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Spousal Tax Deduction, Social Security System and the Labor Supply of Japanese Married Women*

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Abstract

Japanese spousal tax deduction and social security system cause a piecewise linear and discontinuous budget constraint for a married woman. Using a sample from the Japanese Panel Survey of Consumers, we estimate a labor supply model that simultaneously controls for wage endogeneity, sample selection into labor force as well as the possibly endogenous selection between different segments of the non-linear budget constraint. The effects of tax and social security system on the labor supply behavior of married women are more complex than the previous literature has pointed out. In particular, there are notable differences in the labor supply behavior of women who choose different segments of the budget constraint. The wage elasticity of women in the budget segment I (annual income less than the "1.03 million yen ceiling") is twice more negative (-1.28) than women in the budget segment III (annual income greater than the "1.41 million yen ceiling") (-0.60). The wage elasticity smaller than -1 for the budget segment I suggests that these women may be adjusting their hours of work so as to contain their income within the 1.03 million yen ceiling. Education has a positive effect on the hours of work for the budget segment III, but has no effect for the segment I. Unlike the budget segment III, the positive effect of education on wage is non-existent for the women in the budget segment I, indicating an under-utilization of the human capital of women who have chosen to be dependent on the husbands' income on the tax and social security purposes.

Keywords: Female labor supply; Spousal deduction; Social Security System; Non-linear budget constraint

JEL Classification: J20, H24

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1. Introduction

The spousal tax deduction and the social security system in Japan causes a piecewise linear and often discontinuous budget constraint for a married woman: Due to the spousal tax deduction schedule which is decreasing with the wife's income, a typical wife faces a high marginal tax rate for the income range between 1.03 million yen and 1.41 million yen. A typical married women who is dependent on the husband's income do not have to pay for social security coverage up to her income equal to 1.3 million yen. However, she begins to pay the premium for the social security coverage after her income exceeds 1.3 million yen, creating a sudden dip in her budget constraint.

It has long been pointed out that such a non-linear budget constraint causes a married women to adjust her labor supply so as to contain her annual income below the 1.03 million yen in order to avoid the high marginal tax rate and the dip in the budget constraint. Such behavior of married women to adjust her income is often termed '**income adjustment behavior**'. In an aging Japan, a further decrease in labor force in the near future is forecasted to be unavoidable[1], and the government policy to stimulate female labor supply would be necessary to achieve stable economic growth.[2] Thus, potential work disincentive effects of the tax and social security system have attracted much attention from researchers.

The past studies have employed several methods to examine the work disincentive effect of the spousal tax deduction and the social security system in Japan. Since spousal tax deduction is irrelevant for single women, and since single women have to pay her socials security coverage regardless of her income, the tax and social security system have no work disincentive effect for single women. Thus, the first method is to separately estimate wage elasticity for married women and for single women to examine the work disincentive

[1] See National Institute of Population and Social Security Research (2008).

[2] We simulated the effect of an aging population in Japan on taxation, social security and economic growth, and also found that a drastic decrease in labor force would result in a decrease in economic growth in the future. See Kato (2002), and Ihori, Kato, Kawade, and Bessho (2006).

effect (Abe and Otake 1995). As will be explained in detailed later, the dip in the budget constraint due to the social security system occurs only for wives whose husbands are covered by the Type II social security system (coverage for private and public sector employees). Thus, the second method is to include in the hours worked equation the dummy variable indicating if the husband is covered by the Type II social security system, then examine the sign of the coefficient (Oishi 2003). Some data sets commonly used in the past studies ask respondents if they have considered the spousal tax deduction or the social security payment when deciding the hours of work. The third method is to include a dummy variable for those who consider the spousal deduction and the social security payment in the hours worked equation, and examine the sign of the coefficient (Kantani 1997; Higuchi 1995).

Although the above mentioned methods have shed light on some aspects of the work disincentive effects of the spousal tax deduction and the social security system, these methods are not able to investigate potentially more complex effects of these systems on the labor supply behavior of married women. For example, the first method only focuses on the differences between married and single women, ignoring the possibility that, within married women, there are significant differences in the labor supply behavior of women who have chosen to work within the 1.03 million yen threshold, and women have decided to work above the 1.41 million yen threshold. The second method assumes that the effects of the type of the husband's social security coverage has the same effect for any women regardless of their income levels, ignoring the possibility that the type of social security coverage may be less relevant for women who have chosen to work above the 1.3 million yen threshold than those who have decided to work within that threshold. The third method does not allow for the possibility that other labor supply parameters such as wage elasticity could be different between the women who have adjusted their income and the women who have not. In addition, the third method has an obvious problem of the potential endogeneity in the income adjustment behavior.

Therefore, in order to further examine potentially more complex effects of the spousal tax deduction and the social security system on the labor supply behavior of Japanese women, we need to examine possibly different labor supply behaviors of women who have chosen different segments of the non-linear budget constraint. This is the purpose of our study. We contribute to the literature by estimating a labor supply model separately (but jointly) for different segments of the non-linear budget constraint in order to highlight the differences in the labor supply behavior of women in different budget segments. By separately estimating the model, there is an additional problem of potentially endogenous selection between different segments of the budget constraint. We simultaneously (and efficiently) control for (1) a possibly endogenous selection between different segments of the budget constraint, (2) non-random selection into labor force, as well as (3) wage endogeneity in a maximum likelihood estimation. Thus, one additional contribution of this paper is to provide a model that simultaneously (and efficiently) control for all the sources of bias discussed in the literature.

We organize our paper as follows: Section 2 describes the tax and the social security system in Japan. Section 3 discusses the prior literature. Section 4 presents the data and variables. Section 5 presents our model and Section 6 presents the results. Section 7 concludes.

2. Tax and social security system in Japan

Table 1 shows the 2002 income tax schedule for an employed worker. Employed workers are entitled to receive the employee tax deduction. Table 2 shows the employee tax deduction schedule. The amount of deduction depends on one's income. Due to the tax deduction schedule, workers begin to pay tax only after their income exceeds 1.03 million yen. Besides the employee deduction, a married worker is entitled to receive a spousal tax deduction, depending on the spouse's income level. In the following, we briefly explain the spousal tax deduction system in Japan. Throughout this section, we refer to the husband as the primary income earner, and the wife as the secondary income earner.

In 2002, the husband is given the annual tax deduction of 760 thousand yen when the wife's annual income is less than 700 thousand yen. When the wife's income exceeds this threshold, this spousal tax deduction is reduced by 50 thousand yen for each 50 thousand yen earned by the wife. When the husband's income is less than 10,000 thousand yen, this reduction in the spousal deduction continues until the wife's income reaches 1,410 thousand yen. When the husband's income is greater than 10,000 thousand yen, this reduction continues until the wife's income reaches 1,030 thousand yen, then it becomes zero once the wife's income exceeds 1,030 thousand yen threshold.

Thus, the reduction in the spousal tax deduction is almost one-to-one. When husband's income is less than 10,000 thousand yen, spousal deduction can be approximated by the following:

$$SpousalDeduction = 760 \quad for\ 0 \leq Y_w < 700 \tag{1}$$

$$= 1,410 - Y_w \quad for\ 700 \leq Y_w \leq 1,410 \tag{2}$$

$$= 0 \quad for\ Y_w > 1,410 \tag{3}$$

where Y_w is the wife's annual income. All the figures above are in thousand yen. When the husband's income is greater than 10,000 thousand yen, we replace equation (2) by "=1,410 -Y_w for 700 $\leq Y_w \leq$1030", and replace equation (3) by "=0 for Y_w>1030". The spousal deduction up to wife's income equal to 1,030 thousand yen is based on the *Allowance for Spouses (AS)* tax legislation. The spousal deduction for the wife's income between 1,030 thousand and 1,410 thousand yen is based on the *Special Allowance for Spouses (SAS)* tax legislation. In other words, only a household with husband's income less than 10,000 thousand yen is eligible for SAS. In our sample, virtually all the working women are eligible for SAS (99.2% of the working women sample). Thus, the discussion that follows will mostly assume SAS eligibility.

This tax deduction system causes a highly non linear budget constraint for married women, majority of whom is the secondary earners. To see this more clearly, let w be the wife's hourly wage, h be the wife's hours of work, t_W be the wife's income tax rate, t_H be the husband's income tax rate, X be the husband's annual income considered exogenous, and D be the tax deduction that the husband could claim other than the spousal deduction. The employee tax deduction has the form $aY+b$. Thus, the total household income can be written as

$$\begin{aligned} &Household\ \ Income \\ &= wh - [wh - \underbrace{(awh+b)}_{Employee\ deduction}]t_W + X - [X - D - \underbrace{(1410-wh)}_{Spousal\ deduction}]t_H \qquad (4) \\ &= \underbrace{w[1-(1-a)t_W - t_H]}_{Wife's\ after-tax\ wage} h + \underbrace{bt_W + 1410t_H + X(1-t_H) + Dt_H}_{Intercept\ of\ the\ budget\ constraint} \qquad (5) \end{aligned}$$

Thus, the effective marginal tax rate for the wife whose husband is eligible for SAS is $[1-(1-a)t_W - t_H]$ in the income range between 1,030 and 1,410 thousand yen. When the wife's income is less than 1,030 thousand, the marginal tax rate is equal to the husband's tax rate since she does not have to pay her own income tax until her income reaches that threshold. Thus, the wife's effective marginal tax rate jumps at the threshold income of 1,030 thousand yen. When the wife's income exceeds 1,410 thousand yen, the wife's marginal tax rate is equal to $[1-(1-a)t_W]$ only, since the spousal deduction is eliminated.

The social security system in Japan causes additional complication to the budget constraint. There are three categories in the social security system. Category I covers self-employed and non-employed. Category II includes (i) the Employee's Pension Plan (EPP) that covers private sector employees and (ii) the Mutual Aid Association (MAA) that covers the public sector employees. Category III covers dependent spouses of the workers covered by the Category II social security system. When the wife's income is less than 1,300 thousand yen, the wife is entitled for Category III retirement plan with no payment. However, when the wife's income exceeds 1,300 thousand yen, the wife is required to pay the MAA premium of 11.3 thousand yen per month (this is the premium in 2002).[3] This causes a sudden drop in the budget constraint.

Furthermore, when the wife's income is less than 1.03 million yen, the husband typically receives an allowance from his employer as a fringe benefit. This fringe benefit is completely eliminated when the wife's income exceeds 1.03 million yen (see Abe 2009 for a more detailed discussion). Thus, this fringe benefit causes a further discontinuity in the wife's budget constraint.

Considering above mentioned spousal deduction, the social security system and the fringe benefit, the budget constraint for a wife who is eligible for SAS can be described as in Figure 1. We can roughly divide the budget constraint into 3 segments. Segment I is income between 0 and 1.03 million yen where she faces at most her husband's marginal tax, and not her marginal tax and her husband's marginal tax combined. There is a dip in the budget constraint at wife's income equal to 1.03 million yen since the fringe benefit that the husband receives from his employer is cut off at this point. The 1.03 million yen threshold is often called '**1.03 million yen ceiling**', since many married women attempt to contain their income below this ceiling. Segment II is the income range between 1.03 million and 1.41 million yen where she faces a combined marginal tax of her husband's and her own. She also faces a dip in the budget constraint at income equal to 1.30 million yen due to the social security payment. Segment III is the income range above 1.41 million yen. The threshold of 1.41 million yen where spousal deduction is eliminated is often called '**1.41 million yen ceiling**'. At 1.41 million yen, the budget constraint could still be 'dipped'.

[3]The wife could choose EPP coverage instead. In this case the wife pays 8.65% of her annual salary as the EPP premium (this is the premium in 2002).

The budget constraint 'recovers' around the income equal to 1.44 million yen.[4] In this sense, one may consider it better to choose the budget segment III starting from income equal to 1.44 million yen. Alternatively, one may consider it better to choose the budget segment III starting from the '**1.30 million yen ceiling**' where the dip in the budget constraint occurs. However, the choice of this threshold is not particularly important since, theoretically, nobody would choose to work where the budget constraint is dipped. This segmentation is similar to Akabayashi (2006). Akabayashi replaced a dip in the budget constraint with a horizontal line in his structural estimation.

It is widely believed that wives who choose Segment I have '**income adjustment behavior**'. More specifically, these wives are believed to adjust their hours of work so that their annual income is always below the 1.03 million yen ceiling. In an extreme case, the wife would supply labor so that her annual income is always constant, that is $wh{=}constant$, for which case the wage elasticity is always -1. The work disincentive effect of the 1.03 million yen ceiling has been the focus of the study of female labor supply in Japan (Oishi, 2003; Abe and Otake, 1995; Akabayashi, 2006). Segment II is peculiar since it faces higher marginal tax rate plus the dips in the budget constraint. It turns out that there are only a few observations in our data set who have chosen this segment. In Segment III, there are no incentive for 'income adjustment'.

One way to take into account such a non-linear budget constraint is to compute the likelihood that an individual chooses a particular budget segment given a pre-specified utility function. Then, one could estimate the labor supply parameters structurally by using maximum likelihood method. Akabayashi (2006) estimates such a structural model for Japanese married women. However, since the purpose of this paper is to highlight the differences in the labor supply behavior of women who choose different segments of the

[4] Since she will start paying 11.3 thousand yen per month as social security payment, her annual income will not 'recover' until she earns more than $1{,}300+11.3\times12\approx1{,}435.6$ thousand yen.

budget constraint, we instead estimate a labor supply model separately for each budget segment. By separating samples into three segments, there is an additional problem of the sample selection between different segments of the budget constraint. We estimate a model that simultaneously controls for possibly endogenous sample selection into different budget segments, in addition to the sample selection into labor force and the wage endogeneity.

It should be noted that the women whose husbands are covered by Type I retirement plan are not eligible for the Type III retirment. These women have to pay MAA premium regardless of their income level. Thus, for these women, there is no dip in the budget constraint at the 1.30 million yen. Since we would like see the effects of the segmented budget constraint caused by the social security system, we have drop women whose husbands are covered by Type I retirement plan (women whose husbands are self-employed workers) from our analysis.

3. Prior literature

Oishi (2003) uses a sample of 423 married women from *Kokumin Seikatsu Kiso Chousa* to investigate the work disincentive effect of the tax and social security system in Japan. She includes a dummy variable indicating if the husband is covered by the Type II social security. She finds a negative effect of the Type II coverage on the wife's hours worked, which is interpreted as the work disincentive effect. Her model, however, does not allow for the possibility that (i) the type of her husband's social security may not be relevant for women who has chosen to work above the 1.41 million yen ceiling, and (ii) the husband's social security type may affects the hours of work *indirectly* by affecting the women's choice between different segments of the non-linear budget constraint. In addition, her model is a simple OLS, ignoring potential wage endogeneity and non-random sample selection into labor force.

By using a large sample of married women from the *General Survey of Part-Time Workers* (GSPT), Abe and Otake (1995) investigates the work disincentive effect of the spousal deduction and the social security system by estimating hours worked equation separately for single working women and for married working women without kids (DINKS).[5] They find that the wage elasticity is more negative for DINKS (-0.506) than for single women (-0.24). They interpreted the more negative wage elasticity for DINKS as partly due to the income adjustment behavior. This study does not allow for the possibility that labor supply behavior of women may also be different within DINKS group depending on which budget segments wives have chosen. They control for wage endogeneity in 2SLS procedure. However, they do not control for non-random sample selection into labor force.

GSPT asks respondents if they have adjusted their labor supplies so as to contain their income below the 1.03 million yen ceiling or the 1.3 million yen ceiling. Kantan (1997) examines the work disincentive effects of the tax and social security system by including the 'income adjustment dummy' of the GSPT in the hours worked equation. He finds a negative and statistically significant coefficient for the dummy, which is interpreted as the work disincentive effect. This study does not allow for the possibility that other labor supply parameters such as wage elasticity could be different between women who have 'adjusted their income' and women who have not. Kantani's (1997) model is a simple OLS, thus ignoring potential endogeneity in the income adjustment behavior as well as non-random sample selection into labor force.

Akabayashi (2006) takes into account the non-linearity by structurally estimating a model, a model similar to Hausman (1980) and Moffit (1986). His data are from GSPT. He finds that the wife's labor supply responds to her husband's decreasing spousal tax deduction is greater than the responds to her own income tax. Since GSPT does not contain non-

[5]More precisely, they compare (i) single working women plus married working women with non-working husbands and (ii) married working women without kids with working husbands.

workers, he takes into account the sample selection by using truncated maximum likelihood estimation.

Other studies of female labor supply are worth noting here. Kuroda and Yamamoto (2008a) estimate the inter-temporal substitution elasticity using a sample from the *Japanese Panel Survey of Consumers*, the same data source we utilize in this study. They first estimate a wage offer equation. The predicted wage is then included in the hours worked equation to estimate the wage elasticity. The hours worked equation also includes the Heckman sample selection correction terms. This is one of few studies that control for sample selection into labor force using non-working sample. Identification of wage effect is achieved by imposing exclusion restrictions. The wage elasticity is interpreted as the inter-temporal substitution elasticity due to the inclusion of the wife's education, the husband's education, year dummies and prefectural dummies in the hours worked equation, which are assumed to determine the marginal utility of wealth. They find that the inter-temporal wage elasticity is positive but small and insignificant ranging between 0.05 and 0.20.[6]

Hill (1989) uses the 1975 survey of women in Tokyo Metropolitan Area[7] to estimate a labor supply model for married women. She estimates labor supply separately for employees, and family workers (workers in informal sector) while controlling for trichotomous selection between non-working, working as an employee, and working as a family worker. Wage endogeneity is controlled for in the three stage least square procedure with wife's labor market experience as the only excluded instrument. She finds that uncompensated wage elasticity is 0.26 for employees while it is 0.25 for family workers.

Thus, none of the previous studies have sufficiently investigated the difference in the labor supply behavior of women who choose different segments of the budget constraint. We

[6]Kuroda and Yamamoto (2008b) conduct a similar analysis using data aggregated by prefecture, age group and gender. They find positive wage elasticities ranging between 0.10 and 0.97.

[7]Conducted by the National Institute for Vocational and Occupational Research.

are able to contribute to the literature by highlighting the differences in the labor supply behavior of women who choose different segments of the budget constraint. In terms of econometric methods, only Kuroda and Yamamoto (2008a) and Hill (1989) simultaneously control for wage endogeneity as well as non-random sample selection. Therefore, we also contribute to the literature by providing a model that simultaneously controls for (i) wage endogeneity, (ii) non-random sample selection into labor force as well as (iii) potential endogenous selection between different segments of the budget constraint in an efficient maximum likelihood estimation framework.

4. Data, variables and summary statistics

Our sample is from the the *Japanese Panel Survey of Consumers* (JPSC) for the period between 1994 and 2003. This is a panel of randomly chosen 1500 Japanese women who were between age 23 and 34 at the initial survey which was in 1993, and an added panel of 500 women aged 24 to 27 in 1997. Most of the past studies used data sets that contain only part-time workers, omitting full-time workers and non-workers (GSPW for example). In contrast, JPSC contains full-time workers, part-time workers as well as non-workers, allowing us to control for the sample selection bias as well as to include full-time workers. Furthermore, JPSC contains a rich set of personal and job characteristics. The disadvantage of JPSC is its small cross sectional units. The *General Survey of Part-Time Workers* contains 13,000 workers (1995 Survey). As noted in Section 2, we drops women whose husbands are covered by Type I social security from our sample in order to highlight the work disincentive effect of the segmented budget constraint created by the spousal deduction and the social security system.

The hourly wage variable is constructed as follows. Respondents report whether they are paid hourly, daily, weekly or monthly. When respondents are paid hourly, we use their reported hourly wage as the wage variable. When respondents are paid daily, we use (Reported Daily Wage)/8 as the wage variable, assuming that they work 8 hours per day. Annual hours workers is then computed as (Annual Pre-tax Income)/(Hourly Wage). This construction of the wage variable and the hours worked variable would minimize the division bias. This is because it would be easier for workers to recall their hourly wages and annual income than to recall their hours of work. Thus hourly wage and annual income would be more accurately measured, minimizing potential division bias. The construction of wage and annual hours worked variables is similar to Akabayashi (2006).

For women who are paid weekly or monthly, they report the monthly equivalent amount of salary. Unlike jobs that pay hourly or daily, jobs that pay weekly or monthly would also entail bonuses. This needs to be incorporated in the computation of hourly wage. Thus, we compute the hourly wage as (Annual Pre-tax Income)$\div$(Annual Hours Worked). Annual pre-tax income is reported by each respondent. Annual hours worked is constructed as (Annual Days Worked)$\times$(Weekly Hours Worked)/5. Both annual days worked and weekly hours worked are reported in ranges in JPSC. We chose the middle point of each range for computation.

After-tax wage is computed based on the income tax schedule in Table 1, the employee deduction schedules in Table 2 as well as the spousal deduction schedule described in Section 2. The non-wife income is constructed as follows. First, from wife's and husband's annual income, we compute the intercept term of the budget constraint given in equation (5). This intercept can be interpreted as the wife's virtual income. We then add income earned from assets by the wife and the husband to this virtual income. Finally, we subtract the amounts of social security payment made by the husband and the wife to construct the non-wife income. The amount of social security payments are estimated by assuming that the wife is covered by the MAA when her income exceeds 1.30 million yen, and that the husband is covered by EPP[8].

Our construction of non-wife income takes into account the income tax, but ignores other taxes such as the tax on the interest income. We could alternatively use the reported amount of tax and social security payment to construct the non-wife income. However, this variable is missing for a significant portion of the sample. Thus, in order to increase the sample size, we construct the non-wife income as described in the previous paragraphs.

Table 3 shows the summary statistics of the variables utilized in this study separately for workers in the three budget segments described in Figure 1. There are 1413 person-year observations in the budget segment I, only 231 person-year observations in the segment II, and 1555 person-year observations in the segment III. The average hours worked is 940 hours for the segment I, 1561 hours for the segment II and 2078 hours for the segment III. Thus, hours worked is increasing with the budget segment. Average after-tax hourly wage is 761 yen for the segment I, 645 yen for the segment II and 1487 yen for the segment III. A drop in the wage in the budget segment II is due to the higher marginal tax rate for this budget segment. In fact, pre-tax wage rate is increasing with the budget segment (869 yen, 906 yen and 1721 yen for the budget segment I, II and III respectively). Average age is 35.4 for the segment I, 35.0 for the segment II and 34.2 for the segment III. Thus, women in the budget segment III are slightly younger than women in other segments, though the difference appears to be minor. Labor market experience is higher for the budget segment III (14.3 years) than for the segments II and III (12.7 years and 11.5 years respectively).

As is shown in Table 3, we utilize a number of explanatory/instrumental variables in the estimation of the hours worked equation. Wife's age and the number of children below 6 are included virtually in any estimation of female labor supply. We include a dummy variable indicating if the wife is living with parents (her own parents and/or her husband's

[8]In 2002, the payment for MAA is 13.3 thousand yen per month while the payment for EPP is 8.65% of the salary.

parents). Wives living with parents are expected to work longer hours since parents typically provide household work, thus reducing wives' housework. Several past studies include asset variables. (Assets) is the summation of household saving plus the value of securities. We also include the amount of loans the family paid back during the month preceding the interview.[9] In addition, we include a dummy indicating if the household owns a house instead of living in a rented house.

We include three industry dummies (manufacturing, retail and services) to control for the possibility that industry characteristics could affect the hours worked. About 70% of all the working sample is in these three industries. We include three variables for job characteristics: full-time dummy, number of employees and a dummy variable indicating if the individual holds a managerial position. Job contents may be more intensive in a larger firm, for full-time workers, and for managerial positions. Thus, we expect these variable to have a direct and positive impact on hours worked.

Finally, we consider two human capital variables as potential candidates for the excluded instruments for the identification of the wage elasticity: wife's education in years and her labor market experience in years. In addition, we use wife's mother's education and mother-in-law's education as additional excluded instruments.

Figure 2-A shows the wife's pre-tax annual income. Observations are heavily concentrated in the income range between 0.9 million yen and 1 million yen, indicating that women are adjusting their hours of work so that their annual income is less than the 1.03 million yen ceiling. Figure 2-B shows the histogram of the wife's after-tax wage rate. The wage rate is highly skewed to the right.

It is well known that the age-labor force participation profile for Japanese women is M-shaped. Nakamura and Ueda (1999) show that the labor force participation profile has

[9]The data ask the total amount of the existing loans only for a limited number of years.

its first peak at age between 20-24 (above 70%), drops to near 50% at age between 30-34, then attains its second peak (70%) at age between 45-49. In order to see if age-hours worked profile has a similar shape, Figure 2-C shows the average hours worked by age. The hours worked are the highest at age 24, exhibit some declining trend until age 40, then show a very slight increase afterwards. This trend could suggest that the age-hours worked profile is M-shaped, where the graph is capturing the dipping part of the profile. However, the change in hours worked after age 25 appears to be rather gradual. Thus, it is not conclusive whether or not the hours profile has an M-shape.

5. The model

We separately estimate labor supply equations for different segments of the budget constraint described in Figure 1. Since there are only 231 observations in Segment II, we decided that we are not able to obtain meaningful estimates for this budget segment. Thus, we dropped this budget segment from our analysis. By doing so, we implicitly assume that wives' choice among budget segments is typically dichotomous, between segment I and segment III only.

By separating the sample into the budget segment I and segment III, we have the problem of potentially endogenous selection between different segments of the budget segments as well as non-random selection into labor force and wage endogeneity. In order to control for all the sources of bias, we estimate the following model.

$$\begin{aligned}
log(hour)_{it}^{(III)} &= \beta_{11} log(wage)_{it} + \beta_{12} Z'_{1it} + (\underbrace{\rho_1 \chi_i + \epsilon_{it}^{III}}_{Error\ term}) && (6)\\
log(wage)_{it}^{(III)} &= \alpha_1 Z'_{1it} + \gamma_1 Z'_{2it} + (\rho_2 \chi_i + u_{it}^{III}) && (7)\\
log(hour)_{it}^{(I)} &= \beta_{21} log(wage)_{it} + \beta_{22} Z'_{1it} + (\rho_3 \chi_i + \epsilon_{it}^{I}) && (8)\\
log(wage)_{it}^{(I)} &= \alpha_2 Z'_{1it} + \gamma_2 Z'_{2it} + (\rho_4 \chi_i + u_{it}^{I}) && (9)\\
Budget\ segment\ selection: \quad B_{it}^{*} &= \alpha_3 Z'_{1it} + \gamma_3 Z'_{2it} + (\rho_5 \chi_i + v_{it}^{B}) && (10)
\end{aligned}$$

$$Labor\ force\ selection: \quad I_{it}^{*} = \alpha_4 Z_{1it}' + \gamma_4 Z_{2it}' + (\rho_6 \chi_i + v_{it}^{L}) \tag{11}$$

Equation (6) is the hours worked equation for the budget segment III, and equation (7) is its corresponding reduced form wage equation. The error terms for both equations are decomposed into two parts (inside the parentheses). The first part is $\rho_j \chi_i$ for j=1,2. The term χ_i is the unobserved heterogeneity that affects all the equations. The term ρ_j is the factor load for χ_i for the j^{th} equation. The second part is the usual disturbance term, ϵ_{it}^{III} and ϵ_{it}^{I}, which are assumed to be uncorrelated with any of the explanatory variables. The covariance between the two error terms is given by Cov($\rho_1\chi_i$ +ϵ_{it}^{III}, $\rho_2\chi_i$+u_{it}^{III})=$\rho_1\rho_2$. Therefore, the assumption of wage exogeneity for the segment III is equivalent to $\rho_1\rho_2 = 0$.

Equation (8) is the hours worked equation for the budget segment I, and equation (9) is the corresponding reduced form wage equation. Similar to the case for the budget segment III, wage is exogenous if $\rho_3\rho_4$=0. Equation (10) is the selection equation between the two budget segments such that, if $B_{it}^{*} > 0$, the person chooses the budget segment III, and chooses the budget segment I if otherwise. The correlations of the error terms between the budget segment selection equation and the hours worked equations are captured by χ_i when $\rho_j\rho_5 \neq 0$ for j=1,3. If $\rho_j\rho_5$ are not equal to zero for j=1,3, the failure to control for this non-random selection would introduce a bias in the hours worked equations. Finally, equation (11) is the labor force participation equation where women participate in the labor force if $I_{it}^{*} > 0$. The effect of non-random selection into labor force is captured by χ_i when $\rho_6\rho_j \neq 0$ for j=1,..,5.

We estimate all the equations jointly by using a maximum likelihood estimation. In doing so, we assume that $\chi_i \sim N(0,1)$ and all the usual disturbance terms for the hours worked equations and wage equations (ϵ^{III},ϵ^{I},v^{III},v^{I}) are independent and distributed normally. We assume that residual terms for the two selection equations, v_{it}^{B} and v_{it}^{L}, are independent and follow the logistic distribution. By jointly estimating all the equations, we can control for any correlations among these equations. Thus, this model simultaneously controls for all the sources of bias discussed so far, namely the wage endogeneity, the endogenous selection between different budget segments, and the self selection into labor force. The likelihood function is in the Appendix. We estimate the model with FORTRAN programs with first analytic derivatives using GQOPT optimizer.

6. Estimation results

6.1 OLS, 2SLS and Fixed Effect Results

Before presenting our joint estimation results, it is useful to first examine more conventional models (OLS, 2SLS and the fixed effect models). In 2SLS model, we control for potential wage endogeneity. A conventional choice of excluded instruments is the wife's background variables, such as her mother's education and father's education. Since the wife's own human capital characteristics such as the labor market experience and her education are correlated with her wage, one may be tempted to use these variables as excluded instruments. Kuroda and Yamamoto (2008a,b), Yamada (2007) and Hill (1987) use labor market experience as one of their excluded instruments. However, it is not *a priori* clear whether these variables would satisfy the orthogonality conditions.

Therefore, in the preliminary regressions, we have conducted extensive specification tests using the test of orthogonality of the subset of the instruments (Hayashi 2000:220). We found that (i) the wife's labor market experience is orthogonal to the error term in the hours worked equation when used as an excluded instrument, but (ii) the wife's education does not satisfy the orthogonality condition when used as excluded instruments, thus the wife's education should be included directly in the hours worked equation. Intuitively speaking, the wife's education is not a valid excluded instrument since it is correlated with unobserved taste for work. Besides the wife's labor market experience, we use the wife's mother's education, its squared term, the mother-in-law's education and its squared term as additional excluded instruments.[10]

Table 4 shows the results. The OLS wage elasticity is -0.49 for the budget segment III while it is -1.30 for the segment I. Thus, the OLS wage elasticity is twice more negative for the budget segment I than for the segment III. As for the 2SLS results, the excluded instruments in the first stage wage regressions are jointly significant determinants of the wage for both budget segments at the 5% significance level. The Hansen's J does not reject the validity of the over-identifying restrictions for both budget segments (P-value=0.96 for the budget segment III, and P-value=0.72 for the budget segment I). Thus, our model specifications appear to be valid. Finally, the exogeneity of the wage is rejected for both budget segment, supporting the use of an instrumental variable regression. For the budget segment III, the estimated wage elasticity increases from the OLS estimate of -0.49 to a positive estimate of 0.096, thought it is not statistically significant. This elasticity estimate falls in the range estimated by Kuroda and Yamamoto (2008a) [0.05 to 0.20]. For the budget segment I, the estimated wage elasticity significantly drops from the OLS estimate of -1.30 to -4.01.

It should be noted that, for the budget segment I, among the excluded instruments, only the wife's labor market experience has a statistically significant coefficient. Thus, our instruments are somewhat weak. Such weak instruments and the insignificant wage coefficient for the segment III indicate that we would need a more efficient method for addressing the wage endogeneity than 2SLS (such as our maximum likelihood estimation).

Another way to control for wage endogeneity is to apply a fixed effect model. For the budget segment III, the fixed effect wage elasticity drops substantially from the OLS result of -0.49 to -0.65. Intuitively, the fixed effect model eliminates the unobserved time-

[10]We do not use father's education since it has no explanatory power on the wife's wage rate.

invariant effects, such as taste for work, that affect both wage and the hours worked in the same direction, thus eliminating an upward bias in the wage elasticity. For the segment I, the wage elasticity changes only slightly from the OLS estimate of -1.28 to -1.24.

6.2 Results for our joint estimation incorporating unobserved heterogeneity

Table 5 shows the results of our joint maximum likelihood estimation presented in Section 5. We impose the common exclusion restrictions for the wage and the selection equations. The exclusion restrictions are the same as the ones used in the 2SLS model presented in the previous section. First, let us present the wage elasticity estimate for the budget segment III. The wage elasticity drops considerably from the OLS estimate of -0.49 to -0.60. Note that the factor loads for the hours worked equation (ρ_1) and the wage equation (ρ_2) are both negative and statistically significant, indicating that the OLS estimate would be biased upward.[11] The factor loads for the budget segment selection and the labor force selection equations (ρ_5 and ρ_6) are both negative and statistically significant. The estimated correlation between the hours worked error term and the budget segment selection error term is 0.571, while it is 0.573 between the hours worked error term and the labor force selection equation error term.[12] Thus, the correlations between the hours worked equation and the two selection equations are relatively high, which would caused a significant selection bias in the OLS estimate.

A large drop in the wage elasticity is similar to the result for the fixed effect model. The estimated wage elasticity of -0.60 is not far from the fixed-effect estimate of -0.65. However, the wage elasticity for our joint estimation contrasts sharply with the 2SLS wage elasticity of 0.096. One possible reason for this discrepancy is that, while the 2SLS procedure could

[11] Since $\rho_1\rho_2 > 0$.

[12] The correlation between hours worked equation error and the budget segment selection error is given by $\rho_1\rho_5/(\sqrt{\rho_1^2+\sigma_\epsilon^2}\sqrt{\rho_5^2+\sigma_v^2})$.

eliminate both time-invariant and time-varying unobserved heterogeneity, our current model controls only for time-invariant unobserved heterogeneity. However, this discrepancy could also arise from the inefficiency in the 2SLS estimation. Bound et al. (1995) show that when the correlation between the instrumental variables and the endogenous variable is weak, 2SLS estimate is biased in the finite sample. Although our excluded instruments are significant determinants of the wage in the 2SLS model (F-stat=9.48), the test of weak instruments provided by Stock and Yogo (2002) cannot reject the null hypothesis that the bias in the 2SLS wage coefficient, relative to the OLS bias, exceeds 10.%[13] Thus, an efficient maximum likelihood estimation such as ours may provide a more accurate estimate than the 2SLS. It should also be noted that the statistical control for the endogenous selection between the two budget segments as well as other sources of bias are likely to have contributed to this discrepancy as well.

For the budget segment I, the estimated wage elasticity is -1.28 which is almost the same as the OLS estimate. The factor load for the hours worked equation is small (0.015) and statistically insignificant. Thus, the effects of the unobserved heterogeneity through the wage equation and the two selection equations would have little impact on the hours worked equation, suggesting that the wage is not endogenous for the budget segment I. We cannot reject the null hypothesis that the wage elasticity is smaller than -1. This suggests a possible 'income adjustment behavior' of wives in this budget segment.

Other coefficients are of interest. The coefficient for the non-wife income has an unexpected positive sign for the segment III. This could arise from the possible endogeneity of the non-wife income; if a wife with a high taste for work marries a husband with high income, the effect of non-wife income will be biased upward. A positive coefficient for the non-wife income is also found in Hill (1989). The effect of age on the hours worked is posi-

[13]The test statistic (Kleibergen-Paap F statistic) is 9.49 while the the critical value for the 10% IV relative bias is 10.83

tive for the budget segment III (0.003) while it is negative for the budget segment I (-0.003), though both of the coefficients are not statistically significant. The results for the selection equation between the two budget segments and the labor force participation equation indicate that, as age increases, (i) the likelihood of choosing the budget segment I increases (the wife becomes dependent on the husband' income) and (ii) the likelihood of being out of labor force increases. These results indicate that the age-hours worked profile has a hump shape, the shape similar to the well-known M-shaped age-labor force participation profile for Japanese women; At a relatively young age, women are in the budget segment III where the effect of age on the hours worked is positive. Then these women move to the budget segment I where the effect of age is negative.

Living with parents has a positive and statistically significant effect on the labor force participation, confirming Sasaki's (2002) finding. However, at the 5% significance level, living with parents does not have significant effects on the hours worked for both of the budget segments as well as on the selection between the budget segments. The effect of the number of kids on the hours worked is twice more negative for the budget segment I (-0.08) than for the budget segment III (-0.04). The differing effects of children could be due to the fact that most of the women in the budget segment I hold a part-time job where working hours are considerably more flexible than a full-time position. The more negative effect of young children on the hours worked for the segment I is also consistent with Ueda's (2007) findings that the utility losses from childcare in a life-cycle childbearing model is greater for part-time workers than for full-time workers. The greater utility losses for part-time workers could have resulted in a greater decrease in the hours worked for the segment I in our data.

The number of children also has negative and statistically significant effect on the selection between the budget segments and on the labor force participation. The estimated coefficient indicates that, as age increases by one, the probability of women to choose the budget segment I increase by 5% and , and the likelihood of being out of labor force increase only by 1.4% computed at the sample mean. Full-time workers work 28% more hours than part-timers in the segment III. Full-time workers work 17% more hours in the segment I though this effect is statistically insignificant.

One extra year of education will increase the hours of work by 4.6% for women who are in the segment III. However, the wife's education has little impact on the hours worked for women in the segment I. Thus, conditional on the wife's decision to be dependent on the husband's income (i.e., decision to choose the segment I), her education makes no difference in the hours worked. This result could be due to the income adjustment behavior of women in the segment I. If women supply labor so as to contain her income at 1.03 million yen, higher taste for work represented by the education level should be less important in determining the hours of work.

The effect of education on wage is also notably different for the budget segment III and I. One extra year of education increase wage rate by 5.3% for the segment III. However, the effect of education is non-existent for the budget segment I (coefficient=-0.004). There are two probable explanations for this pattern. First, there may be a career interruption when a woman moves from the segment III to the segment I (to be dependent on the husband's income on the tax and social security purpose), probably due to the need for child care. A career interruption could depreciate women's human capital, eliminating the effect of education on wage. Second, women may be choosing jobs for the less-skilled such as clerical work upon moving to the budget segment I in order to contain her income below the 1.03 million yen threshold. In this case, education has no impact on wage not because women's human capital has depreciate but because they have chosen low paying job. If the second explanation is true, the impact of women choosing the budget segment I is not only the reduction in the female labor supply but also an under-utilization of females' human capital.

In sum, there are notable differences in the labor supply behaviors of women in the two budget segments. Wage elasticity is twice more negative for the women in the budget segment I (-1.28) than for women in the budget segment III (-0.60). We cannot reject the null hypothesis that the wage elasticity is smaller than -1 for those in the budget segment I, suggesting a possible 'income adjustment behavior' of women in this budget segment. Education has a positive effect on the hours of work for the budget segment III, but has no effect for the segment I. Moreover, the positive effect of education on wage completely disappears when women choose the budget segment I, indicating that the current tax and social security system could lead not only to a reduction in the female labor supply but also to an under-utilization of females' human capital. The effect of the number of children on the hours of work is twice more negative for the budget segment I than for the segment III. The sign of the effect of age on the hour of work is positive for the budget segment III while it is negative for the segment I.

7. Conclusion

Our estimation results have revealed that the effects of tax and social security system on the labor supply behavior of married women are more complex than the previous literature has pointed out. There are notable differences in the labor supply behavior of women who choose different segments of the budget constraint. In particular, the wage elasticity of women who choose the budget segment I (annual income less than 1.03 million yen ceiling) is twice more negative (-1.28) than women who choose the budget segment III (annual income greater than 1.41 million yen ceiling) (-0.60). In the case of the budget segment I, we cannot reject the null hypothesis that the wage elasticity is smaller than -1, suggesting that these women may be adjusting their hours of work so that their income does not exceed the 1.03 million yen ceiling. Education has a positive effect on the hours of work for the budget segment III, but has not effect for the segment I. We discussed that this result is also consistent with the hypothesis of the income adjustment behavior of women in the budget segment I. Moreover, the positive effect of education on wage disappears when women choose the budget segment I, indicating that the current tax and social security system could lead not only to a reduction in the female labor supply but also to an under-utilization of females' human capital. The effect of the number of kids on the hours worked is also twice more negative for the budget segment I (-0.08) than for the budget segment III (-0.04). The effect of age on the hours worked is positive for the women in the budget segment III while it is negative for the women in the budget segment I. Younger women are more likely to choose the budget segment III while older women tend to choose the budget segment I. These results indicate that age-hours worked profile for Japanese married women has a hump-shape, a shape similar to the well-known M-shaped age-labor force participation profile for Japanese women. Our maximum likelihood estimation improved upon the previous literature in that it simultaneously controlled for various sources of bias discussed in the literature, and that it provided a much more efficient estimate of the wage elasticity than the 2SLS procedure.

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Table 1: National Income Tax Brackets in 2002

Taxable Income Range in 1000 yen (y)	Marginal tax rate (%)
$1 \leq y < 3{,}300$	10%
$3{,}300 \leq y < 9{,}000$	20%
$9{,}000 \leq y < 18{,}000$	30%
18,000 and more	37%

Tax schedule has been changed in 1995 and 1998. We took into account these changes when we computed the after tax wage rate.

Table 2: The Employee Tax Deduction Schedule in 2002

Gross Income Range in 1000 yen (y)	Total Deduction (Basic + Employer deduction)
$1 \leq y < 1{,}625$	1,030
$1{,}625 \leq y < 1{,}800$	0.4y+380
$1{,}800 \leq y < 3{,}600$	0.3y+560
$3{,}600 \leq y < 6{,}600$	0.2y+920
$6{,}600 \leq y < 10{,}000$	0.1y+1,580
10,000 and more	0.5y+2,080

Tax deduction schedule was changed in 1995 and 2003. We took into account these changes when we computed the after tax wage rate.

Table 3: Summary Statistics

	Segment I (#Obs=1413) Mean (Std.Dev)	Segment II (#Obs=231) Mean (Std.Dev)	Segment III (#Obs=1555) Mean (Std.Dev)	All (#Obs=3199) Mean (Std.Dev)
Dependent variable				
Hours worked	940.033	1561.375	2078.038	1538.072
	(437.910)	(523.879)	(532.276)	(736.148)
Explanatory variables				
Basic Variables				
Wage (After tax)	761.413	645.814	1487.486	1106.002
	(378.447)	(346.085)	(655.464)	(647.415)
Non-wife income	437.788	379.929	382.903	406.931
	(169.688)	(128.590)	(130.231)	(151.321)
Age	35.452	35.017	34.350	34.885
	(4.265)	(4.159)	(4.692)	(4.501)
# Kids $\leq$ age 6	0.485	0.541	0.556	0.524
	(0.721)	(0.732)	(0.759)	(0.741)
Household Characteristics				
†Living with parents	0.401	0.372	0.473	0.434
	(0.490)	(0.484)	(0.499)	(0.496)
Assets				
Assets (in 10,000 yen)	483.971	376.269	686.442	574.613
	(1,021.527)	(808.890)	(1,340.496)	(1,180.478)
Monthly loan	8.576	8.079	8.721	8.611
payment (in 10,000 yen)	(17.753)	(13.802)	(18.509)	(17.870)
†Own a house	0.587	0.450	0.572	0.570
	(0.492)	(0.499)	(0.495)	(0.495)
Job Characteristics				
†Manufacturing	0.143	0.160	0.176	0.160
	(0.350)	(0.368)	(0.381)	(0.367)
†Retail	0.348	0.355	0.139	0.247
	(0.477)	(0.480)	(0.346)	(0.431)
†Service	0.311	0.351	0.271	0.294
	(0.463)	(0.478)	(0.444)	(0.456)
# Employees	265.188	272.937	514.935	387.147
	(368.191)	(366.456)	(434.167)	(420.197)
†Full-time	0.042	0.238	0.826	0.437
	(0.200)	(0.427)	(0.379)	(0.496)
†Managerial	0	0	0.007	0.003
position	-	-	(0.084)	(0.059)
Human Capital and Other Characteristics				
Wife's labor market	11.506	12.750	14.345	12.976
experience (years)	(4.281)	(4.102)	(4.827)	(4.743)
Wife's education	14.102	14.017	14.408	14.245
(years)	(1.068)	(1.374)	(1.122)	(1.130)
Mother-in-law's	10.735	10.528	10.723	10.714
education(years)	(1.746)	(1.686)	(1.565)	(1.657)

(a) † indicates that the variable is a dummy variable. (b) Inside the parentheses are the standard deviations.

Table 4: OLS, 2SLS and Fixed Effect results

	OLS Results		**2SLS Results**				**Fixed effect**	
	Dependent var=		**Segment III**		**Segment I**		Dependent var=	
	Log(hours worked)		Log	Log	Log	Log	Log(hours worked)	
	Seg. III	**Seg. I**	Hour eq.	Wage eq.	Hour eq.	Wage eq.	**Seg. III**	**Seg. I**
log(After tax	**-0.489**^{a}	**-1.283**^{a}	0.096		**-4.008**^{a}		**-0.648**^{a}	**-1.214**^{a}
wage)	(0.021)	(0.043)	(0.123)		(0.665)		(0.034)	(0.063)
Non-wife income	**0.038**^{a}	-0.009	-0.012	**0.086**^{a}	0.028	0.010	0.015	0.006
(1 million yen)	(0.0001)	(0.0001)	(0.013)	(0.009)	(0.026)	(0.008)	(0.011)	(0.012)
Age	0.003	-0.002	0.001	**-0.009**^{b}	**-0.021**^{b}	-0.003	**0.018**^{a}	**0.032**^{a}
	(0.002)	(0.004)	(0.002)	(0.004)	(0.010)	(0.003)	(0.003)	(0.010)
# Kids $\leq$ age 6	**-0.018**^{b}	**-0.086**^{a}	**-0.038**^{a}	**0.037**^{a}	0.013	**0.034**^{a}	**-0.036**^{a}	**-0.091**^{b}
	(0.008)	(0.025)	(0.013)	(0.013)	(0.058)	(0.017)	(0.011)	(0.041)
Live with	0.007	-0.002	**0.082**^{a}	**-0.136**^{a}	**-0.143**^{b}	**-0.048**^{b}	0.014	0.036
parents	(0.014)	(0.033)	(0.024)	(0.024)	(0.071)	(0.020)	(0.033)	(0.088)
Assets	**0.001**^{b}	**0.002**^{b}	0.000	**0.001**^{b}	0.003	0.000	(0.0004)	0.001
(1 million yen)	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.001)	(0.0004)	(0.001)
Monthly Loan	-0.001	0.067	-0.008	0.015	0.005	-0.015	0.013	0.031
(1 million yen)	(0.026)	(0.069)	(0.033)	(0.047)	(0.129)	(0.039)	(0.028)	(0.063)
Own a house	0.009	0.034	0.007	0.008	0.017	-0.003	-0.038	0.044
	(0.015)	(0.033)	(0.019)	(0.024)	(0.067)	(0.021)	(0.023)	(0.055)
Manufacturing	**-0.059**^{a}	**0.072**^{c}	0.008	**-0.121**^{a}	**-0.203**^{c}	**-0.105**^{a}	0.012	0.153
	(0.014)	(0.042)	(0.025)	(0.027)	(0.109)	(0.030)	(0.067)	(0.095)
Retain	-0.016	**-0.066**^{c}	**0.054**^{c}	**-0.114**^{a}	**-0.159**^{c}	**-0.053**^{c}	0.022	0.060
	(0.020)	(0.039)	(0.032)	(0.032)	(0.084)	(0.028)	(0.078)	(0.095)
Service	0.008	0.009	0.037	-0.032	**0.301**^{a}	**0.085**^{a}	0.044	0.098
	(0.017)	(0.044)	(0.024)	(0.026)	(0.121)	(0.031)	(0.050)	(0.081)
Log(#employees)	**0.028**^{a}	**0.013**^{c}	-0.002	**0.052**^{a}	**0.025**^{c}	0.003	-0.013	**0.037**^{a}
	(0.005)	(0.007)	(0.009)	(0.007)	(0.014)	(0.005)	(0.010)	(0.014)
Full-time	**0.218**^{a}	**0.176**^{a}	0.025	**0.303**^{a}	-0.385	**-0.195**^{a}	**0.070**^{c}	0.094
	(0.019)	(0.054)	(0.048)	(0.027)	(0.271)	(0.079)	(0.038)	(0.073)
Managerial	**0.111**^{c}		0.070	0.065			**0.084**^{a}	
position	(0.063)		(0.093)	(0.149)			(0.020)	
Wife's	**0.033**^{a}	-0.012	**0.015**^{c}	**0.037**^{a}	0.044	0.017		
education	(0.006)	(0.014)	(0.008)	(0.009)	(0.036)	(0.011)		
Mother's	**10.091**^{a}	**15.235**^{a}		**0.215**^{a}		0.000		
education	(0.153)	(0.361)		(0.065)		(0.072)		
(Mother's				**-0.009**^{a}		0.000		
education)^2				(0.003)		(0.003)		
Mother-in-law's				0.095		-0.011		
education				(0.081)		(0.070)		
(Mother-in-law's				-0.004		0.000		
education)^2				(0.004)		(0.003)		
Labor market				**0.019**^{a}		**-0.011**^{a}		
experience				(0.003)		(0.003)		
Constant	**10.091**^{a}	**15.235**^{a}	6.650	**4.182**^{a}	**32.566**^{a}	**6.451**^{a}	**11.626**^{a}	**13.262**^{a}
	(0.153)	(0.361)	(0.746)	(0.558)	(4.240)	(0.510)	(0.229)	(0.555)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R squared(a)	0.417	0.447		0.389		0.106	0.551	0.391
							(within)	(within)
# obs	1555	1413	1555	1555	1413	1413	1555	1413

Note (a) R squared for the 2SLS hours worked equations are not reported since they are negative. (b) Inside the parentheses are robust standard errors. (c) a Significant at 1%, b Significant at 5%, c Significant at 10%

Table 5: Joint estimation incorporating unobserved heterogeneity term

	Segment III		Segment I		Segment	Labor force
	Log(Hour) equation	Log(Wage) equation	Log(Hours) equation	Log(Wage) equation	selection equation(a)	participation equation(b)
Log(After tax wage)	**-0.603**[a]		**-1.287**[a]			
	(0.014)		(0.055)			
Non-wife income (1 million yen)	**0.033**[a]	**0.072**[a]	-0.006	**0.014**[a]	**-0.453**[a]	0.032
	(0.004)	(0.006)	(0.012)	(0.005)	(0.073)	(0.040)
Age	0.003	**-0.013**[a]	-0.003	0.001	**-0.203**[a]	**-0.121**[a]
	(0.002)	(0.003)	(0.005)	(0.003)	(0.039)	(0.030)
# Kids $\leq$ age 6	**-0.043**[a]	0.005	**-0.079**[a]	**0.054**[a]	**-1.118**[a]	**-1.355**[a]
	(0.008)	(0.011)	(0.022)	(0.013)	(0.148)	(0.067)
Living with parents	**0.027**[c]	**-0.100**[a]	-0.009	**-0.063**[a]	**0.459**[c]	**0.606**[a]
	(0.015)	(0.019)	(0.030)	(0.022)	(0.239)	(0.164)
Assets (1 million yen)	0.007	0.0005	0.002	0.0007	-0.002	**-0.018**[a]
	(0.005)	(0.001)	(0.002)	(0.001)	(0.022)	(0.005)
Monthly loan (1 million yen)	0.001	0.025	0.064	-0.017	0.355	0.103
	(0.004)	(0.058)	(0.115)	(0.081)	(0.527)	(0.353)
Own a house	0.008	0.004	0.028	-0.020	0.006	**0.526**[a]
	(0.014)	(0.020)	(0.034)	(0.023)	(0.226)	(0.152)
Manufacturing	**-0.031**[c]	**-0.080**[a]	0.074	**-0.102**[a]	-0.351	
	(0.018)	(0.020)	(0.066)	(0.032)	(0.250)	
Retail	**-0.044**[a]	**-0.125**[a]	-0.053	-0.036	**-1.195**[a]	
	(0.017)	(0.025)	(0.046)	(0.025)	(0.239)	
Service	-0.015	**-0.048**[b]	0.021	**0.096**[a]	-0.288	
	(0.014)	(0.022)	(0.047)	(0.025)	(0.239)	
log(#employees)	**0.019**[a]	**0.035**[a]	**0.013**[c]	0.003	**0.146**[a]	
	(0.003)	(0.005)	(0.007)	(0.005)	(0.048)	
Full-time	**0.279**[a]	**0.323**[a]	0.172	**-0.197**[a]	**4.676**[a]	
	(0.014)	(0.020)	(0.133)	(0.038)	(0.215)	
Managerial position	0.042	-0.012				
	(0.118)	(0.104)				
Wife's education	**0.046**[a]	**0.053**[a]	-0.015	-0.004	**0.571**[a]	**0.349**[a]
	(0.005)	(0.009)	(0.0141)	(0.009)	(0.122)	(0.083)
Mother's education		**0.134**[b]		0.001	0.653	0.047
		(0.059)		(0.088)	(0.879)	(0.658)
(Mother's education)^2		**-0.006**[b]		0.0004	-0.033	-0.007
		(0.003)		(0.004)	(0.039)	(0.029)
Mother-in-law's education		0.034		0.093	**-1.577**[c]	**-3.671**[a]
		(0.069)		(0.076)	(0.837)	(0.761)
(Mother-in-law's education)^2		-0.001		-0.004	**0.067**[c]	**0.159**[a]
		(0.003)		(0.003)	(0.036)	(0.034)
Labor market experience		**0.022**[a]		**-0.027**[a]	**0.437**[a]	**0.617**[a]
		(0.003)		(0.004)	(0.039)	(0.029)
Constant	**10.621**[a]	**4.827**[a]	**15.320**[a]	**6.143**[a]	-0.932	**14.177**[a]
	(0.125)	(0.506)	(0.445)	(0.592)	(6.303)	(5.547)
χ_i (ρ_j for j=1,..6)	**-0.142**[a]	**-0.160**[a]	0.035	**0.136**[a]	**-2.841**[a]	**-2.941**[a]
	(0.008)	(0.010)	(0.023)	(0.023)	(0.243)	(0.137)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes

Note: (a) The 'dependent variable' is B_{it}=1 if the individual chooses the budget segment III, and B_{it}=0 if otherwise. (b) The 'dependent variable' is I_{it}=1 if the individual participate in the labor force, and I_{it}=0 if otherwise. (c) Inside the parentheses are standard errors. (d) a Significant at 1%, b Significant at 5%, c Significant at 10%. (e) Log likelihood = -4825.54906. (f) The null hypothesis that ρ_j for j=1,...,6 are simultaneously equal to zero is rejected (log likelihood ratio test statistic is 2018.269).

Figure 1: Budget Constraint for a Typical Wife

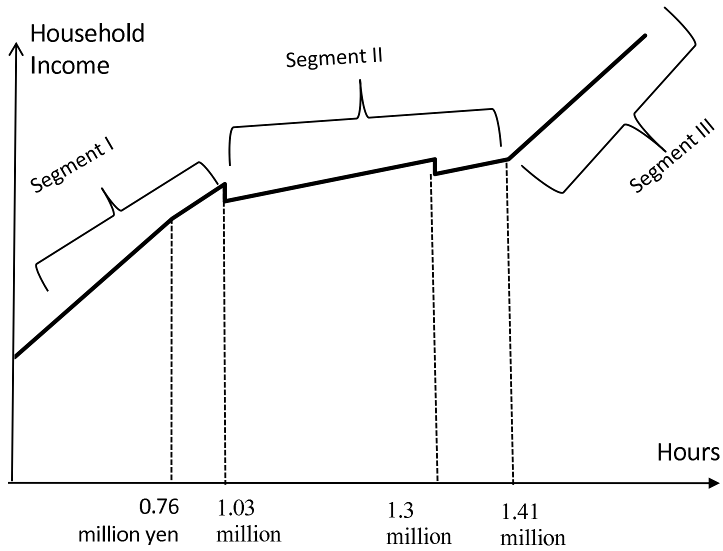
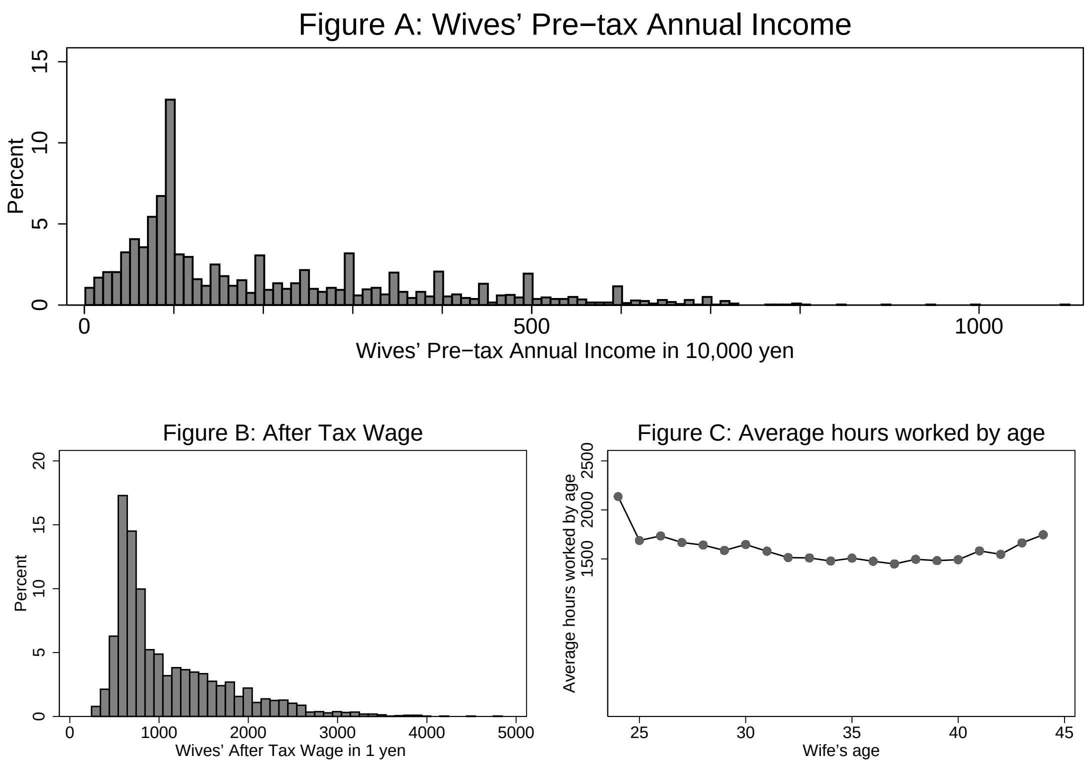


Figure 2: Graphs of Annual Income, Wage and Hours Worked



Appendix: The likelihood function

For brevity, consider the following model.

$$h_{it} = \alpha' X_{it} + (\rho_1 \chi_i + \epsilon_{it}) \tag{12}$$

$$I^*_{it} = \beta' Z_{it} + (\rho_2 \chi_i + v_{it}) \tag{13}$$

We assume that $\epsilon_{it} \sim N(0, \sigma^2_\epsilon)$, $v_{it} \sim$ *logistic*, and $\chi_i \sim N(0,1)$. The individual participate in the labor force if $I^* > 0$. The likelihood contribution of i^{th} individual conditional on χ_i is written as

$$\begin{aligned} L_i(\Phi|\chi_i) &= \prod_t \phi(h_{it} - \alpha' X_{it} - \rho_1 \chi_i, \sigma^2_\epsilon) \\ &\times [1 - logit(\beta' Z_{it} + \rho_2 \chi_i)]^{1-I_{it}} [logit(\beta' Z_{it} + \rho_2 \chi_i)]^{I_{it}} \end{aligned} \tag{14}$$

where $\phi(\mu, \sigma^2)$ is the normal density function with mean μ and variance σ^2, and logit(v)= $e^v/(1+e^v)$. $I_{it} = 1$ if the individual participates in the labor force, and it is 0 if otherwise. To obtain the unconditional likelihood function, we integrate out χ_i by applying the Gauss-Hermite approximation to normal integral with 25 mass points. This is written as

$$L_i(\Phi) \approx \sum_{k=1}^{20} w_k L_i(\Phi|v_k) \tag{15}$$

where weights w_k and support v_k are computed by Gauss-Hermite quadrature. The likelihood function is obtained by multiplying $L_i(\Phi)$ over all i.