The Effects of Capital Taxation Using Dynamic Macro-Econometric Model of the Japanese Economy
—Simulation Analysis Including Households without Financial Assets—

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Abstract

In order to maximize social welfare, it is important to ensure stable economic growth by revitalizing private-sector. From this viewpoint, it is necessary to design capital taxation such that it avoids undue distortions in the corporate sector as much as possible. On the other hand, as the government’s fiscal situation is deteriorating, reform on tax system must also be consistent with fiscal sustainability. With these perspectives in mind, we developed a dynamic macro-econometric model (dynamic CGE model) that contributes to the analysis of capital taxation, in reference to Radulescu (2007) and Radulescu and Stimmelmayr (2010), while including households without financial assets. In this paper, we report the results of various numerical simulation analyses, maintaining neutrality of tax revenues.

Keywords: dynamic macro-econometric model, capital taxation, liquidity-constrained consumers, tax revenue neutrality

JEL Classification: C54, H21, H25

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I. Introduction

In order to maximize social welfare, it is important to ensure stable economic growth by revitalizing private-sector. From this viewpoint, it is necessary to design capital taxation such that it avoids undue distortions in the corporate sector as much as possible. On the other hand, as the government’s fiscal situation is deteriorating, reform on tax system must also be consistent with fiscal sustainability. With these perspectives in mind, we developed a dynamic macro-econometric model (dynamic CGE model) that contributes to the analysis of capital taxation, maintaining neutrality of tax revenues.

Among previous studies concerning capital taxation using a dynamic macro-econometric model (dynamic CGE model) are Radulescu (2007) and Radulescu and Stimmelmayr (2010). Radulescu (2007) and Radulescu and Stimmelmayr (2010) conducted numerical simulations using a dynamic macro-econometric model with respect to the capital tax reform programs in Germany (including dual income taxation). This paper seeks to extend the models in Radulescu (2007) and Radulescu and Stimmelmayr. Let us explain the salient characteristics of our model. First, we designed the corporate sector in more detail compared with other studies. Specifically, (1) various means of financing (retained earnings, new debts and new equity issuance) are embedded in the model, (2) an agency (risk) premium is endogenously determined in a debt interest rate, and (3) the model formulates allowance for corporate equity (ACE) and allowance for net investment (accelerated write-off) in the tax bases.

Second, we introduced heterogeneity in the corporate sector. Specifically, the model includes (1) PIH consumers who have financial assets and can afford intertemporal consumption smoothing in accordance with the Permanent Income Hypothesis, and (2) LIQ consumers who face a liquidity constraint and cannot build up savings.

Third, we constructed a two-country open economy model, incorporating the current account balance and net foreign assets. Specifically, (1) the trade balance is endogenously determined in such a way that domestic investments and savings are balanced, and (2) a full home bias is assumed with respect to stocks and corporate bonds while domestic and foreign government bonds are internationally traded.

This paper contributes to the literature by analyzing an economy in which the LIQ consumers, who do not have financial assets and cannot afford intertemporal consumption smoothing, are explicitly embedded: the LIQ consumers are not subject to interest income tax, income gain tax and capital gains tax. Therefore, the macro-economic effects of imposing these taxes may be affected by the heterogeneity of the household sector. Previous studies, such as Radulescu (2007) and Radulescu and Stimmelmayr (2010), conducted their analyses using models including only PIH consumers with financial assets, whose behavior follows the Permanent Income Hypothesis.

In the long term, these taxes will affect the accumulation of capital stock. That, in turn, will have secondary spillover effects on LIQ consumers through changes in their wage rate.
Examples of policy analysis in this paper include: “analysis of how taxation affects macro-economic variables (GDP, effective marginal tax rate, capital cost, capital stock, debt ratio, labor supply, effective wage rate, consumption, social welfare, etc.),” “analysis of dual income taxation,2” “analysis of allowance for corporate equity (ACE) in the corporate tax base and net investment allowance (accelerated write-off),” and “analysis concerning the “New View” related to finance.3”

This model can implement various simulations which contribute to solve policy challenges we face, while based on specific calibrations.

The rest of this paper is as follows. Section 2 explains the theoretical structure of the dynamic macro-econometric model that contributes to the analysis of capital taxation. Section 3 explains data and calibration of parameters. Section 4 shows the simulation results. Section 5 summarizes the findings of this paper.

II. Theoretical models

II-1. Assumptions of the model4

II-1-1. Normalization of variables and long-term path of balanced growth (steady-state equilibrium)

We assume that the Japanese and overseas economies have a constant technological progress rate expressed as $1+\text{tech} = \frac{X_{t+1}}{X_t}$ ($X_t$: level of labor-augmenting technological progress) and a population rate expressed as $1+n$. We also assume that as in the case of Kuzmof et. al. (2010), the variables in the model are normalized by the technological progress level $X_t$ and the population growth rate ($1+n$)$^5$. The normalized variables thus converge to time-invariant constant values in the long-run equilibrium (steady state). Hereafter, the gross economic growth rate is expressed by the equation $G \equiv 1+g = (1+\text{tech})(1+n)$ ($g$=net economic growth rate) while the time index is dropped from the variables in the steady state.

II-1-2. Assets and their rates of return

Outstanding of stocks and bonds and their rates of return are as follows: stocks $V$ are issued by domestic corporations (after-tax rate of return $r^V$); debts $B$ are issued by domestic corporations (pre-tax rate of return excluding the premium $i^\text{BH}$); sovereign bonds $D^\text{GH}$ are issued by the home government (pre-tax rate of return $i^\text{H}$), stocks $V^F$ are issued by foreign corporations (after-tax rate of return $r^V^F$); sovereign bonds $D^\text{GF}$ are issued by foreign governments (pre-tax rate of return $i^F$).

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2 Under dual income taxation, given that capital is more mobile than labor, labor income is progressively taxed while capital income is taxed at single rate lower than the lowest tax rate applied to labor income.
3 According to the New View, widely accepted in the field of corporate finance theory, net investment is financed by retained earnings and new borrowings in a developed economy, without the involvement of new equity issuance ($\eta=0$). (Auerbach (1979); Bradford (1981); Sinn (1987))
4 The theoretical model discussed herein much owes to Radulescu (2007).
5 Variables related to labor are normalized only by $(1+n)$. The rate of return and the wage rate are not normalized.
This model assumes complete home bias in stocks and bonds issued by corporations. Therefore, stocks and bonds issued by domestic corporations are held only by domestic residents while stocks and bonds issued by foreign corporations are held only by foreign residents. In addition, it is assumed that portfolio selection across these asset classes is made under imperfect substitution, with the rates of return allowed to vary across them (Goulder and Eichengreen (1992)). However, we assume perfect substitution between sovereign bonds issued by the home and foreign governments \((i_H^H = i_F^F)\).

Denoting the tax rate on interest income as \(\tau^t\), the after-tax rates of corporate and government bonds in the domestic fund investment sector (household sector) is calculated as follows, based on the residence principle of taxation: the after-tax rate of return on bonds issued by domestic corporations is expressed as \(r_{BH}^H = (1 - \tau^t) i_{BH}^H\), while the after-tax rate of return on sovereign bonds issued by the home government is expressed as \(r_H^H = (1 - \tau^t) i_H^H\). The after-tax rate of return on sovereign bonds issued by foreign governments is represented by the equation \(r_F^F = (1 - \tau^t) i_F^F\).

II-2. Corporate sector

II-2-1. Assumptions in the corporate sector

We assume a linear homogenous CES (Constant Elasticity of Substitution) production function incorporating capital and labor as follows (eq.(1)):

\[
Y_t = F(K_t, L_t) = A_t d\left(\frac{L_t}{\xi}\right) + (1 - d) \left(1_{\xi-1} - \xi\right) K_t^{\frac{1}{\xi-1}}
\]

where \(Y_t\) = value added of the production; \(K_t\) = capital stock at the beginning of the date \(t\); \(L_t\) = the labor input; \(A_t\) = standardization coefficient; \(d\): the parameter concerning factor input share; \(\xi\): the elasticity of substitution concerning factor inputs.

Capital stock is determined by the Q-theory discussed by Tobin (1969), and Hayashi (1982), etc. Smoothing of capital spending over time is characterized by the adjustment cost convex function \(J(I, K)\). The adjustment cost function \(J\) satisfies the conditions \(J_I > 0\), \(J_K > 0\), and \(J_K < 0\) and is homogenous of degree one, thus converges to 0 in the steady state.\(^6\) \(I\) represents the amount of investment.

We assume that retained earnings and issuance of new debts and shares are financing instruments in the corporate sector. Regarding debt finance, we assume that a risk premium goes up as the corporate debt ratio rises. The agency cost function \(m(b)\) that determines the risk premium is formulated as a convex function, satisfying the conditions \(m' > 0\) and \(m'' > 0\) as shown below (Strulik (2003)).

\[
m_t = m(b_t) = \frac{m_1 (b_t - m_2)^2}{b_t}, \quad b_t = \frac{B_t}{K_t}
\]

\(^6\) Differential \(J_I\) and \(J_K\) also converges to 0 in the steady state.
where \( b_t \): debt ratio; \( m_1 \) and \( m_2 \): the coefficient concerning the agency cost function (\( m_1 > 0, -1 < m_2 < 1 \)); \( B_t \): the debt amount at the beginning of date \( t \).

II-2-2. Calculation of corporations’ after-tax profits, corporate tax and dividend payouts

Typical corporations’ after-tax profit \( \pi_t \) and the corporate tax amount \( T^p_t \) are given as follows:

\[
\pi_t = Y_t - J_t - w_tL_t - \delta K_t - \left( i^{BH}_t + m_t \right) B_t - T^p_t \tag{3}
\]

\[
T^p_t = \tau^p \left[ Y_t - J_t - w_tL_t - \delta K_t - \left( z_1i^{BH}_t + m_t \right) B_t - z_2r^{imp}_t \left( K_t - B_t \right) - z_3IN_t \right] \tag{4}
\]

where \( w_tL_t \): the amount of wages paid (\( w_t \) represents the wage rate); \( \delta K_t \): depreciation cost (\( \delta_t \) represents the depreciation rate); \( \left( i^{BH}_t + m_t \right) B_t \): the payment cost of interest on debts, including the premium; \( \tau^p \): the corporate income tax rate; \( r^{imp}_t \): the imputed rate of return on equity; \( I_t \): gross investment amount; \( IN_t \equiv I_t - \delta K_t \): net investment amount. \( z_1 \) is a parameter indicating how much of the cost of paying interest on debts may be deducted from the corporate tax base, usually takes the value 1. \( z_2 \) is a parameter indicating the amount of the imputed return on corporate equity (ACE: Allowance for Corporate Equity) that may be deducted from the corporate tax base, usually takes the value 0. \( z_3 \) is a parameter indicating how much of the net investment may be deducted from the corporate tax base (net investment deduction and accelerated write-off), usually takes the value 0. If \( z_3 \) takes the value 1, it means that full immediate write-off is allowed, and the corporate tax payable \( T^p_t \) is equivalent to the so-called cash flow tax.

The accumulation equation concerning debts in the corporate sector and the cash flow identity are given as follows:

\[
GB_{t+1} = BN_t + B_t \tag{5}
\]

\[
IN_t = \left( \pi_t - Div_t \right) + BN_t + VN_t \tag{6}
\]

where \( BN_t \): the amount of new debt issue; \( Div_t \): the realized value of dividend payout; \( VN_t \): the amount of new equity injection. The cash flow identity (6) indicates that the net investment \( IN_t \) is financed by the retained earnings \( \pi_t - Div_t \), the new debt issue \( BN_t \), and the new equity injection \( VN_t \). When formulas (3) and (4) are substituted into formula (6), the realized payment value \( Div_t \) can be calculated as follows.

\[
Div_t = (1 - \tau^p) \left[ Y_t - J_t - w_tL_t - \delta K_t - m_tB_t \right] - (1 - z_1\tau^p)i^{BH}_tB_t + z_2\tau^p r^{imp}_t \left( K_t - B_t \right) + z_3\tau^p IN_t + \left( BN_t + VN_t - IN_t \right) \tag{7}
\]

II-2-3. Calculation of the corporate value (market capitalization)

Corporations (households as shareholders) determine capital investment and its financing to maximize the corporate value (market capitalization). The corporate value \( V_t \) (market capitalization) of a representative company at the beginning of date \( t \) must satisfy the following non-arbitrage condition in equilibrium:

\[
r^V V_t = (1 - \tau^D) Div_t + (1 - \tau^G) \left[ GV_{t+1} - V_t - VN_t \right] \tag{8}
\]

where \( r^V \): required rate of return on equity; \( V_t \): market capitalization at the beginning of the date \( t \); \( \tau^D \): income gain tax rate; \( \tau^G \): capital gain tax rate. For the purpose of simplifica-
tion, these items after tax are indicated as follows: \( \theta^P \equiv 1 - \tau^P; \theta^D \equiv 1 - \tau^D; \theta^G \equiv 1 - \tau^G \).

When non-arbitrage condition (8) is transformed, the following formula is obtained.

\[
(1 + \frac{r^V}{\theta^G}) V_t = \left( \frac{\theta^D}{\theta^G} \right) \text{Div}_t - VN_t \Bigg) + GV_{t+1}
\]

We use the definitions as follows:

\[
re_t \equiv \frac{r^V}{\theta^G} = \frac{r^V}{1 - \tau^G}, \chi_t \equiv \frac{\theta^D}{\theta^G} \text{Div}_t - VN_t
\]

where \( re_t \) represents the tax-adjusted effective rate of return on equity, and \( \chi_t \) represents the tax-adjusted dividend payout minus new equity injection. If these items are substituted into the above formula, we obtain the formula \((1+re_t) V_t = x_t + GV_{t+1} \). If the corporate value at the end of the date \( t \) is redefined as \( V^e_t \equiv (1 + re_t) V_t \) and substituted into the above formula, we obtain the following formula:

\[
V^e_t = \chi_t + GV^e_{t+1} \frac{1 + re_{t+1}}{1 + re_{t+1}} \tag{9}
\]

If formula (9) is solved in the forward direction and the transversality condition is imposed, we obtain the following formula:

\[
V^e_t = \sum_{i=0}^{\infty} \frac{G^e \chi_{i+t}}{\prod_{j=1}^{i} (1 + re_{i+j})}
\]

This formula indicates that the corporate value \( V^e_t \) equals the discounted present value of the cumulative total of future tax-adjusted dividend payouts minus future new equity injection.

From the above, we see that in order to calculate the corporate value \( V^e_t \), information on the amount of dividend payout \( \chi_t \) (adjusted for tax and new equity injection) in each term is necessary. Below, we will calculate the value of \( \chi_t \). According to an empirical study by Auerbach and Hassett (2003), net investments by corporations are only partly financed through new equity injection. Therefore, under our model as well, the relationship is formularized under the assumption that the proportion \( \eta \) of the net investment \( IN_t \) is financed by the new equity injection \( VN_t \).

\[
VN_t = \eta (1 - z_t \tau^P) IN_t \tag{10}
\]

The view that net investment is financed only through retained earnings and new debts without the implementation of new equity injection (\( \eta = 0 \)) in a matured economy, which is known as the “New View,” is considered to be highly accepted in the field of corporate finance theory. (Auerbach (1979); Bradford (1981); Sinn (1987)).

If the dividend payout amount (after tax and new equity issuance adjustment) \( \chi_t \) is calculated under the assumption of formula (7), we obtain the following equation:

\[
\chi_t = \gamma^D \left[ Y_t - J_t - w_t L_t - \delta K_t - m_t B_t - \left( \frac{1 - z_t \tau^P}{\theta^P} \right) i^{bn} B_t \right] + \gamma^D z_t \tau^P \gamma^t_{imp} (K_t - B_t) - \gamma^t (I_t - \delta K_t) \tag{11}
\]
The tax rate factor coefficients $\gamma^D$, $\gamma^B$, and $\gamma^I$ are defined as follows:

$$\gamma^D \equiv \frac{\theta^D \theta^G}{\theta^G}, \quad \gamma^B \equiv \frac{\theta^B}{\theta^G}, \quad \gamma^I \equiv \frac{\theta^D}{\theta^G} (1 - \eta) + \eta (1 - z_3 \tau^P)$$

II-2-4. optimal path for corporations

We consider how to maximize the corporate value $V^e$ of a representative company at the end of the date $t$. If Bellman’s principle of optimality is applied to formula (9), the maximization problem of the corporate value can be expressed as follows using the value function $V^e(K_t, B_t)$, determined by the state variables $(K_t, B_t)$:

$$V^e_t(K_t, B_t) = \max_{\chi_t} \left[ \chi_t + \frac{G}{1 + \eta} V^e_{t+1}(K_{t+1}, B_{t+1}) \right]$$

s.t.

$$GK_{t+1} = I_t + (1 - \delta) K_t, \quad GB_{t+1} = BN_t + B_t$$

If the shadow price concerning the state variables $(K_t, B_t)$ are defined as $q_t \equiv \frac{dV^e_t}{dK_t}$, $\lambda_t \equiv \frac{dV^e_t}{dB_t}$, the first order condition concerning the choice variable $(L_t, I_t, BN_t)$ is obtained as follows. The shadow price $q$ concerning the state variable $K_t$ is known as Tobin’s marginal $Q$ (Tobin (1969); Hayashi (1982)).

(a) Labor input amount $L_t$:

$$\frac{d\chi_t}{dL_t} = 0, \text{ or } F_{L,t} = w_t \quad (13)$$

(b) Capital investment amount $I_t$:

$$\frac{d\chi_t}{dI_t} + \frac{G}{1 + \eta} \frac{dV^e_{t+1}}{dK_{t+1}} \frac{dK_{t+1}}{dI_t} = 0, \text{ or } q_{t+1} = (1 + \eta) \left[ \gamma^D J_t + \gamma^I \right] \quad (14)$$

(c) New debt issue amount $BN_t$:

$$\frac{d\chi_t}{dBN_t} + \frac{G}{1 + \eta} \frac{dV^e_{t+1}}{dB_{t+1}} \frac{dB_{t+1}}{dBN_t} = 0, \text{ or } \lambda_{t+1} = - (1 + \eta) \gamma^B \quad (15)$$

Next, if the differential coefficient $V^e_t$ concerning the state variables $(K_t, B_t)$ are calculated under the assumption that optimal conditions (13), (14) and (15) are in place, the following equation based on the envelope theorem is obtained.

(d) Capital stock $K_t$:

$$\frac{dV^e_t}{dK_t} = \frac{d\chi_t}{dK_t} + \frac{G}{1 + \eta} \frac{dV^e_{t+1}}{dK_{t+1}} \frac{dK_{t+1}}{dK_t}, \text{ or } \gamma_t = \gamma^D \left[ F_{K,t} - J_{K,t} + (m_t)'(b_t)^2 + \frac{z_2 \tau^P}{\theta^G} \gamma^I \right] - (\gamma^D - \gamma^I) \eta + \frac{1 - \delta}{1 + \eta} q_{t+1} \quad (16)$$
(e) Debt stock $B_t$:
\[
\frac{dV_t^r}{dB_t} = \frac{dX_t}{dB_t} + \frac{G}{1 + re_{t+1}} \frac{dV_{t+1}^r}{dB_{t+1}} dB_t
\]

or
\[
\lambda_t = -\gamma^D \left[ (m_t') b_t + m_t + \frac{(1 - z_t^L \tau_t^p)}{\theta^p} \right] + \frac{z_t^2 \tau_t^p \gamma_t^\text{imp}}{1 + re_{t+1}} \lambda_{t+1} \tag{17}
\]

If first order condition (15) concerning the new debt issue amount $B_{N_t}$ is substituted into envelope condition (17), we obtain the formula that determines the company’s debt ratio $b_t$.

\[
re_t \gamma^D \frac{z_t^2 \tau_t^p \gamma_t^\text{imp}}{\theta^p} = \gamma^D \left[ (m_t') b_t + m_t + \frac{(1 - z_t^L \tau_t^p)}{\theta^p} \right] \tag{18}
\]

The left side represents the value obtained by subtracting the profitability rate attributable to the deduction of notional dividend payouts from the corporate tax from the required rate of return on corporate equity. In other words, it represents the effective cost of equity finance. The right side represents the total sum of the marginal cost attributable to the premium risk of the debt and the debt interest rate adjusted for profits attributable to the deduction of the debt-servicing cost from the corporate tax. In short, it represents the effective cost of debt finance. Formula (18) indicates that when a corporation implements optimal finance, the cost of equity and debt finance is equalized, without incentivizing a change in the equity-debt ratio. In other words, formula (18) is the equation that determines corporations’ optimal capital structure (debt ratio).

II-3. Household sector I (PIH consumers: consumers who can afford intertemporal consumption smoothing)

II-3-1. Optimization problem

PIH consumers, who can afford intertemporal consumption smoothing in accordance with the Permanent Income Hypothesis, possess lump-sum assets managed by investment trusts and determine today’s consumption and the amount of financial assets to be carried over tomorrow. Under the budget constraint, consumers maximize the sum of discounted present value of utility to be gained from future consumption and leisure. As for the utility function, we use a standard utility function which assumes a constant relative risk aversion.

\[
\text{Max}_{Z_t^{\text{PIH}}, Z_t^{\text{inv}}} : U_t^{\text{PIH}} = \sum_{i=0}^{\infty} \frac{1}{(1 + \rho^H)^i} u(Z_t^{\text{PIH}}) = \sum_{i=0}^{\infty} (\beta^H)^i \frac{(Z_t^{\text{PH}H})^{1-1/\sigma} - 1}{1 - 1/\sigma} \tag{19}
\]

s.t.
\[
Z_t^{\text{PH}H} = C_t^{\text{PH}H} - \varphi (L_t^{S,\text{PH}H}) \tag{20}
\]
\[
\varphi (L_t^{S,\text{PH}H}) = (v^{P,\text{PH}H})^{-1/\varepsilon^{\text{PH}H}} \frac{(L_t^{S,\text{PH}H})^{1+1/\varepsilon^{\text{PH}H}}}{1 + 1/\varepsilon^{\text{PH}H}} \tag{21}
\]
\[(1 + \tau^C) C_{t}^{PH} + A_{t}^{H} = (1 + r_{bar}^{H,t+1}) A_{t+1}^{H}/G + \{w_{t} L_{t}^{S,PH} - \tau L_{t}^{L,PH} (w_{t} L_{t}^{S,PH} - LTA_{t}^{PH})\} + T_{t}^{H,PH} \]  

(22)

wherer $U_{t}^{PH}$: lifetime utility for PIH consumers; $\rho^H$: rate of time preference by domestic consumers; $u$: CRRA (constant relative risk aversion) type of utility function; $Z_{t}^{PH}$: the level of felicity for PIH consumers; $\beta^H$: the subjective discount rate of domestic consumers (≡ 1/$(1 + \rho^H)$); $\sigma$: intertemporal elasticity of substitution (1/$\sigma$ represents the level of relative risk aversion); $C_{t}^{PH}$: amount of consumption by PIH consumers; $\phi$: dis-utility arising from labor; $L_{t}^{S,PH}$: labor supply by PIH consumers; $\nu_{t}^{PH}$: the scaling parameter of PIH consumers; $\epsilon_{t}^{PH}$: PIH consumers’ elasticity concerning labor supply; $\tau^{C,t}$: consumption tax rate (time-variable); $A_{t}^{H}$: lump-sum assets managed by domestic investment trusts (at the beginning of the date $t$); $r_{bar}^{H,t}$: the rate of return on domestic investment trusts (after-tax); $w_{t}$: wage rate; $\tau^{L,PH}$: labor income tax rate applicable to PIH consumers; $LTA_{t}^{PH}$: the amount of deduction from the tax base of the labor income tax applicable to PIH consumers; $T_{t}^{H,PH}$: lump-sum net transfer from the home government.

If Bellman’s principle of optimality is applied, the above optimization problem can be expressed as follows, using the lifetime utility (value function) $U_{t}^{PH*}(A_{t}^{H})$, determined by the state variable $A_{t}^{H}$:

$$U_{t}^{PH*}(A_{t}^{H}) = \max\{u(Z_{t}^{PH}) + \beta^H U_{t+1}^{PH*}(A_{t+1}^{H})\}$$  

(23)

s.t.

$$A_{t}^{H} = (1 + r_{bar}^{H,t}) A_{t+1}^{H}/G + \{w_{t} L_{t}^{S,PH} + \tau^{L,PH} LTA_{t}^{PH} + T_{t}^{H,PH}\} - (1 + \tau^C) (Z_{t}^{PH} + \phi(L_{t}^{S,PH}))$$  

(24)

II-3-2. Optimal Path

If the shadow price concerning the state variable is defined as $\kappa_{t}^{PH*} ≡ \partial U_{t}^{PH*}/\partial A_{t}^{H}$, the primary condition concerning the choice variable ($Z_{t}^{PH}$, $L_{t}^{S,PH}$) and the envelope condition concerning the state variable $A_{t}^{H}$ is obtained as follows:

(a) Felicity level $Z_{t}^{PH}$:

$$\frac{\partial U_{t}^{PH*}}{\partial Z_{t}^{PH}} + \beta^H \frac{\partial U_{t+1}^{PH*}}{\partial A_{t+1}^{H}} \frac{\partial A_{t+1}^{H}}{\partial Z_{t}^{PH}} = 0$$, or $K_{t}^{PH} = \frac{u'(Z_{t}^{PH})}{\beta^H (1 + \tau^C)}$  

(25)

(b) Labor supply amount $L_{t}^{S,PH}$ of PIH consumers:

$$\beta^H \frac{\partial U_{t+1}^{PH*}}{\partial A_{t+1}^{H}} \frac{\partial A_{t+1}^{H}}{\partial L_{t}^{S,PH}} = 0$$, or $L_{t}^{S,PH} = v_{t}^{PH} \left[\left(1 - \tau^{L,PH}\right) w_{t}\right] \epsilon_{t}^{PH}$  

(26)

(c) Financial asset $A_{t}^{H}$:

$$\frac{\partial U_{t}^{PH*}}{\partial A_{t-1}^{H}} = \beta^H \frac{\partial U_{t+1}^{PH*}}{\partial A_{t+1}^{H}} \frac{\partial A_{t+1}^{H}}{\partial A_{t-1}^{H}}$$, or $K_{t}^{PH} = \frac{\beta^H (1 + \tau^C)}{G}$  

(27)

If formula (25) is substituted into formula (27) in order to obtain the value for the following term, Euler’s equation is obtained.
II-3-3. Calculation of the intertemporal budget constraint equation

In budget constraint equation (24), the total amount of take-home labor income and transfer income is given as:

$$y_{D,PIH}^t = \left(1 - \tau^L_{PIH}\right) w_t L_{S,PIH}^t + \tau^L_{PIH} L_{TA}^t_{PIH} T^H_{PIH} t - (1 + \tau^C) \phi \left(L_{S,PIH}^t\right)$$

(29)

If budget constraint equation (24) is solved in the forward direction over an infinite period of time, the following equation is obtained (Eq.30).\(^7\)

$$\left(1 + \tau^C_t\right) z_{PH}^t + \sum_{i=1}^{\infty} G^t \left(1 + \tau^C_{i+1}\right) z_{PH}^{i+1} = (1 + \bar{r}^H_{t-1}) \left(A^H_{t-1}/G\right) + \left(y_{D,PH}^t + \sum_{i=1}^{\infty} G^t y_{i+1,PH}^t \prod_{j=1}^{t-1} \left(1 + r^H_{i+j-1}\right)\right)$$

(30)

Here, the equation is rewritten as follows.

The value equivalent to total assets:

$$TW^PH_t = \left(1 + \tau^C_t\right) z_{PH}^t + \sum_{i=1}^{\infty} G^t \left(1 + \tau^C_{i+1}\right) z_{PH}^{i+1}$$

(31)

The value equivalent to total human assets\(^8\):

$$H^PH_t = y_{D,PH}^t + \sum_{i=1}^{\infty} G^t y_{i+1,PH}^t \prod_{j=1}^{t-1} \left(1 + r^H_{i+j-1}\right)$$

(32)

If formulas (31) and (32) are substituted into formula (30), the formula that expresses the total asset \(TW_t\) of PIH consumers is obtained.

$$TW^PH_t = \left(1 + \tau^C_t\right) z_{PH}^t + \sum_{i=1}^{\infty} G^t \left(1 + \tau^C_{i+1}\right) z_{PH}^{i+1} + \frac{1}{1 + \bar{r}^H_{t-1}}$$

(33)

If \(TW^PH_{t+1}\) is calculated through formula (31) and is compared with \(TW^PH_t\), the following formula is obtained:

$$TW^PH_t = \left(1 + \tau^C_t\right) z_{PH}^t + \frac{G}{1 + \bar{r}^H_{t}} TW^PH_{t+1}$$

(34)

Likewise, the following formula is obtained through formula (32):

$$H^PH_t = y_{D,PH}^t + \frac{G}{1 + \bar{r}^H_{t}} H^PH_{t+1}$$

(35)

\(^7\) In Formula (30), the transversality condition is also imposed to asset stocks.

\(^8\) “Overall human assets” as referred to here is the total of discounted present values of future disposable incomes.
II-3-4. Dynamics of the marginal propensity of consumption

Here, Euler’s equation (28) is expressed in a different way. Let us assume that the felicity level $Z_{PHI_t}$ including consumption in the current term is determined as follows:

$$(1 + \tau_i^C)Z_{PHI_t} = mpc_t \times TW_{PHI_t}$$

(36)

$m$pc represents the marginal propensity of consumption concerning total assets. If formula (36) is substituted into Euler’s equation (28), the following formula is obtained:

$$\left(\frac{mpc_{t+1}}{mpc_t}\right)\left(\frac{TW_{PHI_{t+1}}}{TW_{PHI_t}}\right) = \frac{1 + \tau_{t+1}^C}{1 + \tau_t^C} \left[\beta^H \left(1 + \rho_t^H\right)\right]^{1-\sigma} \left[\frac{G}{1 + \rho_t^H}\right]^\sigma$$

(37)

If formula (34), which links $TW_{PHI_t}$ and $TW_{PHI_{t+1}}$ is substituted into formula (36) in order to calculate $TW_{PHI_{t+1}}/TW_{PHI_t}$, the following equation is obtained:

$$\frac{TW_{PHI_{t+1}}}{TW_{PHI_t}} = \frac{1 + \rho_t^H (1 - mpc_t)}{G}$$

II-4. Household sector II (LIQ consumers: consumers incapable of building up savings)

II-4-1. Optimization problem

LIQ consumers facing a liquidity constraint are those who cannot build up savings due to a lack of access to the financial market. For such consumers, the consumption amount in the current term is determined by the labor income in the same term. Under this budget constraint, LIQ consumers maximize the sum of discounted present value of the utility to be gained from future consumption and leisure. The utility function of LIQ consumers is assumed to be the same as that of PIH consumers.

$$\max_{\{C_t\}} U_{LIQ}^t = \sum_{i=0}^{\infty} \frac{1}{(1 + \rho^H)^i} u(Z_{LIQ_t+i}^{LIQ}) = \sum_{i=0}^{\infty} \left(\frac{\beta^H}{1 + \rho^H}\right)^i \left(Z_{t+i}^{LIQ}\right)^{1-\sigma} - 1 \over 1 - 1/\sigma$$

s.t.

$$Z_{LIQ_t} = C_{LIQ_t} - \phi(L_{S,LIQ_t})$$

(39)

$$\phi(L_{S,LIQ_t}) = (\nu_{LIQ})^{-1/\nu_{LIQ}} \left(L_{t}^{S,LIQ}\right)^{1+1/\nu_{LIQ}}$$

(40)

$$1 + \tau^C_t)C_{LIQ_t} = \{w_tL_{S,LIQ_t} - \tau_{LIQ} L_{t}^{S,LIQ} \} + T_{H,LIQ_t}$$

(41)

where $U_{LIQ}^t$: lifetime utility of LIQ consumers; $\rho^H$: the rate of time preference by domes-
tic consumers (the same rate as in the case of PIH consumers); $Z_{LIQ}^t$: the felicity level of LIQ consumers; $\beta^H$: the subjective discount rate of domestic consumers ($= 1/(1+\rho^H)$, the same as in the case of PIH consumers); $\sigma$: intertemporal elasticity of substitution (1/$\sigma$ represents the level of relative risk aversion; the same as in the case of PIH consumers); $C_{LIQ}^t$: the amount of consumption by LIQ consumers; $L_{S,LIQ}^t$: labor supply of LIQ consumers; $\nu_{LIQ}$: LIQ consumers’ elasticity concerning labor supply; $\epsilon_{LIQ}$: LIQ consumers’ elasticity concerning labor supply; $\tau^{CLIQ}$: the consumption tax rate (time-variable; the same as in the case of PIH consumers); $w_t$: the wage rate (the same as in the case of PIH consumers); $\tau^{L,LIQ}$: the labor income tax rate for LIQ consumers; $LTA_{LIQ}^t$: the amount of deduction from the labor income tax base of LIQ consumers; $T^{H,LIQ}_t$: lump-sum net transfer from the home government to LIQ consumers.

II-4-2. Optimal path

If shadow price concerning constraint equation (41) is defined as $\kappa_{LIQ}^t$, the first order condition concerning the choice variable ($C_{LIQ}^t, L_{S,LIQ}^t$) is obtained as follows:

(a) LIQ consumption $C_{LIQ}^t$:

$$\{C_{LIQ}^t - \phi (L_{S,LIQ}^t)\} - 1/\sigma - \kappa_{LIQ}^t (1 + \tau^{CLIQ}) = 0 \quad (42)$$

(b) Labor supply amount $L_{S,LIQ}^t$ of LIQ consumers:

$$\{C_{LIQ}^t - \phi (L_{S,LIQ}^t)\} - 1/(\sigma - \phi' (L_{S,LIQ}^t)) + \kappa_{LIQ}^t (1 - \tau^{L,LIQ}) w_t = 0 \quad (43)$$

(c) Budget constraint equation (liquidity constraint equation):

$$\{w_t L_{S,LIQ}^t - \tau^{L,LIQ} (w_t L_{S,LIQ}^t - LTA_{LIQ}^t)\} + T^{H,LIQ}_t = 0 \quad (44)$$

If $\kappa_{LIQ}$ is eliminated from formulas (42) and (43), Euler’s equation concerning the labor supply of LIQ consumers is obtained.

$$L_{S,LIQ}^t = \nu_{LIQ} w_t \epsilon_{LIQ} \left(1 + \tau^{CLIQ}\right)$$

Through the intra-temporal budget constraint equation, the amount of consumption by LIQ consumers is determined as follows:

$$C_{LIQ}^t = \left\{w_t L_{S,LIQ}^t - \tau^{L,LIQ} (w_t L_{S,LIQ}^t - LTA_{LIQ}^t)\right\} + T^{H,LIQ}_t \left(1 + \tau^{CLIQ}\right)$$

II-5. Calculation concerning social welfare (lifetime utility) of PIH and LIQ consumers (long-term equilibrium)

The social welfare $U_{k}^*$ ($k = PIH, LIQ$) of PIH and LIQ consumers is obtained through the following formula when their objective functions (19) and (36) are evaluated in the steady state.

$$U_{k}^* = \frac{u(Z^k)}{1 - \beta^H} = \frac{1}{1 - 1/\sigma} \frac{(Z^k)^{1-1/\sigma} - 1}{1 - \beta^H}$$

(47)
II-6. Fund investment sector

The domestic fund investment sector invests in domestic stocks (A^V), domestic corporate bonds (A^{BH_H}), domestic government bonds (A^{GH_H}) and foreign government bonds (A^{GF_H}), by using financial sources A^H supplied from households. Therefore, the portfolio A^H of this sector at the beginning of the period t is expressed as follows (Figure 1).

\[ A^H_t = A^V_t + A^{BH_H}_t + A^{GH_H}_t + A^{GF_H}_t \]  

It is assumed that the domestic fund investment sector is facing the zero profit condition under perfect competition. In this case, the following equation must be valid.

\[ r_{\text{bar}}^H A^H_t = r^V A^V_t + r^{BH_H} A^{BH_H}_t + r^{GH_H} A^{GH_H}_t + r^{GF_H} A^{GF_H}_t + \omega^H_t \]

\( \omega^H_t \) represents the variable cost related to domestic fund investment (usually expressed as \( \omega^H_t = 0 \)). In the steady state, the average rate of return \( r_{\text{bar}}^H \) for households converges toward approximately \( \rho^H + g \).

The domestic fund investment sector maximizes the utility function \( W_t \) that is given as follows:

\[ \text{Max : } W_t = \left[ \sum_k \left( \alpha^k \right)^{\frac{1}{1+\mu}} \left( 1 + r^k_t \right) \frac{A^k_t}{\mu} \right]^{1+\mu} \]  

s.t.

\[ A^H_t = \sum_k A^k_t \]  

\( A^k_t \) represents the outstanding of asset k (k = V, B_H, GH_H, GF_H), at the beginning of the date t. \( \alpha^k \) represents the preference parameter concerning the asset k, and \( \mu \) represents the elasticity between asset classes. The first order condition concerning the choice variable \( A^k_t \) is obtained as follows:

\[ A^k_t = \left( 1 + r^k_t \right)^{\alpha^k} \left[ \sum_k \alpha^k \left( 1 + r^k_t \right)^{\mu} \right]^{-1} \]  

Here, the value equivalent to the geometric mean of the gross returns \( 1+r^k_t \) on individual asset classes is defined as:

---

10 As was mentioned in 2.1.2, a full home bias is assumed with respect to corporations’ stocks and debts.
\[ 1 + r^C,H_t = \left[ \sum_k A^k (1 + r^k_t)^\mu \right]^{1/\mu} \]  

(52)

If formula (52) is substituted into formula (51), the demand function concerning each asset class is obtained.

\[ d^k_t = A^k_t / A^H_t = a^k \left( 1 + r^C,H_t \right) \mu \]  

(53)

\( a^k \) represents the proportion of the asset \( A^k \) in the overall portfolio \( A^H \) at the beginning of the date \( t \).

**II-7. The government sector**

The total tax revenue \( TTR_t \) is comprised of corporate income tax, dividend income (income gain) tax, capital gain tax, interest income tax, labor income tax and consumption tax.

\[ TTR_t = T^P_t + T^D_t + T^G_t + T^I_t + T^L_t + T^C_t \]  

(54)

where \( TTR_t \), total tax revenue; \( T^P_t \), corporate income tax revenue; \( T^D_t \), dividend income (income gain) tax revenue; \( T^G_t \), capital gain tax; \( T^I_t \), interest income tax revenue; \( T^L_t \), labor income tax revenue; \( T^C_t \), consumption tax revenue

\[ T^D_t = \tau^D \text{Div}_t \]  

(55)

\[ T^G_t = \tau^G \left[ G V_{t+1} - V_t - V_N \right] \]  

(56)

\[ T^I_t = \tau^I \left[ i^{RH,H} A + i^{GH,H} + i^F A^{GH,H} \right] \]  

(57)

\[ T^L_t = \tau^L \left[ \text{wT,L} \text{PI} - \text{LTA}_{PI} + \text{wT,L} \text{LIQ} - \text{LTA}_{LIQ} \right] \]  

(58)

\[ T^C_t = \tau^C \left[ C_{PI} + C_{LIQ} \right] \]  

(59)

Government expenditure (including transfer payment) is financed by government bond issuance and tax collection. Therefore, the government budget constraint equation is given as follows:

\[ C^G_t + T^H_t + (1 + i^H_{t-1}) \text{D}^G_{t-1} / G = D^G_t + TTR_t \]  

(60)

\( C^G_t \) represents government expenditure (exogenous), \( T^H_t \) represents lump-sum net government transfer payment, and \( D^G_t \) represents the balance of government bonds issued by the home government at the beginning of the date \( t \).

The government sector adopts the following equation as a fiscal rule

\[ D^G_{t+1} = D^G_t + \text{D}_{bar}^G \]  

(61)

\( \text{D}_{bar}^G \) represents the target for the government bonds outstanding (exogenous).

The lump-sum net transfer payment \( T^H_t \) and the consumption tax rate \( \tau^C \) are endogenously determined so as to ensure that government budget constraint equation (60) and fiscal rule (61) are valid. The rule on the distribution of the lump-sum transfer payment \( T^H_t \) to PIH and LIQ consumers is endogenously given as follows:

\[ T^{H,PI} = (1 - \text{wt}^{H,LIQ} \times \alpha^{H,LIQ}) \times T^H_t \]  

(62)

\[ T^{H,LIQ} = \text{wt}^{H,LIQ} \times \alpha^{H,LIQ} \times T^H_t \]  

(63)

\( \text{wt}^{H,LIQ} \) represents the additional weight related to net government transfer payment to
LIQ consumers (usually expressed as wt\textsuperscript{TH,LIQ} = 1), and α\textsuperscript{TH,LIQ} represents the rate of distribution of net government transfer payment to LIQ consumers (usually expressed as α\textsuperscript{TH,LIQ} = proportion of LIQ households)

II-8. *Equivalence of three aspects and the international balance of payments (various identities)*

(a) Determination of the gross domestic product GDP and the gross national product GNP:

Based on the principle of equivalence of three aspects of national income, GDP is determined through the following equation:

\[
GDP_t = Y_t
\]  

(64)

Likewise, based on the principle of equivalence of three aspects, the trade balance TB\textsubscript{t} is passively determined so as to satisfy the following equation.

\[
TB_t = GDP_t - C_t - C^G_t - I_t
\]  

(65)

The income balance IB\textsubscript{t} is determined as follows:

\[
IB_t = i^F_t \text{A}_{GF,H}^G - i^H_t \text{A}_{GH,F}^F
\]  

(66)

Consequently, the gross national product GNP\textsubscript{t} is determined as follows:

\[
GNP_t = GDP_t + IB_t
\]  

(67)

(b) Determination of the net foreign asset NFA:

The current account balance CA\textsubscript{t} is determined as follows:

\[
CA_t = TB_t + IB_t
\]  

(68)

Consequently, the net foreign asset NFAt is determined so as to satisfy the following equation:

\[
NFA_t = A_{GF,H}^G - A_{GH,F}^F
\]  

(69)

\[
NFA_t = CA_t + NFAt_{t-1}/G
\]  

(70)

II-9. *Foreign sector*

The foreign sector exists only for the purpose of closing the model. Therefore, the behavioral equations concerning the foreign sector are very simply structured.

II-9-1. *Foreign corporate sector*

Concerning foreign companies’ production technologies, we assume a linear homogeneous Cobb-Douglas function incorporating capital and labor as production factors.

\[
Y^F_t = F^F(K^F_t, L^F_t) = (K^F_t)^{1-d^F} (L^F_t)^{d^F}
\]  

(71)

where \(Y^F_t\): the production value of added value; \(K^F_t\): capital stock at the beginning of the date t; \(L^F_t\): the labor input; \(d^F\): the parameter concerning input shares.

Under the production technology constraints expressed by formula (71), foreign corporations maximizes the following profit \(\pi^F_t\).

\[
\pi^F_t = F^F(K^F_t, L^F_t) - w^F_t L^F_t - (r^{VF}_t + \delta^F) K^F_t
\]  

(72)

where \(w_t\): the wage rate; \(L^F_t\): the labor input; \(r^{VF}_t\): the capital cost; \(\delta^F\): the depreciation
rate. The first order condition concerning foreign corporations is as follows:

\[ F^F_{L,t} \equiv \frac{\partial F^F_t}{\partial L^F_t} = d^F \left( \frac{K^F_t}{L^F_t} \right)^{1-d^F} = w^F_t, \] or \( d^F Y^F_t = w^F_t L^F_t \) \hspace{1cm} (73)

\[ F^F_{K,t} \equiv \frac{\partial F^F_t}{\partial K^F_t} = (1 - d^F) \left( \frac{K^F_t}{L^F_t} \right)^{d^F} + \delta^F, \] or \( (1 - d^F) Y^F_t = (r^F + \delta^F) K^F_t \) \hspace{1cm} (74)

The capital investment \( I^F_t \) is determined so as to satisfy the following capital accumulation equation:

\[ I^F_t = G K^F_{t+1} - (1 - \delta^F) K^F_t \] \hspace{1cm} (75)

It is assumed that finance is entirely implemented through the equity stock \( V^F_t \):

\[ V^F_t = K^F_t \] \hspace{1cm} (76)

II-9-2. Foreign household sector

A representative foreign consumer owns assets managed by investment trusts and determines the consumption in the current term and financial assets to be carried over to the following term.

Under the budget constraint, a consumer maximizes sum of the discounted present value of the utility. Here, the utility function is a logarithmic type.

\[ \text{Max } U^F_t = \sum_{i=0}^{\infty} \frac{1}{(1 + \rho^F)^i} u(C^F_{i+1}) = \sum_{i=0}^{\infty} (\beta^F)^i \log(C^F_{i+1}) \] \hspace{1cm} (77)

s.t.

\[ C^F_t + A^F_t = (1 + \tau^{F-1}_{t-1}) A^F_{t-1} / G + w^F_t L^F_t - T^\text{lump,F}_t \] \hspace{1cm} (78)

where \( U^F_t \): lifetime utility; \( \rho^F \): the rate of time preference by foreign consumers; \( u \): the logarithmic utility function; \( \beta^F \): the subjective discount rate of foreign consumers (\( \equiv 1 / (1 + \rho^F) \)); \( C^F_i \): the amount of consumption; \( L_\text{bar,F} \): labor supply (exogenous); \( A^F_t \): assets managed as investment trusts (at the beginning of the date \( t \)); \( r_\text{bar,F} \): the rate of return on foreign investment trusts; \( w^F_t \): the wage rate; \( T^\text{lump,F}_t \): lump-sum fixed tax.

The following inter-temporal Euler’s equation is obtained by resolving the above optimization problem.

\[ \frac{u'(C^F_t)}{u'(C^F_{i+1})} = \frac{\beta^F (1 + \rho^F)}{G} \] \hspace{1cm} (79)

As in 2.3.3., the consumption amount \( C^F_t \) satisfying Euler’s equation (79) is determined so as to satisfy the following equation:

\[ C^F_t = (1 - \beta^F) \times TW^F_t \] \hspace{1cm} (80)

\[ TW^F_t = (1 + r_\text{bar,F}_{t-1}) (A^F_{t+1} / G) + H^F_t \] \hspace{1cm} (81)
\[
H_t^{F} = (d_t^F Y_t^F - T_t^{lump,F}) + \frac{G}{1 + \bar{r}_t^F} H_{t+1}^{F} \tag{82}
\]

TW^F_t represents the total assets of foreign consumers and H^F_t represents the total human assets of foreign consumers.

II-9-3. Foreign fund investment sector

The foreign fund investment sector invests in foreign stocks (A^{VF}_t), domestic government bonds (A^{GH,F}_t), and foreign government bonds (A^{GF,F}_t) using lump-sum assets A^F_t supplied by households as fund sources. Therefore, the portfolio A^F_t at the beginning of the date t is expressed as follows (Figure 2).

\[
A^F_t = A^{VF}_t + A^{GH,F}_t + A^{GF,F}_t \tag{83}
\]

It is assumed that the foreign fund investment sector faces the zero profit condition under perfect competition. In this case, the following equation must be valid.

\[
r^F_t A^F_t = r^{VF}_t A^{VF}_t + i^H_t A^{GH,F}_t + i^F_t A^{GF,F}_t + \omega^F_t.
\]

\omega^F_t represents the variable cost concerning foreign fund investment (usually expressed as \omega^F_t = 0). As mentioned later, the rates of return \(i^H\) and \(i^F\) on domestic and foreign government bonds in the above equation are pre-tax returns because foreign governments do not impose interest income tax. In the steady state, the average rate of return \(r_{bar}^F\) for households converges toward approximately \(\rho^F + g\).

The demand function concerning the asset k (= VF, GH_F, GF_F) of the foreign fund investment sector is given as follows, as in the case of the domestic fund investment sector.

\[
a^k_t \equiv \frac{A^k_t}{A^F_t} = a^k \left( \frac{1 + r^F_t}{1 + \bar{r}_t^{CF,F}} \right)^\mu \tag{84}
\]

\[
1 + \bar{r}_t^{CF,F} \equiv \left[ \sum_k a^k (1 + r^F_t)^\mu \right]^{1/\mu} \tag{85}
\]

where \(a^k_t\): assets at the beginning of the date t; \(a^k_t\): proportion of the asset \(A^k_t\) in the overall portfolio at the beginning of the date t; \(1 + \bar{r}_t^{CF,F}\): the geometric mean of the rates of return on individual asset classes.

II-9-4. Foreign government sector

Interest payments on foreign government bonds are financed by the collection of lump-sum fixed taxes.
\[ T_{\text{lump,F}} = (1 + i_{t-1}^F) \frac{D_{\text{GF}}^{t-1}}{G} - D_{\text{GF}}^t \]  
\[ D_{\text{GF}}^t = D_{\text{GF}}^{t-1} = D_{\text{bar}}^{GF} \]

\( D_{\text{GF}}^t \) represents the balance of foreign government bonds at the beginning of the term \( t \), and \( D_{\text{bar}}^{GF} \) represents the target for the foreign government bonds (exogenous).

In the steady state, formula (86) is expressed as follows:
\[ T_{\text{lump,F}} = [(1 + i^F)/G - 1] D_{\text{bar}}^{GF} \cong (i^F - g) D_{\text{bar}}^{GF} \]  

II-10. Market equilibrium

The market equilibrium conditions are as follows:
(a) Labor market:
\[ L_{S,PH}^t + L_{S,LIQ}^t = L^t \]  
\[ L_F^t = L_F^t \]  

(b) Stock market
\[ A_V^t = V^F_t \]  
\[ A_{VF}^t = V^F_t \]

(c) Bond (corporate debt) market
\[ A_{B,H}^t = B_t \]

(d) Government bond market
\[ A_{GH,H}^t + A_{GH,F}^t = D_{\text{GH}}^t \]  
\[ A_{GF,H}^t + A_{GF,F}^t = D_{\text{GF}}^t \]

III. Data and calibration

III-1. Macro-economic data used in the baseline scenario

The macro-economic data (including tax revenue) used in the baseline scenario has been set in reference to Kumof et al (2010) and other studies. Table 1 is a list of the major data

<table>
<thead>
<tr>
<th>(Macro-economic variables)</th>
<th>(Unit: %)</th>
<th>(Tax rates)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private consumption/GDP</td>
<td>59.4</td>
<td>Corporate income tax rate 35</td>
</tr>
<tr>
<td>Private capital investment/GDP</td>
<td>26.3</td>
<td>PIH labor income tax rate 30</td>
</tr>
<tr>
<td>Government investment and consumption/GDP</td>
<td>15.0</td>
<td>LIQ labor income tax rate 30</td>
</tr>
<tr>
<td>Net exports/GDP</td>
<td>- 0.54</td>
<td>Consumption tax rate 8</td>
</tr>
<tr>
<td>Employee compensation/GDP</td>
<td>60.0</td>
<td>Interest income tax rate 20</td>
</tr>
<tr>
<td>Total tax revenue/GDP</td>
<td>30.4</td>
<td>Dividend income tax rate 20</td>
</tr>
<tr>
<td>Net government transfer payment/GDP</td>
<td>14.4</td>
<td>Capital gains tax rate 0</td>
</tr>
</tbody>
</table>

Note: Total tax revenue and the labor income tax rate include social security payments. As this model does not take into consideration tax collection failure and progressive taxation, the above figures concerning taxes do not necessarily matches the actual figures.
used in the scenario. Total tax revenue and the labor income tax rate include social security payment. As this model does not take into consideration tax collection failure and the progressive tax rate, among other factors, the above figures concerning taxes do not necessarily match the actual figures.

When we calculated the capital gains tax revenue with a tax rate of 20%, which is the same as the actual rate in 2013, the revenue became less than 1% of the total tax revenue. Therefore, in our simulation, the capital gains tax rate is assumed to be zero.

The assumed government bond yield in the initial steady is 3.0% (after-tax government bond yield is 2.4%), the assumed rate of return on equity is 5.0%, and the assumed GDP growth rate is 1.5% (the population growth rate of 0.0% + the labor-augmenting technological progress rate of 1.5%). Concerning the corporate balance sheet, the assumed debt ratio is 62.6%. As for the assumed mix of finance for new investments, the share is 45% for retained earnings, 50% for new debt issuance and 5% for new equity issuance.

III-2. Calibration of deep parameters

In principle, the deep parameters in the corporate and household sectors have been set in such a way that they are consistent with the values adopted in previous studies. Table 2 is a list of the major deep parameters used.

Using the elasticity of the debt ratio concerning the corporate tax rate (=0.5), the coefficients $m_1$ and $m_2$ in the agency cost function $m(b) = m_1 + (b - m_2)^2/b$ were calibrated as follows: $m_1 = 0.118$; $m_2 = 0.428$. The agency premium $m(b)$ in the initial steady state in the baseline scenario came to approximately 0.74%.

The inter-temporal elasticity of substitution is 0.8 based on Rausch (2009). The elasticity concerning labor supply (common to PIH and LIQ consumers) is 0.2 based on Kuroda and Yamamoto (2007) (Frisch elasticity; working hours selection model). LIQ consumers’ share in the total number of consumers was calibrated in such a way that LIQ consumers account for 25% of the total labor supply among all consumers (Kumof et al (2010)).

Table 2. List of major deep parameters

<table>
<thead>
<tr>
<th>(Corporate sector)</th>
<th>(Household sector)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elasticity of substitution between capital and labor</td>
<td>1.26</td>
</tr>
<tr>
<td>Depreciation rate</td>
<td>0.09</td>
</tr>
<tr>
<td>Elasticity of the debt ratio concerning the corporate tax rate</td>
<td>0.5</td>
</tr>
<tr>
<td>Elasticity of inter-temporal substitution</td>
<td>0.8</td>
</tr>
<tr>
<td>Elasticity concerning labor supply</td>
<td>0.2</td>
</tr>
<tr>
<td>Subjective discount rate</td>
<td>0.97</td>
</tr>
<tr>
<td>Share of households facing the liquidity constraint</td>
<td>0.25</td>
</tr>
</tbody>
</table>

---

11 The discrepancy between the sum of demand items and GDP is reflected as an increase in inventories (an exogeneous variable).
12 The actual figures in the 2012 Annual Financial Statements Statistics of Corporations by Industry (all-industry basis).
13 The Frisch elasticity refers to the wage elasticity of labor supply in cases where the marginal effect (shadow price) concerning assets in the current term is assumed to remain constant.
IV. Simulation results

IV-1. Simulation results concerning individual tax items (long-term equilibrium)

In this sub-section, we report on the simulation results concerning individual tax items. Table 3 shows the long-term economic impact of the implementation of a tax reduction equivalent to 1% of GDP in terms of percentage changes and percentage point changes from the baseline values (excluding the effects of policy shocks) of macroeconomic variables. PIH in the table refers to consumers who behave in accordance with the Permanent Income Hypothesis, while LIQ refers to consumers facing a liquidity constraint in the form of a lack of financial asset holdings. In the simulation analysis concerning the above individual tax items, net government transfer payment (lump-sum payment) was adopted as an adjusting factor intended to maintain tax revenue neutrality (government budget constraint equation). The effective wage rate $w^k_{at}$ for PIH or LIQ consumers in the table was defined as: $w^k_{at} \equiv \frac{(1 - \tau^{L,k})}{(1 + \tau^C)}w$ ($\tau^{L,k}$: the labor income tax rate for PIH or LIQ consumers; $\tau^C$: the consumption tax rate; $w$: before-tax wage rate). A simulation was not conducted with respect to the capital gains tax because the impact of a capital gains tax reduction equivalent to 1% GDP would cause a change of more than 100% in the values of economic parameters in the baseline scenario.

Table 3. Changes in major macro-economic variables (long-term percentage changes and percentage point changes) 14

<table>
<thead>
<tr>
<th>Tax items for tax reduction</th>
<th>Corporate income tax</th>
<th>PIH labor income tax</th>
<th>LIQ labor income tax</th>
<th>Consumption tax</th>
<th>Interest income tax</th>
<th>Dividend income tax</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP</td>
<td>2.4</td>
<td>0.5</td>
<td>0.5</td>
<td>0.3</td>
<td>2.4</td>
<td>0.4</td>
</tr>
<tr>
<td>EMTTR (effective marginal tax rate) (*)</td>
<td>-5.9</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>-4.4</td>
<td>0.3</td>
</tr>
<tr>
<td>Capital cost (*)</td>
<td>-0.4</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>-0.4</td>
<td>-0.1</td>
</tr>
<tr>
<td>Capital stock</td>
<td>5.4</td>
<td>0.4</td>
<td>0.5</td>
<td>0.3</td>
<td>5.4</td>
<td>0.9</td>
</tr>
<tr>
<td>Debit ratio (*)</td>
<td>-2.9</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>1.0</td>
<td>3.9</td>
</tr>
<tr>
<td>Equilibrium labor input amount (PIH/LIQ)</td>
<td>0.3/0.3</td>
<td>0.6/0.0</td>
<td>0.0/2.0</td>
<td>0.3/0.3</td>
<td>0.3/0.3</td>
<td>0.1/0.1</td>
</tr>
<tr>
<td>After-tax effective wage rate (PIH/LIQ)</td>
<td>1.6/1.6</td>
<td>3.2/0.0</td>
<td>0.0/9.5</td>
<td>1.5/1.5</td>
<td>1.6/1.6</td>
<td>0.3/0.3</td>
</tr>
<tr>
<td>Net government transfer payment (PIH/LIQ)</td>
<td>-1.4/-1.4</td>
<td>-5.3/-5.3</td>
<td>-5.2/-5.2</td>
<td>-5.7/-5.7</td>
<td>-2.3/-2.3</td>
<td>-3.7/-3.7</td>
</tr>
<tr>
<td>Consumption (PIH/LIQ)</td>
<td>1.3/1.0</td>
<td>1.2/-1.5</td>
<td>-1.2/6.7</td>
<td>0.4/0.2</td>
<td>1.4/0.8</td>
<td>1.1/-0.8</td>
</tr>
<tr>
<td>Overall consumption</td>
<td>1.2</td>
<td>0.6</td>
<td>0.6</td>
<td>0.4</td>
<td>1.3</td>
<td>0.7</td>
</tr>
<tr>
<td>Social welfare measured in terms of lifetime utility (PIH/LIQ)</td>
<td>1.6/1.7</td>
<td>1.2/-3.1</td>
<td>-1.8/12.0</td>
<td>0.3/0.0</td>
<td>1.9/1.2</td>
<td>1.6/-1.7</td>
</tr>
</tbody>
</table>

Note: The long-term economic impact expected from the tax reduction equivalent to 1% of GDP is shown in terms of percentage changes and percentage point changes (*) from the baseline values (without the assumption of a policy shock). PIH refers to consumers whose behavior follows the Permanent Income Hypothesis, while LIQ refers to consumers who face the liquidity constraint. The effective wage rate $w^k_{at}$ for PIH or LIQ consumers is defined as $w^k_{at} \equiv \frac{(1 - \tau^{L,k})}{(1 + \tau^C)}w$ ($\tau^{L,k}$: labor income tax rate applicable to PIH or LIQ consumers; $\tau^C$: consumption tax rate; $w$: pre-tax wage rate). As an adjusting factor intended to maintain tax revenue neutrality (government budget constraint equation), net government transfer payment (lump-sum payment) is adopted.

14 If the pre-tax and after-tax rate of return are represented by $u$ and $s$, respectively, the effective marginal tax rate (EMTR) is defined as $\text{EMTR} = \frac{(u-s)}{u}$.
First, let us summarize the results of the simulation analysis in this sub-section. The long-run tax reduction multiplier (the long-term impact of mitigation of the distortion caused by the tax reduction) came to approximately 2.4 for the corporate income tax, 0.5 for each of the PIH labor income tax and the LIQ labor income tax, 0.3 for the consumption tax, 2.4 for the interest income tax and 0.4 for the income gain tax, under the assumption of maintaining tax revenue neutrality through net government transfer payment (lump-sum payment). These multiplier values are consistent with the results obtained by Romer and Romer (2010) (the maximum multiplier value was 3), who conducted an empirical estimation of tax multipliers in the United States.\(^\text{15}\) On the other hand, as our model does not explicitly include the effective exchange rate, the multipliers may be overestimated due to the underestimation of the effects of crowding-out (crowding-in) exercised through net exports.

Meanwhile, the impact of tax reduction on the social welfare (lifetime utility) of PIH and LIQ consumers are as follows: corporate income tax: 1.6% and 1.7%; PIH labor income tax: 1.2% and minus 3.1%; LIQ labor income tax: minus 1.8% and 12.0%; consumption tax: 0.3% and 0.0%; interest income tax: 1.9% and 1.2%; and income gain tax: 1.6% and minus 1.7%. Below, we will explain in detail the simulation results concerning individual tax items.

(a) Simulation results concerning a corporate income tax reduction equivalent to 1% of GDP

The long-term tax reduction multiplier concerning corporate income tax (when compared with a lump-sum tax case) is approximately 2.4. The corporate income tax reduction lowers the effective marginal tax rate (EMTR) and capital cost, thereby increasing capital stock. As the increase in capital stock increases companies’ demand for labor, the effective wage rate rises.\(^\text{16}\) The corporate income tax reduction reduces net government transfer payment, which acts as an adjustment factor to maintain tax revenue neutrality (government budget constraint equation), but disposable income increases because the impact of the increase in labor income outweighs the impact of the decline in transfer payment. Consumption by both PIH and LIQ consumers increases, while social welfare (lifetime utility) improves approximately 1.6% and 1.7% for PIH and LIQ consumers, respectively.

(b) Simulation results concerning a PIH labor income tax reduction equivalent to 1% of GDP

The long-term tax reduction multiplier concerning the PIH labor income tax (when compared with a lump-sum tax case) is approximately 0.5. The reduction of the PIH labor income tax raises the after-tax effective wage rate for PIH consumers, thereby increasing labor supply. The reduction of the PIH labor income tax reduces net government transfer payment, which acts as an adjustment factor to maintain tax revenue neutrality (government budget constraint equation). In the case of PIH consumers, the impact of the increase in labor income outweighs the impact of the decline in net government transfer payment. Therefore, disposable income increases, resulting in higher consumption. For LIQ consumers, only the decline in net government transfer payment occurs, so disposable income decreases, result-

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\(^\text{15}\) Romer and Romer (2010) identified the tax reduction shock using information obtained from such sources as reports by the U.S. Congressional Budget Office and pointed out the possibility that the tax multiplier may be around 3 at a maximum.

\(^\text{16}\) As the increase in capital stock is higher than the increase in labor demand, the capital-to-labor ratio grows.
ing in lower consumption. Social welfare (lifetime utility) improves approximately 1.2% for PIH consumers and deteriorates approximately 3.1% for LIQ consumers.

(c) Simulation results concerning an LIQ labor income tax reduction equivalent to 1% of GDP

The long-term impact of the tax reduction multiplier concerning the LIQ labor income tax (when compared with a lump-sum tax case) is approximately 0.5. The reduction of the LIQ labor income tax raises the after-tax effective wage rate for LIQ consumers, thereby increasing labor supply. It reduces net government transfer payment, which acts as an adjustment factor to maintain tax revenue neutrality (government budget constraint equation). For PIH consumers, only the decline in net government transfer payment occurs, so their disposable income decreases, resulting in lower consumption. In the case of LIQ consumers, as the impact of the increase in labor income outweighs the impact of the decline in net government transfer payment, disposable income increases, resulting in higher consumption. Social welfare (lifetime utility) deteriorates approximately 1.8% for PIH consumers and improves approximately 12.0% for LIQ consumers.

(d) Simulation results concerning a consumption tax reduction equivalent to 1%

The long-term tax reduction multiplier concerning the consumption tax (when compared with a lump-sum tax) is approximately 0.3. The reduction of the consumption tax raises the after-tax effective wage rate, thereby increasing labor supply. The reduction of the consumption tax reduces net government transfer payment, which acts as an adjustment factor to maintain tax revenue neutrality (government budget constraint equation). However, as the impact of the increase in labor income outweighs the impact of the reduction of net government transfer payment, disposable income increases. Consumption by both PIH and LIQ consumers grows, while social welfare (lifetime utility) improves approximately 0.3% for PIH consumers and remains almost flat for LIQ consumers.

(e) Simulation results concerning an interest income tax reduction equivalent to 1% of GDP

The long-term tax reduction multiplier concerning the interest income tax (when compared with a lump-sum tax case) is approximately 2.4. The interest income tax reduction reduces the effective marginal tax rate (EMTR) and capital cost, thereby increasing capital stock. As the increase in capital stock increases companies’ demand for labor somewhat, the effective wage rate rises. The interest income tax reduction reduces net government transfer payment, which acts as an adjustment factor to maintain tax revenue neutrality (government budget constraint equation). However, as the impact of the increase in labor income outweighs the impact of the reduction of the transfer payment, disposable income increases. Consumption by both PIH and LIQ consumers grows, while social welfare (lifetime utility) improves approximately 1.9% for PIH consumers and approximately 1.2% for LIQ consumers.

(f) Simulation results concerning an income gain tax reduction equivalent to 1% of GDP

The long-term tax reduction multiplier concerning the income gain tax (when compared with a lump-sum tax case) is approximately 0.4. The reduction of the income gain tax reduces capital cost, thereby increasing capital stock. However, under the New View, which ar-
gues that net investment is financed mainly by retained earnings and new borrowings, rather than by new equity issuance, this impact is not conspicuous.\footnote{In this paper, the proportion of net investments financed by new equity issuance (eta) is calibrated to be 5\%.} The reduction of the income gain tax reduces net government transfer payment, which acts as an adjustment factor to maintain tax revenue neutrality (government budget constraint equation). As the impact of the increase in labor income is outweighed by the impact of the reduction of the transfer payment, disposable income decreases. In the case of PIH consumers, their financial assets, a factor that could affect consumption, increase, resulting in higher consumption. In the case of LIQ consumers, as they do not own financial assets, only the impact of the decline in disposable income arises, resulting in lower consumption. Social welfare (lifetime utility) improves approximately 1.6\% for PIH consumers and deteriorates approximately 1.7\% for LIQ consumers.

IV-2. Simulation analysis based on a tax system reform package (long-term equilibrium)

The tax system reform package discussed in this sub-section is designed as described in the following two scenarios based on the concept of dual income taxation and the New View. The tax system reform is implemented in such a way as to maintain tax revenue neutrality, with the consumption tax rate adopted as an adjustment factor to satisfy the government budget constraint equation. To enable comparison between scenarios, adjustments are made so as to keep the tax reduction margin (excluding the margin of the consumption tax rate as an adjusting factor) constant across all scenarios. Table 4 shows a list of tax rates by the scenarios in this subsection, and Table 5 shows the long-term economic impact under these scenarios.

Scenario 1 is based on a “moderate DIT.”\footnote{In order to enable comparison with the dual income taxation system that was discussed in past studies, this paper assumes a somewhat looser version of the dual income taxation system.} Under this scenario, the corporate income tax rate is set at a level slightly lower (35\%→25\%) than the average labor income tax rate (30\%) in order to ensure that the lowest labor income tax rate is set at the same level as the corporate income tax rate, which is one of the features of dual income taxation (DIT). With respect to income gain taxation, the tax rate is set at zero (20\%→ zero) in order to avoid creating distortions due to double taxation.

Scenario 2 is based on the New View. In principle, this scenario is similar to Scenario 1 (moderate DIT) but reflects the New View’s argument that income gain taxation does not significantly affect companies’ capital investment behavior. Specifically, the income gain tax rate remains unchanged at 20\%. The interest income tax rate is lowered to 10\% (20\%→ 10\%) in order to maintain consistency with the margin of the tax reduction (excluding the consumption tax rate as an adjustment factor) under Scenario 1 (moderate DIT).\footnote{Under the actual interest income tax system in Japan, the tax rate applicable to non-taxable entities, such as non-residents and non-profit organizations, is set at zero or at lower rates than the rate applied to residents. However, this paper ignores that point.}
Simulation results concerning Scenario 1 (moderate DIT) Under the tax system reform based on moderate DIT, the reduction of the corporate income tax lowers the effective marginal tax rate (EMTR), while the interest income tax increase raises it. In this simulation, the impact of the former outweighs the impact of the latter, so the EMTR and capital cost decline, resulting in growth in capital stock. The reduction of the income gain tax (abolition of double taxation) is also expected to make small contributions to the growth in capital stock. As the growth in capital stock increases companies’ demand for labor somewhat, the effective wage rate rises.

As the tax system reform is implemented in such a way as to maintain tax revenue neutrality, it is necessary to raise the consumption tax rate, which acts as an adjustment factor.
The margin of the increase in the consumption tax rate in this scenario is the largest of all scenarios (an increase of 1.5 points).

In the case of PIH consumers, the impact of the increase in labor income due to the rise in the effective wage rate and the increase in the amount of equilibrium labor input outweighs the negative impact of the increase in the consumption tax rate, so disposable income increases, resulting in higher consumption. In the case of LIQ consumers, the impact of the increase in labor income is mostly canceled out by the negative impact of the increase in the consumption tax rate, so disposable income and consumption remains unchanged. Overall consumption increases and GDP also grows (+2.4%). Social welfare (lifetime utility) improves approximately 2.2% for PIH consumers and deteriorates approximately 0.2% for LIQ consumers (the deterioration is attributable to dis-utility due to an increase in labor supply).

(b) Simulation results concerning Scenario 2 (New View)

The tax system reform based on the New View lowers the EMTR and capital cost through the reduction of the corporate income tax and interest income tax. As the increase in capital stock increases companies’ demand for labor somewhat, the effective wage rate rises. As the tax system reform is implemented in such a way as to maintain tax revenue neutrality, it is necessary to raise the consumption tax rate, which acts as an adjustment factor.

Under the New View, income gain taxation does not significantly affect companies’ capital investment behavior, so keeping the income gain tax rate unchanged as is the case under this scenario does not have much of a negative impact on capital accumulation. For that reason, the margin of the increase in the consumption tax rate is the smallest of all scenarios (an increase of 0.9 points). As the impact of the increase in labor income due to the rise in the effective wage rate and the growth in the amount of equilibrium labor input outweighs the negative effects of the increase in the consumption tax rate, disposable income increases. Overall income increases, and GDP also grows (+3.2%). Social welfare (lifetime utility) improves approximately 2.0% for PIH consumers and approximately 1.7% for LIQ consumers.

IV-3. Other simulation analyses (long-term equilibrium)

The scenario in this sub-section is set as follows. The simulation is conducted in such a way to maintain tax revenue neutrality. The consumption tax rate is adopted as an adjustment factor to maintain tax revenue neutrality (government budget constraint equation). Table 6 shows the long-term economic impact under the scenarios in this subsection.

Scenario A1 is based on the implementation of ACE (Allowance of Corporate Equity). In order to avoid, as much as possible, creating distortions due to taxation on companies’ normal profits, the imputed rate of return on corporate equity is partially deducted from the corporate income tax base. The baseline value of the return on corporate equity (5.0%) is adopted as the imputed rate of return on corporate equity \( r^{imp20} \). The parameter \( z2 \) that measures the deduction is set at 0.2.

Scenario A2 is based on the implementation of net investment deduction (accelerated
write-off). Under this scenario, net investment is partially deducted from the corporate tax base. The parameter $z_3$ that measures the deduction is set at 0.2.

(a) Simulation results concerning Scenario A1 (implementation of ACE)

As the implementation of ACE reduces the tax on companies’ normal profits, the EMTR and capital cost decline, resulting in an increase in capital stock. As the increase in capital stock increases companies’ demand for labor somewhat, the effective wage rate rises. Disposable income increases, resulting in higher consumption. Social welfare (lifetime utility) improves approximately 0.6% for PIH consumers and approximately 0.8% for LIQ consumers.

(b) Simulation results concerning Scenario A2 (net investment deduction (accelerated write-off))

The implementation of net investment deduction (accelerated write-off) reduces the EMTR and capital cost, resulting in an increase in capital stock. As the increase in capital stock increases companies’ demand for labor somewhat, the wage rate rises. Disposable income increases, resulting in higher consumption. Social welfare (lifetime utility) improves approximately 1.7% for PIH consumers and approximately 3.2% for LIQ consumers.

V. Summary

In this paper, we developed a dynamic macro-econometric model (dynamic CGE model) that contributes to the analysis of capital taxation, in reference to Radulescu (2007), and Radulescu and Stimmelmayr (2010). Under this model, we conducted several numerical
simulation analyses under the assumption of maintaining tax revenue neutrality. These analyses are done not only to explore how to impose capital taxation (corporate income tax, income gain tax, capital gains tax and interest income tax) so as to avoid creating distortions in the corporate sector, but also to implement the tax system reform while maintaining fiscal sustainability.

Among notable features of our model are: 1) that the corporate sector is realistically designed; 2) that liquidity-constrained households without financial asset are included in the model; 3) that the model is analyzed in a bilateral open economy setting explicitly incorporating the current account balance and net foreign assets.

The results of the analyses in this paper can be summarized as follows. First, under the assumption of maintaining tax revenue neutrality through net government transfer payment (lump-sum payment), the long-term tax reduction multiplier (when compared with a lump-sum tax case) is approximately 2.4 in the case of the corporate income tax, 0.5 in the case of the PIH labor income tax, 0.5 in the case of the LIQ labor income tax, 0.3 in the case of the consumption tax, 2.4 in the case of the interest income tax and 0.4 in the case of the income gain tax. 21

Second, it was confirmed that if a tax system reform is implemented based on a dual income taxation system under which the lowest labor income tax rate is set at the same rate as the corporate income tax rate, social welfare improves in most cases even under the assumption of maintaining tax revenue neutrality.

Third, it was confirmed that if ACE (Allowance for Corporate Equity), which refers to partial deduction of the imputed rate of return on corporate equity from the corporate tax base, or net investment deduction (accelerated write-off) is implemented as a policy measure to avoid creating distortions due to taxation on companies’ normal profits, social welfare (lifetime utility) improves in most cases even under the assumption of maintaining tax revenue neutrality.

Future challenges related to this paper are as follows: (1) conducting analysis concerning income redistribution measures such as reforming a deduction system related to the PIH and LIQ labor income taxes and changing the proportion of net government transfer payment distributed to LIQ consumers; (2) conducting analysis concerning the social welfare function of the overall economy (e.g. how to prioritize the utility for PIH and LIQ consumers); (3) measuring the impact of a tax system reform related to fixed assets in the case of the introduction of land as a production factor (supply amount is fixed).

References


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21 As was mentioned in 4.1, the values of these multipliers are consistent with the results of the study by Romer and Romer, which empirically estimated the tax reduction multiplier in the United States. On the other hand, it is necessary to keep in mind the possibility that the crowding-out (crowding-in) effect exercised through net export may be underestimated, resulting in an overestimation of the multiplier.


