The effects of the 1.03 million yen ceiling in a dynamic labor supply model *

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Abstract

In this paper, I examine the effects of the "1.03 million yen ceiling" in a dynamic labor supply model with endogenous retirement. In Japan, married women have reasons to constrain their annual earnings to less than or equal to 1.03 million yen in order to receive various benefits available for low-income wives, and in fact, many married women choose to do so. Optimal labor supply choices in a dynamic model exhibit a pattern that is not seen in a static framework, which I call the "spillover effect." The welfare consequences of the ceiling are also discussed.

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Key words: 1.03 million yen ceiling, part-time work, dynamic labor supply model

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1 Introduction

The ”1.03 million yen ceiling,” which describes the behavior that married women who work on a part-time basis try to constrain their earnings to less than or equal to 1.03 million yen (roughly equal to 9,200 US dollars), has attracted much attention in recent policy debates over Social Security reform and tax reform in Japan. Wives of salary-earner husbands whose earnings do not exceed 1.03 million yen are eligible to receive several types of benefits. The benefits include the following: (1) a married woman with low earnings is eligible for Social Security and health care benefits through her husband's coverage, (2) the husband can claim the Exemption for Spouse or the Special Exemption for Spouse on his income tax return, and (3) the husband often receives allowance for spouse from his employer, if the wife's earnings are lower than a specified threshold.

Work disincentive effects of the 1.03 million yen ceiling are pointed out by Higuchi (1995), Nagase (1997), Akabayashi (2004), Nagase and Nawata (2005), and Abe and Ohtake (1995), among others, in a framework of static labor supply. In the previous literature, the 1.03 million yen ceiling is criticized for two reasons. First, it distorts labor supply by married women, causing efficiency loss. Evidence shows that the earnings of married part-time women workers are heavily concentrated around 1-million yen (Akabayashi (2004), Oishi (2003), Nagase and Nawata (2005), Abe and Ohtake (1995), Abe (2003)): if married women reduce their hours of work even though their marginal product of labor exceeds their marginal disutility from labor, the ceiling introduces distortion in labor supply.[1]

The second criticism is from equity consideration. Married women who earn less than 1.03 million yen pay no income tax and no Social Security taxes, although they are eligible for health and public pension benefits through their husbands' coverage.[2] The wife's earnings up to 1.03 million yen are almost tax-free, while, if a middle-income person earns an additional 1 million yen, the marginal tax rate would be at least 19 percent.[3]

[1] The threshold value was 1 million yen from 1989 to 1994, so the analyses using the data for this period uses the word ”1 million yen ceiling” for the threshold.

[2] Of these, public pension and health care benefits are provided for wives with annual earnings less than 1.3 million yen, instead of 1.03 million yen. Evidence indicates that the concentration mainly occurs at 1.03 million yen, instead of 1.3 million yen.

[3] The marginal tax rate is calculated by adding the employees' portion of Social Security taxes (about 12 percent), income tax (the lowest rate is 10 percent), and local taxes (the lowest rate is 5

Although the 1.03 million yen ceiling has attracted much attention, little is known about the dynamic consequences of the ceiling. Previous studies that examined the effect of the ceiling on part-time labor supply almost always used a static framework. In this paper, I use a simple dynamic labor supply model and a numerical example to assess the consequences of the 1.03-million-yen ceiling.[4] The labor supply schedule in a dynamic model has properties that are not present in a static framework, which I call the "spillover effect" in this paper.

The rest of the paper is organized as follows. Section 2 provides a brief summary of the Japanese income and Social Security participation rules that are relevant for married women's labor supply decisions. In Section 3, two sets of empirical evidence on part-time work are presented in order to motivate the subsequent analysis. Section 4 presents a dynamic labor supply model, and properties of optimal labor supply choices and efficiency consequences of the 1.03 million yen ceiling are discussed. Section 5 uses a numerical example to illustrate the results of Section 4. Section 6 concludes.

2 Tax and Social Security Systems

In this section, the income tax and Social Security system concerning labor supply of married women are explained briefly.[5] In Japan, Social Security enrollment rules and firm benefit policies create work disincentive effects for married women.

The social insurance participation rules relevant for low-income married women are as follows: when the wife's earnings are below 1.3 million yen per year, she is eligible to receive Social Security and health care benefits as a dependent of the salary-earner husband. So, for example, when the wife works part-time, as long as her earnings are below 1.3 million yen, she does not have to contribute Social

percent), taking into account the deductions for Social Security contributions and for employment income.

[4]Means-tested transfers with discontinuous jump in a static budget constraint are found in other settings as well. Medicaid in the United States creates a budget constraint with the "Medicaid notch" (Gruber 2000). The public pension benefit of the working elderly used to be cut discretely for earnings exceeding a threshold, although such features were eliminated in several steps from 1989 to 2005 (Ohtake and Yamaga 2004; Abe 2001).

[5]A detailed and thorough explanation of the tax and Social Security system that affects married women's labor supply in Japan can be found in Akabayashi (2004), Yamada (2004), and Nagase and Nawata (2005) among others.

Security insurance premiums out of her earnings, yet she is eligible to receive benefits through the husband's coverage. On the other hand, if the working hours of a part-time employee exceed 30 hours per week, the employer has to enroll her in Employees' Pension Program and has to provide employer-provided health insurance. Overall, to avoid paying social insurance contributions (insurance premium for public pension, health insurance, and unemployment insurance), the wife has reasons to limit her hours of work.

Furthermore, in many cases, as long as the wife's earnings are less than or equal to 1.03 million yen per year, the husband's employer provides an allowance for the spouse as a part of the husband's fringe benefits. Since this allowance is usually cut completely once the earnings exceed the threshold, it is likely to create work disincentive effects in the wife's labor supply. The income tax system creates kinks in the budget constraint at several points at the annual earnings between 1.03 million yen to 1.65 million yen.

A typical budget constraint for married women who intends to work on a part-time basis is shown in Figure 1a. For married women, the marginal tax rate for earnings between 1.03 million yen and 1.41 million yen is quite high. Furthermore, there are sizable lump-sum Social Security taxes either at the earnings of 1.3 million yen or at the weekly hours of 30 hours. Note also that the marginal tax rate falls rather substantially for earnings over 1.41 million yen. Therefore, although there is a severe penalty for earning between 1.03 million and 1.41 million yen, once the earnings exceed 1.41 million, the marginal penalty for work diminishes.

The 1.03 million yen ceiling is most relevant for married female part-time employees with salary-earner husbands. Female full-time employees usually earn much more than 1 million yen, so the ceiling is irrelevant for them. It is likely to be irrelevant for self-employed and family workers because the tax treatment of self-employed income is different from that for wage/salary earners, and family workers are less likely to be married to salary-earner husbands.

3 Stylized facts surrounding the 1.03 million yen ceiling

3.1 Concentration of Earnings around 1.03 million yen

As explained in Section 2, the static budget constraint for married women who work part-time has a discontinuous dip at annual earnings of 1.03 million yen. With such a budget constraint, it is expected that this group of workers has reasons to constrain hours of work so that the earnings remain 1.03 million yen or less. In the following, I present evidence of the extent to which this occurs.

In Figure 2 and Figure 3, the earnings distributions for female part-time workers are plotted by using the data from the General Survey of Part-time Workers Conditions (GSPWC) in 1990 and 1995 (Ministry of Labor of Japan). For comparison purposes, the distributions for married women (Figure 2) and single women (Figure 3) are shown separately. Single women generally are not eligible for the types of benefits married women receive. The figures for both 1990 and 1995 clearly indicate that the married women's earnings had a concentration around 1.03 million yen, while no such patterns are observed for single women. This suggests that the 1.03 million yen ceiling is a binding constraint in determining married women's part-time labor supply.

3.2 The "Continuity" in Participation in Part-time Work

Next, I present evidence on participation patterns in part-time work by senior high school graduate women, by cohort. Part-time work is most prevalent for middle-aged senior high school graduates, so I focus on this group here. Figure 4 illustrates the cohort experiences of participation in part-time work by using 4 cross sections (years 1987,1992,1997 and 2002) of the Employment Status Surveys (the Ministry of Public Management, Home Affairs, Posts and Telecommunications of Japan).[6] Specifically, the ratios of the number of part-time employees to population (called part-time employment ratio in the following) are plotted against age for various cohorts of female senior high school graduates.

[6] A more detailed description of women's labor force experiences using the repeated cross sectional data of the Employment Status Surveys is found in Abe (2005).

There are significant cohort differences in the likelihood of participating in part-time employment. Later cohorts of female high school graduates are much more likely to work as part-time workers than earlier cohorts are. It is also notable that the part-time employment ratio does not decline with age until around age 60. Since the cohort differences are large, the cross sectional profile that relates participation to age does not mimic the retirement pattern of each cohort. The pattern in Figure 4 also suggests that part-time workers have a strong attachment to work.[7] At the same time, it illuminates the importance of considering dynamic aspects (such as continuation in part-time employment or timing of retirement) in understanding labor supply of female part-time workers. In the rest of the paper, I confine attention to the behavioral and efficiency consequences of the 1.03 million yen ceiling in a dynamic labor supply model.

4 A Dynamic Labor Supply Model

In this section, I present a simple dynamic model of labor supply, in order to assess behavioral consequences of the 1.03 million yen ceiling. The main differences in the following framework from other research are *endogenous retirement* and *consumption smoothing*. The importance of consumption smoothing in analyzing labor supply has been pointed out in the literature on intertemporal labor supply (MaCurdy 1981; Blundell and MaCurdy 1999; and others). Heckman, Lochner and Cossa (2003) incorporate the Earned Income Tax Credit (EITC) in the United States in a dynamic model of labor supply and skill formation, to simulate the implications of the on-the-job-training model and those of the learning-by-doing model. Sefton, Van de Ven and Weale (2005) use a simulation model of retirement behavior with the means-tested transfer system in assessing the impact of the transfer systems in the UK and Denmark.

[7] Since the data used here are repeated cross sections, the retirement is measured by the net decline in participation within each cohort. It may accompany an increase in participation for some and an increase in exit by others. Therefore, it is not necessarily retirement in a usual sense.

4.1 Model

The model I use is a simple dynamic labor supply model in which a worker retires because the value of her leisure increases as she ages. The utility is additively separable over time, and the worker maximizes the present discounted value of the utility function. For simplicity, it is assumed that the woman makes decisions from AGE_0 to $AGE_0 + T$. To simplify the notation, the time period is denoted as woman's age minus AGE_0, thus from year 0 to year T, where T is fixed and exogenous. T is set to 24 (so the total number of period is 25 years) because this model is concerned with retirement behavior of women who enter the workforce in their late 30s or 40s. The household maximizes the following utility function, which is a simplified version of Gustman and Steinmeier (1986):[8]

$$\sum_{t=0}^{T} \rho^t u(C_t, \overline{L} - h_t, t) = \sum_{t=0}^{T} \rho^t \{\ln(C_t - \overline{C}) + \alpha_t \ln(\overline{L} - h_t)\}, \tag{1}$$

where t denotes the index for year, C_t is consumption in year t, $\overline{C}$ is the subsistence level of consumption, $\overline{L}$ is the annual time endowment, h_t is the hours of work in year t, and ρ is the discount rate. $\overline{L}$ is assumed to be fixed over time. The one-period utility depends on consumption and the wife's leisure time. The α_t grows as the worker ages, reflecting that the value of leisure increases with age. With this utility function, retirement occurs because the (marginal) disutility of work increases with age. Note that the utility function is additively separable over time, and consumption and leisure are separable within period.

The budget constraint is:

$$A_0 + \overline{A} + \sum_{t=0}^{T} \frac{w_t h_t + TRF_t - C_t}{(1+r)^t} = 0, \tag{2}$$

where $A_0 + \overline{A}$ is the asset level at the beginning, w_t is the hourly wage rate of the wife, TRF_t is the transfer payment received by the household in period t, and r is the interest rate at which the household borrows and saves. $\overline{A}$ is equal to the present discounted value of the subsistence level of consumption for each period (i.e., $\overline{A} = \sum_{t=0}^{T} \frac{\overline{C}}{(1+r)^t}$). Rewriting equation (2) gives:

[8]Alternatively, Burtless and Moffitt (1985) assume that the fixed cost of work increases as the worker ages.

$$A_0 + \overline{A} + \sum_{t=0}^{T} \frac{w_t h_t + TRF_t - (C_t - \overline{C}) - \overline{C}}{(1+r)^t}, \tag{3}$$

$\overline{A}$ and $\sum_{t=0}^{T} \frac{\overline{C}}{(1+r)^t}$ cancel out in equation (3). A_0 is called as "initial asset" level in the rest of the paper; however, in understanding the value of the initial asset in numerical examples, it should be understood as the surplus over the present discounted value of minimum consumption. Furthermore, the asset level in time t, denoted A_t in the rest of the paper, is the surplus of the household's asset in time t over the present discounted value of minimum consumption from time t to time T: in other words, at time t, the household possesses asset equal to $\sum_{s=t}^{T} \frac{\overline{C}}{(1+r)^s} + A_t$.

An implicit assumption made here is that the husband's labor supply is unaffected by the wife's labor supply, so the discounted sum of the husband's earnings is included in $A_0 + \overline{A}$. For simplicity, it is assumed that $\rho = 1/(1+r)$.[9]

The term TRF_t is determined as follows:

$$TRF_t = \begin{cases} TRF & \text{if } w_t h_t \leq \theta \\ 0 & \text{otherwise,} \end{cases} \tag{4}$$

where θ is the threshold value of earnings. The household receives transfer benefits of amount TRF in year t, as long as the wife's earnings are less than or equal to the threshold (θ), including the case that she does not work at all. When her earnings are more than the threshold value, the household is ineligible for receiving the transfer payment. This is the simplest form of means-tested transfer. In the context here, the benefits represent the allowance for spouse from the husband's employer, and the amount of Social Security contributions from which the wife is exempted by being a low-income dependent of the salary-earner husband.[10] This abstracts the main features of the Japanese Social Security system and the firms' fringe benefit policies explained in Section 2. The static budget constraint has a dip at the point where the wife's earnings exceed the threshold, because the wife

[9]The same assumption is made in Hubbard, Skinner and Zeldes (1995) and Hyslop (2001).

[10]The assumption here means the wife can receive benefits after her retirement. This may not be quite consistent with reality in the following sense. If the husband is older than the wife, he is likely to retire from his career job sometime around the wife's retirement. When he retires, he stops receiving allowance for spouse from his employer. In addition, when the husband is not working, the wife is much less likely to be covered by the husband's public pension and health insurance.

(or the household) loses a fixed sum of benefits at that point; thus, it is nonlinear and non-convex. Figure 1b shows the simplified single-period budget constraint of equation (4). The simplification is motivated by the fact that, from the earnings tabulation in Figure 2, the 1.03 million yen ceiling seems to influence labor supply choices more significantly than any other non-linearities and non-convexities in the budget constraint.

Since retirement is one of the main focuses of the present analysis, the following constraint is also imposed:

$$h_t \geq 0. \tag{5}$$

It is assumed that the wife chooses her hours of work for each period to maximize her dynamic utility, under perfect foresight. The model solves for the optimal labor supply choices of the wife ($h_t, t = 0, 1, \cdots, T$) and the household's consumption ($C_t, t = 0, 1, \cdots, T$). The wife's optimal labor supply determines the receipt of transfer at each period.

The model here differs from many of the intertemporal labor supply models in the following two ways. First, due to the means-tested transfer, the static budget constraint has a discrete dip at the point where the earnings reach the threshold. This is similar to fixed cost of work, but here, the dip is located at a point of positive working hours, instead of at the point of zero hours (work vs. no-work margin). [11] Second, in many dynamic models of retirement behavior, choice of working hours is modeled as a discrete variable (for example, Rust and Phelan 1997; Sefton, Van de Ven and Weale 2005). The discrete choice specification is not very attractive here, because the behavior to set earnings equal to, or very close to, the threshold (θ) cannot be captured by a discrete choice of hours. Furthermore, part-time workers in Japan have more flexibility in their choices of working hours than other workers do, which makes it reasonable to model the working hours as a continuous variable.

4.2 Value Functions and the Conditions for the Optimum

In this subsection, I present the conditions for the optimal labor supply choice when the household faces the means-tested transfer scheme explained above. To

[11] Heckman, Lochner and Cossa (2003) incorporate nonlinearities and noncovexities in the one-period budget set created by the EITC in a dynamic labor supply model.

do so, two value functions are defined. Let the value function for the state when the household chooses to receive benefits in period t be $V^B[A_t, t]$, where the superscript stands for ”Benefits (B).” Likewise, denote the value function for the state where the household chooses not to receive benefits (i.e., the wife's earnings exceed the threshold θ) as $V^{NB}[A_t, t]$, where the superscript stands for ”No Benefits (NB).” Note that the value functions depend on the transfer status in period t.[12]

Let $V[A_t, t]$ be the value function for this dynamic optimization problem. Given the utility function, the budget constraint and the transfer scheme, V^B and V^{NB} are expressed as:

$$V^B[A_t, t] = u(C_t, \overline{L} - h_t, t) + V[(1+r)A_t + w_t h_t + TRF \cdot I(w_t h_t \leq \theta_t) - C_t, t+1], \quad (6)$$

$$V^{NB}[A_t, t] = u(C_t, \overline{L} - h_t, t) + V[(1+r)A_t + w_t h_t - C_t, t+1], \quad (7)$$

where $I(w_t h_t \leq \theta)$ is an indicator function that takes value 1 if the earnings do not exceed the threshold and zero otherwise. Since the household chooses to receive benefits by constraining hours when it finds that to be worthwhile, the value function for the household in period t ($V[A_t, t]$) is the maximum of V^B and V^{NB}:

$$V[A_t, t] = max(V^B[A_t, t], V^{NB}[A_t, t]). \quad (8)$$

This is the value function that appears in the second term in equations (6) and (7).

In order to derive the optimum, form the Lagrangian to maximize V^B subject to constraints (4) and (5):

$$\begin{aligned} L = u(C_t, \overline{L} - h_t, t) + V[(1+r)A_t + w_t h_t + TRF \cdot I(w_t h_t \leq \theta) - C_t, t+1] \\ + \mu_{1t}(\frac{\theta}{w_t} - h_t) + \mu_{2t} h_t, \end{aligned} \quad (9)$$

where μ_{1t} is the multiplier for the constraint for receiving benefits in period t, and μ_{2t} is the multiplier for the zero-hour constraint in period t. The first order

[12] Working hours become shorter as the wife ages, so for the periods close to retirement, V^B becomes the relevant value function. In early years when the disutility from leisure is small, the wife may choose to earn more than the threshold for a limited number of periods.

conditions for maximizing V^B are:

$$\frac{\partial V^B}{\partial C_t} = \rho^t \cdot u_C - V_A = 0, \tag{10}$$

$$\frac{\partial V^B}{\partial h_t} = -\rho^t \cdot u_L + V_A \cdot w_t - \mu_{1t} + \mu_{2t} = 0. \tag{11}$$

Since the constraints $\theta/w_t - h_t = 0$ and $h_t = 0$ are never satisfied simultaneously, there are three cases to consider: (a) the threshold binds, (b) no work, and (c) interior solution for hours. When the threshold binds $(\theta/w_t - h_t = 0)$, equation (11) implies:

$$\frac{\partial V^B}{\partial h_t} = -\rho^t \cdot u_L + V_A \cdot w_t \geq 0. \tag{12}$$

When $h_t = 0$ binds (i.e. no work), (11) implies:

$$\frac{\partial V^B}{\partial h_t} = -\rho^t \cdot u_L + V_A \cdot w_t \leq 0. \tag{13}$$

In the third case, hours are determined as an interior solution, so both μ_{1t} and μ_{2t} are zero. Then (11) becomes:

$$\frac{\partial V^B}{\partial h_t} = -\rho^t \cdot u_L + V_A \cdot w_t = 0. \tag{14}$$

In the final case, the wife's labor supply is determined at the hours where the marginal disutility is equal to the wage rate multiplied by the marginal value of asset. The first order conditions for the case when the household chooses not to receive benefits (maximizing V^{NB}) are similar to (10) and (14), because hours are determined as an interior solution. Note that earnings have to be more than θ in the NB case.

V_A's in the first order conditions above are the marginal value of asset. Because $\rho = 1/(1 + r)$, $V_A[A_t, t]/\rho^t = V_A[A_0, 0]$. Following previous literature, I denote $V_A[A_0, 0]$ as λ in the rest of the paper. Note that first order conditions are expressed in terms of u_L, u_c, λ and w_t.

4.3 Characteristics of Labor Supply Behavior

In this subsection, properties of the profile of working hours (h_t plotted against t) from the above model are examined. In understanding the effects of the means-tested transfer, the allocation in this case and other cases are compared. The case where the household optimizes under the means-tested transfer is called as the ”Transfer Regime.” The hypothetical case where the transfer system does not exist is called as the ”No-Transfer-Regime.”

The means-tested transfer affects the labor supply choices in three different ways. First, the wealth effect from the transfer payments reduces hours of work and years of work.[13] Second, because of the means-test, the wife sets her earnings exactly equal to the threshold for some of the periods in order to receive benefits. These two effects reduce the wife's hours of work and the number of years she works. Note that these effects are present in most static labor supply models as well. The third effect, which is not found in a static framework, is the transfer's spillover effect on labor supply in years when the threshold does not bind. Hours of work in the non-binding years (the years when $w_t h_t < \theta$ or $w_t h_t > \theta$) tend to be long in the sense explained below. The intuition behind this result is that, in order to partially compensate for the transfer's effects of reducing labor supply (i.e., the first two effects), the wife works long hours in years when the threshold does not bind.

To understand the impacts of the transfer system, it is useful to separate out the wealth effect. To do so, let PDV_TRF be the present discounted value of the transfer payments received by the household at the optimal labor supply choice.[14] Then, find the labor supply and consumption schedules when the initial asset is equal to $A_0 + PDV\_TRF$ in the absence of the transfer system. This is equivalent to giving benefits as a lump-sum payment, and the household spends them as it wishes. Call the allocation in this case ”No-Wealth-Effect (NoWE) case.” Note that the wealth effect created by the means-tested transfer is removed from this allocation, giving the following proposition:

Proposition 1. *Let λ_{MTT} be the marginal utility of asset when the household faces*

[13] In a static model, this effect is referred as income effect. I call it wealth effect because of the dynamic nature of the model.

[14] Note that the value of PDV_TRF depends on the labor supply choices of the wife.

the Means-Tested Transfer, and λ_{NoWE} be that under the No Wealth Effect case. Then:

$$\lambda_{MTT} \geq \lambda_{NoWE}.$$

Proof. Under the Transfer Regime, the household faces a constraint for each period that is nonexistent under the No-Wealth-Effect case. The transfer payment is provided if and only if the wife's earnings in period t are less than the threshold; while under the No-Wealth-Effect case, the benefits are provided as a lump-sum payment. Because the value of the lump sum transfer in the No-Wealth effect case is set equal to the present discounted value of benefits under the Transfer Regime, the household is endowed with the same level of exogenous asset in both cases. Since additional constraints are imposed under the Transfer Regime in minimizing λ, at the optimum, λ_{MTT} is at least as large as λ_{NoWE}. □

Proposition 1 says that the marginal utility of asset under the Transfer Regime, λ_{MTT} is greater than or equal to λ_{NoWE}, reflecting the fact that the means-tested transfer creates distortion. Since the resources provided exogenously are the same for the two cases, the only difference is the distortion stemming from the way transfer payment is provided (whether it is means-tested or lump-sum). Proposition 1 implies the following:

Corollary 1 (Spillover Effect). *Suppose hours in period t are determined as an interior solution. Let the hours under the No-Wealth-Effect case be h_t^{NoWE} and those under the Transfer Regime be h_t^{MTT}. Then:*

$$h_t^{NoWE} \leq h_t^{MTT}.$$

This follows directly from a standard comparative static result on the first order condition for the interior optimum (equation (14) and the similar equation for No-Benefit state), using Proposition 1.

Corollary 1 is understood as the "spillover effect" of the ceiling. Under the Transfer Regime, the wife supplies more hours than she would under the No-Wealth-Effect case for the periods she chooses not to set her annual earnings equal to the threshold. In the retirement context, Corollary 1 means that the hours just before retirement tend to be longer under the Transfer Regime than those under the No-Wealth-Effect case. The reason is the following: because α_t parameter in the

utility function (the coefficient attached to leisure) increases with age, working hours decline as the wife ages. After a certain point, the ceiling does not bind any more since the unconstrained hours do not yield earnings that exceed the threshold. In those periods, the wife tends to supply more labor than the case where the means-tested transfer is absent, after controlling for the wealth effect. Note that this effect comes through λ : the threshold makes the wife earn less in the constrained periods, which increases the value of λ (Proposition 1). This, in turn, increases hours of work under the Transfer Regime for the periods when the threshold does not bind. The spillover effect may exist for early periods as well. When t is small and α_t is small, the wife may choose to supply hours so that her earnings exceed the threshold. The hours for such periods under the Transfer Regime are longer than the hours under the No-Wealth-Effect case.

4.4 Lifecycle welfare cost of the ceiling

In the nonlinear budget set literature, welfare comparisons for different tax regimes are done by using the expenditure function. Here, I use the method in a dynamic context, following Auerbach and Kotlikoff (1987).[15]

Let U_{MTT} be the present discounted value of the utility under the Transfer Regime, U_{NoWE} be that under the No-Wealth-effect case, and U_{NT} be the present discounted value of the utility when the transfer does not exist. The monetary equivalent for the utility level under the Transfer Regime is calculated by finding the asset level necessary to yield the utility level of U_{MTT} under the No-Transfer Regime. The lifecycle welfare cost of the ceiling is evaluated by comparing the allocation of the No-Wealth-Effect case and the Transfer Regime. To see this point, write the lifecycle deadweight loss as:

$$DWL = PDV\_TRF - \{A(U_{MTT}) - A(U_{NT})\}, \tag{15}$$

where $A(U)$ is the function that gives the value of the initial asset that yields the dynamic utility equal to U under the No-Transfer Regime. Equation (15) can be rewritten as:

[15] A recent example in a static context is Friedberg (2000).

$$
\begin{aligned}
DWL &= PDV\_TRF - \{A(U_{MTT}) - A(U_{NoWE})\} - \{A(U_{NoWE}) - A(U_{NT})\} \\
&= A(U_{NoWE}) - A(U_{MTT}),
\end{aligned}
\tag{16}
$$

The second equality in equation (11) follows because, by definition, $A(U_{NoWE}) - A(U_{NT})$is equal to PDV_TRF: in the No-Wealth-Effect case, the amount equal to PDV_TRF is given to the household as a lump-sum payment. Thus, the dynamic deadweight loss is measured by the difference in the initial asset level that yields utility U_{NoWE} and the initial asset level that yields utility U_{MTT}.

It is interesting to note that dynamic deadweight loss comes from multiple periods, including those years when the worker does not set her hours equal to the threshold. As Corollary 1 shows, hours in the non-binding periods are longer than those attained in the absence of the ceiling, which is also a source of the distortion.

5 An Illustration: A Numerical Example

In this section, I present a numerical example to illustrate the properties of the labor supply patterns for the model presented above and the welfare costs of the ceiling. The model is solved numerically. The solution algorithm used is explained in the Appendix.

5.1 Parameter Values for the Example

Parameters of the model are set as follows. For α_0 (the value of the utility function parameter of the initial period), I use 0.85. This corresponds to 0.46 in the Stone-Geary type utility function where the coefficients attached to the log of consumption add up to 1.[16] The annual endowment of time is 4000 hours.[17] The hourly wage is set to 850 yen, which is a typical wage rate for female part-time workers in Japan. The value of transfer payments (TRF) is set to 210,000 yen per

[16]Hoynes (1996) provides 0.46 as an estimate for the parameter attached to the wife's leisure time in the Stone-Geary utility function. Her model is based on a static labor supply model of low-income couples in the PSID. Hyslop (2001) provides estimates ranging from 0.36 to 0.42, based on the sample of continuously married couples in the PSID.

[17]It is set to 8736 hours per year in Browning, Deaton and Irish (1985) and 90 hours per week (4680 hours per year) in Blundell and Walker (1986).

year, and the threshold value (θ) is set to 1.03 million yen.[18] Asset value at the beginning (A_0) ranges from 8 million yen to 20 million yen. As explained before, this amount is the surplus of the asset level over the present discounted value of the subsistent level of consumption. The hourly wage, the transfer amount, and the threshold value are be fixed for period 0 to T to keep the analysis simple and make the properties of the model as transparent as possible. The parameter values are summarized in Table 1. While only typical labor supply schedules are presented in the following as examples, the model is solved for a range of initial asset levels.

5.2 Hours Profile

In Figure 5-1, the labor supply schedule under the Transfer Regime (thick line with circle markers), that under the No-Transfer Regime (thick line with square markers), and that in the No-Wealth-Effect case (dotted line) are drawn, for the initial asset value (A_0) of 900 million yen. The vertical axis is the annual hours of work of the wife, and the horizontal axis is t (the wife's age minus AGE_0). The properties of optimal hours choices discussed in the previous section are seen in this figure. First, reflecting the wealth effect of the transfer payments, hours under the No-Transfer Regime are longer than under the No-Wealth-Effect case: without the transfer, the wife works longer hours for more periods than she would do under the Transfer Regime. Second, because the transfer is means-tested, the wife sets her earnings equal to the threshold for 10 years in this case, as the flat portion of the schedule of the Transfer Regime from year 3 to year 12 shows. Third, hours in the unconstrained years (for years 0 to 2 and years 13 to 20 in Figure 5-1) are longer under the Transfer Regime than in the No-Wealth-Effect case. This is the spillover effect explained in Corollary 1: in the presence of the means-tested transfer, the wife constrains her hours of work in the interim periods (years 3 to 12 in Figure 5-1) but supplies more hours in the unconstrained

[18] The transfer amount is roughly equal to the workers' portion of the minimum amount of public pension contributions plus the average level of allowance for spouse provided by the husband's employer. The value of 210,000 yen is understood as a lower bound for TRF. As for the value of threshold, the actual value of the tax-exempt limit was 0.9 million yen from 1984 to 1988, 1 million yen from 1989 to 1994, and 1.03 million yen from 1995 to 2004. The income limit for social insurance participation has also been revised several times in the past two decades. The National Pension premium amount has also increased over time.

periods, compared with the hours in corresponding years under the No-Wealth-Effect case. In the retirement context, this means a delay in retirement. In years close to retirement, the threshold no longer binds; thus, Corollary 1 applies. The means-tested transfer discourages labor supply in a single period, but in a model with endogenous retirement, the wife responds by staying in the labor market longer than she would otherwise.

Figure 5-2 illustrates hours schedules for the initial asset levels of 1700 million yen. Because of the high initial asset, the hours schedule does not have a portion with long hours (about 2000 hours per year) at the low t's. The three properties explained above are seen in these cases as well.

Detailed statistics and properties of the optimal labor supply schedules are shown in the left portion of Table 2 for the initial asset level (A_0) of 9 million yen, 12.5 million yen, and 17 million yen. The first row gives the number of years of work. In all of these three examples, the wife retires later under the Transfer Regime than under the No-Wealth-Effect case. For the first two cases (A_0 of 9 million yen and 12.5 million yen), retirement is delayed by 1 year. For A_0 of 17 million yen, it is delayed by 2 years in the same sense. Row (2) shows the number of years with positive hours and earnings less than the threshold. With an initial asset level of 9 million yen, if the transfer system is nonexistent, the wife spends only 8 years such working hours, while, in the presence of the Transfer, 17 out of 20 years of working life are spent with earnings less than the threshold. A similar pattern is observed for other asset levels. Therefore, under the Transfer Regime, married female part-time workers mostly set their hours equal to the threshold, even in a dynamic setting. Row (4) provides the sum of working hours of the wife (summed over the 25 years without discounting hours at different points in time). For the case considered here, it is less under the Transfer Regime than under the No-Wealth-Effect case, by 9-15 percent. Overall, the working hours are reduced because of the transfer system, even though the spillover effect of Corollary 1 partially offsets the work disincentive effects.

The magnitude of the spillover effect can be seen in rows (4) and (5). Row (4) lists the sum of hours of unconstrained years in early periods, which I call ”early-unconstrained years” below. These are the years when the wife is young, her leisure's value is small, and she earns more than the threshold. The indices of time for unconstrained years at the beginning are listed in the first line in row (4) in

square brackets. The second line gives the sum of undiscounted hours from these years. For example, with A_0 of 9 million yen, the first 3 years (from t=0 to t=2) correspond to early-unconstrained years, and the total from the three years is 7216 hours. This is about 4.6 percent longer than the sum of hours for the first three years under the No-Wealth-Effect case. For A_0 of 12.5 million yen, the number of early-unconstrained years is 2, from t=0 to t=1. The magnitude of spillover effects is similar to the case of A_0 is 9 million yen. For A_0 of 17 million yen, the early-unconstrained years do not exist because of the wealth effect of the high initial asset. The magnitude of spillover effects is larger for unconstrained years just before full retirement. These are shown in row (5) of Table 2, in the same manner as row (4). For A_0 of 9 million yen, the last 7 years of working life are the unconstrained years with earnings less than θ. The sum of working hours in these 7 years (from t=13 to t=19) is 4272 hours, while, in the No-Wealth-Effect case, the total hours supplied from year 13 to year 19 would be 2865 hours. Therefore, the spillover effect boosts the hours before retirement by about 49 percent. This example indicates that the magnitude of the spillover effect is sometimes large.

5.3 Welfare Cost of the Ceiling

Rows (6) to (8) of Table 2 give figures that are concerned with the efficiency consequences of the means-tested transfer. The present discounted sum of the transfer payment is shown in row (6). The value of transfer rises as the initial asset of the household increases, so the transfer scheme is regressive in this example. Here, the wives in households with high initial asset supply less part-time labor and are more likely to collect benefits. This is consistent with the concern raised by Oishi (2003) in a discussion of distributional consequences of the 1.03 million yen ceiling. Row (7) lists the value of lifecycle deadweight loss defined in Section 4.4. The ratio of the deadweight loss to the wife's earnings is shown in row (8). The ratio of deadweight loss to the wife's earnings ranges from 3 percent to 5 percent for this example.

5.4 Policy Simulations -Reducing the Threshold Value to 650 thousand yen

In discussions of the 2004 Japanese Social Security Reform, proposals to reduce the earnings (or hours) threshold for Social Insurance participation for low-earning (or low-hours) workers were seriously considered, although such changes were not included in the 2004 reform. Specific proposals offered were: (1) to reduce the required weekly hours for Social Insurance participation at the employer from 30 hours per week to 20 hours per week and (2) to reduce the earnings threshold to be a dependent of the husband to 650 thousand yen, from 1.3 million yen. The rationale for such a proposal is twofold. First, if the value of the threshold is sufficiently low, most part-time workers do not try to constrain their hours of work; thus, work disincentive effects from the threshold are eliminated. Another merit from such a policy change would be to increase the premium revenue of Social Security through more participation by part-time workers, which would improve the financial soundness of the Social Security system. The dynamic labor supply model above is used to examine the effect of work patterns and welfare costs for the policy option of making the threshold value (θ) to be 650 thousand yen from 1.03 million yen.

The right portion of Table 2 shows the statistics for the allocation with the threshold value of 650 thousand yen. Note that the spillover effect is present for this case as well because hours in rows (4) and (5) are smaller in the "Transfer Regime" column than in the "No-Wealth-Effect" column. For this example, reducing the threshold value from 1.03 million to 650 thousand yen increases the total number of hours only slightly; for the three asset levels considered here, total hours in row (3) increase by less than 3 percent. The welfare costs of the ceiling, when the threshold value is reduced to 650 thousand yen, are shown in row (7) of Table 2. The ratio of deadweight loss to the wife's earnings declines a little, although not substantially, compared with the case where the threshold is equal to 1.03 million yen. For example, the ratio declines from 3.1 percent to 2.4 percent when A_0 is 9 million yen. Therefore, in this particular example, welfare cost does not fall much by the proposed policy change. One of the reasons is that, since disutility from work increases with age, at some point, the 650 thousand yen restriction starts to bind. So reducing the threshold value does not necessarily make

the threshold much less likely to bind. If the welfare cost does not fall much by reducing the threshold value, it would be more important to focus on distributional consequences of such policy changes.

6 Conclusion

The 1.03 million yen ceiling is criticized for efficiency and equity considerations (Higuchi 1995, and others). Hatta and Oguchi (1999) propose to remove the threshold for Social Security participation. One of the recent policy proposals calls for reducing the earnings threshold to be covered by the husband's Social Security and health insurance to 650 thousand yen, thereby making it a non-binding constraint (Ministry of Labor, Health and Welfare 2001). To my knowledge, most discussions on this topic are based on a static labor supply framework.

In this paper, I derive optimal labor supply decisions in a dynamic model with endogenous retirement when the 1.03 million yen ceiling is present. I show that the allocation from a dynamic model has a feature that is not captured in a static model. Specifically, when a woman optimizes over multiple years, she tends to set annual hours so that her earnings are equal to the earnings threshold, but she increases hours in unconstrained years (spillover effect). She partially offsets the work disincentive effect of the means-test by increasing her work effort in other years. In retirement context, it can be understood as delayed retirement.

The model by French (2005), which analyzes the dynamic effects of health and Social Security rules on the work effort of older men in the United States, has features somewhat similar to the present model. In his policy simulation analysis, he predicts that the *elimination* of the Social Security Earnings Test would delay retirement. The settings and the basis of comparison are different from his model and the present model, so direct comparisons cannot be made. Nevertheless, note that the spillover effect shown in this paper argues that the *presence* of a means-test delays retirement; therefore, its elimination makes retirement early, keeping other factors constant.

This paper also provides results from a policy simulation exercise of reducing the threshold value to 650 thousand yen by using a numerical example. For the examples considered in the paper, reducing the threshold does not substantially

reduce the welfare cost of the ceiling.

Since evidence suggests that female part-time workers in Japan have a strong attachment to the labor force, more attention should be paid to the dynamic impact of the 1.03 million yen ceiling (or the 1.3 million yen threshold for Social Security Participation) on women's labor supply and its distributional consequences. While the analysis here is motivated by the retirement behavior of female part-time workers in Japan (for whom micro-level panel data are unavailable at the point of this writing), similar considerations may apply to reentry behavior into part-time work by young women. Furthermore, the same kind of dynamic analysis is potentially useful in understanding the effects of other means-tested transfers.

Appendix

In this appendix, the solution algorithm employed to derive the optimal allocation under the Transfer Regime is explained. The problem differs from a standard optimization problem in that the static budget constraint has a discontinuous dip, and therefore, the choice set is non-convex. The problem is complicated at the point where the optimal hours schedule exhibits a change from the state of not receiving benefits to the state of receiving benefits (choice of between V^B and V^{NB} in equation (8) in the text). In order to obtain the optimal allocation for the household, I first use the Maximum Principle technique to derive the candidate solution. While this algorithm is computationally simple, for some asset levels, it does not find an allocation that satisfies the budget constraint. This happens when the two allocations for which the timing of the state change from the No Benefit state (for which the value function is V^{NB}) to the Benefit state (for which the value function is V^B) differs by one year and the two allocations yield similar levels of dynamic utility. For example, when an allocation in which the threshold starts to bind in year 3 and an allocation in which the threshold starts to bind in year 4 give similar levels of utility, the algorithm based on Maximum Principle cannot find the optimum. What happens in such cases is that a small change in the value of the marginal utility of assets (λ) results in a large jump in the terminal asset level, from a large positive value to a large negative value. The source of this jump is the discontinuity created by the transfer payment. For those cases, the value function

is evaluated numerically to approximate the solution using the dynamic programming technique. The evaluation of value function is made simple by the fact that α_t rises over time, so the wife's hours of work never increase as she ages. Therefore, once the household starts to receive transfer, it continues to do so until the final period (T). In the following, the specific procedure using Maximum Principle (MP procedure) and the procedure using dynamic programming are explained in turn.

A.1 Maximum Principle (MP) Procedure

In searching the optimal allocation, I restrict the search to the allocation with the property that the consumption is smoothed. In other words, consumption satisfies the following relationship:

$$\frac{u_c(C_{t+1}, \overline{L} - h_{t+1}, t+1)}{u_c(C_t, \overline{L} - h_t, t)} = \frac{\rho}{1+r} \tag{A1}$$

The reason for limiting the search is as follows. Suppose an optimal allocation does not smooth consumption so (A1) is violated. Then, it is possible to reallocate consumption across periods and improve utility, by keeping the labor supply choices constant (therefore, the total value of the resource constant) and reallocating consumption as equation (A1) is satisfied. Since there is no constraint for the value of consumption other than the budget constraint, such an allocation is feasible. Due to separability of consumption and leisure within period and separability of utility across periods, such reallocation increases the present discounted value of utility. Restricting the search for this type of allocations significantly simplifies the solution search. In order to use the Maximum Principle technique, define the Hamiltonian function as:

$$\begin{aligned} H(A_t, t) =& \rho^t\{(\ln(C_t - \overline{C}) + \alpha_t \ln(\overline{L} - h_t)\} \\ &+ \lambda_t\{rA_t + (1+r)(w_t h_t + TRF_t - C_t)\} \end{aligned} \tag{A2}$$

H(.) is maximized with respect to C_t and h_t, subject equations (4) and (5) in the text. The intertemporal arbitrage condition gives

$$\lambda_t = \frac{\lambda_0}{(1+r)^t}. \tag{A3}$$

This is a standard condition in the intertemporal labor supply models.[19]

The solution algorithm for the MP procedure proceeds as follows:

Step 1. Set an initial value for λ_0. Denote it as $\lambda_{0(1)}$.

Step 2. Find the optimal allocation (C_t and h_t for t=0,1,c.T) given0, by maximizing (A2) with respect to C_t and h_t, subject to (4) and (5) in the text. Denote this allocation as $C_{(1)}$ and $h_{(1)}$, where C is the vector of consumption schedule of $(C_0, C_1, \cdots, C_T)$, h is the labor supply schedule of $(h_0, h_1, , \cdots, h_T)$, where the subscript in parentheses ((1) in this case) stands for the first iteration.

Step 3. Check whether $C_{(1)}$ and $h_{(1)}$ satisfy the budget constraint (equation (2) in the text). Then set the value of λ_0 for the next step ($\lambda_{0(2)}$) to the value that satisfies the budget constraint with $C_{(1)}$ and $h_{(1)}$.

Step 4. Continue Step 1 to Step 3 until the value of λ_0 that is consistent with the budget constraint is found.

In Step 2, the household decides whether it receives benefits or not for each period from t=0 to T. If it decides to receive benefits, the value of $H(.)$ becomes:

$$H(A_t, t) = \rho^t[u(C_t^B, h_t^B, t) + \lambda_0\{rA_t + (1+r)(w_t h_t^B + TRF - C_t^B)\}], \tag{A4}$$

where the superscript B attached to C_t and h_t indicates optimal consumption and hours for the state receiving benefits. If it decides not to receive benefits, $H(.)$ is:

$$H(A_t, t) = \rho^t[u(C_t^{NB}, h_t^{NB}, t) + \lambda_0\{rA_t + (1+r)(w_t h_t^{NB} - C_t^{NB})\}], \tag{A5}$$

where the superscript NB stands for the No-Benefit receipt state. Benefits are received in period t if the following condition is met:

$$\{u(C_t^B, h_t^B, t) - u(C_t^{NB}, h_t^{NB}, t)\} + \lambda_0(1+r)\{(w_t h_t^B + TRF - C_t^B) - (w_t h_t^{NB} - C_t^{NB})\} \geq 0 \tag{A6}$$

[19] λ_0 is denoted as λ in the text. Here, subscript 0 is added to clarify the time period in forming the Hamiltonian.

It can be shown that the conditions for optimum in the MP algorithm are the same as those using the dynamic programming technique, as long as the value function is approximated as a linear function.

A.2 The Dynamic Programming Procedure: Evaluation of the Value Function

I use the above procedure for various values of initial asset levels. For some of the asset values, the allocation that satisfies the optimality conditions and the budget constraint cannot be found by the MP procedure. Such cases are the ones where the number of years with No Benefit state changes by one year (like from 3 years to 2 years) by a small change in the value of λ_0. Using the dynamic programming technique allows me to approximate the solution in cases where the MP procedure does not find the solution. I numerically evaluate the value function at the neighborhood of the value of λ_0 obtained from the MP procedure. Note that the regime change between the state with benefits to the state without benefits (choice of V^B and V^{NB}) occurs only once, from the NB to B. To derive the optimum for the case involving a regime change from the B state to the NB state, the value function is evaluated at grid points of asset levels. For some of computationally costly cases, cubic spline interpolation is used to obtain the value at relevant asset levels. To do so, I use the GAUSS codes of cubic spline routine written by Paul Söderlind.[20] By using the procedure above, the value function is derived for the grid points of initial asset levels from 8 million yen to 20 million yen, by an increment of 100,000 yen, for the parameter values shown in Table 1. The hours schedules for initial asset levels higher than 20 million yen are qualitatively similar to the one when A_0 equals 20 million yen.

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[20]The codes are distributed at the following web site: http://www.american.edu/academic.depts/cas/econ/gaussres/regress/c_spline/c_spline.htm.

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Table 1: Parameter Values for the Numerical Example

Utility Function Parameters

α_0	Value attached to leisure	0.85
g_α	growth rate for α	0.05
ρ	discount rate (=1/(1+r))	0.9804
$\bar{L}$	time endowment (in annual hours)	4000
T+1	Number of years for the optimization (0,1,….T)	25

Policy Parameters

θ	(threshold for earnings, in yen)	1,030,000
TRF	(Transfer Payment per year, in yen)	210,000

Wage and Assets

w_t	(Hourly Wage, in yen, t=0,1…T)	850
A_0	(Initial Asset, in yen)	ranges from 8 million yen to 20 million yen
r	interest rate	0.02

Table 2 Labor Supply Schedules and Deadweight Loss

Asset Level (in 10,000 yen)	900				
Threshold Value (in 10,000 yen)	103			65	
	Transfer Regime	No Wealth Effect	Transfer Nonexistent	Transfer Regime	No Wealth Effect
(1) Total Number of Years worked (years)	20	19	20	20	19
(2) Number of years worked with earnings<threshold	17	8	8	13	4
(3) Total Number of Hours worked (in hours, not discounted)	23606	25993	28678	24066	26567
(4) Total Number of Hours worked in the unconstrained years at the beginning (in hours, not discounted)	[from t=0 to t=2] 7216	[from t=0 to t=2] 6896	---	[from t=0 to t=6] 15675	[from t=0 to t=6] 14936
(5) Total Number of Hours worked in the unconstrained years just before retirement (in hours, not discounted)	[from t=13 to t=19] 4272	[from t=13 to t=19] 2865	---	[from t=15 to t=19] 1508	[from t=15 to t=19] 772
(6) Present Discounted Value of Transfer (10,000 yen)	356.42	---	---	279.56	---
(7) Deadweight Loss from the Transfer Scheme (10,000 yen)	53.82	---	---	43.71	---
(8) Deadweight Loss/Wife's Earnings	0.031	---	---	0.024	---

Table 2 Labor Supply Schedules and Deadweight Loss (continued)

Asset Level (in 10,000 yen)	1250				
Threshold Value (in 10,000 yen)	103			65	
	Transfer Regime	No Wealth Effect	Transfer Nonexistent	Transfer Regime	No Wealth Effect
(1) Total Number of Years worked (years)	19	18	19	19	18
(2) Number of years worked with earnings<threshold	17	8	8	13	5
(3) Total Number of Hours worked (in hours, not discounted)	20929	23341	26041	21393	23899
(4) Total Number of Hours worked in the unconstrained years at the beginning (in hours, not discounted)	[from t=0 to t=1] 4709	[from t=0 to t=1] 4494	---	[from t=0 to t=5] 13106	[from t=0 to t=5] 12471
(5) Total Number of Hours worked in the unconstrained years just before retirement (in hours, not discounted)	[from t=13 to t=19] 4103	[from t=13 to t=19] 2748	---	[from t=15 to t=18] 1405	[from t=15 to t=18] 710
(6) Present Discounted Value of Transfer (10,000 yen)	376.60	---	---	298.21	---
(7) Deadweight Loss from the Transfer Scheme (10,000 yen)	52.79	---	---	42.69	---
(8) Deadweight Loss/Wife's Earnings	0.034	---	---	0.026	---

Table 2 Labor Supply Schedules and Deadweight Loss (continued)

Asset Level (in 10,000 yen)	1700				
Threshold Value (in 10,000 yen)	103			65	
Regime	Transfer Regime	No Wealth Effect	Transfer Nonexistent	Transfer Regime	No Wealth Effect
(1) Total Number of Years worked (years)	18	16	17	18	16
(2) Number of years worked with earnings<threshold	18	7	7	14	4
(3) Total Number of Hours worked (in hours, not discounted)	17133	20058	22842	17538	20583
(4) Total Number of Hours worked in the unconstrained years at the beginning (in hours, not discounted)	0	---	---	[from t=0 to t=3] 8669	[from t=0 to t=3] 8156
(5) Total Number of Hours worked in the unconstrained years just before retirement (in hours, not discounted)	[from t=10 to t=17] 5016	[from t=10 to t=17] 3318	---	[from t=13 to t=17] 1986	[from t=13 to t=17] 1018
(6) Present Discounted Value of Transfer (10,000 yen)	418.19	---	---	336.63	---
(7) Deadweight Loss from the Transfer Scheme (10,000 yen)	66.85	---	---	55.33	---
(8) Deadweight Loss/Wife's Earnings	0.052	---	---	0.041	---

Figure 1a: The Static Budget Constraint

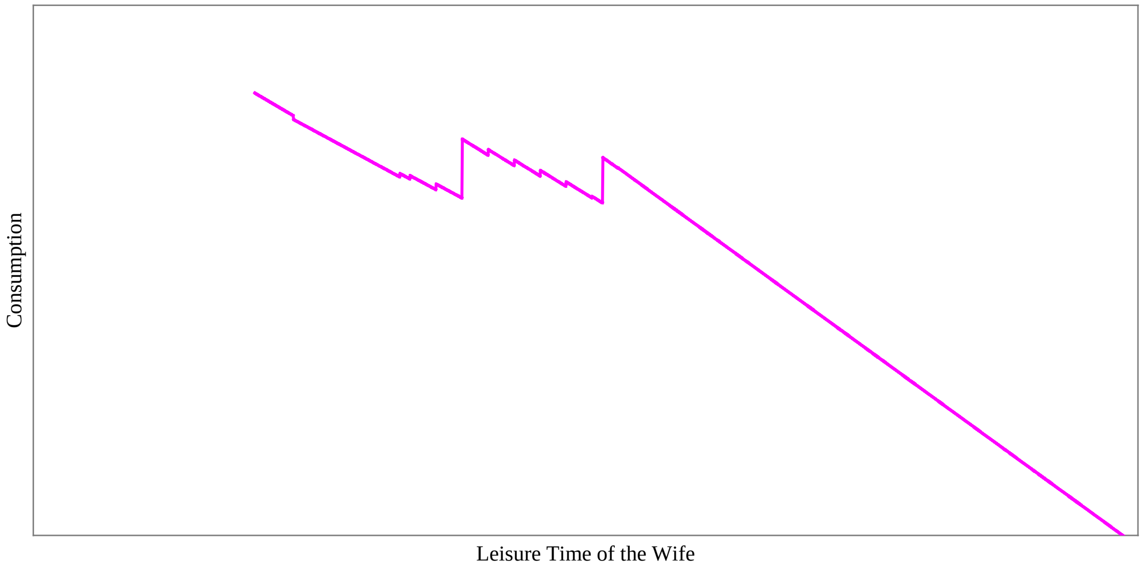
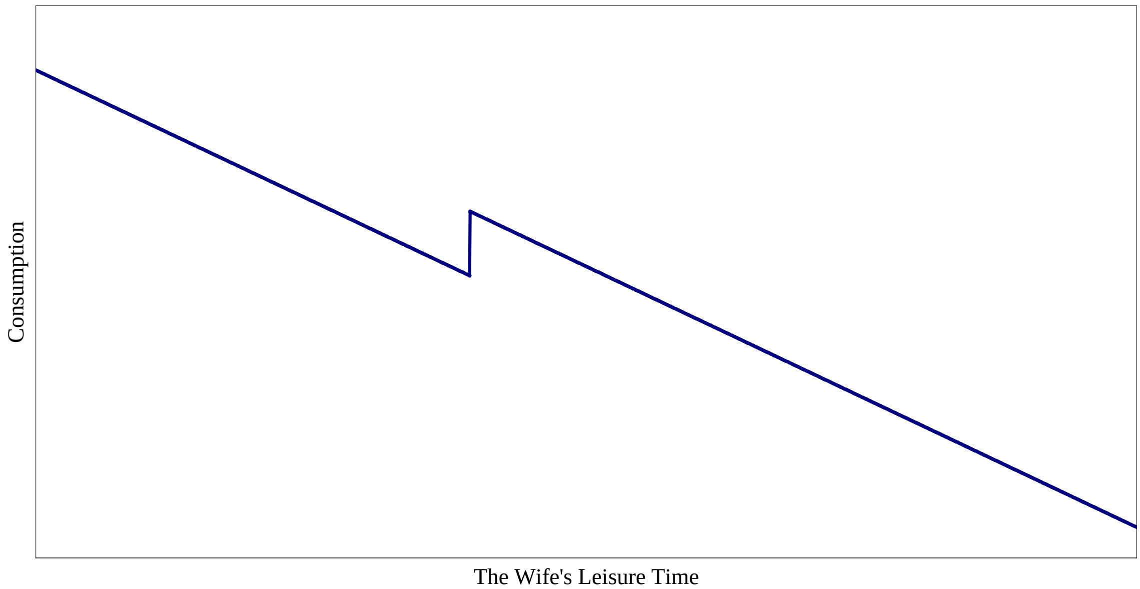


Figure 1b: Transfer System Assumed in the Model
(A simplified single-period budget constraint)



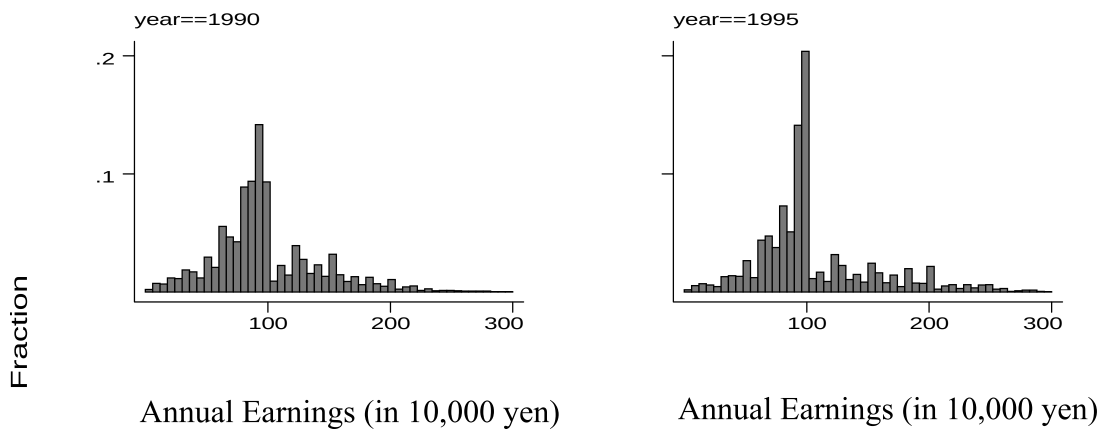


FIGURE 2:Earnings Distribution in 1990 and 1995: Married Women

Source: Author's calculations from the GSPWC data

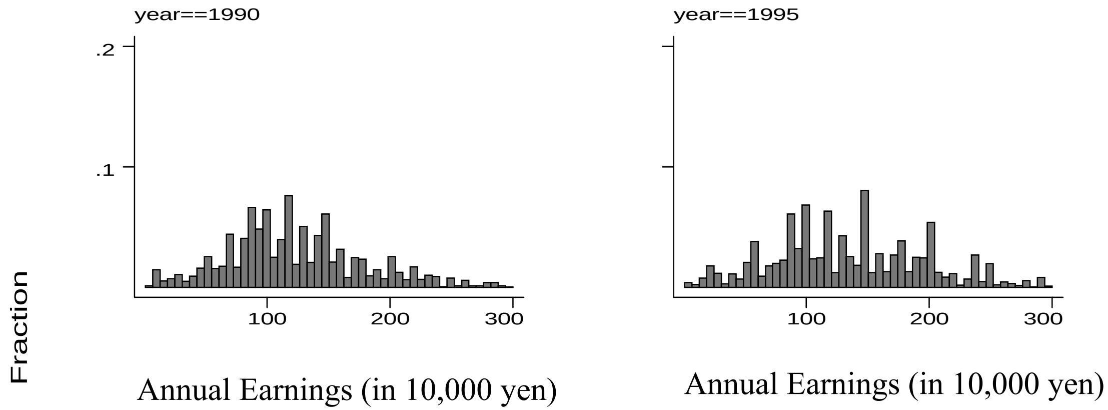
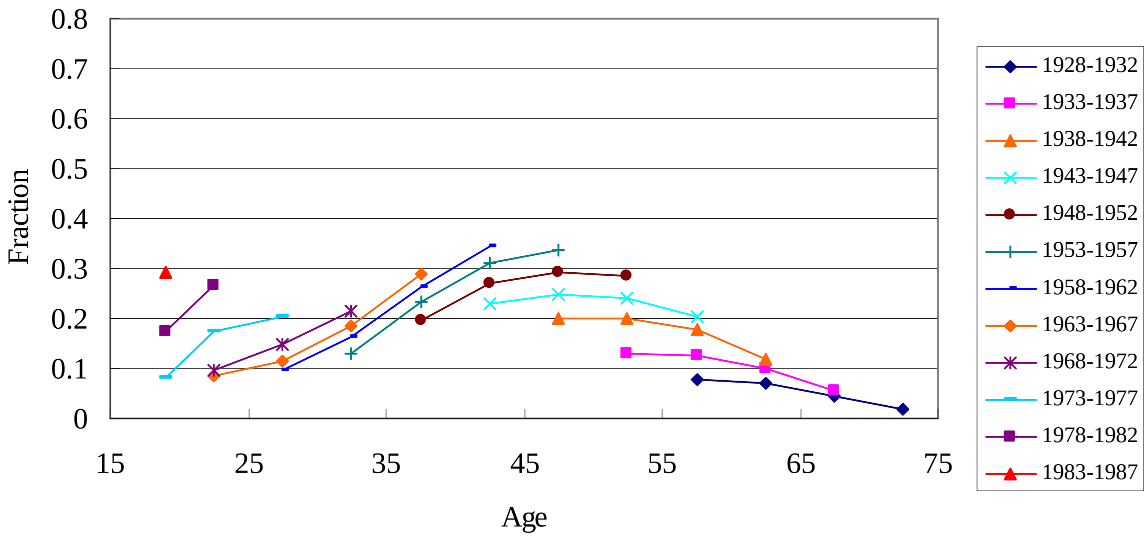


FIGURE 3: Earnings Distribution in 1990 and 1995: Single Women

Source: Author's Calculations from the GSPWC data

Figure 4: Cohort Profile of Part-time Employment Ratio: Senior High School Graduates



Note: The legends indicate the birth year intervals of each cohort.

Source: Employment Status Surveys (1987,1992,1997,2002), the Ministry of Public Management, Home Affairs, Posts and Telecommunications of Japan

Figure 5-1: Hours Schedule (Initial Asset=900)

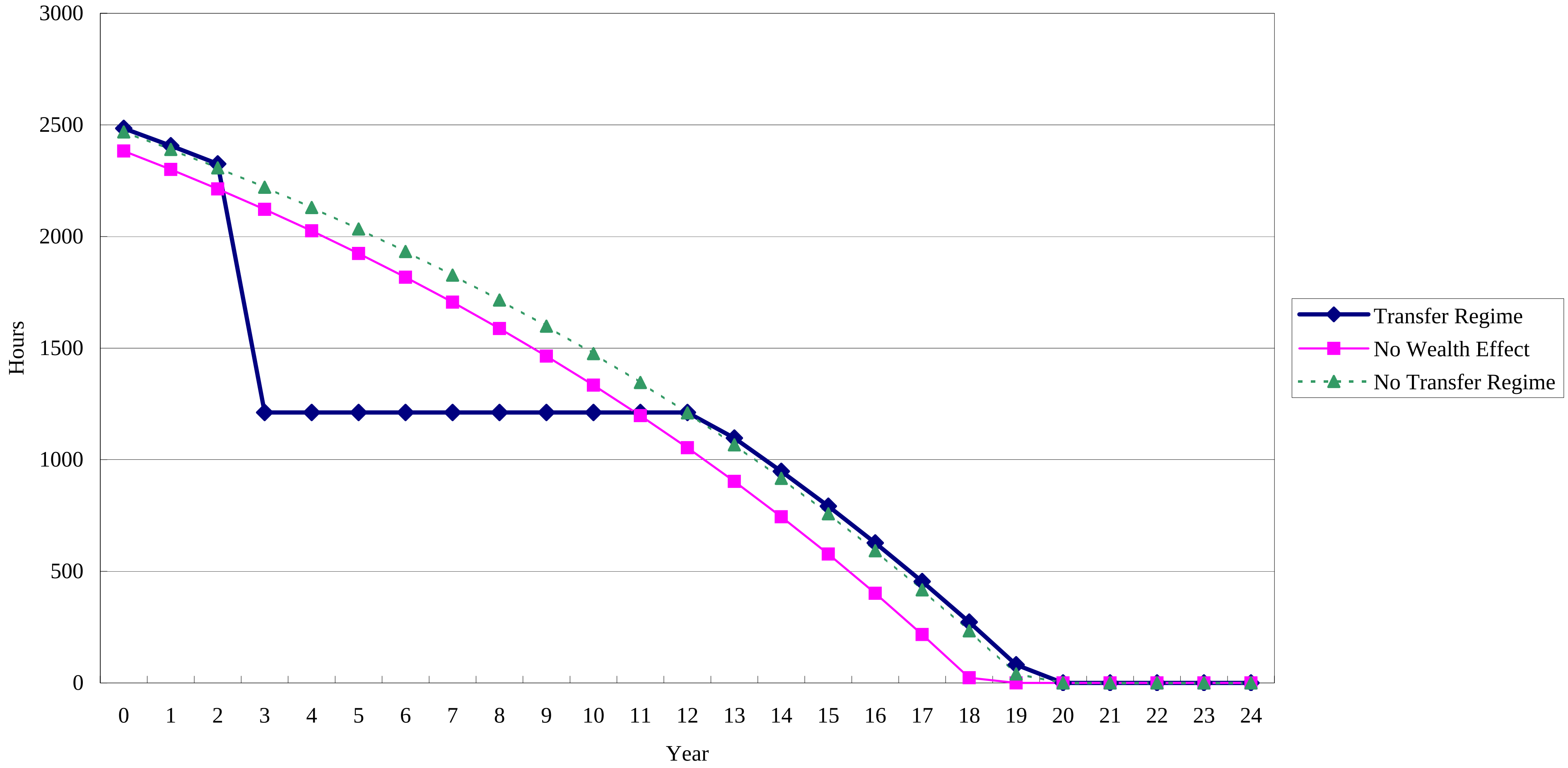


Figure 5-2: Hours Schedule (initial Asset=1700)