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

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Abstract

We examine the implications of the international agreement on a minimum corporate tax for multinational investment, measured using forward-looking effective tax rates (ETRs). We show that Pillar Two breaks the equivalence between otherwise equivalent forms of efficient economic-rent taxation—cash-flow taxation and an allowance for corporate equity (ACE). When the top-up tax binds, the minimum tax can fall on the normal return under systems that would otherwise be neutral. Moreover, the marginal effective tax rate (METR) under a cash-flow tax is weakly lower than under an ACE. A key policy implication is that, to preserve efficiency, domestic profit tax design can aim to avoid a binding minimum tax—for example, by combining a cash-flow tax with a statutory rate of at least 15 percent. We apply the ETR methodology to a cross-country sample and illustrate magnitudes under Pillar Two, showing that jurisdictions with statutory rates below 15 percent experience higher ETRs once the top-up tax applies than in the pre–Pillar Two baseline. Finally, the framework clarifies how the minimum tax interacts with investment incentives, enabling quantification of how Pillar Two reshapes ETR differentials relevant for multinational location decisions and international capital allocation.

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

JEL Classification: H21, H25, F23

1 Introduction

The G20/OECD-led Inclusive Framework agreement to establish a 15 percent global minimum effective corporate tax rate ("Pillar Two") represents a path-breaking modification to the century-old international corporate tax architecture. With implementation underway in many jurisdictions, recent studies have focused on how the minimum tax may alter tax competition and profit shifting.[1] Equally important—but thus far less explored—is how a minimum tax affects real investment incentives and the domestic design of profit taxes. In particular, how does the global minimum corporate tax alter the familiar properties of efficient economic-rent taxation? These are the central questions of this paper.

These questions are directly relevant for understanding international capital allocation and cross-border income flows because multinational activity responds to cross-country tax differences through both real channels (capital accumulation, the location of production, and international factor movements) and financial channels (the location of reported profits and cross-border income flows). Pillar Two is designed primarily to address the latter, by curbing very low taxation of profits—most starkly when the associated substance (tangibles and payroll) is small—thereby weakening incentives to locate reported profits in low-tax jurisdictions. At the same time, competition over real investment can persist under Pillar Two because the rules interact with domestic tax-base provisions and with the design of tax incentives. This paper develops a framework to measure the effective tax on investment under alternative tax-incentive regimes and, importantly, under fundamental reforms toward efficient rent taxation. This raises a natural benchmark question: do rent-tax designs that are neutral in the absence of a minimum tax remain neutral once the Pillar Two top-up mechanics apply?

Scholars have long proposed profit-tax designs that avoid the common distortions of existing corporate income taxes (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 deductibility, 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

[1]Several studies examine 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).

by leaving the normal return (the opportunity cost of investment) untaxed, while taxing economic rent (returns above the normal return).

Efficient economic-rent taxation broadly falls into two main classes of models that yield identical outcomes. The first is cash-flow taxation, one form of which is the R-based cash-flow tax. This system provides for immediate expensing of capital investment (the entire cost is deducted upfront rather than through depreciation allowances) while eliminating both interest deductibility and the taxation of interest income.[2] The second class 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 differing design details, a fundamental result is that both classes are equivalent in net-present-value terms and eliminate the above distortions.[4] Establishing this equivalence forms the backbone of our analysis, enabling a consistent comparison between pre- and post-minimum-tax outcomes.

We use a dynamic investment model to derive 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 (1998, 2003) and King (1974)[5]—are a standard tool for evaluating tax effects on investment and countries' attractiveness as hosts of new investments, especially by multinational enterprises. Beyond statutory rates, these measures account for tax-base provisions (notably depreciation rules and the treatment of losses) over the 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 tax on economic rent and is important for discrete location choices. We show that both the ACE and the R-based cash-flow tax imply a zero METR and identical AETRs in the absence of a minimum tax, unlike a standard 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

[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 debt-equity financing), while disallowing interest deductions.

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

[5]See also Hall and Jorgenson (1967) and King and Fullerton (1984).

[6]The discussion focuses on origin-based rent taxation, since it is the prevailing form of CITs and given the implications of Pillar Two for tax policy. Theoretically, rent taxation can be destination-based akin to value-added taxes (see, e.g., Devereux et al. (2021) and Hebous and Klemm (2020)). Under such a border-adjustment system, eliminating both investment distortions and debt bias remains the role of either the ACE or the cash-flow tax.

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 tax burden and METR are higher under the ACE than under the cash-flow tax; (ii) a region where the minimum tax applies only under the ACE, implying a zero METR under the cash-flow tax but not under the ACE; and (iii) a region where the minimum tax is not binding under either system (generally at statutory rates well above 15 percent), restoring equivalence.

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

Under the minimum tax, neither the top-up rate nor the top-up base under an ACE can fall below that under the cash-flow tax, ceteris paribus, because Pillar Two treats them differently. Immediate expensing is considered a temporary timing measure and triggers an upward adjustment to covered taxes—the rules treat the reduced tax in a given year "as if" it had been paid—leaving the Pillar Two effective rate unchanged.[9] In contrast, the ACE can reduce the Pillar Two effective rate (as it is not treated as a timing measure) and can therefore trigger a top-up tax. The exact treatment depends on whether the ACE is refunded, as we model in detail. 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 these (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, eliminating

[7] Profit is referred to as "GloBE Income" in the agreement: accounting profit after some adjustments, such as excluding certain intercompany dividends. "Covered" taxes refer to taxes attributable to income.

[8] To avoid confusion, the Pillar Two effective rate is a contemporaneous average tax rate (tax over income), not the forward-looking ETR 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 a given project declines over time due to depreciation of tangibles, given labor. In the rules, the SBIE is computed at the firm level.

the minimum tax altogether. While this restores efficiency for that investment under both the ACE and the cash-flow tax, it is driven by project characteristics. An efficient rent tax should be neutral with respect to the decomposition of assets and labor, maintaining a zero METR irrespective of project or firm characteristics.

Those findings are policy-relevant in two complementary ways: (i) they guide how countries can respond to the minimum tax through domestic tax base and rate choices, as well as incentive design, *given the Pillar Two rules*; and (ii) they indicate how alternative minimum-tax designs could better preserve investment efficiency.

Regarding countries' responses, our derivations of ETRs are useful for evaluating reform options. We also provide corresponding Stata commands, which—beyond replicating this paper—incorporate a wide range of additional policy-relevant options.[11]

Differences in forward-looking effective tax rates shape discrete location choices of high-profit projects and, more broadly, foreign direct investment (FDI) patterns. Beyond the theoretical comparisons, a key contribution of the paper is to provide an applied framework that maps the Pillar Two rules into forward-looking ETRs using actual data. We illustrate how the methodology can be used to compute METRs and AETRs that incorporate minimum-tax mechanics together with country-specific features of profit taxation (including depreciation allowances and the treatment of losses). This enables consistent quantification of how Pillar Two changes forward-looking ETRs and how alternative domestic design choices—including incentives treated differently under the rules—translate into investment distortions.

We use our methodology to compute ETRs for jurisdictions with statutory rates below 15%. For these jurisdictions, the average METR rises from 5.4% to 11.7%. The resulting increase in the world simple-average METR is from 15.6% to 18.1% (and the average AETR from 16.4% to 18.7%). Using an empirical benchmark in which a 5 percentage-point reduction in the METR is associated with roughly a 1.5–1.6% higher long-run machinery-and-equipment capital stock,[12] the global METR increase of 2.5 percentage points corresponds to an illustrative ceteris paribus long-run decline of about 0.8% in that capital-stock measure ($2.5/5 \times 1.6$). These calculations are illustrative: the key point is precisely that countries may respond by shifting toward Pillar Two–compatible incentives (notably refundable credits), and our framework quantifies how such policy choices reshape forward-looking ETRs and, ultimately, investment.

[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] Wen and Yilmaz (2020).

Profit shifting, by contrast, responds to cross-country *statutory* tax differentials (IMF, 2023). In the limiting case of "profits without substance" (i.e., SBIE $= 0$), Pillar Two implies that profits reported in any jurisdiction with $\tau < 15\%$ face an additional top-up of $0.15 - \tau$, compressing the tax differential vis-à-vis a 15% location by $100 \times (0.15 - \tau)$ percentage points (absent offsetting reactions in higher-tax jurisdictions). Using this logic and elasticities from the literature, IMF (2023) estimates that introducing the Pillar Two minimum tax reduces the amount of profit relocated for tax purposes by 36 percent (under simplifying assumptions). However, while this points toward reduced incentives for profit shifting, jurisdictions can combine tax reforms under Pillar Two in ways that yield the same top-up yet imply different forward-looking ETRs on *investment*, which we quantify using the methodology developed here.

We also study how the global minimum tax interacts with tax incentives under these tax systems. A non-refundable tax credit tends to generate a larger top-up tax than a refundable tax credit and can trigger top-up taxes even when statutory rates are well above 15 percent. Importantly, we show that, consistent with the Pillar Two rules, the METR can become negative without triggering a top-up tax (effectively providing a subsidy through refundable credits). Thus, Pillar Two makes refundable tax credits particularly attractive instruments for incentivizing investment.[13] These mechanisms imply that Pillar Two can affect the location of real investment and international capital allocation, and our framework can be used ex ante to evaluate incentive designs and construct cross-country forward-looking ETR measures under Pillar Two.

Within our framework, the key policy lesson is that a country is generally better off avoiding the minimum tax altogether and relying on the domestic tax system to raise revenue, as this can be more efficiency-enhancing. A statutory CIT rate below 15 percent likely results in taxing the normal return due to a binding minimum tax. Alternatives more conducive to investment include combining a statutory rate of at least 15 percent with an R-based cash-flow tax, which prevents the top-up tax and yields a zero METR.[14] This insight also connects to recent reforms that provide full expensing, such as those in the United States and the UK, which converted temporary full expensing to a permanent measure in 2024.[15] The implications of the ACE under Pillar Two are also relevant for countries that have adopted it, such as Belgium and Turkey, as well as for the EC

[13] At the time of writing, discussions are ongoing on treating other incentives—such as qualified refundable tax credits—as "refundable" for Pillar Two purposes even if they are non-refundable under domestic law.

[14] A higher statutory rate would still retain a zero METR while raising revenue from economic rent. Further elements shaping country responses to Pillar Two can be found, for example, in Hebous et al. (2024).

[15] 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.

(2022) draft Directive on the "Debt-Equity Bias Reduction Allowance" (DEBRA).

The other policy implication is that an efficient minimum tax should ideally fall on economic rent only, without undermining efficiency features of 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 in 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 could be defined as "EBIT minus investment" (with carryforward). Such a cash-flow-like top-up base would make the minimum tax compatible with efficient rent-tax designs (restoring equivalences) and would eliminate debt bias.

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.

2 Standard CIT

2.1 No Minimum Tax

Consider a firm that invests K_0 units of capital at $t = 0$, produces once at $t = 1$, and sells the remaining undepreciated capital at the end of period $t = 1$. Let r denote the real discount rate, $\delta \in (0, 1)$ the economic depreciation rate, $\tau \in [0, 1)$ the statutory profit tax rate, and $\phi \in (0, 1]$ the declining-balance (DB) depreciation parameter for tax purposes. Let p denote the (real) marginal revenue product of capital in period 1, net of economic depreciation. For generality, suppose the firm finances a share α of the initial investment with debt and the remaining share $1 - \alpha$ with new equity or retained earnings.[16]

Before specifying the firm's value function, we clarify the treatment of capital gains realized in period 1. We assume that capital gains are not taxed immediately upon realization; instead, the tax liability is proportional to the asset's remaining depreciated value.

[16] Because we abstract from personal income taxes, financing with retained earnings and with newly issued equity yields the same value function.

Under these assumptions, the firm's value function is

$$V_{\mathrm{DG}} = -K_0 + \frac{1-\tau}{1+i}\left(P_1F(K_0,L_1) - W_1L_1\right) + \frac{(1-\delta)(1+\theta)}{1+i}K_0 \\ -\sum_{t=1}^{\infty}\frac{\tau\phi(1-\phi)^{t-1}\Big[(1-\delta)(1+\theta)-(1-\phi)\Big]}{(1+i)^t}K_0 + \tau\phi K_0 + \alpha\tau i\frac{(1-\tau\phi)}{1+i}K_0. \tag{1}$$

Under constant returns to scale (CRS) and optimal labor choice at $t = 1$, the maximized operating surplus can be written as $(1+\theta)(p+\delta)K_0$ (see Online Appendix for the derivation). Let

$$1 + i = (1 + r)(1 + \theta),$$

and define the present value of the declining-balance allowance stream per unit of capital as

$$A = \sum_{t\geq 0}\frac{\phi(1-\phi)^t}{(1+i)^t} = \phi\,\frac{1+i}{i+\phi}.$$

Substituting into (1) yields

$$V_{\mathrm{DG}} = \left[\frac{(1-\tau)(p+\delta)}{1+r} - \frac{(1-\tau A)(r+\delta)}{1+r} + \alpha\tau i\frac{(1-\tau\phi)}{1+i}\right]K_0. \tag{2}$$

Consider first an equity-financed project ($\alpha = 0$). The AETR is defined as the net present value of taxes normalized by the net present value of the economic return:

$$\mathrm{AETR} = \frac{\text{Economic rent under } \tau = 0 \ - \ \text{Economic rent under } \tau > 0}{\text{NPV of the economic return}}.$$

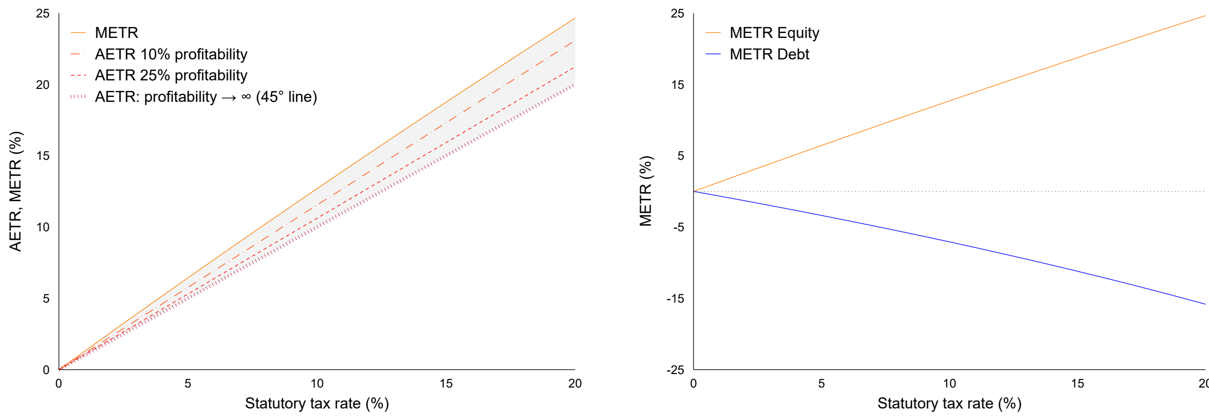
Using Equation 2, we obtain[17]

$$\mathrm{AETR} = \tau\frac{(p+\delta)-(r+\delta)A}{p}. \tag{3}$$

The AETR increases (i) with τ, holding profitability fixed; and (ii) with the interest rate (discount rate), holding τ fixed. For high profitability—that is, as $p \to \infty$ and the term $\frac{\delta - A(r+\delta)}{p}$ approaches zero—the AETR converges to the statutory tax rate τ, as shown in the left panel of Figure 1. The shaded area illustrates that, for a given τ, the AETR declines as profitability increases and approaches the 45° line (i.e., AETR $= \tau$) in the limit of very high profitability. In Figure 1, the

[17]Equation 3 is equivalent to Equation 5 in the working paper version.

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



(a) *Equity-Funded Investment*

(b) *Debt Bias*

Note: METR denotes the marginal effective tax rate, computed for the marginal investment that just breaks even. AETR denotes the average effective tax rate. The figure assumes inflation of 5%, a real interest rate of 5%, economic depreciation of 25%, tax depreciation of 25%, and full loss offset. The left panel assumes full equity financing. For a given profitability level, both AETR and METR increase with the statutory rate. For a given statutory rate, AETR increases as profitability declines and converges to the statutory rate as profitability rises; in the limit ($p \to \infty$), AETR approaches the 45° line. The right panel illustrates debt bias: under full debt finance, the METR is negative (i.e., the tax system subsidizes the marginal investment).

AETR increases as profitability declines for the calibration shown, although for a given level of profitability the AETR can be lower under alternative parameterizations (notably, with higher depreciation allowances).

Higher depreciation allowances lower the AETR (by raising A), consistent with empirical evidence that accelerated depreciation increases investment, such as Zwick and Mahon (2017) for the US and Maffini et al. (2019) for the UK. Note that, for a given investment profile, the AETR can exceed τ depending on depreciation and inflation. In particular, as seen from Equation 3, higher inflation or less generous tax depreciation increases the AETR by lowering A. The AETR is central to the discrete location choice of new investments by multinationals, particularly those generating high profitability from proprietary assets (Devereux & Griffith, 1998). It is also widely used in international tax ranking databases, such as Oxford CBT (2017) and OECD (2023).

Investment distortion

The METR is defined for the marginal investment, i.e., the case of zero economic rent. Let $\tilde{p}$ denote the value of p that sets post-tax economic rent equal to zero. The cost of capital is obtained from the first-order condition for investment,

$$\frac{\partial V_{\text{DG}}}{\partial K_0} = 0,$$

which yields the (net-of-depreciation) user cost of capital:

$$\frac{\partial V_{\text{DG}}}{\partial K_0} = 0 \quad \Rightarrow \quad \tilde{p} = \frac{(r+\delta)(1-\tau A)}{1-\tau} - \delta. \tag{4}$$

The METR is then

$$\text{METR} = \frac{\tilde{p} - r}{\tilde{p}}. \tag{5}$$

In the absence of tax, the marginal investment satisfies $p = r$. If METR $= 0$, the investment that just breaks even pre-tax remains viable after tax, so the tax system does not distort the marginal investment decision. If METR > 0, the tax drives a wedge between the pre-tax and post-tax required return, rendering the marginal investment unprofitable. Under the CIT, an equity-financed investment typically faces a positive METR that increases with τ (Figure 1). If METR < 0, the marginal investment is subsidized.[18]

Debt bias

The financing of investment is an important determinant of the METR and AETR under a standard CIT. Debt-financed investments benefit from interest deductibility and therefore tend to face lower AETRs than fully equity-financed investments, which receive no deduction for the normal return. With partial debt finance ($0 \leq \alpha \leq 1$), the net present value of taxes—and hence the AETR in (3)—must be adjusted for interest deductions. The AETR becomes

$$\begin{aligned} \text{AETR} &= \underbrace{\tau \left[1 + \frac{\delta - A(r+\delta)}{p}\right]}_{\text{full equity financing}} - \underbrace{\frac{\tau\alpha\, i\,(1-\tau\phi)}{p(1+\theta)}}_{\text{debt bias}}, \\ \tilde{p} &= \underbrace{\frac{(r+\delta)(1-\tau A)}{1-\tau} - \delta}_{\text{full equity financing}} - \underbrace{\frac{\alpha\,\tau i\,(1-\tau\phi)}{1+\theta}}_{\text{debt bias}}. \end{aligned} \tag{6}$$

Reducing interest deductions—for example, by lowering the debt share α—raises the AETR, while the tax benefit from debt finance increases with τ. Setting $\alpha = 0$ reduces (6) to (3) and (4).

[18] If the policy intention is to tax the normal return, this can be achieved at the individual level while maintaining a zero METR at the corporate level.

There are two sources of debt bias. First, debt receives interest deductions, captured by the additional term $-\frac{\tau\alpha\, i\,(1-\tau\phi)}{p(1+\theta)}$ in (6). Second, the amount deducted is not tied to the normal return and can exceed it.[19] As a result, the METR for a fully debt-financed investment can be negative due to interest deductions that exceed 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 a higher statutory rate increase debt bias. The welfare implications of debt bias have been studied extensively, generally motivating reforms that reduce or eliminate the tax preference for debt finance (e.g., IMF, 2016; Mirrlees Review, 2011; Sørensen, 2017; Weichenrieder and Klautke, 2008).

One approach to eliminating debt bias is the Comprehensive Business Income Tax (CBIT) proposed by Department of the Treasury (1992). The CBIT treats debt like equity by denying interest deductions while exempting interest income. As a result, Equation 3 also gives the AETR for debt-financed investment under the CBIT, thereby neutralizing debt bias relative to (6). However, the CBIT leaves the investment distortion unaddressed, as the METR remains positive (cf. (5)). Two rent-tax systems that address both investment distortion and debt bias are cash-flow taxation and the allowance for corporate equity (ACE). Next, we examine how the minimum tax affects METRs and AETRs under the CIT.

2.2 Introducing a Minimum Tax to a Standard CIT

Under Pillar Two, the minimum tax is computed in two steps. First, in each year t, the top-up tax rate is

$$\tau_t^{\text{topup}} = \max\left(0,\, \tau_{min} - \frac{T_t^c}{\pi_t^c}\right),$$

where $\tau_{min} = 15\%$.[20] Covered domestic taxes are $T_t^c = \tau\pi_t^c$ and covered income is π_t^c, which includes loss carryforwards from previous periods. We will see later that under the ACE or cash-flow taxation, the domestic tax base generally differs from π_t^c. Under the CIT considered here (starting from a system without tax incentives), the domestic tax base and covered profit coincide, implying

$$\tau_t^{\text{topup}} = \max(0,\, \tau_{min} - \tau). \tag{7}$$

[19] In the standard CIT system, the per-period deduction for debt is typically denoted $i(1-\tau\phi)\big((1+\theta)(1-\delta)\big)^{t-1}$ for all $t \geq 1$, while a deduction for the normal return is expressed as $i(1-\phi)^t$ for all $t \geq 1$. The latter implies a zero METR for all inflation and depreciation levels. Under the standard debt deduction, in contrast, both AETR and METR depend on inflation and the depreciation rate.

[20] More generally, the threshold 15% can be replaced by a parameter $0 < a < 1$.

Second, if $\tau_t^{\text{topup}} > 0$, the top-up tax is applied to covered profit in excess of the substance-based income exclusion (SBIE). After a transition period, the SBIE is set at 5% of tangible assets and payroll. The top-up base in year t is therefore

$$\max\big(0,\, \pi_t^c - \text{SBIE}_t\big),$$

which explicitly captures that if $\text{SBIE}_t > \pi_t^c$ in some t, the top-up base is zero and there is no carryover.[21] If $\tau_t^{\text{topup}} = 0$, the minimum tax is not binding, irrespective of the SBIE. Hence, total tax in year t is

$$T_t^{\text{Pillar2}} = \tau\pi_t + \max(0,\, \tau_{min} - \tau)\, \max\big(0,\, \pi_t^c - \text{SBIE}_t\big), \qquad \forall\, t \geq 0. \tag{8}$$

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 (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').[22]

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, even if the pre-minimum-tax rate exceeds 15 percent in NPV terms when considering the investment as a whole, a top-up tax can still apply in some years. The NPV of the tax therefore

[21] If instead the top-up base were written as $\pi_t^c - \text{SBIE}_t$, the analysis would implicitly assume that any "excess SBIE" can be carried forward to reduce future top-up bases.

[22] 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. The treatment of the current U.S. GILTI and its coexistence with Pillar Two remain under discussion at the time of writing.

accounts for any yearly top-up taxes paid over the lifetime of the investment. Second, when the minimum tax is binding, the top-up tax amount is generally a function of the SBIE, which depends on two factors: (i) the value of the (tangible) asset; and (ii) wages, which evolve endogenously in each period with the optimal capital–labor ratio (depending on the functional form).

Losses can be carried forward indefinitely under Pillar Two rules as a deduction in the computation of π_t^c. In our analysis, as is standard in the literature, we maintain full loss offset and assume that any tax-loss refunds or interest on the loss carryforward do not affect the Pillar Two effective rate.

Under Pillar Two, the cost of capital and the AETR depend on the production technology—assumed here to exhibit constant returns to scale—and are given by the following expressions (see the Appendix for the derivation):

$$\tilde{p}^{\min} = \begin{cases} \dfrac{1}{1-\tau^{\min}} \Bigg[(r+\delta)(1-\tau A) - \tau \dfrac{i(1-\tau\phi)}{1+\theta} \\ \qquad + (\tau^{\min}-\tau)\left(\dfrac{\theta}{1+\theta} - \delta - \dfrac{i(1-\tau\phi)}{1+\theta} - \dfrac{\gamma_K}{1+\theta} - \gamma_L\,\omega\,\lambda \right) \Bigg] - \delta, & \text{if the top-up tax binds,} \\ \tilde{p}, & \text{otherwise.} \end{cases} \tag{9}$$

$$\text{AETR}^{\min} = \text{AETR} + \frac{1}{p}\max\{0, \tau^{\min}-\tau\}\max\Big\{ (p+\delta) + \frac{\theta}{1+\theta} - \delta - \frac{i(1-\tau\phi)}{1+\theta} - \frac{\gamma_K}{1+\theta} - \gamma_L\,\omega\,\lambda,\ 0 \Big\}. \tag{10}$$

where γ_K denotes the capital carve-out, γ_L the payroll carve-out, ω the real wage, and λ the labor-to-capital ratio implied by the firm's optimal labor choice (i.e., after optimizing the value function with respect to labor). Determining $\omega\lambda$ requires specifying the production technology. Throughout the paper (and in the accompanying Stata routine), we use a Cobb–Douglas production function for quantification.[23]

If the top-up tax does not bind—either because the top-up rate is zero (i.e., the jurisdictional ETR exceeds the minimum rate) or because GloBE income is zero—the expressions revert to those under the standard CIT without a minimum tax. Accordingly, $\tilde{p}$ and the AETR correspond to the no–minimum-tax case, as in Equations 4 and 3 for an equity-financed project, respectively. The

[23] In the working paper version, the payroll-to-capital ratio was taken from empirical sources and treated as exogenous. This approach effectively imposes a fixed capital–labor ratio regardless of whether the minimum tax applies. In the present version, the ratio is endogenized and determined consistently within the firm's optimization problem.

METR is always defined as in Equation 5.[24]

Thus, the minimum tax raises the METR and AETR in the top-up region (left panel of Figure 2). Both the METR and AETR under Pillar Two exhibit kinks, determined by the cutoff at $\tau = \tau_{min} = 15\%$. Above this cutoff, the minimum tax is no longer binding, and both the METR and AETR converge to those shown in Figure 1.[25] 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. If no top-up tax applies, the AETR reduces to the no-minimum-tax case (the 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 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 $\tau < \tau_{min}$, and the minimum tax binds (if $\pi_t^c - SBIE_t > 0$), the resulting METR and AETR are weakly higher than under the standard CIT without a minimum tax.

(b) If $\tau \geq \tau_{min}$, 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 terms $\left(\sum_{t=1}^{\infty} \frac{SBIE_t}{(1+i)^t} = \frac{r}{r+\delta}\right)$, the top-up tax amount is weakly positive.*

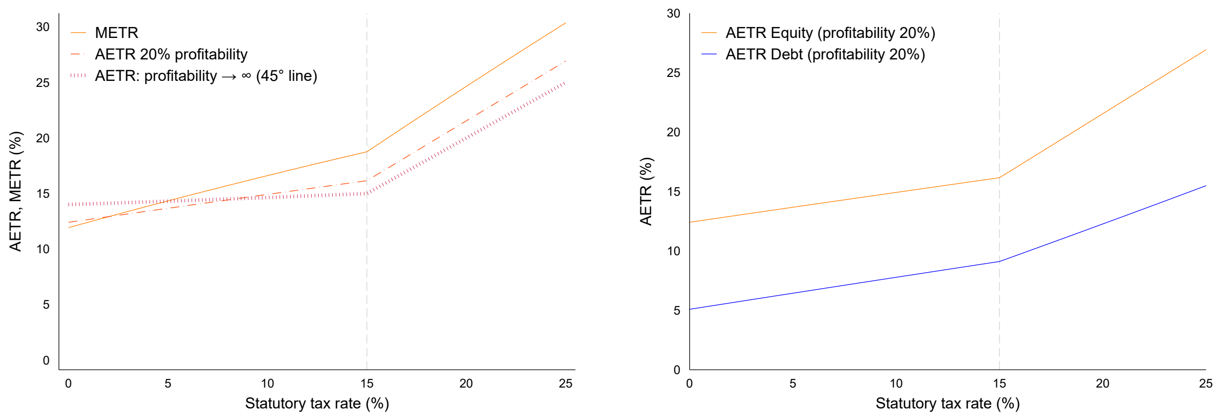
Proof. See Appendix. □

[24] In Equation 9, the top-up binds if $(\tilde{p}_{\min} + \delta)(1+\theta) - \delta(1+\theta) - i(1-\tau\phi) - (1+\theta)\omega\lambda > 0$.

[25] The left panel of Figure 2 reveals an intriguing quirk of the minimum tax. At very low statutory rates (around 5% in the figure), the AETR is lower for low-profit firms and increases with profitability. This occurs because, when profits are small, depreciation allowances and capital-carve-out adjustments—scaled by inverse profitability—dominate the minimum-tax component and depress the effective tax rate. As profitability rises, these base-adjustment terms become negligible and the labor-adjusted minimum-tax component increasingly governs the AETR.

This raises a policy-relevant question: which tax base provisions or tax system designs can reduce the METR—ideally to zero—without causing the minimum tax to fall on the normal return? The rest of the paper addresses this question, first by analyzing tax base provisions under a standard CIT and then by examining how the minimum tax affects efficient rent-tax designs

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



(a) *Standard CIT and a Minimum Tax* **(b)** *Debt vs. Equity; p =20%*

Note: METR denotes the marginal effective tax rate, computed for the marginal investment that just breaks even after tax. AETR denotes 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%, and a tax depreciation rate of 25%. Assets are assumed to be entirely tangible (i.e., yielding the lowest possible top-up tax, given payroll). The payroll-to-capital ratio is derived from a Cobb–Douglas production function with a capital share of 40%. As profitability increases (for a given statutory rate), the AETR converges to the statutory tax rate outside the top-up region (the 45° line) and to the minimum rate of 15% within the top-up region (the horizontal line). The right panel illustrates 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 in cash (or equivalents) within four years, referred to as "qualified refundable tax credits (QRTCs)." QRTCs increase 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). They also raise the top-up tax base by the amount of the credit. The second type of credits includes any other tax credits, which are deemed "non-qualified refundable tax credits (NQRTCs)" and reduce covered taxes (that is, NQRTCs decrease the numerator in the Pillar Two effective rate). A NQRTC lowers the Pillar Two effective rate by more than a QRTC (of the same amount) does, and hence implies a higher τ^{topup} (Table 1). NQRTCs do not change the top-up tax base.

Let X_t denote the amount of the tax credit in period t, so that the tax amount without a

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

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

minimum is $(\tau\pi_t^c) - X_t$. Considering the minimum tax, the average tax payment in period t for the QRTCs and NQRTCs, respectively, is:

$$ATR_t^Q = \tau - \frac{X_t}{\pi_t^c} + \max\left(0, \left(\tau_{min} - \frac{\tau\pi_t^c}{\pi_t^c + X_t}\right)\right) \max\left(0, 1 + \frac{X_t}{\pi_t^c} - \frac{SBIE_t}{\pi_t^c}\right), \tag{11}$$

$$ATR_t^{NQ} = \tau - \frac{X_t}{\pi_t^c} + \max\left(0, \left(\tau_{min} - \tau + \frac{X_t}{\pi_t^c}\right)\right) \max\left(0, 1 - \frac{SBIE_t}{\pi_t^c}\right). \tag{12}$$

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 total tax than the QRTC as $SBIE \to \pi^c$.

Proof. See Appendix. □

Intuitively, for part (b) of Proposition 3, if $SBIE_t = \pi_t^c$, then the top-up tax base $(\pi_t^c - SBIE_t)$ is zero for any value of an NQRTC (Table 1). In contrast, under a QRTC there will be a top-up tax, with a base equal to the credit itself $(\pi_t^c + X_t - SBIE_t = X_t)$. However, despite this tax on the credit, the investment faces a lower total tax burden because, for each dollar of refunded cash, only a portion is taxed.

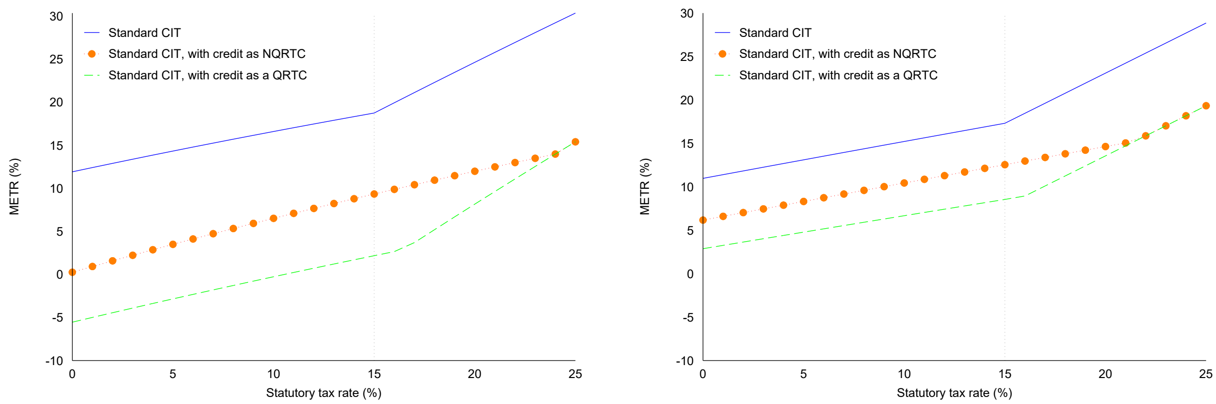
Equations 11 and 12 describe the tax liability in each period under a QRTC and NQRTC, respectively. To derive the METR and AETR in the presence of QRTCs and NQRTCs, we follow the same steps used to derive Equation 3, combining it with Equations 11 and 12 on a period-by-period basis. The economic mechanisms driving the results are described below. The exact formulas are provided in the Appendix.

In addition to the mechanisms outlined in Table 1, both types of credits under Pillar Two affect the firm's *optimal labor choice* for a given level of capital. Through this channel, the payroll carve-out increases, which partially offsets the increase in the top-up tax. Because the optimal labor choice depends on the credit itself, the cost of capital must be solved iteratively as a fixed point. In the analysis, we assume that the credit is linear in capital and report results under a Cobb–Douglas production function. The numerical solution proceeds as follows. In step 1, an initial cost of capital is guessed. In step 2, this guess is substituted into the payroll-to-capital ratio equation to determine $Z = \omega\lambda$. In step 3, the resulting Z is substituted into the cost-of-capital equation and checked for consistency. These steps are iterated until convergence to the fixed-point cost of capital is achieved. In this regard, the NQRTC differs from the QRTC in that it increases the top-up rate substantially more than the QRTC and, because the mitigating payroll-carve-out channel is absent, contributes to higher METRs and AETRs under NQRTCs than under QRTCs.[26]

To get a sense of magnitudes, Figure 3 plots the METRs and AETRs for a fully equity-financed investment under a minimum tax and under 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 QRTCs than under NQRTCs, but converge as τ increases (for a given size of the tax credit). The reason behind the latter is that, at sufficiently high τ, the minimum tax no longer applies. This cutoff value of τ is higher for NQRTCs.

[26] See Sections 1.3 and 1.5 and the summaries on pp. 41–43 of the Appendix.

Figure 3: *Tax Credits under a Minimum Tax*



(a) *METR* **(b)** *AETR; p =20%*

Note: METR denotes the marginal effective tax rate, computed for the marginal investment that just breaks even after tax. AETR denotes 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%, and a tax depreciation rate of 25%. The figure assumes that the assets are entirely tangible (i.e., yielding the lowest possible top-up tax, given payroll). The payroll-to-capital ratio is derived from a Cobb–Douglas production technology with a capital share of 40%. (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 1% of the tax-exclusive value of the investment in period 1.

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 of 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:

$$\begin{aligned} T^{R-based} &= \underbrace{-\tau A K_0 + \frac{\tau A(1-\delta)}{1+r}K_0 + \frac{\tau(p+\delta)}{1+r}K_0}_{\text{standard CIT}} \underbrace{-\tau K_0 + \tau A K_0 - \frac{\tau A(1-\delta)}{1+r}K_0 + \frac{\tau(1-\delta)}{1+r}K_0}_{\text{time value of immediate expensing}} \\ &= \frac{\tau(p-r)}{1+r}K_0 \end{aligned} \tag{13}$$

Equation 13 can be decomposed into two components:

1. The first component, $-\tau A K_0 + \frac{\tau A(1-\delta)}{1+r}K_0 + \frac{\tau(p+\delta)}{1+r}K_0 = \frac{\tau(p+\delta)}{1+r} - \frac{\tau A(r+\delta)}{1+r}$, is the net present value of the standard CIT payment (equivalent to Equation 3).

2. The second component, $-\tau K_0 + \tau A K_0 - \frac{\tau A(1-\delta)}{1+r}K_0 + \frac{\tau(1-\delta)}{1+r}K_0 = \tau(A-1)\frac{r+\delta}{1+r}K_0$, 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 ($\downarrow A$) increase the benefit of immediate expensing.

Dividing Equation 13 by the net present value of the return, gives the AETR under a cash-flow tax:

$$AETR^{R-based} = \frac{\frac{\tau(p-r)}{1+r}K_0}{\frac{p}{1+r}K_0} = \tau(1-\frac{r}{p}) \tag{14}$$

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 $\frac{p-r}{1+r}$ whereas the post-tax economic rent of a project in a cash-flow tax system is $(1-\tau)\frac{(p-r)}{1+r}$. 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 14 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).[27] 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 14 that does not contain an analogous term to $-\frac{\tau\alpha i}{p(1+\theta)}$ in Equation 6. 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.

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

In the case of R-based cash-flow taxation, the domestic tax base π_t and profit as defined under 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^{equity} denote profit for an equity-financed project. For minimum tax purposes, $\pi_t^c = \pi_t^{equity}$ and the top-up base is $\pi_t^{equity} - SBIE_t$. The top-up rate is $\tau_{min} - \frac{\tau\pi_t^{equity}}{\pi_t^{equity}} = \tau_{min} - \tau$; that is, the math is the same as under the standard CIT. This implies that for equity-financed investments, the Pillar Two effective *rate*

[27] 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.

is the same as under the CIT. But for debt-financed investments, 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): $\tau_t^{topup} = \tau_{min} - \frac{\tau\pi_t^{equity}}{\pi_t^{equity} - \text{net interest deductions}} < \tau_{min} - \tau$. The top-up base is π_t^{equity} − interest expenses − $SBIE_t$. Thus, the minimum tax introduces a debt bias even within the cash-flow taxation system.

The expressions for cost of capital and AETR under Pillar Two and cash-flow system depend on the underlying production technology, and in general are (see the Appendix for full derivation):

$$\tilde{p}^{\min} = \begin{cases} \frac{1}{1-\tau^{\min}}\left[(r+\delta)(1-\tau) + (\tau^{\min}-\tau)\left(\frac{\theta}{1+\theta} - \delta - \frac{\gamma_K}{1+\theta} - \gamma_L\,\omega\,\lambda\right)\right] - \delta, & \text{if the top-up tax binds,} \\ \tilde{p} = r, & \text{otherwise.} \end{cases} \tag{15}$$

$$AETR = AETR^{R-based} + \frac{max\big(0,(\tau^{\min}-\tau)\big)max\left(\left[(p+\delta) + \frac{\theta}{1+\theta} - \delta - \frac{\gamma_K}{1+\theta} - \gamma_L\,\omega\,\lambda\right], 0\right)}{p} \tag{16}$$

From Equation 15, it can be readily seen that if $\tau > \tau_{min}$, the cost of capital is equal to real interest rate, and the METR remains zero as no top-up tax applies. However, if $\tau < \tau_{min}$, the top-up tax is applied on the normal return, resulting in $METR > 0$. The expressions for the cost of capital and AETR under cash-flow taxation and Pillar Two are in the appendix. 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 regarded as a timing measure for the top-up tax:*

(a) If $\pi_t^c - SBIE_t \leq 0$ for all 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 $\tau < \tau_{min}$:*
  - *For an equity-funded investment: the R-based cash-flow tax is no longer efficient and $METR > 0$. The resulting AETR is higher than in the absence of a minimum tax.*

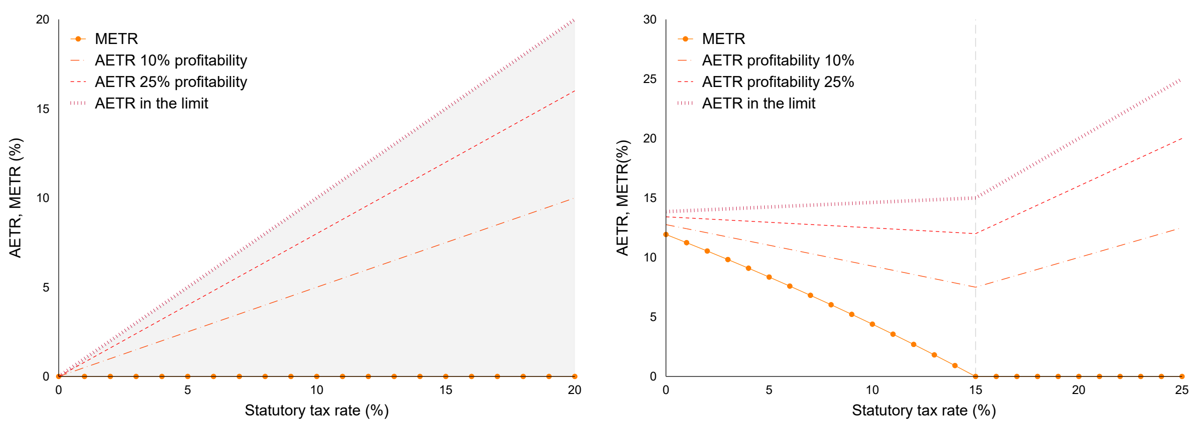
– *For a debt-funded investment: the R-based cash-flow tax remains efficient with METR $= 0$ even in the top-up region. The resulting AETR is the same as in the absence of a minimum tax.*

- *If $\tau \geq \tau_{min}$, 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 to at least 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 $\tau > \tau_{min}$ (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 AETR 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%, and a depreciation rate for tax purposes of 25%. Panel b assumes that the assets are entirely tangible (i.e., the lowest possible top-up tax, given payrolls). The payroll-to-capital ratio is derived under a Cobb–Douglas production technology with a capital share of 40%. As profitability increases (given a statutory rate), the AETR converges to the statutory tax rate outside of the top-up region (the 45° line) and to the minimum rate of 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).[28]

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.

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 specify the equity base for the tax allowance. Suppose the ACE is given on the non-depreciated value of equity in the first period; then the base is inflated (given a higher allowance than the correct ACE) and the allowance becomes non-neutral with respect to τ or depreciation. Such a specification error increases with inflation and τ. In our two-period model, the value of the allowance is:[29]

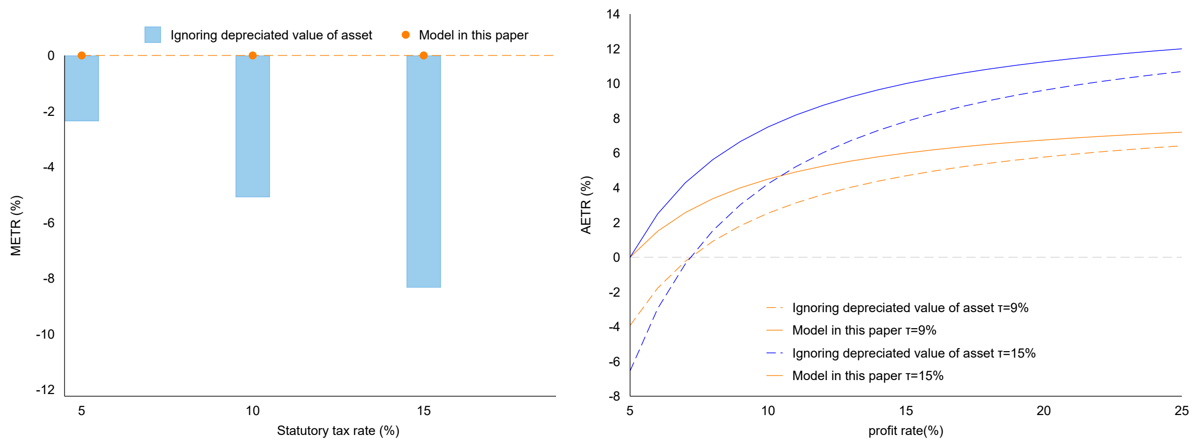
$$\tau(1+\theta)(1-\delta)(1-A)K_0 \tag{17}$$

Thus, we clarify a recurring issue in applied forward-looking ETR work: negative METRs reported for ACE systems can arise from a mis-specification of the allowance base—specifically, overlooking the depreciated value of equity in the first period, which inflates the allowance base. We show numerically that this error can materially bias both METRs (even producing negative values) and AETRs for low-profitability investments.

[28] 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).

[29] 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 17.

Figure 5: *METR and AETR under the ACE*



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

Note: METR stands for the marginal effective tax rate. AETR stands for the average effective tax rate. ACE stands for the 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 an AETR that increases with profitability and the statutory tax rate. 'Literature' refers to the common pitfall of granting the ACE on the non-depreciated value of assets.

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) of 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 profitability increases the underestimation of the AETR declines; that is, the underestimation of the METR is more severe than that of the AETR at 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 13 and 14) and a METR of zero.*

Proof. See Appendix. □

Eliminating Investment Distortions

Since the METR under the ACE is zero, the tax does not affect the marginal investment. The AETRs on economic rents 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 eliminates tax-motivated financial structures because returns to equity receive deductions similar to those for interest expenses. Note that the ACE allows an interest deduction for debt that is lower than that under the standard CIT. Precisely, the deduction for debt in each period under the standard CIT is $i(1-\tau\phi)\left[(1+\theta)(1-\delta)\right]^{t-1}\ \forall t \geq 1$. By contrast, the interest deduction under the ACE accounts only for the normal return and is expressed as: $i\,(1-\varphi)^{t}\ \forall t \geq 1$. One condition for neutrality under the ACE is that the allowance rate equals 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 as 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 (τ_{min} − *Pillar Two effective rate*) increases, as given by $\max\{0, \tau_{min} - \frac{\tau\pi_t^c}{\pi_t^c+(\tau i K_t)}\}$. The top-up tax base is $\pi_t^c + (\tau i K_t) - SBIE_t$.[30] Two immediate observations emerge in the presence of a top-up tax: (i) given $SBIE_t$, 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 given system, as shown in Table 2, the top-up rate is always lower for debt-financed than for equity-financed investments.

Combining these modifications with Equation 13 (since the ACE yields an identical expression for the AETR without a minimum tax) gives the cost of capital and the corresponding AETR under a fully refundable ACE (as a QRTC) and a minimum tax (see the Appendix for the full expressions). The key insight from comparing the AETRs under a fully refundable ACE (treated as a QRTC) and the cash-flow system is that $AETR^{ACE+Pillar2} > AETR^{R\text{-}based+Pillar2}$ (given τ). The top-up tax makes the ACE lose its efficiency (panel (a) of Figure 6)—just like under the cash-flow

[30] In this two-period model, the capital stock in period 1 satisfies $K_t = (1-\phi)K_0$.

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

	ACE NQRTC	vs	ACE QRTC	vs	R-Based
Equity	$\tau_{min} - \tau \frac{\left[\pi_t^{equity} - i(K_t)\right]}{\pi_t^{equity}}$	$>$	$\tau_{min} - \tau \underbrace{\frac{\pi_t^{equity}}{\pi_t^{equity} + (\tau i K_t)}}_{>0\,\&\,<1}$	$>$	$\tau_{min} - \tau$
Debt	$\tau_{min} - \frac{\tau\left[\pi_t^{equity} - i(K_t)\right]}{\pi_t^{equity} - net\ interest\ deduction}$	$>$	$\tau_{min} - \frac{\tau\left[\pi_t^{equity}\right]}{\pi_t^{equity} - net\ interest\ deduction + (\tau i K_t)}$	$>$	$\tau_{min} - \tau \frac{\pi_t^{equity}}{\pi_t^{equity} - net\ interest\ deduction}$

Note: "Equity" and "Debt" refer to 100% equity-financed and 100% debt-financed investments, respectively. The net interest deduction (i.e., interest expense allowed to be deducted under Pillar Two rules) in period 1 is given by $i(1 - \tau\phi)$. The allowance iK_t corresponds to the normal return to capital, irrespective of the financing mode (debt or equity). In period 1, it is given by $i(1 - \phi)$. Note that π_t^{equity} refers to the base for covered tax for equity-financed projects. 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 that 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 that π_t^c excludes interest deductions.

tax as well. However, 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 tax, 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 regarded as a timing measure for the top-up tax:*

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

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

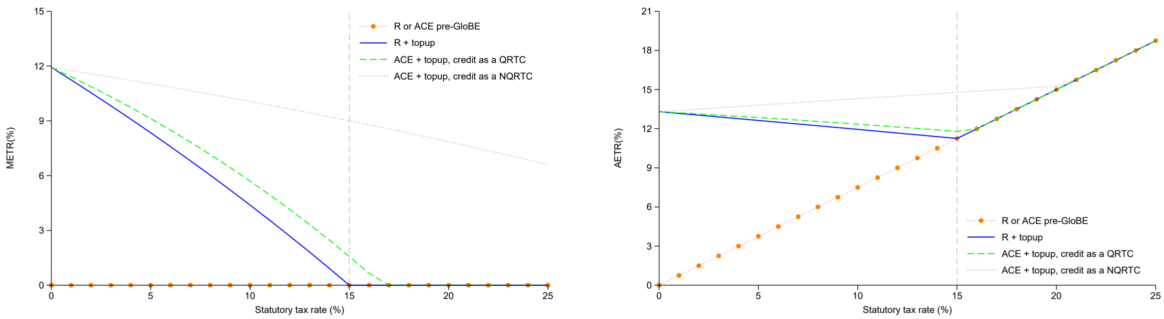
(b) If $[\pi_t^c + (\tau i K_t) - SBIE_t] \leq 0\ \forall\, t$*, no top-up tax applies* $\forall\, \tau$*, and the METR under the ACE is zero.*

(c) If $[\pi_t^c + (\tau i K_t) - SBIE_t] > 0$ *and* $\tau < \tau_t^{ACE\,QRTC}$ *for at least one* 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 the marginal effective tax rate. AETR stands for the average effective tax rate. ACE stands for the 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%, and a depreciation rate for tax purposes of 25%. The figure is based on the assumption that the assets are entirely tangible (i.e., yielding the lowest possible top-up tax, given payroll). The payroll-to-capital ratio is derived under a Cobb–Douglas production technology with a capital share of 40%. 'R-based or ACE, no minimum tax' depicts the METR and AETR before introducing a minimum tax. 'R-based + minimum tax' depicts the METR and AETR under an R-based cash-flow tax inclusive of the minimum tax. 'ACE + top-up, credit as QRTC' depicts the METR and AETR under an ACE system inclusive of the minimum tax when the ACE is considered a QRTC, while 'ACE + top-up, credit as NQRTC' depicts the METR and AETR under an ACE system when the ACE is considered an NQRTC.

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 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 resulting cost of capital and AETR are higher than if it is a QRTC. 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 $\tau_t^{ACE\,NQRTC}$ below which the top-up tax rate becomes strictly positive is given by:

$$\tau_t^{ACE\,NQRTC} = \frac{\tau_{min}\pi_t^c}{\pi_t^c - iK_t},$$

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) of Propositions 6 and 7 reveals that the threshold τ required to prevent a 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 classified as a NQRTC (Figure 6). The classification of the ACE as a NQRTC raises an important question: should the tax 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 tax (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 classified as a NQRTC (regardless of the treatment of losses).

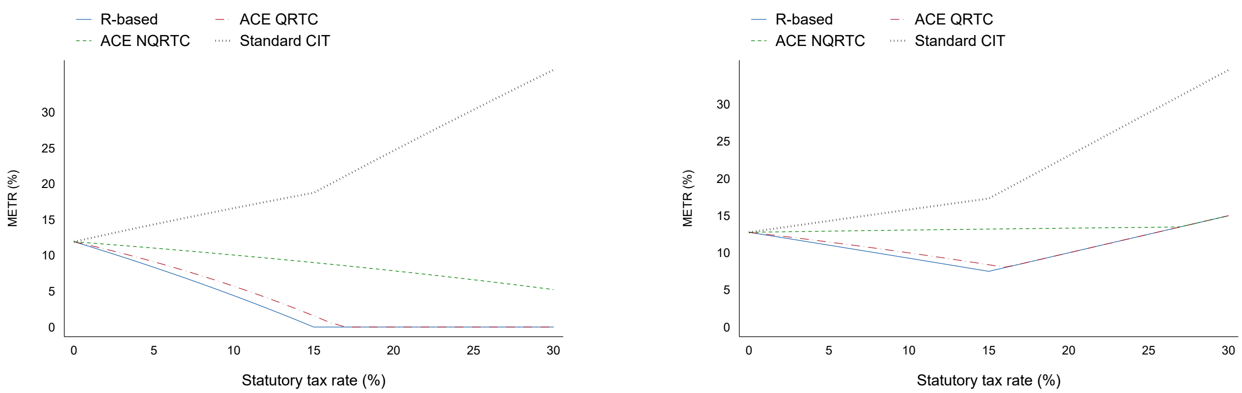
Part (b) of both propositions (6 and 7) describes a situation in which a very large SBIE is sustained throughout the entire life of the investment. Note, however, that even if this condition holds, it does not make the ACE efficient as a system, because it only maintains a zero METR for that particular 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, the 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 under the commonly used CIT system. The METR under the cash-flow tax is never higher than under the other systems, and it is zero as long as there is no top-up tax. With a top-up tax (say at $\tau = 10\%$), the cash-flow METR remains the lowest among all 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 require a higher τ than under the CIT, but the METR would remain zero, conducive to efficiency.

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 5%, a real interest rate of 5%, economic depreciation rate of 25%, and a depreciation rate for tax purposes of 25%. The figures are based on the assumption that the assets are entirely tangible (i.e., the lowest possible top-up tax, given payrolls). The payroll-to-capital ratio is derived under a Cobb–Douglas production technology with a capital share of 40%. 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).

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 (i.e., by carrying forward "$\tau \times (EBIT_t - I_t)$" if $EBIT_t - I_t < 0$) [32]; or alternatively, (ii) permit deductions

[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.

[32] In the two-period model used in this paper, a one-unit investment yields EBIT in period 1 equal to $(1+\theta)(p+\delta) + (1-\delta)(1+\theta)$, while the deduction in period 0 is equal to one. In net present value (NPV) terms, excess profit is therefore

$$\frac{(1+\theta)(p+\delta) + (1-\delta)(1+\theta)}{1+i} - 1 = \frac{p-r}{1+r}.$$

Here, $(1+\theta)(p+\delta)$ denotes the nominal value of production net of wages and intermediate input costs, and $(1-\delta)(1+\theta)$ represents the proceeds from the sale of depreciated capital. Since the domestic corporate tax liability equals $\tau(p-r)/(1+r)$, total taxation inclusive of the top-up tax equals $\tau_{\min}(p-r)/(1+r)$ when $\tau_{\min} > \tau$, and $\tau(p-r)/(1+r)$ when $\tau_{\min} < \tau$. As a result, investment efficiency is preserved irrespective of the inflation rate or the statutory tax rate.

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.

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. 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 (EC, 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.

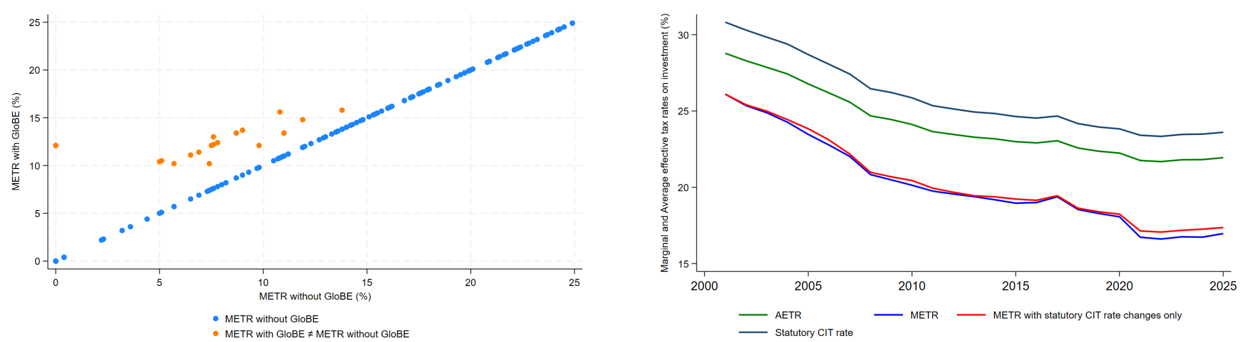
To illustrate the empirical relevance of the framework, we apply our forward-looking ETR methodology to a cross-country sample and compute the implied METR under Pillar Two, comparing outcomes before and after the application of the 15% minimum tax (left panel of Figure 8). This figure shows that jurisdictions with statutory rates below 15% experience a systematic increase in forward-looking effective tax rates due to top-up taxes (Figure 8). Across all countries in our sample, the average METR increases from 18.6% to 19.7%, while the average AETR (not shown in the figure) rises from 20.4% to 21.3%. The effect is driven by countries with statutory rates at or below 15%, where the average METR increases from 7.5% to 11.5% and the average AETR from 9.3% to 13.4%.[33]

How countries react becomes important because Pillar Two reshapes the margin on which countries can compete. By construction, it constrains competition over *profits*: jurisdictions with statutory rates below 15%—or higher-tax countries with preferential regimes that imply rates below 15%—can no longer sustain such low taxation of profits once a top-up tax applies. This restriction is clearest in the limiting case of "profits without substance" (i.e., SBIE $= 0$), where the minimum tax operates most tightly and pushes the tax rate on the residual profit base up to 15%. More generally, Pillar Two compresses the statutory rate differentials that typically motivate profit shifting, thereby reducing incentives to relocate profits to very low-tax jurisdictions.

[33] The sample includes 173 countries for which data on tax depreciation provisions and statutory tax rates are available. The United States is excluded, as its current minimum tax design differs from the country-by-country structure of Pillar Two. The computed effective tax rates under Pillar Two are relevant even when a low-tax jurisdiction does not adopt a qualified domestic minimum top-up tax, provided that the headquarters jurisdiction applies the Income Inclusion Rule, in which case the top-up tax is collected abroad rather than domestically.

At the same time, Pillar Two still leaves scope for competition over *investment* through domestic base provisions and incentive designs that are compatible with its rules. This is the margin our forward-looking ETR framework is designed to quantify: given a tax system, Pillar Two rules, and project characteristics, what METR/AETR does the investment face? Figure 8 illustrates that much of the observed downward trend in METRs and AETRs has been driven by statutory rate cuts. Under Pillar Two, countries can now rely more on base provisions—rather than rate cuts—and specific incentives that yield materially different investment-facing ETRs.

Figure 8: *METRs and AETRs for a Sample of Countries With and Without Pillar Two*



(a) *METR*

(b) *AETR*

Note: METR denotes the marginal effective tax rate for a marginal investment that breaks even after tax, and AETR denotes the average effective tax rate. Countries with identical statutory CIT rates can have different METRs because of differences in tax depreciation rules. The left panel (173 countries) reports METRs under the standard CIT system and under Pillar Two, before and after applying the top-up tax; jurisdictions with statutory CIT rates below 15% typically exhibit higher forward-looking METRs under a binding top-up tax. Although the figure focuses on the statutory CIT system, the same approach extends to tax incentives under Pillar Two (see Section 2.3). The right panel (153 countries) shows average METR and AETR. The blue line incorporates changes in both depreciation rules and statutory rates; the red line holds depreciation rules fixed at 2001 country-specific levels and varies only statutory rates. The gap implies that movements in METRs are driven mainly by statutory rate cuts rather than base changes; since 2020, downward trends flattened. See the Appendix for data sources.

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 and the accompanying 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 can generate a strictly positive top-up rate. For cash-flow taxation, a statutory rate of 15 percent suffices to prevent a top-up tax and thus maintain efficiency. The findings also clarify that the Pillar Two minimum tax creates a debt bias, as it tolerates interest deductions (considered the default setting) even if the total cost of capital investment is immediately deducted, while penalizing notional deductions to equity (as it would lower the Pillar Two effective rate).

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 as EBIT after deducting investment, with the carryforward of unused deductions allowed.

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