Forward-Looking Effective Tax Rates on Investment Under a Standard Corporate Income Tax, Cash-Flow Taxation, and the Allowance for Corporate Capital (Without Minimum Tax (Pillar Two))

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1 Introduction

This document derives the Effective Average Tax Rate (EATR) and the Marginal Effective Tax Rate (METR) under three benchmark corporate tax systems:

- The standard corporate income tax (CIT),
- A cash-flow tax (CFT), and
- An Allowance for Corporate Equity (ACE).

Each system is analyzed under three financing margins (retained earnings, new equity, debt). In addition, the CIT system is extended to incorporate tax holidays and tax incentives.

The discussion regarding the CIT is an extension of the Devreaux Griffith (2003) and Klemm (2012).

Framework.

Following Klemm (2012), we consider the case of a permanent investment project undertaken at a point in time, which generates a stream of operating cash flows as the associated capital stock is employed and gradually depreciates. This framework extends the perturbation approach of Devereux and Griffith (2003) to permanent investments. Both approaches can be viewed as applications of the King and Fullerton (1984) cost-of-capital framework to discrete investment decisions.

Within this setting, the Effective Average Tax Rate (EATR) governs the discrete adoption decision by measuring how taxation reduces post-tax economic rent, while the Marginal Effective Tax Rate (METR) characterizes the tax wedge on a marginal expansion of capital services conditional on adoption, as in Devereux and Griffith (2003).

1.1 Valuation Framework and No-Arbitrage

The analysis begins with the no-arbitrage condition between a risk-free asset earning nominal interest rate i and corporate equity.

Let V_t denote the value of the firm at the beginning of period t. An investor holding a risk-free asset obtains:

$$(1 + (1 - m_i)i)\, V_t. \tag{1}$$

If instead the investor holds the firm's equity, the value at the beginning of $t + 1$ is:

$$\frac{1 - m_d}{1 - c}\, D_t + V_{t+1} - N_t - z\,(V_{t+1} - V_t - N_t). \tag{2}$$

Equating (1) and (2) yields:

$$(1 + (1 - m_i)i)V_t = \frac{1 - m_d}{1 - c} D_t + V_{t+1} - N_t - z\,(V_{t+1} - V_t - N_t). \tag{3}$$

Solving for V_t:

$$V_t = \frac{\frac{1-m_d}{(1-z)(1-c)}}{1 + \frac{(1-m_i)i}{1-z}}\, D_t - \frac{N_t}{1 + \frac{(1-m_i)i}{1-z}} + \frac{V_{t+1}}{1 + \frac{(1-m_i)i}{1-z}}. \tag{4}$$

Let:

$$\rho = \frac{(1 - m_i)i}{1 - z}, \qquad \gamma = \frac{1 - m_d}{(1 - z)(1 - c)},$$

then:

$$V_t = \frac{\gamma D_t - N_t + V_{t+1}}{1 + \rho} \tag{5}$$

Thus incremental economic rent is:

$$R = dV_t = \sum_{s=0}^{\infty} \frac{\gamma\, dD_{t+s} - dN_{t+s}}{(1+\rho)^s} \tag{6}$$

1.2 Firm Cash Flows

Sources of funds:

$$(1+\pi)^s f(K_{t-1+s}) + B_{t+s} + N_{t+s} \tag{7}$$

Uses:

$$D_{t+s} + I_{t+s} + (1+i)B_{t+s-1} + (1+\pi)^s CD(K_{t-1+s}) \tag{8}$$

Define real EBITDA:

$$q(K_{t-1}) = f(K_{t-1}) - CD(K_{t-1})$$

Hence:

$$D_{t+s} = (1+\pi)^s q(K_{t-1+s}) + B_{t+s} - I_{t+s} - (1+i)B_{t+s-1} + N_{t+s} \tag{9}$$

1.3 Introducing Corporate Taxation

After including taxes:

$$D_{t+s} = (1+\pi)^s q(K_{t-1+s}) + B_{t+s} - I_{t+s} - (1+i)B_{t+s-1} + N_{t+s} - \text{Tax}_{t+s} \tag{10}$$

Tax liability:

$$\text{Tax}_{t+s} = \tau\big[(1+\pi)^s q(K_{t-1+s}) - \phi(K_{t-1+s} + I_{t+s}) - iB_{t+s-1}\big] \tag{11}$$

Thus:

$$D_{t+s} = (1+\pi)^s q(K_{t-1+s})(1-\tau) - I_{t+s} + \tau\phi(K_{t-1+s} + I_{t+s}) + B_{t+s} - (1+(1-\tau)i)B_{t+s-1} + N_{t+s} \tag{12}$$

1.4 Economic Depreciation

Following Klemm (2008):

$$dI_t = 1, \qquad dI_{t+s} = 0 \quad \forall s > 0 \tag{13}$$

NPV of pre-tax returns:

$$\sum_{s=0}^{\infty} \frac{(1+\pi)^{s+1} p(1-\delta)^s}{(1+i)^{s+1}} = \frac{p}{r+\delta} \tag{14}$$

If there are tax credits, they influence the tax paid through their NPV. Assuming the net present value of tax credits is $NPV_{credit} = \sum_{t=s}^{\infty} \frac{credit_t}{(1+\rho)^t}$, then we can express the economic rent that includes tax credits and tax holiday as follows:

2 Standard Corporate Tax System

2.1 Retained Earnings

Under retained earnings financing, we have $dN_{t+s} = 0$ and $dB_{t+s} = 0$. The economic rent is therefore:

$$R^{RE} = \sum_{s=0}^{\infty} \frac{\gamma\, dD_{t+s}}{(1+\rho)^s} = \sum_{s=0}^{\infty} \frac{\gamma(1+\pi)^s q(K_{t-1+s})(1-\tau) - \gamma dI_{t+s} + \gamma\tau d\phi(K_{t-1+s} + I_{t+s})}{(1+\rho)^s} \tag{15}$$

Using

$$dI_t = 1, \qquad dI_{t+s} = 0 \text{ for } s \geq 1,$$

and

$$(1+\pi)^s q(K_{t-1+s}) = (1+\pi)^s (p+\delta)(1-\delta)^{s-1},$$

as well as

$$\sum_{s=0}^{\infty} \frac{\gamma\tau\, d\phi(I_{t+s} + K^T_{t-1+s})}{(1+\rho)^s} = \gamma\tau A,$$

the expression for economic rent becomes

$$R^{RE} = \gamma \left[\frac{(1+\pi)(p+\delta)(1-\tau)}{\rho - \pi + \delta(1+\pi)} - 1 + \tau A + NPV_{credit} \right] \tag{16}$$

In the absence of any taxes ($\gamma = 1$, $A = 0$, $\rho = i$), economic rent reduces to:

$$R^* = \frac{(1+\pi)(p+\delta)}{i - \pi + \delta(1+\pi)} - 1 = \frac{p-r}{r+\delta} \tag{17}$$

Definition (EATR). The Effective Average Tax Rate (EATR) is defined as

$$\frac{\text{NPV(pre-tax economic rent)} - \text{NPV(post-tax economic rent)}}{\text{NPV(pre-tax return)}}.$$

Thus,

$$\text{AETR} = \frac{R^* - R^{RE}}{p/(r+\delta)} \tag{18}$$

Substituting for R^* and R^{RE} yields

$$\text{AETR} = \frac{\frac{p-r}{r+\delta} - \gamma\left[\frac{(1+\pi)(p+\delta)(1-\tau)}{\rho-\pi+\delta(1+\pi)} - 1 + \tau A + NPV_{credit}\right]}{p/(r+\delta)} \tag{19}$$

If personal taxes align such that $m_i = z = m_d$, then $\gamma = 1$, $\rho = i$, and A becomes the standard depreciation allowance. In this case,

$$\text{AETR} = \tau\left(1 + \frac{\delta}{p}\right) - (\tau A + NPV_{credit})\frac{r+\delta}{p} \tag{20}$$

Marginal Effective Tax Rate

Cost of Capital and Marginal Effective Tax Rate (METR).
The cost of capital is defined as the marginal return that sets the derivative of post-tax economic rent with respect to the capital stock equal to zero:

$$\frac{dR}{dK} = 0$$

The marginal effective tax rate (METR) measures the proportionate wedge between the required marginal pre-tax return and the investor's required post-tax return. It can be expressed in two ways as:

$$\text{METR} = \frac{(\tilde{p} - r)/(r+\delta)}{\tilde{p}/(r+\delta)} = \frac{\tilde{p} - r}{\tilde{p}}, \tag{21}$$

or

$$\text{METR2} = \frac{(\tilde{p} - r)/(r+\delta)}{r/(r+\delta)} = \frac{\tilde{p} - r}{r} \tag{22}$$

$$\frac{dR}{dK} = 0 = \gamma\left[\frac{(1+\pi)(p+\delta)(1-\tau)}{\rho-\pi+\delta(1+\pi)} - 1 + \tau A + NPV_{credit}\right]$$

Solving for the marginal required return $\tilde{p}$ gives:

$$\tilde{p} = (1 - \tau A - NPV_{credit})\frac{\left[\rho - \pi + \delta(1+\pi)\right]}{(1+\pi)(1-\tau)} - \delta \tag{23}$$

Under $m_i = z = m_d$,

$$\tilde{p} = (1 - \tau A - NPV_{credit})\frac{r+\delta}{1-\tau} - \delta.$$

The marginal effective tax rate can be expressed equivalently as:

$$\text{METR} = \frac{(\tilde{p} - r)/(r+\delta)}{\tilde{p}/(r+\delta)} = \frac{\tilde{p} - r}{\tilde{p}} \tag{24}$$

or

$$\text{METR} = \frac{(\tilde{p} - r)/(r+\delta)}{r/(r+\delta)} = \frac{\tilde{p} - r}{r} \tag{25}$$

2.1.1 Tax Holiday

A tax holiday modifies the timing of both tax payments and depreciation deductions. Suppose the holiday lasts for h years. Taxes and depreciation allowances begin only in period $h+1$.

The NPV of profit taxes becomes:

$$TNPV_{holiday} = \tau(p+\delta)\sum_{s=1}^{\infty}\frac{(1+\pi)^{h+1}(1-\delta)^h}{(1+\rho)^{h+1}} = \tau(1+\pi)(p+\delta)\frac{\left(\frac{1-\delta}{1+\rho}\right)^h(1+\pi)^h}{\rho - \pi + \delta(1+\pi)}.$$

The NPV of depreciation allowances is:

$$A_{holiday} = \sum_{s=h}^{\infty}\frac{\phi(1-\phi)^s}{(1+\rho)^s} = \frac{\phi(1+\rho)}{\rho+\phi}\frac{(1-\phi)^h}{(1+\rho)^h}.$$

Economic rent becomes:

$$R^{RE} = \gamma\left[\frac{(1+\pi)(p+\delta) - \tau(1+\pi)(p+\delta)\left(\frac{1-\delta}{1+\rho}\right)^h(1+\pi)^h}{\rho - \pi + \delta(1+\pi)} - 1 + \tau A_{holiday}\right] \tag{26}$$

Equivalently,

$$R^{RE} = \gamma \left[\frac{(1+\pi)(p+\delta)\left[1-\tau\left(\frac{1-\delta}{1+\rho}\right)^h (1+\pi)^h\right]}{\rho-\pi+\delta(1+\pi)} - 1 + \tau A_{holiday} \right] \tag{27}$$

Using (27), the AETR becomes

$$\text{AETR} = \frac{\frac{p-r}{r+\delta} - \gamma \left[\frac{(1+\pi)(p+\delta)\left[1-\tau\left(\frac{1-\delta}{1+\rho}\right)^h (1+\pi)^h\right]}{\rho-\pi+\delta(1+\pi)} - 1 + \tau A_{holiday} \right]}{p/(r+\delta)} \tag{28}$$

Under $m_i = z = m_d$, we again set $\gamma = 1$, $\rho = i$:

$$\text{AETR} = \frac{\frac{p-r}{r+\delta} - \left[\frac{(1+\pi)(p+\delta)\left[1-\tau\left(\frac{1-\delta}{(1+\pi)(1+r)}\right)^h (1+\pi)^h\right]}{(1+\pi)(r+\delta)} - 1 + \tau A_{holiday} \right]}{p/(r+\delta)} \tag{29}$$

This simplifies to:

$$\text{AETR} = \tau\left(1+\frac{\delta}{p}\right)\left[\frac{1-\delta}{1+r}\right]^h - \tau A_{holiday}\frac{r+\delta}{p} \tag{30}$$

The corresponding cost of capital is:

$$\tilde{p} = \frac{(1-\tau A_{holiday})\big[\rho-\pi+\delta(1+\pi)\big]}{(1+\pi)\big[1-\tau\left(\frac{1-\delta}{1+\rho}\right)^h (1+\pi)^h\big]} - \delta \tag{31}$$

If $m_i = z = m_d$,

$$\tilde{p} = \frac{\big(1-\tau A_{\text{holiday}}\big)(r+\delta)}{1-\tau\left(\frac{1-\delta}{1+r}\right)^h} - \delta \tag{32}$$

2.2 New Equity Financing

When investment is financed through the issuance of new equity, the firm raises additional paid-in capital at the start of period t. The corresponding changes in financing variables are:

$$dN_t = (1-\tau\phi), \qquad dN_{t+s} = 0 \;\; \forall s \geq 1, \qquad dB_{t+s} = 0 \;\; \forall s \geq 0.$$

Relative to retained earnings financing, issuing new equity increases dividends in period t by

$$dD_t = 1 - \tau\phi, \qquad dD_{t+s} = 0 \ \ \forall s \geq 1.$$

Thus, economic rent under new equity financing equals the retained-earnings expression in (16) plus the financing adjustment arising from the issuance of new shares. The resulting post-tax economic rent is:

$$\begin{aligned} R^{NE} &= \frac{\gamma(1+\pi)(p+\delta)(1-\tau)}{\rho - \pi + \delta(1+\pi)} - \gamma + \gamma\tau A + \underbrace{(1-\tau\phi)(\gamma-1)}_{\text{financing adjustment}} \\ &= \gamma\left(\frac{(1+\pi)(p+\delta)(1-\tau)}{\rho - \pi + \delta(1+\pi)} - 1 + \tau A + NPV_{credit} + (1-\tau\phi)\frac{(\gamma-1)}{\gamma}\right) \end{aligned} \tag{33}$$

The corresponding EATR is:

$$\text{AETR} = \frac{\frac{p-r}{r+\delta} - \gamma\left(\frac{(1+\pi)(p+\delta)(1-\tau)}{\rho - \pi + \delta(1+\pi)} - 1 + \tau A + NPV_{credit} + (1-\tau\phi)\frac{(\gamma-1)}{\gamma}\right)}{\frac{p}{r+\delta}} \tag{34}$$

If personal tax rates coincide ($m_i = z = m_d$), then $\gamma = 1$, $\rho = i$, and the depreciation allowance is A. Under this benchmark:

$$\begin{aligned} \text{AETR} &= \frac{\frac{p-r}{r+\delta} - \left(\frac{(p+\delta)(1-\tau)}{r+\delta} - 1 + \tau A + NPV_{credit}\right)}{p/(r+\delta)} \\ &= \tau\left(1 + \frac{\delta}{p}\right) - (\tau A + NPV_{credit})\frac{r+\delta}{p} \end{aligned} \tag{35}$$

Setting economic rent to zero yields the cost of capital:

$$\tilde{p} = \frac{\left[(1-\tau\phi)(\frac{1}{\gamma} - 1) + (1 - \tau A - NPV_{credit})\right]\left(\rho - \pi + \delta(1+\pi)\right)}{(1+\pi)(1-\tau)} - \delta \tag{36}$$

If $m_i = z = m_d$, then $\gamma = 1$ and $\rho = i$:

$$\tilde{p} = \frac{(1 - \tau A - NPV_{credit})(r+\delta)}{1-\tau} - \delta \tag{37}$$

2.2.1 Tax Holiday

Under a tax holiday, the cost of issuing new equity is simply 1 (rather than $(1-\tau\phi)$), since no taxes are paid in the holiday period.

Profit-tax NPV becomes:

$$TNPV_{holiday} = \tau(p+\delta)\sum_{s=1}^{\infty}\frac{(1+\pi)^{h+1}(1-\delta)^h}{(1+\rho)^{h+1}} = \tau(1+\pi)(p+\delta)\frac{\left(\frac{1-\delta}{1+\rho}\right)^h(1+\pi)^h}{\rho-\pi+\delta(1+\pi)}.$$

The NPV of depreciation allowances is:

$$A_{holiday} = \sum_{s=h}^{\infty}\frac{\phi(1-\phi)^s}{(1+\rho)^s} = \frac{\phi(1+\rho)}{\rho+\phi}\frac{(1-\phi)^h}{(1+\rho)^h}.$$

Economic rent under a tax holiday becomes:

$$\begin{aligned} R^{NE} &= \frac{\gamma(1+\pi)(p+\delta)\left[1-\tau(\frac{1-\delta}{1+\rho})^h(1+\pi)^h\right]}{\rho-\pi+\delta(1+\pi)} - \gamma + \gamma\tau A_{holiday} + \underbrace{(\gamma-1)}_{\text{new equity financing}} \\ &= \gamma\left(\frac{(1+\pi)(p+\delta)\left[1-\tau(\frac{1-\delta}{1+\rho})^h(1+\pi)^h\right]}{\rho-\pi+\delta(1+\pi)} - 1 + \tau A_{holiday} + \frac{\gamma-1}{\gamma}\right) \end{aligned} \tag{38}$$

The AETR is therefore:

$$\text{AETR} = \frac{\frac{p-r}{r+\delta} - \gamma\left(\frac{(1+\pi)(p+\delta)\left[1-\tau(\frac{1-\delta}{1+\rho})^h(1+\pi)^h\right]}{\rho-\pi+\delta(1+\pi)} - 1 + \tau A_{holiday} + \frac{\gamma-1}{\gamma}\right)}{p/(r+\delta)} \tag{39}$$

If $m_i = z = m_d$,

$$\text{AETR} = \tau\frac{p+\delta}{p}\left[\frac{1-\delta}{1+r}\right]^h - \tau A_{holiday}\frac{r+\delta}{p} \tag{40}$$

The marginal cost of capital follows from $R^{NE}=0$:

$$\tilde{p} = \frac{\left(\frac{1}{\gamma} - \tau A_{\text{holiday}} - NPV_{credit}\right)\left[\rho-\pi+\delta(1+\pi)\right]}{(1+\pi)\left[1-\tau(\frac{1-\delta}{1+\rho})^h(1+\pi)^h\right]} - \delta \tag{41}$$

If $m_i = z = m_d$,

$$\tilde{p} = \frac{(1 - \tau A_{\text{holiday}})(r + \delta)}{1 - \tau \left(\frac{1-\delta}{1+r}\right)^h} - \delta \tag{42}$$

2.3 Debt Financing

To analyze debt financing, we first determine the borrowing required to finance a one unit investment.

Since the equity effect in period t is $-1 + \tau\phi$, the firm must borrow

$$(1 - \tau\phi)$$

so that the net effect on equity is zero. Thus, initial borrowing equals $(1 - \tau\phi)$.

The path of dividends, and hence economic rent, depends on how debt is repaid. Following Klemm (2008), we assume the ratio of nominal debt to the nominal market value of the asset remains constant over time.

Debt repayment and interest. Principal repayments follow:

$$[(1-\delta)(1+\pi)]^{s-1} [1 - (1-\delta)(1+\pi)], \qquad s \geq 1.$$

Thus,

$$dB_t = (1 - \tau\phi), \tag{43}$$

$$dB_{t+1} = \big((1-\delta)(1+\pi) - 1\big)(1 - \tau\phi), \tag{44}$$

$$dB_{t+s} = [(1-\delta)(1+\pi)]^{s-1}\big((1-\delta)(1+\pi) - 1\big)(1 - \tau\phi), \qquad s \geq 1. \tag{45}$$

Interest payments evolve according to:

$$\text{Int}_{t+1} = i(1 - \tau\phi), \tag{46}$$

$$\text{Int}_{t+2} = i(1-\delta)(1+\pi)(1 - \tau\phi), \tag{47}$$

$$\text{Int}_{t+s} = i(1 - \tau\phi)[(1-\delta)(1+\pi)]^{s-1}, \qquad s \geq 1. \tag{48}$$

The associated tax shield equals:

$$\text{TInt}_{t+1} = \tau i(1 - \tau\phi), \tag{49}$$

$$\text{TInt}_{t+2} = \tau i(1-\delta)(1+\pi)(1-\tau\phi), \tag{50}$$

$$\text{TInt}_{t+s} = \tau i(1-\tau\phi)[(1-\delta)(1+\pi)]^{s-1}, \qquad s \geq 1. \tag{51}$$

The NPV of these adjustments is:

$$F^D = (1-\tau\phi)\,\gamma\frac{\rho-(1-\tau)i}{\rho-\pi+\delta(1+\pi)}.$$

Adding this to the retained-earnings expression yields total economic rent:

$$R^D = \gamma\left[\frac{(1+\pi)(p+\delta)(1-\tau)}{\rho-\pi+\delta(1+\pi)} - 1 + \tau A + NPV_{credit}\right] + (1-\tau\phi)\gamma\,\frac{\rho-(1-\tau)i}{\rho-\pi+\delta(1+\pi)} \tag{52}$$

The associated AETR is:

$$\text{AETR} = \frac{\frac{p-r}{r+\delta} - \gamma\left[\frac{(1+\pi)(p+\delta)(1-\tau)}{\rho-\pi+\delta(1+\pi)} - 1 + \tau A + NPV_{credit}\right] - (1-\tau\phi)\gamma\,\frac{\rho-(1-\tau)i}{\rho-\pi+\delta(1+\pi)}}{p/(r+\delta)} \tag{53}$$

If personal taxes coincide:

$$\text{AETR} = \tau\left(1+\frac{\delta}{p}\right) - (\tau A + NPV_{credit})\frac{r+\delta}{p} - \frac{\tau i(1-\tau\phi)/(1+\pi)}{p} \tag{54}$$

The cost of capital is obtained by setting (52) to zero:

$$\tilde{p} = \frac{(1-\tau A - NPV_{credit})(\rho-\pi+\delta(1+\pi)) - (1-\tau\phi)(\rho - i(1-\tau))}{(1+\pi)(1-\tau)} - \delta \tag{55}$$

With $m_i = z = m_d$,

$$\tilde{p} = \frac{(1-\tau A - NPV_{credit})(r+\delta) - (1-\tau\phi)\frac{\tau i}{1+\pi}}{1-\tau} - \delta \tag{56}$$

2.3.1 Tax Holiday

Under a tax holiday, profit-tax NPV becomes:

$$TNPV_{holiday} = \tau(p+\delta)\sum_{s=1}^{\infty}\frac{(1+\pi)^{h+1}(1-\delta)^h}{(1+\rho)^{h+1}} = \tau(1+\pi)(p+\delta)\frac{(\frac{1-\delta}{1+\rho})^h(1+\pi)^h}{\rho-\pi+\delta(1+\pi)}.$$

The depreciation allowance becomes:

$$A_{holiday} = \frac{\phi(1+\rho)}{\rho+\phi}\frac{(1-\phi)^h}{(1+\rho)^h}$$

The principal path now satisfies:

$$dB_t = 1, \qquad dB_{t+1} = (1-\delta)(1+\pi) - 1, \qquad \ldots$$

Interest payments follow:

$$\text{Int}_{t+s} = i[(1-\delta)(1+\pi)]^{s-1}$$

The tax shield begins only after the holiday:

$$\text{TInt}_{t+s} = \tau i[(1-\delta)(1+\pi)]^{s-1}, \quad s \geq h+1.$$

The associated financing term becomes:

$$F^D = \frac{\gamma}{\rho - \pi + \delta(1+\pi)}\left[\rho - i + \tau i\left(\frac{(1-\delta)(1+\pi)}{1+\rho}\right)^h\right].$$

Economic rent is therefore:

$$R^{RE} = \gamma\Bigg[\frac{(1+\pi)(p+\delta)\big[1-\tau(\frac{1-\delta}{1+\rho})^h(1+\pi)^h\big]}{\rho-\pi+\delta(1+\pi)} - 1 + \tau A_{\text{holiday}} + \frac{\rho - i + \tau i\left(\frac{(1-\delta)(1+\pi)}{1+\rho}\right)^h}{\rho-\pi+\delta(1+\pi)}\Bigg] \tag{57}$$

The AETR is:

$$\text{AETR} = \frac{\frac{p-r}{r+\delta} - \gamma\Bigg[\frac{(1+\pi)(p+\delta)\Big[1-\tau\big(\frac{1-\delta}{1+\rho}\big)^h(1+\pi)^h\Big]}{\rho-\pi+\delta(1+\pi)} - 1 + \tau A_{\text{holiday}} + \frac{\rho - i + \tau i\left(\frac{(1-\delta)(1+\pi)}{1+\rho}\right)^h}{\rho-\pi+\delta(1+\pi)}\Bigg]}{\frac{p}{r+\delta}} \tag{58}$$

If $m_i = z = m_d$:

$$\text{AETR} = \tau \frac{p+\delta}{p}\left[\frac{1-\delta}{1+r}\right]^h - \tau A_{holiday}\frac{r+\delta}{p} - \frac{\tau i}{(1+\pi)p}\left[\frac{1-\delta}{1+r}\right]^h \tag{59}$$

The cost of capital follows from $R^{RE} = 0$:

$$\tilde{p} = \frac{(1-\tau A_{holiday})\big[\rho - \pi + \delta(1+\pi)\big] - \big[\rho - i + \tau i(\frac{1-\delta}{1+\rho})^h(1+\pi)^h\big]}{(1+\pi)\big[1-\tau(\frac{1-\delta}{1+\rho})^h(1+\pi)^h\big]} - \delta \tag{60}$$

2.4 Summary of the Standard CIT System

2.4.1 No Tax Holiday

Consider a project financed by α_1 retained earnings, α_2 new equity, and α_3 debt, where $\alpha_1 + \alpha_2 + \alpha_3 = 1$. The associated economic rent is:

$$R = \gamma\left[\frac{(1+\pi)(p+\delta)(1-\tau)}{\rho-\pi+\delta(1+\pi)} - 1 + \tau A + NPV_{credit} + \alpha_2(1-\tau\phi)\frac{\gamma-1}{\gamma} + \alpha_3(1-\tau\phi)\frac{\rho-(1-\tau)i}{\rho-\pi+\delta(1+\pi)}\right]. \tag{61}$$

The corresponding AETR is:

$$AETR = \frac{\frac{p-r}{r+\delta} - \gamma\left[\frac{(1+\pi)(p+\delta)(1-\tau)}{\rho-\pi+\delta(1+\pi)} - 1 + \tau A + NPV_{credit} + \alpha_2(1-\tau\phi)\frac{\gamma-1}{\gamma} + \alpha_3(1-\tau\phi)\frac{\rho-(1-\tau)i}{\rho-\pi+\delta(1+\pi)}\right]}{p/(r+\delta)}. \tag{62}$$

The cost of capital is:

$$\tilde{p} = \frac{\big[(1-\tau A) - NPV_{credit} + \alpha_2(1-\tau\phi)\frac{1-\gamma}{\gamma}\big](\rho-\pi+\delta(1+\pi)) - \alpha_3(1-\tau\phi)\big[\rho-(1-\tau)i\big]}{(1+\pi)(1-\tau)} - \delta \tag{63}$$

2.4.2 Tax Holiday

If the investment benefits from an h-year tax holiday, economic rent becomes:

$$R = \gamma\left[\frac{(p+\delta)(1+\pi)\big[1-\tau(\frac{1-\delta}{1+\rho})^h(1+\pi)^h\big]}{\rho-\pi+\delta(1+\pi)} - 1 + \tau A_{\text{holiday}} + \alpha_2\frac{\gamma-1}{\gamma} + \alpha_3\frac{\rho - i + \tau i(\frac{1-\delta}{1+\rho})^h}{\rho-\pi+\delta(1+\pi)}\right] \tag{64}$$

The AETR is:

$$AETR = \frac{\frac{p-r}{r+\delta} - \gamma\left[\frac{(p+\delta)(1+\pi)\left[1-\tau(\frac{1-\delta}{1+\rho})^h(1+\pi)^h\right]}{\rho-\pi+\delta(1+\pi)} - 1 + \tau A_{\text{holiday}} + \alpha_2\frac{\gamma-1}{\gamma} + \alpha_3\frac{\rho-i+\tau i(\frac{1-\delta}{1+\rho})^h}{\rho-\pi+\delta(1+\pi)}\right]}{p/(r+\delta)} \quad (65)$$

The cost of capital becomes:

$$\tilde{p} = \frac{\left[(1-\tau A_{holiday}) + \alpha_2\frac{1-\gamma}{\gamma}\right]\left[\rho-\pi+\delta(1+\pi)\right] - \alpha_3\left[\rho - i + \tau i(\frac{1-\delta}{1+\rho})^h\right]}{(1+\pi)\left[1-\tau(\frac{1-\delta}{1+\rho})^h(1+\pi)^h\right]} - \delta \quad (66)$$

3 Cash Flow Tax

A cash flow tax (CFT) operates similarly to a standard corporate income tax but with two key differences: (i) investment is immediately expensed, and (ii) interest payments are not deductible for tax purposes. As a result, the analysis of the standard CIT system carries over with the simplification $A = 1$.

Case 1: Retained Earnings Financing

Under retained earnings financing, economic rent becomes:

$$R^{RE} = \gamma\left[\frac{(1+\pi)(p+\delta)(1-\tau)}{\rho-\pi+\delta(1+\pi)} - 1 + \tau\right] = (1-\tau)\gamma\left[\frac{(1+\pi)p-\rho+\pi}{\rho-\pi+\delta(1+\pi)}\right] \quad (67)$$

In the absence of taxes ($\gamma = 1, A = 0, \rho = i$), economic rent reduces to:

$$R^* = \frac{(1+\pi)(p+\delta)}{i-\pi+\delta(1+\pi)} - 1 = \frac{p-r}{r+\delta} \quad (68)$$

Average Effective Tax Rate

By definition,

$$\text{AETR} = \frac{R^* - R^{RE}}{p/(r+\delta)} \quad (69)$$

Substituting the expressions above:

$$\text{AETR} = \frac{\frac{p-r}{r+\delta} - (1-\tau)\gamma\left[\frac{(1+\pi)p-\rho+\pi}{\rho-\pi+\delta(1+\pi)}\right]}{p/(r+\delta)} \tag{70}$$

If personal income taxes coincide ($m_i = z = m_d$), then $\gamma = 1$, $\rho = i$, and

$$\text{AETR} = \tau\left(1+\frac{\delta}{p}\right) - \tau\frac{r+\delta}{p} = \tau\frac{p-r}{p} \tag{71}$$

Marginal Effective Tax Rate

The cost of capital is obtained by setting marginal economic rent equal to zero:

$$\frac{dR}{dK} = 0 = \gamma\left[\frac{(1+\pi)(p+\delta)(1-\tau)}{\rho-\pi+\delta(1+\pi)} - 1 + \tau\right]$$

Solving for $\tilde{p}$ gives:

$$\tilde{p} = (1-\tau)\frac{\rho-\pi+\delta(1+\pi)}{(1+\pi)(1-\tau)} - \delta = \frac{\rho-\pi}{1+\pi} \tag{72}$$

If $m_i = z = m_d$,

$$\tilde{p} = (1-\tau)\frac{r+\delta}{1-\tau} - \delta = r$$

Thus,

$$\text{METR} = \frac{(\tilde{p}-r)/(r+\delta)}{\tilde{p}/(r+\delta)} = \frac{\tilde{p}-r}{\tilde{p}} = \frac{r-r}{r} = 0 \tag{73}$$

Case 2: New Equity Financing

With new equity financing and $\phi = 1$, the economic rent becomes:

$$\begin{aligned} R^{NE} &= \frac{\gamma(1+\pi)(p+\delta)(1-\tau)}{\rho-\pi+\delta(1+\pi)} - \gamma + \gamma\tau + (\gamma-1)(1-\tau) \\ &= (1-\tau)\gamma\left[\frac{(1+\pi)p-\rho+\pi}{\rho-\pi+\delta(1+\pi)} + \frac{\gamma-1}{\gamma}\right] \end{aligned} \tag{74}$$

The corresponding AETR is:

$$\text{AETR} = \frac{\frac{p-r}{r+\delta} - \left((1-\tau)\gamma\left[\frac{(1+\pi)p-\rho+\pi}{\rho-\pi+\delta(1+\pi)} + \frac{\gamma-1}{\gamma}\right]\right)}{\frac{p}{r+\delta}} \tag{75}$$

If personal taxes coincide ($m_i = z = m_d$), then $\gamma = 1$, $\rho = i$, and equation 75 simplifies to:

$$\begin{aligned}\text{AETR} &= \frac{\frac{p-r}{r+\delta} - \left(\frac{(p-r)(1-\tau)}{r+\delta}\right)}{\frac{p}{r+\delta}} \\ &= \tau\left(1+\frac{\delta}{p}\right) - \tau\frac{r+\delta}{p} = \tau\frac{p-r}{p}\end{aligned} \tag{76}$$

This expression mirrors equation 71, reflecting the fact that, under full expensing and no interest deductibility, financing choices do not affect the tax burden.

To compute the marginal effective tax rate, set post-tax economic rent to zero:

$$R^{NE} = (1-\tau)\gamma\left[\frac{(1+\pi)p-\rho+\pi}{\rho-\pi+\delta(1+\pi)} + \frac{\gamma-1}{\gamma}\right] = 0 \tag{77}$$

The implied cost of capital is:

$$\tilde{p} = \frac{\left(\frac{1}{\gamma}-1\right)[\rho-\pi+\delta(1+\pi)]}{1+\pi} + \frac{\rho-\pi}{1+\pi} \tag{78}$$

If $m_i = z = m_d$, then $\gamma = 1$, $\rho = i$, and the expression collapses to $\tilde{p} = r$.

Case 3: Debt Financing

Under a cash flow tax, immediate expensing implies $\phi = A = 1$, and interest payments are not deductible. Economic rent under debt financing is therefore:

$$\begin{aligned}R^D &= \gamma\left[\frac{(1+\pi)(p+\delta)(1-\tau)}{\rho-\pi+\delta(1+\pi)} - 1 + \tau\right] + (1-\tau)\gamma\frac{\rho-i}{\rho-\pi+\delta(1+\pi)} \\ &= (1-\tau)\gamma\frac{(1+\pi)(p-r)}{\rho-\pi+\delta(1+\pi)}\end{aligned} \tag{79}$$

Consequently,

$$\text{AETR} = \frac{\frac{p-r}{r+\delta} - (1-\tau)\gamma\left[\frac{(1+\pi)(p-r)}{\rho-\pi+\delta(1+\pi)}\right]}{p/(r+\delta)} \tag{80}$$

If $m_i = z = m_d$, then $\gamma = 1$, $\rho = i$, and

$$\text{AETR} = \tau\frac{p-r}{p} \tag{81}$$

The cost of capital is obtained by setting equation 79 to zero. Which results in

$$\tilde{p} = r \tag{82}$$

3.1 Summary of CFT

Consider a project financed by shares α_1 (retained earnings), α_2 (new equity), and α_3 (debt), with $\alpha_1 + \alpha_2 + \alpha_3 = 1$. Economic rent is:

$$R = (1-\tau)\gamma\left[\frac{(1+\pi)p - \rho + \pi}{\rho - \pi + \delta(1+\pi)}\right] + \alpha_2(1-\tau)(\gamma - 1) + \alpha_3(1-\tau)\gamma\frac{\rho - i}{\rho - \pi + \delta(1+\pi)} \tag{83}$$

The Average Effective Tax Rate is:

$$AETR = \frac{\frac{p-r}{r+\delta} - (1-\tau)\left(\gamma\left[\frac{(1+\pi)p-\rho+\pi}{\rho-\pi+\delta(1+\pi)}\right] + \alpha_2(\gamma-1) + \alpha_3\gamma\frac{\rho-i}{\rho-\pi+\delta(1+\pi)}\right)}{p/(r+\delta)} \tag{84}$$

Finally, the cost of capital is obtained by setting (83) to zero:

$$\tilde{p} = \frac{\rho - \pi}{1+\pi} - \alpha_3\frac{\rho - i}{1+\pi} + \alpha_2\frac{\left(\frac{1}{\gamma} - 1\right)[\rho - \pi + \delta(1+\pi)]}{1+\pi} \tag{85}$$

4 Allowance for Equity

Under an Allowance for Corporate Equity (ACE), interest on debt is no longer deductible. Instead, firms receive a tax-deductible allowance on their equity base. The allowance is defined as:

$$\text{allowance}_t = i \times (\text{depreciation value of capital})_t. \tag{86}$$

For example, if depreciation follows a declining-balance method and the investment occurs at time t, the stream of allowances is:

$$\text{allowance}_{t+s} = i(1-\phi)^s, \qquad \forall\, s \geq 1. \tag{87}$$

The net present value (NPV) of these allowances is:

$$NPV_{allowance} = \sum_{s=1}^{\infty} \frac{i(1-\phi)^s}{(1+\rho)^s} = \frac{i(1-\phi)}{\rho+\phi}$$

Recall also that:

$$A = \sum_{s=0}^{\infty} \frac{\phi(1-\phi)^s}{(1+\rho)^s} = \frac{\phi(1+\rho)}{\rho+\phi}$$

These expressions imply:

$$NPV_{allowance} = \frac{i(1-\phi)}{\rho+\phi} = \frac{i(1-A)}{\rho}$$

Because the ACE affects dividends, the allowance is multiplied by γ.

4.1 Retained Earnings Financing

Economic rent under retained-earnings financing becomes:

$$R^{RE} = \gamma\left[\frac{(1+\pi)(p+\delta)(1-\tau)}{\rho-\pi+\delta(1+\pi)} - 1 + \tau A\right] + \tau\gamma\frac{i(1-A)}{\rho} \tag{88}$$

$$= \gamma\left[\frac{(1+\pi)(p+\delta)(1-\tau)}{\rho-\pi+\delta(1+\pi)} - 1 + \tau A + \tau\frac{i(1-A)}{\rho}\right] \tag{89}$$

In the absence of taxes ($\gamma = 1$, $A = 0$, $\rho = i$):

$$R^* = \frac{(1+\pi)(p+\delta)}{i-\pi+\delta(1+\pi)} - 1 = \frac{p-r}{r+\delta}. \tag{90}$$

Average Effective Tax Rate

The EATR is:

$$\text{AETR} = \frac{R^* - R^{RE}}{p/(r+\delta)} \tag{91}$$

Substituting yields:

$$\text{AETR} = \frac{\frac{p-r}{r+\delta} - \gamma\left[\frac{(1+\pi)(p+\delta)(1-\tau)}{\rho-\pi+\delta(1+\pi)} - 1 + \tau A + \tau\frac{i(1-A)}{\rho}\right]}{p/(r+\delta)} \tag{92}$$

If $m_i = z = m_d$, then $\gamma = 1$, $\rho = i$, and A is the standard depreciation allowance:

$$\text{AETR} = \tau\frac{p-r}{p} \tag{93}$$

Marginal Effective Tax Rate

The cost of capital solves $\frac{dR^{RE}}{dK} = 0$:

$$0 = \gamma\left[\frac{(1+\pi)(p+\delta)(1-\tau)}{\rho-\pi+\delta(1+\pi)} - 1 + \tau A + \tau\frac{i(1-A)}{\rho}\right]$$

Thus:

$$\tilde{p} = \left[(1-\tau A) - \frac{\tau\, i(1-A)}{\rho}\right]\left[\frac{\rho-\pi+\delta(1+\pi)}{(1+\pi)(1-\tau)}\right] - \delta \tag{94}$$

If $m_i = z = m_d$, then $\tilde{p} = r$

4.2 New Equity Financing

Under new equity financing, the economic rent equals the retained-earnings expression plus the equity-financing term:

$$R^{NE} = \gamma\left[\frac{(1+\pi)(p+\delta)(1-\tau)}{\rho-\pi+\delta(1+\pi)} - 1 + \tau A + (1-\tau\phi)\frac{\gamma-1}{\gamma} + \tau\frac{i(1-A)}{\rho}\right] \tag{95}$$

The corresponding AETR is:

$$\text{AETR} = \frac{\frac{p-r}{r+\delta} - \gamma\left[\frac{(1+\pi)(p+\delta)(1-\tau)}{\rho-\pi+\delta(1+\pi)} - 1 + \tau A + (1-\tau\phi)\frac{\gamma-1}{\gamma} + \tau\frac{i(1-A)}{\rho}\right]}{p/(r+\delta)} \tag{96}$$

If personal income taxes coincide ($m_i = z = m_d$), then $\gamma = 1$, $\rho = i$ and:

$$\begin{aligned} \text{AETR} &= \frac{\frac{p-r}{r+\delta} - \left(\frac{(p+\delta)(1-\tau)}{r+\delta} + \tau - 1 \right)}{p/(r+\delta)} \\ &= \tau \left(1 + \frac{\delta}{p} \right) - \tau \frac{r+\delta}{p} = \tau \frac{p-r}{p} \end{aligned} \tag{97}$$

This expression matches equation 93, as expected under ACE financing neutrality.

Setting $R^{NE} = 0$ yields the marginal cost of capital:

$$\tilde{p} = \frac{\left[(\frac{1}{\gamma} - 1)(1 - \tau\phi) + (1 - \tau A) - \tau \frac{i(1-A)}{\rho} \right] [\rho - \pi + \delta(1+\pi)]}{(1+\pi)(1-\tau)} - \delta \tag{98}$$

For $m_i = z = m_d$, $\tilde{p} = r$.

4.3 Debt Financing

For debt financing under ACE, start from the CIT expression without interest deductibility and add back the ACE allowance. Economic rent becomes:

$$R^D = \gamma \left[\frac{(1+\pi)(p+\delta)(1-\tau)}{\rho - \pi + \delta(1+\pi)} - 1 + \tau A \right] + \gamma(1 - \tau\phi) \frac{\rho - i}{\rho - \pi + \delta(1+\pi)} + \tau\gamma \frac{i(1-A)}{\rho} \tag{99}$$

$$= \gamma \left[\frac{(1+\pi)(p+\delta)(1-\tau) + (1-\tau\phi)(\rho - i)}{\rho - \pi + \delta(1+\pi)} - 1 + \tau A + \tau \frac{i(1-A)}{\rho} \right] \tag{100}$$

Therefore:

$$\text{AETR} = \frac{\frac{p-r}{r+\delta} - \gamma \left[\frac{(1+\pi)(p+\delta)(1-\tau)}{\rho-\pi+\delta(1+\pi)} - 1 + \tau A + \tau \frac{i(1-A)}{\rho} + (1-\tau\phi) \frac{\rho - i}{\rho-\pi+\delta(1+\pi)} \right]}{p/(r+\delta)} \tag{101}$$

If $m_i = z = m_d$, then:

$$\text{AETR} = \tau \frac{p-r}{p} \tag{102}$$

To obtain the cost of capital, set $R^D = 0$:

$$\tilde{p} = \frac{\left[(1-\tau A) - \frac{\tau\, i(1-A)}{\rho}\right][\rho - \pi + \delta(1+\pi)] - (1-\tau\phi)(\rho - i)}{(1+\pi)(1-\tau)} - \delta \tag{103}$$

If $m_i = z = m_d$, then $\tilde{p} = r$.

4.4 Pitfalls in the Literature

As shown in the preceding discussion, the ACE allowance is computed on the *depreciated* value of capital. However, two recurrent pitfalls appear in the literature.

First, in the case of a fully equity-financed project, the literature often overlooks the fact that the ACE allowance is applied to the depreciated capital stock. Under the theoretical ACE, the allowance is given by

$$\sum_{t=1}^{\infty} i\left[\frac{1-\phi}{1+i}\right]^t, \qquad t \geq 1,$$

which simplifies to

$$1 - A.$$

Instead, it is commonly written as

$$\sum_{t=1}^{\infty} i\left[\frac{(1-\phi)^{t-1}}{(1+i)^t}\right], \qquad t \geq 1,$$

which simplifies to

$$1 - \frac{A}{1+i}.$$

It is immediate that the allowance assumed in the literature exceeds the theoretically correct ACE allowance:

$$\left(1 - \frac{A}{1+i}\right) - (1-A) = \frac{i}{1+i}.$$

Second, the literature frequently assumes that if a project is financed by debt or by new equity, the equity base is zero and therefore no ACE allowance applies. This assumption contradicts the basic premise used to derive the AETR and METR: as stated in the Introduction, profits are distributed each period. Under this assumption, beginning in period 1, any outstanding loan constitutes *negative equity* and therefore requires a clawback through a *negative* ACE allowance.

Do real-world ACE systems operate in this way? Generally, they do not. However, the theoretical

ACE—applied as a tax on economic rent—implies that debt-financed and new-equity-financed projects carry a negative allowance whenever equity is negative.

Abstracting from personal income taxation, the literature therefore typically uses the following expressions for the AETR and the cost of capital for a debt financed project:

$$\text{AETR} = \tau\left(1+\frac{\delta}{p}\right) - (\tau A)\frac{r+\delta}{p} - \frac{\tau i(1-\tau\phi)/(1+\pi)}{p}, \tag{104}$$

and

$$\tilde{p} = \frac{(1-\tau A)(r+\delta) - (1-\tau\phi)\frac{\tau i}{1+\pi}}{(1-\tau)} - \delta \tag{105}$$

The correct formulas, consistent with the theoretical ACE treatment of negative equity, are considerably simpler:

$$\text{AETR} = \tau\left(1-\frac{r}{p}\right), \tag{106}$$

and

$$\tilde{p} = r. \tag{107}$$

4.5 Summary of ACE

For a project financed by α_1 retained earnings, α_2 new equity, and α_3 debt (with $\alpha_1+\alpha_2+\alpha_3=1$), economic rent can be written as:

$$R = \gamma\left[\frac{(1+\pi)(p+\delta)(1-\tau)}{\rho-\pi+\delta(1+\pi)} - 1 + \tau A + \tau\frac{i(1-A)}{\rho} + \alpha_2(1-\tau\phi)\frac{\gamma-1}{\gamma} + \alpha_3(1-\tau\phi)\frac{\rho-i}{\rho-\pi+\delta(1+\pi)}\right] \tag{108}$$

The corresponding AETR is:

$$AETR = \frac{\frac{p-r}{r+\delta} - \gamma\left[\frac{(1+\pi)(p+\delta)(1-\tau)}{\rho-\pi+\delta(1+\pi)} - 1 + \tau A + \tau\frac{i(1-A)}{\rho} + \alpha_2(1-\tau\phi)\frac{\gamma-1}{\gamma} + \alpha_3(1-\tau\phi)\frac{\rho-i}{\rho-\pi+\delta(1+\pi)}\right]}{p/(r+\delta)} \tag{109}$$

Finally, the cost of capital solves $R=0$:

$$\tilde{p} = \frac{\left[(1-\tau A) - \frac{\tau\, i(1-A)}{\rho} + \alpha_2(1-\tau\phi)\left(\frac{1}{\gamma}-1\right)\right]\left[\rho-\pi+\delta(1+\pi)\right] - \alpha_3(1-\tau\phi)(\rho-i)}{(1+\pi)(1-\tau)} \tag{110}$$

Annex: The Equivalence of R-Based, R+F, and S-Based Cash-Flow Taxes

Before illustrating the equivalence between the three types of cash-flow taxes, we first describe the sources and uses of funds in a corporation.

Sources and Uses of Funds

Source	**Use**
Real items	
Sales of goods and services	Purchases of raw materials, wage payments, and payments for services
	Purchases of capital goods (investment expenditure)
Financial transactions other than shares	
Borrowing	Repayment of loans
Interest received	Interest payments
Transactions involving equity	
New shares issued	Repurchase of shares
Decrease in retained earnings	Dividends paid
	Increase in retained earnings
Taxes	Taxes paid

Double-entry accounting implies that sources and uses of funds must be equal each period:

$$\begin{aligned}&\text{Sales} + \text{Borrowing} + \text{Interest received} + \text{New shares issued} + \text{Decrease in retained earnings}\\ &= \text{Purchases} + \text{Loan repayment} + \text{Interest payment} + \text{Repurchase of shares} + \text{Increase in retained earnings}\\ &\qquad + \text{Dividends paid} + \text{Taxes paid}\end{aligned}$$

Tax Bases

R-based cash-flow tax.

$$R\text{-base} = \text{Sales} - \text{Purchases}.$$

R+F-based cash-flow tax.

$$\begin{aligned}(R+F)\text{-base} &= (\text{Sales} + \text{Borrowing} + \text{Interest received}) \\ &\quad - (\text{Purchases} + \text{Interest paid} + \text{Debt repayment} + \text{Increase in retained earnings})\end{aligned}$$

S-based cash-flow tax.

$$\begin{aligned}S\text{-base} &= (\text{Dividends paid} + \text{Increase in retained earnings} \\ &\quad + \text{Repurchase of shares}) - (\text{New equity issued} + \text{Decrease in retained earnings})\end{aligned}$$

Note that the S-base is defined in *net-of-tax* terms. Thus the tax rate applied is

$$\frac{\tau}{1-\tau}.$$

Equivalence Results

We demonstrate that the three tax systems are equivalent for non-financial corporations, and that R+F and S-based cash-flow taxes are equivalent for financial institutions. In particular:

1. Projects earning a normal return incur zero tax in discounted net present value terms.
2. For projects financed through retained earnings or new equity issuance, all three systems yield identical tax payments each period.
3. For debt-financed projects, the R+F and S-based taxes coincide period-by-period.
4. Across all financing mechanisms, the discounted net present value (NPV) of taxes paid is identical for non-financial institutions.

Consider an investment of size I in period 1, yielding $I(1+r)$ in period 2. The investment is financed in three ways: (i) retained earnings, (ii) issuance of new equity, and (iii) debt.

Finance Through Retained Earnings

Period 1

$$\text{R-based: } T = \tau(0-I) = -\tau I.$$

$$\text{R+F-based: } T = \tau\big((0+0+0) - (I+0+0)\big) = -\tau I.$$

$$\text{S-based:} \quad T = \frac{\tau}{1-\tau}\Big((0+0+0) - (0+(1-\tau)I)\Big) = -\tau I.$$

Net-of-tax reduction in retained earnings is $(1-\tau)I$; hence the tax rate applied is $\tau/(1-\tau)$.

Period 2

$$\text{R-based: } T = \tau\big((1+r)I - 0\big) = \tau I(1+r).$$

$$\text{R+F-based: } T = \tau\big((1+r)I + 0 + 0 - (0+0+0)\big) = \tau I(1+r).$$

$$\text{S-based: } T = \frac{\tau}{1-\tau}\Big(0 + (1-\tau)I(1+r) + 0 - (0+0)\Big) = \tau I(1+r).$$

Net present value.

$$\frac{\tau I(1+r)}{1+r} - \tau I = 0.$$

Finance Through Issuance of New Equity

Period 1

$$\text{R-based: } T = -\tau I.$$

$$\text{R+F-based: } T = -\tau I.$$

$$\text{S-based:} \quad T = \frac{\tau}{1-\tau}\Big((0+0+0) - ((1-\tau)I + 0)\Big) = -\tau I.$$

Net-of-tax new equity issuance is $(1-\tau)I$.

Period 2

$$\text{R-based: } T = \tau I(1+r).$$

$$\text{R+F-based: } T = \tau I(1+r).$$

$$\text{S-based: } T = \frac{\tau}{1-\tau}\big((1-\tau)I(1+r)+0+0\big) = \tau I(1+r).$$

Note: Under a distribution-based S tax, period-by-period equivalence fails, but NPV equivalence holds.

Net present value.

$$\frac{\tau I(1+r)}{1+r} - \tau I = 0.$$

Finance Through Debt

Period 1

$$\text{R-based: } T = -\tau I.$$

$$\text{R+F-based: } T = \tau\big((0+I+0)-(I+0+0)\big) = 0.$$

$$\text{S-based: } T = \frac{\tau}{1-\tau}(0) = 0.$$

Period 2

$$\text{R-based: } T = \tau I(1+r).$$

$$\text{R+F-based: } T = \tau\big((1+r)I-(I+Ir)\big) = 0.$$

$$\text{S-based: } T = \frac{\tau}{1-\tau}(0) = 0.$$

Net present value.

$$\text{NPV of taxes} = 0.$$

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