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**Income Redistribution Effect of a Shift from Income
Deduction to Tax Credit
—Discrete Choice Model-Based Simulation
Incorporating Labor Supply—**

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The views expressed in this paper are those of the authors and not those of the Ministry of Finance or the Policy Research Institute.

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Income Redistribution Effect of a Shift from Income Deduction to Tax Credit

—Discrete Choice Model-Based Simulation Incorporating Labor Supply—¹

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Abstract

As of 2017, debate is ongoing with respect to the revision of the income deduction as part of the income tax reform. One option under consideration is shifting from the income deduction to a tax credit program. The objective of this shift would be enhancing the income redistribution function of the income tax system by strengthening its progressiveness. In relation to the debate on this matter, although some past research papers discussed how the income redistribution function may be affected by a shift from the income deduction to tax credit, no previous analysis has explicitly taken into consideration changes in labor supply that may be caused by the shift. Therefore, in this paper, we conduct simulation concerning the impact of a shift to tax credit on the income redistribution effect in consideration of labor supply and examine how much the shift is expected to contribute to the enhancement of the income redistribution function.

The analysis results suggest the possibility that when fixed cost is a determinant factor as to whether or not individual households supply labor, a shift to tax credit may promote labor supply, especially in view of extensive margin, through the income effect although this effect depends on the size of the tax credit amount. However, it should be kept in mind that in this analysis, we were unable to exclude the income effect due to a tax revenue decline.

A shift to transferrable basic deduction under debate at the Tax Commission may also be similar in effect to a shift to tax credit. However, when a spouse's income is close to zero, the deduction is transferred to the other spouse. As a result, the spouse whose income is close to zero receives no income effect, so this measure's effect of promoting labor market participation is limited.

With all those factors considered, a shift to tax credit may be effective in promoting income redistribution not only through a tax system change itself but also through a change in income distribution due to its effect of promoting labor market participation.

However, this paper's analysis is conducted under various preconditions, such as taking dynamic behavior out of consideration for the convenience of simulation conducted within the limitations of data

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constraints. Therefore, the conclusion arrived at through the analysis should be looked at with some reservations.

Keywords: income tax, income deduction, tax credit, income redistribution, labor supply, discrete choice model, structural estimation, simulation

JEL Classification: J20 H23 H24

Introduction

Income tax is one of Japan's main taxes. In fiscal year 2017 (estimate), individual income tax accounted for 30.8% of the total tax revenues, including both national and local tax revenues. Concerning taxation on individual income, particularly labor income, not only have studies been conducted from the viewpoint of income redistribution but also the impact on labor supply has been studied as an important point of debate. Both in and outside Japan, various analyses have been conducted on this point of debate, including from the theoretical and empirical viewpoints. However, as was pointed out by Hayashi (2009), sufficient analyses have not been conducted in Japan.

With respect to the recent points of debate related to income tax in Japan, the Tax Commission's Interim Report on the Future of the Tax System in View of Structural Socio-Economic Changes, which was prepared in November 2016, indicated the recognition that it is necessary to revise the income tax deduction system to restore the income tax's income redistribution function and cited a shift from income deduction to tax credit as an option. In addition, the outline of the ruling parties' fiscal year 2017 tax reform proposals also included references to these points and made clear that discussion would be held on a plan to shift either to the "tax credit system" or the "zero tax rate system." The recognition of the need to revise the income deduction system reflects a flaw of the system that the tax-reducing effect is larger for people with higher income under progressive income tax system because the tax reduction amount for individual taxpayers under this system is calculated by multiplying the income tax deduction amount by the marginal income tax rates applicable to their respective tax rate brackets. On the other hand, in the case of a tax credit system, if a fixed-amount tax credit is introduced, the tax-reducing effect would be uniform across brackets—the tax-reducing effect is not larger for people with higher income unlike in the case of the income tax deduction system—and this means that the income redistribution function would be enhanced. Among studies that discussed the income redistribution function of a shift to tax credit, Tajika and Yashio (2006b) pointed out problems concerning the income deduction system and analyzed the impact of the scaling-back of the income deduction system and a shift to tax credit on the tax burden based on micro simulation using the Comprehensive Survey of Living Conditions. Through the analysis, they showed that it is possible to promote income redistribution in favor of low-income families by partially replacing the income deduction with refundable tax credit. Meanwhile, Doi (2016) conducted micro simulation using data from the Japan Household Panel Survey (JHPS) with respect to a tax system reform under which the labor income deduction, public pension deduction and personal deduction would be abolished in exchange

for creating a tax credit program that would reduce the tax burden in accordance with the family composition under the constraint of tax revenue neutrality. As a result, it concluded that a shift to tax credit would have a positive impact on reducing income inequality.

From the perspective of labor supply, the finding that the tax-reducing effect is different between the cases of income deduction and tax credit presumably means that the budget constraints faced by labor suppliers (including potential suppliers) are also different between the two cases. Specifically, tax credit is presumed to have more favorable effects for low-income workers than income deduction, while income deduction is presumed to have more favorable effects for high-income workers. If the budget constraint faced by labor suppliers changes as a result of a shift to tax credit, the amount of labor supply will also change, which in turn is presumed to lead to a change in the labor income distribution. Therefore, it is necessary to take into consideration not only the income redistribution effect of the tax system but also a change in the labor income distribution that may be caused by a change in labor supply especially in view of extensive margin. With this point in mind, in this paper, we conduct simulation-based measurement of the income redistribution effect of a shift from the income deduction to tax credit while explicitly taking into consideration a change in labor supply due to the shift. Concretely, in order to examine labor supply in terms of working hours, we first obtain parameters of the household's utility function by structural estimation based on discrete choice model under which households choose their working hours among discrete working hours options and then conduct simulation based on the method adopted by Creedy and Kalb (2006), among other researchers. The simulation results confirm that under a model taking into consideration labor supply as well, the income redistribution effect will be enhanced due to a shift to tax credit. With respect to a change in labor supply, the impact of a shift to tax credit is generally small. However, the simulation results suggests the possibility that the shift may lead to an improvement in the inequality indicator through a change in income distribution resulting from new participants in labor market those who previously did not work because of the presence of fixed cost but which have been encouraged to do so by the income effect in the form of an increase in after-tax income.

In the next section, we provide an overview of how each of income deduction and tax credit affects income redistribution and labor supply. In Section 3, we formularize the utility function based on the discrete choice model used in this paper and explain the data used, the tax system, and the estimation results. In Section 4, we explain the simulation method, and in Section 5, we show the simulation results. Finally, in Section 6, we state the conclusion arrived through the analysis and mention future challenges.

2. Effects of Income Deduction and Tax Credit

As was mentioned earlier, under the income deduction system, the tax-reducing effect is larger for people with higher income. For example, the existing basic deduction of 380,000 yen³ has the effect of reducing the tax amount by 152,000 yen in the case of taxpayers whose marginal tax rate is 30% and by 38,000 yen in the case of taxpayers whose marginal tax rate is 10%. The tax reducing-effect is as shown in Figure 1. In other words, the tax-reduction amount is larger for taxpayers with higher income.

< Figure1 >

On the other hand, if a fixed-amount tax credit system is adopted, the tax reduction amount would be same for high- and low-income taxpayers. In consideration of this point, the effects that either the income deduction or the tax credit would have on the budget constraint line is presumed to be as follows in the case of a progressive taxation system.

Figure 2 shows the effects of income deduction. “W” represents the pre-tax wage rate. As for the tax rate brackets, the tax rate is m_1 when the taxable income level is Y_1 or lower, m_2 when the taxable income level is between Y_1 and Y_2 , and m_3 when the taxable income level is above Y_2 . When the income deduction amount is “D,” the level of income to which each income tax rate is applicable rises by “D.” This means that until the taxable income reaches “D,” taxpayers with a level of income below “D” continue to face a budget constraint line with the wage rate “W.” As the levels of income to which other tax rates are applicable also rise by “D”, the point where the budget constraint line bends is presumed to shift upward (left; toward larger labor supply) compared with when income deduction is not applied. Meanwhile, the tax-reducing effect, which is expressed as the vertical distance between the two budget constraint lines, is longer for taxpayers with higher income, as shown in Figure 2. This indicates that the tax-reducing effect of income deduction is larger for taxpayers with higher income.

< Figure2 >

Figure 3 shows the effects of tax credit. The tax rates and other conditions are the same as in the case of income deduction, and the tax credit amount is represented by “C.” The tax burden arises only when the tax amount surpasses the tax credit amount. Therefore, until the taxable income amount reaches C/m_1 , no tax burden arises and the applicable wage rate remains at “W.” At higher income levels, the budget

³ 1USD is 109yen as of March 2019 (Bank of Japan).

constraint line bends at the same point as the line without tax credit, so it is presumed that the budget constraint line is at a location shifted in parallel by the same value as the tax credit amount “C” from the budget constraint line without tax credit.

< Figure3 >

Labor supply is determined based on the budget constraint as a result of individual labor suppliers’ optimizing behavior. Therefore, if income deduction and tax credit have different effects on income, they may also have different effects on labor supply as a result of the utility maximization under different budget constraints. In this paper, we conduct simulation concerning the intensity of the income redistribution effect through a shift from the basic deduction to tax credit and the introduction of a transferrable basic deduction, which was mentioned in the Tax Commission’s interim report.

3. Estimation Method

3.1 Model

We conduct static structural estimation based on a discrete choice model concerning working hours that was used by Bessho and Hayashi (2014) and Bessho (2010). Bessho and Hayashi (2014) conducted simulation concerning the impact of the spouse deduction change on labor supply from each of the husband and wife based on a discrete choice model used by Creedy and Kalb(2005) and Creedy and Kalb(2006). For example, according to the results obtained by them, labor supply (working hours) from women group as a whole would increase 1.6% if the spouse deduction is abolished, while labor supply from full-time housewives, whose labor supply is considered to be affected by the presence of the spouse deduction, would rise 0.1%. In addition, Bessho and Hayashi (2014) pointed out that labor market participation is affected by the presence of fixed cost involved in the labor market participation. Bessho (2010) conducted static analysis using a discrete choice model to estimate the wage elasticity of labor supply. Using data from the Employment Status Survey in 2002, Bessho (2010) estimated the pretax wage rate and set working hour options. Concerning the tax system, Bessho (2010) set the budget constraint on the premise of the labor income tax in 2002. Meanwhile, Adachi and Kaneda (2016) examined changes in households’ tax payment amount and labor supply that would be caused by tax system reform measures such as the abolition of the spouse deduction and a shift to transferrable basic deduction, based on a similar method. They concluded that the abolition of the spouse deduction would lead to an increase in labor supply by spouses.

Bessho and Hayashi (2015) focused on other income deduction programs, evaluated how the degree of

progressiveness of the progressive income tax would change in accordance with changes in the marginal tax rates using the marginal cost concerning public funds that represent the welfare loss due to the progressive tax rates. Among government agencies, the Bureau for Economic Policy Analysis (CPB) (2014) of the Netherlands measured how the wage elasticity of labor supply (extensive margin and intensive margin) would change in accordance with changes in the income tax rate and the deduction amount through estimation and simulation using raw data based on a discrete choice model regarding labor supply.

In addition to a discrete choice model, there is also an analysis method that estimates parameters through maximum likelihood estimation based on the utility function form presented by Hausman (1979, 1980, and 1985). Akabayashi (2006) and Takahashi (2010) used this method to examine the impact of the spouse deduction on women labor supply. However, it has been pointed out that as this method can only focus on the intensive margin, it is not robust in terms of observation errors (Blomquist (1996), Ericson and Flood (1997), and Eklof and Sacklen (2000)).

In light of these methods mentioned above, we examine the impact of a shift from income deduction to tax credit using estimation and simulation methods used in the aforementioned studies. Under the discrete choice model, it is assumed that the determination of working hours is a choice made from among several exogenously predetermined working hours options. One advantage of structural estimation based on a discrete choice model is that changes in working hours and in labor participation are studied through the same procedures. The second advantage is that as it is unnecessary to fully specify the budget constraint, the estimation results are robust in terms of observation errors concerning the wage rate and other items (Flood and Islam (2005)) and the selection heterogeneity (Haan (2006)). The third advantage is that it is possible to take account of the presence of fixed cost involved in labor participation and the nonconvexity of the budget constraint (Blundel and MaCurdy (1999)) in addition to conducting estimation under a multinomial logit model if a specific assumption is made with respect to the error term. The presence of fixed cost involved in labor market participation was pointed out by Hausman(1980) and Cogan (1981) as a factor that has an important impact on individuals' decision-making concerning labor supply. Another advantage is that this method can also be easily applied to the analysis of double-income households' decision-making concerning labor supply (Bessho (2010)). Below, we explain the formularization of the structural estimation conducted in this paper.

First, we set the direct utility based on working hours that includes a probability term including observation errors.

The utility function of the household “i” is specified as follows (j=1...J, s=1...J):

$$U_{ijs} = U(c_i, l_{ij}^m, l_{is}^f | \mathbf{Z}_i) + \varepsilon_{ijs} \quad (1)$$

where c_i is after-tax income, l_{ij}^m is the husband’s leisure hours $\equiv T - h_{ij}^m$, l_{is}^f is the wife’s leisure hours $\equiv T - h_{is}^f$, \mathbf{Z}_i is the vector that represents the household’s characteristics and ε_{ijs} is error term

The tax burden of the household “i” can be obtained as follows:

$$R_i = R(W_i^m h_{ij}^m, W_i^f h_{is}^f, \mathbf{Z}_i, \boldsymbol{\tau}) \quad (2)$$

where W_i^m, W_i^f are the wage rates of the husband and wife, $\boldsymbol{\tau}$ is a parameter concerning the tax

Consequently, the after-tax income of the household “i” can be expressed as follows:

$$c_i = W_i^m h_{ij}^m + W_i^f h_{is}^f - R(W_i^m h_{ij}^m, W_i^f h_{is}^f, \mathbf{Z}_i, \boldsymbol{\tau}) \quad (3)$$

The household “i” makes choices concerning c_i, h_{ij}^m , and h_{is}^f so as to maximize the output of the equation (1) under the constraint of (3). Based on the equation (3), (2) can be expressed as follows:

$$U_{ijs} = V(h_{ij}^m, h_{is}^f, \mathbf{Z}_i, \boldsymbol{\tau}) + \varepsilon_{ijs} \quad (1')$$

where $V(h_{ij}^m, h_{is}^f, \mathbf{Z}_i, \boldsymbol{\tau}) \equiv V(W_i^m h_{ij}^m + W_i^f h_{is}^f - R(W_i^m h_{ij}^m, W_i^f h_{is}^f, \mathbf{Z}_i, \boldsymbol{\tau}), T - h_{ij}^m, T - h_{is}^f | \mathbf{Z}_i, \boldsymbol{\tau})$

The household makes choices concerning (h_{ij}^m, h_{is}^f) from the working hours pairs $J \times J$ so as to maximize the output of the equation (1').

The deterministic portion of the utility function can be expressed as follows:

$$U(\mathbf{v} | \mathbf{Z}_i) = \alpha_{c1i} c_i + \alpha_{c2i} c_i^2 + \alpha_{cki} c_i \mathbf{v} + \mathbf{a}' \mathbf{v} + \mathbf{v}' \mathbf{G} \mathbf{v} - \varphi_{mi} \cdot \mathbf{1}\{h_i^m > 0\} - \varphi_{fi} \cdot \mathbf{1}\{h_i^f > 0\}$$

where $\mathbf{v} = \{T - h_{ij}^m, T - h_{is}^f\}'$, $\mathbf{a} = [\alpha_{mi}, \alpha_{fi}]$. \mathbf{G} represents a two-row, two-column symmetric matrix comprised of $\gamma_{kl}(k, l = m, f)$, while φ represents the fixed cost involved in labor market participation. Concerning the fixed cost, two concepts have been presented: one regards it as an income-based cost by

Blundell and MaCurdy (1999) and Callan et al.(2009), and the other regards it as a utility-based cost by Van Soest (1995) and Peichl and Siegloch (2012). In this paper, we regard the fixed cost as a utility-based cost in consideration of the presence of non-pecuniary cost.

In addition, it is assumed that the following equations stand, with α and φ dependent on Z_i .

$$\alpha_{ki} = \alpha_{k0} + \alpha_k' Z_{ki} (k = m, f)$$

$$\varphi_{gi} = \varphi_{g0} + \varphi_g' Z_{gi} (g = m, f)$$

Assuming that the distribution of error terms follows the type 1 extreme value distribution, we estimate parameters for the utility function based on a multinomial logit model.

3.2 Data and the Tax System Used as a Premise

In this paper, we conduct analysis using proprietary raw data from the Japan Household Panel Survey (JHPS) in 2014. As this analysis also looks at the impact of a transferrable basic tax credit, the sample group is limited to married-couple households. In the case of married-couple households in which the parents are elderly and the children are the main income earners, it is unlikely that the income level of the married couples determines labor supply, so their inclusion in the analysis could produce results inconsistent with theoretical predictions. Therefore, the analysis focused exclusively on nuclear households in which the children are aged 22 or younger, which totaled 1,463 households.

Regarding working hours, annual working hours were calculated by estimating working hours per day from working hours per week and by multiplying the annual working days. Following the example of Bessho and Hayashi (2014), the upper limit on annual working hours was set at 3,000 hours. The working hours option for non-working individuals is Option 1 and seven other separate sets of working hours options were set for men and women based on the equal division of the distribution of working hours, with each option representing the median figure for an equally divided group.⁴ As a result, the total number of possible combinations of working hours options for married couples came to 64 (8 x 8). The upper limit on leisure hours per day was set at 16 hours for an annual upper limit of 5,840 hours (16 x 365). The variables

⁴The annual working hours options are as follows:

Men: 0, 284.71, 848.95, 1877.77, 2137.57, 2398.16, 2747.02, and 2995.94 (unit: hours)

Women: 0, 157.94, 404.90, 716.13, 1086.9, 1535.93, 1920.87, and 2537.64 (unit: hours)

representing each household's attributes are the age of the husband and wife, the academic achievement dummy concerning the husband and wife (university, two-year college, and high school), and the urban area dummy (a dummy as to whether or not the couple lives in Kanto, Chubu or Kansai)⁵, and a dummy as to whether the couple has a child (children) aged 14 years old or younger. Following the example of past studies, a fitted value based on the estimated wage function was used as a pretax wage rate.⁶

In the calculation of the after-tax income of individual households, the tax system in 2014 was used as a premise, and the basic deduction, salary income deduction, spouse deduction, and special spouse deduction were taken into consideration as factors. The medical expense and other deductions were not taken into consideration because of data limitations. Concerning local taxes, although the tax calculation was made based on the previous year's income, it was assumed that the taxes are imposed in the current year on the premise that the difference in the calculation base year has little impact even if the discount rate is taken into consideration. The fixed portion of local taxes was excluded from the calculation because there are differences across local governments, and only the portion proportional to the income level was included. As for social insurance, a universal social insurance rate (13.437%) was applied because information necessary for identifying the premium rate, such as the size of the employer company, was not necessarily available. Child allowances were included in the calculation.

3.3 Estimation Results

The results of the structural estimation are as shown in Table 1. The sign conditions are consistent with past studies. Based on the estimation results, we conducted quasi-concavity test of the preferences as defined by Van Soest (1995). In addition to the test, we conducted a test of income-related increasing function. We conducted simulation with respect to the households that met the conditions concerning quasi-concavity and the income-related increasing function (755 households). Among the households included in

⁵ Kanto; an area including Tokyo capital, Chubu; an area including Nagoya urban district, Kansai; an area including Osaka urban district

⁶As the wage function was estimated separately for men and women, the entire sample of the Japan Household Panel Survey (sample size: 3,124 households) was used. Independent variables used here are age, the academic achievement dummy, the urban area dummy, the dummy concerning the presence or absence of children, and the cross terms concerning these variables. In order to take into consideration the reservation wage for individuals not participating in the labor market, the wage function was estimated based on the sample selection model in the case of both men and women. The non-labor income obtained through the data and its squared term were used as instrumental variables.

the simulation, the pre-tax wage elasticity of labor supply was 0.34 for husbands (the intensive margin at 0.14 and the extensive margin at 0.2) and 0.61 for wives (the intensive margin at 0.27 and the extensive margin at 0.34). Compared with the results of past studies, these figures are somewhat high. However, as Bagain et al (2012) estimated the wage elasticity at 0.08 to 0.46 for husbands and at 0.08 to 0.65 for wives, it may be said that the estimation are consistent with past studies.

4. Simulation

We conducted simulation through the following procedures using the parameters estimated in the previous section. The simulation method is the same as the one designed for a discrete choice model formularized by Creedy and Kalb (2006).

- (i) Generating the matrix $J \times J$ comprised of random numbers that follow the type 1 extreme value distribution. The matrix of the error term concerning the household “i” in the “q”th trial can be expressed as follows:

$$\boldsymbol{\varepsilon}_i^q = [\varepsilon_{i11}^q, \dots, \varepsilon_{i1J}^q, \dots, \varepsilon_{i21}^q, \dots, \varepsilon_{i2J}^q, \dots, \varepsilon_{iJ1}^q, \dots, \varepsilon_{iJJ}^q]'$$

- (ii) Using the above formula, the utility function provides a certain utility level included in the matrix $J \times J$ can be expressed as follows:

$$\mathbf{U}_{ijs}^q = [U_{i11}^q, \dots, U_{i1J}^q, \dots, U_{i21}^q, \dots, U_{i2J}^q, \dots, U_{iJ1}^q, \dots, U_{iJJ}^q]'$$

$$U_{ijs}^q = V(\cdot) + \varepsilon_{ijs}^q$$

- (iii) It was assumed that the value of $\boldsymbol{\varepsilon}_i^q$ as the successful draw $\boldsymbol{\varepsilon}_i^{*k}$ s when the working hours option chosen at the maximum utility level among the utility levels included in \mathbf{U}_{ijs}^q matches the observed working hours choice (h_i^m, h_i^f) .
- (iv) The above procedures were repeated until 100 successful drawss $\{\boldsymbol{\varepsilon}_i^{*1}, \dots, \boldsymbol{\varepsilon}_i^{*k}, \dots, \boldsymbol{\varepsilon}_i^{*K}\}$ were obtained.
- (v) The parameter concerning the tax system was changed from τ to τ^1 . A change from $V(\cdot, \tau)$ to $V(\cdot, \tau^1)$ in the equation (1') caused by this change affects the utility level. In other words, the household “i” chooses the new working hours pair $(h_{i*}^{mk}, h_{i*}^{fk})$ that generates the new maximum utility level $\{V(\cdot, \tau^1) + \varepsilon_{ijs}^*\}$ based on $\boldsymbol{\varepsilon}_i^{*k}$ that takes into consideration the tax system change. As there are 100 successful draws, there are 100 working hours choice $(h_{i*}^{mk}, h_{i*}^{fk})$ per household.⁷

⁷ When no successful draw has been obtained after 100 trials with respect to a household, that household was excluded from the sample.

We observed the average change that occurred when the working hours option changed from (h_i^m, h_i^f) to $(h_{i^*}^{mk}, h_{i^*}^{fk})$. At the same time, as 100 pretax income variations per household were obtained, we observed the average distribution and measured the income redistribution effect of a shift to tax credit.

We conducted simulation concerning the following three scenario cases. Meanwhile, in the baseline case, the actual tax system in 2014 was used. In the scenario cases, the actual tax system remained unchanged except for the change specified in each case.

- (i) Abolish the basic deduction and introduce a basic tax credit concerning both the national taxes (100,000 yen) and local taxes (50,000 yen).
- (ii) Abolish the basic deduction and introduce a basic tax credit concerning both the national taxes (150,000 yen) and local taxes (100,000 yen).
- (iii) Abolish the basic deduction and introduce a transferrable basic deduction⁸ (a tax credit of 300,000 yen for each household; when the spouse's income is above 650,000 yen, the tax credit amount is reduced in inverse proportion to the income level, and when it is above 3.65 million yen, the tax credit amount is set at 150,000 yen for each of husband and wife).

< Figure 4 >

5. Results

Tables 2 and 3 show the tax revenue change rates from the baseline levels and the Gini coefficient values measured based on average income level obtained through equivalent disposable income in individual simulation cases. Table 2 covers all households included in the simulation, while Table 3 covers only households in which both husband and wife are 59 years old or younger and which are thus presumed to be workers' households. In all cases, the value of the Gini coefficient is smaller than the baseline, indicating that income inequality is reduced. From this, it is clear that a shift from income deduction to tax credit (even if tax reduction) will contribute to reducing the Gini coefficient. The finding is consistent with the prediction that a shift to tax credit will strengthen the income redistribution function. One presumed reason is that while the tax reduction amount is larger for higher income households in the case of income deduction, the

⁸ Under this program, the unused portion of the basic deduction for a taxpayer's spouse would be transferred to the taxpayer. The Tax Commission cited the program as a tax reform option for the establishment of a tax system that is neutral in terms of the impact on individuals' working styles. The program would generate a uniform tax-reducing effect for a married couple regardless of the income level of either spouse (see Figure 4).

tax effect is uniform across all income brackets in the case of tax credit.

However, the results also indicate that the income effect due to a shift to tax credit is different between high-income households (with a larger labor supply) and low-income households (with a smaller labor supply). Regarding labor supply, while the change rate is small, the margin of decline is relatively large for households that do not supply labor (Option 1) in the case of a shift to a fixed-amount basic tax credit. In the case (ii) in Table 2, for example, the percentages of husbands and wives choosing Option 1 are down 0.35 points and 0.44 points respectively, compared with the baseline, indicating that the change is relatively large compared with the impact on households already supplying labor. The presumed reason is that an upward shift of the budget constraint (the income effect due to a shift to tax credit) due to a shift from income deduction to tax credit encourages labor supply by households that refrain from supplying labor due to the presence of fixed cost associated with various household factors. Figure 5 shows this relationship as expressed under the leisure-consumption model. In this figure, when the fixed cost “Q” exists, the indifference curve become discontinuous at the point where the amount of leisure hours is maximum. In the case of income deduction, there is no contact point between the budget constraint line and the indifference curve u_0 , which means that the labor supply amount l_0 , namely supplying no labor, is the optimal behavior. As for optimizing behavior in the case of a shift to tax credit, an upward shift of the budget constraint line causes the indifference curve u_1 to contact the budget constraint line at the point “E,” which indicates that the optimal labor supply amount is l_1 .

< Figure5 >

Meanwhile, regarding households already supplying labor, the model predicts that for high-income households, the income effect due to tax burden will promote labor supply. However, the simulation results show that the change in labor supply amount is small. In the case of a tax credit of 100,000 yen, the impact is in effect equivalent to tax exemption for households with income of up to 2 million yen ($100,000 \div$ lowest tax rate of 5%), namely with income of up to a level around the bottom of the current second income tax bracket (see Figure 5). This figure indicates that the amount of labor supply from some low- and middle-income households is expected to decline due to the income effect on the premise that leisure is a normal good. However, in the simulation, the labor supply amount declined in few cases. One possible reason is that it is difficult to adjust working hours flexibly in Japan’s labor environment. Tables 4 and 5 show changes from the baseline in terms of the distribution of working hours options by gender and by income percentile. From these tables, it is clear that the decline in spouses choosing Option 1, namely spouses

not supplying labor (as the analysis was conducted on the basis of household income, spouses not supplying labor may belong to higher income brackets).

Table 6 shows the breakdown of the income redistribution effect into the tax impact and the labor supply impact. This table compares the Gini coefficient value obtained when change in the labor supply amount is not taken into consideration and the value obtained when it is. From the table, it is clear that the Gini coefficient value is smaller when change in the labor supply amount is taken into consideration. This presumably means that change in the income distribution due to change in the labor supply amount contributes to reduce inequality. In other words, it may be said that mechanically evaluating the income redistribution effect with only tax impact could underestimate the income redistribution effect from a shift to tax credit. While the Gini coefficient value is higher than the baseline under some scenario, the probable reason is that the proportion of households for which the tax burden is reduced due to tax credit is relatively small among elderly households, whose labor income level is relatively low, whereas high-income households can fully enjoy the benefits of a shift to tax credit, leading to a slight increase in inequality.

The simulation results show that a shift to a transferrable basic tax credit would strengthen the income redistribution function most. A shift to a transferrable basic tax credit would also encourage labor participation. However, when the income level of one spouse is close to zero, the portion of the tax credit applicable to the spouse is transferred entirely to the other spouse, so the income effect does not arise with respect to the spouse with lower income, which means that the labor participation promotion effect is limited. The impact on households already supplying labor was not much different from the impacts in other cases.

6. Conclusion and Future Challenges

As was mentioned in the previous section, from the viewpoint of change in the labor supply amount, a shift to income tax credit is expected to change the income level of individual households by encouraging labor participation by spouses who were not previously participating in the labor market. This suggests that the income distribution is affected by change in the distribution of labor income caused by both a tax system change itself and a change in labor supply. In light of this, when examining the effects of a shift to tax credit, it is necessary to pay attention not only to the income redistribution effect of the tax system but also to the impact on labor supply, particularly on the willingness of spouses not supplying labor to participate

in the labor market (extensive margin). As the income effect on labor supply is affected by the tax credit size, the credit amount should be set at a tolerable level from the perspective of tax revenue neutrality. It should be noted that in this paper, tax neutrality was not fully achieved, with a slight revenue decline arising, and this means that the income effect due to a tax revenue decline was not excluded. Under the method used in the analysis, it is difficult to adopt an additional constraint in the form of tax revenue neutrality. Therefore, in future studies, it will be necessary to conduct more precise analysis under the constraint of tax revenue neutrality.

While we focused exclusively on the basic deduction, the actual tax system includes other forms of deduction, such as the salary income deduction, dependent deduction and spouse deduction. If a shift to tax credit is to be made, it is necessary to consider the impact of change in the entire deduction system. Concerning the impact of tax measures and subsidies on labor supply, Saez (2002), who discussed the tax system design, argued that when the impact is liable to appear in the form of change in the number of working hours and days (intensive margin), it is necessary to set the minimum guaranteed income at a high level in addition to adopting a negative income tax system. However, Saez (2002) pointed out, when what matters is promoting labor participation (extensive margin), the minimum guaranteed income should desirably be set at a low level in addition to introducing an earned income tax credit. In light of the labor market environment in Japan, it is unlikely that households supplying labor on a full-time basis flexibly adjust the number of working hours and days. In other words, as the extensive margin is relatively important in the labor market environment in Japan, it is considered to necessary, from the viewpoint of Saez's argument, to set the minimum guaranteed income at a low level and design the tax system in a way that encourages labor participation. While it is naturally debatable whether or not the minimum guaranteed income should be provided through basic tax credit, it will be useful to consider tax system changes from this viewpoint.

Finally, I explain challenges related to the analysis, starting with the limitations of the model.

First, the basic model does not take into consideration dynamic decision-making (Abe (2009)). As a result, after-tax income is presumed to be equal to consumption, which means that short-sighted behavior is implicitly assumed. Although various analyses have been conducted in the past with respect to labor supply based on dynamic optimizing behavior, it is beyond the paper's scope. Therefore, analysis with dynamic optimization is a future challenge.

Second, as the analysis set a utility function concerning married couples and is premised on single-entity

decision-making, it did not take into consideration the issue of inter-household resource allocation. In reality, the cost function concerning households does not necessarily match the cost function concerning individual household members (Bargain et al. (2006)).

Other limitations include the assumptions of perfect knowledge of the tax system among consumers, perfect enforcement of the tax system, and the absence of tax evasion and avoidance activities. Also, the analysis took into consideration only individuals' voluntary choices and assumed that the pretax wage rate is fixed and that workers can freely choose the optimal labor supply amount for themselves.

Concerning data, we used raw data from the Japan Household Panel Survey (JHPS). Compared with the Employment Status Survey of the Ministry of the Health, Labour and Welfare, which was used by Bessho and Hayashi (2014), the sample size is small, which may cause sample bias in the respondent group. It is necessary to conduct simulation based on a large dataset like Employment Status Survey and to verify whether similar results can be obtained. Meanwhile, single-person households: among which the proportion of low-income households is considered to be relatively large, were excluded from our analysis because of data constraints and also because a transferrable basic deduction was included in the simulation, although the extensive margin is more important in the case of single-person households. If a similar analysis is to be conducted with single-person households included in the sample, it will be necessary to use a larger dataset. In addition, as was indicated by Blundell (2014), the impact of a shift to tax credit is expected to have a significant impact on elderly people, young people and married women with children because their wage elasticity concerning is high. In light of the tight labor market condition of the Japanese economy, it is important for future analyses to pay attention to those people. Moreover, at this time, we did not take into consideration change in social welfare. When implementing tax system reform, it is necessary to consider social costs associated with tax system changes as well. In future analyses, it will be important to take into consideration this constraint.

Finally, the analysis was conducted from the viewpoint of economics alone, with no regard for the purposes of income deduction and tax credit programs (e.g., the purpose of the deduction of estimated expenses from income). The tax system should not only be analyzed from the viewpoint of economics but also examined from various other aspects, including the purpose of the system. It should be kept in mind that the analysis focused exclusively on the economics of the tax system.

Figure1 Image of the effect of income deduction

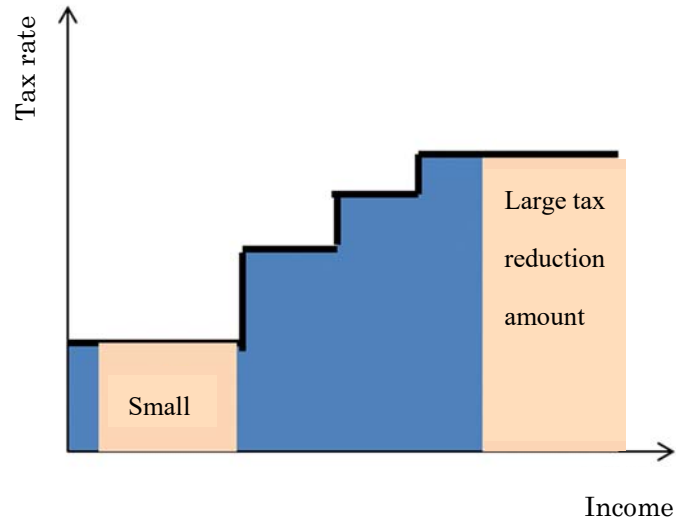


Figure 2 Effect of Income Deduction

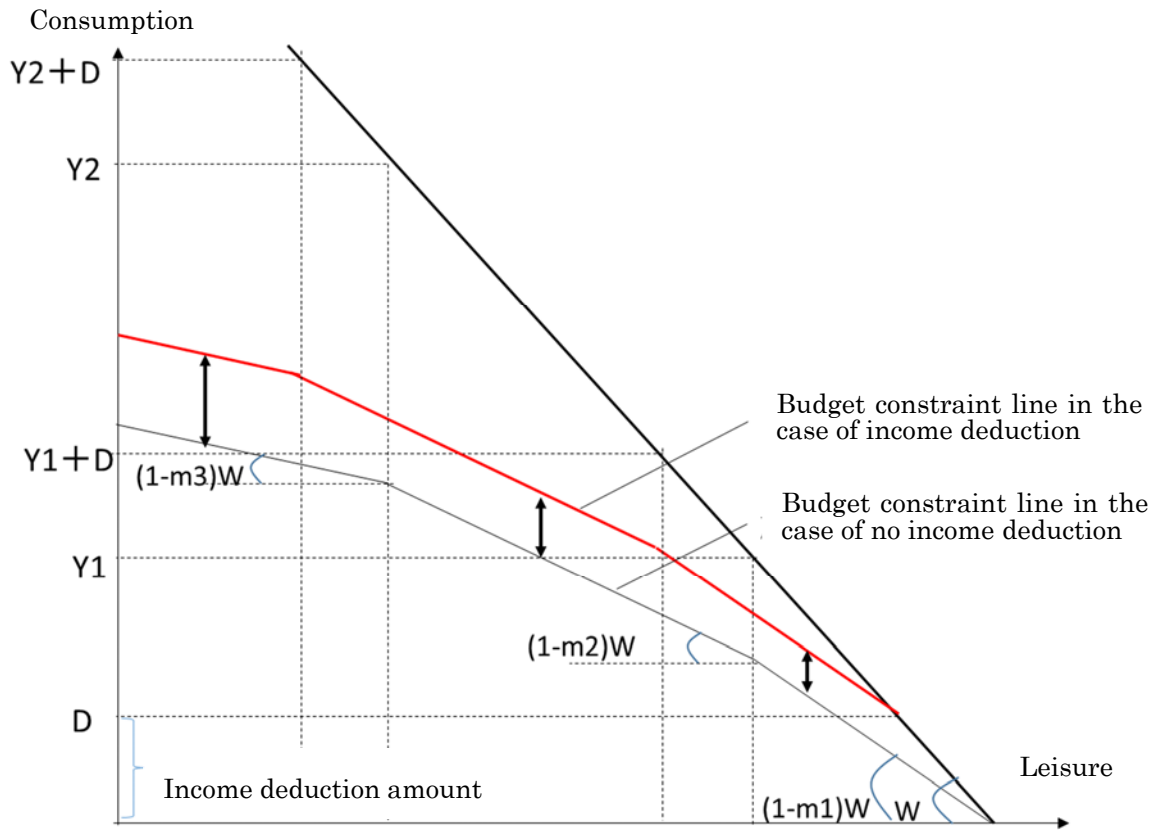


Figure 3 Effect of Tax Credit

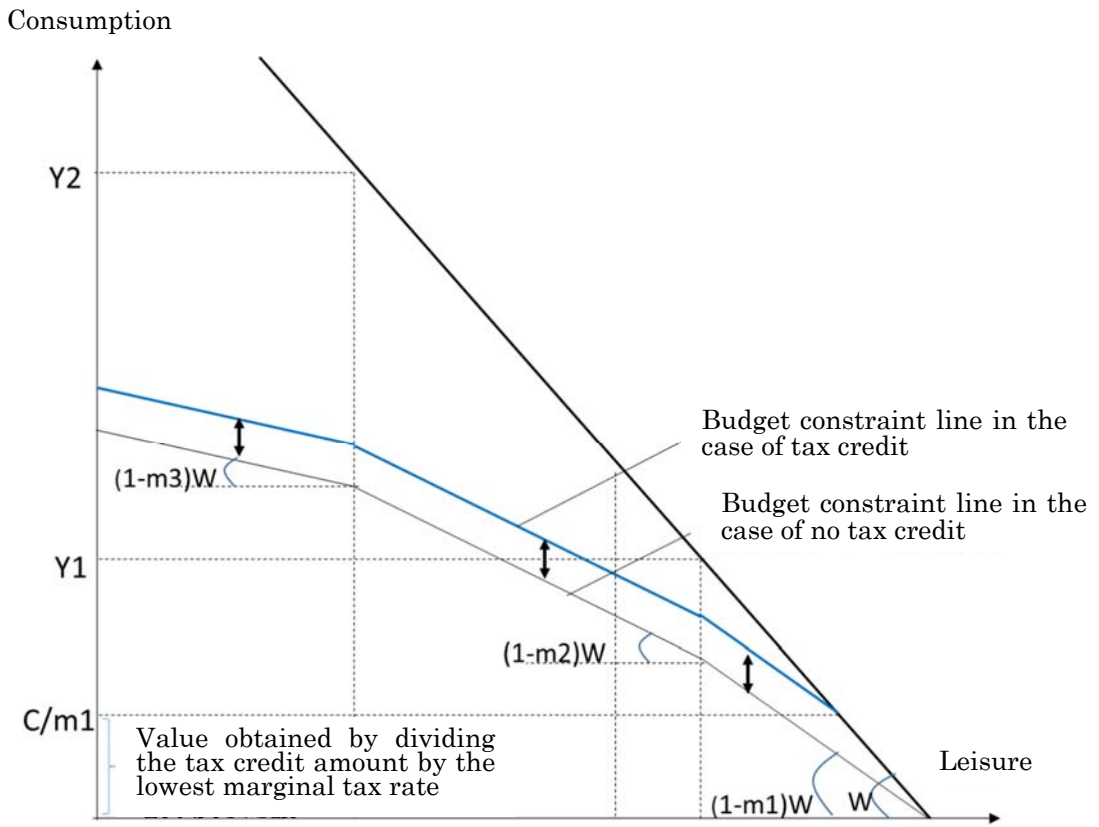


Figure 4 Image of a transferrable basic deduction

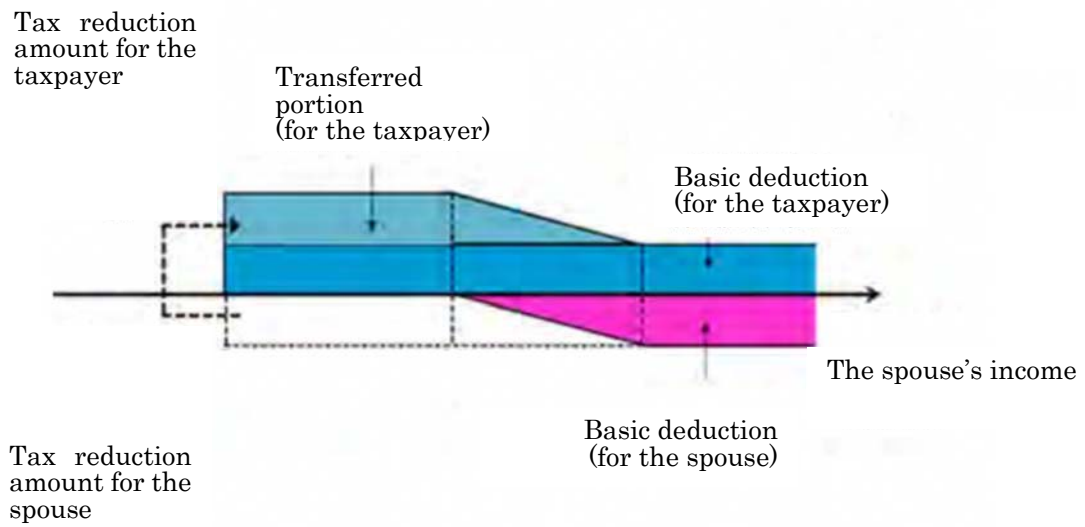


Figure 5 Case of labor participation promotion

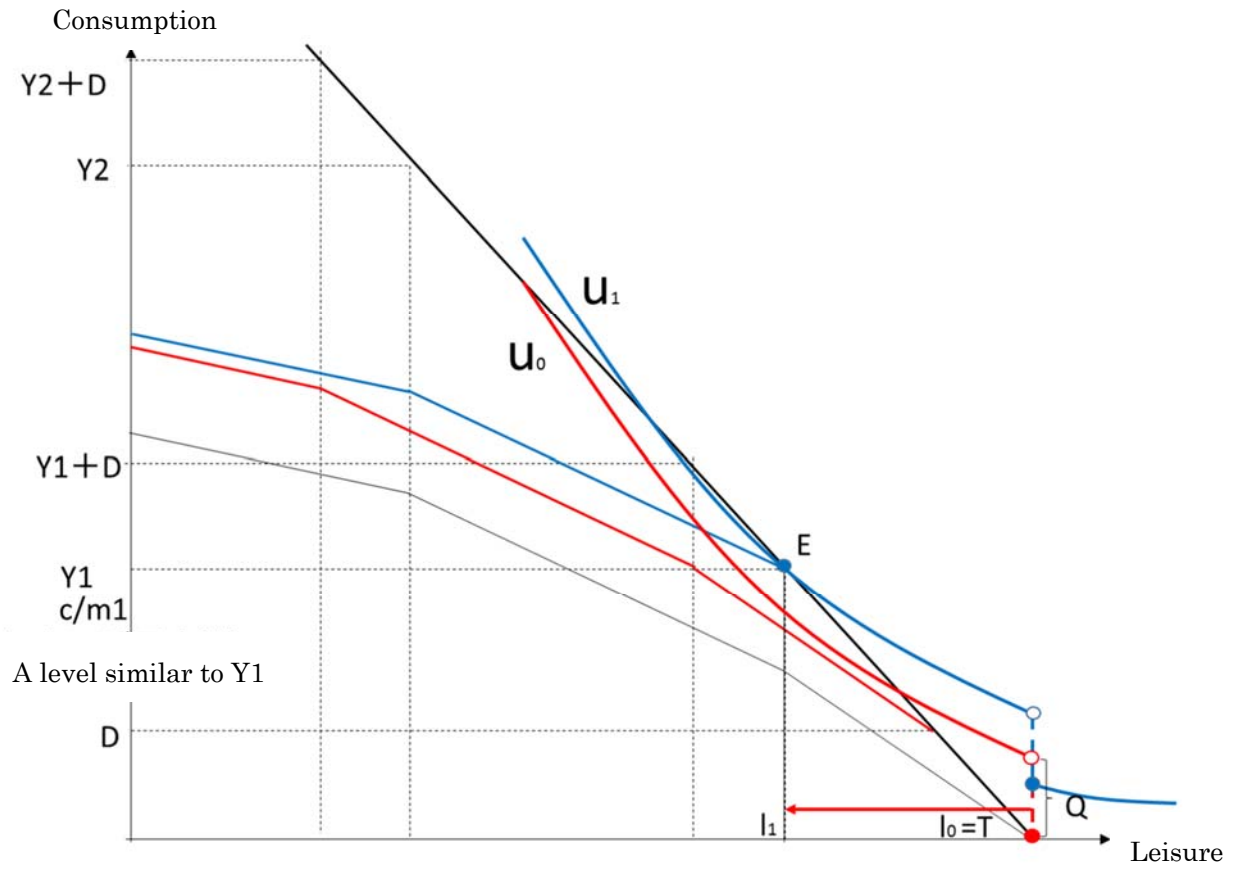


Table 1 Parameters for the utility function obtained through structural estimation

Husband's leisure hours	0.452* (2.06)	Husband's fixed cost	-1.369*** (-7.61)
Wife's leisure hours	0.612* (2.13)	Wife's fixed cost	-1.708*** (-12.46)
Husband's leisure hours × wife's leisure hours	0.00182** (2.88)	Husband's fixed cost × children dummy (14 years old or younger)	0.303* (1.99)
Square of husband's leisure hours	-0.00715** (-3.00)	Wife's fixed cost × children dummy (14 years old or younger)	0.226* (2.35)
Square of wife's leisure hours	-0.00776** (-2.64)	Square of husband's leisure hours × husband's age	0.000146*** (3.72)
After-tax income	0.764*** (3.65)	Square of husband's leisure hours × children dummy (14 years old or younger)	0.00119* (2.39)
Square of after-tax income	-0.0119*** (-4.50)	Square of husband's leisure hours × urban area dummy	0.00111 (1.46)
husband's leisure hours × income	-0.00433** (-2.58)	Square of husband's leisure hours × husband's university degree dummy	-0.00263** (-2.61)
Wife's leisure hours × income	-0.00402* (-2.00)	Square of husband's leisure hours × husband's two-year college degree dummy	-0.00284 (-1.87)
husband's leisure hours × husband's age	-0.0105** (-3.08)	Square of husband's leisure hours × husband's high-school degree dummy	-0.00128 (-1.32)
Wife's leisure hours × wife's age	-0.0250*** (-5.10)	Square of wife's leisure hours × wife's age	0.000285*** (5.48)
husband's leisure hours × children dummy (14 years old or younger)	-0.0936* (-2.26)	Square of wife's leisure hours × children dummy (14 years old or younger)	0.000542 (0.78)
Wife's leisure hours × children dummy (14 years old or younger)	-0.0223 (-0.35)	Square of wife's leisure hours × urban area dummy	-0.00192 (-1.87)
husband's leisure hours × husband's university degree dummy	0.227** (2.58)	Square of wife's leisure hours × wife's university degree dummy	0.000828 (0.50)
husband's leisure hours × husband's two-year college degree dummy	0.258 (1.95)	Square of wife's leisure hours × wife's two-year college degree dummy	-0.00397** (-2.73)
husband's leisure hours × husband's high-school degree dummy	0.109 (1.27)	Square of wife's leisure hours × wife's high-school degree dummy	-0.00436** (-3.19)
Wife's leisure hours × wife's university degree dummy	-0.0750 (-0.48)	N	93632
Wife's leisure hours × wife's two-year college degree dummy	0.380** (2.79)	(Sample size is 1,463 households)	
Wife's leisure hours × wife's high-school degree dummy	0.407** (3.18)	t statistics in parentheses =* p<0.05 ** p<0.01 *** p<0.001	
husband's leisure hours × urban area dummy	-0.100 (-1.50)	Log likelihood = -5110.9904 LR chi2(37) = 1946.91	
Wife's leisure hours × urban area dummy	0.196* (2.03)	Prob > chi2 = 0.0000 Pseudo R2 = 0.1600	

Unit: income: 10,000 yen; leisure hours: hours.

Table 2 Simulation results (all households) (unit for the distribution: %)

	Baseline		Case (i)		Case (ii)		Case (iii)	
Tax revenue change	—		-2.42%		-6.46%		-10.67%	
Gini coefficient	0.34683		0.34533		0.34323		0.34227	
Working hours and option	Husb and	Wife	Husband	Wife	Husband	Wife	Husband	Wife
1	41.78	70.23	41.69	70.05	41.43	69.79	41.33	69.79
2	3.74	6.61	3.73	6.60	3.74	6.61	3.74	6.63
3	9.93	4.06	9.95	4.09	9.96	4.11	9.93	4.11
4	7.97	3.55	7.98	3.60	8.02	3.64	8.03	3.63
5	6.92	3.00	6.95	3.03	6.98	3.06	7.01	3.05
6	7.55	4.63	7.57	4.65	7.63	4.69	7.67	4.67
7	9.81	3.55	9.81	3.55	9.84	3.61	9.88	3.60
8	12.31	4.37	12.32	4.42	12.39	4.50	12.42	4.52
Annual average working hours	1211.9	335.1	1213.6	337.5	1219.5	342.0	1223.0	341.8

Table 3 Simulation results (households in which both husband and wife are 59 years old or younger)

(unit for the distribution: %)

		Baseline		Case (i)		Case (ii)		Case (iii)	
Tax revenue change		—		-0.63%		-3.73%		-5.79%	
Gini coefficient		0.30278		0.30147		0.29907		0.29688	
Working hours option	Husband	Wife	Husband	Wife	Husband	Wife	Husband	Wife	
1	12.81	55.84	12.77	55.71	12.64	55.58	12.58	55.74	
2	3.20	8.95	3.20	8.91	3.19	8.89	3.18	8.93	
3	10.90	5.80	10.94	5.83	10.99	5.85	10.93	5.84	
4	10.63	5.00	10.66	5.05	10.70	5.09	10.70	5.05	
5	10.81	4.85	10.84	4.89	10.87	4.92	10.91	4.90	
6	12.39	7.74	12.37	7.75	12.40	7.77	12.45	7.73	
7	16.85	6.11	16.83	6.11	16.81	6.13	16.85	6.09	
8	22.41	5.71	22.38	5.74	22.39	5.76	22.39	5.73	
Average annual working hours	1963.7	507.3	1963.3	509.1	1965.6	510.9	1968.2	508.3	

Table 4 Change in the working hours option compared with the baseline (by income bracket, men)

Vertical: options; horizontal: income brackets

Case (i)										
	1	2	3	4	5	6	7	8	9	10
1	-0.20%	-0.02%	0.14%	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%
2	-0.01%	0.01%	-0.15%	0.16%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
3	-0.14%	-0.04%	0.19%	0.01%	0.00%	0.00%	0.00%	0.01%	0.00%	0.01%
4	0.01%	0.00%	-0.21%	0.20%	-0.11%	0.11%	0.00%	0.00%	0.00%	0.00%
5	0.01%	0.00%	0.01%	0.00%	0.00%	-0.15%	0.16%	0.00%	0.00%	0.00%
6	0.01%	0.01%	0.00%	0.00%	-0.11%	-0.05%	0.15%	-0.11%	0.10%	0.00%
7	0.01%	0.01%	0.01%	-0.04%	0.05%	0.00%	-0.11%	0.09%	0.00%	0.00%
8	0.01%	0.01%	0.01%	0.00%	-0.01%	-0.01%	-0.01%	0.15%	-0.37%	0.21%

Case (ii)										
	1	2	3	4	5	6	7	8	9	10
1	-1.21%	0.82%	-0.21%	0.28%	-0.07%	0.07%	0.00%	0.00%	0.00%	0.00%
2	-0.02%	-0.11%	-0.03%	0.16%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
3	-0.29%	-0.50%	0.79%	-0.15%	0.15%	0.01%	0.00%	0.01%	0.00%	0.01%
4	0.02%	0.01%	-0.36%	0.20%	0.04%	0.12%	0.00%	0.00%	0.00%	0.00%
5	0.02%	0.01%	-0.14%	-0.06%	0.13%	-0.26%	0.35%	0.00%	-0.14%	0.15%
6	0.02%	0.03%	-0.13%	0.00%	0.05%	-0.04%	0.15%	-0.11%	0.10%	0.00%
7	0.04%	0.02%	0.02%	-0.20%	-0.07%	0.27%	-0.35%	0.20%	0.13%	-0.01%
8	0.05%	0.04%	-0.12%	0.16%	-0.42%	0.32%	-0.06%	0.13%	-0.21%	0.21%

Case (iii)										
	1	2	3	4	5	6	7	8	9	10
1	-1.25%	0.64%	-0.08%	0.26%	-0.08%	0.07%	0.00%	0.00%	0.00%	0.00%
2	-0.12%	-0.01%	-0.03%	0.16%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
3	-0.29%	-0.71%	0.82%	0.00%	0.15%	0.00%	0.00%	0.01%	0.00%	0.01%
4	0.03%	0.01%	-0.36%	-0.10%	0.18%	0.27%	0.00%	0.00%	0.00%	0.00%
5	0.03%	0.01%	-0.14%	-0.06%	-0.02%	-0.26%	0.51%	0.00%	-0.14%	0.15%
6	0.03%	0.05%	-0.13%	0.01%	0.05%	-0.20%	0.15%	0.05%	0.09%	0.00%
7	0.05%	0.02%	0.04%	-0.20%	-0.07%	0.27%	-0.50%	0.19%	0.28%	-0.01%
8	0.06%	0.04%	-0.11%	0.17%	-0.42%	0.32%	-0.07%	-0.14%	0.05%	0.21%

Table 5 Change in the working hours option compared with the baseline (by income bracket, women)

Vertical: options; horizontal: income brackets

Case (i)										
	1	2	3	4	5	6	7	8	9	10
1	-0.36%	-0.02%	-0.05%	0.29%	-0.01%	-0.31%	0.30%	0.16%	-0.15%	0.00%
2	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
3	0.00%	-0.06%	0.07%	0.00%	-0.12%	0.11%	0.01%	0.01%	-0.22%	0.22%
4	0.01%	0.01%	-0.05%	0.05%	0.00%	0.00%	0.00%	-0.09%	0.11%	0.00%
5	0.01%	0.00%	0.01%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%
6	0.01%	0.01%	0.01%	-0.05%	-0.06%	0.12%	-0.10%	0.10%	0.00%	0.00%
7	0.01%	0.01%	0.00%	0.00%	0.01%	0.00%	0.00%	-0.02%	0.00%	0.01%
8	0.02%	0.02%	0.01%	0.01%	0.00%	0.00%	0.01%	0.01%	0.00%	0.00%

Case (ii)										
	1	2	3	4	5	6	7	8	9	10
1	-1.30%	0.27%	-0.18%	0.09%	0.42%	0.00%	0.13%	0.14%	-0.02%	0.04%
2	0.01%	-0.04%	-0.16%	0.17%	-0.28%	0.20%	0.02%	0.02%	0.05%	0.00%
3	0.02%	-0.15%	0.26%	0.02%	-0.18%	0.17%	-0.05%	0.13%	-0.18%	0.20%
4	-0.08%	0.16%	-0.06%	-0.04%	0.03%	-0.13%	-0.02%	0.06%	0.13%	0.00%
5	0.02%	-0.03%	0.04%	0.00%	0.02%	-0.03%	0.02%	-0.02%	0.04%	0.04%
6	0.00%	0.00%	-0.02%	-0.03%	-0.17%	0.05%	0.11%	0.08%	-0.03%	-0.02%
7	0.00%	0.00%	0.00%	0.02%	-0.01%	-0.04%	-0.02%	-0.14%	0.13%	0.00%
8	0.00%	0.10%	-0.06%	0.15%	-0.10%	0.03%	-0.03%	0.01%	-0.14%	0.18%

Case (iii)										
	1	2	3	4	5	6	7	8	9	10
1	-1.35%	-0.10%	-0.03%	-0.03%	0.44%	0.00%	0.16%	0.16%	0.32%	0.01%
2	-0.10%	0.06%	-0.08%	0.15%	-0.25%	0.25%	0.00%	0.00%	0.00%	0.00%
3	0.00%	-0.18%	0.22%	0.00%	-0.20%	0.19%	-0.08%	-0.02%	-0.10%	0.22%
4	-0.11%	0.15%	-0.03%	0.00%	0.06%	-0.09%	-0.05%	0.05%	0.11%	0.00%
5	0.02%	0.00%	0.01%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%
6	0.02%	0.02%	0.02%	-0.04%	-0.19%	0.05%	0.09%	0.10%	-0.01%	-0.01%
7	0.02%	0.03%	0.02%	0.00%	0.01%	0.00%	0.00%	-0.15%	0.12%	0.01%
8	0.05%	0.07%	-0.10%	0.14%	-0.07%	0.07%	0.00%	0.01%	-0.15%	0.14%

Table 6 Difference in the Gini coefficient between when labor supply is taken into consideration (“Considered”) and when it is not (“Not considered”)

All households							
Baseline		Case (i)		Case (ii)		Case (iii)	
Not considered	Considered	Not considered	Considered	Not considered	Considered	Not considered	Considered
0.34683	0.34683	0.34669	0.34533	0.34772	0.34323	0.34816	0.34227

Households in which both husband and wife are 59 years old or younger							
Baseline		Case (i)		Case (ii)		Case (iii)	
Not considered	Considered	Not considered	Considered	Not considered	Considered	Not considered	Considered
0.30278	0.30278	0.30234	0.30147	0.30223	0.29907	0.30115	0.29688

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