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EFFECTS OF IMPUTATION RATIO CHANGE ON OPEN ECONOMY IN THE INTEGRATED INCOME TAX SYSTEM

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ABSTRACT

In this paper, we investigate a representative individual who is both a consumer and a producer, and when the personal income tax of can be deducted from the paid corporate tax, how macroeconomic variables (e.g. consumption, output, price index, exchange rate, and terms of trade) are affected by change in imputation ratio with a New Open Economy Macroeconomics (NOEM) model. We found that when the imputation ratio reduces, price index will rise, consumption and output levels will fall, the exchange rate will remain unchanged, and the country size will determine the effect on terms of trade.

Keywords: Integrated income tax system, Imputation ratio, Micro-foundations, Steady state, Log-Linearization, New open economy macroeconomics.

JEL Classification: H24, H25, F41.

Contribution/ Originality

This study contributes to the existing literature by providing a detailed account of how imputation ratio change on macroeconomic variables in an open economy with the introduction of micro-foundations. We found that the imputation ratio are positively correlated with consumption and output but negatively correlated with the price index.

1. INTRODUCTION

Tax policy is one of the most important fiscal policy tools. According to the statistics from OECD in 2014, the average income tax revenue of OECD countries in 2013 shared about 30% of total tax revenue. Therefore, the macroeconomic effect of tax changes has been a popular issue for scholars. For example, Judd (1987); Chamley (1986); Barro (1990); Turnovsky (1990); Rebelo (1991); Jones and Manuelli (1992); Razin and Yuen (1996); Kim (1998) and De Hek (2006) used

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the representative agent model to indicate that while income tax reduce, the return after tax of capital, investments also reduce, thus disfavored economic growth. As the income tax concerned in existing literature refers to the potential effect of income tax (including labor income and capital income taxes) on economic growth, they overlook the existence of corporate tax (e.g. profits tax) in society in addition to the income tax. In addition, past studies emphasized the effects of income tax on macroeconomic variables (e.g. economic growth) with a closed economy and did not analyze the effects on open economy, thus causing regret, as cross-country connections have been increasingly intense.

As the income tax is levied by household, it will affect the return after tax of savings and labor income to change the consumption, labor supply, and saving decision of the agent and thereby macro economy. As the corporate tax is levied by the profit of a firm, it will change the sales, labor employment, and dividend issue decisions of a firm and thereby macro economy. This income tax system levying taxes on different agents (household and firm) at an independent tax rate is known the independent taxation system. It was a common taxation system in many countries before the 1980s. It was much criticized as it caused double taxation and many social costs. To avoid the potential problems caused by independent taxation, countries in the world, thus changed the taxation system into the integrated income tax system commonly applied in most countries.

Although most European countries apply the integrated income tax system, each country implements the system in different ways and with different rules. According to the OECD classification criteria, the integrated income tax system is practiced in six major ways: (1) Classical System: tax is levied from both dividend income and other capital gains, practiced by Austria and Belgium; (2) Modified Classical System: different rates for dividend income (lower) and other capital gains (higher), practiced by Denmark, Greece, and Japan; (3) Full Imputation: the amount of dividend income tax paid by the corporation can be deducted from the tax payable by shareholders, practiced by Australia, Canada, and Taiwan; (4) Partial Imputation: the amount of dividend income tax paid by the corporation can be deducted from the part of the tax payable by shareholders, practiced by South Korea and the UK; (5) Partial Inclusion: income tax will be levied from only part of the divided income; and (6) Other Type of Systems. This paper investigated cases where the income tax can be partially imputed from the corporate tax of firms.

In past literature, Fullerton *et al.* (1981) estimated the effects of the integrated income tax system on the income allocation, national income, and welfare level in the USA with dynamic general equilibrium analysis based on four integration methods simulating personal income tax and corporate tax. They found that the integrated income tax system currently practiced in the USA could bring a large amount of benefits to welfare. In re-allocation effect, the integrated income tax system belongs to Pareto improvement, i.e. medium-income households gain less than high-income and low-income households. Ballard *et al.* (1985) also estimated the effects of the tax integration with a general equilibrium model. They found that tax integration could improve the financial condition of households of all income levels, with the largest benefits found in the high-income and low-income households. In partial integration, the capital of high-income households will flow to the highest-income and low-income households in the "deducting dividends from the corporate tax" plan; high-income households will get more benefits in the "deducting dividends from the personal income tax" plan. Both high-income and low-income households will get considerable benefits in the shareholders enjoy 15% imputation plan. According to Ballard *et al.* (1985) the integrated income tax system favors the equal allocation of income and improves social welfare, provided that the alternative tax plans ensuring equal amounts of tax revenue and the degree of integration will affect the quantity of benefits. Literature discussing the effects of integrated income tax system by accounting and finance analysis included Gujarathi and Feldmann (2006) and Dempsey and Partington (2008). In conclusion, it is clear that existing literature lacks a complete theoretical basis and the research of the effects on open economy. To remedy such regrets, this study discuss the effect of imputation ratio change on open economy in the integrated income tax system with New Open Economy Macroeconomics (hereinafter referred to as NOEM). This is because NOEM proposed by Obstfeld and Rogoff (1995) offer a more rigorous analysis foundation with micro-foundations.

From theoretical deviation, we found that the imputation ratio are positively correlated with consumption and output levels but negatively correlated with the price index, the country size determines the effect of terms of trade, and exchange rate is unaffected by imputation ratio change. This paper contains four sections. Section 1 is the introduction. Section 2 describes the theoretical model and solution. Section 3 investigates the effects of imputation ratio change on various macroeconomic variables in the integrated income tax system. Section 4 reports the conclusions of this paper.

2. THEORETICAL MODEL

2.1. Model Setting

With the NOEM proposed by Obstfeld and Rogoff (1995) as the theoretical basis, this paper makes the following assumptions:

- There are only two countries in the world: local country and foreign country. Countries have similar economic structure, namely the model is symmetrical, and all economic variables of the foreign countries are marked with an asterisk "*".
- The continuous distribution of the global population lies within interval [0,1], where local agents are distributed within interval [0, n) and foreign agents within interval [n ,1].
- Each agent is both a consumer and a producer, and operates a monopolistically competitive firm producing with own labor (L). The production function is $y = L$, where y is output.
- The integrated income tax is defined as the income tax partially imputed from the paid corporate tax.

2.1.1. Household

Assumed that all agents have the same preference, utility (U) are positively proportional to consumption (C) and real money balance (M / P) but negatively proportional to labor level (L), the lifetime utility function of the representative agent is expressed as follows:

$$U_t = \sum_{t=1}^{\infty} \beta \left[\log C_t + \frac{\chi}{1-\varepsilon} (\frac{M_t}{P_t})^{1-\varepsilon} - \frac{1}{2} L_t(z)^2 \right], \varepsilon \qquad (1)$$

Where β is the discount factor (0< β <1), ε is the elasticity of marginal utility of real money demand,[1] χ represents the importance of real money balance in the utility function, and z refers to a specific product z .

In Eq. (1), the consumption index is defined as a Cobb-Douglas function:

$$C = \frac{c_h(z)^n c_f(z)^{1-n}}{n^n (1-n)^{1-n}} \qquad (2)$$

Where $c_h(z)$ is the local consumer's consumption of local specific product z , and $c_f(z)$ is the local consumer's consumption of foreign specific product z .

Based on the definition of the consumption index in Eq. (2), the local price index (P) can be derived from the problem of expenditure minimization is expressed as follows:

$$P = p_h(z)^n p_f(z)^{1-n} \qquad (3)$$

Likewise, the foreign price index (P^*) is expressed as follows:

$$P^* = p_h^*(z)^n p_f^*(z)^{1-n} \qquad (4)$$

Where $p_h(z)$ represents the price of local product z expressed in the local currency, $p_f(z)$ represents the price of foreign product z expressed in the local currency, $p_h^*(z)$ represents the price of local product z expressed in the foreign currency, and $p_f^*(z)$ represents the price of foreign product z expressed in the foreign currency.

The law of one price is supported by all products:

$$p(z) = Ep_h^*(z); \; p_h^*(z) = Ep_f^*(z) \qquad (5)$$

Where E represents the exchange rate between both countries.

From Eqs. (2) and (3), the consumption of local specific product z and foreign specific product z of local representative consumer is derived as follows:

[1] In Eq. (1), ε is defined as the change in ratio of marginal utility of money trigged by 1% change in real money demand.

$$c_h(z) = \left[\frac{p_h(z)}{P}\right]^{-1} C \tag{6}$$

$$c_f(z) = \left[\frac{p_f(z)}{P}\right]^{-1} C \tag{7}$$

Likewise, the consumption of local specific product z and foreign specific product z of foreign representative consumer is expressed as follows:

$$c_h^*(z) = \left[\frac{p_h^*(z)}{P^*}\right]^{-1} C^* \tag{8}$$

$$c_f^*(z) = \left[\frac{p_f^*(z)}{P^*}\right]^{-1} C^* \tag{9}$$

In the above two expressions, $c_h^*(z)$ is the consumption of local specific product z by foreign consumers and $c_f^*(z)$ is the consumption of foreign specific product z by foreign consumers.

2.1.2. Government

To emphasize the effects of change in imputation ratio in the integrated income tax system, assumed that there is no government consumption expenditures, and the government returns seigniorage, integrated income tax, and corporate tax to the agent in a lump-sum fashion, the budget constraint of the government face is expressed as follows:

$$M_t - M_{t-1} + \tau_1 (W_t L_t - \delta \tau_2 \pi_t) + \tau_2 \pi_t = P_t T_t \tag{10}$$

Where $M_t - M_{t-1}$ is seigniorage revenue, $P_t T_t$ is the real transfer payment, $\tau_1 W_t L_t$ is the income tax revenue, π_t is the firm's profit. $\tau_2 \pi_t$ is the corporate tax revenue, τ_1 is the integrated income tax rate, τ_2 is the corporate tax rate, and δ is the imputation ratio.

2.1.3. Budget Constraint

The budget constraint of the representative agent face is as follows:

$$M_t - P_t C_t = M_{t-1} + W_t(z) L_t(z) - (1-\tau_1)(W_t(z) L_t(z) - \delta \tau_2 \pi_t) + (1-\tau_2)\pi_t + P_t T_t \tag{11}$$

In above expression, the income sources of consumers in period t include money balance in the previous period (M_{t-1}), wage after tax ($W_t(z)L_t(z)-(1-\tau_1)(W_t(z)L_t(z)-\delta\tau_2\pi_t)$), transfer income from the government (P_tT_t) and profit share after tax ($(1-\tau_2)\pi_t$), income that can be consumed by consumers (P_tC_t) and money holding (M_t) in period t.

2.1.4. Aggregate Demand

Local firms face the following demand function ($y^d(z)$) that can be obtained from Eqs. (6) and (8):

$$y^d(z) = nc_h(z) + (1-n)c_h^*(z) = n\left[\frac{p_h(z)}{P}\right]^{-1} C + (1-n)\left[\frac{p_h^*(z)}{P^*}\right]^{-1} C^* \qquad (12)$$

Likewise, the demand function of foreign firms ($y^{*d}(z)$) can be obtained from Eqs. (7) and Eq. (9):

$$y^{*d}(z) = nc_f(z) + (1-n)c_f^*(z) = n\left[\frac{p_f(z)}{P}\right]^{-1} C + (1-n)\left[\frac{p_f^*(z)}{P^*}\right]^{-1} C^* \qquad (13)$$

2.1.5. First Order Conditions

Consider a problem of utility (Eq. (1)) maximization with a budget constraint (Eq. (10)) to get the first order conditions as follows:

$$\beta\frac{P_tC_t}{P_{t+1}C_{t+1}} = 1 \qquad (14)$$

$$\frac{M_t}{P_t} = (\chi C_t)^{\frac{1}{\varepsilon}} \qquad (15)$$

$$L_t = \frac{\{(1-\tau_1) + [1+\tau_2(\delta(1-\tau_1)-1)]\}W_t}{P_tC_t} \qquad (16)$$

In these expressions, Eq. (14) is the Euler equation describing intertemporal consumption behavior, Eq. (15) is the money demand equation describing the substitution relationship between real money demand and consumption, and Eq. (16) is the labor supply equation specifying the substitution relationship between labor supply and consumption.

2.2. Deviation from Steady State

The long-run effects of change in imputation ratio on various macroeconomic variables in the integrated income tax system are investigated below. Symbols used below are defined as subscripted "$_t$" represents the economic variable in the long-run steady state and subscripted "$_0$" represents the economic variable in the initial state. For example, C_t and C_0 represent respectively the consumption level in the long-run steady state and initial state.

The long-run steady state describes the convergent state of the entire economy after experiencing shocks. In the long-run steady state, all variables are unchangeable. Therefore, the following expression is obtained by substituting the budget constraint of household (Eq. (11)) with the budget constraint of government sector (Eq. (10)), we have:

$$C_t = \frac{p_{h,t}(z)y_t(z)}{P_t} \tag{17}$$

Likewise, the case in the foreign country is expressed as follows:

$$C_t^* = \frac{p_{f,t}^*(z)y_t^*(z)}{P_t^*} \tag{18}$$

2.3. Log-Linearization

Log-linearization are used to solve our model for obtain a closed-form solution and analyze the effects of change in imputation ratio on various macroeconomic variables in the integrated income tax system.[2] This paper now derives the degree of fluctuation of all macroeconomic variables around the initial state by 1og-linearization , and the superscript "^" represents the macroeconomic variables after log-linearization. For example, if $\hat{X}_t$ is the log-linearized outcome of variable X_t near initial state X_0, then:

$$\hat{X}_t \equiv \ln\frac{X_t}{X_0} \cong \frac{X_t - X_0}{X_0} \cong \frac{dX_t}{X_0}$$

2.3.1. Log-Linearized Versions of the Price Index

To impute the law of one price (Eq. (5)) into local price index equation (Eq. (3)) and foreign price index equation (Eq. (4)), and to log-linearize it around the initial state, we have:

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[2] Due to the complexity of model setting, common methods used to obtain the closed-form solution between exogenous and endogenous variables in related literature include: (a) log-linearization and (b) numerical simulations. This paper applied log-linearization.

$$\hat{P}_t = n\ddot{p}_{h,t}(z) + (1-n)(\hat{E}_t + \hat{p}^*_{f,t}(z)) \tag{19}$$

$$\hat{P}^*_t = n(\hat{p}_{h,t}(z)) - \hat{E}_t) + (1-n)\hat{p}^*_{f,t}(z) \tag{20}$$

Subtracting Eq. (20) by Eq. (19), the price index difference between both counties is obtained as follows:

$$\hat{P}_t - \hat{P}^*_t = \hat{E}_t \tag{21}$$

2.3.2. Log-Linearized Versions of the World Budget Constraint

The following world budget constraint expression is obtained by collating the budget constraint of local and foreign household (Eqs. (17) and (18)):

$$C^w_t = nC_t + (1-n)C^*_t = n\frac{p_{h,t}(z)y_t(z)}{P_t} + (1-n)\frac{p^*_{f,t}(z)y^*_t(z)}{P^*_t} \tag{22}$$

Taking the log-linearization of Eq. (22) yield:

$$\hat{C}^w_t = n[\hat{p}_{h,t}(z) + \hat{y}_t(z) - \hat{P}_t] + (1-n)[\hat{p}^*_{f,t}(z^*) + \hat{y}^*_t(z) - \hat{P}^*_t] \tag{23}$$

Where C^w_t represents the world consumption, $C^w_t = nC_t + (1-n)C^*_t$.

2.3.3. Log-Linearized Versions of Demand Function

To take the log-linearization of the local and foreign demand functions (Eqs. (12) and (13)) around the initial state, the following expression is obtained by collating with the law of one price (Eq. (5)), local price index (Eq. (19)), and foreign price index (Eq. (20)):

$$\hat{y}_t(z) = -[(1-n)T\hat{O}T_t] + \hat{C}^w_t \tag{24}$$

Likewise, the case in the foreign country is expressed as follows:

$$\hat{y}^*_t(z) = nT\hat{O}T_t + \hat{C}^w_t \tag{25}$$

The difference in the output level change between both counties can be obtained by subtracting Eq. (25) by Eq. (24):

$$\hat{y}_t(z) - \hat{y}^*_t(z) = -T\hat{O}T_t \tag{26}$$

In Eq. (26), terms of trade (*TOT*) is defined as $TOT = p_h(z)/(EP^*_f(z))$.

2.3.4. Log-Linearized Versions of Labor Supply

The local labor supply (Eq. (16)) after log-linearization is obtained as:

$$\hat{y}_t = [\hat{p}_t(z) - \hat{P}_t] - \hat{C}_t + \hat{\delta} \quad (27)$$

Likewise, the case in the foreign country is expressed as follows:

$$\hat{y}_t^* = [\hat{q}_t^*(z^*) - \hat{P}_t^*] - \hat{C}_t^* + \hat{\delta}^* \quad (28)$$

2.3.5. Log-Linearized Versions of Money Demand

To log-linearize the local money demand function (Eq. (15)), we have:

$$\hat{M}_t - \hat{P}_t = \frac{1}{\varepsilon}\hat{C}_t \quad (29)$$

Likewise, the case in the foreign country is expressed as follows:

$$\hat{M}_t^* - \hat{P}_t^* = \frac{1}{\varepsilon}\hat{C}_t^* \quad (30)$$

2.3.6. Solution for Long-Run Steady State

The local and foreign budget constraints (Eqs. (17) and (18)) after log-linearization is obtained as:

$$\hat{C} = \hat{p}_{h,t}(z) + \hat{y}_t(z) - \hat{P}_t \quad (31)$$

$$\hat{C}^* = \hat{p}_{f,t}^*(z^*) + \hat{y}_t^*(z^*) - \hat{P}_t^* \quad (32)$$

In the long-run steady state, we solve the following seven equations: log-linearized versions of world consumption level (Eq. (23)), log-linearized versions of local and foreign demand function (Eqs. (24) and (25)), log-linearized versions of local and foreign labor supply function (Eqs. (27) and (28)), and log-linearized versions of local and foreign household's budget constraint (Eqs. (31) and (32)), this paper want to get the correlation between the exogenous variables and the following seven endogenous variables: local consumption ($\hat{C}_t$), foreign consumption ($\hat{C}_t^*$), world consumption ($\hat{C}_t^w$), local output ($\hat{y}_t(z)$), foreign output ($\hat{y}_t^*(z)$), the difference between the price of local specific goods and local price index ($\hat{p}_{h,t}(z) - \hat{P}_t$), and the difference between the price of foreign specific goods and foreign price index ($\hat{p}_{f,t}^*(z^*) - \hat{P}_t^*$). We thus solve the equations with the Mathematica 10.0, and the results are as follows:[3]

$$\hat{C} = \frac{n\hat{\delta} + (1-n)\hat{\delta}^*}{2} \quad (33)$$

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[3] The subscripted "t" is removed in the following section to simplify expressions.

$$\hat{C}^{*} = \frac{n\hat{\delta} + (1-n)\hat{\delta}^{*}}{2} \quad (34)$$

$$\hat{C}^{W} = \frac{n\hat{\delta} + (1-n)\hat{\delta}^{*}}{2} \quad (35)$$

$$\hat{y}(z) = \frac{\hat{\delta}}{2} \quad (36)$$

$$\hat{y}^{*}(z) = \frac{\hat{\delta}^{*}}{2} \quad (37)$$

$$\hat{p}_{h}(z) - \hat{P} = \frac{(1-n)(\hat{\delta} - \hat{\delta}^{*})}{2} \quad (38)$$

$$\hat{p}_{f}^{*}(z) - \hat{P}^{*} = \frac{n(\hat{\delta} - \hat{\delta}^{*})}{2} \quad (39)$$

In these expressions, Eq. (33) expresses the long-run equilibrium of the local consumption level, Eq. (34) expresses the long-run equilibrium of the foreign consumption level, Eq. (35) expresses the long-run equilibrium of the world consumption level, Eq. (36) expresses the long-run equilibrium of the local output level, Eq. (37) expresses the long-run equilibrium of the foreign output level, Eq. (38) expresses the difference between the price of local specific goods and local price index in the long-run steady state, and Eq. (39) expresses the difference between the price of foreign specific goods and foreign price index in the long-run steady state.

3. EFFECTS OF IMPUTATION RATIO ADJUSTMENT IN THE INTEGRATED INCOME TAX SYSTEM

In this section, we investigate the effects of change in imputation ratio on exchange rate, price index, output, and terms of trade in the integrated income tax system under the long-run.

3.1. Long-Run Effect of Change in Imputation Ratio on Exchange Rate

In the long-run steady state, the local and foreign money demand functions (Eqs. (29) and (30)) can be rewritten as:

$$\hat{P} = \hat{M} - \frac{1}{\varepsilon}\hat{C} \quad (40)$$

$$\hat{P}^{*} = \hat{M}^{*} - \frac{1}{\varepsilon}\hat{C}^{*} \quad (41)$$

By subtracting Eq. (41) by Eq. (40) and make use the difference of the price index change between both countries (Eq. (21)), we have:

$$\hat{E} = \hat{M} - \hat{M}^{*} - \frac{1}{\varepsilon}(\hat{C} - \hat{C}^{*}) \quad (42)$$

To subtracte the equations of local and foreign consumption level in the long-run steady state (Eqs. (33) and (34)), we get:

$$\hat{C} - \hat{C}^* = 0 \tag{43}$$

Then, the exchange rate change in the long-run steady state is obtained by substituting Eq. (42) with Eq. (43):

$$\hat{E} = \hat{M} - \hat{M}^* \tag{44}$$

From Eq. (44) it is clear that only the monetary policy of both countries will affect exchange rate. The foreign expansionary monetary policy (M^*) will lower exchange rate (E) (local currency appreciates), the local expansionary monetary policy (M) will raise exchange rate (E) (local currency depreciates), and imputation ratio change will not affect exchange rate in the integrated income tax system.

3.2. Long-Run Effect of Change in Imputation Ratio on Price Index

By substituting Eq. (40) with Eq. (33), the change in local price index in the long-run steady state is obtained as follows:

$$\hat{P} = \hat{M} - \frac{1}{\varepsilon}\left(\frac{n\hat{\delta} + (1-n)\hat{\delta}^*}{2}\right) \tag{45}$$

From Eq. (45), it is clear that the local commodity price (P) will rise as the local and foreign imputation ratios ($\hat{\delta}$ and $\hat{\delta}^*$) reduce, and country size (n) affects the degree of rise of the local price index: the greater the country size (n) is, the greater the degree of rise of the local price index (P) will be, and vice versa. In addition, the greater the elasticity of marginal utility of real money demand (ε) is, the smaller the degree of rise of the local price index (P), and vice versa.

3.3. Long-Run Effect of Change in Imputation Ratio on Consumption

From Eqs. (33) and (34), it is clear that the consumption level (C) falls as the local and foreign imputation ratios ($\hat{\delta}$ and $\hat{\delta}^*$) reduce, and country size (n) affects the extent of fall of the consumption level. As the country size (n) expands, the extent of fall consumption level increases, and vice versa.

3.4. Long-Run Effect of Change in Imputation Ratio on Output

From Eqs. (36) and (37), it is clear that the local output (y) reduces as the local imputation ratio ($\hat{\delta}$) reduces, and the foreign output (y) reduces as the foreign imputation ratio ($\hat{\delta}^*$) reduces.

3.5. Long-Run Effect of Change in Imputation Ratio on Terms of Trade

The terms of trade change is obtained by subtracting Eq. (39) by Eq. (38):

$$T\hat{O}T = \frac{(1-2n)(\hat{\delta} - \hat{\delta}^{*})}{2} \qquad (46)$$

From Eq. (46), it is clear that the effect on terms of trade remains uncertain as the local and foreign imputation ratios ($\hat{\delta}$ 、 $\hat{\delta}^{*}$) reduce, and the country size (n) decides. When the size of both countries are equal ($n = 0.5$), the local and foreign imputation ratios ($\hat{\delta}$ 、 $\hat{\delta}^{*}$) will not affect terms of trade ($T\hat{O}T$).When the size of the local country is relatively smaller than the foreign county ($n < 0.5$), however, terms of trade ($T\hat{O}T$) deteriorates as the local and foreign imputation ratios ($\hat{\delta}$ 、 $\hat{\delta}^{*}$) reduce. When the size of the local country is relatively larger than the foreign county ($n > 0.5$), however, terms of trade ($T\hat{O}T$) improved as the local and foreign imputation ratios ($\hat{\delta}$ 、 $\hat{\delta}^{*}$) reduce.

4. CONCLUSIONS AND RECOMMENDATIONS

Based on the NOEM proposed by Obstfeld and Rogoff (1995) and by adding both the income tax and corporate tax in the model, this paper investigate the long-run effect of change in imputation ratio in the integrated income tax system on the following macroeconomic variables of a country: consumption, output, price, exchange rate, and terms of trade.

From the results of theoretical derivation, we found that exchange rate will remain unchanged after an imputation ratio change in the integrated income tax system. This is because exchange rate is determined by the consumption of both countries. Due to the model symmetry, the effect of the imputation ratio on the consumption of both countries is consistent, thus imputation ratio change will not affect the exchange rate. However, as the imputation ratio reduces, the commodity price will rise, consumption and output will reduce, but the effect of imputation ratio on terms of trade depends on the parameter of country size.

This is because in the long-run steady state, when the imputation ratio in the integrated income tax system reduces, the personal disposable income will reduce as the amount of imputation reduces, and consumption and output also reduce, while the agent who is both a consumer and a producer in a monopolistic competition market, will raise the commodity price in response, and terms of trade will be improved. In addition, when the foreign country lowers the imputation ratio in the integrated income tax system, the foreign country's demand for local goods will reduce, the local commodity price reduces and terms of trade deteriorates as a result. Therefore, the size of both countries will determine the terms of trade. If the local country is relatively larger than the foreign country, as the local imputation ratio reduces, the extent of improvement of local terms of trade will be greater than the extent of deterioration caused by the imputation ratio reduction of the foreign country. Eventually, local terms of trade will be improved. If the local country is relatively smaller than the foreign country, the result is the opposite. If the size of both countries is the same, terms of trade will be unaffected by the imputation ratio.

Lastly, it is noteworthy that this study investigate issues relating to the integrated income tax system with NOEM, but we only emphasized on the long-run effect with little discussion on the effects of macroeconomic dynamics, future studies can implement short-run analysis and empirical studies on related topics.

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