WIDE VS. NARROW TAX BASES UNDER OPTIMAL INVESTMENT TIMING

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Abstract

This article compares an ACE system with a CBIT system in an open economy. Using a real-option approach we show that, if a firm can decide when to invest, a tradeoff is found. According to traditional wisdom, a high-income firm investing in an ACE system faces a heavier tax burden at each instant. On the other hand, it finds it optimal to invest earlier, thereby enjoying a longer stream of income. If, given the same tax burden, the latter effect is great enough, the firm will prefer the ACE system. In this article we also run a simulation which shows that preference for an ACE system is a realistic result.

JEL Code: H25, H32.

Keywords: corporate taxation, open economy, timing and real options.

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1 Introduction

In the early 90s, two opposing and fairly innovative corporation tax systems were proposed: the Allowance for Corporate Equity (ACE) and the Comprehensive Business Income Tax (CBIT). The implementation of the ACE was advocated by the IFS Capital Taxes Group (1991). Under this system, the tax base is equal to the firm's current earnings, net of the opportunity cost of finance. The CBIT was proposed by the US Treasury Department (1992). It extends the tax base for business, by disallowing interest payments deductibility from the profit tax base. all kinds of capital income are thus taxed at the firm level.

The above systems have different real effects. As argued by Bond (2000), in a closed economy the ACE tax reduces the user cost of capital under equity-financing, while leaving unchanged the tax treatment of debt. This makes the ACE preferable to the CBIT. In a small open economy, instead, the CBIT may be preferred. Since the CBIT system has a wider tax base, it requires a lower tax rate to raise a given amount of revenues. Hence, mobile multinational companies, who usually earn rents, face a less heavy tax burden under such a system.

The above argument against the ACE system disregards two important features of FDIs: their intrinsic riskiness and the ability of firms to choose when to invest. As pointed out by Heckman (2003), the world economy is more variable than it was 30 years ago[1]. Not only business projects are riskier, but also they represent opportunities rather than obligations. Thus, firms behave as if they owned option-rights on business projects. This entails that firms can usually decide when to invest, thereby enjoying a certain degree of flexibility[2]. The value of flexibility can be computed using option pricing techniques[3].

Using a real-option approach, this article shows that riskiness and busi-

[1]The increase in variability is due to increased international mobility of factors and goods; the deregulation of national capital controls and creation of new financial markets; the entry of new countries in international trade, international outsourcing of production on a large scale and, finally, the formidable rise in the use of skill-biased technology.

[2]McDonald and Siegel (1986) show that the opportunity to postpone investment is analogous to a call option.

[3]Graham and Harvey (2001) find that about 25% of the US companies surveyed always or almost always incorporate real options when evaluating a project. Furhermore, McDonald (2000) argues that even when firms apply standard techniques, it is possible that they adopt ad hoc rules of thumb which proxy for optimal timing behaviour.

ness timing are crucial determinants of FDI strategies in an open economy. According to traditional wisdom, a high-income firm investing in an ACE system faces a heavier tax burden at each instant. On the other hand, the firm may find it optimal to invest earlier under an ACE system, and thus it enjoys a longer stream of income. If, therefore, this latter effect is great enough, the firm will prefer the ACE system even in an open economy.

The paper is structured as follows. Section 2 introduces a continuous-time model and computes the effects of taxation on firms' investment strategies. Section 3 compares the ACE and CBIT system and provides some numerical simulations. Finally, section 4 summarizes the results and discusses some topics for further research.

2 The model

In this section we introduce a continuous-time model describing the behavior of a representative firm who decides when to invest. The following hypotheses hold:

1. risk is fully diversifiable and the risk-free interest rate r is given;
2. current income follows a geometric Brownian motion
$$dY(t) = \sigma Y(t)dz, \text{ with } Y(0) = Y,$$
where σ is the variance parameter and z is a Wiener process[4];
3. the firm starts to earn the payoff once a non-depreciable sunk cost, say F, has been paid[5];
4. for simplicity the investment project is fully equity financed[6].

[4]More precisely, the dynamics of $Y(t)$ should be written as $dY(t) = (r-\delta) Y(t) dt + \sigma Y(t)dz$ where $\delta \geq 0$ is the net "dividend" yield, paid out by the firm, and $(r-\delta)$ measures the risk-adjusted rate of return (see McDonald and Siegel, 1985). For simplicity, we thus assume that $r - \delta = 0$. As shown in a companion paper (Panteghini, 2002), if $r - \delta \neq 0$, the relevant discount rate would be δ and the quality of results would be unchanged. For further details see Dixit and Pindyck (1994, Ch. 5 and 6).

[5]As shown in Panteghini (2002), the introduction of depreciation would not affect the qualitative nature of results.

[6]Notice that both the ACE and the CBIT system are expected to be neutral in terms of financial decisions. Thus the qualitive nature of results does not change if we rule out debt-financing. For details on neutrality conditions under ACE taxation, see Bond and Devereux (2003).

Let us next introduce taxation. In line with Boadway and Bruce (1984), the tax base of system i is given by the firm's current income, net of an imputation rate ρ_i. Given the tax rate τ_i, current tax payments are thus equal to

$$T_i(t) = \tau_i \left[Y(t) - \rho_i F \right]. \tag{1}$$

The above notation allows a comparison between different tax systems. If we set $\rho_{ACE} = r$ and $\rho_{CBIT} = 0$, we obtain an ACE and a CBIT system, respectively. Given (1), the post-tax income can be written as

$$Y_i^T(t) = (1 - \tau_i) Y(t) + \rho_i \tau_i F. \tag{2}$$

Let us next define $V_i^T(Y)$ as the firm's after-tax project value under system i. In this article personal taxation will be disregarded. This can be justified by the fact that in many countries there exist tax-exempt entities (such as pension funds). Hence, investors have the opportunity to choose between taxable FDI projects and a tax-exempt financial investment yielding r. For this reason, r will be the relevant discount rate under both the CBIT and the ACE system. Thus the firm's investment decision is one of choosing the optimal investment time, i.e.

$$\max_t E \left\{ \left[V_i^T(Y(t)) - F \right] e^{-rt} \right\}, \tag{3}$$

where $E\{.\}$ denotes the expectation operator[7]. The solution of problem (3), defined as t_i^*, is the optimal time of investment. If, therefore, $t \geq t_i^*$ immediate investment is undertaken. If, instead, $t < t_i^*$, the firm will wait until $t = t_i^*$. It is worth noting that t_i^* may differ from the laissez-faire optimal timing. In this case, taxation distorts investment timing.

The optimal investment time t_i^* can be associated with an income level Y_i^*. This entails that whenever the current income reaches Y_i^*, the firm invests. Omitting for simplicity the time variable, we can thus rewrite the firm's problem as[8]

$$\ell = \max_{Y_i^*} \left\{ \left(\frac{Y}{Y_i^*} \right)^{\beta_1} \cdot \left[\frac{(1 - \tau_i) Y_i^*}{r} - \left(1 - \frac{\rho_i}{r} \tau_i \right) F \right] \right\}. \tag{4}$$

The first term of (4), $\left(\frac{Y}{Y_i^*} \right)^{\beta_1}$, is the present value of 1 Euro contingent on future investment and measures the expected discount factor. As can be

[7] For further details see Dixit and Pindyck (1994, Ch.6).
[8] For full derivation see the Appendix.

seen, $\left(\frac{Y}{Y_i^*}\right)^{\beta_1}$ depends on both current income, Y, and the firm's optimal trigger point Y_i^*. The exponent $\beta_1 > 1$ is a constant which depends on the interest rate and volatility[9]. The second term of (4) measures a perpetual rent, given the starting income Y_i^*.

Solving (4) one obtains the firm's post-tax trigger point

$$Y_i^* \equiv \left[\frac{1 - \frac{\rho_i}{r}\tau_i}{1 - \tau_i}\right] \widetilde{Y}, \tag{5}$$

where $\widetilde{Y} \equiv \frac{\beta_1}{\beta_1 - 1} rF > rF$ is the laissez-faire trigger point. Given (5), we can get the economic intuition behind β_1. As explained by Dixit and Pindyck (1994, Ch. 5 and 6), the term $\frac{\beta_1}{\beta_1 - 1}$ is the 'option value multiple', which accounts for the additional return required to compensate for investment option exercise. Since $\frac{\beta_1}{\beta_1 - 1} > 1$, inequality $\frac{\widetilde{Y}}{F} > r$ holds. According to the static NPV approach, the differential $\left(\frac{\widetilde{Y}}{F} - r\right)$ would be considered as a rent. In an endogenous-time setting, instead, $\left(\frac{\widetilde{Y}}{F} - r\right)$ measures the additional income required to cover the option value. This point, *per se*, partially explains why firms facing sunk costs may look as high-income companies when they operate in a stochastic context. These firms not only face sunk costs but also lose business flexibility when investment is undertaken[10]. As they give up the opportunity to see how uncertainty is resolved, they must account for an additional opportunity cost, which is equal to the option exercised.

Let us next discuss the effects of taxation. Given (5), we can argue that immediate investment is undertaken if $Y > Y_i^*$. If, instead, $Y < Y_i^*$, the firm will wait until Y reaches Y_i^*. Notice that, under an ACE system, we have $\rho_{ACE} = r$ and, hence, $Y_{ACE}^* = \widetilde{Y}$. This equality implies that the tax system is neutral, since the firm's investment timing is unaffected by taxation[11]. Under a CBIT system, instead, we have $\rho_{CBIT} = 0$. In the absence of any tax benefit related to F, therefore, the firm's optimal trigger point is $Y_{CBIT}^* = \frac{\widetilde{Y}}{1 - \tau_{CBIT}} > \widetilde{Y}$. Such an inequality entails that the CBIT induces an

[9] See the Appendix.

[10] As explained by Pindyck (2004), the real-option approach accounts for the basic fact that sunk costs affect investment decision-making when they are not yet sunk.

[11] This neutrality result is equivalent to that obtained in neoclassical model where the firm's user cost is unaffected by taxation.

investment postponement[12].

Under endogenous timing we face two offsetting effects. On the one hand, the CBIT system is characterised by a wider tax base. Thus it requires a lower tax rate in order to raise a given amount of revenues. At any instant, therefore, high-income firms face a less heavy tax burden under the CBIT system. On the other hand, the inequality $Y^*_{ACE} = \widetilde{Y} < Y^*_{CBIT}$ implies that companies investing in the ACE country earn profits earlier thereby enjoying a *longer* stream of profits.

Let us next compute the firm's project value. If $Y > Y_i^*$ the firm invests immediately and timing does not matter. Thus, the firm's project value is simply $\left[V_i^T(Y) - F\right]$. If, instead, $Y < Y_i^*$, the firm waits and timing must be accounted for. Therefore, the firm's value can be written as

$$\max_t E\left\{\left[V_i^T(Y) - F\right] e^{-rt}\right\} = \begin{cases} \left(\frac{Y}{Y_i^*}\right)^{\beta_1} \left[\frac{(1-\tau_i)Y_i^*}{r} - \left(1 - \frac{\rho_i}{r}\tau_i\right) F\right], & \text{if } Y < Y_i^*, \\ \left[\frac{(1-\tau_i)Y}{r} - \left(1 - \frac{\rho_i}{r}\tau_i\right) F\right], & \text{otherwise.} \end{cases} \tag{6}$$

Similarly, we can compute the firm's tax burden[13]. If $Y < Y_i^*$, the firm postpones investment and, therefore, the expected present value of tax payments, defined as $R_i(Y)$, depends on both the current level of Y and Y_i^*. If $Y > Y_i^*$, instead, investment is immediate and only Y matters. As shown in the Appendix we obtain

$$R_i(Y) = \begin{cases} \tau_i \left[\left(\frac{Y}{Y_i^*}\right)^{\beta_1} \left(\frac{Y_i^*}{r} - \frac{\rho_i}{r}F\right)\right] & \text{if } Y < Y_i^*, \\ \tau_i \left(\frac{Y}{r} - \frac{\rho_i}{r}F\right) & \text{otherwise.} \end{cases} \tag{7}$$

Functions (6) and (7) will be used to compare the ACE and the CBIT system.

3 Tax preferences

Given the above results, we can now analyse the tax preferences of a representative firm in an open economy.

[12] This result is equivalent to that obtained with a neoclassical model, where a CBIT is shown to raise the user cost of capital.

[13] For further details on effective taxation see Panteghini (2003).

Assume that there exist two countries. The first country applies an ACE system (i.e. $\rho_{ACE} = r$) with a tax rate τ_{ACE}. The second country implements a CBIT system (i.e. $\rho_{CBIT} = 0$) with a tax rate τ_{CBIT}. The representative firm must decide in which country to invest.

Given the above assumptions it straightforward to prove the following:

Proposition 1 *For any given tax burden, i.e. for*

$$R_{ACE}(Y) = R_{CBIT}(Y) \;\; \forall Y > 0, \tag{8}$$

the firm will prefer the ACE country if $Y < Y^*_{CBIT}$. *Otherwise, the firm will be indifferent.*

Proof. See the Appendix. ■

Proposition 1 shows that a CBIT is never preferred to an ACE system for any given tax burden. As pointed out in the previous section, a firm investing in the ACE country starts to earn profits earlier, thereby enjoying a longer stream of income. Thus the timing effect makes the ACE preferable for $Y < Y^*_{CBIT}$.

Proposition 1 is a preliminary result but does not respond to the main argument against the ACE system. If governments set tax rates in line with normal returns, the CBIT might be preferred by firms earning extra-profits. To stress the importance of the timing effect even for high-income firms we define $\widetilde{Y}$ as the normal income and analyse the impact of both systems on high-income firms. Let us then introduce the following:

- **Assumption 1**: *The CBIT country sets* τ_{CBIT}, *and, in turn, the ACE country sets* τ_{ACE} *such that*

$$R_{ACE}\left(\widetilde{Y}\right) = R_{CBIT}\left(\widetilde{Y}\right). \tag{9}$$

According to Assumption 1, the ACE and the CBIT country consider the laissez-faire trigger point $\widetilde{Y}$ as the normal return and set tax rates in order to collect the same tax revenues. Given Proposition 1, the 'normal' firm chooses the ACE country and invests immediately. However, the focus of our analysis is not on normal returns but rather on FDI decisions yielding an above-normal profitability. For this reason, we will analyse the investment decisions by firms whose current income is $Y > Y^*_{CBIT}$. According to traditional wisdom, these firms would choose a CBIT country. As will be shown the converse may be true. In fact, it is straightforward to prove that:

Proposition 2 *Given Assumption 1, a high-income firm with* $Y > Y^*_{CBIT}$ *will prefer the ACE system if*

i) either τ_{CBIT} *is low enough and* $Y \in \left(Y^*_{CBIT}, \widehat{Y}\right)$, *with* $\widehat{Y} \equiv \frac{\beta_1(1-\tau_{CBIT})^{\beta_1-1}}{\beta_1(1-\tau_{CBIT})^{\beta_1-1}-1} rF$,

ii) or τ_{CBIT} *is high enough.*

Proof. See the Appendix. ■

Proposition 2 highlights the importance of timing to determine tax preferences even for high-income firms. In line with the traditional results it is shown that the CBIT system may be preferred if both τ_{CBIT} is low enough and the firm's income is high enough. However, we prove that even if there exists a threshold value $\widehat{Y}$ above which the CBIT is preferred (point i) of Proposition 2), this is much higher than usually thought.

To give a feeling of the differential $\left(\widehat{Y} - \widetilde{Y}\right)$, we run a simulation and compare the results with Fama and French's (1997) estimates of 48 US industries, over the 1963-1994 period (see See Table 7, pp. 172-173). In line with empirical evidence[14], we set $r = 0.04$ and $\sigma = 0.20$[15]. Given these parameters, it is straightforward to show that if $\tau_{CBIT} < 50\%$, then point i) of Proposition 2 will be applied.

Let us next analyse two scenarios. In the first one, we set $\tau_{CBIT} = 31\%$, which is the rate suggested in 1992 by the US Treasury[16]. In this case, the ACE tax rate ensuring equality (9) will then be $\tau^*_{ACE} = 42.78\%$. In the second scenario, we account for some tax competition pressure, registered over the last decade, and set $\tau_{CBIT} = 25\%$. In this case, the ACE tax rate yielding (9) will be $\tau^*_{ACE} = 37.50\%$. We can thus compute the firm's returns exceeding the risk-free interest rate.

As shown in Table 1, if the net return is 4% then investment is immediately undertaken under the ACE system. If the CBIT system is considered, instead, threshold returns are higher (i.e. 7.59% and 6.67%, respectively). The last row of Table 1 finally reports the threshold values above which the

[14] See e.g. Jorion and Goetzman (1999) and Dimson *et al.* (2002).

[15] Notice that the parameter values used in our simulation coincide with the benchmark assumptions in Dixit and Pindyck (1994, p. 153).

[16] See the US Department of the Treasury (1992).

CBIT country is preferred. As can be seen, they are fairly high.

Table 1 : A numerical simulation (values in %)

	$\tau_{CBIT} = 31\%$	$\tau_{CBIT} = 25\%$
τ^*_{ACE}	42.78	37.50
$\frac{\widetilde{Y}}{F} - r$	4.00	4.00
$\frac{Y^*_{CBIT}}{F} - r$	7.59	6.67
$\frac{\widehat{Y}}{F} - r$	10.52	8.00

Let us then compare the above results with Fama and French's estimates. Under a three-factor model, if $\tau_{CBIT} = 31\%$, only real estates among the 48 industries shows a cost of capital, which is slightly higher than the threshold return $\left(\frac{\widehat{Y}}{F} - r\right)$ (i.e. 11.16% versus 10.52%). When we set $\tau_{CBIT} = 25\%$, 12 industries show an average return which overcomes $\left(\frac{\widehat{Y}}{F} - r\right)$. If, finally, a CAPM is applied, all industries' returns are far below $\left(\frac{\widehat{Y}}{F} - r\right)$, irrespective of the value of τ_{CBIT} applied. We can thus conclude that, in most cases, an ACE system would be preferred.

4 Conclusion

In this paper we have compared an ACE and a CBIT system in an open economy. As we know, the CBIT may require a lower statutory tax rate to gather the same amount of tax revenues. According to traditional wisdom, therefore, mobile multinational companies, who usually earn rents, would prefer the CBIT system.

As we have pointed out, the above argument disregards two important features of FDIs: their intrinsic riskiness and the ability of firms to choose when to invest. When introducing both assumptions, we have two offsetting effects. On the one hand, a firm investing in an ACE system faces a heavier tax burden at each instant. On the other hand, the firm starts to earn profits earlier, thereby enjoying a longer stream of profits. If the latter effect is great enough, the ACE system is preferred even in an open economy.

This article should be considered as the starting point for future research. In particular, a natural extension of the model would be the introduction of tax competition between the ACE and the CBIT country. Another interesting topic would be the analysis of how tax avoidance strategies differ among the two systems.

5 Appendix

5.1 The computation of the objective function (4)

Let us write the Bellman function of $V_i^T(Y)$ as

$$V_i^T(Y) = Y_i^T dt + e^{-rdt} E\left[V_i^T(Y + dY)\right]. \qquad (10)$$

Assume that the boundary condition $V(0) = 0$ holds. This implies that if Y goes to zero, it will stay at zero[17]. Moreover, assume that if Y goes to infinity, no financial bubbles exist. Given the above boundary conditions, we obtain the solution of (10)

$$V_i^T(Y) = \frac{(1-\tau_i)Y}{r} + \frac{\rho_i}{r}\tau_i F. \qquad (11)$$

Notice that a Brownian motion satisfies the Markov property. Namely, the probability of distribution for all future values of Y depends only on its current value. Applying this Property and using the trigger point Y_i^*, one can rewrite (3) as

$$\max_t E\left\{\left[V_i^T(Y) - F\right] e^{-rt}\right\} = \max_t E\left[e^{-rt}\right]\left[V_i^T(Y_i^*) - F\right]. \qquad (12)$$

Following Harrison (1985) it is easy to ascertain that

$$\max_t E\left[e^{-rt}\right] = E\left[e^{-rt_i^*}\right] = \left(\frac{Y}{Y_i^*}\right)^{\beta_1} \text{ for } Y < Y_i^*, \qquad (13)$$

where $\beta_1 > 1$ is the positive root of the characteristic equation $\Psi(\beta) \equiv \frac{\sigma^2}{2}\beta(\beta-1) - r = 0$. Using (11), (12) and (13) one obtains (4).

5.2 The computation of (7)

Given (1), the present value of tax payments is

$$R_i = E\left\{e^{-rt_i^*}\left[\int_{t_i^*}^{\infty} T_i(s)\, e^{-rs} ds\right]\right\}. \qquad (14)$$

[17] For further details on this absorbing barrier see Harrison (1985, Ch. 3).

Easy computations show that, if $t < t_i^*$, (14) can be written as

$$R_i = E\left[e^{-rt_i^*}\right]\left[\tau_i\left(\frac{Y - \rho_i F}{r}\right)\right]. \tag{15}$$

If, instead, $t > t_i^*$, the present value of tax payments is simply

$$R_i = \tau_i\left(\frac{Y - \rho_i F}{r}\right). \tag{16}$$

Using (13), (15) and (16) we thus obtain (7).

5.3 Proof of Proposition 1

Given inequality $Y_{ACE}^* = \widetilde{Y} < Y_{CBIT}^*$, we have three cases:

1. $Y < Y_{ACE}^* < Y_{CBIT}^*$,
2. $Y_{ACE}^* < Y < Y_{CBIT}^*$,
3. $Y_{ACE}^* < Y_{CBIT}^* < Y$.

We will analyse the above cases under condition (8).

Case 1: If $Y < Y_{ACE}^*$, under both regimes the firm will postpone investment. In this case, the ACE system is preferred to the CBIT one if the ACE pre-tax net present value is greater than the CBIT one. Given (6), (7) and (8), one can show that the ACE system is preferable if

$$\left(\frac{Y}{Y_{ACE}^*}\right)^{\beta_1}\left(\frac{Y_{ACE}^*}{r} - F\right) > \left(\frac{Y}{Y_{CBIT}^*}\right)^{\beta_1}\left(\frac{Y_{CBIT}^*}{r} - F\right). \tag{17}$$

Inequality (17) can be rewritten as

$$g\left(\tau_{CBIT};\beta_1\right) > 1$$

where $g\left(\tau_{CBIT};\beta_1\right) \equiv \left(1-\tau_{CBIT}\right)^{-(\beta_1-1)}\left[\frac{1}{\tau_{CBIT}(\beta_1-1)+1}\right]$. Notice that $g\left(0;\beta_1\right) = 1$ and that $\frac{\partial g(\tau_{CBIT};\beta_1)}{\partial \tau_{CBIT}} > 0$. This is sufficient to prove that $g\left(\tau_{CBIT};\beta_1\right) > 1$ $\forall \tau_{CBIT} > 0$. Accordingly, (17) always holds $\forall \tau_{CBIT} > 0$.

Case 2: If $Y \in (Y^*_{ACE}, Y^*_{CBIT})$, investment is immediately undertaken in the ACE country, while it is postponed in the CBIT one. Given (8), the ACE country is preferred to the CBIT one if

$$\left(\frac{Y}{r} - F\right) > \left(\frac{Y}{Y^*_{CBIT}}\right)^{\beta_1} \left(\frac{Y^*_{CBIT}}{r} - F\right). \tag{18}$$

Inequality (18) can be rewritten as $f(Y) > f(Y^*_{CBIT})$, where $f(Y) \equiv \frac{Y - rF}{Y^{\beta_1}}$. It is straightforward to show that $\frac{\partial f(Y)}{\partial Y} = \frac{(\beta_1 - 1)(\widetilde{Y} - Y)}{Y^{\beta_1 + 1}}$. Since $Y \in (Y^*_{ACE}, Y^*_{CBIT})$, we have $\frac{\partial f(Y)}{\partial Y} < 0$. This is sufficient to state that inequality $f(Y) > f(Y^*_{CBIT})$ holds for $Y \in (Y^*_{ACE}, Y^*_{CBIT})$. Hence, (18) always holds.

Case 3: If, finally, $Y > Y^*_{CBIT}$, the firm will immediately invest irrespective of the tax system. Given condition (8), the pre-tax present value will be $\left(\frac{Y}{r} - F\right)$, under both systems. This leads to indifference.

Proposition 1 is thus proven.■

5.4 Proof of Proposition 2

According to Assumption 1, the ACE country sets τ_{ACE} so as to obtain (9). Substituting (7) into (9) yields

$$\tau_{ACE}\left(\frac{Y^*_{ACE}}{r} - F\right) = \left(\frac{Y^*_{ACE}}{Y^*_{CBIT}}\right)^{\beta_1} \tau_{CBIT}\left(\frac{Y^*_{CBIT}}{r}\right). \tag{19}$$

Using (5), equation (19) reduces to

$$\tau_{ACE} = \beta_1 \tau_{CBIT} (1 - \tau_{CBIT})^{\beta_1 - 1}. \tag{20}$$

Given (20), therefore, we can show that $\tau_{ACE} > \tau_{CBIT}$ if $\beta_1 (1 - \tau_{CBIT})^{\beta_1 - 1} > 1$, and vice versa.

Let us next focus on the high-income firm (with $Y > Y^*_{CBIT}$). Define NB as the net benefit arising from investing in the ACE country. NB is given by the difference between the post-tax NPV under the ACE regime and that obtained under the CBIT one. Notice that, given inequality $Y > Y^*_{CBIT}$, the firm will immediately invest irrespective of the tax system. Thus, NB will be

$$NB = \frac{(1 - \tau_{ACE})(Y - rF)}{r} - \frac{(1 - \tau_{CBIT})Y - rF}{r} \text{ for } Y > Y^*_{CBIT}. \tag{21}$$

If $\tau_{ACE} > \tau_{CBIT}$ (i.e. $\beta_1 (1 - \tau_{CBIT})^{\beta_1 - 1} > 1$), the level of current income is crucial for the firm's preferences. Substituting (20) into (21) yields

$$NB = \frac{\tau_{CBIT} \left[\beta_1 (1 - \tau_{CBIT})^{\beta_1 - 1} - 1 \right]}{r} \left(\widehat{Y} - Y \right),$$

with $\widehat{Y} \equiv \frac{\beta_1 (1 - \tau_{CBIT})^{\beta_1 - 1}}{\beta_1 (1 - \tau_{CBIT})^{\beta_1 - 1} - 1} rF > Y^*_{CBIT}$. This entails that NB is positive if $Y < \widehat{Y}$. This proves point i) of Proposition 2.

Let us next turn to point ii). If $\tau_{ACE} < \tau_{CBIT}$ (i.e. $\beta_1 (1 - \tau_{CBIT})^{\beta_1 - 1} < 1$), it is straightforward to show that $NB = \frac{(\tau_{CBIT} - \tau_{ACE}) Y + \tau_{ACE} rF}{r} > 0$ $\forall Y > 0$. This completes Proposition 2.■

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