Forward-Looking Effective Tax Rates under the Global Minimum Corporate Tax*

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Abstract

The international agreement on a minimum corporate tax marks a milestone in global corporate tax arrangements. We examine its implications for forward-looking effective tax rates (ETRs) on investment by multinationals. Specifically, we show that the minimum tax disturbs the equivalence between otherwise equivalent forms of efficient economic rent taxation: a cash-flow tax and an allowance for corporate equity (ACE). The minimum tax falls on the normal return, generating a non-zero marginal ETR under any system. Moreover, the cash-flow ETR cannot exceed that under ACE. To preserve efficiency, key policy implications include ensuring that investments are taxed under the domestic efficient system without triggering the minimum tax rules. We also analyze the implications for the design of tax incentives and provide a routine to compute ETRs for consistent comparison across tax systems or countries.

Keywords: Investment, Minimum Taxation, Corporate Tax Reform, International Taxation, Rent Tax, Effective Tax Rates

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1 Introduction

The G-20/OECD-led 'Inclusive Framework' agreement to establish a minimum effective corporate tax rate of 15 percent (known as 'Pillar Two') represents a path-breaking modification to the century-old international corporate tax arrangements. With implementation underway (in more than 40 capital-exporting countries), recent studies have focused on the important question of how the implementation of a minimum tax would alter tax competition and profit shifting.[1] Equally important—but thus far unexplored—is the question of how a minimum tax affects investment and the domestic design of profit taxes. In particular, how does the minimum corporate tax alter the familiar features of efficient economic rent taxation? These are the central questions of this paper.

Scholars have long proposed profit tax designs that avoid the common distortions of existing corporate income tax (CITs). These distortions manifest in: (i) investment distortions (where some investments that would be worthwhile without a tax become unviable—or unprofitable investments become viable—in the presence of the tax); and (ii) debt bias (where debt financing is tax-favored over equity financing due to interest expense deductions, without analogous deductions for equity returns). The profit tax reforms proposed by, for example, Mirrlees Review (2011), IFS Capital Taxes Group (1991), and Meade Committee (1978), among others, avoid these distortions by leaving the normal return (the opportunity cost of the investment) untaxed, while taxing economic rent (returns over and above the normal returns).

Efficient economic rent taxation broadly falls into two main classes of models that yield identical outcomes. The first is cash-flow taxes, one form of which is the R-based cash-flow tax. This system provides for full expensing of capital investment (that is, the entire cost of capital investment is deducted upfront, rather than following standard depreciation rules), while eliminating both interest deductions and the taxation of interest income.[2] The second class of models for efficient rent taxation provides tax allowances for the normal return. Specifically, the allowance for corporate equity (ACE) permits interest deductions and depreciation, while providing notional deductions for equity returns.[3] Despite the differing design details between the two classes of efficient rent

[1]Several studies look at welfare implications of the minimum tax, including Haufler and Kato (2024), Hebous and Keen (2023), Janeba and Schjelderup (2023), and Johannesen (2022), building on the rich tax competition literature surveyed in Keen and Konrad (2013) and Agrawal et al. (2022).

[2]In the Appendix, we also show the equivalence between the R-based, R+F-based, and S-based cash-flow taxes. The base of the latter is net distributions, while the R+F cash-flow tax defines the base as net real transactions plus net financial transactions.

[3]An equivalent formulation of the ACE is to offer an allowance for capital equal to the normal return (irrespective of the debt-equity financing), while disallowing interest deductions.

taxation models, a fundamental result is that both are equivalent in terms of net present value and achieve the same outcome of eliminating the aforementioned distortions.[4] Establishing this equivalence forms the backbone of our analysis, enabling a consistent comparison between pre- and post-minimum taxation.

We use a dynamic investment model to derive the forward-looking effective tax rates for the CIT, the cash-flow tax, and the ACE under a minimum tax, while also considering tax incentives aimed at attracting investment. Forward-looking effective tax rates—pioneered by Devereux and Griffith (2003), King (1974), and King and Fullerton (1984)[5]—have become a standard analytical tool for evaluating the effects of taxes on investment and countries' attractiveness as hosts of new investments, especially by multinational enterprises. These rates are frequently used by policy institutions, as seen in Congressional Budget Office (2017), Department of the Treasury (2021), OECD (2023), and Oxford CBT (2017), inter alia. Beyond the statutory tax rate, forward-looking effective tax rates account for tax base provisions (notably depreciation and the treatment of losses) over the entire horizon of the investment. If the marginal effective tax rate (METR) is zero, the pre- and post-tax *normal* returns are equal, preserving investment efficiency. The average effective tax rate (AETR) measures the net present value of the tax on economic return, and it is important for the discrete investment location choice of multinationals. We show that both the ACE and R-based cash-flow tax result in a zero METR and identical AETRs. The zero-METR result under both systems contrasts with the CIT, which distorts investment and financing decisions.[6]

The first key insight of this paper is that a minimum tax akin to Pillar Two breaks the equivalence between cash-flow taxation and the ACE. We show that under both systems, the minimum tax can fall on the normal return. Overall, however, under minimum taxation, the R-based cash-flow tax either maintains its non-distorting features or results in lower distortion than the ACE, ceteris paribus. Specifically, there are three regions: (i) one where the minimum tax applies in both cases, and the amount of the tax and the METR are higher under the ACE than under the cash-flow tax; (ii) a region where the minimum tax applies only in the case of the ACE, meaning the METR is zero for the cash-flow tax but not for the ACE; and (iii) a region where the minimum tax is not binding

[4] An excellent discussion of this equivalence can be found in Boadway and Keen (2010).

[5] See, also, for example, Hall and Jorgenson (1967).

[6] The discussion here focuses on origin-based rent taxation since it is the prevailing form of CITs and given the imminent implications of Pillar Two for tax policy. Theoretically, rent taxation can be destination-based akin to value-added taxes (see, for example, Devereux et al., 2021 and Hebous and Klemm, 2020). Under such a border-adjustment system, eliminating both the investment distortion and debt bias remains the role of either the ACE or the cash-flow tax (i.e., if the METR is zero under an origin-based system, it remains zero with a border-adjustment). The role of the border-adjustment is to eliminate international downward pressures on tax rates and incentives for profit shifting.

under both systems, for sufficiently high CIT rates (generally well above 15 percent), and thus the equivalence between them is restored.

To uncover the driver of this key result, we need to spell out the Pillar Two rules. The minimum tax proceeds in two steps. First, the rate is determined, and it is strictly positive if the ratio of (covered) taxes to profits is below a threshold (15 percent in the agreement).[7] We will refer to this ratio as the Pillar Two effective rate $\left(\frac{T_t^c}{\pi_t^c}\right)$.[8] For example, if this ratio is 5 percent in year t, the top-up tax rate is 10 percent. Second, the tax base is determined as profit, excluding a portion equal to 5 percent of tangible assets and payrolls (after a transition period). This portion is called the substance-based income exclusion (SBIE); thus, the top-up base is: $\pi_t^c - SBIE_t$. Therefore, the minimum tax amount is strictly positive if both the top-up rate and the top-up base are strictly positive.

Under the minimum tax, for the ACE, neither the top-up rate nor the top-up base can fall below that of the cash-flow tax, ceteris paribus. The reason for this is that Pillar Two treats them differently. Specifically, immediate expensing is considered a 'temporary timing measure' that leads to an upward adjustment to covered taxes; that is, the rules treat the reduced tax in a given year 'as if' it had been paid, leaving the Pillar Two effective rate unchanged.[9] This means that immediate expensing does not, by itself, trigger a top-up tax, as it does not lead to changes in the top-up rate or base. In contrast, the ACE can trigger a top-up tax because it reduces the Pillar Two effective rate (as it is not considered a temporary timing measure). The exact treatment of the ACE depends on whether it is refunded, as we model in detail. However, in any case, whenever the top-up tax binds under the R-based cash-flow tax, it must also bind under the ACE; it may bind under the ACE while not binding under the R-based cash-flow tax.

There is a caveat to the (non)equivalence results. If the SBIE is very large over the entire duration of the investment[10], the top-up base is zero for all years under any system, thereby eliminating the minimum tax altogether. While this situation restores efficiency for both the ACE and cash-flow tax systems, it is driven by a project-specific variable that depends on the decomposition of assets and labor. An efficient rent tax should be neutral with respect to any decomposition of assets,

[7] Profit is referred to as 'GloBE Income' in the agreement, which is accounting profit after some adjustments, such as deducting dividends received from related parties, since these are typically exempt from the CIT. 'Covered' taxes refer to taxes attributable to income (e.g., sales taxes are not 'covered' taxes for this purpose).

[8] To avoid confusion, we note that the Pillar Two effective rate is an average tax rate (i.e., tax payment over income) and not the forward-looking effective rate typically used in economic analysis.

[9] The upward adjustment reflects the temporary difference between accounting and tax recognition (Article 4.4 in OECD, 2021).

[10] Note that the SBIE of the project decreases over time due to depreciation of tangibles, given labor. In the rules, the SBIE is calculated at the firm level.

maintaining a zero METR on any investment, irrespective of project or firm characteristics.

Moreover, we study the interaction between the global minimum tax and tax incentives under the above tax systems. A non-refundable tax credit tends to generate a higher top-up tax than an equivalent amount of a refundable tax credit. It can even trigger top-up taxes for statutory tax rates well above 15 percent. Importantly, we show that, in compliance with the global minimum tax rules, the METR in a country can become negative without triggering a top-up tax (i.e., effectively providing a subsidy through income tax credits). Thus, Pillar Two makes it more appealing for countries to use refundable tax credits (i.e., a subsidy) for incentivizing investment.

The findings reported here are policy-relevant and can be viewed in two complementary ways: (i) to guide how countries can respond to the minimum tax through domestic tax base and rate choices, as well as the design of tax incentives, *given the Pillar Two rules*; and (ii) to indicate how to improve the design of the minimum tax rules.

Regarding countries' responses, our derivations of the ETRs are important for evaluating reform options. We also provide the corresponding Stata commands, which—beyond replicating this paper—incorporate a wide range of additional policy-relevant options.[11] The key lesson is that a country would be better off avoiding the minimum tax altogether and relying on the domestic tax system to raise revenue, as it offers more efficiency-enhancing features. A statutory CIT rate below 15 percent likely results in taxing the normal return due to the binding minimum tax. Alternative options would be conducive to investment, notably combining a statutory rate of at least 15 percent with an R-based cash-flow tax, which prevents the top-up tax and generates a zero METR.[12] This finding is not only an academic insight; it also supports recent reforms that provide full expensing, such as those in the United States (since 2017, although set to expire in 2024) and the UK, which converted temporary full expensing to a permanent measure in 2024.[13] The unsatisfactory implications of the ACE under the Pillar Two minimum tax, as demonstrated here, are also relevant for countries that have adopted it, such as Belgium, Italy, and Turkey, as well as for the European Commission (2022) proposal in a draft EU Directive known as the 'Debt-Equity Bias Reduction Allowance' (DEBRA).

The other policy implication from our study is that an efficient design of a minimum tax

[11] Including different designs of tax incentives. All derivations are available in the Online Appendix. To install the commands, type in Stata: `ssc install etr`.

[12] A higher statutory rate would still retain the zero METR while raising revenue from the excess return. Further elements that shape country responses to Pillar Two can be found, for example, in Hebous et al. (2024).

[13] Both countries, however, still allow interest deductions (subject to caps). See Adam and Miller, 2023. Many other countries offer full expensing under certain conditions or accelerated depreciation, including Australia, Egypt, and South Africa.

should ideally fall on economic rent only, without interfering with efficiency features of the domestic tax design. To achieve this, the top-up tax base should ideally relieve the normal return from the minimum tax (which is generally different from the SBIE). While the temporary timing approach of Pillar Two is an elegant way to preserve the time value of immediate expensing, our analysis suggests that to retain efficiency under a minimum tax, the top-up base can be defined as 'EBIT minus investment' (allowing carryforward). Such a 'cash-flow-like' top-up base makes the minimum tax compatible with any efficient rent tax designs (thereby maintaining tax equivalences) and eliminates debt bias.

Finally, another important result from the model presented here concerns a recurring and puzzling observation in the applied literature on forward-looking ETRs. This issue is not merely a side effect of the analysis but goes to the heart of of establishing a consistent, systematic comparison. Specifically, many studies have reported negative METRs for ACE systems, including Congressional Budget Office, 2017, Department of the Treasury, 2021, OECD, 2023, and Project for the EU Commission, 2022. A negative METR contradicts the underlying theory that it should be zero.[14] The observed inconsistencies with theory arise primarily because the depreciated value of equity in the first period is often overlooked, thereby unintentionally inflating the value of the allowance. This mis-specification effectively provides an allowance greater than the book value of equity.[15] We show with numerical examples using a prototypical parameterization that this overestimation of the ACE base can lead to a significant underestimation of the METR, resulting in negative values instead of the expected zero. AETRs—corresponding to various levels of profitability, particularly for low-return investments—would similarly be underestimated.

The rest of the paper is structured as follows. Section 2 presents a permanent investment model of METRs and AETRs for a standard corporate income tax (CIT) under a minimum tax similar to Pillar Two. Section 3 discusses an R-based cash-flow tax under a minimum tax. Section 4 establishes the equivalence between the ACE and the R-based cash-flow tax, highlighting how and when this equivalence breaks down. Finally, Section 5 synthesizes the key findings, while Section 6 concludes.

[14]Although negative METRs can occur in practice—for instance, if countries provide allowances higher than the normal return. Under a default model, the METR for an ACE system (or cash-flow tax) must be zero, absent deviations from theory.

[15]To put it simply, suppose an investment of 100 is made, and tax depreciation follows a straight-line method at 20 percent annually. In the first period, the ACE would apply to an equity level of 80 (not 100), and in the second period to 60 (not 80 plus inflation), and so on. Without this correction, the ACE system deviates from its theoretical neutrality with respect to inflation and depreciation.

2 Standard CIT

2.1 No Minimum Tax

The starting point is a permanent investment model without taxes.[16] In period 0, consider an investment of I units of capital. As there is no production or return at this stage, the profit is: $\pi_0 = -I$. In period 1, the investment, I, starts yielding returns, and hence the accounting profit is: $\pi_1 = [(1+\theta)(p+\delta)]I$, where θ represents inflation and p denotes real economic return, and δ is the rate of economic depreciation. In period 2, $(1-\delta) \times I$ comprises the remaining capital that continues to generate returns, resulting in $\pi_2 = (1+\theta)^2(p+\delta)(1-\delta)$; and so forth. The investment lasts until the asset is economically obsolete. The net present value of this investment (NPV) is given by:

$$\sum_{t=0}^{\infty} \frac{\pi_t}{(1+i)^t} = -I + \sum_{t=1}^{\infty} \frac{(1+\theta)^t(p+\delta) \times (1-\delta)^{t-1} I}{(1+i)^t} = \frac{(p-r)I}{r+\delta}, \tag{1}$$

where i is the nominal interest rate and r is the real interest rate.[17] If $p = r$, economic rent is zero (it is a marginal investment). If $p > r$, the investment yields economic rent. The sum of the economic depreciation and the real economic return net of economic depreciation, $(p+\delta)$, equals the real return before depreciation, interest expense, and tax (EBIDTA).

Next, consider a standard CIT. Let the tax depreciation function be denoted by φ; for example, a straight-line depreciation over five years implies that $\varphi = 20$ percent annually.[18] In period 0, the taxable profit is a loss equal to the capital depreciation for tax purposes, given by the function φ, that is, $\pi_0^T = -\varphi(I)$. In period t, for an equity-financed investment, the taxable profit before adjusting for loss carryforwards from previous periods is: $\pi_t = (1+\theta)^t(p+\delta) \times (1-\delta)^{t-1} I - \varphi(K_t)$, $\forall\, t > 0$, where the tax depreciated asset K_t is defined as follows: $K_0 = I,\ K_1 = I - \varphi(I), K_2 = I - \varphi(I) - \varphi\left(I - \varphi(I)\right)$, and so on.

For comparability with the literature and as a theoretical benchmark, this paper assumes full loss offset, meaning that the tax value of losses is either refundable or carried forward with interest (unless stated otherwise). We relax the full loss offset assumption in the Online Appendix. Let τ denote the statutory corporate income tax (CIT) rate, and assume that the investment is fully

[16] The Appendix presents a step-by-step derivation of all results. The model builds on various contributions to the literature including Devereux and Griffith (2003), King and Fullerton (1984), and Klemm (2008).

[17] Note that $(1+i) = (1+\theta)(1+r)$.

[18] Tax depreciation is assumed to be the same as accounting depreciation.

financed with equity. The tax amount in each period is:

$$T_0 = -\tau\varphi(I), \tag{2}$$

$$T_t = \tau(1+\theta)^t(p+\delta) \times (1-\delta)^{t-1}I - \tau\varphi(K_t) \qquad \forall\ t > 0. \tag{3}$$

The net present value of the total tax amount, T (without the time index t), over the lifetime of the investment is:

$$T = -\tau A + \frac{\tau(p+\delta)}{r+\delta}I, \tag{4}$$

where $A \equiv \sum_{t=0}^{\infty} \frac{\varphi(K_t)}{(1+i)^t}$, and for convenience later: $\frac{A}{I} \equiv \tilde{A}$.

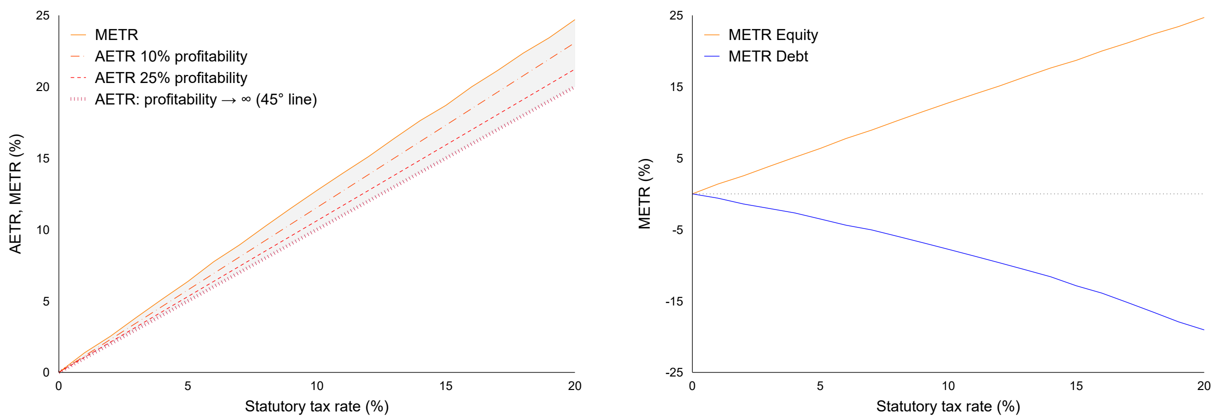
The AETR is the net present value of the tax (given in Equation 4), normalized by the net present value of the pre-tax total income stream, net of depreciation:

$$AETR = \frac{T}{\frac{p}{r+\delta}I} = \tau\left[1 + \frac{\delta - \tilde{A}[r+\delta]}{p}\right]. \tag{5}$$

The AETR increases (i) as τ increases (for a given profitability); or (ii) as interest rate (discount factor) increases (given τ). For high levels of profitability (that is, as $p \to \infty$ and the term $\frac{\delta-\tilde{A}[r+\delta]}{p}$ approaches zero), the AETR converges toward the statutory tax rate τ, as shown in the left panel of Figure 1. The shaded area demonstrates that the AETR line tilts downward as profitability increases (given τ) reaching the limit where it fully coincides with the 45° line at extremely high profitability (in other words, it approaches τ). In Figure 1, the AETR increases as profitability declines (given τ), but the AETR can also decline with profitability under a different calibration (notably, for higher depreciation).

Higher depreciation allowances lower the AETR (by raising the term A), consistent with empirical evidence that accelerated depreciation is effective in accelerating investment, such as Zwick and Mahon (2017) for the US and Maffini et al. (2019) for the UK. Note that, given an investment profile, the AETR can exceed τ depending on depreciation and inflation. In particular, as readily seen from Equation 5, high inflation or less generous tax depreciation increases the AETR by lowering A. The AETR is crucial for the discrete location choice of new investments by multinationals, particularly those that generate high profitability from proprietary assets (Devereux and Griffith, 1998). It is frequently used in international tax ranking databases, such as Oxford CBT (2017) and OECD (2023).

Figure 1: *AETRs and METRs without a Minimum Tax*



(a) *Equity-Funded Investment*

(b) *Debt Bias*

Note: METR stands for the marginal effective tax rate, computed for the marginal investment that just breaks even. AETR stands for the average effective tax rate. The figure assumes an inflation rate of 5%, a real interest rate of 5%, an economic depreciation rate of 25%, a depreciation rate for tax purposes of 25%, and full loss offset. The left panel assumes full equity financing and shows that both the AETR and the METR are increasing in the statutory rate (for a given profitability). The AETR converges to the statutory tax rate as profitability increases (for a given statutory rate). This convergence is depicted in the shaded region and through vertical movement along the AETR lines corresponding to 10% and 25%, profitability. In the limit (as profitability $\to \infty$), the AETR approaches the 45° line. The right panel visualizes the debt bias. The METR for a fully debt-financed investment (blue line) is negative (i.e., a subsidy).

Investment Distortion

The METR corresponds to the case of no economic rent (i.e., defined for the marginal investment). To derive the METR, we need to find the value of p that makes the post-tax economic rent of the investment ($\tilde{p}$) zero, by setting the difference between Equations 4 and 1 equal to zero and solving for $\tilde{p}$. This $\tilde{p}$ is also known as the net-of-depreciation user cost of capital. The METR is then given by:

$$METR = \frac{\tilde{p} - r}{\tilde{p}}, \tag{6}$$

where $\tilde{p} = \frac{(r+\delta)(1-\tau\tilde{A})}{1-\tau} - \delta$.[19] Without a tax, the marginal investment yields $p = r$. If the METR = 0, at the margin, the investment that just breaks even remains viable in the presence of the tax, indicating that the tax system is efficient. If the METR > 0, there is a tax wedge between pretax and post-tax return, making this marginal investment unprofitable due to the tax. Under the CIT, an

[19] This approach is based on a discrete investment project with a given pre-tax NPV. It delivers results equivalent to those in King (1974) under constant returns to scale, where the investment level adjusts until the marginal revenue product equals the marginal cost of capital—unless otherwise noted. Further details are provided in the Appendix.

equity-financed investment faces a positive METR that increases linearly with τ (Figure 1). If the METR < 0, the investment at the margin is subsidized.[20]

Debt Bias

The source of financing of the investment is one important determinant of the METR and AETR under a standard CIT. Debt-financed investments benefit from deducting interest expenses and therefore are associated with lower AETRs than fully equity-financed investments that receive no deductions on their returns. For debt-financed investments, the NPV of taxes and the corresponding AETR (in Equation 5) should be modified to allow for interest deductions. Given some degree of debt financing ($0 \leq \alpha \leq 1$), the AETR becomes:

$$AETR = \underbrace{\tau\left[1 + \frac{\delta - \tilde{A}[r+\delta]}{p}\right]}_{AETR\text{ for full equity-financing}} - \underbrace{\frac{\tau\alpha i}{p(1+\theta)}}_{\text{debt bias}}, \tag{7}$$

Decreasing interest deductions (by lowering the share of debt α) raises the AETR. The tax benefit from debt-financing increases in τ. If $\alpha = 0$, then Equation 7 collapses to 5.

Precisely, there are two elements of debt bias. First, debt receives interest deductions (the presence of the additional term $-\frac{\tau\alpha i}{p(1+\theta)}$ in Equation 7). Second, the amount of the interest deduction in this new term is not tied to the normal return and can well exceed it.[21] The METR for the fully debt-financed investment is even negative due to excessive interest deductions beyond the normal return (right panel of Figure 1). The extent of this negative METR depends on inflation, depreciation, and the tax rate. Higher inflation, higher depreciation, and higher tax rates increase the debt bias. The welfare implications of the debt bias have been studied in various papers, ultimately calling for a system that eliminates the tax-favored debt treatment (to name a few: IMF, 2016; Mirrlees Review, 2011; Sørensen, 2017; and Weichenrieder and Klautke, 2008).

One way to eliminate the debt bias is the Comprehensive Business Income Tax (CBIT) that was proposed by Department of the Treasury (1992). The CBIT treats debt as equity, by denying interest deductions and exempting interest income. Hence, Equation 5 also gives the AETR on debt-funded investment under the CBIT, thereby neutralizing the debt bias (compared to Equation 7). However,

[20] If the policy intention is to tax the normal return, it can still do it at the individual level while maintaining a zero METR at the corporate level.

[21] In the standard CIT system, the typical deduction for debt in each period is denoted as $i((1+\theta)(1-\delta))^{t-1}\ \forall t \geq 1$, while the deduction to account for normal return is expressed as $i(1-\varphi)^t\ \forall t \geq 1$. The latter leads to a zero METR for all inflation and depreciation levels. On the other hand, the AETR and METR under the standard debt deduction are dependent on inflation and the depreciation rate.

the CBIT leaves the investment distortion unaddressed (as the METR remains greater than zero as in Equation 6). The two efficient rent tax systems that address both investment distortion and debt bias are cash-flow taxation or the ACE. Next, we examine how the minimum tax affects the METRs and AETRs under the CIT.

2.2 Introducing a Minimum Tax to a Standard CIT

The minimum tax under Pillar Two is determined in the following sequence. First, in each year, the top-up tax rate (τ_t^{topup}) is computed as the difference between 15 percent and the ratio of covered domestic taxes ($T_t^c = \tau\pi_t^c$) to covered income (π_t^c), where π_t^c includes loss carryforwards from previous periods.[22] We will see later that under the ACE or cash-flow taxation, the domestic tax base generally differs from π_t^c. But for the CIT, the domestic tax base and the covered profit are here the same (starting from a system without any tax incentives). Thus,

$$\tau_t^{topup} = \max\left(0, \left(15\% - \frac{T_t^c}{\pi_t^c}\right)\right) = \max\left(0, \left(15\% - \frac{\tau\pi_t^c}{\pi_t^c}\right)\right) = \max\left(0, (15\% - \tau)\right), \quad (8)$$

Second, in year t, if the top-up tax rate (τ_t^{topup}) is greater than zero, a top-tax is applied to the covered profit in excess of the SBIE in t, set at 5 percent of tangible assets and payroll, after a transition period. Thus, the top-up base in t is $\max(0, \pi_t^c - SBIE_t)$, where the term 'max' explicitly accounts for the fact that if $SBIE_t > \pi_t^c$ in some t there will be no carryover.[23] If τ_t^{topup} is zero, the minimum tax is not binding, irrespective of the SBIE. Hence, in any t, the total tax (T_t) including the top-up tax, is given by:

$$T_t^{Pillar2} = \tau\pi_t + \left[\max\left(0, (15\% - \tau)\right) \times \max(0, \pi_t^c - SBIE_t)\right], \ \forall\, t \geq 0. \quad (9)$$

If, in year t, for example, $\tau = 0$, π^c is 100, and the SBIE is 20, then the covered tax is zero, the top-up rate (τ^{topup}) is 15 percent, and the resulting top-up tax is 12 (that is, $15\% \times (\pi^c - SBIE)$). This means, the average tax rate is 12 percent while Pillar Two effective rate on profit exceeding the SBIE (after the top-up) becomes 15 percent. If the covered tax is 5, then the top-up rate is 10 percent, the top-up tax is 8, and the total tax paid is 13.

Under Pillar Two, for the calculation of the effective tax rate on investment in a host country

[22] Generally, the 15% can be replaced by a parameter $0 < a < 1$.

[23] If alternatively, the top-up base is expressed as $\pi_t^c - SBIE_t$, then the analysis would be based on the strong assumption that the firm can carry forward any 'excess SBIE' to future periods to lower future top-up bases.

(where the investment actually takes place), it is irrelevant whether the host country or the headquarters country applies the top-up tax. The reason is that the in-scope multinational investor should pay the top-up tax anyway; that is, the host country cannot lower its effective tax rate by ceding the revenue from the top-up tax to other countries. Pillar Two allows the host country to collect the top-up revenue (if it adopts a specific rule called the 'qualified domestic top-up tax' rule), or else the headquarters country would collect the top-up tax (via the 'income inclusion rule').[24]

Two aspects are worth stressing when considering how a minimum tax affects investment. First, the minimum tax test is applied on a yearly basis, rather than at the end of the investment. That is, conceptually, even if the pre-minimum tax exceeds 15 percent in NPV terms when considering the investment as a whole, a top-up tax can still be applied in some years. The NPV of the tax thus considers any yearly top-up taxes that are paid over the lifetime of the investment. Second, if $\tau_t^{topup} > 0$, then the top-up tax amount in any year t is a function of the SBIE. Conceptually, the investment-specific SBIE is time-varying due to depreciation of tangible assets throughout the investment duration. Thus, the SBIE is independent of the mode of financing (debt or equity), but depends on the nature of the asset (tangibles versus intangibles). For the derivation of the expressions for the effective tax rates, we do not make any assumptions about the SBIE. From the standpoint of the investor, these equations provide a menu of AETRs for different values of the SBIE. There can be different values of the SBIE that are consistent with the same project. First, to the extent that the production technology of the investment enables substitution between tangibles, intangibles, and labor, the value of the SBIE can be optimized to lower the tax (since the SBIE considers only tangibles and labor). Second, beyond the project itself, the values of the assets and payrolls of other projects (or firms that belong to the group) increase the SBIE.

Losses can be carried forward indefinitely under Pillar Two rules as a deduction in the computation of π_t^c. In our baseline analysis, we maintain the full loss offset and assume that any tax loss refunds or interest on the loss carryforward do not affect the Pillar Two effective rate. We relax the full loss offset assumption in the Online Appendix. Pillar Two rules do not stipulate how to handle a full loss offset.

The NPV of the tax under Pillar Two for an equity-financed investment has an additional term compared to the NPV under a standard CIT:

[24]The current U.S. minimum tax design, known as 'Global Intangible Low-Taxed Income (GILTI)', is somewhat of an exception, as it is not imposed on a country-by-country basis. This worldwide 'blending' approach makes the investment location choice not a discrete one. It is not yet clear whether GILTI will be recognized as an IIR without being converted to a country-by-country design.

$$T^{Pillar2} = T^{No\,minimum} + \sum_{t=1}^{\infty} \max(0, (15\% - \tau)) \frac{\max\left(0, (\pi_t^c - SBIE_t)\right)}{(1+i)^t}, \tag{10}$$

where $T^{No\,minimum}$ is the net present value of the total tax amount without a minimum tax. The first term in Equation 10 is the same as in Equation 4 for the standard CIT. The second term in Equation 10 is zero as long as there is no top-up tax; otherwise it is strictly positive. The resulting AETR is:

$$AETR^{Pillar2} = AETR^{No\,minimum} + \frac{\sum_{t=1}^{\infty} \max(0, (15\% - \tau)) \frac{\max(0, (\pi_t^c - SBIE_t))}{(1+i)^t}}{\frac{p}{r+\delta}}, \tag{11}$$

where $AETR^{No\,minimum}$ is the AETR in the absence of a minimum tax as in Equation 7.

To compute $METR^{Pillar2}$, we also use Equation 6. However, the computation of the cost of capital, $\tilde{p}$, is performed using a routine that calculates the net present value of all paid taxes—including the top-up tax—while accounting for the non-carry-forward of unused SBIE in years when it exceeds π_t^c.[25] By definition, $METR^{Pillar2} \geq METR$, because in the limit, if there is no top-up during the lifespan of the project, the two are equal, whereas any top-up—even in a single year—increases the METR.

Thus, the calibrations illustrate that the minimum tax raises both the METR and AETR in the top-up region (left panel of Figure 2). Under Pillar Two, both the METR and AETR exhibit kinks determined by the cutoff at $\tau = 15\%$. Above this threshold, the minimum tax is no longer binding, and the METR and AETR converge to the values shown in Figure 1.[26] Moreover, the minimum tax sustains the debt bias (right panel of Figure 2).

The AETR or METR in the top-up region are also influenced by the size of the SBIE in the years when the top-up tax is applied. The AETR is highest (approaching 15%) when the investment relies entirely on intangible assets and has zero payrolls (resulting in a generally low SBIE). It is lowest when the investment is heavily dependent on tangible assets and high payrolls (resulting in a high SBIE). Thus, theoretically, for some investments, the top-up amount can be zero, eliminating the kink in the AETR function, even for $\tau < 15\%$, if the SBIE is sufficiently large. Note that if there is no top-up tax at all, Equation 11 collapses to Equation 5, reflecting a standard CIT. In the top-up region, where $\tau < 15\%$, the minimum tax generally raises the METR (compared to a standard CIT), because it affects the normal return of an equity-financed investment. For $\tau \geq 15\%$, the METR is

[25] See our Stata commands `etr` and `dieter`.

[26] The left panel of Figure 2 reveals an intriguing quirk resulting from the minimum tax: at a very low τ, around 5% in the chart, the AETR increases with profitability. This occurs because the SBIE deduction becomes less valuable in the early years, while the top-up tax is highest.

unaffected and remains identical to that in Figure 1. The following propositions summarize the key results:

Proposition 1. *Under a standard CIT and a minimum tax and a full loss offset:*

(a) If $\tau < 15\%$, there is a top-up tax at least in one year, t, during the investment if $\pi_t^c - SBIE_t > 0$. The rustling METR and AETR are higher than under the standard CIT without a minimum tax.

(b) If $\tau \geq 15\%$, the minimum tax has no implications.

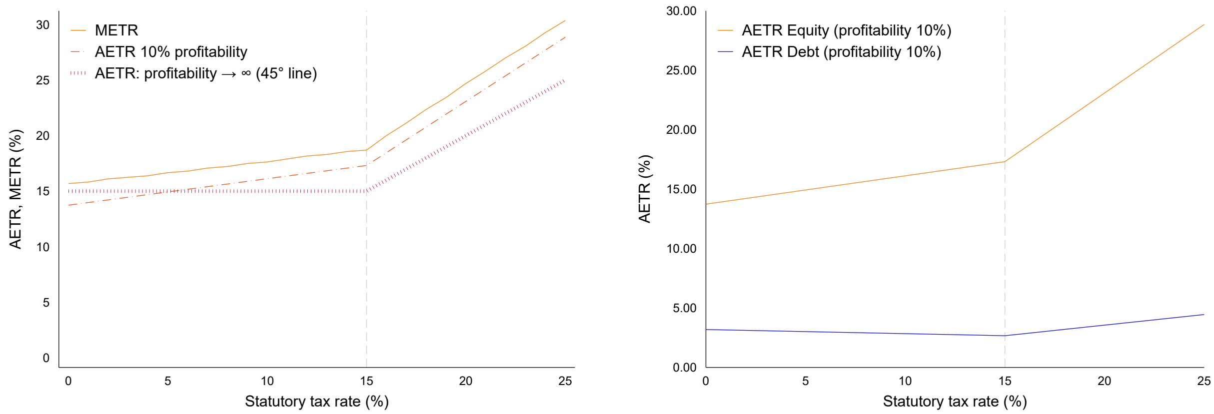
Proof. See Appendix. □

Proposition 2. *If $\tau_t^{topup} > 0 \, \forall t$, even if the SBIE is equal to the normal return in NPV term $\left(\sum_{t=1}^{\infty} \frac{SBIE_t}{(1+i)^t} = \frac{r}{r+\delta}\right)$, the top-up tax amount is strictly positive.*

Proof. See Appendix. □

The policy-relevant question that arises is: what tax base provisions or tax system designs can lower the METR (ideally to zero to eliminate investment distortion) without triggering a minimum tax that falls on normal return? This question is the focus of the remainder of the paper, starting with an analysis of tax base provisions under a standard CIT and then examining how efficient rent tax designs are affected by the minimum tax.

Figure 2: *AETRs under a CIT and a Minimum Tax*



(a) *Standard CIT and a Minimum Tax*

(b) *Debt vs. Equity; p =10%*

Note: METR stands for the marginal effective tax rate, computed for the marginal investment that just breaks even (post-tax). AETR stands for the average effective tax rate. The figure assumes full equity financing, an inflation rate of 5%, a real interest rate of 5%, an economic depreciation rate of 25%, a depreciation rate for tax purposes of 25%, and a full loss offset. The figure assumes that the assets are entirely tangibles (i.e., the lowest possible top-up tax, given payrolls), and payrolls comprise 50 percent of tangibles (the average for U.S. multinationals taken from the Bureau of Economic analysis). This means that the calibration sets the SBIE at 5% of 150% of tangibles. The analysis takes into account that the SBIE cannot be carried forward. As profitability increases (given a statutory rate), the AETR converges to the statutory tax rate (the 45° line outside of the top-up region and to the minimum rate of 15% in the top-up region (horizontal line). The right panel visualizes the debt bias that persists under the minimum tax.

2.3 Tax Incentives under a Standard CIT and a Minimum Tax

Pillar Two rules distinguish between two types of domestic tax credits. The first is refundable tax credits paid as cash (or equivalents) within four years, referred to as 'qualified refundable tax credits (QRTCs)'. QRTCs increase the covered income by the full amount of the credit; that is, QRTCs increase the denominator in the Pillar Two effective rate causing it to decline (Table 1). And it raises the top-up tax base by the amount of the credit. The second type of credits includes any other tax credits, which are then deemed as non-qualified refundable tax credits (NQRTCs) that reduce the covered tax (that is, NQRTCs decrease the numerator in Pillar Two effective rate). A NQRTC lowers the Pillar Two effective rate by more than a QRTC (of the same amount) does, and hence gives a higher τ^{topup} (Table 1). NQRTCs do not change the top-up tax base.

Let X denote the amount of the tax credit, so that the tax amount without a minimum is $(\tau\pi_t^c) - X_t$. Considering the minimum tax, the average tax payment in period t for the QRTCs and

Table 1: *Top-up Rate and Base with Tax Credits*

	No Credits	QRTC	NQRTC
Top-up rate	$15\% - \frac{\tau\pi_t^c}{\pi^c}$	$15\% - \frac{\tau\pi_t^c}{\pi^c + X_t}$	$15\% - \frac{\tau\pi_t^c - X_t}{\pi_t^c}$
Top-up base	$\pi_t^c - SBIE_t$	$\pi_t^c + X_t - SBIE_t$	$\pi_t^c - SBIE_t$

Note: (N)QRTC stands for a (Non)Qualified Refundable Tax credit. X is the amount of the tax credit. $SBIE$ is substance-based income exclusion.

NQRTCs, respectively, is:

$$ATR_t^Q = \tau - \frac{X_t}{\pi_t^c} + \max\left(0, \left(15\% - \frac{\tau\pi_t^c}{\pi^c + X_t}\right)\right) \max\left(0, 1 + \frac{X_t}{\pi_t^c} - \frac{SBIE_t}{\pi_t^c}\right), \tag{12}$$

$$ATR_t^{NQ} = \tau - \frac{X_t}{\pi_t^c} + \max\left(0, \left(15\% - \tau - \frac{X_t}{\pi_t^c}\right)\right) \max\left(0, 1 - \frac{SBIE_t}{\pi_t^c}\right). \tag{13}$$

Following the logic of deriving Equation 5 and using Equations 12 and 13, we derive the AETRs and define the METR as in Equation 6 (as documented in the Appendix). However, when the tax liability is lower than the credit amount in a given year, the excess credit is carried forward without interest. Since the timing of the carryovers and the amounts of credits granted in a given year affect the NPV of taxes at the end of the project, there is no closed-form expression for either the AETR or the METR. Therefore, we use a routine to compute both, also taking into account that any excess of the SBIE above the covered income cannot be carried forward.[27] The key lessons from the ETRs with tax credits are summarized in Proposition 3.

Proposition 3. *Under a standard CIT, full loss offset, and a binding minimum tax,*

(a) Both QRTCs and NQRTCs increase the top-up tax by less than the value of the credit. Hence, the total tax is lower with either QRTCs or NQRTCs than under a CIT without tax credits.

(b) The QRTC results in a lower AETR than the NQRTC when the SBIE is low, and vice versa. The NQRTC leads to a lower AETR than the QRTC as $SBIE \to \pi^c$.

Proof. See Appendix. □

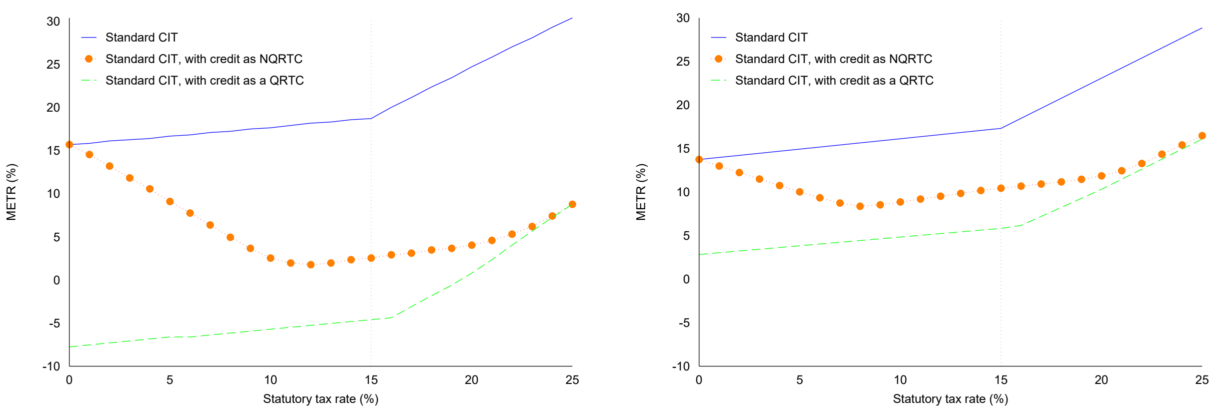
Intuitively, regarding part (b) of Proposition 3, if $SBIE = \pi^c$, then the top-up tax base ($\pi_t^c - SBIE_t$) is zero for any value of a NQRTC (Table 1). In contrast, under a QRTC, there will be a top-up

[27] Note that the equivalence between the approach of King (1974) and that of Devereux and Griffith (2003) does not hold under a top-up tax combined with a QRTC or an NQRTC. However, the difference tends to be negligible in practice, as discussed in the Appendix.

tax, the base of which is the credit itself ($\pi_t^c + X_t - SBIE_t = X_t$). However, despite this tax on that credit, the investment ends up with a lower total tax because, for each dollar of refunded cash, only a portion is taxed.

To get a sense of the magnitudes, Figure 3 plots the METRs and AETRs for a fully equity-financed investment in the presence of a minimum tax and the different types of tax credits. The two main messages are: (i) a negative METR (i.e., a subsidy) is possible even under a minimum tax through a QRTC; and (ii) the METR and AETR tend to be lower under the QRTCs than NQRTCs, but converge as τ increases (for a given size of the tax credit). The reason behind the latter is that the application of the minimum tax is prevented at some high τ. This cutoff τ is higher for NQRTCs.

Figure 3: *Tax Credits under a Minimum Tax*



(a) *METR* **(b)** *AETR; p =10%*

Note: METR stands for the marginal effective tax rate, computed for the marginal investment that just breaks even (post-tax). AETR stands for the average effective tax rate. The figure assumes full equity financing, an inflation rate of 5%, a real interest rate of 5%, an economic depreciation rate of 25%, a depreciation rate for tax purposes of 25%, and full loss offset. The figure assumes that the assets are entirely tangibles (i.e., the lowest possible top-up tax, given payrolls), and payrolls comprise 50 percent of tangibles (the average for U.S. multinationals taken from the Bureau of Economic Analysis). This means that the calibration sets the SBIE at 5% of 150% of tangibles. The analysis takes into account that the SBIE cannot be carried forward. (N)QRTCs are (non)qualified refundable tax credits that affect the top-up rate and base as in Table 1. The size of the credit is assumed to be 10 percent of the value of the investment in net present value terms.

3 Cash-Flow Tax

3.1 No Minimum Tax

The tax base for the R-based cash-flow tax comprises net real transactions ('R-based'), meaning it includes only real (non-financial) cash flows. This system eliminates the tax deductibility of interest payments and the corresponding taxation of interest income received by lenders, such as banks. Gross inflows are represented by sales, including sales of capital goods. Gross outflows cover all expenses including labor costs, and purchases of intermediate and capital goods. Financial transactions like interest payments, variations in net debt, and dividend distributions are excluded from the tax base. In cases of losses, the system allows for immediate tax refunds or the option to carry these losses forward, applying an appropriate interest rate. The R-based cash-flow tax is thus not identical to a CIT providing immediate expensing (which would be combining a 100 depreciation upfront with interest deductions), as we will discuss below.

The other forms of cash-flow taxes are the R+F-based cash-flow tax (where the tax base includes net real transactions and net financial transactions) and the S-based cash-flow tax (where the base is net distributions of companies to shareholders). We show in the Appendix (along the lines in Meade Committee, 1978) that these are equivalent to the R-based cash-flow tax, and proceed here with the R-based form.

The NPV of the total tax paid under the R-based cash-flow tax is:

$$\begin{aligned} T^{R-based} &= -\tau I + \sum_{t=1}^{\infty} \tau \frac{(1+\theta)^t (p+\delta) \times (1-\delta)^{t-1} I}{(1+i)^t} \\ &= \underbrace{-\tau A + \frac{\tau(p+\delta)}{r+\delta} I}_{\text{standard CIT}} \quad \underbrace{-\tau I + \tau A}_{\text{time value of immediate expensing}} \\ &= \frac{\tau(p-r)}{r+\delta} I. \end{aligned} \tag{14}$$

Equation 14 can be decomposed into two components:

1. The first component, $-\tau A + \frac{\tau(p+\delta)}{r+\delta} I$, is the net present value of the standard CIT payment overtime.

2. The second component, $-\tau I + \tau A = \tau(A - I)$, represents the reduction in the net present value of the tax due to immediate expensing (compared to a standard CIT). *Higher* tax rates ($\uparrow \tau$), *higher* discount rate ($\downarrow A$), or *lower* standard depreciation rate ($\downarrow A$)) increases the benefit of immediate expensing.

Dividing Equation 14 by the net present value of the return, gives the AETR under a cash-flow tax:

$$AETR^{R-based} = \frac{\frac{\tau(p-r)}{r+\delta}I}{\frac{p}{r+\delta}I} = \tau(1-\frac{r}{p}). \quad (15)$$

As under a standard CIT, the AETR gradually converges to the statutory tax rate τ as economic rent increases ($\uparrow p$), since then the ratio r/p approaches zero. The left panel of Figure 4 visualizes this convergence toward the 45° line as profitability increases (given τ). For instance, the AETR for an investment with profitability of 20 percent is always higher than that with a profitability of 10 percent. However, the AETR for a fully equity-funded investment under the cash-flow tax remains lower than under a standard CIT (the left panel of Figure 1 versus that in 4).

Eliminating Investment Distortions

The pre-tax economic rent is $\frac{p-r}{r+\delta}$ whereas the post-tax economic rent of a project in a cash-flow tax system as $(1-\tau)\frac{(p-r)}{r+\delta}$. Solving for the user cost of capital that sets the post-tax economic rent to zero gives $\tilde{p} = r$.

If profit equals the normal return $r = p$, Equation 15 collapses to zero for any τ and, hence, the METR is zero for all τ (recalling that the METR corresponds to the AETR of a project that yields economic return equal to the cost of capital). This result makes the cash-flow tax efficient: it does not affect the decision to undertake the marginal investment (since post-tax return is equal to pretax return).[28] On the contrary, for a standard CIT, for example with the parameterization in Figure 1 at $\tau = 15$ percent, the METR on a fully-equity funded marginal investment reaches 20 percent (compared to zero under a cash-flow tax).

Eliminating Debt Bias

The R-based cash-flow tax does not allow interest deductions, as shown in Equation 15 that does not contain an analogous term to $-\frac{\tau\alpha i}{p(1+\theta)}$ in Equation 7. The system is, therefore, independent of the mode of financing (debt or equity), and R-based cash-flow tax eliminates the debt bias of the standard CIT system. It is also not affected by the depreciation function since it does not include the term A.

[28] Sandmo (1979) proves that τ needs to be constant to ensure the neutrality of the cash-flow tax, although future changes in τ remain consistent with investment neutrality if the weighted average of those future changes is equal to the initial τ.

3.2 A Minimum Tax with an R-based Cash-Flow System

In the case of the R-based cash-flow taxation, the domestic tax base π_t and profit as defined in the minimum tax rules, π_t^c, may differ, which means the domestic tax paid and covered tax may also differ. This difference arises because Pillar Two treats immediate expensing and interest deductions differently, with particularly important consequences for debt-financed investments. Consider first equity-financed investments. Pillar Two treats immediate expensing as a timing measure and calculates tax paid following accounting procedures. Let π_t be the profit for an equity financed project. Profit (for the minimum tax rules) π_t^c is equal to π_t and the top-up base is $\pi_t - SBIE_t$. The top-up rate is $15\% - \frac{\tau\pi_t}{\pi_t} = 15\% - \tau$; that is, the math is the same as under the standard CIT. This implies that for equity-financed investments, the Pillar Two effective *rate* is the same as under the CIT. But for debt-financed investments, the interest is not deducted for domestic tax purposes, whereas it is deductible from π_t^c . Thus, the Pillar Two effective rate is higher (and, consequently, the top-up rate is lower) for debt-financed investments compared to equity-financed investments (see also Table 2): $\tau_t^{topup} = 15\% - \frac{\tau(\pi_t^c + net\ interest\ deductions)}{\pi_t^c} < 15\% - \tau$. The top-up base is: $\pi_t - interest\ expenses - SBIE_t = \pi_t^c - SBIE_t$. Thus, the minimum tax introduces a debt bias even within the cash-flow taxation system.

The NPV of the tax on equity-financed investment is given by augmenting Equation 15 as follows:

$$T^{R-based,\,Pillar2} = \tau\frac{(p-r)}{r+\delta}I + \max(0, 15\% - \tau)\sum_{t=1}^{\infty}\frac{\max\left(0, (\pi_t^c - SBIE_t)\right)}{(1+i)^t}. \tag{16}$$

The AETR becomes:

$$AETR^{R-based,\,Pillar2} = \tau(1-\frac{r}{p}) + \frac{\max(0, 15\% - \tau)\sum_{t=1}^{\infty}\frac{\max(0,\,(\pi_t^c - SBIE_t))}{(1+i)^t}}{p/(r+\delta)}. \tag{17}$$

From Equation 17, it can be readily seen that if $\tau > 15\%$, the METR remains zero as no top-up tax applies. However, if $\tau < 15\%$, the top-up tax is applied on normal return, resulting in $METR > 0$. Proposition 4 summarizes the implications of Pillar Two under an R-based cash-flow tax.

Proposition 4. *Under a minimum tax and a full loss offset that is regraded as a timing measure for the top-up tax:*

(a) If $\pi_t^c - SBIE_t \leq 0\ \forall t$, no top-up tax applies and the R-based cash-flow tax system retains its efficiency (METR = 0)

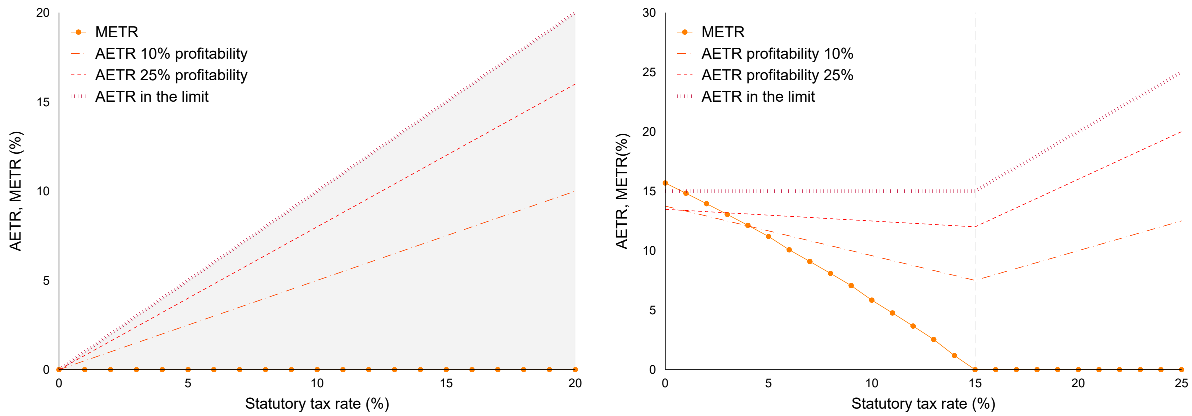
(b) *If* $\pi_t^c - SBIE_t > 0$ *for at least one* t*:*

- *If* $\tau < 15\%$*:*
  - *For an equity-funded investment: the R-based cash-flow tax is no longer efficient and the METR > 0. The resulting AETR is higher than in the absence of a minimum tax.*
  - *For a debt-funded investment: the R-based cash-flow tax remains efficient with a METR = 0 even in the top-up region. The resulting AETR is the same as in the absence of a minimum tax.*
- $\tau \geq 15\%$*, the R-based cash-flow tax retains its efficiency for any investment (METR = 0), and the AETRs in the R-based cash-flow tax with or without a minimum tax are identical.*

Proof. See Appendix. □

Part (b) of Proposition 4 is a key result for guiding countries' responses to the minimum tax. Generally, the minimum tax generates a kink in the AETR for the R-based cash-flow system (Figure 4). From a policy standpoint, it might be a surprising outcome that the METR *increases* as the statutory tax rate τ decreases if there is a top-up tax (as displayed in the right panel of Figure 4). This means that raising τ up to 15 percent is good for the marginal investment. The reason behind this result is that the top-up tax falls on normal return, which would not be taxed at all if $\tau > 15$ percent (or in the absence of a minimum tax altogether).

Figure 4: *METR and AETRs under Cash-Flow Taxes*



(a) *No Minimum Tax* **(b)** *Minimum Tax*

Note: METR stands for the marginal effective tax rate, computed for the marginal investment that just breaks even (post-tax). AETR stands for the average effective tax rate. The figure plots the METR and AETRs under an R-based cash-flow tax assuming full equity financing, an inflation rate of 5%, a real interest rate of 5%, an economic depreciation rate of 25%, a depreciation rate for tax purposes of 25%, and full loss offset. Panel b assumes that the assets are entirely tangibles (i.e., the lowest possible top-up tax, given payrolls), and payrolls comprise 50 percent of tangibles (the average for U.S. multinationals taken from the Bureau of Economic analysis). This means that the calibration sets the SBIE at 5% of 150% of tangibles. The analysis takes into account that the SBIE cannot be carried forward. As profitability increases (given a statutory rate), the AETR converges to the statutory tax rate (the 45○ line outside of the top-up region and to the minimum rate, 15%, in the top-up region (horizontal line).

4 ACE

4.1 Without a Minimum Tax

The other class of efficient rent tax models achieves efficiency by providing allowances for normal returns. It can be in the form of an allowance for corporate capital, irrespective of the financing mode and instead of interest deductions (Boadway and Bruce, 1984). Or equivalently, and as implemented in a few countries, the design maintains interest deductions and tax depreciation while providing notional deductions for equity at the 'normal' return rate (i).[29]

The ACE is neutral with respect to the choice of the tax depreciation method under full loss offset (Keen and King, 2002). Higher depreciation in earlier periods is offset—in NPV terms—by lower future values of the assets and, hence, lower allowances. The ACE is also neutral with respect to inflation. The increase in the real tax amount (with high nominal profits due to inflation) is counterbalanced by an increase in the ACE.

[29]In practice, the allowance rate is linked to the yields on long-term government bonds, as for example in Belgium, Italy, and Türkiye (Hebous and Klemm, 2020; Hebous and Ruf, 2017).

To correctly evaluate an ACE regime, and establish that it is equivalent to cash-flow taxation before introducing a minimum tax, it is crucial to correctly specify the equity base for the tax allowance. Suppose the ACE is given to the non-depreciated value of equity in the first period, then it is not only that the base is inflated (given a higher allowance than the correct ACE) but also the allowance becomes non-neutral with respect to τ or depreciation. Such a specification error increases with inflation and τ. In our analysis, we calculate the allowance based on the *tax-depreciated* value of capital K_t, as it should be[30]:

$$\pi_0^T = -\varphi(I) \tag{18}$$

$$\pi_t^T = (1+\theta)^t(p+\delta) \times (1-\delta)^{t-1} I - \varphi(K_t) - \underbrace{i \times (K_t)}_{\text{ACE}} \qquad \forall t > 0, \tag{19}$$

where $K_0 = I$ and $K_1 = I - \varphi(I)$, $K_2 = I - \varphi(I) - (I - \varphi(I))$, and so on. This implies that the allowance in period 0 is zero. In period 1, the allowance is not for the entire investment I, but for what remains after depreciation. This issue is not a mere technicality, as failing to specify the ACE base can mislead the evaluation.

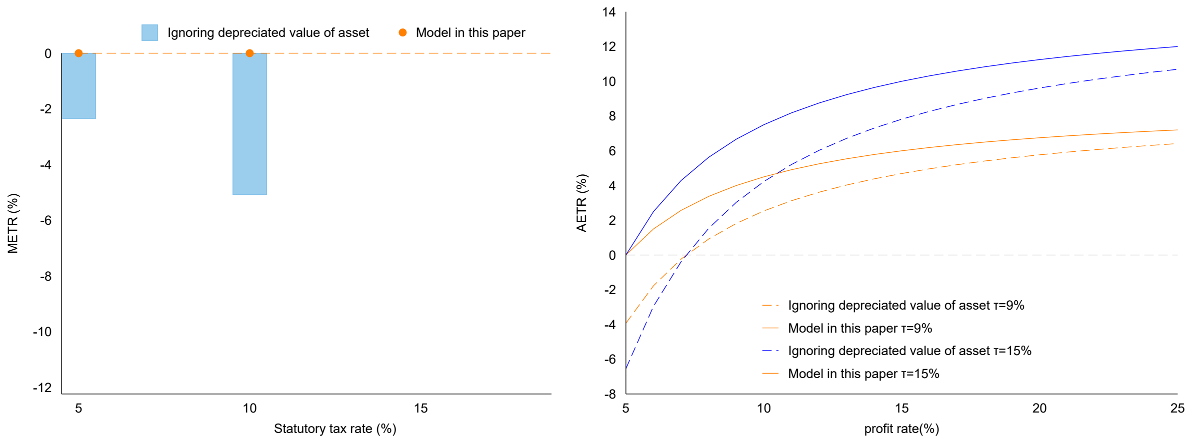
Figure 5 depicts the margin of error if the ACE is granted to the entire investment (as previously done in applied work). For the marginal investment (panel a in Figure 5), and $\tau = 15$ percent, the METR is underestimated by 8 percentage points. Figure 5 also shows that our model predicts a zero METR irrespective of τ. In panel b, we see that as the profitability increases the underestimation of the AETR declines; that is, the underestimation of the METR is more severe than that of the AETR at a high profitability. Moreover, in the Appendix, we show that the METR is neutral with respect to the choice of the depreciation function or inflation.

Proposition 5. *Under a full loss offset, in the absence of a minimum tax the ACE implies the same AETR as the R-based cash-flow tax (as given in Equations 14 and 15) and a zero METR.*

Proof. See Appendix. □

[30] Here, the allowance $i \times (K_t)$ is given to the normal return to capital, irrespective of the financing mode (debt or equity). An alternative way of writing it is as follows. The extent of debt-financing reduces the allowance for equity, which is offset by an equivalent amount of interest deductions (that is, no debt bias): In period 1, $\pi_t^1 = (1+\theta)(p+\delta)I - \varphi(I - \varphi(I)) - \underbrace{i \times I}_{\text{interest on loan}} - (-\underbrace{i \times \varphi(I)}_{\text{ACE}}) = (1+\theta)(p+\delta)I - \varphi(I - \varphi(I)) - i \times (I - \varphi(I))$. This is equivalent to the taxable income of a project financed with retained earnings as shown in Equation 19.

Figure 5: *METR and AETR under the ACE*



(a) *METR* **(b)** *AETR*

Note: METR stands for marginal effective tax rate. AETR stands for average effective tax rate. ACE stands for allowance for corporate equity. The figure assumes an inflation rate of 5%, a real interest rate of 5%, an economic depreciation rate of 25%, and a depreciation rate for tax purposes of 25%. 'Model in this paper' refers to the model in this paper, which predicts a zero METR for the ACE (under any statutory tax rate), and increasing AETR in profitability and in the statutory tax rate. 'Literature' refers to the common pitfall of granting the ACE on the non-depreciated value of assets.

Eliminating Investment Distortions

Since the METR under the ACE is zero, the tax does not affect the marginal investment. The AETRs on economic rent under the ACE will be the same as under the R-based cash-flow tax without a minimum tax (and are, thus, depicted in the upper panels of Figure 4).

Eliminating Debt Bias

The ACE puts an end to tax-motivated financial structures because returns to equity receive similar deductions as interest expenses. Note that the ACE allows interest deduction of debt by an amount that is lower than that in the standard CIT. Precisely, the deduction for debt in each period under the standard CIT is $i\left[(1+\theta)(1-\delta)\right]^t \; \forall t \geq 0$. By contrast, the interest deduction under the ACE only accounts for normal return and it is expressed as: $i\,(1-\varphi)^t \; \forall t \geq 1$. One condition for the neutrality under the ACE is that the allowance rate is equal to the normal rate of return (at which interest is deducted).

4.2 Introducing a Minimum Tax under an ACE

Any minimum tax raises the question of how to treat the allowance for the normal return. Under Pillar Two rules, there are two possibilities for classifying the ACE: either as a QRTC or an NQRTC (discussed in Subsection 2.3). If the ACE is classified as a QRTC, the allowance is refunded; otherwise, it is classified as an NQRTC.

The ACE as a QRTC and a Minimum Tax

As a QRTC, the ACE raises covered profit, which lowers the Pillar Two effective rate (by raising the denominator), and thus the top-up tax rate (15% $-$ *Pillar Two effective rate*) goes up, as given in: $\max(0, 15\% - \frac{\tau\pi_t^c}{\pi_t^c + (\tau i K_t)})$. The top-up tax base is $\pi_t^c + (\tau i K_t) - SBIE_t$. Two immediate observations emerge in the presence of a top-up tax: (i) given a $SBIE$, the ACE top-up base is always larger than that for the R-based cash-flow tax since $(\pi_t^c + \tau i K_t - SBIE_t) > (\pi_t^c - SBIE_t)$; and (ii) the ACE top-up rate is always higher than the R-based top-up rate (Table 2). Within a system, as shown in Table 2, the top-up rate is always lower for debt-financed than for equity-financed investments.

Table 2: *Top-up Rate: ACE vs. R-Based Cash-Flow Tax*

	ACE NQRTC	vs	ACE QRTC	vs	R-Based
Equity	$15\% - \tau\frac{[\pi_t^c - i(K_t)]}{\pi_t^c}$	$>$	$15\% - \tau \underbrace{\frac{\pi_t^c}{\pi_t^c + (\tau i K_t)}}_{>0\,\&\,<1}$	$>$	$15\% - \tau$
Debt	$15\% - \frac{\tau[\pi_t^c + \textit{net interest deduction} - i(K_t)]}{\pi_t^c}$	$>$	$15\% - \frac{\tau[\pi_t^c + \textit{net interest deduction}]}{\pi_t^c + (\tau i K_t)}$	$>$	$15\% - \tau - \tau\frac{(\textit{net interest deduction})}{\pi_t^c}$

Note: "Equity" and "Debt" refer to 100% equity-financed and 100% debt-financed investments, respectively. The interest deduction is given by $((1+\theta)(1-\delta))^{t-1}$. The allowance "$iK_t$" corresponds to the normal return to capital, irrespective of the financing mode (debt or equity). Note that π_t^c deducts net interest expenses, which causes π_t^c to differ across systems and projects based on financing. For equity-financed projects, interest deductions are zero. In the case of debt financing and the ACE, Pillar Two allows total interest deductions, whereas under the ACE, interest deductions are limited to the normal return iK_t. This necessitates adjusting the numerator to ensure only the normal return iK_t is deducted in the NQRTC case. For a QRTC, we add the tax value of iK_t to income (as per Pillar Two rules) and adjust the numerator to ensure π_t^c excludes interest deductions.

Combining these modifications with Equation 14 (since the ACE yields an identical expression for the AETR without a minimum tax), the NPV of the tax and the corresponding AETR for an equity-funded investment under a fully refundable ACE (as a QRTC) and a minimum tax are, respectively:

$$T^{ACE+Pillar2} = \left\{ \frac{\tau(p-r)}{1+r} I \right\} + \sum_{t=1}^{\infty} \max\left(0, 15\% - \left(\frac{\tau\pi_t^c}{\pi_t^c + \tau i K_t}\right)\right) \frac{\max\left(0, (\pi_t^c + \tau i K_t - SBIE_t)\right)}{(1+i)^t}. \tag{20}$$

$$AETR^{ACE+Pillar2} = \tau\left(1 - \frac{r}{p}\right) + \frac{\sum_{t=1}^{\infty} \max\left(0, 15\% - \left(\frac{\tau\pi_t^c}{\pi_t^c + \tau i K_t}\right)\right) \frac{\max(0, (\pi_t^c + \tau i K_t - SBIE_t))}{(1+i)^t}}{\frac{p}{r+\delta} I}. \tag{21}$$

The key insight (from comparing Equations 16 and 20) is that $T^{ACE+Pillar2} > T^{R-based+Pillar2}$ (given τ) as long as $\pi_t^c + \tau i K_t > SBIE_t$ in at least one t. The top-up tax makes the ACE lose its efficiency (panel (a) of Figure 6). In the presence of a top-up tax, both the METR and the AETR are higher under the ACE than under the cash-flow tax (Figure 6). Without any top-up tax, the AETRs for both systems coincide, and the METR remains zero.

The lower the depreciation, the higher the effective rate of the ACE, thereby widening the difference between both systems. Also, under the top-up, the ACE is no longer neutral with respect to inflation; as inflation increases, $T^{ACE+Pillar2}$ goes up, and the ACE moves further away from the R-based tax.

Proposition 6. *Under a minimum tax, an ACE that is regarded as a QRTC, and a full loss offset that is regraded as a timing measure for the top-up tax:*

(a) The threshold $\tau^{ACE\,QRTC}$ below which the top-up tax rate becomes strictly positive is given by:

$$\tau_t^{ACE\,QRTC} = \frac{15\%\pi_t^c}{\pi_t^c - 15\%(iK_t)}.$$

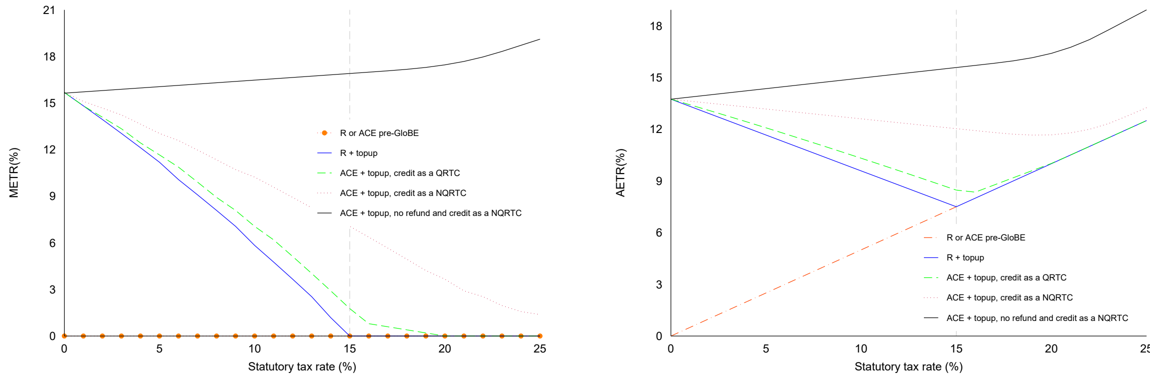
(b) If $[\pi_t^c + (\tau i K_t) - SBIE_t] \leq 0 \; \forall \; t$, no top-up tax applies $\forall \; \tau$, and the METR under the ACE is zero.

(c) If $[\pi_t^c + (\tau i K_t) - SBIE_t] > 0$ and $\tau < \tau_t^{ACEQRTC}$ for any t, then a top-up tax applies, and the METR > 0.

(d) Under (c) above, the top-up tax amount, and hence the METR, are larger than under the R-based cash-flow tax, ceteris paribus.

Proof. See Appendix. □

Figure 6: *ACE vs. R-based Cash-flow Tax Under a Minimum Tax*



(a) *METR* **(b)** *AETR, p=10%*

Note: METR stands for marginal effective tax rate. AETR stands for average effective tax rate. ACE stands for allowance for corporate equity. The figure assumes full equity financing, an inflation rate of 5%, a real interest rate of 5%, an economic depreciation rate of 25%, a depreciation rate for tax purposes of 25%, and a full loss offset. The calibration sets the SBIE at 5% of 150% of tangibles, and the analysis takes into account that the SBIE cannot be carried forward. 'R-based or ACE, no minimum tax' depicts the METR and AETR before introducing a minimum tax, 'R-based + minimum tax' describes the METR and AETR of R-based cash-flow tax inclusive of the minimum tax. 'ACE topup, credit as QRTC' depicts the AETR and METR of an ACE system inclusive of the minimum tax when the ACE is considered a QRTC, while 'ACE topup, credit as NQRTC' shows the AETR and METR of an ACE system when the ACE is considered an NQRTC'. 'ACE + topup, no refund and credit as a NQRTC' additionally relaxes the assumption of full loss offset by allowing the carryforward of losses without refunds or interest.

The ACE as a NQRTC and a Minimum Tax

Countries that adopt an ACE do not refund it. Therefore, treating the ACE as a NQRTC presents a relevant case. If the ACE is deemed as a NQRTC, then the Pillar Two effective rate declines because of a decrease in covered taxes by the amount of the ACE (that is, lowering the numerator): $15\% - \frac{\tau\pi_t^c - \tau i K_t}{\pi_t^c}$, but the top-up base is not affected by this ACE: $\pi_t^c - SBIE_t$. The NPV of the total tax under the minimum tax need to be augmented to account for the possibility of a top-up tax. The additional term for the AETR is $\frac{\sum_{t=1}^{\infty} \max\left(0, 15\% - \tau(1-\frac{iK_t}{\pi_t^c})\right)\frac{\max(0,(\pi_t^c - SBIE_t))}{(1+i)^t}}{\frac{p}{r+\delta}I}$. Proposition 7 summarizes the key insights.

Proposition 7. *Under a minimum tax, and an ACE that is regarded as a NQRTC:*

(a) For any t, the threshold $\tau^{ACE\,NQRTC}$ below which the top-up tax rate becomes strictly positive is given by:

$$\tau^{ACE\,NQRTC} = \frac{15\%\pi_t^c}{\pi_t^c - ik_t},$$

and hence $\tau_t^{ACE\,NQRTC} \geq \tau_t^{ACE\,QRTC}\ \forall\ t$.

(b) *If* $[\pi_t^c - SBIE_t] \leq 0\ \forall\ t$, *no top-up tax applies for any* τ.

(c) *If* $[\pi_t^c - SBIE_t] > 0$ *and* $\tau < \tau_t^{ACE\,NQRTC}$ *for any* t, *then there is a top-up tax and the METR > 0.*

(d) *The top-up tax amount when the ACE is QRTC cannot exceed that when it is NQRTC.*

Proof. See Appendix. □

Comparing part (a) in Propositions 6 and 7 reveals that the threshold τ required to prevent the top-up tax is lower when the ACE is classified as a QRTC rather than a NQRTC, but remains higher than 15%. This can be clearly seen in Figure 6. The METR is significantly higher if the ACE is a NQRTC (Figure 6). The classification of the ACE as a NQRTC raises an important question: Should the value of losses be modeled as refundable or non-refundable? We offer both scenarios here. The general result (see the Appendix) is that for any system, non-refunding the tax value of losses always increases the METR. Without full loss offset, a NQRTC ACE gives the highest rate. A NQRTC ACE with full loss offset is between the NQRTC ACE without full loss offset and the QRTC ACE (with full loss offset). This means, generally, refunding the ACE brings it closer to the R-based cash-flow (i.e., considering it as a QRTC), but it would still remain inefficient and more distorting than the R-based cash-flow tax under a minimum tax. The AETR is also significantly higher if the ACE is a NQRTC (regardless of the treatment of losses).

Part (b) in both propositions (6 and 7) describes a situation in which a very large SBIE is sustained throughout the entire life of the investment. Note, however, that even if this condition holds, it does not make the ACE efficient as a system, because it only maintains a zero METR for that particular investment, not for all investments (depending on the decomposition of tangibles, intangibles, and payroll).

Finally, comparing part (c) in Propositions 6 and 7, the higher top-up rate applied to the smaller base under the NQRTC ultimately leads to overcompensation, resulting in a higher top-up tax amount than under the QRTC ACE (unless $SBIE_t = \pi_t\ \forall\ t$; see Proposition 3).

5 Putting It Together: Comparing the Effects of Different Tax Designs on Investment under a Minimum Tax

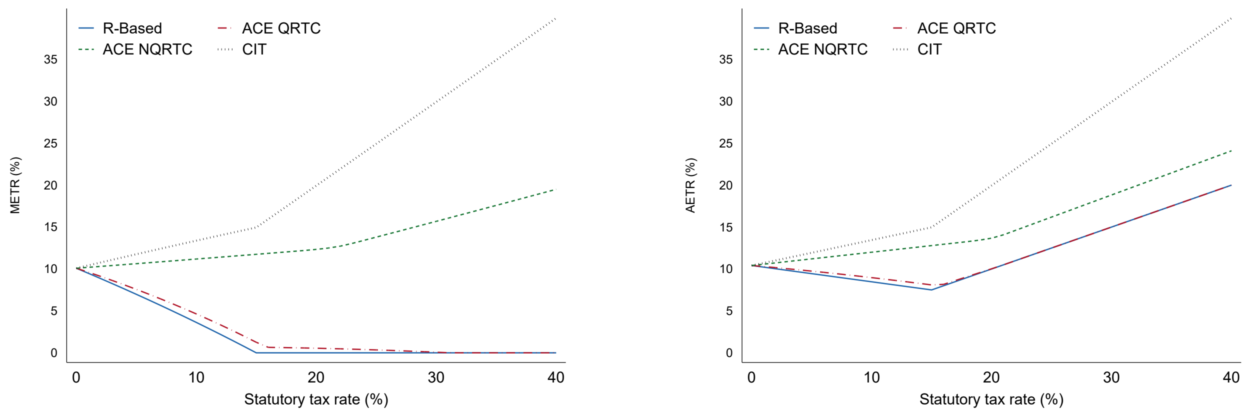
Before concluding, we put the pieces together by comparing the CIT, cash-flow tax, and the ACE, where the ACE can be considered as a QRTC or NQRTC. Consider an equity-funded investment (panel (a) of Figure 7). For any τ, the METR is highest for the commonly existing CIT systems. The METR under the cash-flow tax is never higher than in other systems, and it is zero as long as there is no top-up tax. With a top-up tax (say at $\tau = 10$ percent), the cash-flow METR remains the lowest among all other tax designs.[31] From a policy standpoint, looking at panel (b) of Figure 7, if, e.g., the policy intention is to keep the AETR as high as under the CIT, then the cash-flow tax would set a higher τ (than that under the CIT), but the METR would remain zero, conducive to efficiency.

The analysis in this paper indicates ways to modify the top-up tax base to enhance efficiency. (i) Define the base of the top-up tax as $EBIT_t - I_t$," while allowing carryover with interest (by $\tau \times (EBIT_t - I_t)$" if $EBIT_t - I_t < 0$); or alternatively, (ii) permit deductions for the normal return by modifying the top-up tax base to: "$\pi_t - (ik_{t-1})$," also while allowing for carryover with interest. In addition, both options require allowing the carry-forward of the value of tax losses with interest.

Lastly, we note a few caveats. First, the ranking of policies presented here is not intended to favor one policy over another, but rather to offer a consistent metric for comparison (based on investment efficiency) that informs tax policy decisions. The effectiveness of any policy in attracting investment is ultimately an empirical question, and the extent to which ETRs matter—that is, their elasticities—is left for future research. Here, we provide the method to compute them consistently, including under the minimum tax. Second, as noted in the introduction, the tax policies considered here are not merely theoretical; some countries, for example, are moving in the direction of cash-flow taxation, offering full expensing while restricting interest deductions. The ACE is also proposed in the DEBRA (European Commission, 2022). Third, the analysis here does not preclude aiming to tax the normal return, which can be done at the individual level if that is the policy objective. Derivations in the appendix and the Stata routine incorporate such a policy, along with several other policy combinations.

[31] In the working paper, we show that the ACE outperforms the cash-flow tax only if both systems do not allow refunding tax losses, especially in the absence of a top-up tax.

Figure 7: *METRs and AETRs Across Different Tax Designs*



(a) *METRs*

(b) *AETRs*

Note: METR stands for marginal effective tax rate. AETR stands for average effective tax rate. This figure assumes a fully equity-funded investment, an inflation rate of 2%, a real interest rate of 5%, an economic depreciation rate of 25%, a depreciation rate for tax purposes of 25%, and an SBIT at 5% of 150%. ACE (N)QRTCs are (non)qualified refundable tax credits equal to the normal return, which affect the top-up rate and base as in Table 1. ACE NQRTC in addition relaxes the assumption of full loss offset (i.e., the tax value of losses is not refunded but losses are carried forward without interest).

6 Conclusion

We presented a comprehensive model that enables a coherent comparison of the METRs and AETRs on investment and the cost of capital under a standard CIT and efficient rent tax designs with different variants, with and without the Pillar Two minimum taxation. The key lessons from the detailed analysis—including in the appendix together with the Stata routine—guide profit tax reform evaluation and countries' responses to the minimum tax, as well as building cross-country ETR databases.

We show that the Pillar Two minimum tax can fall on the normal return, and in a particular manner that alters the balance between the ACE and the R-based cash-flow tax. The top-up tax depends on both the top-up rate and the associated top-up base, which are higher under the ACE than under the R-based cash-flow tax. In the presence of a minimum tax, the ACE cannot outperform the cash-flow tax on efficiency grounds. Even with high statutory CIT rates—well above 15 percent—the ACE generates a strictly positive top-up rate. For cash-flow taxation, by contrast, a statutory rate of 15 percent suffices to prevent a top-up tax and thus maintain efficiency. Our findings also clarify that the Pillar Two minimum tax creates a debt bias, as it tolerates interest deductions (allowing interest expense deductions without lower the Pillar Two effective rate), even when the full cost of capital investment is immediately deducted, while penalizing notional equity deductions (which would lead lower the Pillar Two effective rate). The cash-flow tax and ACE are becoming increasingly relevant as more countries adopt full expensing while limiting interest deductibility, and in light of the European Commission's December 2022 proposal to introduce an ACE.

From a policy standpoint, the analysis suggests that avoiding the top-up tax through the appropriate domestic economic rent tax design eliminates distortions to investment and financing structures. For instance, the METR for new investments is zero under an R-based cash-flow tax with a statutory CIT rate of at least 15 percent. In this system, the METR will be zero for all investments, whether made by companies that are in-scope or out-of-scope of Pillar Two. This renders a two-tier system redundant, because by preventing the application of the top-up tax, all companies will face the same tax treatment. Such a design becomes superior—on efficiency grounds—to, for example, a standard CIT with a statutory rate below 15 percent that results in a strictly positive METR. That is, raising revenue through the domestic cash-flow tax while avoiding the global minimum tax is more conducive to investment than raising the same amount from any lower-tax regime that inevitably involves the minimum tax. Moreover, tax incentives through refundable tax credits are particularly attractive instruments under the minimum tax, as they can even generate negative METRs without triggering the application of the minimum tax.

Finally, a global minimum tax design should ideally not interfere with efficient domestic rent tax designs. Equivalence between efficient rent designs under minimum taxation can be achieved by appropriately defining the top-up tax base to reflect the normal return, specifically EBIT after deducting investment (with the carryforward of unused deductions allowed).

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