Does the Extension of Spousal Exemptions Coverage in Japanese Tax System Encourage Female Hourly Informal Employees to Work More?

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Abstract:

The Spouse Exemption (SE) in the Japanese tax system creates an incentive for women to strategically control their labor income below a certain threshold, ensuring their husbands' eligibility for individual income tax deductions. The 2017 tax reform, by raising the upper limit of SEs' income threshold, expanded the scope of spousal deductions. This reform was expected to motivate women to increase labor supply, yet there has been minimal prior research that empirically validates its resulting policy effects. To address this gap, I begin by theoretically abstracting this reform as changes in the full exemption amount and the reduction in marginal exemption due to increased wives' labor supply. Subsequently, I analyze variations in female labor supply across different income ranges based on shifts in the household budget constraint and demonstrate the potential impact of the pre-reform labor supply distribution on the policy effects of SEs reform. I then employ empirical methods to test these theoretical predictions. Specifically, this study employs a Difference-in-Differences method with two-way fixed effects to estimate the overall treatment effect of this reform. Heterogeneity analysis is conducted on samples from different income ranges prior to the reform. Furthermore, a Quantile Difference-in-Differences estimation is used to assess the treatment effect of the reform on the distribution of labor supply. To account for potential bias from sample selection, the Propensity Score Matching is implemented to match the treatment and control groups before conducting the Difference-in-Differences analysis. Additionally, recognizing the challenge for formally employed workers to autonomously control labor supply and the inability to accurately identify wage rates for non-hourly wage workers, this study confines its focus to hourly wage women engaged in informal employment. The results of the empirical analysis suggest a limited overall impact on female labor supply. However, middle-income women prior to the reform notably reduced their labor supply due to the combined effects of substitution and income. In contrast, the treatment effects on labor supply for low and high-income women were not statistically significant. Moreover, the reform significantly reduced labor supply among women engaged in long-duration

work. In the realm of policy implementation, the study's findings are consistent with prior research, furnishing additional evidence for the partial or complete abolishment of SEs.

Keywords:

Japanese Tax System; Spouse Exemptions; Female Labor Supply

Classification codes:

H24, J21, J20, H31, J08, H22

1. Introduction

To address the challenges posed by low birthrates and an aging population, the Japanese government has actively promoted increased labor force participation, particularly among women. However, the existing spousal[1] exemptions[2] within Japan's tax system, known as the Spouse Exemption and Special Exemption Systems (referred to as SEs[3] hereafter), have faced criticism for dampening female labor supply. Specifically, these exemptions allow a certain portion of taxable income to be excluded if claimed by the husband, based on the combined income of the husband and wife. Consequently, many women have adjusted their working hours to keep their income within specific limits, enabling their husbands to qualify for the exemption. Multiple surveys have revealed that a considerable number of spouses in Japan have altered their work schedules in consideration of the income thresholds associated with SEs. For instance, data from the General Survey on Part-time Workers published by the Ministry of Health, Labor and Welfare of Japan (2016), indicate that between October 2015 and September 2016, 20.2% of part-time workers (a significant segment of informal employees), who were married, acknowledged modifying their work hours to gain tax or social security benefits.

The pivotal 2017 reform of the SEs in Japan was heralded as a significant stride towards enhancing female labor force participation. Minister of Finance Asō, during the 193rd Session of the National Diet, asserted that the 2017 SEs reform "eliminates the need for concerns regarding working hour adjustments" (Ministry of Finance, 2017). The reform was anticipated to raise the income threshold for spouses eligible for SEs, thereby expanding the scope of coverage and allowing wives to augment their labor supply without the fear of reducing their husband's SEs.

Despite the perceived benefits, research delving into the effects of the 2017 SEs reform on female labor supply has been scarce. Moreover, my constructed theoretical model indicates that the changes in the husband's SEs produce substitution and income effects that may not necessarily lead to a proportional increase in the wife's labor supply. Notably, the impact of the SEs reform on wives varies

[1] The so-called spouse in the SEs is not limited to “woman.” “Man,” the third gender, and the others are also eligible to be called “spouses.” However, data from the Population Census in 2015 show approximately 1,131 thousand households with unemployed husbands and employed wives in 2015, accounting for 4.1% of the total number of households in Japan. Since this kind of family accounts for a relatively small proportion, for simplicity, in this paper, the term “spouse” in the SEs indicates women, and the taxpayer indicates men by default.

[2] The “Koujo” in Japanese is translated as “exemption” in this paper by referring to the translation of the studies of Yokoyama (2018) and the official reports of National Tax Agency of Japan (2018), although some studies translated the “Koujo” as “allowance” (Akabayashi, 2006; Besho and Hayashi, 2014) or “deduction” (Adachi & Kaneda, 2016).

[3] The SEs consist of two sub-schemes, the spousal exemption (SE) and special spousal exemptions (SSE). During the study period (2015-2019), both the SE and SSE provide a tax exemption for the filing taxpayers, based on the total income of them and their spouses. Importantly, the coverage of these two exemptions does not overlap.

across income ranges, with the income effect being contingent on initial labor supply levels. This underscores the need to not only examine policy effects heterogeneity across income brackets but also to gauge how policy changes reshape the distribution of female labor supply. Consequently, this study aims to estimate the treatment effects of the 2017 SEs reform on hourly-paid informal female employees' labor supply. Furthermore, it seeks to conduct a nuanced analysis of treatment effects within distinct income ranges and across varying labor supply distributions.

Yokoyama (2018) also accentuates the disparate treatment effects of SEs reforms on female labor supply across different earnings ranges. The SEs encompass two sub-schemes: the spousal exemption (SE) and special spousal exemptions (SSE). The 2004 tax reform eliminated SSE eligibility for low-income spouses, leading to non-overlapping populations between the SE and SSE (refer to Footnote 3). Essentially, this reform narrowed the scope of SSE coverage. Yokoyama's study demonstrated that the partial removal of SSE in 2004 in Japan, through an income effect, led to increased labor supply among low-income women due to the "compression" of the household budget constraint. Can we then infer that the expansion of SEs coverage in 2017 might decrease the labor supply of women with an "expanded" household budget constraint? My empirical findings support this conjecture, confirming that the 2017 SEs reform increased labor supply for women whose pre-reform earnings (PRE) ranged from 1.05 million yen to 2.01 million yen. On the contrary, the reform had no discernible effect on women with PRE exceeding 2.01 million yen or falling below 1.05 million yen, as it did not impact their household budget constraints.

Moreover, my theoretical model suggests that beyond exploring treatment effects variation across income ranges, it's pertinent to examine the repercussions of the SEs reform on labor supply distribution. Empirical analysis reveals that the SEs reform notably reduced the labor supply of long-hour workers, while its impact on medium and short-hour workers' labor supply was insignificant. This discrepancy can be attributed to the stronger income effect on female workers with longer work hours under otherwise similar conditions. Synthesizing results from the analysis of different income range samples, it becomes apparent that the expansion of SEs coverage is more likely to influence women with medium incomes but longer work hours.

Furthermore, I encountered limitations in establishing significant evidence of the SEs reform's impact on labor supply across the entire sample, which aligns to some extent with previous research findings. Most scholars contend that while the SE system suppresses female labor supply, the increase resulting from reforms or even the complete abolition of the SE system is limited. Structural estimations by Akabayashi (2006), Takahashi (2010), and Bessho and Hayashi (2014) suggest that even the complete

elimination of the SEs system would only raise spousal labor supply by 5.6%, 0.7%, and 1.6%, respectively. These results suggest that abolishing the SE system wouldn't significantly alleviate the severe labor shortage. Yokoyama (2018) similarly fails to provide substantial evidence of the average treatment effect of the 2004 reform on female labor supply. However, contrasting conclusions have been drawn by other scholars. Mori and Urakawa (2009) find a notably positive average treatment effect of this reform, whereas Sakata and McKenzie (2005) reach the opposite conclusion, acknowledging possible endogeneity due to omitted variables.

Learning from Sakata and McKenzie (2005) and referencing the standard model proposed by Salanié (2012), it's crucial to control for factors such as wage rates, labor supply elasticity, and the influence of past labor habits when estimating the treatment effects of SEs reform. These factors have often been overlooked in prior studies (Adachi & Kaneda, 2016; Sakata & McKenzie, 2005; Yokoyama, 2018; Yokoyama & Kurumai, 2016). To accurately capture individual wage rates, a trade-off was made that may limit the generalizability of certain findings. Specifically, this study exclusively focuses on female formal employees under an hourly wage system, as only the wages of hourly-paid workers can be clearly ascertained. Attempts were also made to expand the sample to include all informal female employees without controlling for wage rates. However, treatment effects remained statistically insignificant across overall context, different income ranges, and various labor supply distributions.

In summation, the findings of this study indicate that the expansion of SEs coverage in the 2017 reform had limited treatment effects on labor supply among hourly-paid informal female employees as a whole. Nevertheless, it significantly curtailed the labor supply of medium-income individuals and those engaged in long-hour work. A growing sentiment within academia advocates for partial or complete abolition of the SEs system. While past research has primarily demonstrated this by assessing how women's labor supply alters after SEs' abolition or partial removal, this study takes a contrarian stance. By demonstrating that expanding SEs is not conducive to enhancing female labor supply, it offers evidence in favor of the argument for partial or complete abolition of the SEs system.

To provide clarity regarding the methodology and support for the conclusions reached, the subsequent sections of this study are organized as follows: Section 2 presents a succinct overview of the SEs system. Section 3 introduces a theoretical model that elucidates the effects of reforms on women's labor supply. Section 4 delineates the research design adopted for empirical analysis. In Section 5, empirical results are presented, along with an interpretation of their implications. Finally, Section 6 encapsulates the findings, draws conclusions, and delves into study limitations.

2. The Spouse Exemption System

In Japan, a taxpayer with a spouse living in the same household can claim the SEs. In such cases, a certain amount is exempted based on the total income of both the taxpayers and their spouses. Additionally, husband and wife cannot claim the SEs simultaneously, and the rules of the SEs differ depending on the spouse's income type and types of income tax return

The SEs consist of two sub-schemes, the SE and special SSE, which were established in 1961 and 1987, respectively. However, the SEs have faced substantial criticism in recent decades due to their departure from the principle of tax neutrality. These exemptions disrupt spouses' employment decisions and working hours, incentivizing them to curtail their income to a specific threshold in order to qualify for SEs eligibility criteria (Takahashi, 2010). In response to this criticism, the 2017 tax reform in Japan made significant changes to the SEs, such as increasing the income thresholds of the spouse, making the exemption amount regressive with the taxpayer's income, and making these exemptions unavailable for taxpayers with extremely high income. This effectively extended the SEs' coverage. It's worth noting that the schedules of SEs differ for spouses with solely wage income and spouses with multiple income types. This research solely pertains to spouses with wage income alone. Therefore, the SEs schedules before and after the reform for these spouses are presented in Table 1, while the SEs schedules for spouses with other income types are provided in Appendix 1.

Table 1. Schedules of the Spousal Exemptions for spouses with sole income from earnings.

		Taxpayer's total amount of income		Spousal Exemptions
		¥12,200,000 or less	Over ¥12,200,000	
Spouse's total amount of income	¥1,030,000 or less	¥380,000	¥380,000	spousal allowance
	Elderly qualified spouses (Those older than 70 years old)	¥480,000	¥480,000	
	¥1,030,001 to ¥1,050,000	¥380,000	¥0	Special Spousal Allowance
	¥1,050,001 to ¥1,100,000	¥360,000		
	¥1,100,001 to ¥1,150,000	¥310,000		
	¥1,150,001 to ¥1,200,000	¥260,000		
	¥1,200,001 to ¥1,250,000	¥210,000		
	¥1,250,001 to ¥1,300,000	¥160,000		
	¥1,300,001 to ¥1,350,000	¥110,000		
	¥1,350,001 to ¥1,400,000	¥60,000		
	¥1,400,001 to ¥1,410,000	¥30,000		
	over ¥1,410,000	¥0		

a. *Schedules applied for income before 2018.*

		Taxpayer's total amount of income			Spousal Exemptions
		¥11,200,000 or less	¥11,200,001 to ¥11,700,000	¥11,700,001 to ¥12,200,000	
Spouse's total amount of income	¥1,030,000 or less	¥380,000	¥260,000	¥130,000	Spousal Exemption
	Elderly qualified spouses (Those older than 70 years old)	¥480,000	¥320,000	¥160,000	
	¥1,030,001 to ¥1,500,000	¥380,000	¥260,000	¥130,000	Special Spousal Exemption
	¥1,500,001 to ¥1,550,000	¥360,000	¥240,000	¥120,000	
	¥1,550,001 to ¥1,600,000	¥310,000	¥210,000	¥110,000	
	¥1,600,001 to ¥1,670,000	¥260,000	¥180,000	¥90,000	
	¥1,670,001 to ¥1,750,000	¥210,000	¥140,000	¥70,000	
	¥1,750,001 to ¥1,830,000	¥160,000	¥110,000	¥60,000	
	¥1,830,001 to ¥1,900,000	¥110,000	¥80,000	¥40,000	
	¥1,900,001 to ¥1,970,000	¥60,000	¥40,000	¥20,000	
	¥1,970,001 to ¥2,010,000	¥30,000	¥20,000	¥10,000	
	over ¥2010,000	¥0	¥0	¥0	

b. *Schedules applied for income in 2018 and 2019.*

3. A Theoretical Model: Effect of the SEs on the Working Hours of Married Women

The 2017 SEs reform reduced the full deduction amount that taxpayers with income exceeding 11.2 million yen could claim, leading to a deformation of the budget line for households with husbands whose income exceeds 11.2 million yen. For the sake of analysis simplicity, I only consider husbands, whose total amount of income prior to the reform is below 11.2 million Japanese yen. This is because, on one hand, according to the 2017 JPSED, male employees with an annual income exceeding 11.2 million Japanese yen accounted for only 6.05% of the total male employees. On the other hand, given the diminishing marginal utility of consumption, high-income taxpayers' wives are less likely to adjust their labor supply in response to tax reform.

Consider a household with two suppliers of labor, a husband and a wife. The term "spouse" in this context refers to the wife, whose income is lower than her husband's. I assume that: (i) The husband's income is predetermined and exogenous. The wife chooses her working hours, taking her husband's income as given, as in Japan the husband's work status is hardly affected by his wife's work status (Akabayashi, 2006; Kuroda & Yamamoto, 2008). (ii) The wage rate of the wife is exogenous and determined by the labor market. (iii) The income tax rate for the husband is progressive, while the tax rate for the wife is proportional. (iv) Leisure is a normal good. (v) The wife has sole earnings from her jobs.

Then, the common utility function for this household to maximize utility is formalized as

$$max_{L_w,C}\ U(C,H) \tag{1}$$

$$s.t.\,C = (1-t_w)wH + [i_m - t_m(i_m - E)]. \tag{2}$$

$$E = E_{full} - MwH. \tag{3}$$

Here, all parameters are non-negative. C represents the consumption of a unit-priced aggregate good for both the husband and wife. H represents the working hours of the wife. In the constraint equation, w represents the hourly wage of the wife. i_m represents the income of the husband. t_w and t_m represent the effective tax rates for wife's income and husband's income, respectively. And t_m is an increasing function of $(i_m - E)$. E denotes the SEs function, which are defined later.

The function E represents the SEs function, indicating the amount of SEs that are exempted from

the husband's income according to the SEs schedules. Given the husband's income, the actual deduction function should be stepped down. For simplicity, I smooth it into a continuous linear function. E_{full} is the full SEs, i.e., the maximum SEs that the husband can claim. M represents the marginal loss of SEs due to the increase of wife's earnings. I abstract this reform as adjustments to E_{full} and M.

If I assume the wife's available hours to be 1, then $Y = 1 - H$ indicates her leisure time. Under the set, the household budget constraint can be formulated as:

$$C = -S_w Y + R_w, \tag{4}$$

where S_w and R_w represent the price of the wife's leisure and the household's income, respectively, which are defined as:

$$S_w = (1 - t_w - Mt_m)w. \tag{5}$$

$$R_w = (1 - t_w - Mt_m)w + (1 - t_m)i_m + E_{full}t_m. \tag{6}$$

Then, on one hand, the impact of changes in the full deduction of spouse (E_{full}) on the wife's optimal working hours H^* can be expressed as follows:

$$\frac{\partial H^*}{\partial E_{full}} = -\frac{\partial Y^*}{\partial R_w}\left(\frac{\partial R_w}{\partial E_{full}} + \frac{\partial R_w}{\partial t_m}\frac{\partial t_m}{\partial E_{full}}\right) = \frac{\partial Y^*}{\partial R_w}\left[-t_m + \frac{\partial t_m}{\partial E_{full}}\left(i_m - \left(E_{full} - Mw\right)\right)\right]. \tag{7}$$

Here, $Y^* = 1 - H^*$, indicating the optimal leisure time for the wife. The term $\frac{\partial Y^*}{\partial R_w} > 0$ because leisure is a normal good. $\frac{\partial t_m}{\partial E_{full}} < 0$ because a higher tax deduction cap means less taxable income and a lower effective tax rate for the husband, given the same total amount of husband's income. The term $\left(i_m - \left(E_{full} - Mw\right)\right)$ represents the taxable income of the husband when his wife works for one unit hour, which is greater than 0. Thus, $\frac{\partial H^*}{\partial E_{full}} < 0$ always holds, indicating that an increase in the full SEs results in a negative income effect, which means that an increase in the full SEs leads to a decrease in the wife's labor supply by lowering her household income.

On the other hand, the effects of the variation of M on the optimal working hours can be formulated as

$$\frac{\partial H^*}{\partial M} = -\left[\frac{\partial Y^*}{\partial S_w}\left(\frac{\partial S_w}{\partial M} + \frac{\partial S_w}{\partial t_m}\frac{\partial t_m}{\partial M}\right) + \frac{\partial Y^*}{\partial R_w}\left(\frac{\partial R_w}{\partial M} + \frac{\partial R_w}{\partial t_m}\frac{\partial t_m}{\partial M}\right)\right]$$
$$= \frac{\partial Y^*}{\partial S_w}\left(wt_m + \frac{\partial t_m}{\partial M}bw\right) + \frac{\partial Y^*}{\partial R_w}\left[wt_m + \frac{\partial t_m}{\partial M}\left(i_m - E_{full} + Mw\right)\right]. \quad (8)$$

The Slutsky equation of $\frac{\partial Y^*}{\partial S_w}$ is

$$\frac{\partial Y^*}{\partial S_w} = \left(\frac{\partial Y^*}{\partial S_w}\right)_U - Y_0\frac{\partial Y^*}{\partial R_w}, \quad (9)$$

where Y_0 represents the original leisure time. $\left(\frac{\partial Y^*}{\partial S_w}\right)_U < 0$ is the Slutsky term, which is the compensated derivative of the wife's leisure with respect to the price of leisure. By substituting equation (9) into equation (8), I obtain:

$$\frac{\partial H^*}{\partial M} = -\left(\frac{\partial Y^*}{\partial S_w}\right)_U\left(wt_m + \frac{\partial t_m}{\partial M}Mw\right) - \frac{\partial Y^*}{\partial R_w}\left[wH_0t_m + \frac{\partial t_m}{\partial M}\left(i_m - \left(E_{full} - MwH_0\right)\right)\right]. \quad (10)$$

Here, the first term represents the substitution effect, while the second term indicates the income effect. It is evident that the substitution effect maintains a positive value because $\frac{\partial t_m}{\partial M} > 0$[4] holds, indicating that an increase in the net wage S_w caused by an increase in E (or a decrease in M), may make the wife's job more attractive and consequently encourage her to work more.

On the other hand, the income effect remains negative, as the term $\left(i_m - \left(E_{full} - MwH_0\right)\right)$, representing the original taxable income of the husband, is clearly positive. The income effect could be explained by two parts. Firstly, an increase in E (a decrease in M) raises the demand for leisure by raising the household income (R_w) if leisure is a normal good, which subsequently reduces the wife's labor supply. Secondly, a decrease in her net wage also leads to an increase in R_w and thus make the wife work less.

3.1. Heterogeneity of Policy Effects Across Income Ranges

3.1.1. Simplified Budget Constraint Analysis

We referred to Yokoyama (2018)'s research, which investigates how women's optimal working hours

[4] $\frac{\partial t_m}{\partial M} = \frac{\partial t_m}{\partial E}\frac{\partial E}{\partial M} = -wH\frac{\partial t_m}{\partial E} > 0$

change in response to shifts in their budget constraint lines using the theory of substitution effect and income effect. In Figure 1, I present the schedules of SEs and household budget lines before and after the reform for different income ranges of the husband. The red solid lines represent the pre-reform budget lines, while the green dashed lines represent the post-reform budget lines. Here, the presence of E causes the kinks on the household budget lines, and the dips at the points where $wH = 1.05$ and $wH = 1.41$ are shifted upward to the point where $wH = 1.5$ and $wH = 2.01$, respectively, due to the forward movement of the stepwise portion of the SEs. It is important to note that the leisure is assumed as a normal good and the slope of the budget line in Figure 1 reflects the net wage of the wife, i.e., the price of leisure (S_w).

Next, I confirm the impact of the SEs reform on the wives' labor supply by their earnings level. First, the reform has no impact on their budget line if their earnings exceed 1.05 million yen, which represents the upper threshold of full SEs. Therefore, theoretically, this reform will not affect the labor supply of these women. Similar expectations can be made for the wife whose earnings exceed 2.01 million yen prior to the reform.

However, for wives with incomes ranging from 1.05 million yen to 2.01 million yen, the SEs reform indeed altered their family budget constraint. Firstly, as a substantiated tax cut policy, the SEs reform increased the leisure demand of women in this income range through a negative income effect, leading to a decrease in their labor supply.

Next, based on the changes in the budget constraint slope, the reform resulted in a positive substitution effect on labor for wives in the 1.05 million to 1.41 million yen income range, as it increased their net wages. Furthermore, it did not affect the net wages of wives in the 1.41 million to 1.5 million yen income range, thereby having no substitution effect. However, it lowered the net wages of wives in the 1.5 million to 2.01 million yen income range, leading to a negative substitution effect.

Therefore, overall, wives in the 1.5 million to 2.01 million yen income range will decrease their labor supply due to the negative substitution effect and negative income effect. Wives in the 1.41 million to 1.5 million yen income range will decrease their labor supply due to a negative income effect. Unfortunately, I couldn't determine the magnitude of labor supply changes for wives in in this income range.

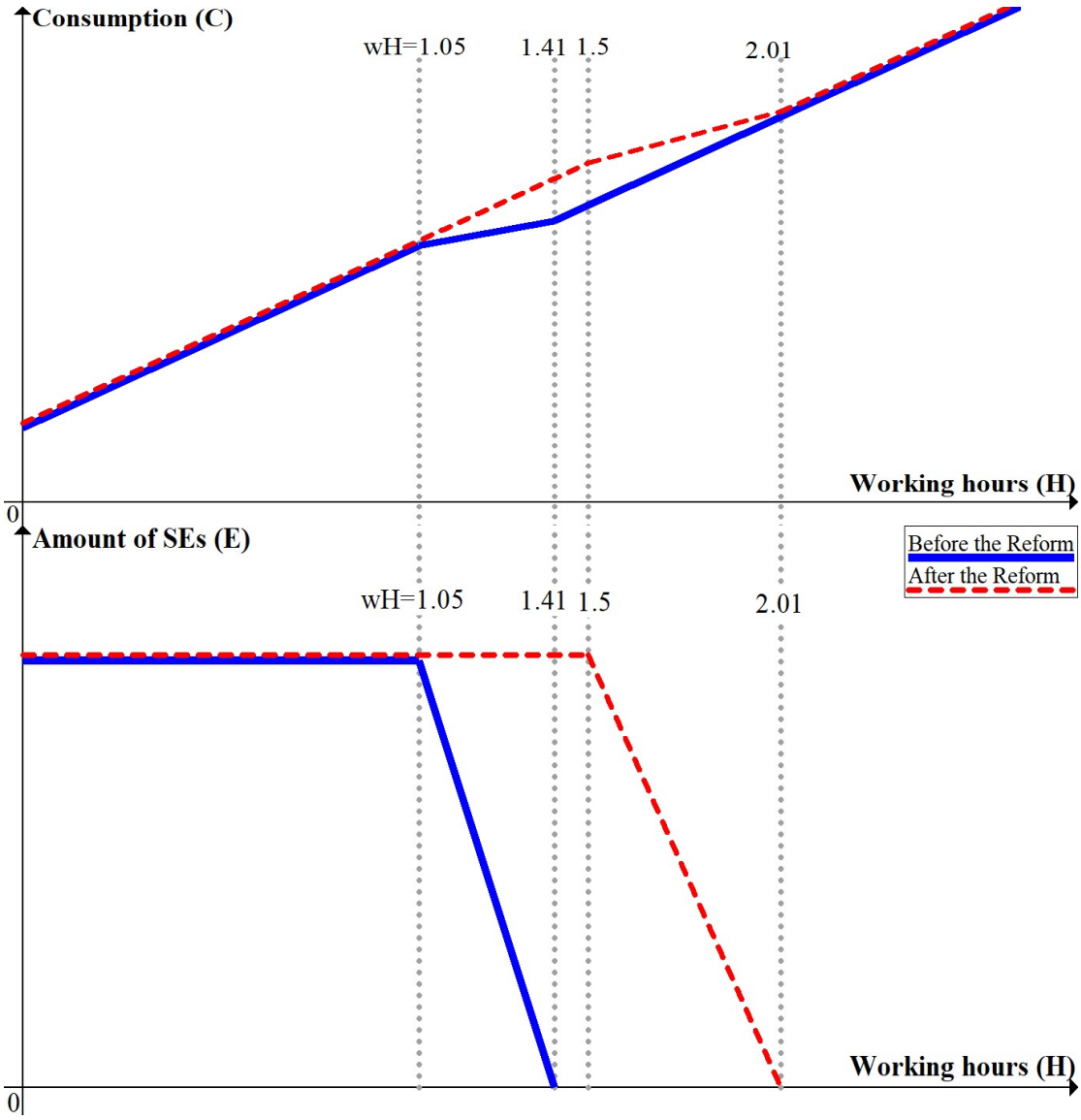

Figure 1. Household budget lines and SEs schedules when the income of the husband less than 11.2 million yen. (Unit of wH: million yen)

Note: the employment income deduction, standard deduction, residence tax exemption, and insurance premium are not taken into consideration.

3.1.2. What if the employment income deduction, standard deduction, residence tax exemption, and insurance premium are taken into consideration?

Previous studies have mentioned that 1 million yen is a conventional income threshold for women in Japan. Specifically, for residents in most prefectures, earning below 1 million yen annually may qualify them for a partial exemption from the residence tax[5]. Moreover, if their earning remains below

[5] The maximum amount exempted from inhabitant tax (per income) is 0.45 million yen, so if earning is less than 1 million yen and there is no other income, no residence tax (income-based portion) will be imposed.

1.03 million yen, considering the combination of employment income deduction and standard deduction, they will be exempt from income tax. Furthermore, if a woman's annual earning is below 1.3 million yen, her insurance premiums will be collectively covered by the employee's pension plan or mutual aid association to which her husband belongs, thereby relieving her of the individual obligation to pay them[6].

Therefore, considering a more realistic budget constraint, as shown in Figure 2, in addition to the kinks and digs caused by SEs, the budget constraint should also exhibit kinks and digs around income levels of 1 million, 1.03 million, and 1.3 million yen. These kinks may lead to the optimal labor supply of wives being compressed to 1 and 1.3 million yen, even after the SEs reform. Therefore, on one hand, **Proposition 1** suggests that the SEs reform will not change the labor supply of wives with incomes below 1,050,000 yen. The existence of income thresholds at 1 million and 1.03 million yen makes it costly for wives to pursue the new SEs income threshold, leading to a decreased likelihood of increasing labor supply. On the other hand, **Proposition 2** posits that wives in the income range of 1,050,000 to 1,410,000 yen will increase their labor supply due to the SEs reform. However, if a wife's income exceeds the 1.3-million-yen threshold, the household will incur an income loss, potentially weakening the labor supply increase effect for wives within this income range caused by the SEs reform.

Based on the above analysis, I propose the following propositions:

- **Proposition 1**: The SEs reform has no impact on the working hours of married women whose pre-reform earnings are below 1.05 million yen or above 2.01 million yen.
- **Proposition 2**: The SEs reform has an impact on working hours of women whose pre-reform earnings fall between 1.05 million and 1.41 million yen, but it does not lead to women with earnings below 1.3 million breaking through this income threshold.
- **Proposition 3**: The SEs reform decreases the working hours of women whose pre-reform earnings fall between 1.41 million and 2.01 million yen.

[6] Among the members of the National Pension, the spouse aged 20 or older but under 60 years old who is dependent on the second insured person enrolled in the Employee's Pension Insurance and Mutual Aid Association (with an annual income of less than 1.3 million yen) is referred to as the third insured person. The insurance premium for the third insured person is collectively borne by the Employee's Pension Insurance and Mutual Aid Association in which the spouse is enrolled, so there is no need to pay it separately.

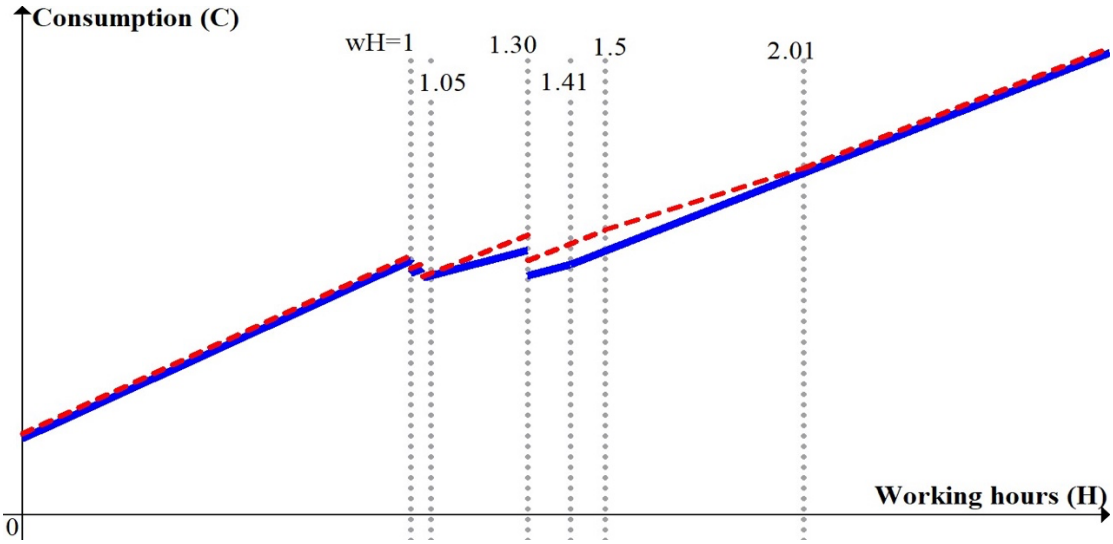

Figure 2. Household budget lines when the income of the husband less than 11.2 million yen. (Unit of wH: million yen)

Note:
(1) The employment income deduction, standard deduction, residence tax exemption, and insurance premium are taken into consideration.
(2) Since the point at wH=1.03 is too close to the points at wH=1 and wH=1.05, vertical lines have not been individually marked to maintain visual aesthetics.

3.2. Heterogeneity of Policy Effects Across Original Working Hours

Equations 7 and 10 indicate that the distribution of the wife's original working hours does not influence the policy effect resulting from changes in the full deduction. However, it does affect the policy effect resulting from changes in the marginal deduction loss caused by an increase in the wife's labor hours. Specifically, the H_0 in the income effect term suggests that wives with longer working hours before the reform face a stronger income effect compared to wives with shorter working hours. As a result, for wives with longer working hours prior to the reform, the income effect generated by the reform is more likely to exceed the substitution effect. Ultimately, they are more likely to experience policy effects that oppose the direction of M, leading to changes in labor supply. Based on this, I give the following proposition:

- **Proposition 4**: The reform leads to changes in labor supply for women who had longer working hours before the reform.

4. An Empirical Analysis: Does the Extension of SEs Coverage Encourage Hourly Female Employees to Work More?

The theoretical model suggests that the effects of SEs reform may vary for wives with different income ranges. Based on this, I propose three propositions regarding the policy effects on women from different income groups. In this section, I will verify these propositions by estimating the average treatment effects of the reform on the labor supply of women from various income ranges. Furthermore, considering the potential influence of extremes, I followed Yokoyama (2018)'s empirical research framework and estimated the treatment effects at different quantiles of the sample to examine the robustness of the results.

4.1. Data and Preprocessing

The data utilized in this study were derived from the initial five waves of the Japanese Panel Study of Employment Dynamics (JPSED), which tracks the fluctuations in employment, income, and work conditions of respondents. The first wave of the JPSED was conducted in January 2016, encompassing a sample size of 49,131 individuals in Japan. Over the period of 2016 to 2020, successful tracking of 42.2% of the respondents was achieved. Importantly, it should be noted that respondents were instructed to base their responses on the preceding December, resulting in a one-year lag between the collection and publication of the data relative to the year in which the information reflects. For instance, the data for 2016 actually represents the respondents' status in 2015.

Certain pre-processing steps were undertaken to ensure the data accurately portrayed credible content. Specifically, I restricted the sample to women aged 15-64 years (working age) who reported their primary occupation as hourly paid. Additionally, to maintain consistency between the pre-reform and post-reform samples, I excluded samples that contained solely pre-reform or post-reform data, as well as samples that exhibited changes in marital status before and after the reform. Moreover, considering that if wives have additional types of income besides their earnings, the income threshold for SEs will be shifted leftward. Therefore, I removed samples where wives had income other than primary and secondary

employment, which constitute 12.02% of the total sample. Furthermore, to maintain consistency between the empirical research and the theoretical model, I excluded samples in which the average annual income of husbands exceeded 11.2 million yen before the reform, accounting for 1.62% of the total sample. Lastly, to mitigate the influence of outliers, I truncated the top and bottom 0.5% of values for the wage rate and the bottom 0.5% of values for working hours.

4.2. Methodology

As only taxpayers with legally recognized spouses are eligible to apply for the SEs, and couples cannot simultaneously apply, I define the treatment group as married women whose average annual income before the reform is less than or equal to their husband's average annual income before the reform. Conversely, the control group consists of unmarried women or married women whose average annual income before the reform is higher than their husband's.

4.2.1. A Linear Difference-in-Differences Analysis

Based on the estimation model from previous studies (Sakata & McKenzie, 2005; Yokoyama, 2018), I will employ the panel Two-way Fixed Effects Difference-in-Differences (Two-way FE DID) approach to estimate the policy effects of SEs reform on female labor supply across various earnings strata. The estimation model is presented as follows:：

$$Working\ hours_{it} = \beta_0 + \beta_1(Treat_i \times Post_t) + \beta_2 X_{it} + \mu_{it},$$

where $Treat_i = 1$ for the treatment group and $Post_t = 1$ for the sample from 2018 and 2019. The coefficient β_1 represents the average treatment effects, which are of primary interest in this analysis. X_{it} is the covariate matrix. Furthermore, to estimate the responses of women from different pre-reform earnings (PRE) strata to the reform, besides analyzing the entire sample, I also conducted separate estimations for women with average PRE[7] below 1,050,001

[7] Average PRE refers to the arithmetic mean of income data from the years 2015, 2016, and 2017, for which data is available.

yen, between 1,050,001 and 1,410,000 yen, between 1,410,001 and 2,010,000 yen, and above 2,010,001 yen before the reform, to assess their respective average treatment effects. It is important to emphasize that, to prevent introducing selection bias, the income range restrictions were applied to both the treatment and control groups. For example, when estimating the average treatment effect for the sample with average PRE less than 1,050,001 Japanese yen, samples from both the treatment and control groups that fall outside the income range were removed.

4.2.2. A Quantile Difference-in-Differences Model

Following the approach of Yokoyama (2018), I adopted the Conditional Quantile Difference-in-Differences (CQDID) model to verify the heterogeneity of policy effects across different original working hours.

$$Working\ hours_{it} = \beta_0^\tau + \beta_1^\tau (Treat_i \times Post_t) + \beta_2^\tau Treat_i + \beta_3^\tau Post_t + \beta_4^\tau X_{it} + \mu_{it},$$

where τ represents the τ-th quantile. Our main focus is on β_1^τ, as it reflects the treatment effect on the τ-th quantile of working hours.

4.2.3. Before DID: A Propensity Score Matching

Before conducting the two aforementioned DID analyses, I employed propensity score matching (PSM) with radius matching method with 0.01 caliper to mitigate sample selection bias and enhance comparability between the treatment and control groups, due to the failure to meet the parallel trends assumption between the treatment group and the control group in labor hours before the reform[8]. Based on Wang et al. (2023) and Zhang et al. (2020) as references, I employed a year-by-year matching approach, treating each year's sample as cross-sectional data for matching. Subsequently, I combined the matched samples from each year into a panel for regression analysis. Moreover, to retain sample information as much as possible, I calculated the average propensity score for each individual based on the yearly

[8] I utilized the event study method to test the parallel trends assumption between the treatment group and the control group. The results of this test are provided in the appendix.

matching propensity scores. These average propensity scores were then used as sampling weights in the DID analysis for estimating policy effects.

For a consistent PSM estimation, two assumptions need to be satisfied (Cho et al., 2020; ROSENBAUM & RUBIN, 1983). First, the "ignorability" assumption requires that the treatment decision is independent of the outcome. Second, the "overlap" assumption requires that the propensity score of the control and treatment groups, calculated by probit or logistic regression, should be close enough to be matched. Unfortunately, the "ignorability" assumption cannot be tested formally (Cho et al., 2020). Nevertheless, the variables (the marriage status and the comparison between the income of the wives and their husbands) used to identify the treatment group are not directly related to labor supply. Thus, it is logical to assume that the intervention was independent of the female labor supply. Furthermore, as far as the "overlap" assumption was concerned, according to the results of PSM, control groups on support existed for all treatment groups. Therefore, both assumptions were satisfied, and PSM was applied in this case.

4.3. Variables and Descriptive Statistics

The covariate matrix X_{it} comprises lagged variables of the female's wage rate and the logarithm of household per capita income, lagged variable of the female's labor hours, age, age squared, the number of preschool children, dummy variable for whether the wife lives with her parents or not, dummy variable for whether the wife owns a house or not, and the degree of flexibility in work hours. The theoretical model indicates that the female's wage rate, the female's original working hours, and the husband's income are critical variables influencing the policy effects. Thus, these variables' effects need to be controlled to derive unbiased policy effects. Due to the lagged nature of these effects, I actually control for their lagged variables. However, considering the impact of sample attrition, I prioritize using one-period-lagged variables first, and if those are unavailable, I resort to two-period-lagged variables, and if those are still unavailable, turn to three-period-lagged variables. Moreover, recognizing that even if the wife desires to increase labor supply, objective job market conditions may prevent her from doing so, it is essential to control for the wife's labor market constraints. Lastly, the effects of individual and family characteristics like age and childcare

on labor supply should not be overlooked. A detailed explanation of the variables involved in this study is presented in Table 2, while Table 3 provides descriptive statistics.

In this study, both PSM and DID analyses employ the same covariate matrix X_{it}. In practice, the propensity score should include variables that simultaneously affect treatment selection and treatment outcomes (Qiu, 2020). However, in this study, variables influencing treatment selection overlap with those influencing treatment outcomes. Specifically, the division between the treatment and control groups is based on marital status and the relative income between the wife and husband. Under the assumption of exogeneity of husband's income, factors affecting marital status (e.g., age) and the wife's income-related factors (e.g., wage rate, husband's income) also influence the female's working hours. Therefore, when selecting the PSM covariate matrix X_{it}, I primarily considered covariates that pertain to the causal relationship of labor hours, which is the treatment outcome. Furthermore, theoretically, with the use of PSM controlling for observed covariates X_{it}, the potential outcome distributions for both treatment and control groups become similar, and unobserved variables should not systematically affect potential outcomes, making the data similar to a randomized controlled experiment within the same strata of X_{it}. However, recognizing that year-by-year PSM cannot guarantee the randomness of treatment assignment over time, I refer to the research design of Wang et al. (2023). On one hand, I control for the covariate matrix X_{it} in the year-by-year PSM to reduce sample selection bias in each cross-section. On the other hand, in the DID analysis, I again control for the covariate matrix X_{it} to minimize estimation bias.

Table 2. Notation and explanation of variables

Variables	Explanation
Working hours	Total hours worked per week in December (unit: hour)
Treat	Treatment group dummy (equals 1 for individuals from the treatment group)
Post	Reform (intervention) instruction dummy (equals 1 for observations from 2018 to 2019)
Year dummy variables	
2017.year	Equals 1 for observations from 2017
2018.year	Equals 1 for observations from 2018
2019.year	Equals 1 for observations from 2019
Marry	Marital status dummy (equals 1 for married individuals)
Wage	Hourly wage of women (unit: yen)
Earnings of wife	Sum of annual earnings from primary and secondary employment (unit: 10,000 yen)
Income of husband	Annual income of husband (unit: 10,000 yen)
Per capita household income	For unmarried women, this variable equals the woman's earnings; For married women, this variable equals the arithmetic average of her own earnings and her husband's income. (unit: 10,000 yen)
Age	Age of individual
Age2	Square of individual’s age
Own house	Own house dummy (equals 1 for individuals living in their own houses instead of rented or borrowed houses)
Living with parents	Living with parent dummy (equals 1 for individuals living with their father or mother or both)
Number of preschool children	The number of children aged 6 and below
Work hour flexibility	Work hour flexibility (equals 1 for individuals who claim they have flexibility in working hours.)

Table 3. Descriptive Statistics

Variables	All	Treatment Group	Control Group

	N	Mean	SD	N	Mean	SD	N	Mean	SD
Marry	3882	.611	0.488	2244	1	0.000	1638	.077	0.267
Working hours	3882	29.083	11.420	2244	25.486	10.305	1638	34.011	11.031
Wage	3882	1108.118	452.285	2244	1067.557	443.965	1638	1163.684	457.776
Earnings of wife	3882	153.2	107.077	2244	124.215	66.755	1638	192.908	135.453
Income of husband	2364	476.623	231.430	2240	491.979	222.409	124	199.226	215.985
Age	3882	45.145	10.231	2244	47.56	8.802	1638	41.838	11.094
Own house	3882	.676	0.468	2244	.768	0.422	1638	.549	0.498
Living with parents	3882	.302	0.459	2244	.125	0.331	1638	.545	0.498
Number of preschool children	3882	.1	0.385	2244	.164	0.489	1638	.012	0.107
Work hour flexibility	3882	.369	0.482	2244	.419	0.494	1638	.299	0.458

4.4. Empirical Results and Discussion

4.4.1. Propensity Score Matching

To assess the balance between the treatment and control groups after PSM, I conducted logistic regressions for the outcome variable "treat" using all covariates with both the pre-matching and post-matching samples. The results are presented in Table 1. Before matching, the covariates significantly influenced whether a sample was identified as the treatment or control group. However, after matching, the z-values of the estimated coefficients for all covariates decreased, and most of them no longer pass the hypothesis tests at the 95% confidence level. This indicates an improvement in addressing selection bias caused by the covariates between the treatment and control groups.

4.4.2. Policy Effects Across Pre-Reform Earnings Ranges of Women

Graph 3 depicts the density distribution of working hours in the treatment group sample before and after the reform, represented by blue and red lines respectively. The left side of the graph shows the distribution of working hours for the entire treatment group sample, while the right side shows the distribution within different PRE ranges in the treatment group. From this figure, it's evident that the majority of hourly-paid wives have their weekly working hours concentrated between 10 to 40 hours, regardless of whether it's before or after the SEs reform. Among these, the samples with around 20 hours of weekly labor stand out, and their PRE values mostly fall below 1.41 million yen. Conversely, samples with PRE values above 1.41 million yen tend to work between 30 to 40 hours per week. By comparing the density distributions before and after the reform, it is evident that the SEs reform did not significantly impact the overall labor time distribution of the treatment group samples. However, the steeper peak after the reform suggests that after SEs reform, wives' labor hours exhibit a more clustered distribution. Additionally, observing the density distribution of the entire treatment group sample reveals that at both the left and right tails of the density curve, the curve before the reform is slightly higher than that after the reform. This indicates a reduction in extreme short-hour and extreme long-hour workers after the reform, contributing to a decrease in the dispersion trend of labor hours.

Table 4. Balance Tests

VARIABLES	(1) Unmatched	(2) Matched
lag_ Working hours	-0.113***	-0.009
	(-12.480)	(-0.735)
log (lag_ Wage)	-3.239***	-1.346**
	(-10.091)	(-2.291)
log (lag_ Per capita household income)	3.354***	0.477*
	(14.156)	(1.789)
Age	0.239***	0.501***
	(3.171)	(2.716)
Age2	-0.002***	-0.005**
	(-2.819)	(-2.532)
Own house	1.668***	-0.229
	(8.397)	(-0.700)
Number of preschool children	2.427***	0.622*
	(5.782)	(1.676)
Living with parents	-2.399***	-0.135
	(-11.644)	(-0.363)
Work hour flexibility	0.537***	0.552*
	(3.108)	(1.776)
Constant	2.034	-4.984
	(0.823)	(-1.125)
Observations	3,882	3,091

Note:

*(1) Robust z-statistics in parentheses are employed (*** p<0.01, ** p<0.05, * p<0.1).*

(2) The regression of the matched sample employs the propensity scores as sampling weights.

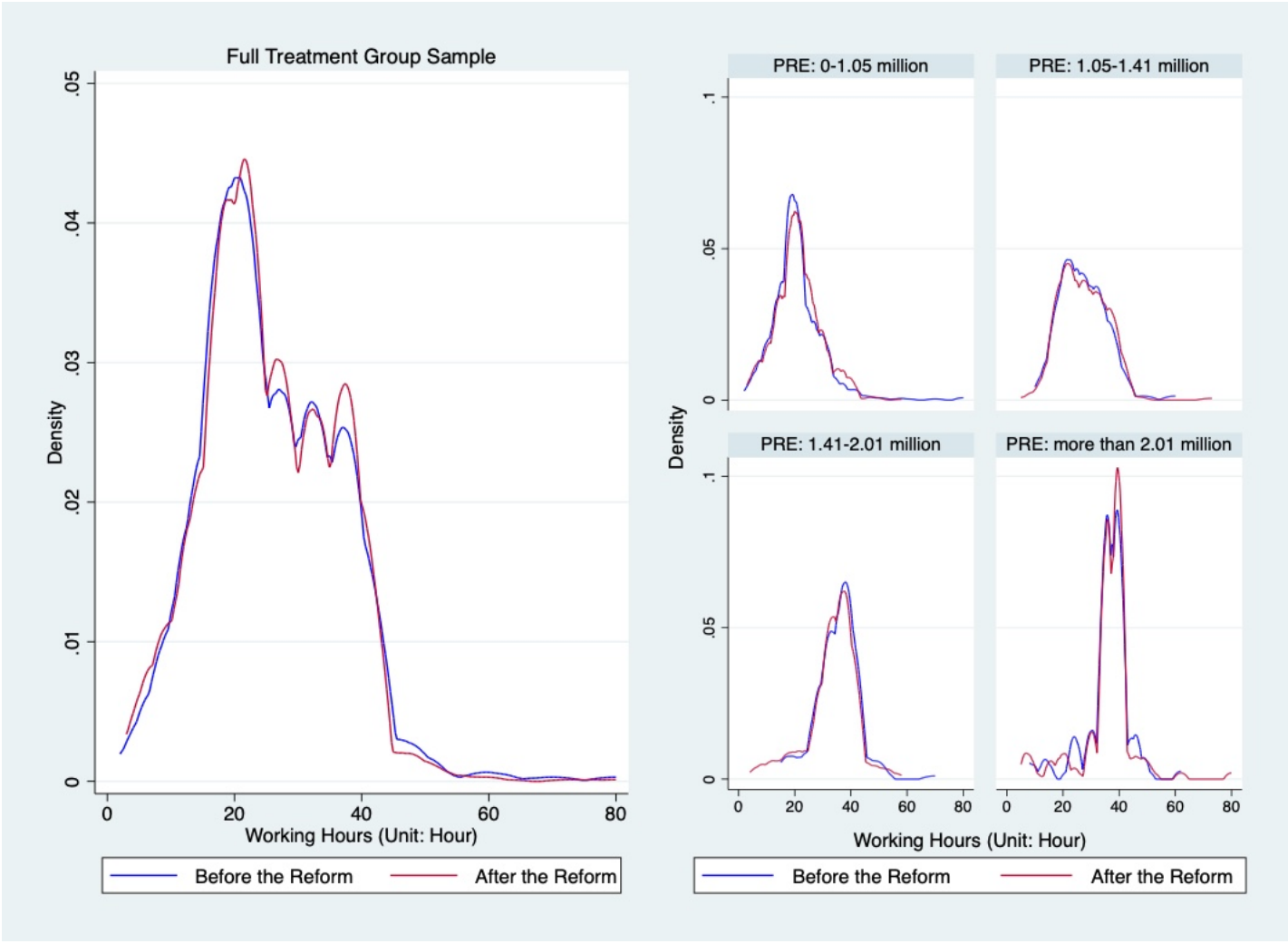

Figure 3. Distribution of working hours in the treatment group.

Note: The graph is plotted based on the treatment group sample before PSM.

Table 5 reports the DID results based on the full sample, where Regressions 3 and 4 present the estimates for the unmatched sample, and Regressions 5 and 6 show the estimates for the sample after PSM matching. Overall, whether using the unmatched or matched sample, with or without including covariates, the estimated coefficient of the Treat × Post variable indicating the policy effect is not significant. This suggests that there is insufficient evidence to prove that the SEs reform has had an impact on the average working hours of female hourly-paid workers. However, even though the policy effects cannot be verified through statistical significance, the negative estimated coefficient cautions against expecting a promotion of labor supply due to the SEs reform.

Table 6 presents the results of heterogeneity analysis based on different income ranges. First, the results of Regressions 7 and 10 demonstrate that we cannot establish significant effects of the SEs reform on hourly-paid females with PRE less than 1.05 million yen and PRE greater than 2.01 million yen. This validates the correctness of **Proposition 1**. For the sample with PRE greater than 2.01 million yen, on one hand, the SEs reform did not alter their household budget constraint. On the other hand, they did not deliberately control their income below the income threshold to qualify for SEs before the reform. Therefore, the insignificant policy effect is not surprising. In contrast, women with PRE less than 1.05 million yen had suspicions of intentionally suppressing their labor income to secure SEs eligibility before the reform. Even though the reform did not modify their household budget, the increased income threshold for full SEs from 1.05 million to 1.5 million yen allowed them to increase labor supply without concerning the reduction in SEs amount, which partly explain the positive sign of the estimated policy effect coefficient. However, the lack of statistical significance suggests limited labor supply increase due to the heightened income threshold for full SEs. This should be contributed into the still exists of the income threshold around 1 million yen caused by the employment income deduction, standard deduction, and residence tax exemption persists after the SEs reform (refer to Figure 2).

The result of Regression 8 in Table 6 partly confirms **Proposition 2**. First, the negative estimated coefficient of the policy effect in Regression 8 indicates that although the SEs reform increases the labor supply of women with earnings between 1.05 and 1.41 million yen through a positive substitution effect, the negative income effect simultaneously leads these women to increase leisure and reduce labor supply. Moreover, the income effect outweighs the substitution effect, causing a reduction in the average weekly labor hours of women within this income range by 7.446

hours. Moreover, to understand the impact of the insurance premiums' income threshold on the policy effect, I conducted regressions on the samples with PRE between 1.05 and 1.3 million yen, and between 1.3 and 1.41 million yen, using 1.3 million yen as the threshold. The results are presented in Regressions 8-1 and 8-2 of Table 6. The findings reveal that the average weekly labor hours decreased by 10.303 hours for the sample with PRE below 1.3 million yen. This could be attributed to the change in the budget constraint due to the SEs reform and also the presence of a 1 million yen income threshold, which might lead women with pre-reform incomes between 1.05 and 1.3 million yen to intentionally lower their labor income to below 1 million yen, considering the income thresholds for employment income deduction, standard deduction, and residence tax exemption.

Lastly, Regression 9 in Table 6 demonstrates that women with PRE between 1.41 and 2.01 million yen decreased their average weekly working hours by 5.120 hours, aligning with the prediction of **Proposition 3**. According to the theoretical model's analysis, within this income range, the decrease in labor supply for women with PRE less than 1.5 million yen can be attributed to the negative income effect brought about by the SEs reform. The reduction in labor supply for women with pre-reform income greater than 1.5 million yen is a combined result of negative income effects and negative substitution effects.

4.4.3. Policy Effects on the Distribution of Working Hours

Table 7 presents the policy effects of the SEs reform on the 15th, 50th, and 85th percentiles of labor hours. The results from QDID analysis reveal that the SEs reform significantly reduced labor hours at the 85th percentile for the treatment group[9]. However, the policy effects are not statistically significant at the 15th percentile and median. This suggests that the reform primarily impacted long-hour workers and does not provide conclusive evidence of its effects on individuals with shorter working hours.

Furthermore, Figure 4 illustrates the treatment effects of QDID across the 1st to 99th percentiles of labor hours. The solid red dots represent the estimated coefficients for Treat × Post, while the

[9] The 85th percentile of weekly working hours for the treatment group remained at 38 hours both before and after the reform.

hollow white dots indicate the upper and lower bounds of the 95% confidence intervals. Overall, the estimated coefficients are close to 0 before the median, and they gradually deviate from 0 after the median, trending downward. This indicates that the policy effects of the SEs reform are concentrated among women with longer labor hours prior to the reform, while the impact on those with shorter labor hours is limited.

Notably, around the 85th percentile, the upper bound of the confidence interval is also below 0, proving a pronounced negative treatment effect on labor hours for the treatment group samples near the 85th percentile. Additionally, the wider confidence intervals near the lower and upper percentiles result from larger coefficient standard errors, indicating less precise estimates for the treatment effects compared to the estimates around the median percentile.

The finding that the policy effects of the SEs reform are more significant among long-hour workers are consistent with the **Proposition 4** put forth based on the theoretical model. On one hand, the model suggests that the income effect stemming from changes in the marginal deduction from an increase in labor supply is greater for wives with longer work hours, implying a higher likelihood of reduced labor supply due to policy changes. On the other hand, considering the diminishing marginal utility of labor supply, longer-hour workers experience a smaller utility loss from reducing labor supply compared to shorter-hour workers, making them more likely to respond to policy changes by decreasing their labor supply.

4.4.4. Can the Same Conclusions be Extended to All Female Informal Employees?

The theoretical analysis indicates that the wage rate is one of the core explanatory variables influencing female working hours, consistent with classical labor economics theory. Therefore, considering that wage rate data is not available or accurately identifiable for non-hourly wage employees, the empirical analysis in this study has been limited to informal employees under hourly wage arrangements. However, as long as wage rates per unit of labor time are obtainable, the theoretical model's analysis can be applied to non-hourly wage employees as well. Then under the assumption of disregarding the endogeneity issues stemming from uncontrolled wage rate variable, can the conclusions drawn from the empirical section be extended to all female informal employees?

Most previous studies have chosen to overlook the influence of wage rates and estimate the impact of SEs reform on spouses' labor supply without controlling for wage rates (Adachi & Kaneda, 2016; Sakata & McKenzie, 2005; Yokoyama, 2018; Yokoyama & Kurumai, 2016). Among them, Yokoyama (2018) compared wage rates in 2003 and 2004-2006 and found no significant differences, thus overlooking the impact of wage rates. However, the absence of differences in the time trend of wage rates cannot necessarily conclude that there are no differences in cross-sectional individual wage rates, potentially introducing endogeneity issues regarding the influence of individual wage rates on labor hours.

To estimate the policy effects of SEs reform on all female informal employees, I extended the empirical analysis using the same research design and data processing procedure to include all female informal employees, investigating the policy effects of SEs reform on women within different PRE ranges and with varying initial labor hours. It is worth noting that I did not include wage rates in the control variable matrix. The results of the empirical analysis are presented in Appendix 5 and Appendix 6. The policy effects of SEs reform on female working hours are no longer significant within different PRE ranges and have limited impact on the distribution of working hours. This suggests that the same research design does not necessarily demonstrate policy effects of SEs reform on the labor supply of all female informal employees.

The inconsistent empirical results stemming from the hourly wage sample and the entire sample can be attributed to two main reasons. Firstly, there are valid reasons to suspect that omitted wage rate variables have led to endogeneity issues, causing biases in estimates based on the entire sample. To address this concern, wage rates of employees under wage payment schemes other than hourly wages must also be obtainable. Secondly, I propose a hypothesis suggesting that women under hourly wage systems might find it easier and be more willing to adjust their labor hours based on income thresholds defined by tax and social security systems. There are a couple of reasons for this: firstly, women under hourly wage systems have the objective ability to control their labor hours on an hourly basis, enabling a more precise management of their labor income; secondly, there could be a reverse causality issue, suggesting that these women are not necessarily adjusting their labor hours because of the hourly wage nature of their work, but rather choosing hourly wage work to facilitate labor hour adjustments due to their stronger subjective intent. However, it's important to note that currently there is a lack of data or research to support this hypothesis. If

relevant studies can follow up on this, an analysis of heterogeneity based on different wage payment forms in relation to the policy effects of SEs reform on informal female employees could contribute to a more nuanced understanding of tax reform.

Table 4. Balance Tests

VARIABLES	(1) Unmatched	(2) Matched
lag_ Working hours	-0.113***	-0.009
	(-12.480)	(-0.735)
log (lag_ Wage)	-3.239***	-1.346**
	(-10.091)	(-2.291)
log (lag_ Per capita household income)	3.354***	0.477*
	(14.156)	(1.789)
Age	0.239***	0.501***
	(3.171)	(2.716)
Age2	-0.002***	-0.005**
	(-2.819)	(-2.532)
Own house	1.668***	-0.229
	(8.397)	(-0.700)
Number of preschool children	2.427***	0.622*
	(5.782)	(1.676)
Living with parents	-2.399***	-0.135
	(-11.644)	(-0.363)
Work hour flexibility	0.537***	0.552*
	(3.108)	(1.776)
Constant	2.034	-4.984
	(0.823)	(-1.125)
Observations	3,882	3,091

Note:

*(3) Robust z-statistics in parentheses are employed (*** p<0.01, ** p<0.05, * p<0.1).*

(4) The regression of the matched sample employs the propensity scores as sampling weights.

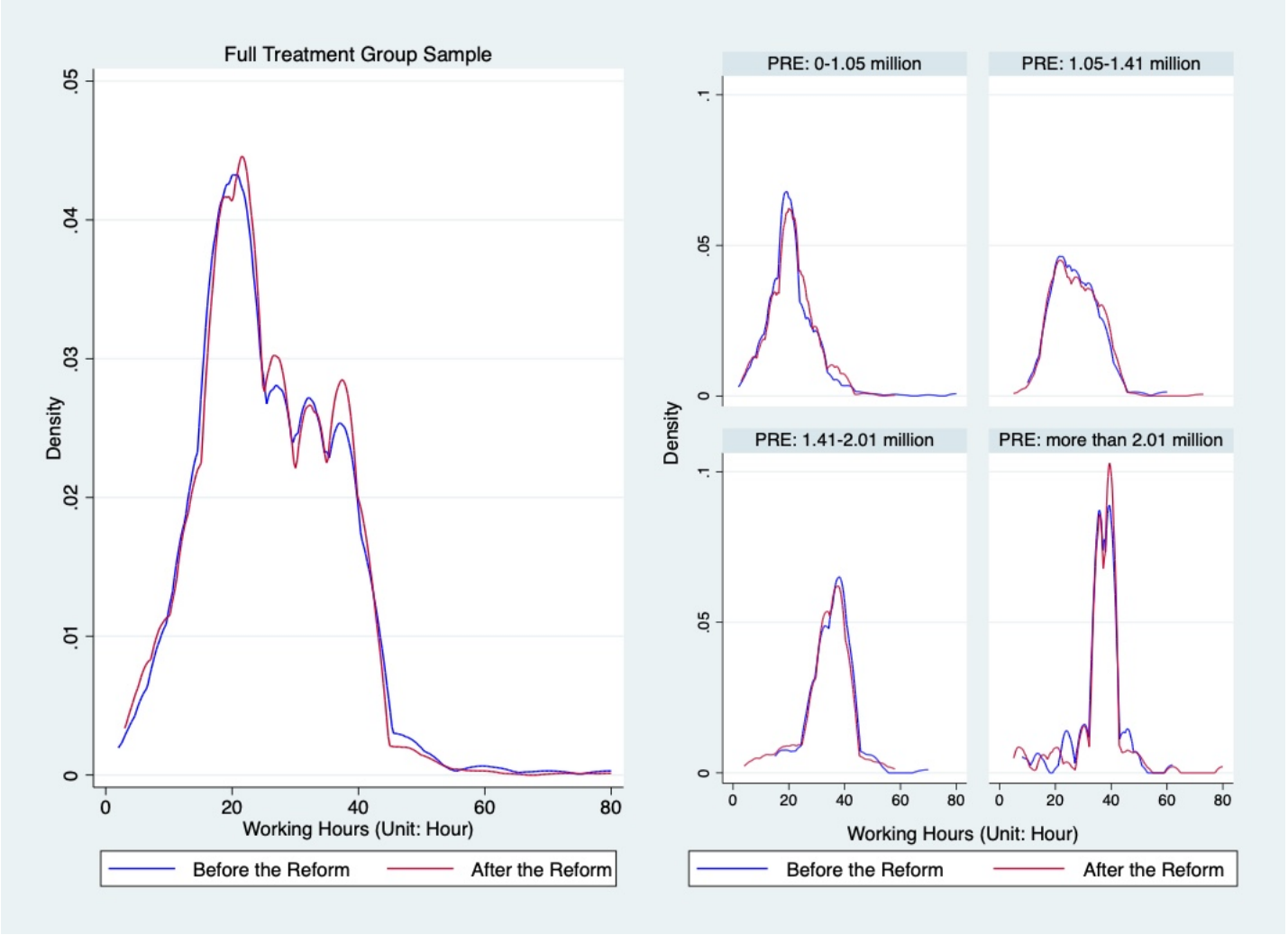

Figure 3. Distribution of working hours in the treatment group.

Note: The graph is plotted based on the treatment group sample before PSM.

Table 5. Results of DID based on full sample.

VARIABLES	(3) Unmatched (Full)	(4) Unmatched (Full)	(5) Matched (Full)	(6) Matched (Full)
Treat × Post	-0.417	-0.288	-2.723	-2.060
	(-0.819)	(-0.525)	(-1.415)	(-1.406)
lag_ Working hours		-0.250***		-0.270***
		(-7.766)		(-3.541)
log (lag_ Wage)		2.007		-3.940
		(0.767)		(-0.501)
log (lag_ Per capita household income)		0.769**		-0.143
		(2.180)		(-0.099)
Age		2.696**		5.628**
		(1.985)		(2.521)
Age2		-0.007		-0.036*
		(-0.953)		(-1.770)
Own house		0.900		2.124*
		(1.111)		(1.691)
Number of preschool children		-0.975		-0.526
		(-1.266)		(-0.384)
Living with parents		-1.226		-7.034*
		(-0.856)		(-1.846)
Constant	29.203***	-85.288	28.338***	-113.359
	(104.335)	(-1.511)	(37.136)	(-1.305)
Observations	3,882	3,882	3,091	3,091
R-squared	0.001	0.065	0.021	0.151
Number of id	1,821	1,821	1,646	1,646
ID FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES

Note:

*(1) Robust t-statistics in parentheses are employed (*** p<0.01, ** p<0.05, * p<0.1).*

(2) The regression of the matched sample employs the propensity scores as sampling weights.

(3) The variable "Work hour flexibility" is omitted due to the fixed effects model.

(4) To save space, the year variables are not presented.

Table 6. Results of DID based on sample in different pre-reform earnings ranges.

VARIABLES	(7) Matched (0-105)	(8) Matched (105-141)	(8-1) Matched (105-130)	(8-2) Matched (130-141)	(9) Matched (141-201)	(10) Matched (More than 201)
Treat × Post	2.717	-8.057***	-10.629***	-3.839	-4.811**	0.737
	(1.243)	(-2.776)	(-3.544)	(-1.388)	(-2.078)	(0.475)
lag_ Working hours	-0.210**	-0.141*	-0.091	-0.250	-0.467***	-0.159**
	(-2.282)	(-1.672)	(-1.155)	(-1.448)	(-12.176)	(-2.091)
log (lag_ Wage)	-15.852	8.013	7.423	11.199*	15.063	-13.810
	(-1.327)	(1.548)	(1.007)	(1.912)	(1.583)	(-1.542)
log (lag_ Per capita household income)	2.629	-0.538	-0.982	2.975	-4.511***	0.494
	(1.620)	(-0.321)	(-0.546)	(0.646)	(-6.050)	(0.896)
Age	3.102	-2.033	-4.183	-0.886	11.415*	6.064***
	(1.482)	(-0.562)	(-1.052)	(-0.362)	(1.874)	(2.669)
Age2	-0.029*	0.023	0.041*	0.003	-0.074	-0.056**
	(-1.913)	(1.133)	(1.684)	(0.106)	(-1.524)	(-2.242)
Own house	1.232	1.984	0.756	2.567	0.022	3.755
	(0.576)	(1.098)	(0.294)	(1.321)	(0.016)	(1.055)
Number of preschool children	1.145	-1.250	2.037	-5.958*	-2.816	0.386
	(0.888)	(-0.403)	(0.519)	(-1.870)	(-0.518)	(0.179)
Living with parents	-2.742	-6.145	-9.130*	6.228	7.697***	-15.865**
	(-1.556)	(-1.064)	(-1.662)	(1.301)	(3.052)	(-2.505)
Constant	38.927	22.122	87.330	-22.163	-394.675*	-15.225
	(0.361)	(0.140)	(0.490)	(-0.338)	(-1.810)	(-0.154)
Observations	1,282	546	435	111	593	670
R-squared	0.111	0.204	0.291	0.309	0.638	0.267
Number of id	746	275	223	52	305	320
ID FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Note:

*(1) Robust t-statistics in parentheses are employed (*** p<0.01, ** p<0.05, * p<0.1).*

(2) The regression of the matched sample employs the propensity scores as sampling weights.

(3) The variable "Work hour flexibility" is omitted due to the fixed effects model.

(4) To save space, the year variables are not presented.

Table 7. Results of Quantile DID based on full sample.

VARIABLES	(11) 20th	(12) 50th	(13) 80th
Treat × Post	-0.199	-0.012	-7.841**
	(-0.061)	(-0.006)	(-2.336)
Treat	-2.492	-0.944	-2.075
	(-0.752)	(-0.548)	(-0.993)
Post	0.827	0.086	7.559**
	(0.257)	(0.047)	(2.233)
lag_ Working hours	0.673***	0.839***	0.466***
	(10.565)	(17.986)	(4.941)
log (lag_ Wage)	1.248	2.008	4.114**
	(0.866)	(1.561)	(2.089)
log (lag_ Per capita household income)	1.255	0.337	-1.190
	(0.671)	(0.163)	(-0.354)
Age	0.253	-0.416	-1.153
	(0.678)	(-0.544)	(-0.631)
Age2	-0.004	0.004	0.011
	(-1.009)	(0.501)	(0.586)
Own house	0.485	-1.126	-1.283
	(0.224)	(-1.435)	(-0.662)
Number of preschool children	1.204*	0.431	2.299
	(1.811)	(0.282)	(0.514)
Living with parents	1.436	0.196	0.200
	(1.197)	(0.193)	(0.045)
Work hour flexibility	-0.541	0.644*	0.020
	(-0.553)	(1.895)	(0.030)
Constant	-12.610	0.936	29.762
	(-1.512)	(0.058)	(0.821)
Observations	3,091	3,091	3,091

Note:

*(1) Robust t-statistics in parentheses are employed (*** p<0.01, ** p<0.05, * p<0.1).*

(2) The regression of the matched sample employs the propensity scores as sampling weights.

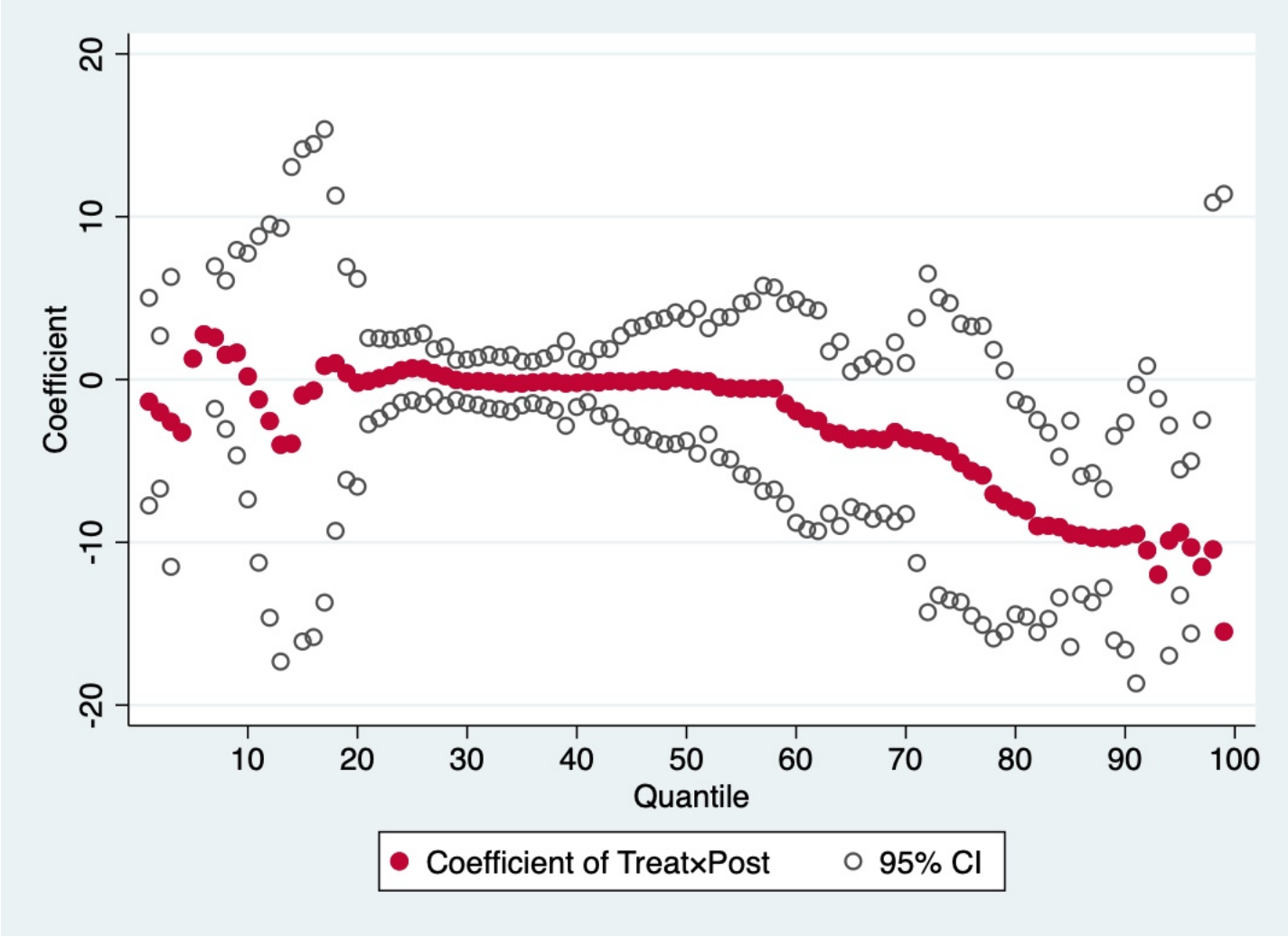

Figure 4. Coefficients of the interaction term in the QDID estimations.

5. Conclusion

In the Japanese tax system, the Spouse Exemptions (SEs) scheme provides taxpayers with a personal income tax deduction when their spouse's income falls below specified thresholds. In some cases, to ensure that husbands qualify for this deduction, certain wives choose to reduce their working hours in order to keep their income below the SEs thresholds. Consequently, the SEs system is recognized for its potential to suppress female labor supply. The 2017 SEs reform sought to expand the scheme by increasing the income threshold for spouses, with the expectation that this change would encourage wives to enhance their labor supply without being constrained by their husband's SEs eligibility. However, the literature on the policy effects of the 2017 SEs reform on female labor supply is notably limited.

To address this research gap, I narrowed my focus to hourly-paid informal female employees and proceeded to estimate the treatment effects of the SEs reform on their labor supply. This estimation involved categorizing by pre-reform income (PRE) and conducting a thorough heterogeneity analysis. Furthermore, I delved into examining how the SEs reform influenced the distribution of labor supply.

Employing a linear Propensity Score Matching Quantile Difference-in-Differences (PSM-DID) methodology, I evaluated the overall impact of the SEs reform on labor supply and conducted a heterogeneity analysis to explore the effects within distinct PRE ranges for female labor supply. The results uncovered no compelling evidence of the SEs reform exerting a significant influence on the labor supply of the overall sample. Investigation of different PRE-range samples indicated that the SEs reform yielded positive yet statistically insignificant treatment effects on female labor supply for individuals earning below 1.05 million yen and those earning above 2.01 million yen. This phenomenon may be attributed to the unaltered family budget constraint experienced by females within these specific PRE ranges. On the contrary, the SEs reform did lead to a significant reduction in labor supply for females earning between 1.05 and 2.01 million yen. This adverse treatment effect aligns well with the theoretical model I introduced, which can be ascribed to the combination of income and substitution effects.

Additionally, employing the Propensity Score Matching Quantile Difference-in-Differences

(PSM-QDID) approach, I scrutinized the treatment effects of the SEs reform across various original labor hour categories. The findings highlighted a noteworthy decline in labor supply among high-hour workers due to the impact of the SEs reform. Conversely, the policy's effects on individuals with shorter working hours and those with moderate working hours were not statistically significant. This disparity can be attributed to the interrelation between the reform's effect and the wife's pre-reform labor hours, stemming from changes in the marginal deduction that materialized with the wife's increased labor hours.

The contribution of this study lies in its estimation of the policy effects of the 2017 SEs reform on labor supply among hourly-paid informal women. In tandem with this empirical analysis, I formulated a theoretical model to elucidate the varying effects of the reform across different PRE ranges and labor supply distributions. Furthermore, the integration of wage rate data into the analysis addressed endogeneity concerns present in prior research. However, this approach led to the constraint of the sample to solely hourly-paid employees, which somewhat limits the study's generalizability. When I expanded the study's scope to encompass all informal female employees, across the overall sample, diverse PRE ranges, or varying labor supply distributions, the treatment effects ceased to achieve statistical significance.

In conclusion, the findings of this study cast doubt on the anticipated outcome of expanding SEs coverage as a means of bolstering female labor supply. Drawing parallels with research on the effects of the partial abolition of the Spouse Special Exemption in 2004, there is reason to consider that measures such as reducing, partially abolishing, or even completely abolishing the SEs system might prove more effective in encouraging increased female labor supply.

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Appendices

Appendix 1. Schedules of the Spousal Exemptions for spouses with multiple types of income.

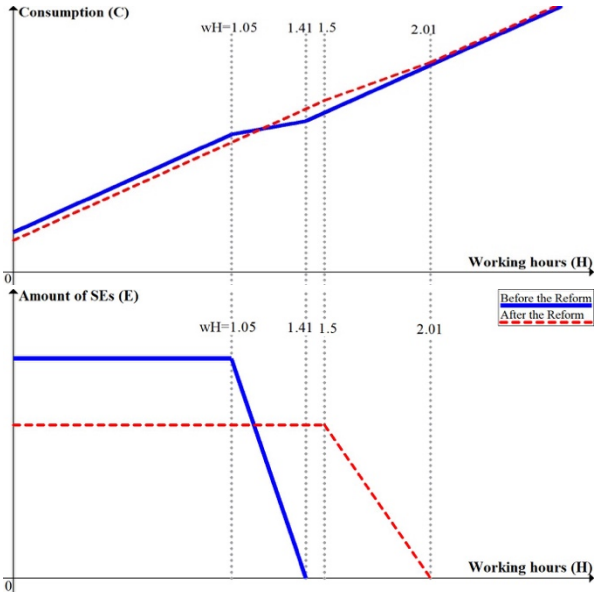
		Taxpayer's total amount of income		Spousal Exemptions
		¥10,000,000 or less	Over ¥10,000,000	
Spouse's total amount of income	¥380,000 or less	¥380,000	¥380,000	Spousal Exemption
	Elderly qualified spouses (Those older than 70 years old)	¥480,000	¥480,000	
	¥380,001 to ¥400,000	¥380,000	¥0	Special Spousal Exemption
	¥400,001 to ¥450,000	¥360,000		
	¥450,001 to ¥500,000	¥310,000		
	¥500,001 to ¥550,000	¥260,000		
	¥550,001 to ¥600,000	¥210,000		
	¥600,001 to ¥650,000	¥160,000		
	¥650,001 to ¥700,000	¥110,000		
	¥700,001 to ¥750,000	¥60,000		
	¥750,001 to ¥760,000	¥30,000		
	Over ¥760,000	¥0		

b. Schedules applied for income before 2018.

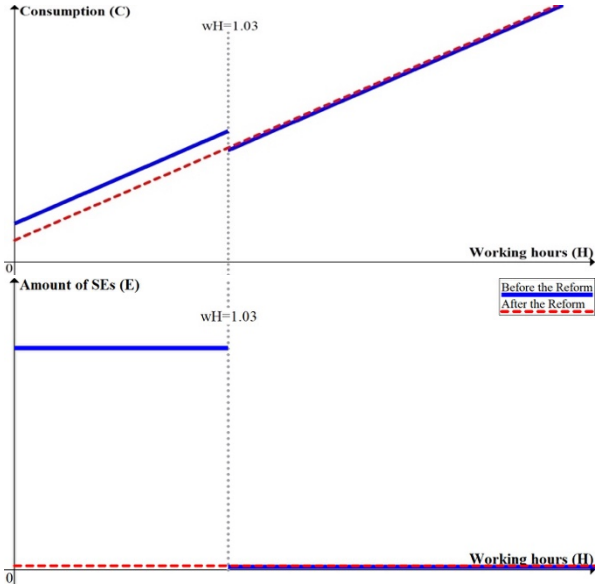
		Taxpayer's total amount of income			Spousal Exemptions
		¥9,000,000 or less	¥9,000,001 to ¥9,500,000	¥9,500,001 to ¥10,000,000	
Spouse's total amount of income	¥380,000 or less	¥380,000	¥260,000	¥130,000	Spousal Exemption
	Elderly qualified spouses (Those older than 70 years old)	¥480,000	¥320,000	¥160,000	
	¥380,001 to ¥850,000	¥380,000	¥260,000	¥130,000	Special Spousal Exemption
	¥850,001 to ¥900,000	¥360,000	¥240,000	¥120,000	
	¥900,001 to ¥950,000	¥310,000	¥210,000	¥110,000	
	¥950,001 to ¥1,000,000	¥260,000	¥180,000	¥90,000	
	¥1,000,001 to ¥1,050,000	¥210,000	¥140,000	¥70,000	
	¥1,050,001 to ¥1,100,000	¥160,000	¥110,000	¥60,000	
	¥1,100,001 to ¥1,150,000	¥110,000	¥80,000	¥40,000	
	¥1,150,001 to ¥1,200,000	¥60,000	¥40,000	¥20,000	
	¥1,200,001 to ¥1,230,000	¥30,000	¥20,000	¥10,000	
	over ¥1,230,000	¥0	¥0	¥0	

a. Schedules applied for income in 2018 and 2019.

Appendix 2. Household budget lines and SEs schedules when the income of the husband is *more than 11.2 million yen (Unit of wH: million yen).*



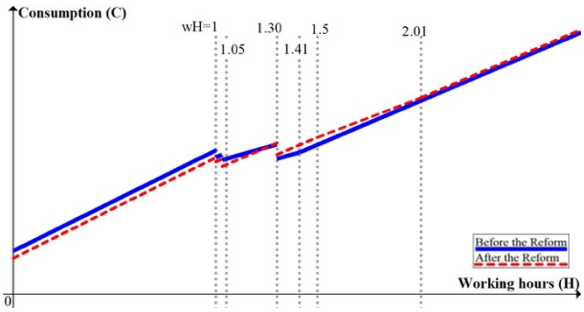
a. *The case when the income of the husband is less than 12.2 million yen but more than 11.2 million yen.*



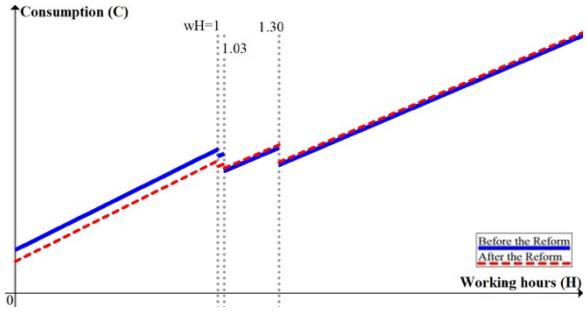
b. *The case when the income of the husband is more than 12.2 million yen.*

Note: the employment income deduction, standard deduction, residence tax exemption, and insurance premium are not taken into consideration.

Appendix 3. Household budget lines and SEs schedules when the income of the husband is *more than 11.2 million yen (Unit of wH: million yen).*



a. *The case when the income of the husband is less than 12.2 million yen but more than 11.2 million yen.*



b. *The case when the income of the husband is more than 12.2 million yen.*

Note:

(1) The employment income deduction, standard deduction, residence tax exemption, and insurance premium are taken into consideration.

(2) Since the point at wH=1.03 is too close to the points at wH=1 and wH=1.05, vertical lines have not been individually marked to maintain visual aesthetics.

Appendix 4. Parallel trend assumption test.

	(14) Pool regression workhour
2016.year×treat	-1.798***
	(-3.841)
2018.year×treat	-2.542***
	(-5.287)
2019.year×treat	-2.958***
	(-6.172)
Post	0.924**
	(2.352)
lag_Working hours	0.664***
	(34.584)
log (lag_Wage)	0.779
	(1.613)
log (lag_ Per capita household income)	0.928***
	(3.418)
Age	0.242**
	(2.082)
Age2	-0.003**
	(-2.189)
Own house	-0.577*
	(-1.782)
Number of preschool children	0.043
	(0.128)
Living with parents	0.324
	(0.940)
Work hour flexibility	-1.035***
	(-3.901)
Constant	-4.278
	(-1.122)
Observations	3,882
R-squared	0.525

*Note: Robust t-statistics in parentheses (*** p<0.01, ** p<0.05, * p<0.1).*

Appendix 5. Results of DID based on sample of all female informal employees in different pre-reform earnings ranges.

VARIABLES	(15) Matched (Full)	(16) Matched (0-105)	(17) Matched (105-141)	(17-1) Matched (105-130)	(17-2) Matched (130-141)	(18) Matched (141-201)	(19) Matched (More than 201)
did	0.117	-2.249	-0.769	-0.788	-0.903	0.428	-0.335
	(0.109)	(-1.141)	(-0.594)	(-0.541)	(-0.366)	(0.295)	(-0.210)
l_workhour	-0.112***	-0.149***	-0.165***	-0.170**	-0.162	-0.349***	0.001
	(-2.606)	(-3.557)	(-2.815)	(-2.437)	(-1.637)	(-4.833)	(0.018)
log_l_householdincome	-0.694	0.910	3.966	4.505	0.929	-0.130	-3.781
	(-0.499)	(0.929)	(1.452)	(1.476)	(0.521)	(-0.121)	(-1.314)
age	1.608	3.553	6.490***	7.715***	-2.644	3.423	-3.725
	(0.991)	(1.636)	(3.051)	(3.024)	(-0.405)	(0.906)	(-1.016)
age2	-0.013	-0.017	-0.036**	-0.048**	0.008	-0.037	0.020
	(-0.996)	(-1.536)	(-2.078)	(-2.334)	(0.297)	(-1.251)	(0.787)
myhouse	-7.757**	-5.413**	-1.156	-3.589*	2.574*	1.021	-11.898**
	(-1.977)	(-2.297)	(-0.750)	(-1.811)	(1.856)	(0.443)	(-2.364)
prechildren	-1.511	-1.830*	4.950	6.812*	-2.589	-6.236***	7.342***
	(-1.281)	(-1.902)	(1.385)	(1.938)	(-0.393)	(-3.046)	(2.799)
liveparent	-1.110	0.199	-1.444	-1.304	-0.149	-0.845	-3.892
	(-0.568)	(0.131)	(-0.739)	(-0.619)	(-0.069)	(-0.440)	(-0.829)
Constant	-4.749	-101.240	-213.698**	-245.517**	134.736	-33.126	197.977
	(-0.079)	(-1.096)	(-2.470)	(-2.331)	(0.516)	(-0.263)	(1.398)
Observations	8,485	3,872	1,360	1,111	249	1,363	1,890
R-squared	0.035	0.042	0.085	0.103	0.068	0.192	0.091
Number of id	4,616	2,210	710	585	125	751	945
ID FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES

Appendix 6. Coefficients of the interaction term in the QDID estimations based on sample of all female informal employees.