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Changes in Effective Tax Rates due to Fundamental Corporate Tax Reforms: Analysis of Financing Neutrality Using a Forward-Looking Model

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Changes in Effective Tax Rates due to Fundamental Corporate Tax Reforms: Analysis of Financing Neutrality Using a Forward-Looking Model

Toshiyuki Uemura*

Abstract

While the current corporate tax system in Japan allows interest expense on debt to be deductible, no such mechanism exists for other financing, leading to a "debt bias." Therefore, the Comprehensive Business Income Tax (CBIT), Allowance for Corporate Equity (ACE), and Allowance for Corporate Capital (ACC) have been proposed. According to international comparisons by the OECD, the marginal effective tax rates in ACE-adopting countries are low, and these countries have reformed their corporate tax systems toward financing neutrality.

This study conducts a comprehensive survey of empirical analyses of Japan's effective corporate tax rates and classifies them into four effective corporate tax rates. Further, fundamental corporate tax reform proposals using forward-looking effective tax rates are analyzed in line with Hanappi (2018), OECD (2020), and Spengel et al. (2020), who conducted international comparative studies of effective corporate tax rates. This study makes improvements to Japan's 2020 parameters in Spengel et al. (2020) to obtain the cost of capital (user cost of capital), marginal effective tax rate, and average effective tax rate values by financing and assets. The parameters of the proposed reforms are then incorporated into a model of the effective corporate tax rate to conduct a simulation analysis under a constant statutory tax rate.

First, a simple CBIT that does not allow deductions of interest expenses increases the cost of capital, marginal effective tax rate, and average effective tax rate for debt financing. Second, a simple ACE that allows the deduction of opportunity cost at the notional interest rate on equity lowers the cost of capital, the marginal effective tax rate, and the average effective tax rate for retained earnings and new equity. Third, a simple ACC that allows all financing to deduct opportunity costs at the notional interest rate lowers the cost of capital, marginal effective tax rate, and the average effective tax rate for all financing.

However, these results are difficult to compare due to different average effective tax rates. Therefore, conducting similar simulations under a constant average effective tax rate results in statutory tax rates of 25.57% for CBIT, 42.33% for ACE, and 42.62% for ACC, compared with 31.30% for the base case. Thus, CBIT reduces its tax rate by five percentage points from the current rate, but ACE/ACC requires a ten percentage point increase. It is also indicated that CBIT increases the cost of capital and the marginal effective tax rate while ACE/ACC reduces these rates.

The above simulations are conducted assuming a simple CBIT with no deductible interest expense, a simple ACE/ACC where the notional interest rate matches the nominal interest rate, and

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the rate at which ACE/ACC is applied matches the statutory corporate income tax rate. Simulations that relax these conditions are conducted under a constant average effective tax rate.

First, under CBIT, varying the deductibility of interest expenses has a limited effect on the cost of capital and the marginal effective tax rate. Second, when the notional interest rate is set lower than the nominal interest rate or when the tax rate to which ACE/ACC is applied is set lower than the statutory tax rate, the effect on the marginal effective tax rate is significant.

These results have some implications: CBIT can ensure financing neutrality, but it increases the cost of capital and the marginal effective tax rate, which may negatively affect investment. On the contrary, ACE/ACC decreases the cost of capital and marginal effective tax rate, which can positively affect investment. In particular, the ACE has been introduced in many countries and is considered a promising proposal for future corporate tax reform in Japan.

JEL classification: H25, H32

Keywords: Financing Neutrality, Forward-Looking Effective Tax Rates, Fundamental Corporate Tax Reform

I. Introduction

This study evaluates some fundamental tax reforms by analyzing the effects of corporate tax reforms aimed at making corporate financing neutral on firms' effective tax rates in Japan. As in other developed countries, Japan's corporate tax system has expanded its tax base and lowered its tax rate, and the momentum for reform has settled in recent years. However, the current corporate tax system is not free from challenges. The first is to ensure financing neutrality.

Under the current Japanese corporate tax system, interest expenses on debt can be deducted from the tax base by including it as a deductible expense, but no such mechanism exists for retained earnings or new equity, which are means of raising finance. The existence of a "debt bias," which favors debt financing for tax purposes can distort corporate behavior, causing companies to take on excessive debt. During the occurrence of a financial crisis, such as the Great Recession, the financial strength of companies that rely on debt are at a high risk of bankruptcy.

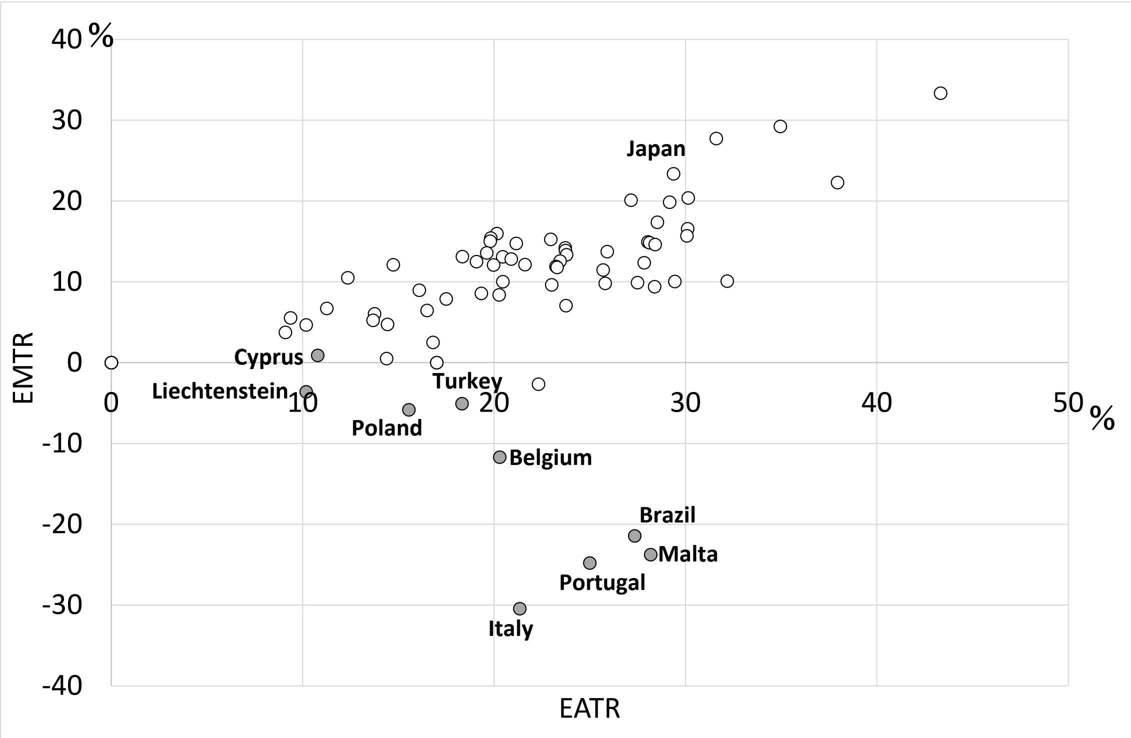

Figure 1: Average and Marginal Effective Tax Rates by OECD for Each Country (2020)

Therefore, several radical corporate tax reforms have been proposed to achieve financing neutrality. For example, the Comprehensive Business Income Tax (CBIT) proposed by the U.S. Department of Treasury (1992) disallows the deductibility of interest expenses. On the other hand, the ACE (Allowance for Corporate Equity) proposed by the Institute of Fiscal Studies (1991) and Devereux and Freeman (1991) allows the deduction of opportunity costs at the notional interest rate for retained earnings and new equity. The Allowance for Corporate Capital (ACC), a further development of ACE, allows the deduction of opportunity costs at the notional interest rate for all financing[1]. It can be said that CBIT does not allow the deductibility of interest expense, while ACE/ACC allows the deduction of the opportunity cost of the notional interest rate and that both aim for financing neutrality through opposite means.

OECD.Stat (https://stats.oecd.org/) reports the effective tax rates estimated by the OECD for each country, which includes the Effective Average Tax Rate (EATR) and the Effective Marginal Tax Rate (EMTR). The data for the 77 countries for 2020 are shown in Figure 1. The countries shown in the gray dots in Figure 1 have introduced ACE, and these countries are characterized by particularly low marginal effective tax rates[2].

This study analyzes how the effective tax rate would change if these radical corporate tax reform proposals aimed at financing neutrality were applied to the Japanese corporate tax system. As described below, there are various types of effective tax rates, but the analysis in this study uses an effective tax rate based on a forward-looking model.

The structure of this article is as follows: Section 2 describes the characteristics of effective tax rates and provides a survey of previous empirical studies on the effective corporate tax rate in Japan; Section 3 presents the theoretical model; Section 4 provides the model parameters; Sections 5 and 6 present the simulation results and policy implications of tax reform aimed at financing neutrality, and Section 7 concludes the study.

II. Characteristics of Effective Tax Rates and Survey of Empirical Analyses in Japan

This section describes the characteristics of effective tax rates as the analytical tool for this study. There is a distinction between forward- and backward-looking models of effective tax rates as well as between average and marginal effective tax rates.

Figure 2 illustrates the concepts of forward-looking and backward-looking models. The effective tax rate is expressed as the ratio of tax burden to profits. Corporate profits are divided into normal profit (NP) and excess profit (EP). Normal profit is the profit demanded by shareholders, while excess profit is the profit more than the normal profit. When a firm's capital stock is structured to maximize its value, its excess profit is zero.

When the time horizons are past, present, and future, current profits are generated from past capital stock (i.e., past investments), and future profits are generated from investments made in the present. The former is a backward-looking model, and the latter is a forward-looking model, distinguished by the superscript lowercase letters b and f, respectively.

[1] The theoretical background for ACC is Broadway and Bruce (1984).
[2] See Hebous and Klemm (2018) and Yamada (2020, 2021) for ACE introduction countries.

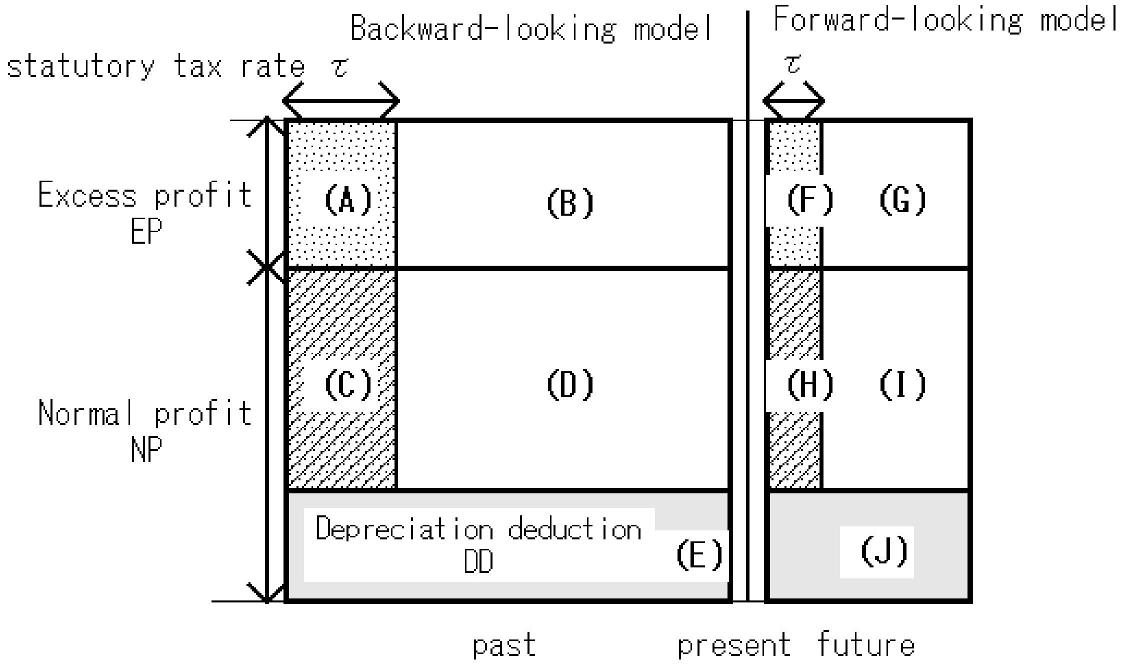

Figure 2: Concepts of Forward-looking and Backward-looking Models

Expressed in terms of the area in parentheses in Figure 2, the current normal profit $NP^b = (C) + (D) + (E)$ and excess profit $EP^b = (A) + (B)$ which are generated by the capital stock in the past, and the future normal profit $NP^f = (H) + (I) + (J)$ and excess profit $EP^f = (F) + (G)$ which are generated by the capital stock in the future. These profits constituted the tax base.

Suppose that a tax depreciation system exists, and that depreciation can be deducted from the taxable base. The corporate income tax burden is determined by multiplying the taxable base with the statutory tax rate τ. For the sake of simplicity, let us assume that the only tax system that allows depreciation deductions from the taxable base is depreciation deductions (DD), then it can be illustrated as $DD^b = (E)$ for the backward-looking model and $DD^f = (J)$ for the forward-looking model.

The tax burden TAX can be calculated by multiplying the tax base obtained based on the statutory tax rate τ. According to Figure 2, the tax burden TAX^b for the backward-looking model is $(A) + (C)$ or (C), and the tax burden TAX^f for the forward-looking model is $(F) + (H)$ or (H).

Assuming that the average effective tax rate is the average effective tax rate when normal profits and excess profits are included in the tax base, and the marginal effective tax rate is the marginal effective tax rate when only normal profits are included in the tax base, four effective tax rates were defined, as shown in Table 1: the backward-looking model, the forward-looking model, the average effective tax rate, and the marginal effective tax rate.

Table 1 also shows earlier studies of these four effective tax rates: the backward-looking average effective tax rate is Feldstein and Summers (1979), the backward-looking marginal effective tax rate is Gordon, Kalambokidis and Slemrod (2004a,b), Devereux and Griffith (2003) for forward-looking average effective tax rates, and King and Fullerton (1984) for forward-looking marginal effective tax rates.

Table 2 provides a comprehensive summary of empirical studies on firms' effective tax rates in Japan[3]. The empirical analysis of Japan is dominated by existing studies on the backward-looking average effective tax rate and forward-looking marginal effective tax rate. This study conducts an analysis utilizing the effective average and marginal tax rates in a forward-looking model, which has rarely been done in empirical studies in Japan. Spengel et al. (2016) conducted a simulation analysis of tax reforms aimed at financing neutrality using a forward-looking model, as in this article, they focused their analysis on EU countries. This study focuses on Japan and analyzes tax reforms aimed at financing neutrality using average and marginal effective tax rates based on a forward-looking model.

Table 1: Effective Tax Rate Concepts and Early Studies

	Effective Average Tax Rate $EATR$	Effective Marginal Tax Rate $EMTR$
Backward-looking model	$EATR^b = \frac{(A)+(C)}{(A)+(B)+(C)+(D)+(E)} = \frac{\tau(EP^b + NP^b - DD^b)}{(EP^b + NP^b)}$ Feldstein and Summers (1979)	$EMTR^b = \frac{(C)}{(C)+(D)+(E)} = \frac{\tau(NP^b - DD^b)}{NP^b}$ Gordon, Kalambokidis and Slemrod (2004a,b)
Forward-looking model	$EATR^f = \frac{(F)+(H)}{(F)+(G)+(H)+(I)+(J)} = \frac{\tau(EP^f + NP^f - DD^f)}{(EP^f + NP^f)}$ Devereux and Griffith (2003)	$EMTR^f = \frac{(H)}{(H)+(I)+(J)} = \frac{\tau(NP^f - DD^f)}{NP^f}$ King and Fullerton (1984)

[3] Uemura (2022b) for the average effective tax rate and Uemura (2022c) for the marginal effective tax rate provide an exhaustive survey of existing Japanese studies.

Table 2: Empirical Analysis of Effective Tax Rates for Japanese Firms

	Effective Average Tax Rate $EATR$	Effective Marginal Tax Rate $EMTR$
Backward-looking model	Keidanren (Japan Business Federation), Finance Department (1984a), Kubouchi (1984), Kansai Economic Research Center (1984), Business Policy Forum, Japan (1986), Ishi (1988), Tajika and Yui (1988a, 1988b, 2000a), Hagihara (1993), Totani (1994), Atoda, Hidaka and Yoshida (2000), Cabinet Office (2002), Cabinet Office, Director for Policy Coordination (2002), Hayashida (2002, 2003, 2004, 2018), Mizuno (2003), Ministry of Economy, Trade and Industry (2006), Yoshida (2008), Miyoshi (2006, 2007, 2008, 2009), Tajika (2010), Shibutani (2013, 2014, 2017a, 2017b, 2018, 2019), Shibutani and Tahira (2014)	Hayashida (2012, 2018), Tahira and Shibutani (2015)
Forward-looking model	Iwamoto (1987), Totani, Iwamoto and Nakai (1989), Suzuki (2010a, 2010b, 2011, 2014a, 2014b, 2014c), Baba, Kobayashi and Sato (2021), Uemura (2022a)	Iwamoto (1987), Totani, Iwamoto and Nakai (1989), Business Policy Forum, Japan (1986), Iwata, Suzuki and Yoshida (1987), Tajika, Hayashi and Yui (1987), Shoven and Tachibanaki (1988), Tajika and Yui (1988a, 1988b, 2000b), Iwata and Yoshida (1990), Kikutani and Tachibanaki (1990), Hagihara (1994), Tachibanaki (1996), Koma (1997), Nakatuka (2002), Hayashida (2007, 2009), Hayashida and Uemura (2010), Suzuki (2010a, 2010b, 2011, 2014a, 2014b, 2014c), Baba, Kobayashi and Sato (2021), Uemura (2022a)

III. Effective tax rate based on forward-looking model

This section presents a theoretical model of the effective tax rate based on a forward-looking model. Forward-looking effective tax rates were formulated in line with Hanappi (2018), OECD (2020), and Spengel et al. (2020), who conduct international comparative studies of effective corporate tax rates. First, following the traditional King (1964) setting, the capital market arbitrage conditions are presented.

$$\{1 + (1 - m^i)i\}V_t = \frac{1-m^d}{1-c} D_{t+1} - N_t + V_{t+1} - z(V_{t+1} - N_{t+1} - V_t) \quad (1)$$

where time t, interest income tax rate m^i, nominal interest rate i, firm value V, dividend income tax rate m^d, dividend deduction rate c for income tax, dividend D, new equity issuance N, and effective tax rate z on capital gains.

The left-hand side is the income after the shareholder invests the value of asset V in a deposit with nominal interest rate i and bears interest income tax at interest income tax rate m^i. On the other hand, the right-hand side is the after-tax income received in period $t+1$ by a shareholder who owns shares in the firm from the end of period t. The first and fourth terms on the right-hand side are the after-tax dividend and the capital gains tax, respectively. For a risk-neutral shareholder, the right-hand side and the left-hand side must be equal.

The above can be summarized as follows:

$$V_t = \frac{\{\gamma D_t - N_t - V_{t+1}\}}{1+\rho} \quad (2),$$

$$\rho = \frac{(1-m^i)i}{1-z} \quad (3),$$

$$\gamma = \frac{(1-m^d)}{(1-z)(1-c)} \quad (4),$$

where ρ is the nominal discount rate for shareholders and γ is the composite tax rate that represents the tax treatment of dividends and capital gains.

Using the accounting identity formula in the enterprise, dividend D is shown as follows:

$$D_t = Q(K_{t-1})(1-\tau) - I_t + B_t - \{1 + i(1-\theta\tau)\}B_{t-1} + \tau\varphi(K^T_{t-1}) - \tau_e(1-\tau)K^T_{t-1} + N_t \quad (5),$$

where is the production function $Q(K)$, capital stock K, statutory rate of corporate income tax τ, investment I, debt B, deductibility ratio of interest expense $\theta \in [0,1]$, statutory depreciation rate φ, statutory property tax rate τ_e, and the accounting book value of assets K^T. The first term on the right-hand side is after-tax income, the fourth term is after-tax interest expense, the fifth term is tax savings resulting from the depreciation system, and the sixth term is the amount of property tax. The fourth term on the right-hand side shows that when a company finances its operations with debt, the cost of interest payments to creditors reduces the company's value, while tax savings can be realized by deducting the cost of interest payments. Paragraph 6 also considers property tax deductibility. Note that the prices of the firm's output and investment goods at the end of period t are standardized at one and increase annually by inflation rate π.

Capital stock K and the accounting book value of asset K^T will be as follows:

$$K_t = (1-\delta)K_{t-1} + I_t \quad (6),$$

$$K_t^T = (1-\varphi)K_{t-1}^T + I_t \quad (7)$$

where is the economic capital depletion rate δ. The firm increases its capital stock in period t by one unit at the end of this period [4].

Here, by considering the impact of one unit of a firm's investment on firm value, economic rent R is formulated as follows:

$$R = (1+\rho)dV_t = \sum_{s=0}^{\infty}\left\{\frac{\gamma dD_{t+s} - dN_{t+s}}{(1+\rho)^s}\right\} \quad (8).$$

First, consider the case in which the firm invests in one unit of retained earnings. In this case, by taking advantage of the fact that debt and new stock issuances are zero ($dB = dN = 0$) in equations (5) and (8), the economic rent R^{RE} can be obtained due to retained earnings.

$$R^{RE} = \sum_{s=0}^{\infty}\frac{\gamma dD_{t+s}}{(1+\rho)^s} = \gamma\left\{\sum_{s=0}^{\infty}\frac{dQ(K_{t-1+s})(1-\tau)}{(1+\rho)^s} - \sum_{s=0}^{\infty}\frac{dI_{t+s}}{(1+\rho)^s} + \tau\varphi\sum_{s=0}^{\infty}\frac{dK_{t-1+s}^T}{(1+\rho)^s} - \tau_e(1-\tau)\sum_{s=0}^{\infty}\frac{dK_{t-1+s}^T}{(1+\rho)^s}\right\} \quad (9)$$

When a firm invests one unit in period 0 and sells its capital stock in period 1, the economic rent R^{RE} is as follows:

$$R^{RE} = -\gamma\{1 - A + \tau_e(1-\tau)\} - \nu\tau\pi + \frac{\gamma}{1+\rho}\{(p+\delta)(1+\pi)(1-\tau) + (1-\delta)(1+\pi)(1-A)\} \quad (10).$$

The first term on the right-hand side is the effect of a one-unit investment in period 0 on reducing dividends to shareholders; the second term on the right-hand side is the effect of changes in asset values due to inflation on taxation; and the third term on the right-hand side is the after-tax dividends to shareholders and gains on sales of assets in period 1. Here, 、 $v = \{0, 0.5, 1\}$ is the asset valuation method, where $v = 0$ is treated as Last In First Out (LIFO), $v = 1$ as First In First Out (FIFO), and $v = 0.5$ as a mixture of both. When p is the pre-tax rate of return, the marginal productive capacity of capital is $Q(K_{t+1}) = (p+\delta)(1+\pi)$ and A is the present value of tax savings from the depreciation system.

The present value of tax savings from the depreciation system, A, consists of the statutory corporate income tax rate, τ, and the present value of the depreciation allowance, PDV (the present discount value of depreciation allowance).

$$A = \tau \cdot PDV \quad (10)$$

The PDV depends on the depreciation method, with Hanappi (2018), OECD (2020), and Spengel et al. (2020) modeling the PDV according to each country's system.

This study presents a model of the depreciation method used in Japan's current tax system. The first is the straight-line (SL) method. L is the legal life of depreciable assets.

[4] An opening model that increases the capital stock at the beginning of the period and an ending model that increases the capital stock at the end of the period lead to slight changes in the model; Devereux and Griffith (2003) use an opening model, while this study uses an ending model, which is often used in international comparisons.

$$PDV_{SL} = \varphi\left\{1 + \left(\frac{1}{1+\rho}\right) + \left(\frac{1}{1+\rho}\right)^2 + \cdots + \left(\frac{1}{1+\rho}\right)^{L-1}\right\} = \frac{\varphi(1+\rho)}{\rho}\left\{1 - \left(\frac{1}{1+\rho}\right)^{1/\varphi}\right\} \quad (11)$$

The Declining-Balance method with a switch to a Straight Line, i.e., the DBSL method has also been used in Japan [5]. The DBSL is a depreciation method that initially uses the declining balance method but switches to the straight-line method midway through the depreciation period. In Japan, the "200% declining balance method", a type of DBSL, is applied. The PDV using the "200% declining balance method" is expressed as follows:

$$PDV_{DBSL} = \frac{\varepsilon}{1+\rho}\left\{1 + \left(\frac{1-\varepsilon}{1+\rho}\right) + \left(\frac{1-\varepsilon}{1+\rho}\right)^2 + \cdots + \left(\frac{1-\varepsilon}{1+\rho}\right)^{L^*-1}\right\} + \frac{(1-\varepsilon)^{L^*}}{L-L^*}\left\{\left(\frac{1}{1+\rho}\right)^{L^*+1} + \cdots + \left(\frac{1}{1+\rho}\right)^{L}\right\} \quad (12).$$

where is the statutory useful life L, the period L^* ($0 \leq L^* \leq L$) of time during which the declining balance method is applied and is the statutory depreciation rate $\varphi = 1/L^*$ for the period of the declining balance method[6]. With an additional parameter a that accelerates depreciation, $\varepsilon = a\varphi$. Under the current "200% declining-balance method," $a = 2$, and under the "250% declining-balance method" applied in the past in Japan, $a = 2.5$.

Next, a situation is considered in which the firm makes one unit of investment by issuing new shares and raising external financing, such as debt. In equations (5) and (8), using the fact that $dB = 0$ and $dN = 1$ in the case of new stock issuance and $dB = 1$ and $dN = 0$ in the case of debt financing, the cost of external financing F can be obtained as follows:

$$F = \gamma \mathrm{d}B_t\left\{1 - \frac{1+i(1-\theta\tau)}{1+\rho}\right\} - (1-\gamma)dN_t\left(1 - \frac{1}{1+\rho}\right) \quad (13).$$

Thus, the economic rent R when external financing is considered is as follows:

$$R = R^{RE} + F \quad (14)$$

$$F = \begin{cases} F^{RE} & \text{(Retained earnings)} \quad F^{RE} = 0 \\ F^{NE} & \text{(New equity)} \quad F^{NE} = -\frac{\rho}{1+\rho}\{1+\tau_e(1-\tau)\}(1-\gamma) \\ F^{DE} & \text{(Debt)} \quad F^{DE} = \frac{\gamma}{1+\rho}\{1+\tau_e(1-\tau)\}\{\rho - i(1-\theta\tau)\} \end{cases} \quad (15)$$

To formulate the average effective tax rate $EATR$, economic rent R^* is considered in the absence of a tax system. In Equation (9), the economic rent R^* with no taxation ($\tau = 0$, $z = 0$, $c = 0$, $m^i = 0$, $m^d = 0$, $\tau_e = 0$) is obtained as follows:

$$R^* = -1 + \frac{(p+\delta)(1+\pi)}{1+i} + \frac{(1-\delta)(1+\pi)}{1+i} = \frac{p(1+\pi)-i+\pi}{1+i} = \frac{p - \frac{1-\pi}{1+\pi}}{\frac{1+i}{1+\pi}} = \frac{p - \frac{1-\pi}{1+\pi}}{1+\frac{1-\pi}{1+\pi}} = \frac{p-r}{1+r} \quad (16).$$

Here $(1+i) = (1+r)(1+\pi)$ is used. The first term on the right-hand side is the cost of

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[5] The PDV for the pure declining balance method DB (Declining Balance method) is as follows: $PDV_{DB} = \varphi\left\{1 + \left(\frac{1-\varphi}{1+\rho}\right) + \left(\frac{1-\varphi}{1+\rho}\right)^2 + \cdots\right\} = \frac{\varphi(1+\rho)}{\rho+\varphi}$.

[6] The optimal switching period that maximizes the present value A of tax savings from the depreciation system is calculated as $L^* = L(1 - 1/a)$. In Japan, L^* is specified in the "Ministerial Ordinance on the Useful Life of Depreciable Assets," and in the simulation analysis that follows, the useful life parameter is given according to the current system.

investment due to the decrease in the dividend of one unit in period 0; the second term on the right-hand side is the dividend that one unit of investment in period 0 brings in period 1; and the third term on the right-hand side is the gain on sale of assets in period 1.

Based on the above, the EATR is shown as follows:

$$EATR = \frac{R^{*}-(1-z)R}{p/(1+r)} \quad (17)$$

The denominator represents the present value of the pre-tax return rate. The numerator is the difference between the economic rent without taxation and taxation.

The marginal effective tax rate $EMTR$ is then obtained as the effective tax rate when the economic rent R is zero, that is, when the investment is made such that the capital stock is optimal. The pre-tax rate of return p when the economic rent R is zero in Equation (9) is obtained as the cost of capital $\tilde{p}$ (user cost of capital).

$$\tilde{p} = \frac{(1-A)\{\rho+\delta(1+\pi)-\pi\}+v\tau\pi+(1+\rho)(1-\tau)\tau_e}{(1+\pi)(1-\tau)} - \frac{F(1+\rho)}{\gamma(1+\pi)(1-\tau)} - \delta \quad (18)$$

The marginal effective tax rate, $EMTR$, is then obtained as follows:

$$EMTR = \frac{\tilde{p}-s}{\tilde{p}} = \frac{w}{\tilde{p}} \quad (19)$$

$$s = \frac{(1-m^{i})i-\pi}{1+\pi} \quad (20).$$

where s is the shareholder's rate of return in the absence of corporate taxation and w is the "tax wedge."

The following relationship between the average effective tax rate $EATR$ and the marginal effective tax rate $EMTR$ is shown by the cost of capital $\tilde{p}$.

$$EATR = \frac{\tilde{p}}{p}EMTR + \left(1-\frac{\tilde{p}}{p}\right)T \quad (21)$$

$$T = 1-\gamma(1-\tau)\frac{(1+r)(1+\pi)}{1+\rho} \quad (22).$$

where T is the adjusted statutory tax rate.

Now, the cost of capital $\tilde{p}$, the $EATR$ and $EMTR$ are calculated by asset and financing. Spengel et al. (2020) uses the asset and financing weight parameters of representative firms to measure the following composite cost of capital $\bar{\tilde{p}}$, composite $\overline{EATR}$ and composite $\overline{EMTR}$.

$$\bar{\tilde{p}} = \sum \alpha_k \beta_f \widetilde{p_{k,f}} \quad (23)$$

$$\overline{EATR} = \sum \alpha_k \beta_f \, EATR_{k,f} \quad (24)$$

$$\overline{EMTR} = \frac{\bar{\tilde{p}}-s}{\bar{\tilde{p}}} \quad (25)$$

where is the weight of investment assets α_k, is the weight of financing sources β_f, is the subscript k for assets, and the subscript f is the financing source for a representative firm. The sum of the weights of investment assets and financing sources is 1.

$$\sum \alpha_k = \sum \beta_f = 1 \quad (26)$$

Spengel et al. (2020) considers five assets: industrial buildings ($k = 1$), intangibles ($k = 2$), machinery ($k = 3$), financial assets ($k = 4$), and inventory ($k = 5$), and three types of financing are considered: retained earnings ($f = 1$), new equity issuance ($f = 2$), and debt ($f = 3$), which is also followed in this study.

The relationship between the composite cost of capital $\bar{\tilde{p}}$, composite average effective tax rate $\overline{EATR}$, and composite marginal effective tax rate $\overline{EMTR}$, considering the above asset mix and financing, is as follows:

$$\overline{EATR} = \frac{\sum \alpha_k \beta_f \widetilde{p_{k,f}} \cdot \overline{EMTR}}{p} + \left(1 - \frac{\bar{\tilde{p}}}{p}\right) T \qquad (27).$$

IV. Parameters Setting

By setting various parameters to the model in the previous section, the cost of capital $\tilde{p}$, the average effective tax rate $EATR$, and the marginal effective tax rate $EMTR$ by asset or financing may be obtained. This study obtains "Base Case 1" based on the Japanese case for 2020 in Spengel et al. (2020), but with the model and parameters modified to fit the Japanese tax system [7]. Table 3 shows the parameters of "Base Case 1".

This study uses the Japanese parameters from Spengel et al. (2020) but with some modifications. The economic parameters, such as the economic capital depletion rate δ, real interest rate r, inflation rate π, and pre-tax rate of return p are the same as in the Spengel et al. (2020) setting. The statutory corporate income tax rate τ is calculated by the basic national corporate tax rate of 23.2%, the local corporate tax rate of 10.3%, the corporate inhabitant tax rate of 10.4%, the standard enterprise tax rate of 1%, the special enterprise tax rate of 2.6%, and the standard enterprise value-added tax rate of 1.2%, which are also the parameters for "Base Case 1" [8]. Note that this study is concerned with the effective tax rate at the firm level and does not analyze the effective tax rate at the shareholder level. Therefore, the interest income tax rate m^i, dividend income tax rate m^d, dividend deduction rate c, and effective tax rate z on capital gains are set to zero, and the composite tax rate, $\gamma = 1$.

For the depreciation method, the study adopts 38 years for industrial buildings, 8 years for intangibles, and 10 years for machinery, as the legal useful life assumed by Spengel et al. (2020). However, according to the "Annexed Table of Ministerial Ordinance Concerning Useful Lives of Depreciable Assets," the statutory depreciation rate φ_1 for industrial buildings with a legal useful life of 38 years is listed as 2.7%, and this value is used [9]. For machinery with a statutory useful life of 10 years, the "200% declining balance method", a type of DBSL, is applied,

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7 In obtaining "Base case 1", the Japanese case of Spengel et al. (2020) was replicated to confirm the results.

8 The effective corporate tax rate is calculated as {23.2% (1+10.3% + 10.4%) + 3.6% + 1.2%} / (1+3.6% + 1.2%) = 31.3%. Corporate inhabitant tax rates are those in the 23 wards of Tokyo.

9 The statutory depreciation rate for industrial buildings in Spengel et al. (2020) is 2.63%.

and the DBSL model of Spengel et al. (2020) is modified to adopt parameters that fit the current system of the Japanese tax system. Specifically, the machine with a statutory useful life of 10 years ($L = 10$) has a statutory useful life of 20%, a declining balance method period of 5 years ($L^{*} = 5$), and a straight-line method period of 5 years; the declining balance method is initially applied and then switched to the straight-line method [10].

Table 3: Parameters of "Base Case 1"

Economic depreciation rate		
Industrial buildings ($k = 1$)	δ_1	3.1%
Intangibles ($k = 2$)	δ_2	15.35%
Machinery ($k = 3$)	δ_3	17.5%
Real interest rate	r	5%
Inflation rate	π	2%
Pre-tax rate of return	p	20%
Statutory corporate income tax rate	τ	31.3%
Statutory depreciation rate		
Industrial buildings ($k = 1$)	φ_1	2.7% ($L = 38$) SL
Intangibles ($k = 2$)	φ_2	12.5% ($L = 8$) SL
Machinery ($k = 3$)	φ_3	20% ($L = 10$) DBSL ($a = 2$、$L^{*} = 5$)
Deductibility ratio of interest expense	θ	96.34%
Statutory rate of property tax	τ_e	1.4%
Valuation for financial assets ($k = 4$)	v_4	1
Valuation for inventories ($k = 5$)	v_5	0.5
Weights of investment assets		
Industrial buildings ($k = 1$)	α_1	20%
Intangibles ($k = 2$)	α_2	20%
Machinery ($k = 3$)	α_3	20%
Financial assets ($k = 4$)	α_4	20%
Inventories ($k = 5$)	α_5	20%
Weights of financing sources		
Retained Earnings ($f = 1$)	β_1	55%
New equity ($f = 2$)	β_2	10%
Debt ($f = 3$)	β_3	35%

The statutory property tax rate τ_e is set at 1.4% (standard rate), similar to Spengel et al. (2020), and applies to industrial buildings and machinery; Spengel et al. (2020) also adds a 0.3% city planning tax as another property tax, but since the city planning tax in the current system is levied only in certain areas. However, this study does not consider city planning tax because it is only levied in certain areas under the current system. The valuation method for financial assets

[10] Spengel et al. (2020) models the PDV as follows, using DBSL as the depreciation method for machinery under the Japanese tax system, with L_1 as the applicable period for the declining balance method, L_2 as the applicable period for the straight-line method, and $L(=L_1+L_2)$ as the legal life of the machinery.

$$PDV_{DBSL} = \left\{\left(\frac{\varphi_{DB}}{1+\rho}\right) + \left(\frac{(1-\varphi_{DB})\varphi_{DB}}{1+\rho}\right)^2 + \left(\frac{\{1-(1-\varphi_{DB})\varphi_{DB}\}\varphi_{DB}}{1+\rho}\right)^3 + \cdots\right\} + \left\{\left(\frac{\varphi_{SL}}{1+\rho}\right)^{L_1+1} + \left(\frac{\varphi_{SL}}{1+\rho}\right)^{L_1+2} + \cdots + \left(\frac{\varphi_{SL}}{1+\rho}\right)^{L}\right\}$$

and inventory is the same as that in Spengel et al. (2020). The deductibility ratio of interest expenses is set at 96.34%, considering that the 1.2% tax rate of the value-added portion of the enterprise tax is not deductible [11].

For the asset weight parameter α, industrial buildings, intangibles, machinery, financial assets, and inventory were all set at 20%, whereas the financing weight parameter β was set at 55% retained earnings, 10% new equity issuance, and 35% debt. These settings were the same as those in Spengel et al. (2020).

V. Simulation Analysis of Fundamental Corporate Tax Reform Proposals (i)

The "Base Case 1" in Table 4 is calculated based on the parameters given in the previous section. The cost of capital, marginal effective tax rate $EMTR$, and average effective tax rate $EATR$ are calculated for each asset type (industrial buildings, intangibles, machinery, financial assets, and inventory) using retained earnings, new equity issuance, and debt financing. The composite costs of capital, composite $EMTR$, and composite $EATR$ are also listed [12].

According to the results of the "Base Case 1" calculations, retained earnings and new equity issuances have the same composite costs of capital, composite $EMTR$, and composite $EATR$. However, for debt, the composite cost of capital is lower, the composite $EMTR$ is negative, and the composite $EATR$ is lower. This is because of the deductibility of interest expenses on debt. The preferential treatment of debt in financing can be understood from the "Base Case 1" calculation results. The following section refers to Spengel et al. (2016) to simulate radical corporate tax reform based on the base case.

First, it addresses CBIT, which limits the deductibility of interest expenses. To represent the simplest CBIT, a simulation was performed with the deductibility ratio of interest expense $\theta =$ 0%. The results are shown in Table 4, "CBIT Case 1".

Of the results by financing, only debt has changed compared to "Base Case 1". The arrows next to the cost of capital values indicate whether the cost of capital has increased or decreased compared to "Base Case 1". In this case, the cost of capital with respect to debt increased, as did the marginal and average effective tax rates. Consequently, the composite cost of capital, composite $EMTR$, and composite $EATR$ also increase. An increase in the cost of capital would negatively impact investment.

Second, the ACEs that establish additional deductions are addressed to treat equity and

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[11] It is obtained as 100% - (1.2% / 31.3%) = 96.3417%.

[12] The computed firm-level composite cost of capital, composite $EMTR$, and composite $EATR$ for Japan in 2020 in Spengel et al. (2020) are 8.1%, 38.1%, and 34.1%, respectively. The difference in the results from the "Base Case 1" in this study is caused by the parameter modifications described in the previous section.

debt equally and a specific deduction is set up for the opportunity cost calculated from the notional interest rate for financing through retained earnings and new equity. To represent ACE in the model, the additional costs of ACE and F^{ACE}, are added to the additional cost of retained earnings, F^{RE}, and the additional cost of new equity issuance, F^{NE}.

$$F = \begin{cases} F_{ACE}^{RE} & \text{(Retained earnings)} \quad F_{ACE}^{RE} = F^{RE} + F^{ACE} \\ F_{ACE}^{NE} & \text{(New equity)} \quad F_{ACE}^{NE} = F^{NE} + F^{ACE} \\ F_{ACE}^{DE} & \text{(Debt)} \quad F_{ACE}^{DE} = F^{DE} \end{cases} \quad (28)$$

The additional cost of ACE, F^{ACE}, is formulated as follows [13]:

$$F^{ACE} = \frac{\gamma}{1+\rho}\{1 + \tau_e(1-\tau)\}(\tau^{res} - \tau^{ord})i^{ord} \quad (29)$$

where the notional profit rate, i^{ord}, the tax rate, τ^{res} with the ACE applied, and the tax rate, τ^{ord} without the ACE are applied. The property tax rate τ_e applies to industrial buildings and machinery. First, to assume a simple ACE, simulations are performed with i^{ord} equal to the nominal interest rate ($i^{ord} = i$), τ^{res} equal to the statutory corporate income tax rate ($\tau^{res} = \tau$), and τ^{ord} at 0% [14]. The result is the "ACE Case 1" in Table 4.

Among the results by financing, retained earnings and new equity have changed compared to the "Base Case 1". The cost of capital with respect to retained earnings and new equity decreases, as do the marginal effective tax rate and the average effective tax rate. Consequently, the composite cost of capital, composite $EMTR$, and composite $EATR$ also decrease. A decrease in the cost of capital is expected to positively impact investment.

Third, the study addresses ACC, which establishes an additional deduction for all financing at the notional interest rate: while ACE does not allow the deductibility of interest expense on debt, ACC allows the opportunity cost at the notional interest rate to be deducted. To represent ACC in the model, the additional cost of retained earnings F_{ACC}^{RE}, the additional cost of new equity issuance F_{ACC}^{NE}, and the additional cost of debt F_{ACC}^{DE} are set as follows:

$$F = \begin{cases} F_{ACC}^{RE} & \text{(Retained earnings)} \quad F_{ACC}^{RE} = F_{ACE}^{RE} \\ F_{ACC}^{NE} & \text{(New equity)} \quad F_{ACC}^{NE} = F_{ACE}^{NE} \\ F_{ACC}^{DE} & \text{(Debt)} \quad F_{ACC}^{DE} = F^{DE} + F^{ACC} \end{cases} \quad (30).$$

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[13] In the additional cost F^{ACE} of ACE, the additional cost of retained earnings F_{ACE}^{RE} and the additional cost of issuing new equity F_{ACE}^{NE} are as follows:
$F_{ACE}^{RE} = 0 + \frac{\gamma}{1+\rho}\{1 + \tau_e(1-\tau)\}(\tau^{res} - \tau^{ord})i^{ord}$,
$F_{ACE}^{NE} = -\frac{\rho}{1+\rho}\{1 + \tau_e(1-\tau)\}(1-\gamma) + \frac{\gamma}{1+\rho}\{1 + \tau_e(1-\tau)\}(\tau^{res} - \tau^{ord})i^{ord} = \frac{\gamma}{1+\rho}\{1 + \tau_e(1-\tau)\}(\tau^{res} - \tau^{ord})i^{ord} - \frac{\gamma}{1+\rho}\rho(1-\gamma)$.

[14] According to Spengel et al. (2020), for example, in Belgium, which has ACE, τ^{res} is equal to the statutory corporate income tax rate at 33.99% and τ^{ord} is 0% (both in 2020). Similarly, in Italy, τ^{res} equals the statutory corporate income tax rate at 31.3% and τ^{ord} is 3.79% (both in 2020).

The additional cost of ACC, F^{ACC}, is formulated as follows [15]:

$$F^{ACC} = \frac{\gamma}{1+\rho}\{1+\tau_e(1-\tau)\}\{(\tau^{res}-\tau^{ord})i^{ord}-\theta i\tau\} \quad (31).$$

The property tax rate τ_e applies to industrial buildings and machinery; as with ACE, a simple ACC is first assumed and then the simulation is run assuming a notional interest rate $i^{ord} = i$, a tax rate $\tau^{res} = \tau$ with ACC applied, and a tax rate $\tau^{ord} = 0\%$ without ACC applied. The result is "ACC Case 1", shown in Table 4.

In both cases, the results are impacted and changed compared to "Base Case 1". The cost of capital decreases, as do the marginal and average effective tax rates. Consequently, the composite cost of capital, composite $EMTR$, and composite $EATR$ also decrease. A decrease in the cost of capital is expected to positively impact investment.

In Table 4, a simulation of the simplest CBIT, ACE, and ACC is presented. CBIT raises the cost of debt capital and marginal effective tax rate to ensure financing neutrality: ACE lowers the cost of capital and marginal effective tax rate for retained earnings and new equity to ACE and ACC are the opposite. However, ACE cannot ensure full financing neutrality as it continues to deduct debt: ACC can ensure full financing neutrality by addressing debt as well.

Table 5 shows the simulation results for "Base Case 1" and the constant average effective tax rate "CBIT Case 2," "ACE Case 2," and "ACC Case 2." For CBIT, the statutory tax rate was 25.57%, lower than 31.30% in "Base Case 1" because of the broadened tax base. On the other hand, for the ACE and ACC, the statutory tax rates are 42.33% and 42.62%, respectively, owing to the narrower tax base.

First, in "CBIT Case 2" under a constant average effective tax rate, the cost of capital, marginal effective tax rate, and average effective tax rate for retained earnings and new equity decrease with the reduction in the statutory tax rate but those for debt increase. The composite cost of capital and composite EMTR increase, which is considered to negatively impact investment. On the other hand, "ACE Case 2" and "ACC Case 2" under a constant average effective tax rate are considered to have a positive effect on investment because the cost of capital and marginal effective tax rate decreases for all financing. However, it should be noted that both resulted in statutory tax rates exceeding 40%.

Figures 3 and 4 illustrate the statutory tax rate, composite cost of capital, composite EMTR, and composite EATR for the simulation results in Tables 4 and 5, respectively. As shown in Figure 3, the statutory tax rate for each case in Simulation Results 1 is the same at 31.3% for

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[15] In the additional cost of ACC, F^{ACC}, the additional cost of debt, F^{DE}_{ACC}, is as follows:
$F^{DE}_{ACC} = \frac{\gamma}{1+\rho}\{1+\tau_e(1-\tau)\}\{\rho - i(1-\theta\tau)\} + \frac{\gamma}{1+\rho}\{1+\tau_e(1-\tau)\}\{(\tau^{res}-\tau^{ord})i^{ord}-\theta i\tau\} = \frac{\gamma}{1+\rho}\{1+\tau_e(1-\tau)\}[\rho - i + (\tau^{res}-\tau^{ord})i^{ord}] = \frac{\gamma}{1+\rho}\{1+\tau_e(1-\tau)\}(\tau^{res}-\tau^{ord})i^{ord} + \frac{\gamma}{1+\rho}\{1+\tau_e(1-\tau)\}(\rho - i).$

"Base Case 1". On the other hand, Figure 4 varies the statutory tax rate so that a composite EATR of 30.21% is realized. Therefore, the statutory tax rate is reduced in "CBIT Case 2," which has a wider tax base, while the statutory tax rate is increased in "ACE Case 2" and "ACC Case 2," which have a narrower tax base.

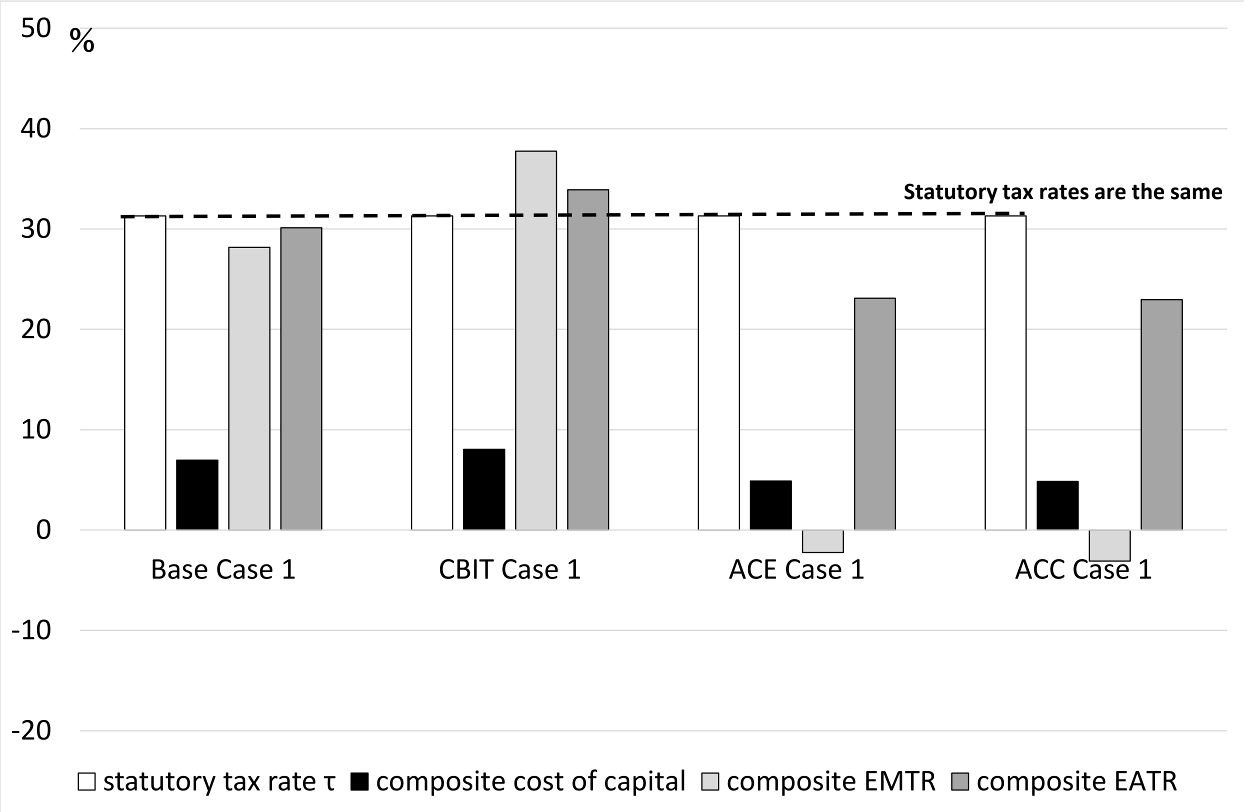

Figure 3: Simulation Result 1 ($p = 20\%$, constant statutory tax rate)

By comparing Figures 3 and 4, the impact of changes in statutory tax rates on the composite cost of capital, composite EMTR, and composite EATR may be examined. In the case of the change from "CBIT Case 1" to "CBIT Case 2," the reduction in the statutory tax rate lowers the composite EMTR and composite EATR; however, as the reduction in the statutory tax rate is small, no significant change occurs. On the other hand, the changes from "ACE Case 1" to "ACE Case 2" or from "ACC Case 1" to "ACC Case 2" cause a particularly large decrease in composite EMTR due to the increase in statutory tax rates. Thus, the results indicate that the change to ACE/ACC has a greater impact on composite EMTR than CBIT.

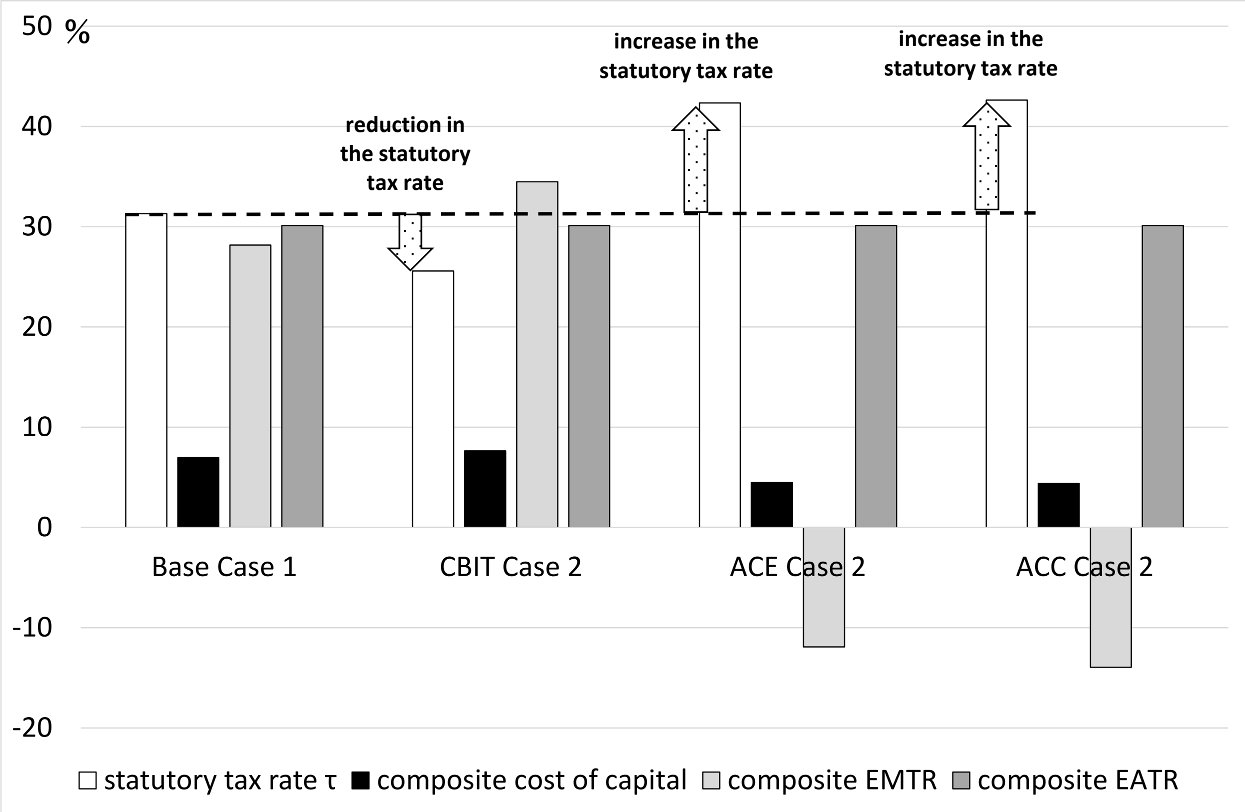

Figure 4: Simulation Result 2 ($p = 20\%$, constant average effective tax rate)

Table 4: Simulation Results 1 ($p = 20\%$, constant statutory tax rate)

	Base Case 1（%）			CBIT Case 1（%）			ACE Case 1（%）			ACC Case 1（%）		
	τ＝31.30%			τ＝31.30% $\theta = 0\%$			$\tau^{res} = 31.30\%$ $\tau^{ord} = 0\%$ $i^{ord} = 7.1\%$			$\tau^{res} = 31.30\%$ $\tau^{ord} = 0\%$ $i^{ord} = 7.1\%$		
	Cost of capital	$EMTR$	$EATR$	Cost of capital	$EMTR$	$EATR$	Cost of capital	$EMTR$	$EATR$	Cost of capital	$EMTR$	$EATR$
Retained Earnings (composite)	8.03	37.76	33.90	8.03(→)	37.76	33.90	4.85(↓)	−3.09	22.96	4.85(↓)	−3.09	22.96
Industrial buildings	8.86	43.57	36.74	8.86(→)	43.57	36.74	5.66(↓)	11.64	25.74	5.66(↓)	11.64	25.74
Intangibles	7.38	32.23	31.64	7.38(→)	32.23	31.64	4.21(↓)	−18.86	20.75	4.21(↓)	−18.86	20.75
Machinery	8.03	37.76	33.89	8.03(→)	37.76	33.89	4.83(↓)	−3.49	22.90	4.83(↓)	−3.49	22.90
Financial assets	8.17	38.81	34.37	8.17(→)	38.81	34.37	5.00(↓)	0.00	23.48	5.00(↓)	0.00	23.48
Inventories	7.72	35.27	32.83	7.72(→)	35.27	32.83	4.55(↓)	−9.81	21.94	4.55(↓)	−9.81	21.94
New equity (composite)	8.03	37.76	33.90	8.03(→)	37.76	33.90	4.85(↓)	−3.09	22.96	4.85(↓)	−3.09	22.96
Industrial buildings	8.86	43.57	36.74	8.86(→)	43.57	36.74	5.66(↓)	11.64	25.74	5.66(↓)	11.64	25.74
Intangibles	7.38	32.23	31.64	7.38(→)	32.23	31.64	4.21(↓)	−18.86	20.75	4.21(↓)	−18.86	20.75
Machinery	8.03	37.76	33.89	8.03(→)	37.76	33.89	4.83(↓)	−3.49	22.90	4.83(↓)	−3.49	22.90
Financial assets	8.17	38.81	34.37	8.17(→)	38.81	34.37	5.00(↓)	0.00	23.48	5.00(↓)	0.00	23.48
Inventories	7.72	35.27	32.83	7.72(→)	35.27	32.83	4.55(↓)	−9.81	21.94	4.55(↓)	−9.81	21.94
Debt (composite)	4.97	−0.68	23.36	8.03(↑)	37.76	33.90	4.97(→)	−0.68	23.36	4.85(↓)	−3.09	22.96
Industrial buildings	5.78	13.43	26.14	8.86(↑)	43.57	36.74	5.78(→)	13.43	26.14	5.66(↓)	11.64	25.74
Intangibles	4.32	−15.67	21.15	7.38(↑)	32.23	31.64	4.32(→)	−15.67	21.15	4.21(↓)	−18.86	20.75
Machinery	4.95	−1.04	23.30	8.03(↑)	37.76	33.89	4.95(→)	−1.04	23.30	4.83(↓)	−3.49	22.90
Financial assets	5.12	2.27	23.87	8.17(↑)	38.81	34.37	5.12(→)	2.27	23.87	5.00(↓)	0.00	23.48
Inventories	4.67	−7.08	22.34	7.72(↑)	35.27	32.83	4.67(→)	−7.08	22.34	4.55(↓)	−9.81	21.94
Industrial buildings (composite)	7.78	35.72	33.02	8.86(↑)	43.57	36.74	5.70(↓)	12.28	25.88	5.66(↓)	11.64	25.74
Intangibles (composite)	6.31	20.74	27.97	7.38(↑)	32.23	31.64	4.25(↓)	−17.73	20.89	4.21(↓)	−18.86	20.75
Machinery (composite)	6.95	28.09	30.18	8.03(↑)	37.76	33.89	4.87(↓)	−2.62	23.04	4.83(↓)	−3.50	22.89
Financial assets (composite)	7.10	29.60	30.70	8.17(↑)	38.81	34.37	5.04(↓)	0.81	23.61	5.00(↓)	0.00	23.48
Inventories (composite)	6.66	24.87	29.16	7.72(↑)	35.27	32.83	4.59(↓)	−8.84	22.08	4.55(↓)	−9.81	21.94
Composite	6.96	28.16	30.21	8.03(↑)	37.76	33.90	4.89(↓)	−2.23	23.10	4.85(↓)	−3.10	22.96

Table 5: Simulation Results 2 (p = 20%, constant average effective tax rate)

	Base Case 1（%）			CBIT Case 2（%）			ACE Case 2（%）			ACC Case 2（%）		
	τ＝31.30%			τ = 25.57%　θ = 0%			τ^{res} = 42.33% τ^{ord} = 0%　i^{ord} = 7.1%			τ^{res} = 42.62% τ^{ord} = 0%　i^{ord} = 7.1%		
	Cost of capital	$EMTR$	$EATR$	Cost of capital	$EMTR$	$EATR$	Cost of capital	$EMTR$	$EATR$	Cost of capital	$EMTR$	$EATR$
Retained Earnings (composite)	8.03	37.76	33.90	7.63(↓)	34.48	30.21	4.40(↓)	－13.58	30.02	4.39(↓)	－13.95	30.21
Industrial buildings	8.86	43.57	36.74	8.47(↓)	40.95	33.24	5.17(↓)	3.31	33.24	5.16(↓)	3.02	32.41
Intangibles	7.38	32.23	31.64	6.99(↓)	28.44	27.88	3.72(↓)	－34.34	28.06	3.71(↓)	－34.90	28.25
Machinery	8.03	37.76	33.89	7.78(↓)	35.70	30.73	3.84(↓)	－30.27	28.39	3.81(↓)	－31.36	28.54
Financial assets	8.17	38.81	34.37	7.65(↓)	34.64	30.28	5.00(↓)	0.00	31.74	5.00(↓)	0.00	31.97
Inventories	7.72	35.27	32.83	7.28(↓)	31.29	28.93	4.28(↓)	－16.81	29.67	4.27(↓)	－17.05	29.88
New equity (composite)	8.03	37.76	33.90	7.63(↓)	34.48	30.21	4.40(↓)	－13.58	30.02	4.39(↓)	－13.95	30.21
Industrial buildings	8.86	43.57	36.74	8.47(↓)	40.95	33.24	5.17(↓)	3.31	33.24	5.16(↓)	3.02	32.41
Intangibles	7.38	32.23	31.64	6.99(↓)	28.44	27.88	3.72(↓)	－34.34	28.06	3.71(↓)	－34.90	28.25
Machinery	8.03	37.76	33.89	7.78(↓)	35.70	30.73	3.84(↓)	－30.27	28.39	3.81(↓)	－31.36	28.54
Financial assets	8.17	38.81	34.37	7.65(↓)	34.64	30.28	5.00(↓)	0.00	31.74	5.00(↓)	0.00	31.97
Inventories	7.72	35.27	32.83	7.28(↓)	31.29	28.93	4.28(↓)	－16.81	29.67	4.27(↓)	－17.05	29.88
Debt (composite)	4.97	－0.68	23.36	7.63(↑)	34.48	30.21	4.59(↓)	－8.94	30.56	4.39(↓)	－13.95	30.21
Industrial buildings	5.78	13.43	26.14	8.47(↑)	40.95	33.24	5.36(↓)	6.71	32.78	5.16(↓)	3.02	32.41
Intangibles	4.32	－15.67	21.15	6.99(↑)	28.44	27.88	3.91(↓)	－27.92	28.60	3.71(↓)	－34.90	28.25
Machinery	4.95	－1.04	23.30	7.78(↑)	35.70	30.73	4.03(↓)	－24.18	28.94	3.81(↓)	－31.36	28.54
Financial assets	5.12	2.27	23.87	7.65(↑)	34.64	30.28	5.19(↓)	3.60	32.28	5.00(↓)	0.00	31.97
Inventories	4.67	－7.08	22.34	7.28(↑)	31.29	28.93	4.47(↓)	－11.92	30.21	4.27(↓)	－17.05	29.88
Industrial buildings (composite)	7.78	35.72	33.02	8.47(↑)	40.95	33.24	5.24(↓)	4.53	32.43	5.16(↓)	3.02	32.41
Intangibles (composite)	6.31	20.74	27.97	6.99(↑)	28.44	27.88	3.79(↓)	－32.02	28.25	3.71(↓)	－34.90	28.25
Machinery (composite)	6.95	28.09	30.18	7.78(↑)	35.70	30.73	3.90(↓)	－28.07	28.58	3.81(↓)	－31.36	28.54
Financial assets (composite)	7.10	29.60	30.70	7.65(↑)	34.64	30.28	5.07(↓)	1.29	31.93	5.00(↓)	0.00	31.97
Inventories (composite)	6.66	24.87	29.16	7.28(↑)	31.29	28.93	4.35(↓)	－15.05	29.86	4.27(↓)	－17.05	29.88
Composite	6.96	28.16	30.21	7.63(↑)	34.48	30.21	4.47(↓)	－11.91	30.21	4.39(↓)	－13.95	30.21

Table 6: Simulation Results 3 ($p = 10\%$, constant average effective tax rate)

	Base Case 3（%）			CBIT Case 3（%）			ACE Case 3（%）			ACC Case 3（%）		
	$\tau = 31.30\%$			$\tau = 26.47\%$ $\theta = 0\%$			$\tau^{res} = 40.64\%$ $\tau^{ord} = 0\%$ $i^{ord} = 7.1\%$			$\tau^{res} = 40.92\%$ $\tau^{ord} = 0\%$ $i^{ord} = 7.1\%$		
	Cost of capital	$EMTR$	$EATR$	Cost of capital	$EMTR$	$EATR$	Cost of capital	$EMTR$	$EATR$	Cost of capital	$EMTR$	$EATR$
Retained Earnings (composite)	8.03	37.76	36.49	7.52(↓)	33.51	29.12	4.48(↓)	−11.57	28.94	4.47(↓)	−11.89	29.12
Industrial buildings	8.86	43.57	42.17	8.36(↓)	40.18	32.20	5.26(↓)	4.89	31.24	5.24(↓)	4.64	31.41
Intangibles	7.38	32.23	31.99	6.88(↓)	27.32	26.76	3.81(↓)	−31.31	26.94	3.79(↓)	−31.80	27.13
Machinery	8.03	37.76	36.49	7.71(↓)	35.11	29.80	4.01(↓)	−24.56	27.55	3.99(↓)	−25.47	27.69
Financial assets	8.17	38.81	37.44	7.51(↓)	33.39	29.07	5.00(↓)	0.00	30.48	5.00(↓)	0.00	30.69
Inventories	7.72	35.27	34.37	7.15(↓)	30.10	27.77	4.33(↓)	−15.50	28.49	4.32(↓)	−15.71	28.68
New equity (composite)	8.03	37.76	36.49	7.52(↓)	33.51	29.12	4.48(↓)	−11.57	28.94	4.47(↓)	−11.89	29.12
Industrial buildings	8.86	43.57	42.17	8.36(↓)	40.18	32.20	5.26(↓)	4.89	31.24	5.24(↓)	4.64	31.41
Intangibles	7.38	32.23	31.99	6.88(↓)	27.32	26.76	3.81(↓)	−31.31	26.94	3.79(↓)	−31.80	27.13
Machinery	8.03	37.76	36.49	7.71(↓)	35.11	29.80	4.01(↓)	−24.56	27.55	3.99(↓)	−25.47	27.69
Financial assets	8.17	38.81	37.44	7.51(↓)	33.39	29.07	5.00(↓)	0.00	30.48	5.00(↓)	0.00	30.69
Inventories	7.72	35.27	34.37	7.15(↓)	30.10	27.77	4.33(↓)	−15.50	28.49	4.32(↓)	−15.71	28.68
Debt (composite)	4.97	−0.68	15.42	7.52(↑)	33.51	29.12	4.66(↓)	−7.38	29.46	4.47(↓)	−11.89	29.12
Industrial buildings	5.78	13.43	20.98	8.36(↑)	40.18	32.20	5.43(↓)	7.97	31.76	5.24(↓)	4.64	31.41
Intangibles	4.32	−15.67	11.00	6.88(↑)	27.32	26.76	3.98(↓)	−25.56	27.46	3.79(↓)	−31.80	27.13
Machinery	4.95	−1.04	15.29	7.71(↑)	35.11	29.80	4.19(↓)	−19.34	28.07	3.99(↓)	−25.47	27.69
Financial assets	5.12	2.27	16.45	7.51(↑)	33.39	29.07	5.17(↑)	3.37	30.99	5.00(↓)	0.00	30.69
Inventories	4.67	−7.08	13.38	7.15(↑)	30.10	27.77	4.50(↓)	−11.03	29.00	4.32(↓)	−15.71	28.68
Industrial buildings (composite)	7.78	35.72	34.75	8.36(↑)	40.18	32.20	5.32(↓)	5.99	31.42	5.24(↓)	4.64	31.41
Intangibles (composite)	6.31	20.74	24.64	6.88(↑)	27.32	26.76	3.87(↓)	−29.24	27.12	3.79(↓)	−31.80	27.13
Machinery (composite)	6.95	28.09	29.07	7.71(↑)	35.11	29.80	4.08(↓)	−22.68	27.73	3.99(↓)	−25.47	27.69
Financial assets (composite)	7.10	29.60	30.09	7.51(↑)	33.39	29.07	5.06(↓)	1.21	30.66	5.00(↓)	0.00	30.69
Inventories (composite)	6.66	24.87	27.02	7.15(↑)	30.10	27.77	4.39(↓)	−13.90	28.67	4.32(↓)	−15.71	28.68
Composite	6.96	28.16	29.12	7.52(↑)	33.51	29.12	4.54(↓)	−11.89	29.12	4.47(↓)	−11.89	29.12

VI. Simulation Analysis of Fundamental Corporate Tax Reform Proposals (ii)

The simulation analysis in the previous section assumes the simplest CBIT, ACE, and ACC. Realistically, these tax reforms may be oriented toward implementing more moderate tax reforms. Therefore, in this section, a simulation is conducted in which the tax parameters in CBIT, ACE, and ACC are adjusted under the constant average effective tax rate of the "Base Case 1."

First, with respect to CBIT, although in the previous section a simulation was conducted in which the deductibility ratio of interest expense θ was set to zero ($\theta = 0\%$), here a simulation in which θ was varied in steps is conducted. The results are shown in Figure 5. The result of $\theta = 0\%$ on the left side of Figure 5 corresponds to "CBIT Case 2," and the result of $\theta = 96.34\%$ on the right side corresponds to "Base Case 1."

Figure 5 shows that changing the deductibility ratio of interest expense, θ, does not significantly change the composite cost of capital but it changes the composite $EMTR$ to an extent. θ affects only debt financing and has a limited effect on the overall cost of capital and composite $EMTR$. It is also possible to confirm that the statutory corporate income tax rate τ, which ensures a constant average effective tax rate, does not change significantly[16].

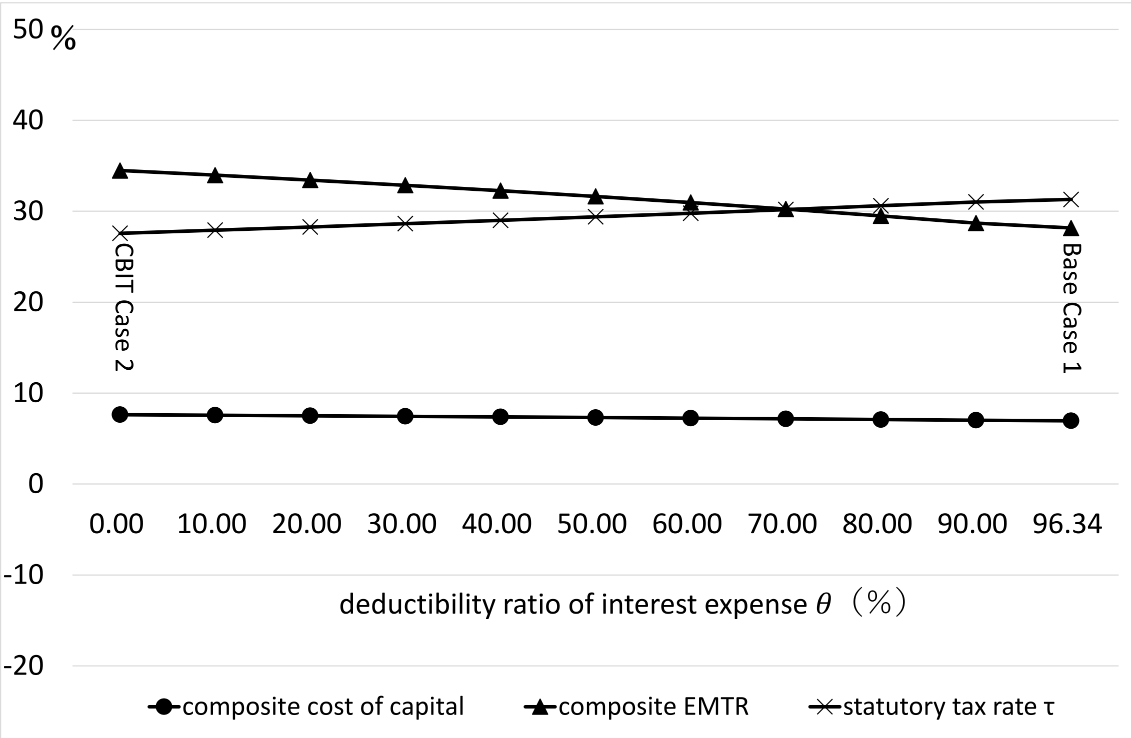

Figure 5: CBIT: Effect of changing the deductibility ratio θ of interest expense ($p = 20\%$, constant average effective tax rate)

[16] For ease of comparison, the vertical axis memories in Figures 5, 6, and 7 are equal.

Second, regarding ACE/ACC, the previous section assumed that the notional interest rate i^{ord} is equal to the nominal interest rate ($i^{ord} = i$), but such a setting may be difficult. For example, in Belgium, where ACE has been introduced, the notional interest rate i^{ord} is linked to the 10-year government bond rate. In other words, the notional interest rate i^{ord} is likely to be set lower than the market rate. Therefore, a simulation in which the i^{ord} was varied in steps is conducted and the results are shown in Figure 6. The results for $i^{ord} = 7.1\%$ on the left side of Figure 6 correspond to the "ACE Case 2" and "ACC Case 2," while the results for $i^{ord} = 0\%$ on the right side correspond to the "Base Case 1".

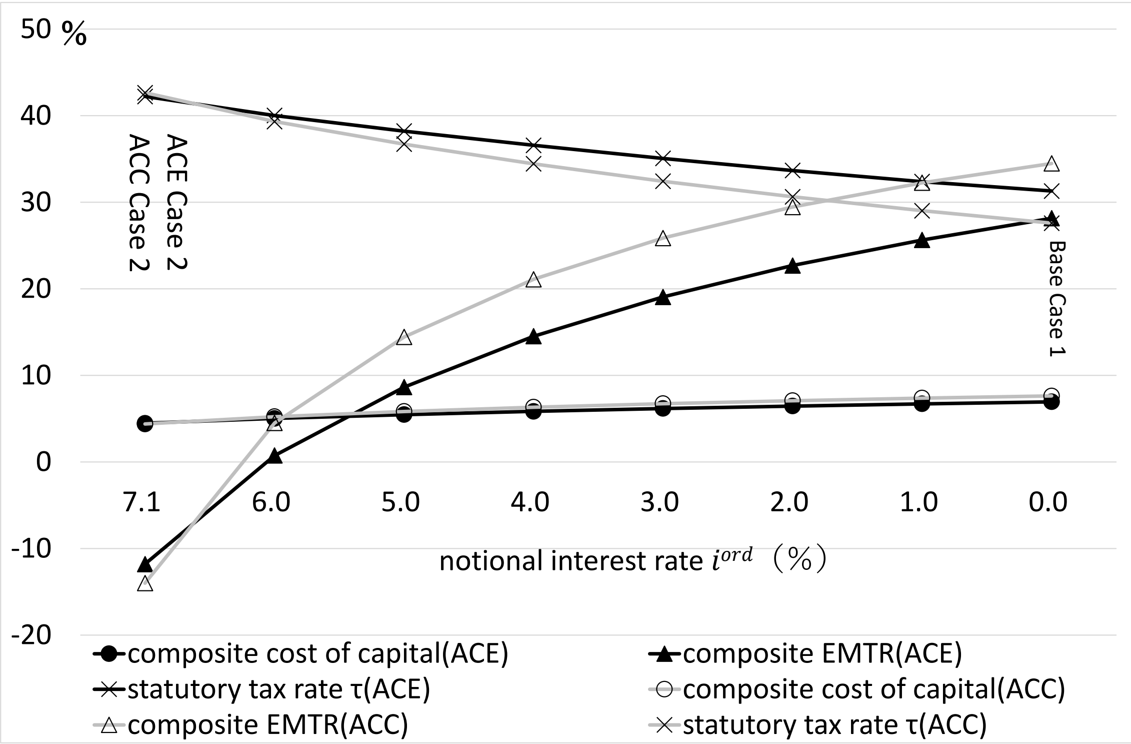

Figure 6: ACE/ACC: Effect of a change in the notional interest rate i^{ord} ($p = 20\%$, constant average effective tax rate)

Figure 6 shows that a change in the notional interest rate i^{ord} does not significantly change the composite cost of capital but the composite $EMTR$ does. Thus, for ACE/ACC, the notional interest rate is important when considering incentives for investment[17]. Comparing ACE and ACC, ACC has a higher marginal effective tax rate and a lower statutory tax rate when the notional interest

[17] If the interest rate in the country's economy is low, the ACE/ACC notional interest rate will also be set low, thus limiting the impact of the introduction of ACE/ACC on the cost of capital and marginal effective tax rate.

rate is lower.

Third, with respect to ACE/ACC, the previous section assumes that the tax rate τ^{res} applying ACE/ACC is equal to the statutory corporate income tax rate ($\tau^{res} = \tau$); but a lower rate than the statutory rate could be set even if, τ^{res} is equal to the statutory rate, the rate τ^{ord} not applying ACE/ACC is positive, and the tax rate to be applied is effectively reduced. Therefore, a simulation was conducted in which τ^{res} was varied in steps. The results are shown in Figure 7. The results for $\tau^{res} = 42.4\%$ on the left side of Figure 7 correspond to the "ACE Case 2" and "ACC Case 2," while the results for $\tau^{res} = 0\%$ on the right side correspond to the "Base Case 1."

Figure 7 shows a change in the tax rate τ^{res} applying ACE/ACC does not significantly change the composite cost of capital but the composite EMTR does. Therefore, for ACE/ACC, setting the tax rate to apply ACE/ACC or not to apply ACE/ACC is important when considering incentives for investment; comparing ACE and ACC, if the tax rate that applies ACE/ACC is lower, the marginal effective tax rate for ACC is higher, and the statutory tax rate is lower.

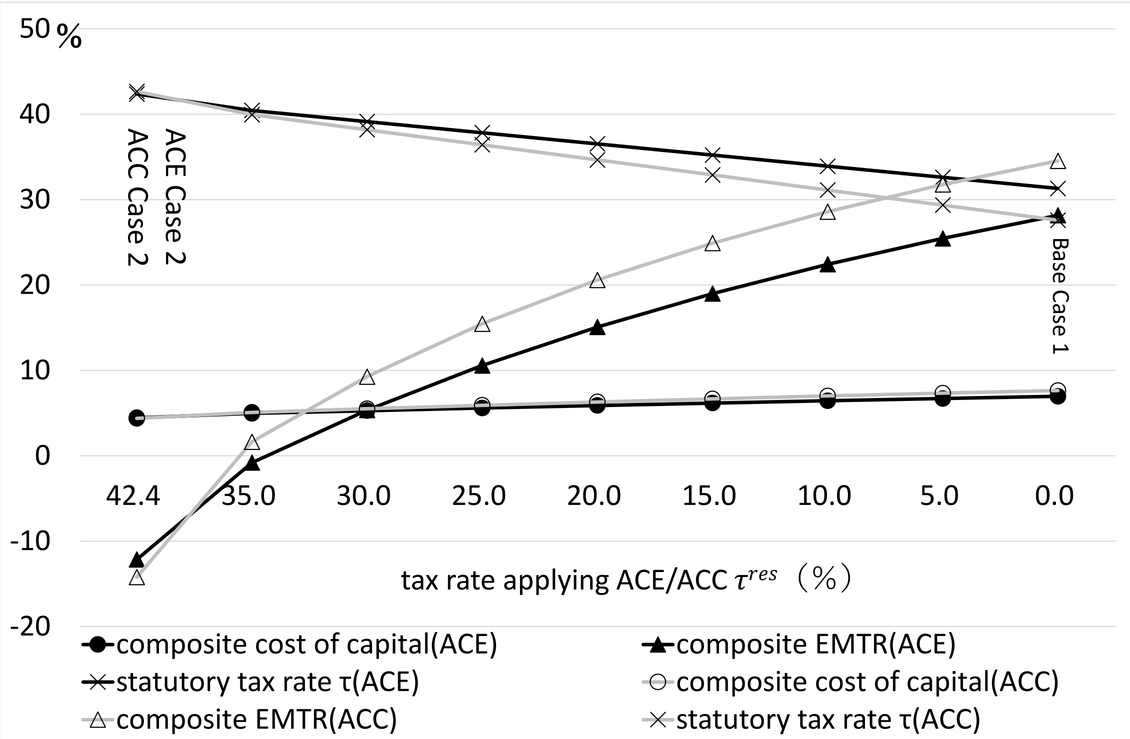

Figure 7: ACE/ACC: Effect of changing tax rate τ^{res} applying ACE/ACC ($p = 20\%$, constant average effective tax rate)

VII. Conclusion

This study analyzes the impact of fundamental tax reforms aimed at financing neutrality on Japan's effective corporate tax rate using a forward-looking model of effective tax rates. Forward-looking effective tax rates are formulated in line with Hanappi (2018), OECD (2020), and Spengel et al. (2020), who conducted international comparative studies of effective corporate tax rates. Improvements have been made to obtain the cost of capital, marginal effective tax rate, and average effective tax rate values by financing and assets.

CBIT, ACE, and ACC are then included as fundamental tax reform proposals and their parameters are incorporated into a model of the effective corporate tax rate to conduct a simulation analysis. First, a simple CBIT that does not allow deductions of interest expenses increases the cost of capital, marginal effective tax rate, and average effective tax rate for debt financing. Second, a simple ACE that allows the deduction of opportunity cost at the notional interest rate on equity lowers the cost of capital, the marginal effective tax rate, and the average effective tax rate for retained earnings and new equity. Third, a simple ACC that allows all financing to deduct opportunity costs at the notional interest rate lowers the cost of capital, marginal effective tax rate, and the average effective tax rate for all financing.

However, these results are difficult to compare because of the different average effective tax rates. Therefore, a simulation was conducted under a constant average effective tax rate, that results in statutory corporate income tax rates of 25.57% for CBIT, 42.33% for ACE, and 42.62% for ACC, compared with 31.30% in the base case. Thus, CBIT could be reduced by five percentage points from the current tax rate, but ACE/ACC would require a ten percentage point increase. It was also shown that under a constant average effective tax rate, CBIT would raise the cost of capital and the marginal effective tax rate, whereas ACE/ACC would lower these values.

The above simulations are conducted assuming a simple CBIT with no deductible interest expense, a simple ACE/ACC where the notional interest rate matches the nominal interest rate, and the rate at which ACE/ACC is applied matches the statutory corporate income tax rate. Simulations that relax these conditions are conducted under a constant average effective tax rate.

First, under CBIT, varying the deductibility of interest expenses has a limited effect on the cost of capital and the marginal effective tax rate. Second, when the notional interest rate is set lower than the nominal interest rate or when the tax rate to which ACE/ACC is applied is set lower than the statutory tax rate, the effect on the marginal effective tax rate is significant.

From the above results, several implications can be obtained.

First, CBIT can be financing neutral, but it increases the cost of capital and the marginal effective tax rate and may have a negative effect on investment. Second, ACE/ACC decreases the cost of capital and marginal effective tax rate, which could positively affect investment. ACE was introduced in European countries and is considered a promising proposal for future corporate tax reform in Japan.

First, the analysis is limited to the corporate level and does not analyze the shareholder level. A shareholder-level analysis is necessary because the proposed radical tax reform is a reform that is proposed with the integration of the corporate and shareholder levels in mind.

Second, although tax revenue neutrality should originally be used in the simulation analysis, it was difficult to conduct a tax revenue-neutral simulation analysis that included tax revenues generated by profits from the capital stock from past investments with the forward-looking model in this study. Therefore, for the sake of comparison, the statutory tax rate and the average effective tax rate was held constant, however; but a simulation that is tax revenue neutral should originally be used.

Third, the study analysis based on the forward-looking model does not make use of industry-specific data or corporate financial data. For example, Abe (2010) and Yamada (2020) estimated the statutory corporate income tax rate required when CBIT and ACE are introduced, and such analysis based on real data is important. For ACE/ACC, the introduction of the deduction of opportunity cost based on the notional interest rate is expected to increase the number of loss-making corporations and if tax revenue is neutral, a significant increase to the statutory tax rate may be necessary. An analysis using actual data will be required to determine the consequent increase in statutory tax rate.

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