs	3010	3010	3010	3010	3010	3010

Table. A.3.

	First difference estimation					
	(1)	(2)	(3)	(4)	(5)	(6)
D2	0.967 (14.862)	1.131 (14.870)	1.130 (14.873)	1.049 (14.883)	1.019 (14.884)	0.996 (14.888)
D3	-12.657 (15.153)	-12.493 (15.162)	-12.540 (15.178)	-12.465 (15.175)	-12.143 (15.183)	-12.170 (15.196)
D4	-9.554 (15.399)	-9.357 (15.413)	-9.349 (15.424)	-9.307 (15.424)	-9.365 (15.428)	-9.382 (15.436)
Marriage dummy	-19.528 (12.768)	-19.218 (12.820)	-19.239 (12.819)	-19.235 (12.796)	-19.446 (12.796)	-19.417 (12.795)
D2×Marriage dummy	25.163 (20.580)	24.913 (20.607)	24.913 (20.610)	25.110 (20.652)	25.197 (20.654)	25.203 (20.656)
D3×Marriage dummy	34.444* (20.304)	34.137* (20.339)	34.237* (20.356)	34.154* (20.332)	34.096* (20.332)	34.126* (20.347)
D4×Marriage dummy	28.505 (20.642)	28.032 (20.678)	28.196 (20.708)	28.212 (20.701)	28.451 (20.725)	28.471 (20.731)
ΔMinimum wage	0.184 (0.208)	0.191 (0.209)	0.191 (0.209)	0.193 (0.209)	0.193 (0.208)	0.195 (0.208)
D2×ΔMinimum wage	-0.012 (0.597)	-0.018 (0.597)	-0.018 (0.597)	-0.015 (0.597)	-0.014 (0.597)	-0.013 (0.598)
D3×ΔMinimum wage	0.558 (0.613)	0.551 (0.613)	0.553 (0.614)	0.550 (0.614)	0.536 (0.614)	0.538 (0.615)
D4×ΔMinimum wage	0.426 (0.626)	0.418 (0.626)	0.417 (0.627)	0.415 (0.627)	0.417 (0.627)	0.418 (0.627)
Marriage dummy×ΔMinimum wage	0.772 (0.504)	0.760 (0.506)	0.761 (0.506)	0.760 (0.505)	0.769 (0.505)	0.767 (0.505)
D2×Marriage dummy×ΔMinimum wage	-0.982 (0.824)	-0.972 (0.825)	-0.972 (0.825)	-0.979 (0.826)	-0.984 (0.826)	-0.984 (0.827)
D3×Marriage dummy×ΔMinimum wage	-1.421* (0.813)	-1.409* (0.815)	-1.413* (0.815)	-1.409* (0.814)	-1.406* (0.814)	-1.407* (0.815)
D4×Marriage dummy×ΔMinimum wage	-1.083 (0.830)	-1.064 (0.832)	-1.070 (0.833)	-1.070 (0.832)	-1.082 (0.833)	-1.083 (0.834)
ΔAge	NO	YES	YES	YES	YES	YES
ΔNon-labor income	NO	NO	YES	YES	YES	YES
ΔHusband's income	NO	NO	NO	YES	YES	YES
ΔUnemployment rate	NO	NO	NO	NO	NO	YES
ΔNumber of preschool children	NO	NO	NO	NO	YES	YES
Adjusted R2	0.013	0.013	0.013	0.013	0.014	0.014
Num. of Obs	3010	3010	3010	3010	3010	3010

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References

Abe, Y., 2009. The effects of the 1.03 million yen ceiling in a dynamic labor supply model. Contemporary Economic Policy 27, 147–163. https://doi.org/10.1111/j.1465-7287.2008.00115.x.

Abe, Y., Ohtake, F., 1995. Zeisei shakai hosho seido to part-time roudousha no roudou kyoukyuu koudou (Tax and social security system and part-time workers' labor supply behavior). Kikan Shakai Hosho Kenkyu 31, 120–134. in Japanese.

Adachi, Y., Kaneda, T., 2016. Spousal deduction and female labor supply. Journal of Household Economics 43, 13–29. [in Japanese].

Akabayashi, H., 2006. The labor supply of married women and spousal tax exemptions in Japan. Review of Economics of the Household 4, 349–378. https://doi.org/10.1007/s11150-006-0012-5.

Akesaka, M., Ito, Y., Ohtake, F., 2017 Impact of Change in Minimum Wages on Employment and Poverty in Japan ISER Discussion Paper number 999 [in Japanese].

Allegretto, S.A., Dube, A., Reich, M., 2011. Do minimum wages really reduce teen employment? Accounting for heterogeneity and selectivity in state panel data. Industrial Relations 50, 205–240. https://doi.org/10.1111/j.1468-232X.2011.00634.x.

Bessho, S., Hayashi, M., 2014. Intensive margins, extensive margins, and spousal allowances in the Japanese system of personal income taxes: A discrete choice analysis. Journal of the Japanese and International Economies 34, 162–178. https://doi.org/10.1016/j.jjie.2014.06.001.

Connolly, S., Gregory, M., 2002. The national minimum wage and hours of work: Implications for low paid women. Oxford Bulletin of Economics and Statistics 64, 607–631. https://doi.org/10.1111/1468-0084.64.s.3.

Dickens, R., Machin, S., Manning, A., 1999. The effects of minimum wages on employment: Theory and evidence from Britain. Journal of Labor Economics 17, 1–22. https://doi.org/10.1086/209911.

Dickens, R., Riley, R., Wilkinson, D., 2012. Re-examining the impact of the national minimum wage on earnings, employment and hours: The importance of recession and firm-size. Research Report for the Low Pay Commission.

Hguchi, Y., Sato, K., Kobayashi, T., 2011. Saiteichingin Hikiage no Keizai Kouka: Panel Niyoru Bunnseki. Keio/KYOTO GLOBAL COE DISCUSSION PAPER SERIES DP, pp. 2011–2025.

Hyslop, D., Stillman, S., 2007. Youth minimum wage reform and the labour market in New Zealand. Labour Economics 14, 201–230. https://doi.org/10.1016/j.labeco.2005.10.001.

Kamińska, A., Lewandowski, P., 2015. The Effects of Minimum Wage on a Labour Market with High Temporary Employment (IBS Working Papers, 07/2015). Institute for Structural Research, Warsaw.

Kawaguchi, D., Mori, Y., 2021. Estimating the effects of the minimum wage using the introduction of indexation. Journal of Economic Behavior and Organization 184, 388–408. https://doi.org/10.1016/j.jebo.2021.01.032.

Machin, S., Manning, A., Rahman, L., 2003. Where the minimum wage bites hard: Introduction of minimum wages to a low wage sector. Journal of the European Economic Association 1, 154–180. https://doi.org/10.1162/154247603322256792.

Neumark, D., Mark S., William W. 2004b. Minimum wage effects throughout the wage distribution. Journal of Human Resources 39(2):425–50.

Neumark, D., and Olena, N. 2007. Minimum wage effects in the longer run. Journal of Human Resources 42(2): 435-52.

Oishi, A., 2003. Yu haigu sha josei no roudou kyoukyuu to zeisei shakai hoshou seido. Kikan Shakai Hoshou Kenkyu 39, 286–305 [in Japanese].

Origo, F., Pagani, L., 2009. Flexicurity and job satisfaction in Europe: The importance of perceived and actual job stability for well-being at work. Labour Economics 16, 547–555. http://doi.org/10.1016/j.labeco.2009.02.003.

Stewart, M., Swaffield, J., 2008. The other margin: Do minimum wages cause work hours adjustments for low-wage workers? Economica 75, 148–167.

Takahashi, S., 2010. An estimation of the work disincentive effects of the spousal deduction and the social security systems on the labor supply of Japanese married women. Japan Labor Review 52, 28–43. in Japanese.

Wong, S., 2017. Minimum wage impacts on wages and hours worked of low-earning workers in Ecuador Working Papers PMMA. PEP-PMMA.

Yokoyama, I., 2018. How the tax reform on the special exemption for spouse affected the work-hour distribution. Journal of the Japanese and International Economies 49, 69–84. https://doi.org/10.1016/j.jjie.2018.04.002.

Zavodny, M., 2000. The effects of the minimum wage on hours of work. Labour Economics 7, 729–750.