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Evaluating Universal Basic Income

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Abstract

This paper examines the macroeconomic effects of universal basic income (UBI). Most social security benefits are provided only when certain eligibility conditions are met. By contrast, UBI provides a uniform payment to all households without imposing eligibility criteria or conditions for receipt.

The results are as follows. In both the dynamic general equilibrium (DGE) model and the dynamic stochastic general equilibrium (DSGE) model, a positive UBI payment shock increases gross domestic product, and this effect persists even after the shock has dissipated. This finding suggests that UBI may have a growth-enhancing effect, primarily because it promotes capital accumulation. The results also show that the increase in gross domestic product is larger in the DSGE model than in the DGE model. This is because the presence of inflation encourages investment in real capital, thereby generating greater capital accumulation in the DSGE model than in the DGE model.

Keywords: Basic Income, DSGE Model, Ramsey Model

JEL Codes: H23, E20

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1. Introduction

This paper aims to examine the macroeconomic effects of universal basic income. Under most social security systems, benefits are provided only when certain conditions are satisfied. To receive an old-age pension, for example, individuals must have reached a specified age and fulfilled the relevant contribution requirements. Eligibility for unemployment insurance benefits also depends on the length of the contribution or insured period. Furthermore, because eligibility for public assistance is determined through a means test based on the principle of subsidiarity, the scope of beneficiaries is necessarily highly restricted.

By contrast, universal basic income (UBI) provides a uniform payment to all households without imposing eligibility criteria or conditions for receipt. In Japan, a payment of 100,000 yen per person was provided in 2020 in response to the spread of COVID-19. Since this payment was made universally without income or other eligibility requirements, it may be regarded as a typical example of a one-off basic-income-type payment.

Because universal basic income provides income even to individuals who are not employed, it is often argued that it may weaken incentives to work and reduce labor supply. Economic theory also predicts that, as long as leisure is a normal good, an increase in income reduces labor supply. Accordingly, the introduction of universal basic income may be expected to decrease labor supply.

Indeed, Balakrishnan, Costa, Haushofer, and Waltenberg (2024), Gromadzki (2024), and Vivalt, Rhodes, Bartik, Broockman, Krause, and Miller (2024) show that universal basic income reduces labor supply, a finding that is consistent with the economic theory described above. However, Jones and Marinescu (2022) and Salehi-Isfahani and Mostafavi-Dehzooei (2018) find that universal basic income does not reduce labor supply. Thus, the presence of universal basic income does not necessarily lead to a decline in labor supply.

The desirability of universal basic income has also been examined from the perspective of uncertainty. Luduvice (2024) and Ghazanchyan, Goumilevski, and Mourmouras (2024) show that universal basic income is desirable when uncertainty is taken into account. By preventing individuals from falling into a state of having no income, universal basic income can be regarded as functioning as a form of insurance. Moreover, by reducing the risk of income fluctuations in the face of uncertainty, it can improve welfare.

There are also studies that analyze universal basic income using macroeconomic models. Chrisp (2023) reviews the existing literature that examines universal basic income through macroeconomic modeling. Jaimovich, Saporta-Eksten, Setty, and Yedid-Levi (2024) show that, because universal basic income weakens the need for self-insurance, it reduces precautionary saving and thereby lowers capital accumulation. Babilla and Thierry (2023), using a DSGE model, demonstrate that replacing oil subsidies with universal basic income can reduce inequality and promote economic growth. Hollander, Havemann, and Steenkamp (2024), by contrast, show that universal basic income requires substantial fiscal resources and that the financing burden can have a negative effect on economic growth.

The preceding review shows that universal basic income has been analyzed from a variety of perspectives. This raises the question of what type of analysis can be regarded as making an original contribution. One possible contribution is a comparison across different macroeconomic models.

This paper compares the effects of universal basic income under three models: (i) a Ramsey model, which is a dynamic general equilibrium (DGE) model; (ii) a small open economy model; and (iii) a dynamic stochastic general equilibrium (DSGE) model. To ensure comparability, the same parameter values are used across all three models. The purpose is to examine how the predicted effects of universal basic income differ depending on the model employed.

Although such cross-model comparisons remain relatively uncommon in existing literature, they may provide important policy implications. By identifying which model best captures the economic structure of a particular country, researchers can offer more realistic predictions of the likely effects of introducing a universal basic income policy in that country.

The results of the analysis are as follows. In both the DGE and DSGE models, a positive shock to universal basic income payments raises gross domestic product, and this effect persists even after the shock has dissipated. This suggests that universal basic income may have a growth-promoting effect. The underlying mechanism is the increase in capital accumulation induced by the policy.

Furthermore, the effect on gross domestic product is found to be larger in the DSGE model than in the DGE model. This is because the presence of inflation encourages investment in real capital, thereby promoting greater capital accumulation in the DSGE model than in the DGE model.

The remainder of this paper is organized as follows. Section 2 discusses universal basic income and labor supply, as well as universal basic income and uncertainty, within a static framework. This section provides the basic concepts necessary for discussing universal basic income before moving on to the dynamic models.

Section 3 presents an analysis based on a DGE model, specifically a Ramsey model. This section also introduces a small open economy model. Section 4 describes the DSGE model. Section 5 conducts simulation analyses of (i) the DGE model, (ii) the small open economy model, and (iii) the DSGE model, using parameter values obtained through calibration. The final section provides the conclusion of the paper.

2. Static Model

Before introducing the dynamics models, we examine universal basic income within a static framework.

2.1 Labor supply and Basic Income

Whether universal basic income affects labor supply is a question that is frequently discussed whenever the policy is considered. This section also examines that issue. We begin by setting up the model. First, let u denote the utility function.

$$u = u(c, l) \tag{1}$$

where c denotes consumption and l denotes leisure. We assume that the marginal utilities of consumption and leisure are both positive, but diminishing. That is, $\frac{\partial u}{\partial c} > 0, \frac{\partial u}{\partial l} > 0, \frac{\partial^2 u}{\partial c^2} < 0, \frac{\partial^2 u}{\partial l^2} < 0$. The budget constraint is given by:

$$c = (1 - l)w + T \tag{2}$$

Each individual is endowed with one unit of time, which is allocated between leisure and labor. Accordingly, labor supply is given by $1 - l$. Let w denote the wage rate per unit of time, and let T denote the level of universal basic income benefits. To examine whether universal basic income affects labor supply, consider the figure below.

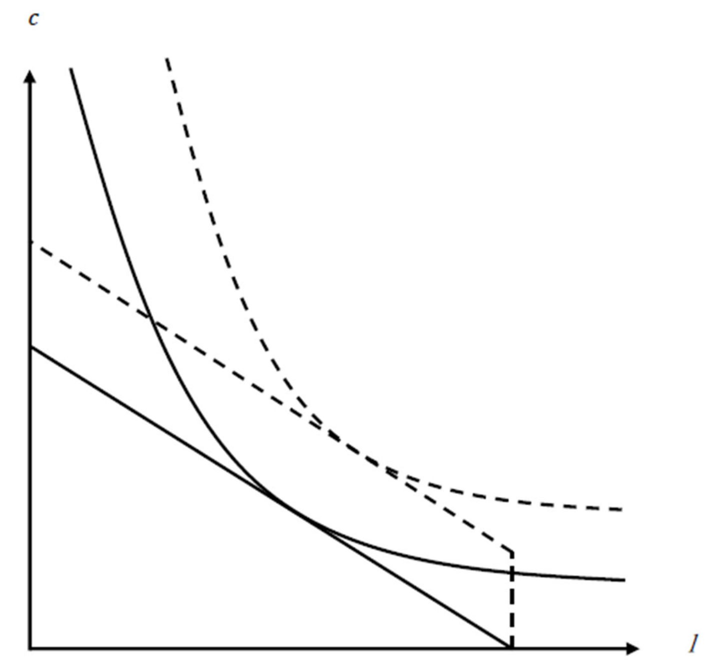

Fig. 1: Universal Basic Income and Labor Supply

The solid line represents the budget constraint in the absence of universal basic income, while the curve represents an indifference curve tangent to that budget constraint. If leisure is a normal good, the introduction of universal basic income shifts the budget constraint upward and to the right, as shown by the dashed line. The point of tangency between the budget constraint and the indifference curve also moves upward and to the right. Therefore, under the standard assumptions of the economic model, universal basic income increases leisure and consequently reduces labor supply.

2.2 Uncertainty in Static Model

We consider an economy with two types of individuals: employed workers and unemployed individuals. Employed workers receive wage income, whereas unemployed individuals receive unemployment benefits. These benefits are financed by contributions collected from employed workers. In addition, universal basic income is provided to both employed and unemployed individuals. We first assume the following utility function:

$$u_t^i = \ln c_{t+1}^i \tag{3}$$

Here, u_t^i denotes utility and c_{t+1}^i denotes consumption in period $t+1$. The superscript i is an index indicating the individual's employment status: $i = e$ denotes an employed worker, whereas $i = u$ denotes an unemployed individual. Current utility in period t depends on the level of consumption in the following period, $t+1$. The period $t+1$ budget constraints for employed and unemployed individuals are given, respectively, as follows:

$$c_{t+1}^e = (1-\tau)w + T \tag{4}$$

$$c_{t+1}^u = b_{t+1} + T \tag{5}$$

Here, b_{t+1} denotes unemployment benefits, and τ denotes the income tax rate used to finance those benefits. Employed individuals are assumed to supply one unit of labor inelastically. Universal basic income, denoted by T, is provided to both employed and unemployed individuals. Because individuals do not know in period t whether they will be employed or unemployed in period $t+1$, we consider expected utility, Eu.

$$Eu = p\ln\big((1-\tau)w + T\big) + (1-p)\ln(b_{t+1} + T\ ) \tag{6}$$

Here, p denotes the probability of being employed, while $1-p$ denotes the probability of being unemployed. Accordingly, in period $t+1$, the proportion of employed individuals is p, and the proportion of unemployed individuals is $1-p$. The population size is normalized to one.

The government budget constraint is given by:

$$p\tau w = (1-p)b_{t+1} + T \tag{7}$$

The tax rate and the level of universal basic income are treated as exogenous variables, while the level of unemployment benefits, b_{t+1}, is determined so as to satisfy the government budget constraint.

We now examine the change in expected utility resulting from a marginal introduction of universal basic income from an initial situation in which $T = 0$. Tax revenue is held constant, and the necessary funds are raised by reducing unemployment benefits. The purpose of this analysis is to evaluate the effect of replacing part of a targeted benefit, namely unemployment benefits, with a uniform benefit in the form of universal basic income. Differentiating the expected utility given by equation (6) yields the following expression:

$$\frac{dEu}{dT} = \frac{p}{(1-\tau)w} - \frac{p}{1-p}\frac{1}{b_{t+1}} \tag{8}$$

From the government budget constraint, note that $(1-p)db_{t+1} + dT = 0$. Therefore, in deriving equation (8), db_{t+1} can be replaced by an expression in terms of dT. We now derive the condition under which $\frac{dEu}{dT} > 0$.

Because the derivative is evaluated at $T = 0$, the condition $p\tau w = (1-p)b_{t+1}$ holds. Solving this equation for b_{t+1}, substituting the resulting expression into equation (8), and imposing $\frac{dEu}{dT} > 0$ yields the following inequality:

$$\tau > \frac{1}{1+p} \tag{9}$$

At the same time, it is reasonable to impose the condition that workers' disposable income, $(1-\tau)w$, exceeds the level of unemployment benefits, b_{t+1}. The inequality corresponding to this condition is given as follows:

$$\tau < 1 - p \tag{10}$$

There is no value of τ that simultaneously satisfies conditions (9) and (10). Thus, in the presence of uncertainty, a policy that increases universal basic income by reducing unemployment benefits, which are targeted transfers, is not desirable for all individuals.

This result depends on the presence of uncertainty. In the absence of uncertainty, for example, employed individuals experience an increase in utility because their disposable income rises by the amount of universal basic income payment. By contrast, unemployed individuals experience a decline in utility because the reduction in unemployment benefits exceeds the amount of universal basic income they receive.

3. DGE (Dynamics General Equilibrium) Model

In this section, we use a Ramsey model to examine the effects of a basic income. Specifically, we consider two types of households. The first type earns labor income and allocates it between consumption and saving. The second type is unemployed and receives unemployment benefits. We assume that the unemployed household is hand-to-mouth and uses all of its unemployment benefits for current consumption. The utility functions of the employed and unemployed households are given as follows:

$$U_t^i = \sum_{s=t}^{\infty} \rho^{s-t} ln c_s^i, 0 < \rho < 1. \tag{11}$$

Here, i is an index: $i = e$ denotes an employed household, whereas $i = u$ denotes an unemployed household.

Next, we consider the budget constraints, which are given as follows:

$$K_{t+1} = (1 - \tau)w_t + r_t K_t + (1 - \delta)K_t - c_t^e + T. \tag{12}$$

Here, r_t denotes the interest rate, K_t the capital stock, and δ the depreciation rate. Since employed households save, their budget constraint is given by equation (12). By contrast, unemployed households use their unemployment benefits entirely for consumption, and thus their budget constraint is given as follows:

$$c_t^u = b_t. \tag{13}$$

In this model, the population size is also normalized to one. The proportions of employed and unemployed households are $p$and $1 - p$, respectively, and there is no population growth.

We derive the optimal consumption allocation that maximizes the utility function in equation (11), subject to the budget constraint in equation (12). The Euler equation for consumption is given as follows:

$$\frac{c_{t+1}^e}{c_t^e} = \rho(r_{t+1} + 1 - \delta). \tag{14}$$

Next, we turn to the production function. We assume the following Cobb–Douglas production function:

$$Y_t = AK_t^{\theta} L_t^{1-\theta}, 0 < A, 0 < \theta < 1. \tag{15}$$

Here, Y_t denotes output and L_t denotes labor input. In labor market equilibrium, since the population size is normalized to one and the proportion of employed households is p, labor input is also equal to p.

The wage rate and the interest rate are determined by the conditions that each factor price equals the marginal product of the corresponding input factor, as follows:

$$w_t = (1 - \theta)AK_t^{\theta} L_t^{-\theta}, \tag{16}$$

$$r_t = \theta A K_t^{\theta-1} L_t^{-\theta}, \tag{17}$$

Although the details are omitted here, this model is a standard Ramsey model with a unique saddle-path-stable steady-state equilibrium. We now derive a linear approximation for the simulation analysis. Linearizing equations (12)–(14), (16), and (17) around the steady state yields the following expressions. Here, a hat denotes the percentage deviation from the steady state, while a tilde denotes the absolute deviation from the steady state.

$$\hat{c}_{t+1}^e - \hat{c}_t^e = \rho \tilde{r}_{t+1}. \tag{A.1}$$

This is the linear approximation of the consumption Euler equation in equation (14). Note that, in the steady state, the following relationship holds: $\rho = \frac{1}{r+1-\delta}$.

$$\hat{K}_{t+1} = \frac{(1-\tau)w\hat{w}_t + \tilde{r}_t K + r_t K \hat{K}_t + (1-\delta)K\hat{K}_t - c^e \hat{c}_t^e + \tilde{T}_t}{K}. \tag{A.2}$$

This equation is derived from equation (12), which represents both the household budget constraint and the law of motion for capital.

$$\hat{w}_t = \theta \hat{K}_t, \tag{A.3}$$

$$\tilde{r}_t = (\theta - 1)K\hat{K}_t. \tag{A.4}$$

These equations are obtained by linearizing equations (16) and (17), respectively, around the steady state.

Next, we linearize the government budget constraint in equation (7). The tax rate is assumed to remain unchanged. We consider a policy that increases basic income benefits while reducing unemployment benefits under a constant tax rate.

$$b\hat{b}_t = \frac{p\tau}{1-p} w\hat{w}_t - \frac{\tilde{T}_t}{1-p}. \tag{A.5}$$

The equation suggests that although the provision of basic income directly reduces unemployment benefits, it may increase capital accumulation and thereby partially mitigate the decline in unemployment benefits.

Next, from equation (13), the rate of change in the consumption of unemployed households is given as follows:

$$\hat{c}_t^u = b\hat{b}_t. \tag{A.6}$$

Basic income benefits are provided according to the following rule:

$$\tilde{T}_t = \phi \tilde{T}_{t-1} + f, 0 < \phi < 1, 0 < f. \tag{A.7}$$

Here, f represents the policy shock at the initial date and is assumed to be zero from the following period onward. The parameter ϕ represents the degree of policy persistence. A larger value of ϕ indicates that the policy remains in effect for a longer period.

Thus, in the closed-economy model, the simulation can be conducted using equations (A.1)–(A.7). In the small open economy model, the interest rate and the wage rate are assumed to be fixed. In addition, the law of motion for capital is modified as follows:

$$\hat{K}_{t+1} = \frac{rK\hat{K}_t + (1-\delta)K\hat{K}_t - c^e\hat{c}_t^e + \tilde{T}_t}{K}. \tag{B.1}$$

The government budget constraint is then modified as follows:

$$b\hat{b}_t = -\frac{\tilde{T}_t}{1-p}. \tag{B.2}$$

Therefore, in the small open economy model, the simulation can be conducted using equations (A.1), (A.6), (A.7), (B.1), and (B.2).

4. DSGE (Dynamics Stochastic General Equilibrium) Model

In this section, we examine the macroeconomic effects of basic income using a DSGE model. Unlike the Ramsey model, the DSGE model incorporates inflation and the effects of aggregate demand on gross domestic product in the short run. Therefore, it is expected to yield results that differ from those of the Ramsey model, in which gross domestic product is determined by aggregate supply. The model is specified as follows:

4.1 Households

Households are assumed to derive utility from consumption and real money balances. Specifically, we assume the following utility function:

$$U_t^e = E_t \sum_{s=t}^{\infty} \rho^{s-t}(lnc_s^e + lnm_s), 0 < \rho < 1. \tag{18}$$

Here, m_s denotes real money balances, and E_t is the expectations operator. Although money holdings can also be regarded as a means of saving, this utility function applies to employed households. Unemployed households are assumed to be hand-to-mouth, and their utility function is given by equation (11).

Next, we consider the household budget constraint. Households have two means of saving: holding money and investing in physical capital as a real asset.

$$m_t + b_t^s + c_s^e + I_t = \frac{1}{1+\pi_t}\left((1+i_t)b_{t-1}^s + m_{t-1}\right) + (1-\tau)w_t + r_t K_{t-1} + T + \varphi_t. \tag{19}$$

Here, b_t denotes holdings of safe assets, I_t investment, π_t the inflation rate, and i_t the nominal interest rate. Although r_t has previously been referred to simply as the interest rate, it is interpreted here as the real interest rate. In addition, φ_t denotes the profits generated by monopolistically competitive firms owned by households. The budget constraint of unemployed households is given by equation (13).

The law of motion for capital is given as follows:

$$K_{t+1} = I_t + (1-\delta)K_t - S\left(\frac{I_t}{I_{t-1}}\right)I_t, 0 < \delta < 1, S' > 0, S(1) = S'(1) = 0. \tag{20}$$

$S\left(\frac{I_t}{I_{t-1}}\right)$ represents investment adjustment costs, implying that undertaking investment entails additional costs. This specification is commonly used in DSGE models. Because of these adjustment costs, even when a policy shock induces changes in investment, the response of investment is gradual.

Maximizing utility subject to equations (19) and (20), and letting λ_t and γ_t denote the Lagrange multipliers associated with equations (19) and (20), respectively, yields the following equations:

$$\frac{1}{c_t^e} = \rho E_t \frac{1}{c_{t+1}^e}\frac{1+i_{t+1}}{1+\pi_{t+1}}. \tag{21}$$

$$1 = q_t\left(1 - S\left(\frac{I_{t-1}}{I_{t-2}}\right) - S'\left(\frac{I_t}{I_{t-1}}\right)\frac{I_t}{I_{t-1}}\right) + E_t q_{t+1}\frac{1+i_{t+1}}{1+\pi_{t+1}} S'\left(\frac{I_{t+1}}{I_t}\right)\left(\frac{I_{t+1}}{I_t}\right)^2. \tag{22}$$

$$E_t\left(r_{t+1} + q_{t+1}(1-\delta)\right) = E_t q_t \frac{1+i_{t+1}}{1+\pi_{t+1}}. \tag{23}$$

where $q_t = \frac{\gamma_t}{\lambda_t}$. Note that λ_t is equal to the marginal utility of consumption, while $\gamma_t$can be interpreted as the value of capital.

4.2 Firms

There are two types of firms: final-goods-producing firms and intermediate-goods-producing firms. The production function of the final-goods-producing firms is assumed to take the following form:

$$Y_t = \left(\int_0^1 Y_{jt}^{\frac{\varepsilon-1}{\varepsilon}} \right)^{\frac{\varepsilon}{\varepsilon-1}}, 1 < \varepsilon. \tag{24}$$

Here, Y_t denotes the final good, and Y_{jt} denotes intermediate good j. The demand function for intermediate good $j$can be derived from the profit-maximization condition as follows:

$$Y_{jt} = \left(\frac{p_{jt}}{p_t} \right)^{-\varepsilon} Y_t. \tag{25}$$

Here, p_t denotes the price of the final good, and p_{jt} denotes the price of intermediate good j. The relationship between the prices of intermediate goods and the final good is given as follows:

$$p_t = \left(\int_0^1 p_{jt}^{1-\varepsilon} \right)^{\frac{1}{1-\varepsilon}}, \tag{26}$$

$$p_t Y_t = \int_0^1 p_{jt} Y_{jt} dj. \tag{27}$$

Next, we consider intermediate-goods-producing firms. Their production function is assumed to take the following form:

$$Y_{jt} = AK_{jt-1}^{\theta} L_{jt}^{1-\theta}, 0 < A, 0 < \theta < 1. \tag{28}$$

Although this production function is identical to equation (15), it differs in that it includes the subscript j. Each intermediate-goods-producing firm produces its output according to the production function given by equation (28). The cost function, C_{jt}, is given as follows:

$$C_{jt} = w_{jt} N_{jt} + r_{jt} K_{jt-1}. \tag{29}$$

We consider the cost-minimization problem in which equation (29) is the objective function and equation (28) is the constraint. Letting ω_{jt} denote the Lagrange multiplier associated with the constraint in equation (28), we obtain the following equations:

$$w_{jt} = \omega_{jt} (1-\theta) AK_{jt}^{\theta} L_{jt}^{-\theta}, \tag{30}$$

$$r_{jt} = \omega_{jt} \theta AK_{jt}^{\theta-1} L_{jt}^{1-\theta}, \tag{31}$$

It can be shown that the following equation holds, implying that ω_{jt} represents the additional cost of increasing output by one unit; that is, ω_{jt} is the marginal cost.

$$C_{jt} = w_{jt}N_{jt} + r_{jt}K_{jt-1} = \omega_{jt}Y_{jt}. \tag{31}$$

Real profits are given by $\frac{p_{jt}}{p_t}Y_{jt} - \omega_{jt}Y_{jt}$. Substituting equation (25) into this expression and solving the profit-maximization problem yields the following equation:

$$\omega_{jt} = \frac{\varepsilon - 1}{\varepsilon}\frac{p_{jt}}{p_t}. \tag{32}$$

We now consider price stickiness. Calvo (1983) assumes that, for some reason, a certain proportion of firms are unable to reset their prices optimally in period t, and examines price setting under this assumption. We adopt the same specification here. This type of price-setting mechanism is commonly used in DSGE models.

Let β denote the proportion of firms that are able to adjust their prices, and $1 - \beta$ the proportion of firms that are unable to do so. The deviation of the inflation rate from its steady-state level is then given as follows. The derivation is omitted.

$$\tilde{\pi}_t = E_t\tilde{\pi}_{t+1} + \frac{\beta^2}{1-\beta}\widehat{\omega}_t. \tag{C.1}$$

4.3 Policy

The basic income policy is assumed to follow equation (A.5). That is, we consider a policy that increases basic income benefits while reducing unemployment benefits.

Next, we consider monetary policy. The nominal interest rate in period t is assumed to depend on the nominal interest rate in period $t-1$, the inflation rate, and gross domestic product, that is, the output of the final good. The monetary policy rule is specified as follows:

$$\tilde{\imath}_t = \chi\tilde{\imath}_{t-1} + (1-\chi)\big(\psi_1 E_t\tilde{\pi}_{t+1} + \psi_2\hat{Y}_t\big), 0 < \chi < 1, 0 < \psi_1, \psi_2. \tag{C.2}$$

4.4 Equilibrium

To conduct the simulation analysis, we linearize the model around the steady state. Linearizing the consumption Euler equation in equation (21) yields the following expression:

$$E_t\hat{c}^e_{t+1} = \hat{c}^e_t + E_t(\tilde{\imath}_{t+1} - \tilde{\pi}_{t+1}). \tag{C.3}$$

Linearizing the investment equation in equation (22) around the steady state yields the following expression:

$$\hat{I}_t = \frac{1+i}{2+i+\pi}\hat{I}_{t-1} + \frac{1+i}{2+i+\pi}E_t\hat{I}_{t+1} + \frac{1+i}{(2+i+\pi)S"(1)}\hat{q}_t. \quad \text{(C.4)}$$

Equation (23) is known as the Fisher equation. Linearizing it around the steady state yields the following expression:

$$\hat{q}_t = E_t\tilde{\pi}_{t+1} - \tilde{\iota}_t + \frac{E_t(r\hat{r}_{t+1} + (1-\delta)\hat{q}_{t+1})}{r+1-\delta}. \quad \text{(C.5)}$$

Linearizing the capital accumulation equation in equation (20) around the steady state yields the following expression:

$$\widehat{K}_t = \delta\hat{I}_t + (1-\delta)\widehat{K}_{t-1}. \quad \text{(C.6)}$$

The goods-market equilibrium condition is given by $Y_t = pc_t^e + (1-p)c_t^u + pI_t$.

Since the population size is normalized to one, consumption and investment demand by employed households are multiplied by their population share, p. Similarly, the consumption of unemployed households is multiplied by their population share, $1-p$. Linearizing this condition around the steady state yields the following expression:

$$\widehat{Y}_t = \frac{pc^e}{Y}\hat{c}_t^e + \frac{(1-p)c^u}{Y}\hat{c}_t^u + \frac{pI}{Y}\hat{I}_t. \quad \text{(C.7)}$$

Linearizing the production function in equation (15) around the steady state yields the following expression:

$$\widehat{Y}_t = \theta\widehat{K}_t. \quad \text{(C.8)}$$

Therefore, the effects of a basic income policy can be analyzed using equations (C.1)–(C.8) and (A.3)–(A.5).

4.5 Steady State

The steady-state equilibrium is characterized by the following equations:

The consumption Euler equation

$$1 = \rho\frac{1+i}{1+\pi}. \quad (33)$$

The Fisher equation (note that $q = 1$follows from equation (22)).

$$r + 1 - \delta = \frac{1+i}{1+\pi}. \tag{34}$$

The capital accumulation equation.

$$\delta = \frac{I}{K}. \tag{35}$$

The wage rate (note that $L = p$in labor-market equilibrium).

$$w = (1-\theta)AK^{\theta}L^{-\theta}, \tag{36}$$

Real interest rate.

$$r = \theta AK^{\theta-1}L^{1-\theta}, \tag{37}$$

Marginal cost.

$$\omega = \frac{\varepsilon - 1}{\varepsilon}. \tag{38}$$

Production function.

$$Y = AK^{\theta}L^{1-\theta}. \tag{39}$$

Equilibrium of final goods market.

$$Y = pc^{e} + (1-p)c^{u} + pI. \tag{40}$$

Government budget constraint.

$$p\tau w = (1-p)b \tag{41}$$

5. Results

5.1 Macroeconomic Effects in a Closed Economy Model

The parameter values are set as follows:

ρ	0.960596
δ	0.05
θ	0.4
A	0.9998
p	0.975
τ	0.017179
ϕ	0.5
β	0.25

Table 1 ：Parameter Setting

De la Croix and Doepke (2003) conduct simulations by setting the quarterly discount factor in a real business cycle model equal to 0.960596. Since one period in the present model corresponds to one year, ρ is set equal to 0.99^4. The depreciation rate, δ, is set under the assumption that capital is fully depreciated over 20 years. Eguchi (2011) sets $\beta = 0.25$ and then we consider the same parameter about pricing.

The parameter θ represents the capital share of income and is set equal to 0.4 in light of recent trends.[1] Adenotes total factor productivity. Its value is obtained from the calibration of the DSGE model. This facilitates comparison with the DSGE model.

The parameter p is derived from the unemployment rate, $1-p$. Since Japan's unemployment rate was 2.5% in 2025, p is set equal to 0.975.[2] In addition, τdenotes the tax rate used to finance unemployment benefits. OECD data indicate that the unemployment benefit b amounts to 67% of the pre-unemployment wage.[3] Therefore, based on the

[1] The Ministry of Health, Labour and Welfare (2025), *Analysis of the Labour Economy*, shows in "Trends in the Labour Share by Firm Capital Size" that the labour share is approximately 0.6. Accordingly, the capital share can be regarded as 0.4.

[2] Derived from the Statistics Bureau of Japan, *Summary of the 2025 Annual Average Results of the Labour Force Survey (Basic Tabulation)*.

[3] See OECD, "Benefits in Unemployment as a Share of Previous Income."

unemployment rate and $\frac{b}{w} = 0.6$, τ is set equal to 0.017179.

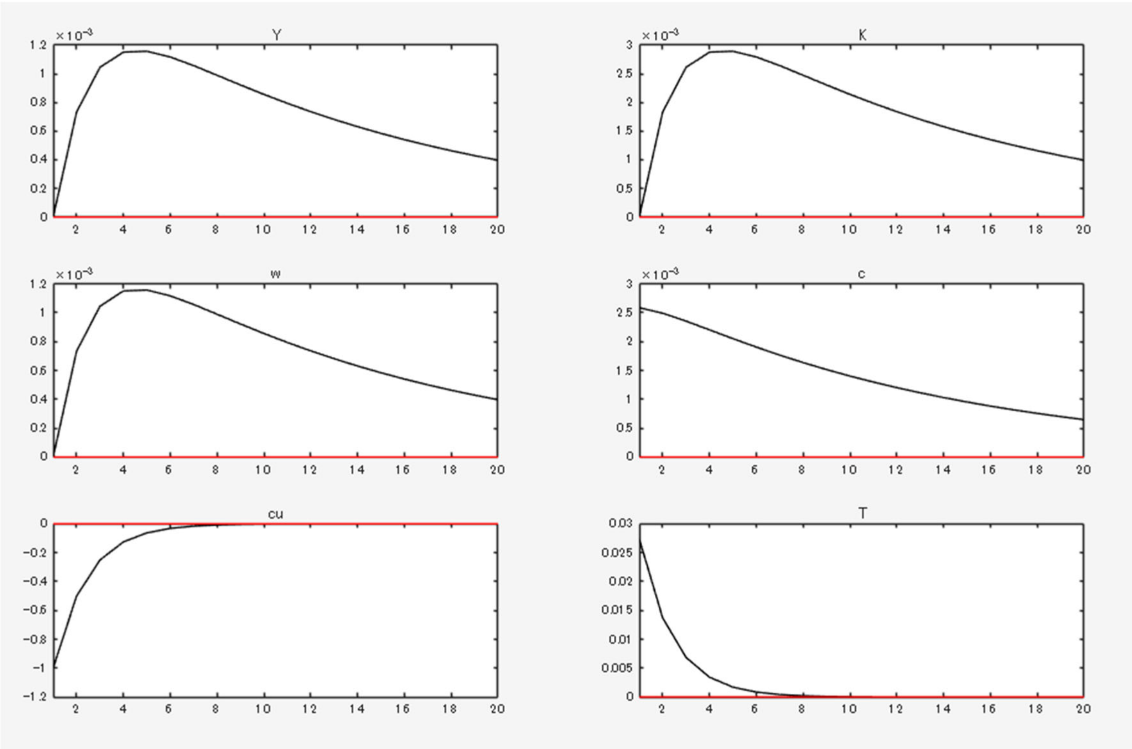

Fig.2：Macroeconomic Effects in a Closed-Economy DGE Model

Figure 2 presents a simulation in which unemployment benefits are initially replaced entirely by universal basic income. In equation (A.7), ϕ is set equal to 0.5. This implies a policy under which the amount of universal basic income is reduced by half in the following period, while unemployment benefits are increased correspondingly.

Because the tax rate is fixed, unemployment benefits and universal basic income are in a trade-off relationship. Moreover, although universal basic income is received by all individuals, unemployment benefits are received only by unemployed individuals. Taking the unemployment rate into account, universal basic income is therefore distributed broadly in relatively small amounts, whereas unemployment benefits are distributed more narrowly in relatively large amounts.

The results show that an increase in universal basic income raises the capital stock by increasing saving. As a result, the wage rate also increases. Although this expands the tax base available to finance unemployment benefits, the magnitude of this effect appears to be limited, as shown in Figure 2.

It should also be noted that even after universal basic income payments have almost disappeared, gross domestic product, Y, remains above its pre-policy level. From the perspective of increasing gross domestic product, the policy can therefore be regarded as desirable.

5.2 Macroeconomic Effects in a Small Open Economy Model

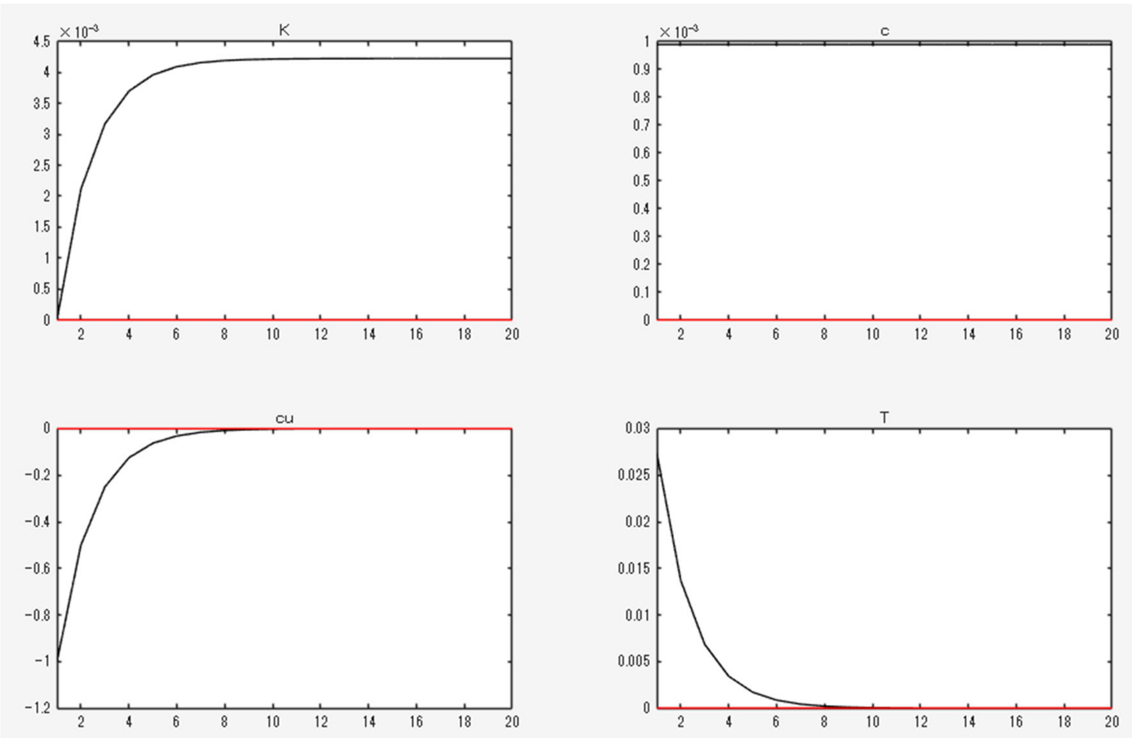

Fig.3：Macroeconomic Effects in a Small Open Economy Model

Next, we examine the simulation results for the small open economy. The interest rate is fixed at the same level as in the closed-economy model. The wage rate in equation (17) is also fixed through the interest rate given by equation (18).

The results show that even after basic income benefits fall to zero, the capital stock continues to increase, and consumption also continues to rise. This occurs because the interest rate remains constant, so the marginal product of capital does not decline. As a result, households continue to earn a constant return on capital, leading to further increases in both the capital stock and consumption.

5.3 Macroeconomic Effects in the DSGE Model

	prior mean	post. mean	90% HPD interval	prior	pstdev
χ	0.5	0.5515	0.5030 0.6037	Beta	0.1
ψ_1	0.5	0.8748	0.8287 0.9292	Norm	0.1
ψ_2	0.5	0.5828	0.4095 0.7428	Norm	0.1
A	1	0.9998	0.8345 1.1640	norm	0.1

Table.2: Calibration Results

Table 2 presents the calibration results. The parameter values are obtained by specifying prior distributions. Here, the parameters related to monetary policy and total factor productivity are calibrated. The posterior means are used as the parameter values. For the remaining parameters, the values reported in Table 1 are used. The corresponding simulation results are presented in Figure 3.

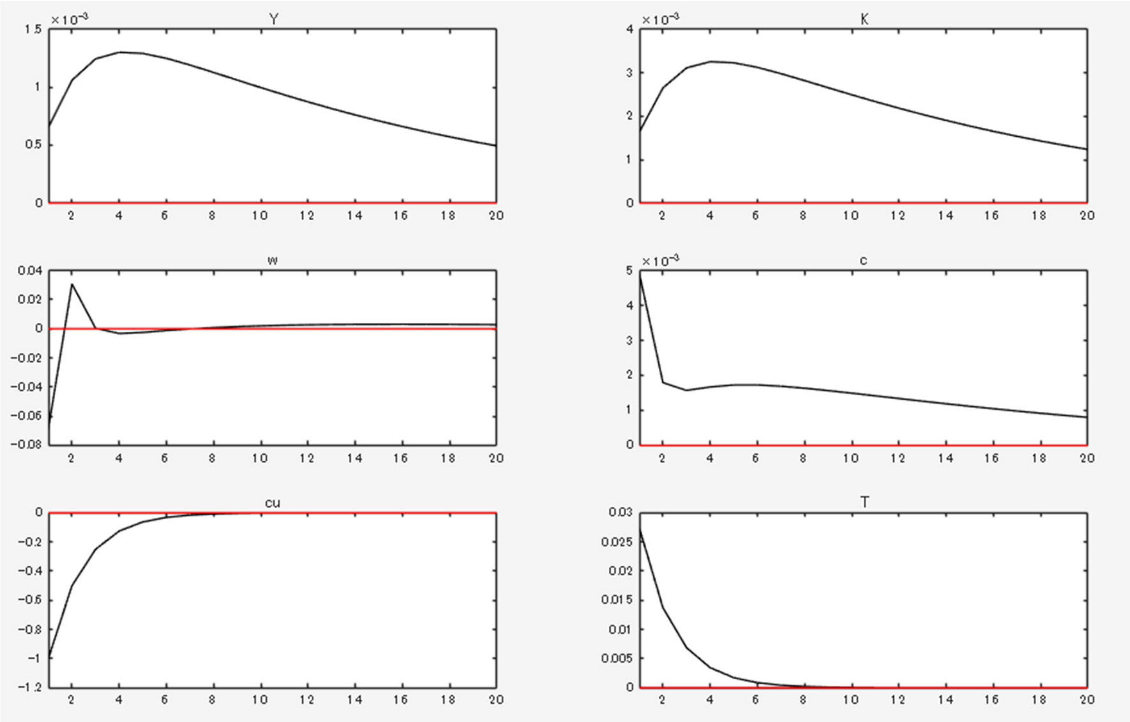

Fig.4：Macroeconomic Effects in the DSGE Model

The overall dynamics are similar to those in the DGE model, but the increase in gross domestic product, Y, is larger in the DSGE model. This is because inflation encourages investment in real assets, resulting in a greater increase in capital accumulation than in the DGE model. Consequently, the increase in gross domestic product is also larger.

However, although gross domestic product increases substantially and this should raise wage income and thereby expand the resources available to finance unemployment benefits, no clear increase in the consumption of unemployed households is observed. Thus, the effect remains limited.

6. Conclusions

This paper examines how basic income affects the macroeconomy. Specifically, it compares the results obtained from three models: (i) a DGE model, (ii) a small open economy model, and (iii) a DSGE model, using the same parameter values across the respective analyses.

The main findings are as follows. In both the DGE and DSGE models, a basic income benefit shock produces a persistent increase in gross domestic product even after the shock has disappeared. This suggests that basic income may have a growth-promoting effect by encouraging capital accumulation. Furthermore, the DSGE model shows a larger increase in gross domestic product than the DGE model. This is because the presence of inflation stimulates investment in physical capital, resulting in greater capital accumulation than in the DGE model.

Although this perspective has received relatively little attention in the existing literature, it has important policy implications. Identifying which type of model best describes the economic structure of each country would make it possible to provide more realistic predictions of the effects of basic income policies on the basis of the model's results.

Appendix A: Calibration

The parameters related to monetary policy and the parameter representing total factor productivity are obtained through calibration. Following Eguchi (2011), they are estimated using an MCMC method.

At this stage, a productivity shock is introduced. For the prior distribution of the shock, an inverse-gamma distribution with a mean of 0.1 and an infinite standard deviation is assumed. The data cover the period from 1994 to 2022.[4] The shock process is specified as follows:

$$\hat{Y}_t = \theta \hat{Y}_t + \hat{A}_{1t} \tag{D.1}$$

A productivity shock is introduced through $\hat{A}_{1t}$.

The data used for calibration are the growth rates of GDP, consumption, the real interest rate, and the real wage rate. An HP filter is applied to these data to extract the trend component of each variable, and the deviations of the actual values from their respective trends are then calculated. The subscript "obs" indicates that the variable is calculated from observed data. These four indicators are incorporated into the calibration model as follows:

$$\hat{Y}_t^{obs} = \hat{Y}_t + u\hat{Y}_t \tag{D.2}$$

$$\hat{c}_t^{obs} = \hat{c}_t + u\hat{c}_t \tag{D.3}$$

$$\hat{r}_t^{obs} = \hat{r}_t + u\hat{r}_t \tag{D.4}$$

$$\hat{w}_t^{obs} = \hat{w}_t + u\hat{w}_t \tag{D.5}$$

For $u\hat{Y}_t$, $u\hat{c}_t$, $u\hat{r}_t$, and $u\hat{w}_t$, inverse-gamma prior distributions with a mean of 0.1 and an infinite standard deviation are assumed. Based on these settings, the model is calibrated, and the parameter values reported in Table 2 are obtained.

---

[4] Data on GDP, consumption, the real interest rate, and the unemployment rate are taken from the Cabinet Office (2023), *Annual Report on the Japanese Economy and Public Finance 2023: Long-Term Economic Statistics*. The real interest rate is calculated by subtracting the inflation rate from the nominal interest rate, measured by the government bond yield. Data on real wages are taken from the *Monthly Labour Survey* available through the Portal Site of Official Statistics of Japan.

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(2026/3/13 checked)

Program Code (only Case 1 Ramsey model)

```
//1. variables

var c K r w Y T cu b;

varexo f;


//2. parameter

parameters rho delta A theta phi tau p;

//2.1 parametervalue

rho=0.960596;

delta=0.05;

A=0.9998;

theta=0.4;

phi=0.5;

tau=0.017179;

p=0.975;


//3.equations

model(linear);

# rbar=1/rho+delta-1;

#
Kbar=(rbar*p^theta/(theta*A))^(1/(theta-
1));

#        wbar=(1-theta)*A*Kbar^theta*p^(-
theta);

# cKbar=(1-tau)*wbar/Kbar+rbar-delta; %
cK denotes c/K

# bbar=0.67*wbar;


c(+1)=c+rho*rbar*r(+1);

K=(1-tau)*w(-1)*wbar/Kbar+r(-
1)*rbar+K(-1)*rbar+(1-delta)*K(-1)-
cKbar*c(-1)+T(-1)/Kbar;

Y=theta*K;

r=(theta-1)*K;

w=theta*K;

cu=b;

b=p*tau*wbar/(1-p)/bbar-T/(1-p)/bbar;

T = phi*T(-1)+f;

end;


//3. steady state check

steady;

check;


//4. simulation

shocks;

var f=(0.027414)^2;
```

```
end;
```

Program Code (Calibration)

```
//1. variables
var A1 pi r w omega i Y c I q K cu b Y_obs c_obs r_obs w_obs;
varexo uY uc ur uw cf;


//2. parameter
parameters A beta rho delta theta phi tau p kai psi1 psi2 s psi3;


//2.1 parametervalue
beta=0.25;
rho=0.960596;
delta=0.05;
%A=1;
theta=0.4;
phi=0.5;
tau=0.017179;
p=0.975;
%kai=0.5;
%psi1=0.5;
%psi2=0.5;
```

```
//5. results
stoch_simul(irf=20) Y K w c cu T;


s=1/7;
psi3=0.1;


//3.equations
model(linear);
# rbar=1/rho+delta-1;
# Kbar=(rbar*p^theta/(theta*A))^(1/(theta-1));
# wbar=(1-theta)*A*Kbar^theta*p^(-theta);
# cKbar=(1-tau)*wbar/Kbar+rbar-delta; % cK denotes c/K
# cbar=cKbar*Kbar;
# bbar=0.67*wbar;
# ibar=0.01;
# pibar=rho*(1+ibar)-1;
# cubar=bbar;
# Ibar=delta*Kbar;
# Ybar=A*Kbar^theta*p^(1-theta);
```

```
pi=pi(+1)+beta^2/(1-beta)*omega;

r=omega+(theta-1)*K;

w=omega+theta*K;

i=kai*i(-1)+(1-kai)*(psi1*pi(+1)+psi2*Y);

c(+1)=c+rho+(i(+1)-pi(+1));

I=(1+ibar)/(2+ibar+pibar)*I(-
1)+(1+ibar)/(2+ibar+pibar)*I(+1)+(1+ib
ar)/(2+ibar+pibar)/s*q;

q(-1)=pi-i(-1)+(rbar*r+(1-
delta)*q)/(rbar+1-delta);

K=delta*I+(1-delta)*K(-1);

Y=theta*K+A1;

Y=p*cbar/Ybar*c+(1-
p)*cubar/Ybar*cu+p*Ibar/Ybar*I;

cu=b;

b=p*tau/(1-p)*wbar/bbar;

A1=psi3*A1(-1)+cf;


Y_obs=Y+uY;

c_obs=c+uc;

r_obs=r+ur;

w_obs=w+uw;

end;

estimated_params;

kai, beta_pdf, 0.5, 0.1;

psi1, normal_pdf, 0.5, 0.1;

psi2, normal_pdf, 0.5, 0.1;

A, normal_pdf, 1, 0.1;

stderr cf, inv_gamma_pdf,   0.1, inf;

stderr uY, inv_gamma_pdf,   0.1, inf;

stderr uc, inv_gamma_pdf,   0.1, inf;

stderr ur, inv_gamma_pdf,   0.1, inf;

stderr uw, inv_gamma_pdf,   0.1, inf;

end;


varobs Y_obs c_obs r_obs w_obs;


estimation(datafile = jpdata, mode_check,
mh_replic =500000, mh_nblocks =2,
mh_drop =0.5, mh_jscale =0.5,
bayesian_irf);
```