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The Impact of Tax Reform in Japan on the Work-Hour and Income Distributions of Married Women

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Abstract

In 2004, Japan abolished part of its spousal exemption regulations. This paper examines, on theoretical and empirical levels, the effects of this tax reform on the income of married women, allowing for heterogeneous effects across income distribution. The empirical results from quantile difference-in-difference estimations and novel decomposition methods indicate that low-income wives increased their labor supply and incomes, in accordance with changes in tax incentives. In contrast, medium- and high-income wives, who were presumably unaffected by the tax reform, decreased their incomes in response to the upward trend of their husbands' incomes during the same period. I argue that this behavior of middle- to high-income wives is due to an increased awareness of the shape of the budget line that were less conspicuous under the previous tax regime.

JEL Classification: J20, H24
Keywords: Female labor supply; Income distribution; Spousal exemption; Tax reform; DiNardo, Fortin, and Lemieux decomposition; RIF regressions; Unconditional Quantile Regressions; Firpo, Fortin, and Lemieux decomposition

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1 Introduction

There is a spousal exemption system in Japan in which the amount of income exemptions a husband can claim reduces as his spouse's income rises. This spousal exemption system has been criticized for discouraging married women from working long hours. As female labor force participation has increased, criticism of the spousal exemption system has also escalated. As a result, part of this spousal exemption system was abolished in 2004 for taxpayers whose spouses' annual earnings were 1.03 million yen ($\approx$USD 10,300) or less. The original purpose of this tax reform was to mitigate the distortion it may have caused to the women's labor supply, and it was expected to increase married women's labor supply; however, statistics show that both the average work hours for married women and their annual incomes slightly decreased after the tax reform. These trends are not observed for single women. Although this simple analysis by statistics may suggest that the tax reform of 2004 did not increase married women's labor supply, further considerations are required in order to understand the real impact of the reform.

First, in the years following the tax reform, the incomes of married men in Japan increased in response to the recovery from the recession that began in the late 1990s. This trend of rising income for married men may have decreased the incomes earned by their spouses and, hence, concealed the real impact of the reform. Therefore, it is important to estimate how the tax reform affected married women's labor supply after controlling for changes in certain exogenous variables, particularly the increase in their husbands' incomes.

Second, although a number of studies have examined how the spousal exemption system influenced the female labor supply (Abe and Ohtake (1995), Higuchi (1995), Kantani (1997), Akabayashi (2006), Takahashi (2010a,b)), few authors have explored how the overall 2004 tax system reform affected the female labor supply. Furthermore, no study has analyzed the overall distributional change due to the tax reform in spite of the fact that the impact of the tax reform should differ in the income groups of married women. Since the tax reform only directly affected low-income married women, only estimating the mean impact among all women could be misleading and could result in missing a change in the labor supply due to the tax reform. In addition, if the tax reform caused any side effects for high-income married women who were presumed to be unaffected by its changes, then restricting the sample to only female workers who were directly affected could also bias the results.[1] Therefore, this paper explicitly considers the heterogeneity among income groups and examines how the reform affected income distribution rather than focusing on the mean.[2][3][4]

Third, people can adjust their incomes not only by altering work hours and/or labor force participation rates but also through their effort at work, their job choices, and their manner of earning income (e.g., salary, dividends, or capital gains). As is often argued in public finance literature, people can also control their after-tax incomes by changing behaviors other than work hours in order to reduce their tax liability. For example, the "new tax responsiveness" literature holds a general view of the concept of the labor supply and uses the response of taxable income to the marginal tax rate as a summary statistic of the behavioral response to taxation (Meghir and Phillips 2008, Feldstein 1995). Moreover, using incomes rather than work hours to analyze the impact of the tax reform in Japan circumvents the concern that it affected behaviors other than their hours of work. Thus, in this paper, I focus on how the tax reform affected incomes.

In Japan, the existence of complicated income exemption schedules and policy-related customs create kinks on the household budget line. One of the most important factors to note about the Japanese tax system is that 1.03 million yen has historically been a critical income threshold for many married women because their husbands lose the standard spousal exemption once their

[1] For example, the way in which high-income married women decreased their incomes in response to some exogenous shock could have been altered by the tax reform, which changed the shape of their budget and also may have influenced their potential labor supply choices.

[2] This point is similar to that of Bitler et al. (2006) who analyzed how the recent welfare reforms in the United States have influenced labor outcomes by using a random assignment experiment. By estimating the quantile-level treatment effects, these authors showed the importance of analyzing the distributional effects rather than concentrating on the average income.

[3] Sakata and McKenzie (2006) took the mean impact of the tax reform into account and found that the tax reform had no impact on labor force participation decisions but a slightly positive effect on the work hours of female workers who worked fewer than 35 hours per week.

[4] A number of overseas studies have also examined how recent tax reforms have affected the female labor supply. For example, Eissa and Liebman (1996) examined the impact of the U.S. Tax Reform Act of 1986, which included an expansion of the earned income tax credit, by using a difference-in-difference (DID) estimation to compare the change in the labor supply of single women with children with that of single women without children. They found that the Tax Reform Act increased labor participation among single women with children. Furthermore, Blundell et al. (1998) examined how the UK tax reforms in the 1980s affected the labor supply by comparing the labor supply responses over time for different groups defined by cohort and education level. They found positive and moderately-sized wage elasticities and negative income effects for women with children.

annual incomes exceed that limit.

The theoretical model in this paper shows that the 2004 tax reform made the kink at this 1.03 million yen threshold more conspicuous than it had been before, which is a finding that allows us to produce the following testable implications. First, the tax reform increased the work hours (and incomes) of married women who earned 1.03 million yen or less annually, but it had no impact on married women above that income threshold when the exogenous parameters remained unchanged; however, second, if an increase in the husbands' incomes is considered, some medium- to high-income married women greatly decrease their incomes to 1.03 million yen (defined as the "income jump" hereafter). Third, even in this case, the "tax reform effect," cannot be negative. Fourth, this income jump among medium- to high-income married women can be explained mostly by the negative effect of the rise in the husbands' incomes (the "husband's income effect" hereafter). Finally, in some cases, this income jump is mitigated by a small positive tax reform effect.

These implications are tested using Japanese panel data from the Keio Household Panel Survey (KHPS). In the empirical investigation, a difference-in-difference (DID) estimation under a quantile regression framework was conducted. The results of both the conditional and the unconditional quantile regressions (CQR and UQR) show that the tax reform increased annual incomes among married women who earned 1.03 million yen or less.

Methodologically, to introduce changes in the exogenous variables, I employ the relatively novel decomposition technique proposed by Firpo et al. (2007, 2010), which enables us to examine whether or not the "income jump" among medium- to high-income married women actually occurred in response to an increase in the husbands' incomes after the tax reform. The results from the FFL decomposition suggest that the magnitude of the composition effect attributable to the husbands' incomes is greatest among medium- to high-income married women. This finding indicates the possibility that the "income jump" to 1.03 million yen predicted by the theory actually occurred in response to an increase in the husbands' incomes among medium- to high-income married women.

Lastly, by utilizing the DFL decomposition method (DiNardo et al. 1996), I illustrate how the behavioral changes shown in the DID estimation and the FFL decomposition affected the overall income distribution. In this decomposition, I reconfirm the previous results, which is that low- and high-income married women gathered at the center of the distribution after the tax reform because the former group increased work hours in response to the tax reform, and the latter group decreased work hours in response to an increase in their husbands' incomes. Accordingly, the mass point at 1.03 million yen in the income distribution became more conspicuous following the reform. These results are consistent with the concept of tax salience, a relatively new topic in taxation literature (Finkelstein 2009, Chetty et al. 2009): I argue that the behavior of middle- to high-income wives is due to an increased awareness of the shape of the budget line that were less conspicuous under the previous tax regime.

Furthermore, the DFL decomposition results also indicate that incomes would have decreased more in response to the increase in the husbands' incomes if the tax reform had not occurred. These results from the FFL and the DFL decompositions support the theoretical implications.

The remainder of this paper proceeds in seven sections. Section 2 describes the tax system in Japan, and Section 3 explains the trends in the Japanese labor market between 2003 and 2006. Section 4 presents a simple theoretical model and the theoretical implications. Section 5 explains the strategies used to test the implications of the theoretical model. Section 6 briefly describes the data, and Section 7 discusses the results from the empirical analysis. Finally, Section 8 concludes the paper.

2 Tax System in Japan

2.1 Spousal Exemptions in Japan

Both income tax and residential tax in Japan have spousal exemptions. Historically, the standard spousal exemption was established in 1961 to support households with full-time housewives by offering more tax exemptions to a husband whose wife worked less; however, because the standard spousal exemption ceased at a certain threshold of the wife's income, there was a problem because the after-tax income of a household in which the wife earned slightly more than the threshold would be less than that of a household in which the wife earned slightly less. This “reversal” phenomenon created a “dip” at the threshold on the household budget, and the special spousal exemption was introduced in the late 1980s to overcome this problem.

The head of the household is eligible for the special spousal exemption if his/her own *total income*[5] is 10 million yen or less per year and his/her spouse's income is below certain thresholds.[6] For the sake of simplicity, for this paper, I assume that the head of the household is the husband and the spouse is the wife.[7]

Table 1 shows the spousal exemptions that apply to different levels of the spouse's annual earnings. The un-parenthesized numbers represent the income tax spousal exemptions, and the parenthesized numbers represent the residential tax spousal exemptions. The standard spousal exemption for income taxes is fixed at 0.38 million yen (≈USD 3,800) and ceases immediately if a wife's annual earnings exceed 1.03 million yen. In contrast, the special spousal exemption declines gradually as the wife's earnings increase.[8]

Note that both the standard and the special spousal exemptions have characteristics that could discourage married women from working long hours. This aspect of the system has been criticized for some time, and this criticism has escalated along with the increase in female labor force participation rate in recent years. As a result, in March of 2003, the Japanese Diet passed legislation to abolish part of the special spousal exemption for taxpayers whose spouses earned 1.03 million yen or less annually. This legislation took effect in the 2004 tax year.[9]

[5] *Total income* is calculated as the total earnings minus the deduction *employment income deduction* for employees and total earnings minus the necessary expenses for other workers.

[6] There is no rule about whether the husband or the wife should claim the spousal exemption, but to be eligible, the spouse's earnings should be lower than the threshold (1.41 million yen≈14,100 USD). Thus, in most cases, the highest-earning spouse claims the spousal exemption because this person is more likely to be eligible.

[7] According to the KHPS conducted between 2004 and 2007, 96 % of married couples listed the husband as the head of the household for tax purposes.

[8] As illustrated in Table 1, the spousal exemption system for residential taxes is similar to that of income tax, except that the starting amount of the spousal exemption is 0.33 million yen instead of 0.38 million yen.

[9] Specifically, this legislation took effect from the 2004 fiscal year for income taxes and from the 2005 fiscal year for residential taxes.

2.2 1.03 Million Yen Threshold

In Japan, all employees begin to pay income tax only after their annual earnings exceed 1.03 million yen. Furthermore, as confirmed in the previous section, husbands lose the standard spousal exemption once their spouses' earnings exceed this threshold. In addition to these two factors, employer-provided spousal allowances could also cause married women to adjust their labor supply so that their annual earnings do not exceed 1.03 million yen.[10]

Figure 1 presents a histogram of the 2003 income distribution of married women based on the KHPS sample. In this figure, there is a conspicuous spike at approximately 1 million yen, just below the 1.03 million yen threshold.[11] This spike reflects the fact that many women adjust their labor supply to ensure that their annual incomes do not exceed 1.03 million yen. Furthermore, since this is the income distribution prior to the tax reform, there is another spike at the old kink in the household budget line, which is 0.7 million yen. This point is discussed in Section 4.[12]

3 Evidence

In this section, I review the trends of the Japanese labor market from 2003 to 2006 in order to examine the effects of the 2004 tax reform. Table 2 summarizes the trends of the Japanese labor market during this period. First, we can see that as Japan was recovering from the recession that started in the late 1990s, the unemployment rate decreased significantly from 5.3 % before 2003 to 4.1 % in 2004-2006; however, both the average annual income and the average work hours slightly

[10]According to a survey conducted by the Japanese Cabinet Office in 2001, the proportion of firms that offer a family allowance system is 83.5 % on average, and 91.5 % among large firms with 1,000 or more employees. The rules for the eligibility of employer-provided spousal allowances differ among employers: 61.5 % of firms that offer family allowances determine the eligibility for spousal allowances based on spouses' earnings. Among these firms, 78.4 % set 1.03 million yen as the critical income threshold at which spousal allowances cease in the tax system, while 13.9 % set the income threshold at that for the social security payment, namely 1.3 million yen. The average spousal allowance per month is 14,500 yen (≈USD 145) (Cabinet Office, Government of Japan 2001).

[11]Several studies have similarly pointed out the considerable cluster of observations around this amount (Abe and Ohtake 1995, Kantani 1997, Higuchi 1995, Takahashi 2010a,b).

[12]In addition to these two spikes, another somewhat smaller spike can be seen at just below 1.3 million yen (Abe and Ohtake 1995, Oishi 2003). This occurs because married women are required to make an individual social security payment once their incomes exceed 1.3 million yen. Thus, 1.3 million yen also serves as a threshold of annual income in Japan, as considered further in Section 4.

decreased among married women after the tax reform contrary to both expectations and the trends observed for single women. Thus, we cannot find any evidence of increased income or work hours among married women. Moreover, there was little change in the average hourly wage rate for both married women and single women during this period, whereas the husbands' incomes increased (and the change was significantly different from zero). This increase in the husbands' incomes could be one reason for the decrease in the wives' work hours. Using a simple calculation, if we compare the effect of the spousal exemption cut with that of the increase in the husbands' incomes, they almost offset one another. This finding implies that only analyzing the average income and the work hours without controlling for the increase in the husbands' incomes may result in missing the increase in the labor supply due to the tax reform.

4 Theory

In this section, I consider the utility maximization problem of a wife who chooses the optimal combination of leisure and consumption given her husbands' income and simulate how the change in the spousal exemption system affects the wife's income choice.[13][14]

Figure 2a illustrates the household budget lines before and after the 2004 tax reform. Since income tax becomes non-zero from annual earnings of 1.03 million yen, this creates a kink at this threshold in both budget lines. By comparing these two budget lines, we can clearly see how the

[13]The unilateral influence on the labor decision (i.e., from husband to wife) is less likely to be true in double-income couples in which the wife also earns a high income; however, in this paper, the wives of interest are those with low incomes because they were the group affected by the 2004 tax reform. Because these women are more likely to belong to traditional households in which the husband is the main earner, the assumption above is likely valid.

[14]Previous studies of the female labor supply have commonly assumed that the husband's decision is predetermined or exogenous (Mincer 1962, Killingsworth 1983, Hyslop 1999, Takahashi et al. 2009, Apps et al. 2012). In contrast, research on household decisions have recently begun to consider collective models that treat a family as a collection of agents with specific preferences (see Chiappori (1988) and Chiappori (1992)). Nevertheless, Donni and Moreau (2007) emphasized that in most developed countries, the male labor supply is rigid and largely determined by exogenous constraints and that the use of such a collective model in this case could be misleading. In the context of the present study, the male labor supply in Japan has historically been much more inelastic than the female labor supply. For example, Kuroda and Yamamoto (2008), who estimated the Frisch labor supply's elasticity by gender, found that the elasticity was 0.7 for men and 1.3 to 1.5 for women from 1992 to 2002. Hence, it is still common to assume that the male labor supply is exogenous in the context of a model of the female labor supply in Japan (e.g. Takahashi et al. (2009)). Thus, in this paper, I assume that imposing the assumption of the husband's exogenous labor supply is not a serious issue for consideration.

tax reform influences the household budget. Because wives that earned 1.03 million yen or less annually lost the special spousal exemption after the tax reform, the intercept of the budget line for this group shifted down. Furthermore, because the special spousal exemption, which declines gradually as the wife's earnings increase, was abolished for those who earned between 0.7 and 1.03 million yen in 2004, the budget line for this income group became steeper after the tax reform. These changes moved the kink in the household budget lines caused by the spousal exemption system from 0.7 million yen to 1.03 million. As a result, the kink at 1.03 million yen that had originally existed because of the limit of nontaxable income became more conspicuous after the tax reform.

For a more realistic budget line, Figure 2b also includes social security payments and spousal allowances. Here, we see that the dip at an income equal to 1.03 million yen is caused by the loss of the spousal allowance that the husband receives from his employer at this point. Furthermore, married women have to make a social security payment once their income exceeds 1.3 million yen, which also creates a dip at this income level. Given these changes in the shape of the budget line, the following proposition can be obtained:

Proposition 1: *Without a change in the exogenous variables, such as a husband's income and the price of goods, the tax reform had no impact on those who originally earned more than 1.03 million yen, but it increased work hours for married women who originally earned 1.03 million yen or less.*

Proof. See Appendix

In Proposition 1, it is assumed that there is no change in the exogenous variables; however, Table 2 confirms that married women experienced an increase in their husband's incomes as well as the impacts of the tax reform during the period of 2003-2006. If such a change in an exogenous variable is considered, there may be a case in which the tax reform affected the labor supply of married women who originally earned more than 1.03 million yen. The next proposition states the possible effects on the labor supply of married women who were presumed to be unaffected by the tax reform when they experienced an increase in their husbands' incomes as well as the impacts of the tax reform.

Proposition 2: *After the tax reform, when an increase in a husband's incomes is considered,*

(a) There are cases in which married women who earned 1.41 million yen or more greatly decreased their work hours to earn only 1.03 million yen; and

(b) These cases occurred only when the increase in a husband's income was sufficiently large and the wife's preference for consumption (or the household's preference for the wife's consumption) was not too strong.

Proof. See Appendix

Proposition 2b presents an important implication about the levels of income and the impact of the tax reform. For a wife to have originally been in the high-income group, her preference for consumption should have been sufficiently strong. However, if the preference for consumption is too strong, the wife is less likely to decrease their incomes to 1.03 million yen even in response to an increase in the husbands' incomes and the changes brought about by the tax reform. In this sense, we can conclude that the income jump did not occur for those who earned extremely high incomes but was more likely to have affected medium- to high-income married women.

In the next proposition, I decompose the jump from 1.41 million yen or more to 1.03 million into the husband's income effect and the tax reform effect.

Proposition 3: *After the tax reform, when an increase in a husband's income is considered,*

(a) The income jump in Proposition 2 is explained mainly by a large negative husband's income effect;

(b) There are cases in which a decrease in the wife's income because of an increase in a husband's income is mitigated by a small positive tax reform effect; and

(c) The tax reform effect cannot be negative in any case.

Proof. See Appendix

In summary, the tax reform made the kink at 1.03 million yen in the budget line more conspicuous than before. As a result, some medium- to high-income married women were dragged to the mass point at 1.03 million yen in the income distribution following a negative shock in the exogenous variables that may have discouraged them from working long hours, such as an increase in the husbands' incomes; however, even in such a case, the tax reform effect cannot be negative. Instead, the income jump among medium- to high-income married women can be explained mainly by a negative husband's income effect and, in some cases, because the income drop is mitigated by a small positive tax reform effect.[15]

5 Empirical Model

In this section, I estimate how the tax reform influenced the labor supply of married women for each income group. Based on the shape of the budget line represented in Figure 2, married women can be divided into the following four groups based on their 2003 income levels: less than 0.7 million yen, 0.7 to 1.03 million yen, 1.03 to 1.41 million yen, and 1.41 million yen or more. In order to determine whether or not the tax reform successfully met its objectives, it is necessary to assess whether or not married women in the lowest and second-lowest income groups in particular increased labor supply after the tax reform. In addition to the tax reform effect on low-income married women, I am also interested in how the labor supply among medium- to high-income married women changed in response to changes in the exogenous variables (such as the husbands' incomes) as well as the tax reform.

I first tested Proposition 1 by carrying out difference-in-difference (DID) estimations for each quantile of incomes and work hours. Then, I employed the FFL decomposition method (Firpo et al.

[15]As confirmed in Figure 2, the 2004 tax reform did not change the starting wage rate but rather decreased the husband's after-tax income via the spousal exemption cut. This decrease in the husband's after-tax income can be thought of as a decrease in wives' non-labor income. Then, given that leisure is a normal good, the reservation wages of married women should decrease in response to the tax reform; it is thus expected that the probability of work will increase; however, the effect of the spousal exemption cut is not exceptionally large, so there is a considerable possibility that the effect of the spousal exemption cut is too small for the reservation wage to be lower than the market wage rate. Furthermore, if we consider that many married women would incur some fixed costs for working, such as the monetary costs of child care or loss of time due to taking their children to child care, this possibility would be more likely.

2007, 2010) to test Propositions 2 and 3. Last, I illustrate how the behavioral changes confirmed in the DID estimation and the FFL decomposition affected the overall income distribution by utilizing the DFL decomposition (DiNardo et al. 1996). This method also enabled us to test Propositions 2 and 3.

5.1 Model

Sakata and McKenzie (2005, 2006) conducted a DID estimation to estimate how the tax reform affected the labor supply of married women. The estimated model in Sakata and McKenzie (2005, 2006) is:

$$Y_{it} = \beta_0 + \beta_1 After_t + \beta_2 Treatment_i + \beta_3 After_t \cdot Treatment_i + X_{it}\gamma + u_{it} \tag{1}$$

where $Treatment$=1 for the treatment group and $After$=1 for samples in periods after the tax reform.[16]

In this paper, I estimate the model presented in Equation (1) by quantile in the income distribution. The same regressions are also performed for labor force participation and work hours in order to strengthen the income regression results. This quantile analysis enabled us to separately examine how the tax reform influenced the low-income married women directly affected by the reform and its impact on other married women who were presumed to be unaffected. According to Proposition 1, I expect the coefficient of the interaction term β_3 to be significantly positive for low quantiles and zero for high quantiles. If β_3 is significantly positive for low quantiles, it implies that the tax reform increased the labor supply among low-income married women, as expected.

Note that the settings of the DID estimation correspond to the case in which there is no change in the exogenous parameters, since husbands' incomes and many of the other exogenous variables are controlled for in the estimation and the coefficients of these explanatory variables, except

[16] A dummy variable indicating labor force participation and work hours are used for Y_{it} in Sakata and McKenzie (2005, 2006). Given that married women are expected to have been affected by the tax reform, they used married women as the treatment group and single women as the control group in this DID estimation.

for the treatment dummy, are also assumed to be the same before and after the tax reform. In the difference-in-differences estimation, both the conditional quantile regression (CQR) and the unconditional quantile regression (UQR) are used to examine the tax reform's impact on each quantile of incomes and work hours. The difference between CQR and UQR is discussed in the Appendix.

5.2 FFL Decomposition Model

For the FFL decomposition method, the total change in Y is divided into the composition and structure effects, which are further decomposed into the contributions of each explanatory variable. In this sense, the Oaxaca-Blinder (OB) decomposition would be the counterpart of this method; however, two characteristics in the FFL decomposition differentiate it from the classic OB decomposition. First, in the FFL decomposition, the re-centered influence function (RIF) of Y instead of Y is used as the dependent variable, which enabled us to examine the distributional changes in Y; this was possible only for the mean in the classic OB decomposition (Firpo et al. 2007, 2010). Second, to calculate the counterfactual distributions, the reweighting method proposed in the DFL decomposition is used (DiNardo et al. 1996). Performing reweighting regressions prevents the difference in the coefficients between the two periods from being contaminated by differences in the distribution of X between the two periods. The details of this technique are discussed in the Appendix.

The purpose of adding the FFL decomposition is to test Propositions 2 and 3. In using this decomposition, I examine whether medium- to high-income married women actually decreased their incomes because of a large negative husband's income effect (and not the tax reform effect). Specifically, the FFL decomposition allows us to check the magnitude of the composition effect attributable to the husbands' incomes. For example, if it is greatest at medium to high quantiles of the income distribution with statistical significance, this finding supports Propositions 2 and 3. In other words, the income jump, which is explained mainly by a large negative husband's income effect, is likely to have occurred for medium- to high-income married women. It is also important to verify that the structure effect attributable to the treatment dummy variable is not significantly negative for these women to ensure that this income jump cannot be explained by the negative tax reform effect.

Furthermore, I also reconfirm the results obtained from the DID estimation and the FFL decomposition. If the coefficient of the treatment dummy variable rises after the tax reform in the DID regression (i.e., the interaction term between the *treatment* and *after* dummy variables is significantly positive in the DID regression) and the structure effect attributable to the treatment dummy variable obtained from the FFL decomposition is significantly positive at low quantiles, this finding would imply that the tax reform contributed to increasing the incomes among low-income women.[17]

6 Data

The dataset used in this study includes Japanese panel data from the KHPS of 2004-2007. The KHPS is conducted on January 31 every year, and it includes observations randomly chosen from most regions and industries in Japan. The KHPS is the first nationwide longitudinal survey in Japan of individuals (4,000 households and 7,000 people) of all ages and both sexes, and it also includes information regarding education, employment, income, expenses, health, and family structure.

The details of the KHPS are as follows: respondents for the first wave (2004) were men and women aged between 20 and 69 as of January 31, 2004, from across Japan. The 2004 wave included 4,005 households, the second wave (2005) included 3,314 out of the 4,005 households in the first wave, the third wave (2006) included 2,887 households, and the fourth wave (2007) included 2,643 households. Additionally, 1,419 households were added to the sample in 2007, and these were included in the presented analysis. The attrition rate from the first wave to the fourth wave was 34 %.[18]

[17]Note that the structure effect attributable to the treatment dummy variable corresponds to the coefficient of the interaction term between the *treatment* and *after* dummy variables in the DID regression. Thus, by examining the structure effect attributable to the treatment dummy variable, it is possible to reconfirm the results for low-income married women in the DID regression.

[18]The sample selection issue that arises from attrition (i.e., from the first to the fourth waves) is expected to be small

Table 3 presents the descriptive statistics for the main sample. The first column in Table 3 reports the overall sample including non-working women, which is used for the probit estimation first conducted to determine how the introduction of the tax reform affected labor force participation decisions.

The real schedule of the spousal exemption is defined with regard to the spouse's *total income*, which, as noted earlier, is calculated as total earnings minus the *employment income deduction* for employees and total earnings minus the necessary expenses for other workers. While these necessary expenses vary among individuals, the *employment income deduction* is fixed among each income level. As a result, the uniform correspondence between annual earnings and the spousal exemption can only be obtained from employment income. Therefore, analyzing how the spousal exemption affects employment income earners is more straightforward. For this reason, the main sample used to assess how the tax reform influenced the income distribution is restricted to employees only, which comprises 41 % of all observations.

Furthermore, in the theoretical model, we assumed the existence of traditional households in which the husband is the main earner and the wife is a dependent, but this assumption is less likely to be true for married women who work for the government. Nishikawa (2002) showed that the gap in work hours between a husband and a wife who works in the public sector is much smaller than that for other types of married couples. This finding implies that the assumption regarding the unilateral influence on labor decisions (from a husband to a wife, and not the reverse) is unlikely to be accurate for these women. For this reason, in the main analyses, I also restrict the sample to employees who work in the private sector only.

Hence, this restricted sample includes 3,206 observations that are employed in the private sector and work at least one hour each year.[19][20] The average age is 44.22 years. Among the four

because the characteristics of the women who participated in the survey in all of the years studied (2004-2007) are similar to those of the women who dropped out of the sample at some point during that time.

[19] If any of these three conditions, namely positive work hours, employment, and being a private sector worker, were not satisfied during the year t, that person was omitted from the sample of the year t.

[20] Only women who reported all the necessary variables were included in the sample in the regression. A comparison of the workers' characteristics between the raw data and the regression sample showed no significant differences. Thus, the sample selection issue that arises from using only people who reported all the necessary variables is expected to be small.

income groups (0-0.7 million, 0.7-1.03 million, 1.03-1.41 million, and 1.41 million+), the highest-earning group comprises the largest number of workers (44 %). Among married women, almost half of the sample is in the income groups directly affected by the tax reform.

Furthermore, although it is the husbands' after-tax incomes, not before-tax incomes, that would actually affect the wives' incomes, there is some concern about using after-tax incomes to control for the husbands' incomes when estimating the tax reform effect: If the husbands' after-tax incomes were used in the estimations, the change in the spousal exemption would also be reflected in the variable. This means that part of the tax reform effect would be captured by the husbands' incomes as well, despite our goal to only capture the impact using the treatment dummy variable. To circumvent this problem, the husbands' after-tax incomes that ignore the spousal exemptions were used in the regressions because this variable comes closer to the economically relevant variable in comparison with the before-tax incomes without introducing the problem stated above. The average value of this variable among married women is 4.84 million yen.

7 Results

7.1 DID Regression Results

Table 4 shows the results of the DID estimations for labor force participation, annual incomes, and work hours. The coefficient of interest pertains to the interaction term between the *treatment* and *after* dummy variables. The treatment group includes married women whose husbands are eligible for the spousal exemptions (i.e., married women who are not the head of the household and have husbands whose *total income* is 10 million yen or less annually). Single women and married women whose husbands are not eligible for the spousal exemptions are used as the control group.

Column 1 reports the probit estimation results using the overall sample including non-working women. The coefficient of the interaction term between the $treatment$ and $after$ dummy variables is insignificant, which suggests that there is no evidence that the tax reform increased labor force participation. This finding might reflect the noise in the regression as well as the possibility that the effect of the spousal exemption cut is too small for the reservation wage rate to be lower than the market wage rate.

The dependent variable in Columns 2-6 is annual income, while the dependent variable for the UQR (Columns 7 to 9) is the RIF of annual income.[21] The CQR of weekly work hours is also added to the table to strengthen the analyses of incomes. The explanatory variables include the treatment dummy, the husband's annual after-tax income that ignores the spousal exemptions, the number of children, age and its square, the tenure and its square, the unionized worker dummy variable, the permanent employee dummy variable, the logarithm of firm size, the educational dummy variables, and the industry dummy variables.[22]

Columns 2 and 3 present the results of the OLS regression and the fixed effects model, respectively. The OLS and the fixed effects estimates for the coefficient of the interaction term are both insignificant, which reflects the fact that they capture the mean impact of the tax reform; however, because only married women whose annual income was 1.03 million yen or less were directly affected by the tax reform, the mean impact estimated in the OLS and the fixed effects model using the overall sample may have missed the real impact of the tax reform on low-income married women.

To determine the heterogeneous impact of the tax reform across income groups, I conducted the same DID estimation by quantile. Column 4 in Table 4 reports the CQR estimates for women whose income is at the 30th quantile, showing that the coefficient of the interaction term is significantly positive at this quantile. These women belong to the lowest and second-lowest income groups, so the married women at this quantile are those directly affected by the tax reform. The

[21]The RIF for the τ th quantile can be computed as $q_\tau + \{\tau - 1(Y \leq q_\tau)\}/f_Y(q_\tau)$ by using the sample estimate of q_τ and the kernel density estimate of $f_Y(q_\tau)$ by using the Epanechnikov kernel.

[22]Table 4 reports the results without the hourly wage rate in X. Forty-three percent of the women in the sample are paid hourly, and hourly wage information is available only for this group. Fifty-one percent of the women in the sample are paid monthly, and the hourly wage for this group must be calculated by dividing the monthly salary by the number of hours worked per month as reported by the workers. This can create a measurement error in the explanatory variable. Thus, in the main analyses, I report the results without including the hourly wage rate; however, as confirmed in Table 2, the hourly wage rate was stable over this period for both married and single women. The sensitivity check that includes the hourly wage rate in X shows that the main results are preserved when the hourly wage rate is included.

CQR estimate shows that married women whose incomes are at the 30th quantile increased their annual incomes by 0.164 million yen.

In contrast, for higher quantiles, the coefficients of the interaction term are close to zero and insignificant. Because the results from the highest-income group, such as the 90th quantile, suffer from large standard errors and the results of interest are the policy impacts on low-income and medium- to high-income women, I report the results up to the 75th quantile. We can observe similar results for the UQR in Columns 7-9. The absence of any significant difference in the results for the interaction term between the CQR and the UQR reflects a uniform sign of the tax effect across workers' characteristics as discussed in the Appendix.

In Columns 10-12, the same regressions are conducted for weekly work hours, which again show significantly positive estimates for the coefficients of the interaction term for low quantiles and insignificant estimates for quantiles above the median. The CQR estimate of the interaction term indicates that the tax reform increased the weekly work hours of low-income married women by 3.589 hours. A simple calculation using the average hourly wage rate shows that this increase in work hours led to an income increase of approximately 0.16 million yen per year, which is consistent with the result of the income regression. I also ran a regression that included asset incomes and the polynomials of the husbands' incomes, and the main results were preserved even when these variables were included.

Note that the results presented in Table 4 are consistent with Proposition 1. In Table 4, the husbands' incomes and many other exogenous variables are controlled for, and it is implicitly assumed that the coefficients of these explanatory variables, with the exception of the treatment dummy, are the same before and after the tax reform. This corresponds to the case in which there is no change in the exogenous variables. Proposition 1 states that in such an environment, the tax reform had no impact on those who originally earned more than 1.03 million yen, while it increased work hours for married women who originally earned 1.03 million yen or less. This finding is demonstrated in Table 4.[23][24]

Figure 3 plots the coefficients for the interaction term between the *treatment* and *after* dummy variables obtained from the CQR for all quantiles. For the income distribution, the 43rd quantile corresponds to 1.03 million yen, thus the magnitude of the tax reform's effect drops near the income distribution's 43rd quantile.[25]

For the distribution of work hours, the magnitude of the coefficient peaks at around the 30th quantile and diminishes in higher quantiles. This finding reflects the fact that the proportion of married women with an income of 1.03 million yen or less peaks at around the 30th quantile of the work hours distribution and declines for higher quantiles.[26]

[23]An advantage of using a DID is that it allows for the removal of the effects of macro shocks, which are common to both treatment and control groups. If a shock that can affect the two groups unevenly occurs at the same time as the tax reform, then the estimated coefficient of the interaction term could be contaminated. Plotting several variables over the pre-treatment period to see if both the eligible married and remaining women faced similar trends beforehand would be a direct way to check the common trend assumption for the DID. However, since 2004 was the initial year of the survey, only year 2003 can serve as the pre-treatment period. Therefore, I implemented DIDs with different control groups: one constitutes only single women and the other constitutes both single and "non-eligible" married women. Due to limited space, I did not report the DID results for this sensitivity check, but I did obtain almost the same results from the two DIDs with different control groups. If the common trend assumption did not hold, the results from the two regressions should be different; thus I believe that the common trend assumption in this DID is satisfied.

[24]In general, there is a possibility that other tax reforms during the same period affect single and married women differently. The only possibility for this issue would be the impact of the Worker Dispatching Law, as it was revised in 2004 when the tax reform occurred. This revision might have affected dispatched workers in the sample. Fortunately, the fraction of dispatched workers in the sample is very small (only 2.5%), and there is no difference in the fractions of dispatched workers between the treatment and control groups. Thus, in this paper, I argue that the revision of this law affects married and single women equally, and that the problemdue to the revision of another lawis not a serious issue.

[25]The reason for the small tax reform effect at the 10th quantile is that the estimates at these extremely low quantiles are likely to be affected by special characteristics that are not captured by the explanatory variables. For example, these women may be members of very conservative households and would, therefore, have little incentive to work more hours even after the implementation of the tax reform. Note that both ends of the distribution are likely to include people who have special characteristics; thus, the standard errors of the interaction term's coefficient at the 10th quantile and at quantiles over the 70th are, indeed, very large. This finding demonstrates the importance of estimating the impact of the tax reform by quantile rather than estimating the mean impact in order to prevent the estimates from being contaminated by the imprecise estimates at extremely low or high quantiles.

[26]To take into account the difference in the husbands' tax rates, I also conducted a regression in which eligible married women whose husbands' tax rate is 20 % (10 %) are used as the treatment (control) group. Since the impact of spousal exemptions on the household budget line rises as the husbands' tax rate increases, the theory predicts that married women whose husbands' tax rate is higher will be affected by the tax reform more than those whose husbands' tax rate is lower. The estimates suggest that the magnitude of the tax reform effect is greater for those whose husbands' tax rate is higher. Thus, the DID estimation results support the theoretical predictions.

7.2 FFL Decomposition Results

The FFL decomposition results for the 25th, 50th, 60th, 70th, and 95th quantiles in the income distribution are reported in Table 5. The odd-numbered columns report the results of the decomposition without reweighting, while the even-numbered columns report the results of the reweighted regression decomposition in which $F(X)$ in 2003 is reweighted for the 2004-2006 period.

First, for both the decomposition without reweighting and the reweighted regression decomposition, the structure effects attributable to the treatment dummy at the 25th quantile are positive at the 10 % significance level. The results here are comparable with those from the DID estimation; the structure effect attributable to the treatment dummy in the FFL decomposition corresponds to the coefficient of the interaction dummy between the *treatment* and *after*the dummy variables in the DID regression. The FFL decomposition results for low-income women indicate that the increase in the coefficient of the treatment dummy, confirmed in Table 4, contributed to the increase in incomes among low-income women.[27]

Second, the composition effects attributable to the husbands' incomes are significantly negative among medium-to high-income women at the 50th and 60th quantiles. Proposition 2 states that some medium-to high-income married women greatly decreased their incomes after the tax reform (from 1.41 million yen or more to 1.03 million yen) in response to an increase in the husbands' incomes. In addition, Proposition 3 emphasizes that the discontinuous jump from 1.41 million yen or more to 1.03 million yen among these women is explained mainly by a large negative effect on the husbands' incomes.

To compare the magnitude of the husbands' income effect among all quantiles, Figure 4 plots

[27] The contribution of each covariate to the unexplained part may depend on arbitrary scaling decisions (Jones and Kelley 1984, Jann 2008). As a related issue, the unexplained part of the decomposition arbitrarily depends on the choice of reference groups when the indicator variables are included in the model (Jones 1983, Oaxaca and Ransom 1999, Firpo et al. 2010); however, identifying the magnitude of the structure effect attributable to the treatment dummy variable is not of interest in this study because the magnitude of the tax reform effect has already been estimated in the DID estimation. Instead, the main objective of using the FFL decomposition is to compare the statistical significance and relative magnitude of the composition effect attributable to the husbands' incomes across all quantiles. Note that the potential problems stated above do not arise when estimating the contribution of each covariate to the explained part (Jones 1983, Jones and Kelley 1984, Oaxaca and Ransom 1999, Jann 2008, Firpo et al. 2010). Thus, it is still meaningful to compare the statistical significance and the relative magnitude of the composition effect attributable to the husbands' incomes across all quantiles.

the composition effect attributable to the husbands' incomes in Table 5. In this illustration, we can see that the magnitude of the negative effect on the husbands' income peaks at around the 60th quantile. This result indicates that the discontinuous income jump among medium- to high-income married women may actually have occurred in response to an increase in the husbands' incomes because this income jump can be explained by a large negative effect on the husbands' income.

At quantiles over the 70th quantile in Table 5, the composition effects attributable to the husbands' incomes become smaller and insignificant. Figure 4 also indicates that the negative effect on the husbands' income ceases at these high quantiles. These results support the theoretical implication that the income jump did not occur for women whose preference for consumption is very strong. Furthermore, as suggested in Proposition 3, there is no quantile in which the tax reform effect is significantly negative.

7.3 DFL Decomposition Results

Lastly, I examine how these changes in optimal income decisions affected the overall income distribution of married women. Figure 5 depicts the DFL decomposition results for the income and work-hour distributions of married women. First, in the income distribution, by comparing the two "actual" distributions, we see that after the tax reform (i), the income distribution is less spread out and (ii) the low- and high-income married women gathered at the center of the distribution. In addition, if we examine the counterfactual distribution, the income distribution would have shifted to the left in response to the increase in the husbands' incomes during the *after* period without the tax reform.

Furthermore, the proportions of those who earned more than 2.5 million yen and between 1.41 million yen and 1.7 million yen decreased during the study period. This change can be explained by the gap between the actual *before* distribution and the counterfactual distribution, which indicates a composition effect. Among the composition effects at the 50th and 60th quantiles in the FFL decomposition, only the husband's income effect is significantly negative. Given that these quantiles correspond to 1.41 million yen and 1.7 million yen, respectively, the distributional change for incomes of 1.41 million yen to 1.7 million yen can be explained by the husband's income effect.

In contrast, for incomes below 1.03 million yen, a different trend is observed. In response to an increase in the husbands' incomes, the actual *before* distribution shifts to the left, namely to where the counterfactual distribution occurs; however, low-income married women were also affected by the tax reform; hence, the decline in their incomes was mitigated by the tax reform effect, which is captured by the gap between the actual *after* distribution and the counterfactual distribution. Similar trends are also observed for work-hour distribution.

Note that these results are closely related to tax salience, a new topic in taxation literature focusing on the behavioral aspect of the impact of taxation (Finkelstein 2009, Chetty et al. 2009): The tax reform made the conventional kink at 1.03 million yen in the budget line in the Japanese tax system more salient, changing the behavior of married women. In other words, increased awareness of the shape of the budget constraint, which was less visible under the previous tax regime, changed the behavior of middle- to high-income wives as well.

8 Conclusion

In 2004, the special spousal exemption was abolished for Japanese taxpayers whose spouses earned 1.03 million yen or less annually in an attempt to increase the labor supply of married women; however, both the average annual income and the average work hours slightly decreased among married women after the tax reform. During the same period, married men's incomes increased, which could have concealed the real impact of the reform. Hence, this paper estimated the actual reform effects by controlling for the trends in certain exogenous variables. Furthermore, as this impact could differ across income groups because of the existence of the tax exemption system, this study examined the income distribution rather than focusing on the mean impact.

The theoretical model presented herein shows that the tax reform caused the kink at 1.03 million yen in the household budget line to be more conspicuous. This suggested five implications, which were tested using empirical data derived from the KHPS for 2004-2006. I first examined how married women in each income group responded to the tax reform by using a DID estimation under a quantile regression framework. The results show that the effects of the tax reform on annual incomes and work hours were significantly positive at low quantiles, which confirms the importance of estimating the impact for each quantile rather than only at the mean level. In contrast, the tax reform effect for high-income women was small and insignificant, which is expected in a setting in which there is no change in the exogenous parameters.

To examine whether or not medium- to high-income married women actually decreased their incomes because of a large negative effect on the husbands' income (rather than the tax reform effect), I adopted the FFL technique, which enabled me to subdivide the structure and composition effects into the contributions of each individual covariate. The structure effect attributable to the treatment dummy was significantly positive for low quantiles, implying that the tax reform contributed to increasing incomes among low-income married women. Furthermore, the magnitude of the composition effect attributable to the husbands' incomes was greatest among medium- to high-income married women, which indicates that the discontinuous income jump among medium- to high-income married women in response to an increase in the husbands' incomes may have occurred because this income jump can be explained mainly by a large negative effect on the husbands' income. The results of the DFL decomposition also show that low- and high-income married women gathered at the center of the income distribution after 2004. Accordingly, the mass point at 1.03 million yen became more conspicuous after the tax reform.

Although the tax reform did contribute to increases in incomes among low-income married women, it also resulted in the kink at the 1.03 million yen threshold in the household budget line becoming more conspicuous, which made it a more attractive income choice than before. Owing to this change in the household budget line, the annual incomes of some medium- to high-income married women decreased to 1.03 million yen when they experienced the effects of both the tax reform and the increase in the husbands' incomes. As a result, the decrease in income caused by a large negative effect on the husband's income offset the increase in incomes among low-income women, which resulted in a slight decrease in the average income of married women. In summary, the important implications that can be derived from the presented findings are that although the tax reform contributed to increasing the labor supply of married women, it also made the conventional distortion at 1.03 million yen in the income distribution more conspicuous, which will remain the case as long as the spousal exemption exists in Japan.

Appendix

Proof of Proposition 1

Figure A.1a depicts the manner in which the tax reform affected the labor supply of married women who earned 1.03 million yen or less annually in a setting in which there was no change in the exogenous variables. If leisure is a normal good, married women who earned less than 0.7 million yen annually prior to 2004 worked more hours after the tax reform because of the positive income effect (i.e., people at point *A* in Figure A.1a will move to point *B* after the tax reform). Married women who earned between 0.7 and 1.03 million yen annually prior to 2004 also worked more hours after the tax reform because of the positive substitution effect (movement from point *C* to point *D*) and the positive income effect (movement from point *D* to point *E*).

In contrast, as Figure A.1b shows, for married women who earned more than 1.03 million yen annually, there was no change in their household budget line after the tax reform. Thus, the tax reform did not affect these women in the labor supply. Q.E.D.

Proof of Proposition 2a

Figure A.2a explains Proposition 2a graphically. The increase in the husbands' incomes makes households richer and shifts the household budget lines to the right.[28] As long as leisure is a

[28] At the same time, the husband's marginal tax rate might also increase for some households that experience an income rise. This increase will flatten the budget line for wives with annual incomes that are between 1.03 million yen and 1.41 million yen, which makes the kink at 1.03 million yen in the budget line more conspicuous. Thus, it is more likely that the income jump in Proposition 2 will be observed when we also consider a change in the husband's tax rate.

normal good, a wife decreases her work hours when a husband's income increases. Given an increase in a husband's income, a wife A −originally at point A− will decrease the number of work hours to point A' according to the income effect. In contrast, a wife B −originally at point B− will jump to point B' if her husband's income increases after the tax reform. Of these two types of wives, wife A has the stronger preference for consumption (i.e., her indifference curve is flatter at each value of leisure than wife B's curve).[29] I confirm that the case illustrated in Figure A.2a is possible by simulating wives' optimal income choices.

The *employment income deduction* can be formulated as $aY + b$, where Y is annual income. Let w be a wife's hourly wage, h be a wife's work hours, t_W be a wife's income tax rate, and t_H be a husband's income tax rate. Then, total household income, I_{HH}, is:

$$I_{HH} = wh - max\{0, [wh-(awh+b)-0.38]t_W\} + I_H - \{I_H - D - SE(h)\}t_H, \qquad \text{(A-1)}$$

where I_H represents the husband's annual income and D the income deductions the husband can claim other than the spousal exemption. Here, SE is the spousal exemption. Note that the wife's choice of work hours will affect the spousal exemption. Therefore, SE can be written as a function of a wife's work hours, h.[30]. In Equation (A-1), household income is calculated as the sum of the annual after-tax incomes of the wife and the husband. The term $(awh + b)$ represents the *employment income deduction*, while 0.38 represents the amount of the *basic deduction* (million yen/year). Since all employees are eligible for the *basic deduction* of 0.38 million yen and the *employment income deduction* of 0.65 million yen, income tax becomes non-zero when annual earnings exceed 1.03 million yen. In Equation (1), I assume that the tax credit is zero.[31][32]

The following four representative utility functions are used in the simulation:

[29] Here, a wife's preference for consumption is considered since it is assumed that a wife solves her utility maximization problem by taking her husband's income as given; however, considering this as the household's preference for the wife's consumption will not change the result. In other words, even in a case in which a wife's work pattern reflects her husband's preferences for this matter, the result would not change.

[30] The model setting here is the same as that in Takahashi et al. (2009)

[31] Since there is no tax credit that depends on the wife's work hours, this assumption does not change the result.

[32] Although residential tax, spousal allowances, and social security payments are not included in Equation (1), these will be considered in the simulations presented later in this section.

1. Cobb-Douglas; $u(c,l) = c^{\alpha} l^{(1-\alpha)} \quad 0 < \alpha < 1$

2. CES; $u(c,l) = \{\alpha c^{\rho} + (1-\alpha) l^{\rho}\}^{1/\rho} \quad \rho \neq 0,\ \rho < 1,\ 0 < \alpha < 1$

3. Power function (CRRA); $u(c,l) = \frac{c^{1-\gamma}}{1-\gamma} + \frac{l^{1-\gamma}}{1-\gamma} \quad \gamma > 0$

4. Stone-Geary; $u(c,l) = \gamma ln(c-A) + (1-\gamma) ln(l-B) \quad c > A,\ l > B$

I calculated the optimal income for attaining the highest utility for 100 different parameter values for each functional specification.[33] To simulate the effect on optimal income when a husband's income increases, a husband's income in the simulation rises from 5.2 million yen to 5.4 million yen, which are the average husbands' income levels in each period. The hourly wage and price of goods are fixed at 1,000 yen and 100 yen, respectively. In the calculation, social security payments, which include deciding among the three available social security categories such as residential tax, employer-provided spousal allowances, and the employment insurance premium, are also considered. Concerning these payments/allowances, the amounts specified in Figure A.3 are assumed. Table A.1 presents the percentages of the 100 simulated optimal incomes that belong to each income group before and after the tax reform. For example, when using the Cobb-Douglas utility function, a wife chose to earn 1.41 million yen or more before the tax reform and 1.03 million yen after the tax reform in only one out of 100 cases.

According to Table A.1, the majority of the income changes for the highest income group are made within the group (i.e., from point A to point A' in Figure A.2a); however, for all of the utility functions, women who earned 1.41 million yen or more before the tax reform decreased their incomes to 1.03 million yen after the tax reform (i.e., from point B to point B' in Figure A.2a). Q.E.D.

[33] α used in the Cobb-Douglas and CRRA functions and γ in the Stone-Geary function are uniformly spaced on [0.1]. For the CES function, α is fixed at 0.5 and ρ is uniformly spaced on [-0.5, 0.5] (a case with ρ=0 was omitted). Moreover, 1.95 million yen and 1 are used for the subsistence levels of consumption and leisure, respectively, in the Stone-Geary function, while 1.95 million yen was the livelihood assistance for a standard household that consisted of three members living in Tokyo in 2003.

Proof of Proposition 2b

Table A.2 shows the probability that married women in the highest income group decreased their incomes to 1.03 million yen after the tax reform, conditional on having originally been in the highest income group . Here, the number of parameter values with which the income jump occurs is divided by the total number of parameter values at annual incomes of 1.41 million yen or more prior to the tax reform. For example, as in the Cobb-Douglas case, when there is an increase in a husband's income of 0.2 million yen, the probability of the income jump occurring among high-income married women is calculated as 1/(1+40) by using the numbers presented in Table A.1. This calculation is useful in predicting how often the income jump occurred among people who originally earned 1.41 million yen or more. The numbers presented in Table A.2 specifically predict how the incomes of the people who originally earned 1.41 million yen or more were affected by the tax reform.

As confirmed in Table A.2, the greater the husband's income increases, the higher the probability of the income jump becomes. When the husband's income increase is only 0.1 million yen (≈USD 1,000), the income jump never occurs for most utility functions ; however, if the increase in a husband's income is greater than 0.1 million yen, the income jump occurs at a positive probability for all utility functions. Thus, the income jump stated in Proposition 2a occurs only when the increase in the husbands' incomes is sufficiently large.

Next, I show that these cases are possible only when the preference for consumption is not too strong . Figure A.2b shows how a wife's optimal income changes if the tax reform occurs and a husband's income increases. This figure reports the results with a sufficiently large increase in a husband's income (i.e., 2 million yen) in order to improve clarity. With the exception of the husbands' incomes after the tax reform, all parameters are set to be the same as those in Table A.1. The dots in Figure A.2b show the optimal income that attains the highest utility for each value of α (i.e., the preference for consumption) when we use a Cobb-Douglas utility function. It is clear from this figure that the higher the parameter value α, the higher the incomes are that people choose. Moreover, only individuals with an α value of 0.6 or higher earned 1.41 million yen or more before the tax reform. Thus, for a wife to have originally been in the high-income group, her preference for consumption had to be sufficiently strong.

By comparing the optimal incomes before the tax reform with those after the reform, we note that individuals with an α value of 0.6-0.65, namely those who originally earned 1.41 million yen or more a year, decreased their annual incomes to 1.03 million yen after the tax reform. These individuals correspond to "wife *B*" in Figure A.2a. Thus, there is a region in the domain of α in which the income jump occurs. In contrast, if the preference for consumption is too strong (α >0.65), the decrease in income is small enough that the income changes for the high-income group are made within the group (i.e., from point A to point A' in Figure A.2a). This finding suggests that the income jump is possible only when the preference for consumption is sufficiently strong, but not too strong. Q.E.D.

Proof of Proposition 3

Figure A.4a illustrates the husband's income and the tax reform effects. The long-dashed line represents the counterfactual budget line if the tax reform in 2004 had not been introduced. In Figure A.4a, a wife would have decreased her income from 1.41 million yen or more at point B to 0.7 million yen at point C if no tax reform had occurred in 2004. This movement from point B to point C can be thought of as a husband's income effect because this change was caused only by an increase in a husband's income; however, the tax reform actually occurred in 2004 as shown by the bold budget line in this figure. Thus, a wife that should have moved to point C actually moved to point B' when the tax reform occurred because point C was no longer available. This movement from point C to point B' can be thought of as a tax reform effect. Thus, the movement from point B to point B' is explained by a large negative effect on the husband's income and a small positive tax reform effect, which implies that the decrease in income among medium- to high-income married women in response to an increase in a husband's income was slightly mitigated by the tax reform.

This can be confirmed by simulating the wives' optimal income choices with four representative utility functions. In Table A.3, the parenthesized numbers represent the counterfactual realizations of the optimal income (i.e., the percentages of the 100 simulated optimal incomes had the tax reform not occurred). These settings are the same as those presented in Figure A.2b. According to the results of the Cobb-Douglas utility function, in six cases out of 100, a wife who earned 1.41 million yen or more before the tax reform decreased her income to 1.03 million yen after the reform. In contrast, the counterfactual realizations of optimal income show that these six cases would have appeared as income jumps from the 1.41 million yen or more group to the 0.7-1.03 million yen group if the tax reform had not happened. In other words, if the income earned by a married woman decreased from 1.41 million yen or more to 1.03 million yen after the tax reform, her income would have decreased even further (to 0.7 million yen) without it, which is represented by the kink that existed prior to the reform. Similar results can be observed for the other preferences .[34]

Given these results, we could conclude that the effect of the tax reform was positive in all cases; however, when we consider a small increase in a husband's income, there are also cases in which a negative effect on the husband's income t is the only explanation for the income jump (i.e., cases in which the tax reform effect is zero). In Table A.3, although a sufficiently large increase in the husbands' incomes of 2 million yen is considered, if the increase in husbands' incomes is as small as the income shown in Table A.1, the tax reform effect is zero in some cases, namely the counterfactual realizations that appear in the same cell as the actual realizations.

We can at least state that the tax reform cannot be negative in any case, as confirmed in Figure A.4b. Since both B' and C in Figure A.4b are available both after the reform and the counterfactual budget lines, a wife who would choose point C in the former would never choose point B' on the

[34]Note that the kink at 1.03 million yen in the household budget line is more conspicuous when we assume a higher hourly wage rate. This kink is caused by the difference in the slopes of the budget line between the 0.7-1.03 million yen and 1.03-1.41 million yen income categories. The difference in the slopes $w\{(1-a)t_W - t_H\}$ grows as the hourly wage rate w increases. Thus, the income jump is more likely when we assume a higher hourly wage rate. In the current simulation, a rounded version of the average hourly wage rate among hourly-paid married women (i.e., 1,000 yen) is used for simplicity; however, even when we adopt the actual average hourly wage rate (881 yen) of hourly-paid workers, the number of cases in which this income jump occurs does not change. Similarly, when we adopt the median hourly wage rate among hourly-paid workers (i.e., 800 yen), the number of income jump cases only decreases by one for each utility function in Table A.3. In contrast, when we adopt a higher wage rate (e.g., 1,342 yen, which is the average hourly wage rate among all married women for all payment types), the number of income jump cases increases by one for some of the utility functions.

latter after the tax reform because point C is always preferable to point B'. Thus, there is no case in which married women face a negative tax reform effect (a movement from C to B'). In other words, as long as the after-tax and counterfactual budget lines overlap in the region of more than 1.03 million yen, it is impossible for a wife who would choose point C on the latter to choose point B' on the former after the tax reform. Therefore, if a married woman greatly decreased her income from 1.41 million yen or more to 1.03 million yen after the tax reform, she would have made the same decision even without the introduction of the tax reform, or she would have decreased her income further to 0.7 million yen. Q.E.D.

CQR vs. UQR

Firpo et al. (2009) showed that the UQR estimates can be represented as a weighted average of CQR estimates. For example, when estimating the effect of unions on wages, the CQR estimate is found to be negative for highly skilled workers (with high educational attainment and extensive labor market experience) and positive for other workers. Suppose that the explanatory variables other than the union status include only the workers' skill level (highly skilled or otherwise) and that the number of highly skilled workers is small. In CQR, wage distributions conditional on skill level are used. The union effects are first estimated separately for the highly skilled workers and for other workers, and then the CQR estimate of the union effect is calculated as the weighted average of the union effects (β) conditional on each skill level, i.e., $E_Z[\beta/Z]$, where Z represents a worker's skill. Therefore, as long as the number of highly skilled workers is smaller than that of other workers, the negative union effects on skilled workers are averaged away by the positive effects on the majority of workers. As a result, the union effects are estimated to be positive for all quantiles in CQR.

In contrast, in UQR, the unconditional distribution is used, and the fraction of highly skilled workers varies by quantile, while it is fixed across quantiles in CQR. Thus, in UQR, at high quantiles of (unconditional) wage distribution that mainly consist of highly skilled workers in the sample, more weight is placed on highly skilled workers. As a result, the UQR estimates of union effect on wages become negative for high quantiles of wage distribution (Firpo et al. 2009).

However, in the context of the tax reform effect in this paper, there is no possibility that the sign of the estimate for the tax-reform effect varies by workers' attributes, although the magnitude of the effect might vary with differences in worker attributes. Thus, it is hard to expect a case in which there is a significant gap between CQR estimates and UQR estimates.

Figure A.5 illustrates what is estimated in the CQR regression. Suppose T is the treatment dummy and Z represents other covariates. The distribution at the left-hand side is the income distribution of the control group conditioning on attributes Z. In Figure A.5, it is assumed for simplicity that there is no change in the income distribution of the control group during the period 2003-2006. The dashed and bold lines at the right-hand side represent the income distributions of the treatment group before and after the tax reform, respectively. $Y_{\tau/T=1,Z}$ represents income at the τ quantile of the income distribution for the treatment group with workers' attributes Z, while $Y_{\tau/T=0,Z}$ represents income at the τ quantile of the income distribution for the control group with Z. The slope of the straight dotted line that connects incomes at the τ quantile of each of the two distributions represents the CQR estimates for the coefficient of the treatment dummy ($\beta_2^{\tau,CQR}$), which is calculated as $\beta_2^{\tau,CQR} = Y_{\tau/T=1,Z} - Y_{\tau/T=0,Z}$. The figure shows an example in which the dotted line rotates around $Y_{0.2/T=0,Z}$ in response to an increase in income among low-income workers in the treatment group, and the slope becomes flatter after the tax reform. Then, the change in the slope, i.e., the gap in the slope between the two dotted lines, represents the magnitude of the interaction term between *treatment* and *after* dummy variables, i.e., $\beta_3^{\tau,CQR}$. In this way, it is expected that the coefficient of the treatment dummy variable, which is originally negative, becomes smaller negative or even positive at low quantiles after the tax reform, in response to the increase in incomes among low-income workers in the treatment group.

Whether we should use CQR or UQR depends upon what we want to know. As is indicated in Figure A.5, since the CQR estimates capture the changes in distribution conditional on X, it will help us to understand the within-group effect of the tax reform. The UQR estimate captures the between-group effect as well as the within-group effect. The UQR estimate might be helpful when we estimate the counterfactual impact of expanding the eligibility of the spousal exemption because it captures the direct impact of increasing the proportion of the treatment group. In general, when an explanatory variable of interest, X, is binary, the coefficient of X from a UQR becomes equal to the effect of increasing the proportion of people with $X{=}1$ on the τ quantile of the distribution (i.e., $\beta_\tau = dq_\tau/dPr[X{=}1]\ \forall\tau$). This holds for all quantiles in a UQR, while in a CQR, it holds only for the mean (Firpo et al. 2009). In the context of the model presented above, the coefficient of the treatment dummy from the UQR is equal to the effect of increasing the proportion of the treatment group on the τ quantile in the income distribution.

Figure A.6 is presented to depict the interpretation of the UQR estimate. In Figure A.6, we see how the income distribution moves after increasing the proportion of the treatment group by one unit. Suppose that before the tax reform, when we increase the proportion of the treatment group by one unit, income at the 20th quantile of the distribution shifts from $Y_{t=0}^{0.2}$ to $Y_{t=0}^{0.2\prime}$. Then $Y_{t=0}^{0.2\prime} - Y_{t=0}^{0.2}$ represents β_2 for the 20th quantile before the tax reform, i.e., $\beta_{2,t=0}^{0.2}$. Similarly, if income at the 20th quantile of the distribution shifts from $Y_{t=1}^{0.2}$ to $Y_{t=1}^{0.2\prime}$ after the tax reform in response to the increase in the proportion of the treatment group, $Y_{t=1}^{0.2\prime} - Y_{t=1}^{0.2}$ represents β_2 for the 20th quantile after the tax reform, i.e., $\beta_{2,t=1}^{0.2}$. Then, the difference in $\beta_2^{0.2}$ between before and after the tax reform corresponds to $\beta_3^{0.2}$. Details regarding unconditional quantile regression are presented in Firpo et al. (2009).[35]

Basics of FFL Decomposition

Conceptually, the influence function (IF) represents the influence of increasing an individual observation on the distributional statistic, such as means, variances, quantiles, and Gini coefficients. For the τth quantile, the influence function $IF(Y;q_\tau,F_Y)$ is known to be equal to $\{\tau - 1(Y \leq q_\tau)\}/f_Y(q_\tau)$. The IF gives us a way to explore how changes in the distribution of Y affect q_τ. The goal here is to compute the effect of changing X on quantiles. The process leading up to this goal is divided into two steps: (1) changes in $X\rightarrow$changes in the distribution of Y and (2) changes

[35] In Figure A.6, the two figures are placed vertically to compare the magnitudes of $\beta_2^{0.2}$ and to show $\beta_3^{0.2}$ as the difference between the two $\beta_2^{0.2}$ values. However, this does not mean that $Y_{t=0}^{0.2} = Y_{t=1}^{0.2}$ holds.

in the distribution of $Y \rightarrow$changes in q_τ. The IF only does step two. To connect steps one and two, we need the Law of Iterated Expectations (LIE). To utilize the LIE, we need the recentered version of the IF, i.e.,RIF, which is simply equal to $q_\tau + IF(Y; q_\tau, F_Y)$. The RIF has a very convenient feature in that its expectation is equal to its distributional statistics (in our case, q_τ):

$$q_\tau = E[RIF] = E_X(E[RIF/X]) \tag{A-2}$$

Then, using the LIE, the distributional statistic can also be expressed in terms of the expectations of the conditional RIF −i.e., a function of X. Thus, by using the RIF, step one can be connected to step one. The details about this process can be found in work by Firpo et al. (2007, 2010).

The counterfactual distribution in FFL is calculated by DiNardo et al. (1996) method using the following reweighting term:

$$\begin{aligned} \omega = \frac{h(X/t \geq 2004)}{h(X/t = 2003)} &= \frac{P(t \geq 2004/X)P(X)/P(t \geq 2004)}{P(t = 2003/X)P(X)/P(t = 2003)} \\ &= \frac{P(t \geq 2004/X)P(t = 2003)}{P(t = 2003/X)P(t \geq 2004)} \end{aligned} \tag{A-3}$$

where the density $h(X/t = T)$ is the p.d.f. of attributes in year T. The second equation is derived from Bayes' rule. In the actual regression of ω, $P(t = T/X)$ can be calculated using propensity scores obtained from the probit model in which $P(t = T)$ is regressed on X, and $P(t = T)$ is calculated as the proportion of the observations from year T in the pooled data.

In Section 7.2, I will report both results without reweighting, i.e., the classic OB decomposition, and results with reweighting. For the latter, the following different pooled samples are used to obtain the composition and the structure effects.

- Estimation 1: Reweighted regression with a pooled sample of X_{03} and$X_{C,04}$: (Only the composition-effect part ($(\overline{X}_{C,04} - \overline{X}_{03})'\beta^{\tau}_{C,03}$) is used)

$$\begin{aligned}
&\overline{X}'_{C,04}\beta^{\tau}_{C,03} - \overline{X}'_{03}\beta^{\tau}_{03} \\
&\quad = \overline{X}'_{C,04}(\beta^{\tau}_{C,03} - \beta^{\tau}_{03}) + (\overline{X}_{C,04} - \overline{X}_{03})'\beta^{\tau}_{03} \\
&or \;\; = \overline{X}'_{03}(\beta^{\tau}_{C,03} - \beta^{\tau}_{03}) + (\overline{X}_{C,04} - \overline{X}_{03})'\beta^{\tau}_{C,03}
\end{aligned} \tag{A-4}$$

- Estimation 2: Reweighted regression with a pooled sample of $X_{C,04}$ andX_{04}: (Only the structure-effect part ($\overline{X}'_{C,04}(\beta^{\tau}_{04} - \beta^{\tau}_{C,03})$) is used)

$$\begin{aligned}
&\overline{X}'_{04}\beta^{\tau}_{04} - \overline{X}'_{C,04}\beta^{\tau}_{C,03} \\
&\quad = \overline{X}'_{04}(\beta^{\tau}_{04} - \beta^{\tau}_{C,03}) + (\overline{X}_{04} - \overline{X}_{C,04})'\beta^{\tau}_{C,03} \\
&or \;\; = \overline{X}'_{C,04}(\beta^{\tau}_{04} - \beta^{\tau}_{C,03}) + (\overline{X}_{04} - \overline{X}_{C,04})'\beta^{\tau}_{04}
\end{aligned} \tag{A-5}$$

where $X_{C,04}$ is the counterfactual 2004-2006 distribution of X obtained from the reweighting method, and $\beta^{\tau}_{C,03}$ is the counterfactual values of the coefficients for the τth quantile. In calculating $X_{C,04}$, the 2003 sample is reweighted to mimic the 2004-2006 sample using the reweighting term defined in Equation (A-3), which means that we should have $plim(X_{C,04}) = plim(X_{04})$. The dependent variable used to obtain $\beta^{\tau}_{C,03}$ is the RIF of Y in 2003, thus the counterfactual values of the coefficients can be thought of as coefficients that would be realized if the determinant structure of Y stayed the same from 2003 to 2004-2006. The composition effect from Estimation 1 and the structure effect from Estimation 2 are used in the FFL decomposition.

Counterfactual values of the coefficients are used here because the difference in the coefficients between the two periods in the classic OB decomposition may be contaminated by differences in the distribution of X between the two years. In the FFL decomposition with reweighting, the (asymptotically) same X is used for the two periods to estimate the structure effect, and hence the difference in β^{τ} should not be contaminated by the difference in the distribution of X.

References

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 (2), 120–134, in Japanese.

Akabayashi, H., 2006. The labor supply of married women and spousal tax deductions in Japan. Review of Economics of the Household 4 (4), 349–378.

Apps, P. F., Kabatek, J., Rees, R., Soest, A. V., 2012. Labor supply heterogeneity and demand for child care of mothers with young children. Netspar Discussion Paper 04/2012-015.

Bitler, M., Gelbach, J., Hoynes, H., 2006. What mean impacts miss: Distributional effects of welfare reform experiments. American Economic Review 96 (4), 988–1012.

Blundell, R., Duncan, A., Meghir, C., 1998. Estimating labour supply responses using tax reforms. Econometrica 66 (4), 827–861.

Cabinet Office, Government of Japan, 2001. The opinion survey on employment system 2001. In Japanese.

Chetty, R., Looney, A., Kroft, K., 2009. Salience and taxation: Theory and evidence. American Economic Review 99 (4), 1145–1177.

Chiappori, P. A., 1988. Rational household labor supply. Econometrica 56 (12), 63–90.

Chiappori, P. A., 1992. Collective labor supply and welfare. Journal of Political Economy 100 (3), 437–467.

DiNardo, J. E., Fortin, N. M., Lemieux, T., 1996. Labor market institutions and the distribution of wages, 19731992: a semiparametric approach. Econometrica 64 (5), 1001–1044.

Donni, O., Moreau, N., 2007. Collective labor supply: A single-equation model and some evidence from French data. Journal of Human Resources 42 (1), 214–246.

Eissa, N., Liebman, J. B., 1996. Labor supply response to the earned income tax credit. Quarterly Journal of Economics 111 (2), 605–637.

Feldstein, M., 1995. The effects of marginal tax rates on taxable income: a panel study of the 1986 tax reform act. The Journal of Political Economy 103 (3), 551–572.

Finkelstein, A., 2009. E-ztax: Tax salience and tax rates. Quarterly Journal of Economics 124 (3), 969–1010.

Firpo, S., Fortin, N. M., Lemieux, T., 2007. Decomposing wage distributions using recentered influence functions regressions. Tech. rep., University of British Columbia, mimeo.

Firpo, S., Fortin, N. M., Lemieux, T., 2009. Unconditional quantile regressions. Econometrica 77 (3), 953–973.

Firpo, S., Fortin, N. M., Lemieux, T., 2010. Decomposition methods in economics. NBER Working Paper Series 16045.

Higuchi, Y., 1995. Sengyo shufu hogoseisaku no keizaiteki kiketsu. Nihon Keizai Shinbun Sha, in Japanese.

Hyslop, D., 1999. State dependence, serial correlation and heterogeneity in intertemporal labor force participation of married women. Econometrica 67 (6), 1255–1294.

Jann, B., 2008. The Blinder-Oaxaca decomposition for linear regression models. The Stata Journal 8 (4), 453–479.

Jones, F. L., 1983. On decomposing the wage gap: A critical comment on Blinder's method. Journal of Human Resources 18 (1), 126–130.

Jones, F. L., Kelley, J., 1984. Decomposing dierences between groups—a cautionary note on measuring discrimination. Sociological Methods and Research 12 (3), 323–343.

Kantani, T., 1997. Josei roudou no tayouka to kadai. Financial Review, 29–49In Japanese.

Killingsworth, M. R., 1983. Labor supply. Cambridge University Press.

Kuroda, S., Yamamoto, I., 2008. Estimating Frisch labor supply elasticity in Japan. Journal of the Japanese and International Economies 22 (4), 566–585.

Meghir, C., Phillips, D., 2008. Labour supply and taxes. IZA Working Paper (3405).

Mincer, J., 1962. Labor force participation of married women. In: Aspects of Labor Economics. Princeton University Press, pp. 63–106.

Ministry of Health, Labor, and Welfare, Government of Japan, 2003. Survey on national health insurance 2003. In Japanese.

Nishikawa, M., 2002. A study on labour supply and work hours of married couples results from the jgss-2000. The University of Tokyo, Instirute of Social Science, ISS Documents 20, 33–44.

Oaxaca, R. L., Ransom, M. R., 1999. Identification in detailed wage decompositions. The Review of Economics and Statistics 81 (1), 154–157.

Oishi, A., 2003. Yu haigu sha josei no roudou kyoukyuu to zeisei shakai hoshou seido. Kikan Shakai Hoshou Kenkyu 39 (3), 286–305, in Japanese.

Sakata, K., McKenzie, C. R., 2005. The impact of the tax reform in 2004 on the female labour supply in Japan. MODSIM 2005 International Congress on Modelling and Simulation.

Sakata, K., McKenzie, C. R., 2006. Haigusha tokubetsu koujo no haishi ha yuhaigu josei no rodo kyokyu wo sokushin shitaka. In: Higuchi, Y. (Ed.), Nihon no Kakei Kodo no Dynamism. Vol. 2. Keio University Press, in Japanese.

Takahashi, S., 2010a. 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 (12), 28–43, in Japanese.

Takahashi, S., 2010b. A structural estimation of the effects of spousal tax deduction and social security system on the labor supply of Japanese married women. A paper presented at the Tokyo Labor Economics Seminar on May 28, 2010.

Takahashi, S., Kawade, M., Kato, R. R., 2009. Labor supply of Japanese married women, sensitivity analysis and a new estimate. Gsir working papers, International University of Japan, economic Analysis and Policy Series.

Table 1: Spousal Exemptions of Income Tax and Residential Tax (Unit: Million Yen)

Spouse's Annual Earnings	Standard Spousal Exemption Amount	Special Spousal Exemption Amount		Total Spousal Exemption Amount	
	No Change	Before	After	Before	After
∼0.699..	0.38 (0.33)	0.38 (0.33)	0.00 (0.00)	0.76 (0.66)	0.38 (0.33)
0.70∼0.749..	0.38 (0.33)	0.33 (0.33)	0.00 (0.00)	0.71 (0.66)	0.38 (0.33)
0.75∼0.799..	0.38 (0.33)	0.28 (0.28)	0.00 (0.00)	0.66 (0.61)	0.38 (0.33)
0.80∼0.849..	0.38 (0.33)	0.23 (0.23)	0.00 (0.00)	0.61 (0.56)	0.38 (0.33)
0.85∼0.899..	0.38 (0.33)	0.18 (0.18)	0.00 (0.00)	0.56 (0.51)	0.38 (0.33)
0.90∼0.949..	0.38 (0.33)	0.13 (0.13)	0.00 (0.00)	0.51 (0.46)	0.38 (0.33)
0.95∼0.999..	0.38 (0.33)	0.08 (0.08)	0.00 (0.00)	0.46 (0.41)	0.38 (0.33)
1.00∼1.03	0.38 (0.33)	0.03 (0.03)	0.00 (0.00)	0.41 (0.36)	0.38 (0.33)
1.030..∼1.049..	0.00 (0.00)	0.38 (0.33)	0.38 (0.33)	0.38 (0.33)	0.38 (0.33)
1.05∼1.099..	0.00 (0.00)	0.36 (0.33)	0.36 (0.33)	0.36 (0.33)	0.36 (0.33)
1.10∼1.149..	0.00 (0.00)	0.31 (0.31)	0.31 (0.31)	0.31 (0.31)	0.31 (0.31)
1.15∼1.199..	0.00 (0.00)	0.26 (0.26)	0.26 (0.26)	0.26 (0.26)	0.26 (0.26)
1.20∼1.249..	0.00 (0.00)	0.21 (0.21)	0.21 (0.21)	0.21 (0.21)	0.21 (0.21)
1.25∼1.299..	0.00 (0.00)	0.16 (0.16)	0.16 (0.16)	0.16 (0.16)	0.16 (0.16)
1.30∼1.349..	0.00 (0.00)	0.11 (0.11)	0.11 (0.11)	0.11 (0.11)	0.11 (0.11)
1.35∼1.399..	0.00 (0.00)	0.06 (0.06)	0.06 (0.06)	0.06 (0.06)	0.06 (0.06)
1.40∼1.409..	0.00 (0.00)	0.03 (0.03)	0.03 (0.03)	0.03 (0.03)	0.03 (0.03)
1.41∼	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)

Note: Table 1 shows the spousal exemptions that apply to different levels of the spouse's annual earnings. The un-parenthesized numbers represent the income tax spousal exemptions and the parenthesized numbers represent the residential tax spousal exemptions. The schedule in this table is applicable only to employees. The schedule applicable to all workers is defined by *total income*, not by total earnings, which are calculated as total earnings minus the *employment income deduction* for employees and total earnings minus the necessary expenses for other workers.

Table 2: Japanese Labor Market Trends between 2003 and 2006

	Before(2003)	After(2004-2006)	Difference
Unemployment Rate (%)	5.30 (2003)	4.10 (2006)	-1.20
Married Women			
Weekly Work Hours	30.37	28.67	-1.69
	(19.11)	(15.93)	(0.54)
Annual Income (million yen)	1.84	1.78	-0.06
	(1.92)	(1.76)	(0.04)
Husband's Annual Income (million yen)	5.23	5.36	0.13
	(3.32)	(3.23)	(0.04)
Hourly Wage Rate (100 yen)	8.81	8.95	0.14
	(8.64)	(8.61)	(0.09)
Single Women			
Weekly Work Hours	36.18	37.46	1.28
	(18.38)	(17.56)	(1.33)
Annual Income (million yen)	2.13	2.25	0.11
	(1.40)	(1.44)	(0.06)
Hourly Wage Rate (100 yen)	9.34	9.55	0.21
	(2.66)	(2.34)	(0.29)

Note: The unemployment rate is obtained from the Statistics Bureau. The other statistics are calculated from the KHPSs 2004-2007. Standard deviations are in parentheses. The sample comprises the 2,896 women who reported information for both the pre- and the post-2004 tax reform periods. The statistics for the post-reform period are calculated as the average of the three years immediately following the tax reform. The statistics for weekly work hours, hourly wage rate, and annual income are obtained from sample participants who worked at least one hour during each period. The average husbands' annual income is obtained from all the married women in the sample. The hourly wage rate of hourly-paid workers is reported in the table because only hourly wage information is available for this group.

Table 3: Descriptive Statistics

	All Women	Private Sector Employees		
	(Sample for the Probit Model)	All	Married Women	Single Women
Hours of Work (per week)	17.98	30.87	28.82	37.73
	(20.89)	(16.98)	(16.53)	(16.65)
Before-Tax Income	1.03	1.78	1.65	2.20
(million yen/year)	(1.60)	(1.52)	(1.53)	(1.40)
Husband's After-Tax Income	4.00	3.72	4.84	0.00
(million yen/year)	(3.14)	(2.99)	(2.49)	0.00
Age	48.15	44.22	46.32	37.25
	(12.86)	(11.31)	(9.78)	(13.14)
Tenure	10.04	7.03	7.50	5.44
	(10.58)	(7.62)	(7.86)	(6.56)
Number of Children	1.37	1.41	1.68	0.54
	(1.08)	(1.10)	(1.00)	(0.95)
Firm Size	149.82	233.80	229.91	246.78
	(181.84)	(197.40)	(197.18)	(197.71)
Dummy Variables				
Married	0.84	0.77	1.00	0.00
Working	0.55	1.00	1.00	1.00
Employee	0.41	1.00	1.00	1.00
Private Sector Employee	0.37	1.00	1.00	1.00
Permanent Employee	0.29	0.59	0.57	0.68
Unionized Worker	0.07	0.14	0.12	0.17
Education Dummy Variables				
Junior High School	0.11	0.06	0.07	0.03
High School	0.55	0.57	0.60	0.46
Junior College	0.22	0.24	0.23	0.28
University	0.12	0.13	0.10	0.22
Income Dummy Variables				
Income$<$0.7	0.54	0.19	0.22	0.11
0.7$\leq$Income$\leq$1.03	0.14	0.25	0.30	0.10
1.03$<$Income$<$1.41	0.06	0.11	0.11	0.11
1.41$\leq$Income	0.27	0.44	0.37	0.68
Observations	10976	3206	2466	740

Note: The first column reports the descriptive statistics for the probit regression, while the descriptive statistics for employees represent those of the sample used in the main analyses. Husbands' after-tax incomes that ignore the spousal exemptions are used for husbands' incomes. All earnings data are corrected for inflation (i.e., real earnings, calculated as nominal earnings divided by the consumer price index (CPI) of each year are reported for women's (before-tax) annual incomes and husbands' (after-tax) annual incomes that ignore the spousal exemptions.) The CPI of each year is 1, 1, 0.997, and 1 for 2003, 2004, 2005, and 2006, respectively. (The base CPI is that of 2003.) The husbands' incomes for single women for single women is treated as zero and included in the sample. For this reason, the average value of the husbands' incomes is low for the sample that consists of both married women and single women.

Table 4: DID Estimation: Effects of the Tax Reform on Labor Supply

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent Variable	Work=1	Annual Income (Million Yen)					RIF of Annual Income			Weekly Hours		
Quantile		Mean		30th	60th	75th	30th	60th	75th	30th	60th	75th
	Probit	OLS	FE	CQR			UQR			CQR		
Treatment	-0.334	-0.667	-0.366	-0.475	-0.464	-0.526	-0.291	-0.783	-0.719	-7.291	-4.801	-5.177
	(0.061)	(0.172)	(0.306)	(0.069)	(0.075)	(0.098)	(0.060)	(0.138)	(0.226)	(1.362)	(1.380)	(1.194)
After	0.129	-0.028	-	-0.138	-0.038	-0.069	-0.090	-0.068	0.011	-1.480	0.190	-1.019
	(0.052)	(0.090)		(0.064)	(0.069)	(0.089)	(0.045)	(0.119)	(0.189)	(1.257)	(1.267)	(1.094)
Treatment·After	-0.021	0.073	0.038	0.164	0.074	0.092	0.154	0.134	0.009	3.589	0.726	1.397
	(0.059)	(0.101)	(0.034)	(0.075)	(0.081)	(0.104)	(0.056)	(0.136)	(0.211)	(1.470)	(1.480)	(1.280)
Husband's Income	-0.053	0.036	0.198	-0.037	-0.032	-0.019	-0.031	-0.068	-0.021	-0.874	-0.811	-0.693
(million yen/year)	(0.008)	(0.037)	(0.127)	(0.006)	(0.007)	(0.009)	(0.007)	(0.019)	(0.025)	(0.122)	(0.131)	(0.120)
Number of Children	-0.034	-0.152	-0.123	-0.067	-0.135	-0.162	-0.034	-0.199	-0.346	-0.873	-0.657	-0.594
	(0.020)	(0.033)	(0.070)	(0.017)	(0.018)	(0.025)	(0.020)	(0.050)	(0.063)	(0.335)	(0.332)	(0.297)
Age	0.191	0.081	-	0.072	0.100	0.110	0.024	0.096	0.193	0.335	0.153	-0.111
	(0.013)	(0.025)		(0.012)	(0.012)	(0.016)	(0.013)	(0.033)	(0.045)	(0.231)	(0.227)	(0.197)
$Age^2/100$	-0.221	-0.104	-	-0.090	-0.125	-0.136	-0.032	-0.135	-0.251	-0.525	-0.285	0.073
	(0.014)	(0.028)		(0.013)	(0.014)	(0.017)	(0.015)	(0.037)	(0.050)	(0.259)	(0.251)	(0.216)
Tenure	-	0.085	0.078	0.069	0.066	0.068	0.063	0.142	0.183	0.666	0.612	0.590
		(0.016)	(0.019)	(0.005)	(0.006)	(0.008)	(0.006)	(0.016)	(0.021)	(0.106)	(0.107)	(0.094)
$Tenure^2/100$	-	0.009	-0.229	-0.054	0.119	0.148	-0.134	-0.197	-0.141	-0.790	-0.649	-0.705
		(0.065)	(0.086)	(0.018)	(0.020)	(0.027)	(0.022)	(0.053)	(0.073)	(0.357)	(0.359)	(0.321)
Unionized Worker	-	0.566	0.153	0.415	0.583	0.573	0.126	0.636	0.963	3.867	0.298	0.415
		(0.101)	(0.079)	(0.049)	(0.050)	(0.064)	(0.041)	(0.125)	(0.182)	(0.925)	(0.933)	(0.814)
Permanent Employee	-	0.614	0.133	0.302	0.424	0.530	0.069	0.640	1.123	5.319	5.660	5.241
		(0.062)	(0.057)	(0.033)	(0.034)	(0.044)	(0.035)	(0.084)	(0.105)	(0.650)	(0.635)	(0.560)
ln (Firm Size)	-	0.072	0.008	0.037	0.066	0.056	0.022	0.027	0.074	0.696	0.489	0.323
		(0.020)	(0.017)	(0.011)	(0.012)	(0.015)	(0.012)	(0.028)	(0.038)	(0.218)	(0.213)	(0.184)
Education	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.083	0.409	0.137	0.160	0.294	0.335	0.189	0.349	0.373	0.151	0.163	0.109
Observations	10976	3206	3206	3206	3206	3206	3206	3206	3206	3206	3206	3206

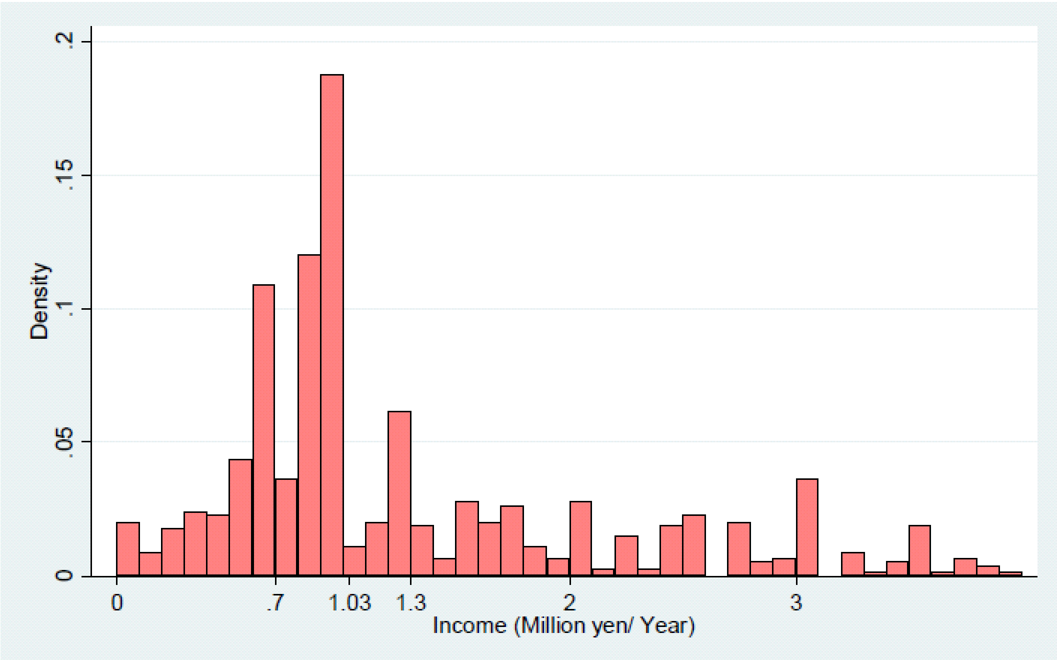
Note: FE stands for the fixed effects model. Marginal effects are reported in Column 1. Standard errors are in parentheses. The probit, OLS, and UQR standard errors are clustered at the individual level. A constant term is also included. Husbands' after-tax incomes that ignore the spousal exemptions are used for husbands' incomes. The treatment group comprises married women whose husbands are eligible for the spousal exemptions (i.e., married women who are not the head of the household and have husbands whose total income is 10 million yen or less per year). Single women and married women whose husbands are not eligible for the spousal exemptions are used as the control group.

Table 5: FFL Decomposition Results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Reweighting	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Quantile	25th		50th		60th		70th		95th	
Total Change:	0.0002	-	-0.0106	-	-0.0072	-	-0.0616	-	-0.0544	-
	(0.0275)		(0.0354)		(0.0708)		(0.0857)		(0.1686)	
Composition Effects:										
Treatment	-0.0027	-0.0023	-0.0040	-0.0035	-0.0041	-0.0036	-0.0045	-0.0039	-0.0046	-0.0040
	(0.0033)	(0.0014)	(0.0050)	(0.0020)	(0.0055)	(0.0027)	(0.0062)	(0.0032)	(0.0096)	(0.0073)
Husband's Income	-0.0026	-0.0027	-0.0115	-0.0118	-0.0169	-0.0165	-0.0055	-0.0049	0.0202	0.0244
	(0.0026)	(0.0024)	(0.0058)	(0.0035)	(0.0093)	(0.0060)	(0.0073)	(0.0066)	(0.0200)	(0.0159)
Other	0.0047	0.0072	0.0025	0.0054	-0.0144	-0.0099	-0.0168	-0.0136	-0.0169	-0.0064
	(0.0125)	(0.0082)	(0.0207)	(0.0116)	(0.0437)	(0.0230)	(0.0542)	(0.0287)	(0.1102)	(0.0553)
Total	-0.0006	0.0021	-0.0131	-0.0098	-0.0354	-0.0300	-0.0268	-0.0224	-0.0013	0.0140
	(0.0130)	(0.0081)	(0.0225)	(0.0116)	(0.0453)	(0.0227)	(0.0544)	(0.0276)	(0.1106)	(0.0531)
Structure Effects:										
Treatment	0.1442	0.1785	0.1272	0.1189	-0.0996	-0.0063	-0.0521	0.0845	-0.0828	-0.1662
	(0.0841)	(0.0822)	(0.1070)	(0.1065)	(0.1973)	(0.1933)	(0.2348)	(0.2496)	(0.6007)	(0.5273)
Husband's Income	-0.1186	-0.1494	0.0044	-0.0090	0.0610	0.0393	-0.1029	-0.0959	0.1650	0.1349
	(0.0792)	(0.0790)	(0.0968)	(0.0963)	(0.1730)	(0.1672)	(0.2084)	(0.2164)	(0.5781)	(0.5042)
Other/Constant	-0.0248	-0.0306	-0.1291	-0.1076	0.0667	0.0416	0.1202	-0.0223	-0.1353	-0.0423
	(0.0544)	(0.0526)	(0.0774)	(0.0729)	(0.1630)	(0.1613)	(0.1952)	(0.2097)	(0.3069)	(0.2934)
Total	0.0008	-0.0015	0.0025	0.0023	0.0282	0.0746	-0.0347	-0.0337	-0.0531	-0.0735
	(0.0265)	(0.0256)	(0.0311)	(0.0292)	(0.0600)	(0.0555)	(0.0730)	(0.0719)	(0.1436)	(0.1331)

Note: Standard errors are clustered at the individual level and reported in parentheses. The dependent variable is the RIF of annual income (million yen). "*Husband's Income*" includes husband's after-tax income that ignores spousal exemptions and its square. The "*Other*" category includes age and its square, the number of children, tenure and its square, the unionized worker dummy variable, the permanent employee dummy variable, the educational dummy variables, and the industry dummy variables. The standard errors of the decomposition components are computed by using the delta method and take into account the variability induced by the stochastic regressors (Jann 2008). The odd-numbered columns report the results of the decomposition that use the RIF regressions without reweighting, while the even-numbered columns report the results of the reweighted regression decomposition, in which $F(X)$ in 2003 is reweighted to 2004-2006.

Figure 1: Spikes in the Annual Income Distribution of Married Women (2003)

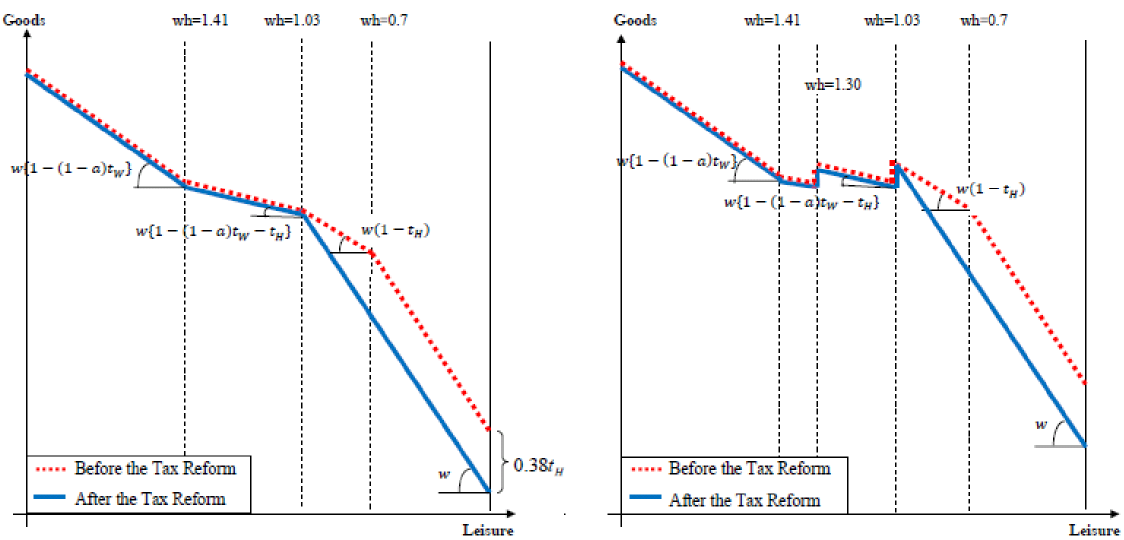


Note: This figure presents the 2003 income distribution of married women sampled in the KHPS. The bin width is 0.1 million yen, but for the bin just below the 1.03 million yen threshold, people earning 0.9 to 1.03 million yen (instead of 0.9 to 1 million yen) are included in order to separate people below this threshold from those above it.

Figure 2: Impact of the Tax Reform on Household Budget Lines

a. Household Budget Lines without Spousal Allowances or Social Security Payments

b. Household Budget Lines with Spousal Allowances and Social Security Payments



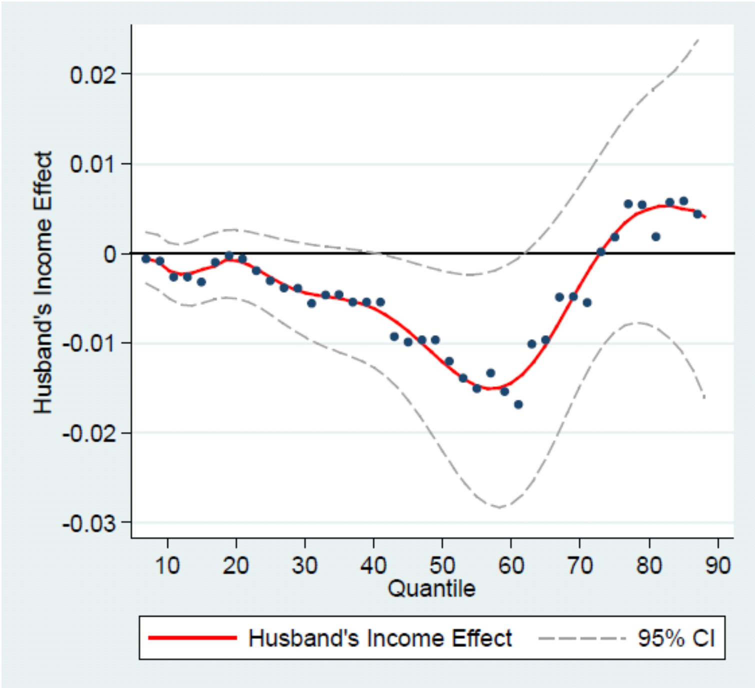
Note: This is the simplest version of the household budget line, which considers neither employer-provided spousal allowances nor social security payments.

Note: In this figure, the employer-provided spousal allowances that cease at 1.03 million yen and social security payments that start from 1.3 million yen are considered.

Figure 3: Coefficients for the Interaction Term in the DID Estimations

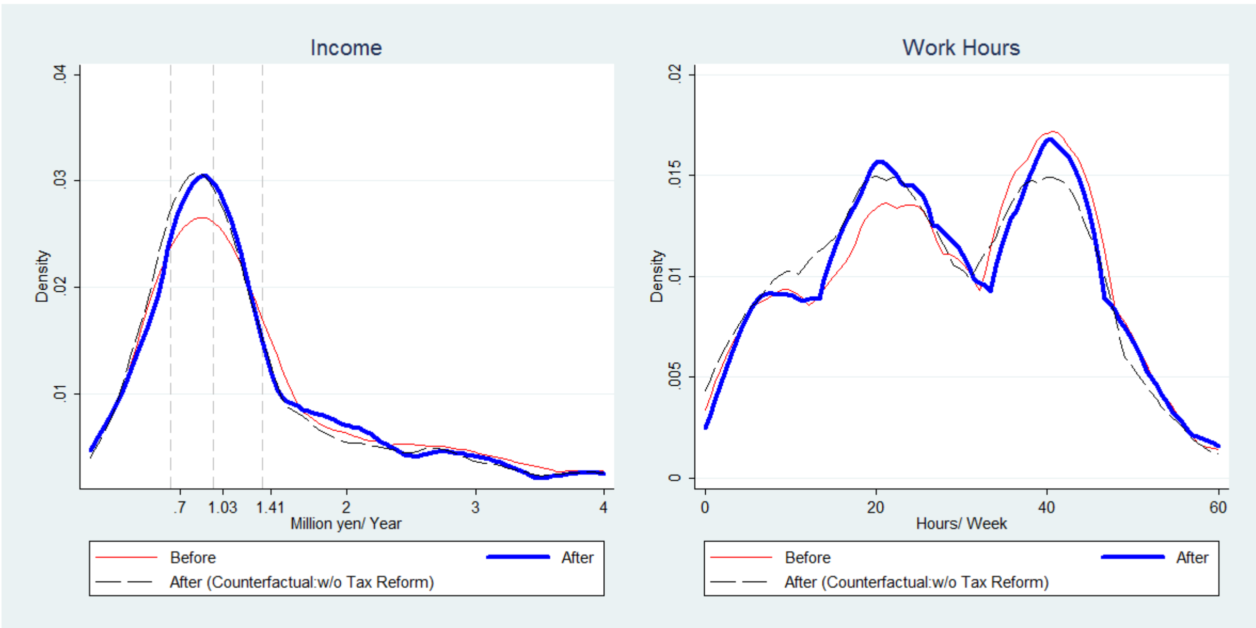
Note: The OLS and CQR estimates for the coefficient of the interaction term are reported. These values are presented in Table 4.

Figure 4: Composition Effect Attributable to Husband's Income in the FFL Decomposition



Note: These coefficients are those obtained from the FFL decomposition in Table 5.

Figure 5: Actual Income and Counterfactual Distributions (DFL Decomposition Result)



Note: The same explanatory variables as applied in the FFL decomposition are used here. The sample comprises married women in the KHPS 2004-2007.

Table A.1: Impact of the Tax Reform with an Increase in Husbands' Incomes on Wives' Optimal Income Choices

Income Group		Homothetic			Non-homothetic
Before	After	Cobb-Douglas	CES	CRRA	Stone-Geary
<0.7	<0.7	39	27	0	28
	[0.7, 1.03)	0	0	0	0
	1.03	0	0	0	0
	(1.03, 1.30)	0	0	0	0
	[1.30, 1.41)	0	0	0	0
	≥1.41	0	0	0	0
[0.7, 1.03)	<0.7	0	1	0	1
	[0.7, 1.03)	6	13	0	5
	1.03	8	16	7	8
	(1.03, 1.30)	0	0	0	0
	[1.30, 1.41)	0	0	0	0
	≥1.41	0	0	0	0
1.03	<0.7	0	0	0	0
	[0.7, 1.03)	0	0	0	0
	1.03	6	10	10	7
	(1.03, 1.30)	0	0	0	0
	[1.30, 1.41)	0	0	0	0
	≥1.41	0	0	0	0
(1.03, 1.30)	<0.7	0	0	0	0
	[0.7, 1.03)	0	0	0	0
	1.03	0	0	0	0
	(1.03, 1.30)	0	0	0	0
	[1.30, 1.41)	0	0	0	0
	≥1.41	0	0	0	0
[1.30, 1.41)	<0.7	0	0	0	0
	[0.7, 1.03)	0	0	0	0
	1.03	0	0	0	0
	(1.03, 1.30)	0	0	0	0
	[1.30, 1.41)	0	0	0	0
	≥1.41	0	0	0	0
≥1.41	<0.7	0	0	0	0
	[0.7, 1.03)	0	0	0	0
	1.03	1	1	1	1
	(1.03, 1.30)	0	0	0	0
	[1.30, 1.41)	0	0	0	0
	≥1.41	40	32	82	50
Observations		100	100	100	100

Note: This table presents the percentages of the 100 simulated optimal incomes that belong to each income group before and after the tax reform for each utility function. The parameters for a husband's income before and after the tax reform are set as the average husband's income from Table 2. The hourly wage and price of goods are fixed at 1,000 yen and 100 yen, respectively. In the calculation, social security payments, which include deciding among the three available social security categories, namely residential tax, employer-provided spousal allowances, and the employment insurance premium, are also considered. Concerning these payments/allowances, the amounts specified in Figure A.3 are assumed.

Table A.2: Probability of a Income Jump among High-Income Married Women (%) by Husband's Income Increase

Increase in Husband's Income (million yen)	Homothetic Cobb-Douglas	CES	CRRA	Non-homothetic Stone-Geary
0.1	0.00	0.00	0.00	1.96
0.2	2.44	3.03	1.20	1.96
0.5	4.88	6.06	2.41	5.88
1	7.32	12.12	4.82	9.80
1.5	12.2	21.21	8.43	13.73
2	14.63	24.24	9.64	17.65

Note: This table reports the probability that married women in the highest income group decreased their incomes to 1.03 million yen in response to an increase in their husbands' incomes after the tax reform, conditional on having originally been in the highest income group. Here, the number of parameter values with which the income jump occurs is divided by the total number of parameter values at annual incomes of 1.41 million yen or more prior to the 2004 tax reform. For example, in the Cobb-Douglas case with an increase in husbands' incomes of 0.2 million yen, the probability of the income jump occurring among high-income married women is calculated as 1/(1+40). The simulation settings are the same as those in Table A.1.

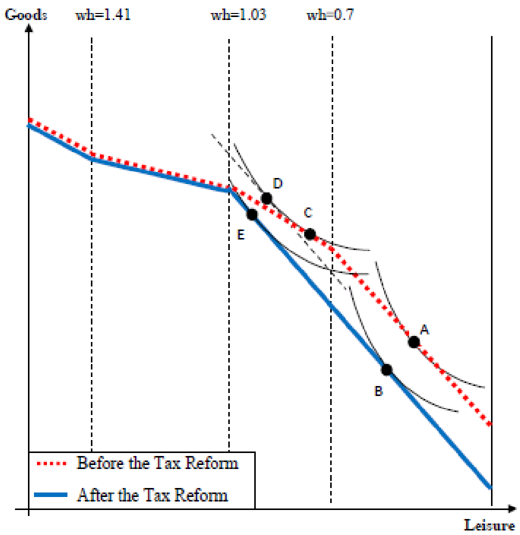
Table A.3: Impact of the Tax Reform with an Increase in Husbands' Incomes on Wives' Optimal Income Choices (Counterfactual Realizations Included)

Income Group		Homothetic			Non-homothetic
Before	After	Cobb-Douglas	CES	CRRA	Stone-Geary
< 0.7	<0.7	39 (39)	27 (27)	0 (0)	28 (28)
	[0.7, 1.03)	0 (0)	0 (0)	0 (0)	0 (0)
	1.03	0 (0)	0 (0)	0 (0)	0 (0)
	(1.03, 1.30)	0 (0)	0 (0)	0 (0)	0 (0)
	[1.30, 1.41)	0 (0)	0 (0)	0 (0)	0 (0)
	≥1.41	0 (0)	0 (0)	0 (0)	0 (0)
[0.7, 1.03)	<0.7	5 (6)	14 (14)	0 (0)	8 (8)
	[0.7, 1.03)	6 (8)	9 (16)	0 (7)	6 (6)
	1.03	3 (0)	7 (0)	7 (0)	0 (0)
	(1.03, 1.30)	0 (0)	0 (0)	0 (0)	0 (0)
	[1.30, 1.41)	0 (0)	0 (0)	0 (0)	0 (0)
	≥1.41	0 (0)	0 (0)	0 (0)	0 (0)
1.03	<0.7	0 (0)	0 (0)	0 (0)	0 (0)
	[0.7, 1.03)	0 (6)	0 (10)	0 (10)	0 (7)
	1.03	6 (0)	10 (0)	10 (0)	7 (0)
	(1.03, 1.30)	0 (0)	0 (0)	0 (0)	0 (0)
	[1.30, 1.41)	0 (0)	0 (0)	0 (0)	0 (0)
	≥1.41	0 (0)	0 (0)	0 (0)	0 (0)
(1.03, 1.30)	<0.7	0 (0)	0 (0)	0 (0)	0 (0)
	[0.7, 1.03)	0 (0)	0 (0)	0 (0)	0 (0)
	1.03	0 (0)	0 (0)	0 (0)	0 (0)
	(1.03, 1.30)	0 (0)	0 (0)	0 (0)	0 (0)
	[1.30, 1.41)	0 (0)	0 (0)	0 (0)	0 (0)
	≥1.41	0 (0)	0 (0)	0 (0)	0 (0)
[1.30, 1.41)	<0.7	0 (0)	0 (0)	0 (0)	0 (0)
	[0.7, 1.03)	0 (0)	0 (0)	0 (0)	0 (0)
	1.03	0 (0)	0 (0)	0 (0)	0 (0)
	(1.03, 1.30)	0 (0)	0 (0)	0 (0)	0 (0)
	[1.30, 1.41)	0 (0)	0 (0)	0 (0)	0 (0)
	≥1.41	0 (0)	0 (0)	0 (0)	0 (0)
≥1.41	<0.7	0 (0)	0 (0)	0 (0)	0 (0)
	[0.7, 1.03)	0 (6)	0 (8)	0 (8)	0 (9)
	1.03	6 (0)	8 (0)	8 (0)	9 (0)
	(1.03, 1.30)	0 (0)	0 (0)	0 (0)	0 (0)
	[1.30, 1.41)	0 (0)	0 (0)	0 (0)	0 (0)
	≥1.41	35 (35)	25 (25)	75 (75)	42 (42)
Observations		100	100	100	100

Note: The parenthesized numbers represent the counterfactual realizations of the optimal income (i.e., the percentages of the 100 simulated optimal incomes had the tax reform not occurred). The simulation settings are the same as those presented in Table A.1, except that Table A.3 reports the results with a sufficiently large increase in husbands' incomes (i.e., 2 million yen).

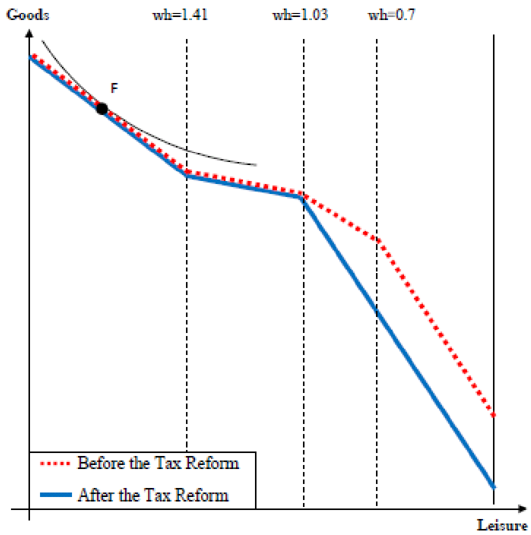
Figure A.1: Impact of the Tax Reform on the Labor Supply of Married Women (Without a Change in the Exogenous Parameters)

a. Impact on Married Women Who Earn 1.03 Million Yen or Less



Note: Married women at point *A* will move to point *B* after the tax reform because of the positive income effect. Married women at point *C* will move to point *E* because of the positive substitution effect ($C \rightarrow D$) and the positive income effect ($D \rightarrow E$).

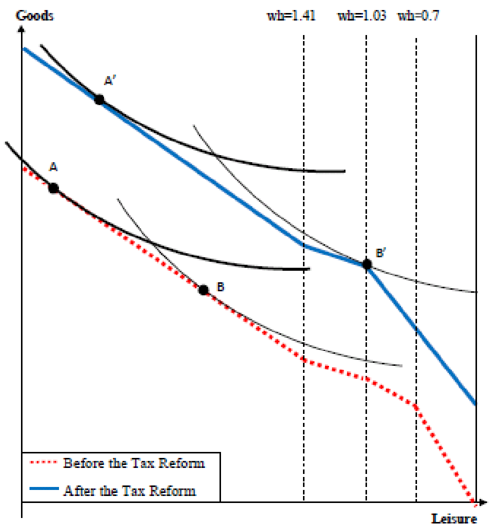
b. Impact on Married Women Who Earn More Than 1.03 Million Yen



Note: Without a change in the exogenous variables, there is no impact on married women who earn more than 1.03 million yen.

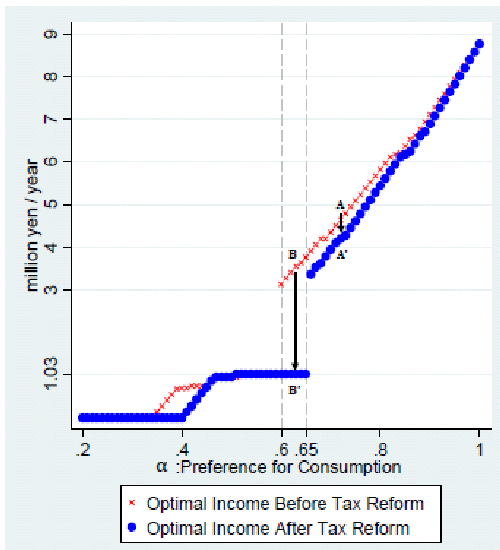
Figure A.2: Change in the Labor Supply of Medium- to High-income Married Women in Response to both the Tax Reform and the Increase in Husband's Income

a. Income Jump from 1.41 Million Yen or More to 1.03 Million Yen



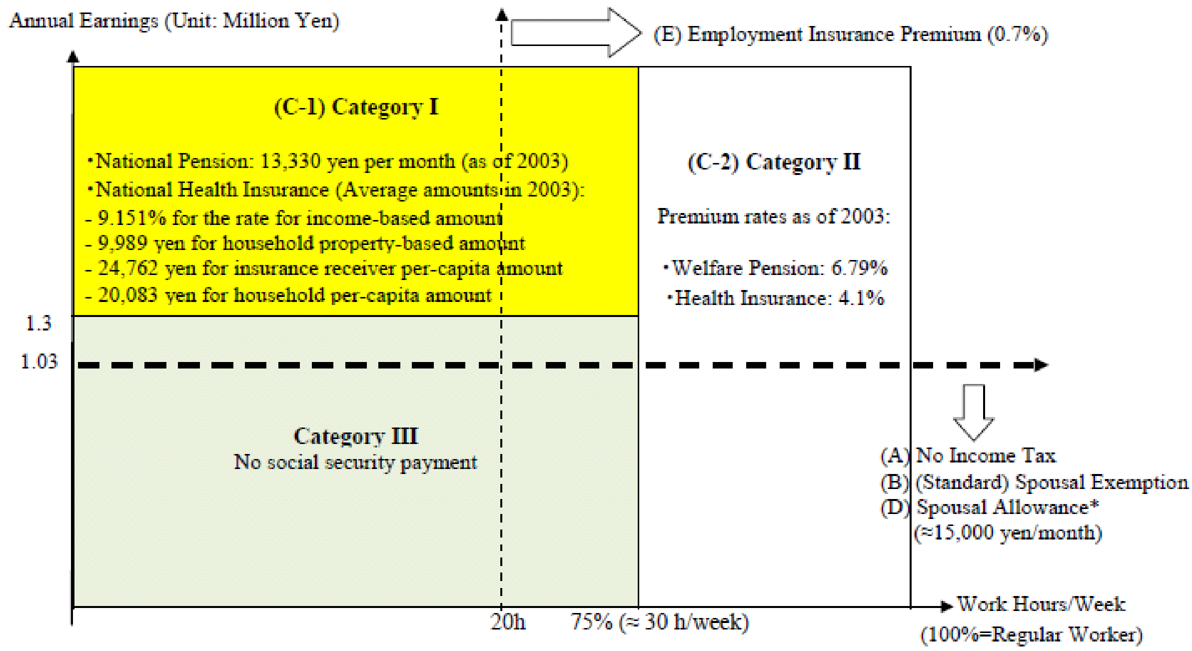
Note: When an increase in a husband's income is considered, some of the married women who earn 1.41 million yen or more will decrease their incomes to 1.03 million yen ($B \to B'$) after the tax reform.

b. Wives' Optimal Income Choices by Preference for Consumption



Note: The dots in Figure A.2b show the optimal income that attains the highest utility for each value of α (i.e., the preference for consumption) when we use the Cobb-Douglas utility function. The simulation settings are the same as those in Table A.1, except that Figure A.2b reports the results with a sufficiently large increase in husbands' incomes (i.e., 2 million yen).

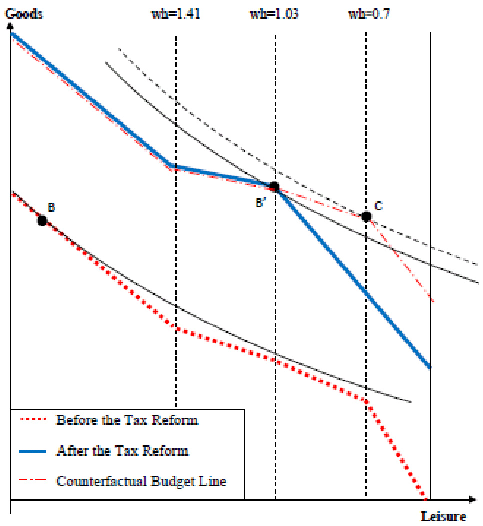
Figure A.3: Simulation Settings



Note: Figure A.3 summarizes the factors that could cause people to adjust their labor supply and the amounts used in the simulation in Section 4. This figure was created based on Table 1 of Oishi (2003). *A. Limit of Nontaxable Income*: All employees in Japan begin to pay income tax only after their annual earnings exceed 1.03 million yen. *B. Spousal Exemption*: The schedules specified in Table A.3 are used in the calculation. *C. Social Security Payments*: The following three categories comprise the social security system in Japan. Category I: Self-employed persons, farmers, etc., aged 20 or over but under 60. Category II: Private company employees and public officers. Category III: Dependent spouses of private company employees and public officers. Wives whose annual incomes are less than 1.3 million yen are classified into Category III and are treated as their husbands' dependents; they do not need to make payments for their own pension and health insurance. However, if their annual income equals or exceeds 1.3 million yen, then they will shift to Category I, in which they are required to pay for the national pension and national health insurance. The national pension as of 2003 was a lump-sum tax of 13,300 yen per month. The national health insurance amounts used in the simulation are the average amounts as of 2003 reported in the Survey on National Health Insurance 2003 (Ministry of Health, Labor, and Welfare, Government of Japan 2003). By contrast, if one's work hours exceed three-quarters of a regular employee's work hours, that worker is classified into Category II, in which people are required to enroll for the employees' pension and health insurance systems (Welfare Pension and Health Insurance). These premiums are proportional to their earnings and halved between employers and employees. *D. Employer-Provided Spousal Allowances*: (*)The income threshold of 1.03 million yen is used in the simulation. *E. Employment Insurance Premium*: The employment insurance system regulates that all workers who work for 20 hours or more per week and are expected to stay employed for more than a certain length of time are covered by the employment insurance. The premium rate as of 2003 was used in the simulation.

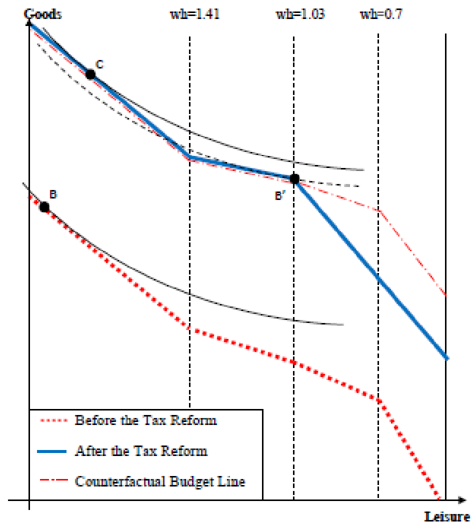
Figure A.4: Decomposition of the Income Jump into the Tax Reform and Husband's Income Effects

a. Decomposition of the Income Jump Effect



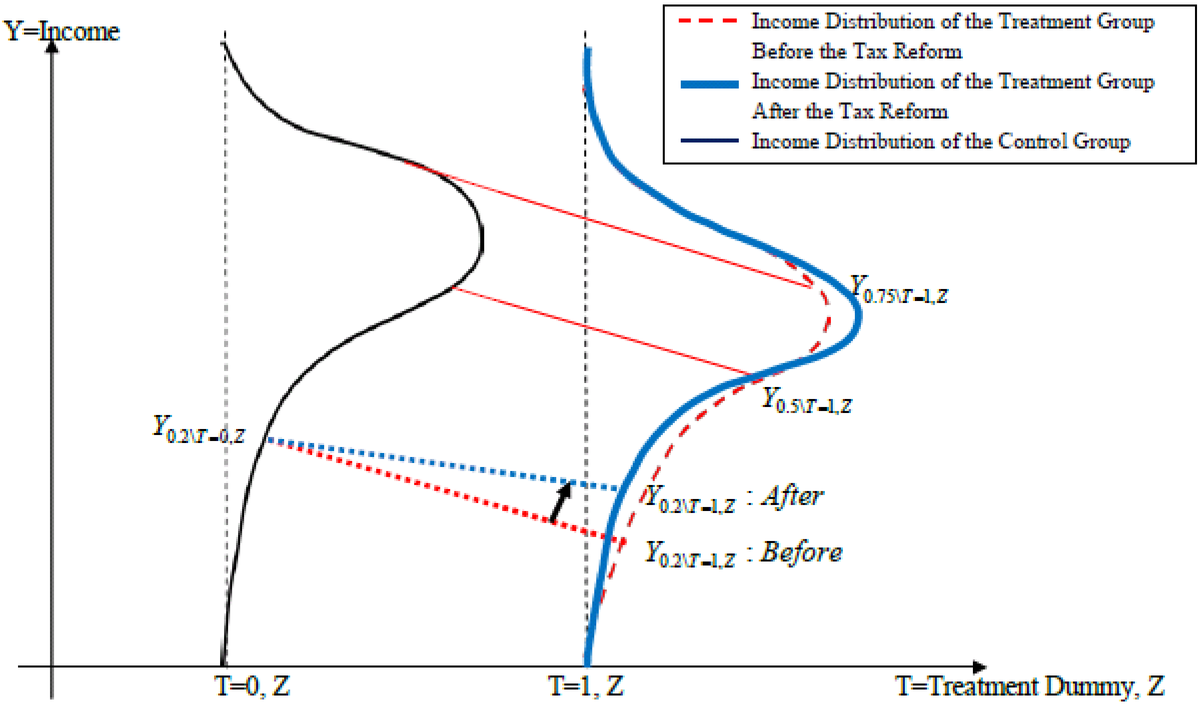
Note: The long dashed line represents the counterfactual budget line if the tax reform in 2004 had not have been introduced. The income jump from B to B' is decomposed into a large negative husband's income effect ($B \rightarrow C$) and a small positive tax reform effect ($C \rightarrow B'$).

b. Tax Reform Effect Cannot Be Negative



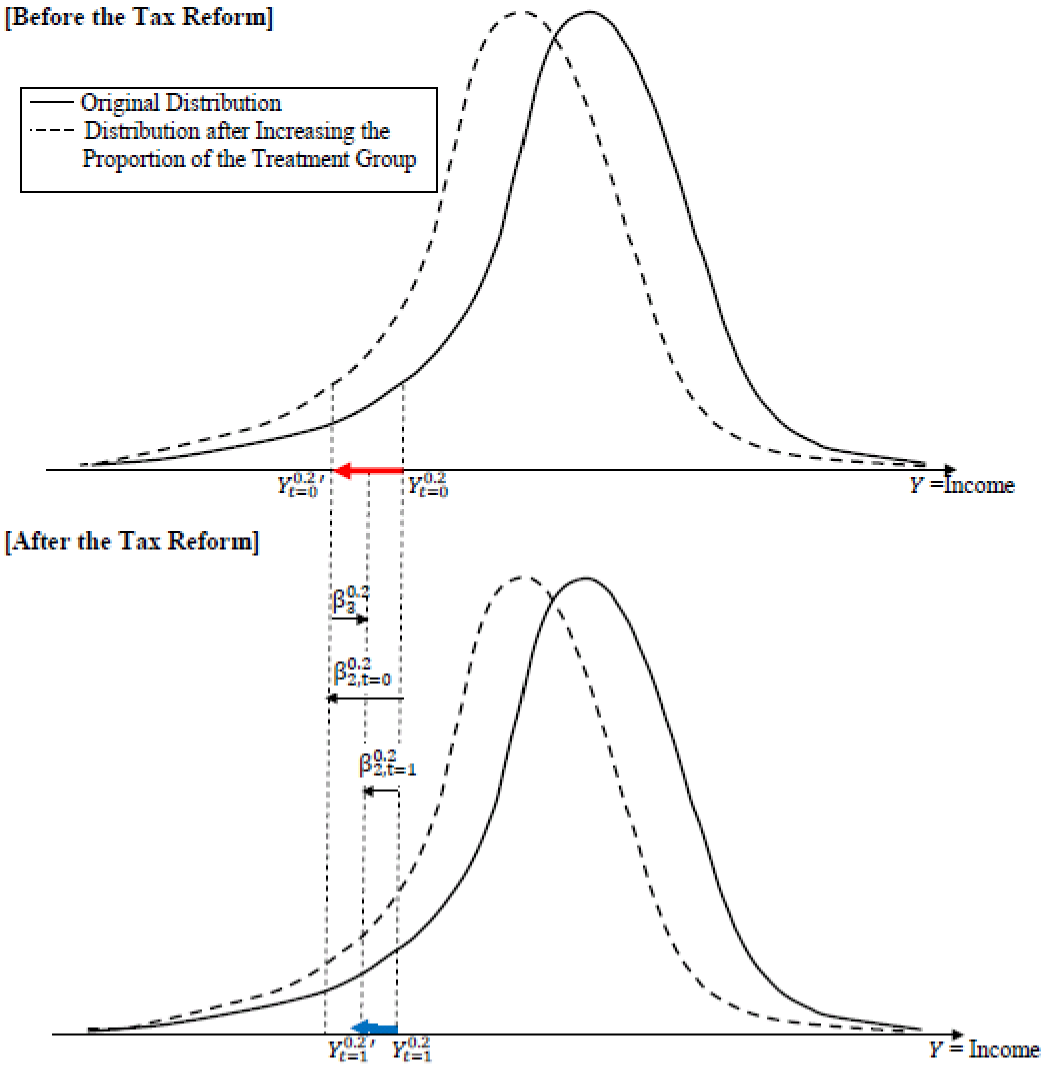
Note: This figure shows that a tax reform effect cannot be negative: both B' and C are available on the post-reform and counterfactual budget lines. A wife who would choose point C on the latter would never choose point B' on the former after the tax reform because point C is always preferable to point B' for her.

Figure A.5: Interpretation of CQR Estimate for β_3



Note: Figure A.5 illustrates the interpretation of the CQR estimate for β_3 visually. The distribution at the left-hand side is the income distribution for the control group conditioning on attributes Z. The dashed and bold lines at the right-hand side represent the income distributions before and after the tax reform, respectively. $Y_{\tau/T=1,Z}$ represents income at the τ quantile of the income distribution for the treatment group with workers' attributes Z, while $Y_{\tau/T=0,Z}$ represents income at the τ quantile of the income distribution for the control group with Z. The slope of the straight dotted line that connects incomes at the quantile of each of the two distributions represents the CQR estimates for the coefficient of the treatment dummy variable (i.e., $\beta_2^{\tau,CQR}$), which is calculated as $\beta_2^{\tau,CQR} = Y_{\tau/T=1,Z} - Y_{\tau/T=0,Z}$. The change in the slope, i.e., the gap in the slope between the two dotted lines, represents the magnitude of the interaction term between *treatment* and *after* dummy variables, i.e.,$\beta_3^{\tau,CQR}$.

Figure A.6: Interpretation of UQR Estimate for β_3 [Change in Income Distribution When Increasing Proportion of the Treatment Group]



Note: Figure A.6 illustrates the interpretation of the UQR estimate for β_3 visually. In Figure A.6, we see how the distribution moves after increasing the proportion of the treatment group by one unit. Suppose that we start from the solid line and that the distribution shifts to the dashed distribution at the left when we increase the proportion of the treatment group by one unit. In the figure, income at the 20th quantile of the distribution shifts from $Y^{0.2}_{t=0}$ to $Y^{0.2\prime}_{t=0}$ when we increase the proportion of the treatment group by one unit before the tax reform. β_2 for the 20th quantile before the tax reform can be calculated as $\beta^{0.2}_{2,t=0} = Y^{0.2\prime}_{t=0} - Y^{0.2}_{t=0}$. Similarly, $\beta^{0.2}_{2,t=1} = Y^{0.2\prime}_{t=1} - Y^{0.2}_{t=1}$. Then, $\beta^{0.2}_{3} = \beta^{0.2}_{2,t=1} - \beta^{0.2}_{2,t=0}$. ($t$=0 and t=1 in superscript mean before and after the tax reform, respectively.) Note that in Figure A.6, the two figures are placed vertically to compare the magnitude of $\beta^{0.2}_{2}$ and to show $\beta^{0.2}_{3}$ as the difference between the two $\beta^{0.2}_{2}$ values. However, this does not mean that $Y^{0.2}_{t=0} = Y^{0.2}_{t=1}$ holds.