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A Firm Lower Bound: Characteristics and Impact of Corporate Minimum Taxation[1]

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Abstract

This paper examines the role of minimum taxes and attempts to quantify their impact on economic activity. Minimum taxes can be effective at shoring up the corporate tax base and enhancing the perceived equity of the tax system, potentially motivating broader taxpayer compliance. Where political and administrative constraints prevent reforms to the standard corporate income tax, a minimum tax can help mitigate base erosion from excessive tax incentives and avoidance. Using a new panel dataset that catalogues changes in minimum tax regimes over time around the world, firm-level analysis suggests that the introduction or reform of a minimum tax is associated with an increase in the average effective tax rate of just over 1.5 percentage points with respect to turnover and of around 10 percent with respect to operating income. Minimum taxes based on modified corporate income lead to the largest increases in effective tax rates, followed by those based on assets and turnover.

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Content	**Page**

I. INTRODUCTION

One of the overriding issues in international corporate income taxation is limiting the ability of firms to artificially (re)allocate profits to low or zero-tax jurisdictions to reduce their worldwide tax liability. Multinational enterprises (MNEs) can exploit differences in domestic tax laws to shift profits across borders and erode domestic tax bases using intra-group transactions, financial arrangements, and corporate structuring, which are unavailable to local companies. Specific avoidance activities include transfer pricing—for example, charging relatively lower prices for goods and services transferred from high-tax to low-tax affiliates—and the strategic use of inter-affiliate debt—for example, financing the activities of high-tax affiliates using debt issued by low-tax affiliates.

As a result, policymakers are keen to eliminate the spectacle of these MNEs with large earnings paying little or no corporate income taxes locally, leaving the burden of corporate income tax (CIT) to fall primarily on domestic (non-MNE) firms and the overall burden of taxes onto less mobile bases more broadly. Yet at the same time, the strategic response of governments has been to constrain CIT revenues instead by exerting downward pressure on CIT rates to attract (or retain) both real investment and mobile paper profits—the former typically driven more by effective tax rates and the latter by statutory rates (Devereux and Griffith 1998, 2003). As a result, CIT rates have fallen by around 20 percentage points on average since 1980 (IMF 2019).

Despite this, corporate income tax revenues have remained robust on average over time. In some countries, for example, the United States, revenues have started to increase even as rates have fallen. And CIT revenues have grown markedly as a share of GDP in countries at all income levels since the early 1980s—making issues of base erosion and profit shifting that much more urgent when it comes to domestic revenue mobilization. While revenues from natural resources have played an important role in explaining this strong performance in recent years, CIT revenues have also benefited from the growing share of corporate profits in national income. Nevertheless, CIT revenues remain volatile for most countries and at risk from globalization and the pervasive use of tax preferences in some regions.

As a result, minimum taxes (MTs) have re-emerged as an instrument of interest to help deter tax evasion and avoidance—particularly for developing economies—by limiting the ability of MNEs to exploit domestic tax system differentials (IMF 2019). These taxes can provide some respite to those policymakers looking to shore up tax systems and ensure they deliver a certain amount of domestic revenue. Developing economies with weaker tax administrations, in particular, face some of the greatest challenges when it comes to effectively taxing this complex segment of large taxpayers. Sub-Saharan Africa has also witnessed a growing tendency to offer tax incentives and special tax treatment to attract footloose international investment, jeopardizing tax neutrality in production incentives across borders and further undermining the buoyancy of the CIT.

In late 2019, the OECD formulated a global anti-base erosion ("GloBE") proposal to stop a harmful race to the bottom on corporate taxes (OECD 2019). The GloBE proposal is based on the premise that, in the absence of a coordinated and multilateral solution, there is a risk of uncoordinated, unilateral action, both to attract more tax base and to protect the existing tax

base, with adverse consequences for all jurisdictions. Therefore, depending on its design, the OECD's proposal hopes to shield developing economies from the pressure to offer inefficient tax incentives—in other words, eliminate CIT competition on both rates and base aimed at attracting investment activity, and stem forgone revenue losses for countries with extensive CIT incentives. While the OECD proposal differs in important ways from the types of MTs this paper focuses on, critics of both proposals are concerned that such instruments may impair the ability of automatic stabilizers to work properly during a sharp economic shock such as the current pandemic driven recession. Furthermore, if developing economies were to introduce MTs, the margin of international competition for mobile investment could in principle shift to the use of subsidies instead—though it would be important to be aware of WTO issues should they arise. Notwithstanding, consensus is building around the importance of MTs to shore up CIT revenues, especially given its potential as a "recovery contribution" to recover lost fiscal resources in the aftermath of the historically unprecedented stimulus packages being rolled out by governments around the world. Even if distorting production efficiency on the margin and potentially slowing down the recovery, MTs may be third-best optimal in a world with a high marginal value of public funds (Mayshar 1990) and scarce resources.

At present, there is little in the literature that reviews and explores the potential impact of MTs on revenues and economic activity. This paper attempts to fill this gap by putting together a database of past and current MTs and using macro- and micro-level data to understand their impact. The rest of the paper is structured as follows. Section II defines MTs and reviews the different types currently in operation in the world. Section III examines some of their efficiency and equity implications. Section IV provides some stylized facts of the novel database we created, and attempts to use it to study the impact of MTs on revenues and corporate behavior through use of macro, firm-level, and administrative data sources. Section V concludes. The appendix explores in greater depth several of the rationales for the use of MTs by countries.

II. WHAT IS A MINIMUM TAX?

As the name suggests, corporate MTs are designed to guarantee a floor on the tax liability of businesses. They can take the form of either a fixed payment or use a modified set of rules, which are typically a simplification of the regular tax system, for example, Austria. Alternative MTs (AMTs) are a subset of MTs that represent a parallel liability to that under the "standard" regime—and in some cases could be optional. Where AMTs operate in tandem with the standard income tax system, the taxpayer must compute their tax liability under both the standard tax regime and a parallel regime. The larger amount is then payable.[2] Like broader MTs, the rules for an AMT can, for example, use broader definitions of income and a less generous set of deductions or separate bases and rates. In some countries, MTs can also be creditable against a company's CIT liability and, in others, it has to be paid even if the company is loss-making.

In this paper, we differentiate corporate MTs based on whether businesses are taxed locally or globally on their income—this also relates in part to whether a jurisdiction operates a territorial

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[2] An MT is distinct from an "add-on minimum tax" that complements the standard corporate income tax but frequently requires taxpayers to make payments under both the standard and add-on tax regimes simultaneously.

or worldwide system of taxation, and whether income is taxed on the basis of source vs. residence. (Figure 1).[3]

Figure 1. Determining the Scope of Minimum Taxes

	Inbound	Outbound
Source (Territorial)	Local Minimum Tax	Global Minimum Tax
Residence[1] (Worldwide)	Global Minimum Tax	

[1]Umbrella term to denote different approaches for determining who is subject to worldwide taxation.

The first category of MT has been introduced by countries that tax businesses on income generated based on activity undertaken within their territory, i.e., income that is sourced locally within their jurisdiction. These are what we will refer to as a "local" minimum tax (LMT). In these cases, LMTs apply to (i) domestic resident corporations, and (ii) "inbound activities", where foreign corporations have income and/or activities in the domestic economy, i.e., significant economic allegiance or physical presence—defined through laws and treaty thresholds. Typical cross-border tax issues related to inbound transactions include branch interest taxes, branch profits taxes, domestic withholding taxes, earnings stripping, tax treaty design, and transfer pricing. In the empirical analysis of Section VI, we focus exclusively on LMTs.

The second category of MT is what we have termed a "global" minimum tax (GMT). These relate to "outbound activities", where a domestic multinational has income and/or activities in other countries. For countries with territorial or source-based tax systems, the foreign earnings of these local MNEs are only taxed—if at all—by the source country. Therefore, relatively high domestic CIT rates can provide an incentive for domestic MNEs to keep their profits in foreign jurisdictions with lower tax rates to shield them from a more punitive domestic tax system. For this reason, countries can implement GMTs to ensure a minimum liability on income earned abroad. In addition to transfer pricing, international tax issues related to outbound transactions can also cover anti-deferral, foreign withholding taxes, income inclusion, foreign tax credits and foreign tax credit limitations.

Examples of GMTs include controlled foreign corporation (CFC) rules, which attempt to limit the artificial deferral of tax by using offshore entities in low-tax jurisdictions. The recent GILTI measure introduced as part of the 2017 U.S. Tax Cuts and Jobs Act (TCJA) is also an example of a GMT, which established a minimum tax that targets high-return, highly-mobile intangible income that could otherwise avoid tax, such as patent income. An important point to note is that a country with a worldwide system of taxation that introduces a minimum tax is operating a form of GMT by default.

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[3] This paper does not consider the MT on personal income and focuses on the determinants and impact of MTs on corporate income.

The OECD's own GloBE proposal[4] is another example of a GMT that is intended to mitigate profit shifting and tax competition by ensuring that multinationals' profits are subject to minimum levels of taxation, either in the residence country or in the source country. It envisages both an "outbound rule" (in the form of an income inclusion rule which is exercised by residence countries on low-taxed foreign earnings) and an "inbound rule" (exercised by source countries through the denial of deductions or tax treaty benefits with respect to low-taxed payments). More traditional local minimum taxes under the scope of this paper are most aligned with the latter "inbound rule" component. As noted in IMF (2019), the potential benefits to developing economies from this proposal will be significantly greater if the inbound rule is given precedence over the outbound rule. Furthermore, the design of a MT should be kept relatively simple—to limit administrative and compliance issues—and applied in all tax jurisdictions. Devereux and others (2020) have examined the behavioral impact of this proposal on MNEs, as well as on potential revenue yield. The authors find that while an implementation of such a proposal on a country-by-country basis would mitigate profit shifting, it would raise cost of capital resulting in lower aggregate investment. This paper does not evaluate residence-based minimum taxes, as under CFCs, GILTI, and the income inclusion rule.

A. The Base of the Corporate Minimum Tax

The choice of base is a defining feature of the MT. It can match the regular CIT system or, in the case of AMTs, represent a rationalization of it. In this sense, differences in the computation of alternative minimum taxable income and regular taxable income arise in the treatment of deductions and income—deductions may be reduced and/or taxable income could be accelerated.[5] In most cases, MTs typically use a simplified base that is readily observable and prevents excessive use of either tax preferences or tax planning techniques. Popular alternative simplified bases include turnover (gross income or receipts), assets (net or gross), or a modified form of net income that differs from the standard system by the number of deductions/exemptions that are allowed.

Turnover-based Minimum Taxes

Taxes on alternative output measures—such as turnover—are common in many tax systems. They have proven particularly popular when it comes to the presumptive taxation of certain types of businesses—differentiated, for example, by size or sector. For those businesses, the costs of complying with—as well as the costs of administering—the general income tax system are

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[4] Or modified versions thereof, such as the Minimum Effective Tax Rate for Multinationals proposed by Picciotto and others (2021).

[5] The standard rules of business income taxation call for the recognition of income as it accrues, that is, at its receipt or when all events have occurred that fix the right to receive the income, whichever comes first (Lyon, 1990). Deductions are permitted only when definite liabilities have been incurred. These standard rules are strongly influenced by—but can differ from—both financial accounting practices and economic principles of income measurement. Both standard rules and regular tax rules depart from economic measures of income by not allowing a deduction for the opportunity cost of equity-financed capital. The standard rules, as embodied in some MTs, additionally depart from economic principles by making little or no attempt to adjust measured income for the effects of inflation. The regular tax system gives some consideration for inflation through accelerated depreciation for equipment and valuation rules for inventory.

regressive and so turnover taxes serve as a simple alternative, given that turnover applies to the broader firm population. In the case of small business presumptive taxes, they substitute for the total liability from corporate income tax, VAT, and payroll tax (Wei and Wen 2019). The MTs considered in this paper do not account for such presumptive schemes and special effort has been made to exclude them in the data. Instead we focus on those turnover-based minimum tax schemes that apply to all companies.

As discussed in Best and others (2015) and Almunia and Rodriguez (2014), a tax on turnover can also be harder to evade than a tax on profits. The argument is that firms can evade profits taxes by either under-reporting sales or over-reporting costs, while evading a turnover tax can only be achieved through under-reporting of sales. Assuming underreporting of output is more difficult than producing false input costs, the turnover-based minimum tax reduces the scope for evasion.

However, turnover (or gross receipts) as a measure of business activity is blind to net margins and, therefore, the viability of a business. For example, two businesses with identical turnover but different cost structures—and, therefore, different pre-tax profit margins—will find themselves penalized more heavily under a turnover tax than a simple profits tax (Table 1). In this way, when businesses are taxed on their sales, they must pay tax even when making small profits or losses and setting too high a tax rate on turnover can make the difference between survival and failure. Therefore, as businesses can make losses or low profits due to large investments, too high a tax rate on turnover could act as a disincentive to making those investments. In addition, too high a rate could be a major burden on new companies in their early years and could, therefore, discourage business growth more broadly.

Therefore, as with the design of presumptive tax systems for small businesses, care must be taken when setting the rate of a turnover tax. Subsequently, turnover-based tax rates are much lower than standard CIT rates on profits, given that the turnover tax liability approximates the liability of the standard CIT liability but over a much larger base. Firms whose profit rates are below the ratio of the turnover tax rate to the CIT rate will pay more under the tax on turnover.

Table 1. AETRs under different turnover tax rates and margins.
(US$ unless otherwise indicated.)

		Turnover (Gross Income) Tax		Profits (Net Income) Tax		
		Firm A	Firm B		Firm A	Firm B
T	Tax rate (percent)	2	2	Tax rate (percent)	20	20
A	**Revenue**	**100,000**	**100,000**	Revenue	**100,000**	**100,000**
B	Costs of Goods Sold	50,000	70,000	Costs of Goods Sold	50,000	70,000
C(=A–B)	**Gross Profit**	**50,000**	**30,000**	**Gross Profit**	**50,000**	**30,000**
D	Expenses	20,000	20,000	Expenses	20,000	20,000
E(=C–D)	**Net Operating Income**	**30,000**	**10,000**	Net Operating Income	30,000	10,000
F	Other Income	5,000	5,000	Other Income	5,000	5,000
G	Other Expenses	7,500	7,500	Other Expenses	7,500	7,500
H(=F–G)	**Net Other Income**	**-2,500**	**-2,500**	**Net Other Income**	**-2,500**	**-2,500**
J(=E+H)	**Net Income before tax**	**27,500**	**7,500**	**Net Income before tax**	**27,500**	**7,500**
K(=J*T)	Taxes payable	2,000	2,000	Taxes payable	5,500	1,500
L(=J–K)	**Net income after tax**	**25,500**	**5,500**	**Net income after tax**	**22,000**	**6,000**
M(=K/L)	**Effective Tax Rate (percent)**	**7.8**	**36.4**	**Effective Tax Rate (percent)**	**25.0**	**25.0**
N(=J/A)	Pretax Profit Margin (percent)	27.5	7.5	Pretax Profit Margin (percent)	27.5	7.5

As of 2018, turnover-based MTs were in use across 31 countries and were most common in low- and lower-middle-income countries. Rates vary between 0.2 percent (Tunisia) to 3 percent (Bolivia, Equatorial Guinea, Guinea, and Madagascar) with an average tax rate of 1.2 percent.

Despite their success in raising revenue, the use of such minimum tax schemes violates the result that optimal tax systems should preserve production efficiency, even in second best environments (Diamond and Mirrlees 1971). As a result, turnover-based taxes are rarely used in more developed economies given production chain cascading, where the same items are taxed multiples times, incentivizing firms to integrate vertically (Keen 2013). In this way, they can also discriminate against industries that, by their nature of production, have several production stages organized as distinct businesses.

Instead, as noted, turnover-based MTs have proven popular as a third-best policy across developing economies—in addition to pre-existing second-best CIT systems—as a means for overcoming informational asymmetries (Best et al. 2015). They allow for a loss in production efficiency in exchange for an increase in revenue efficiency, given the greater difficult firms face to evade the broader turnover base.

Assets-based Minimum Taxes

Assets have proven a popular base for past and present MTs in Latin America, with some countries opting to adjust the base for debt and other liabilities. Specifically, the base is the book value of a firm's assets, with some allowances for depreciation allowance and an adjustment for inflation. While Argentina and Mexico applied the MT to gross assets, Peru, Ecuador, Colombia, and Guatemala defined the MT base as assets net of debt and other liabilities, converting the MT into a tax on equity.

The gross assets tax version of the MT is argued to have an important advantage over traditional income taxes, which do not perform well in periods of substantial inflation (Sadka, 1991). Inflation generally destroys the taxable base for traditional taxes on business income. In periods of high inflation, enterprises accumulate large losses that can be carried forward to future years and that guarantee that the enterprises will escape paying any taxes for several years. This is done by companies changing true sizable profits, via nominal interest deductions, into reported losses for tax purposes. Furthermore, since accumulated losses are in some cases carried forward with indexation for inflation, enterprises could go on without any contribution to tax revenues for many years.

Gross assets may also be a good indicator of normal or average income and a tax on gross assets in the long run has similar effects on employment and capital accumulation as a tax on actual income, but it encourages more efficient uses of capital—therefore enhancing growth (Harrod, 1939; Domar, 1946)—and is easier to administer in developing economies, especially in inflationary environments.[6] Indeed, theory suggests that the market value of a firm's assets is equal to the net present value of the future (after-tax) cash flows they generate. That is, the market value of assets more accurately reflects expected future profits—assuming assets are regularly marked to market—rather than profits (or losses) reported for tax purposes.

In an assets-based MT, the tax base should ideally include all fixed assets, such as land, structures, machinery, and equipment (Sadka and Tanzi, 1992). Together with labor, energy, raw materials, and other variable inputs, these fixed capital assets are integral to firm production. The normal, additional (marginal) contribution of these fixed assets to the firm's stream of incomes are what should be taxed.[7] According to the authors, cash balances, accounts receivable, inventories, and other current assets should not be included in the tax base, since they are understood not to be inherent in the production process. In addition, given the higher fluctuation of working capital and current assets relative to fixed capital assets, excluding them from the MT tax base supports the objective of attaining a relatively acyclical source of government revenues.

Furthermore, the tax base should ideally include not only tangible assets but intangible assets as well. For instance, intangible assets, such as brands, goodwill, and market power, certainly have their own contribution to the firm's ability to pay or potential income. Thus, they should, in principle, be taxed. However, the ongoing difficulty of determining arm's length prices for these intangibles means that from a practical standpoint, they should instead be excluded.

However, a number of caveats apply. Using an assets base rather than an income base for the MT will penalize relatively more capital-intensive firms. This effect can be alleviated in part by distinguishing between gross and net assets, but it cannot be eliminated. A net assets-based MT

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[6] A tax on gross assets is neutral with respect to risk-bearing because the tax liability is then a priori given, independently of whether returns are high or low. In contrast, a tax on actual income without a loss offset discourages risk-bearing since it cuts into the owner's return without offering a tax refund in the case of a loss. Full loss offset encourages risk-bearing by sharing equally in profits and losses.

[7] In order to avoid double taxation, the firm's holdings in fully or partially owned subsidiaries or any other companies should not be included in the firm's tax base because the subsidiary itself is liable to pay the tax on its gross assets.

could lead to firms over-leveraging, as increased debt financing is the most obvious way of increasing liabilities and minimizing the firm's MT liability. If the MT is imposed on gross assets, there is no tax advantage to debt over equity financing—all gross assets, no matter how they have been financed, are equally taxed.

The choice of net vs. gross assets also has implications for the choice of rate. Should a country impose a relatively low tax rate on gross assets or a relatively high tax rate on net assets? In a manner similar to the determination of rate equivalences between a turnover-based tax and the standard CIT, we can do the same for an assets-based tax. Suppose that the expected real marginal return on capital is estimated to be p. Assume further that the real rate of interest is r. Under these circumstances, the presumptive "profit" of the firm is taken to be $p - r$ per unit of value of gross assets (after allowing for an imputed interest on equity). If the existing statutory corporate tax rate is τ_π, then our recommended rate of tax, τ_a, on gross assets is given by $\tau_a = \tau_\pi(p - r)$. When resources are (economy-wide) efficiently allocated, p and r are uniform across all firms. And to maintain interfirm and interindustry efficiency, the tax rate on gross assets must be uniform too.

Data suggest that assets-based MTs are not as popular as turnover-based MTs and are currently in place in only 10 countries. Rates vary between 0.4 percent (Peru) to 2 percent (Panama). The average tax rate is 1.2 percent.

Modified-income Minimum Taxes

These types of MTs deviate far less from the standard CIT system than turnover-based and assets-based MTs. They are typically levied on a base that is similar to the standard CIT base, with some variation in deductions, tax credits, and other allowances. Furthermore, as the data shows, the rates applied to these modified income bases are typically much higher (on average around 10 percent), given that the bases can correspond more closely to the standard CIT base.

Modified-income MTs tend to be almost as sophisticated as the standard CIT regime and are more likely to be used by more advanced economies. For example, in Korea, the income subject to the 10 percent "standard" MT is defined as taxable income before certain tax deductions and credits pursuant to the Special Tax Treatment Control Law or the actual CIT liability after various deductions and credits. Furthermore, the rates applicable vary by the level of income, with SMEs subject to a rate of 7 percent.[8]

Against a backdrop of better quality administration and higher rates of compliance, this likely reflects a greater understanding of the source of base erosion—that is the specific incentives or practices that are most harmful—within the corporate sector and, therefore, can put in place a more targeted MT to remove a specific distortion rather than switch more completely to a whole new base.

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[8] 10 percent if the tax base is <KRW 10 billion; 12 percent if the tax base is >KRW 10 billion and <KRW 100 billion, and 17 percent if the tax base >KRW 100 billion.

B. Carry-forward rules

Typically, loss-making firms will also be subject to MT, which—as mentioned earlier—can exacerbate cash-flow problems—something that will be problematic for business survival in severe economic downturns where liquidity constraints can rapidly morph into insolvency.

Countries vary widely in the availability and length of carry forward provisions, which have important implications for the impact of an MT on investment incentives. In those countries that allow MT payments to be carried forward and applied against future excess of regular income tax liabilities over MT, these provisions closely mimic carry forward rules under the standard CIT, but with the added requirement that they cannot be used to reduce payments below the MT liability in any given year.[9]

Under standard carry forward rules, if a taxpayer pays MT and never returns to paying the regular income tax, then the MT represents a permanent increase in its tax liability. However, if a taxpayer eventually pays sufficient regular income tax to fully exhaust all MT credits, then the MT represents an acceleration of its tax payments. The cost of this acceleration to the taxpayer is measured by the time cost of money.

In the example below, under scenario 1 the taxpayer is able to make full use of its MT credit in year 2, given an initial MT credit available in year 1 (Table 1). Under scenario 2, the use of the MT credit is limited to ensure payment of the MT in year 2.

Table 2. Example of Carry Forward Provisions for Minimum Taxes

	Year 1	Year 2 (Scenario 1)	Year 2 (Scenario 2)
MT liability	100	100	100
Income tax liability	80	140	110
Amount paid	100	120	100
"Excess" MT available to be carried forward	**20**	**0**	**10**

Carry back of MT—where MT payments are carried back and offset against previous years' income tax payments—does not appear to be permitted under MTs. This is also logical in countries with newly introduced MTs. Carry backs require calculation of MT liabilities in previous years to avoid reducing tax payments in those years below the MT floor.

C. Foreign Tax Credit Considerations

An MT should be carefully designed to allow MNEs to credit payments against income tax liabilities in their home country. A problem may arise with MTs based on assets or turnover in

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[9] AMT payments are generally defined as the excess of the AMT over regular income tax liability. For example, in a situation where a taxpayer has an AMT liability of 100 and a regular income tax liability of 80, the amount of AMT deemed to have been paid would be 20.

that some countries only allow credit for foreign taxes that are explicitly levied as income taxes.[10] The increase in the effective tax rate on inward investment that results from this denial of tax credits can be mitigated by allowing firms to carry forward their excess MT payments against regular CIT liabilities. However, this assumes that firms paying the MT will eventually return to paying the regular CIT and that the credit is indexed to preserve its value.

The order in which an MT and regular CIT are credited against one another can also affect the availability of foreign tax credits. Countries that operate assets-based MTs tend to use one of two mechanical approaches to characterize payments. The first is simply to require taxpayers to pay the greater of the regular income tax and MT liabilities, for example, tax rules characterize the entire liability as the greater tax, resulting in the complete denial of tax credits when the MT bites.[11] Under the second approach, an MT is allowed as a credit against regular CIT, for example, tax rules state that when two taxes overlap, the tax that is imposed first is the tax for which credit is available (Byrne 1997). In instances where the MT bites, the amount that would have been paid under the CIT can be credited against taxes payable in the country, while the excess MT must be carried forward and offset against future CIT payments.

Given the importance and ubiquity of U.S. MNEs across global markets, some countries may prefer to design MT carry forward rules that maximize the availability of U.S. tax credits, so as to avoid complicated legal challenges down the road. Where the excess of the MT over income tax is carried forward and used as a credit to reduce income tax liabilities in subsequent years, this could create problems when claiming foreign tax credits in the U.S. Instead, the taxpayer should be required to pay his income tax liability in full, and then receive a refund for the excess MT that was carried forward. This achieves the same outcome as a credit mechanism but does not reduce the amount of U.S. tax credits available.

III. EFFICIENCY AND EQUITY

In this section, we turn to the efficiency and equity properties of an MT. These can be fairly complex and nuanced and should ideally be assessed relative to the standard CIT on a country-by-country basis.[12] In a second-best environment with minimal distortionary tax measures and no tax evasion or informality, there should be no need for an MT. Businesses pay according to ability on a measure of activity (profits) without avoiding their obligations. However, in the presence of limited tax enforcement or tax policy deviations from second-best, an MT can be rationalized as a third-best policy. This relates to the theoretical insight from the public finance literature that when at least one commodity cannot be taxed and pure profits are not taxed at 100%, some production inefficiency becomes desirable, even with otherwise unrestricted tax instruments (Best and others, 2015; Munk, 1978, 1980). For example, MTs can be desirable in response to the proliferation of unproductive and inefficient tax preferences or because of the inability of weak tax administrations to effectively prevent non-compliance. An MT is more likely

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[10] Pre-2018, U.S.-based MNEs encountered this difficulty when seeking U.S. foreign tax credits for assets-based taxes paid in Latin American countries.

[11] The "multiple levies" rule of Treasury reg. section 1.901-2(e)(4).

[12] The properties of a minimum tax can also be gauged in part using the optimal administration framework set out in Keen and Slemrod (2017), by determining the elasticity of tax revenue in response to the imposition of an administratively motivated minimum tax.

to have a positive impact on the overall efficiency of the tax system if its objective is to limit the use of tax preferences that encourage inefficient over-investment and a misallocation of resources. For example, suppose that a country offers generous tax depreciation schedules that encourage over-investment in certain asset classes. In this instance, an MT might help restore the neutrality of the tax system by limiting the use of this inefficient tax preference. Similarly, an MT may help to limit the use of tax planning strategies that distort the financing, asset, and location decisions of MNEs.

We can explore the impact of MTs on the marginal effective tax rate (METR) —that is, the wedge between pre- and post-tax rates of return on investment that provides an investor with his minimum *required* post-tax rate of return. Specifically, we can distinguish between (i) the impact of the MT on the METR (investment distortion), and (ii) the impact on different METRs for different assets (portfolio distortion). However, the design of an MT is critical to how an MT will affect these two distortions. For example, the impact will depend on whether the MT is turnover-based, asset-based, or modified-income based - where a cash-flow based MT might have a low METR, an asset-based one may be higher.

The King-Fullerton (1984) model (henceforth KF model) is the workhorse for understanding the impact of different tax systems on the marginal decision to invest, which can be used to incorporate simple MTs to determine the impact on marginal effective tax rates. Bernheim (1989) includes a modified income MT that reduces the generosity of depreciation allowances in the existing KF model to estimate its impact on the cost of capital and METR. The analysis is applicable to an MT that limits the availability of a broad set of investment incentives and tax credits. It shows that an MT does not alter the METR on an equity-financed investment if the following equation holds:

$$P = \gamma(1 - D^*), \quad (1)$$

where $P = D - D^*$ = value of the tax preference; D is the present value of the tax preference (e.g. the depreciation allowance) per dollar of investment under the standard CIT; D^* is the present value of the preference under the MT, and $\gamma = \left[\frac{\tau - \tau*}{(1 - \tau*)\tau}\right]$. The lower the value of the tax preference (P) and the MT statutory rate ($\tau*$) relative to the CIT statutory rate (τ), the greater the likelihood that an MT will *reduce* METRs.

For a given set of initial tax preferences and CIT rate, it is possible to estimate the MT rate that will leave the METR unchanged. As an example, suppose we have a country with a standard CIT rate of 30 percent, where buildings and vehicles receive depreciation allowance of 5 percent (with a 20 percent initial allowance) and 35 percent (with no initial allowance), respectively, on a declining balance basis.

Now let's assume that this country implements an MT that abolishes depreciation allowances for buildings and vehicles. The MT rate on buildings could be set at 16 percent without affecting investment incentives, as currently buildings receive less generous depreciation allowances under the CIT. However, the MT rate on vehicles would have to be set at a relatively lower rate of 5 percent to leave the METR unchanged.

Equalizing the tax treatment of assets under an MT is likely to improve the neutrality of the tax system. Suppose that an MT introduces the same generosity of tax depreciation allowances for all asset types. In equation (1), this is equivalent to setting D^* equal for all assets. Assets that enjoy substantial tax preferences under the standard CIT will have a high value of P, and according to equation (1) are more likely to experience an increased METR under the MT. The reverse applies to assets that enjoy few tax preferences and have a low value P.

If tax preferences under the standard CIT are not too generous, then introducing an MT with a lower statutory rate can improve incentives for equity-financed investment. While counterintuitive, a higher average tax rate can still be accompanied with a lower METR on certain investments. Bernheim (1989) shows that although an MT restricts the availability of tax preferences and can be a net revenue raiser, its introduction can reduce the tax burden on marginal investments in certain circumstances. An MT imposes a large tax burden on inframarginal investment returns by broadening the tax base. However, investment decisions will typically be driven by METRs. If the tax preferences under the CIT are not too generous, then the impact of a lower statutory MT rate more than offsets the loss of tax preferences for equity-financed investment, resulting in a lower METR under the MT.

An asset-based MT can reduce the dispersion of marginal effective tax rates across asset types. Bernheim (1989) also shows that assets that enjoy highly preferential treatment under the standard CIT will experience increased METRs under the MT, while assets subject to less preferential tax treatment will experience a lower METR. The introduction of an MT will therefore likely result in a convergence in effective tax rates across assets. This is likely to be welfare enhancing absent a strong market failure argument for differential tax treatment of assets—for example, tax credits to incentivize R&D spending are often justified on the grounds that R&D has positive spillovers for the wider economy.

An MT is more likely to increase the cost of capital for debt-financed investments. For investment projects funded by new equity or retained earnings, the discount rate depends only on the investor's required rate of return[13]. However, the required pre-tax rate of return on investments funded by debt is lower, as interest payments are generally tax deductible at the corporate level[14]. If a corporation is subject to an MT, then it pays taxes at a lower marginal rate and the value any permissible interest deductions are diminished in value. This in turn increases the investor's discount rate and makes it more likely that an MT will increase the cost of capital relative to the standard CIT system. However, the combination of generous investment incentives and interest deductibility in many countries' CIT systems can produce negative METRs for debt-financed projects in some countries implying that the CIT system subsidizes such investments. The increase in the cost of capital for highly geared firms from applying an MT may prevent inefficient over-investment and could be welfare enhancing. An MT should also reduce the debt bias in most CIT systems by increasing METRs on debt-financed investments while reducing the METRs on equity-financed investments.

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[13] The treatment of dividend income under the personal income tax will also be relevant in a closed economy but can be ignored if companies have access to international capital markets at the world interest rate.

[14] As noted earlier, an MT based on net assets creates a similar debt bias.

However, to the extent that firms face different probabilities of incurring MT liabilities, the MT can distort the allocation of capital among firms. Graetz and Sunley (1988) argue that if the probability of incurring MT liabilities differs across firms, then introducing an MT may exacerbate differences in METRs between firms. For example, suppose that a country offers a tax incentive to invest in a specific type of asset. If a firm invests only a little in these tax-preferred assets, then providing that its average effective tax rates remains above the floor imposed by the MT, the MT does not bind, and the firm enjoys a low METR. By contrast, if a firm specializes in investing in the tax preferred asset, then its average effective tax rate may fall sufficiently for the MT to bite, denying it the benefit of a lower METR. The result may be to put the specialist firm, which may be a more efficient investor pre-tax, at a competitive disadvantage post-tax to general firms.

An MT is more likely to increase effective tax rates where there is a high degree of uncertainty over investment returns. Van Wijnbergen and Estache (1999) argue that an MT provides governments with a hedge against the risk of CIT revenue shortfalls due to intensive use of tax preferences or tax planning and avoidance strategies. This hedge is asymmetric, as the MT only binds if the average effective tax rate falls below a certain threshold, and its value to the government increases as the degree of uncertainty surrounding future taxable profits increases. Using Monte Carlo analysis to simulate this uncertainty and incorporating the features of a standard CIT plus an MT, the authors find that the METR increases with uncertainty. The intuition is that the government takes its share of the profits through CIT revenues, but does not share in a firm's losses due to the floor on tax liabilities introduced by the MT. This non-linearity becomes more important as the probability of earning low or negative rates of return on investment increase.

Nevertheless, to the extent that firms operating in high risk sectors enjoy a higher average return on investment, an MT may not penalize high risk firms. All else equal, an MT will lead to a larger increase in the METR when rate of return uncertainty is higher. However higher risk firms also tend to enjoy higher average rates of return, and higher expected rates of return reduce the probability of incurring MT liabilities. The net impact of these two offsetting effects on the METR is an empirical matter.

Extending carry forward provisions can also offset the impact of an MT on investment incentives. With sufficiently long carry forward periods for excess MT payments, the METR with an MT will converge to its no-MT level (van Wijnbergen and Estache, 1999). Providing that firms paying MT eventually incur sufficient CIT liabilities to exhaust their MT credits, the long carry forward periods act as a tax smoothing device.

The impact of an MT on average effective tax rates may be more relevant for the location decisions of a multinational investor. A multinational investor seeking to establish a new plant or facility often faces a choice between mutually exclusive locations. These discrete investments will often be expected to earn economic rent, making analysis of the tax burden on the marginal dollar of investment (the METR) less relevant for location decisions. The METR matters when a multinational decides on the size of its investment, conditional on its location. But the location decision is more likely to be influenced by the average effective tax rate (AETR), defined as the difference between the pre-tax and post-tax NPV of a project earning a return in excess of its cost of capital (Devereux and Griffith 2003, Klemm 2008). We have already argued that an MT

raises its revenue from inframarginal returns by broadening the tax base relative to a standard CIT with more generous tax preferences. So while the impact of an MT on the METR is an empirical matter, an MT will unambiguously increase the AETR on projects earning economic rent.

However, an MT would need to gain political traction with the public to be implemented and forge consensus on a minimum acceptable tax rate that all corporate taxpayers should pay on their income or assets, especially as reforming corporate tax preferences may appear technical and of little direct relevance to voters (Avi-Yonah, 2003). For example, the corporate AMT was introduced in the U.S. in response to claims that many large and profitable corporations were paying too little federal income tax. Groups such as Citizens for Tax Justice publicized the use of tax preferences to achieve these low effective tax rates and their campaigns were instrumental in persuading US policy makers to include an MT in the 1985 tax reform package (Brumbaugh, 1989).

A common argument in favor of an MT is that it also improves the fairness of the tax system. This follows the observation across countries that firms with large cash flows and assets—and in some instances, substantial book profits—have faced low effective rates, sometimes for sustained periods of time. In addition, countries interact in setting statutory CIT rates. Devereux, Lockwood, and Redoano (2008) estimate that during 1982–99, among the industrialized OECD countries, a one percentage point change in other countries' weighted average statutory CIT rate resulted in a 0.67 percentage point change in the CIT rate in the home country. They find that the results of their model closely predict the actual fall in the CIT rates. These empirical results are confirmed by policymakers who explicitly mention tax competition as a reason for reducing CIT rates and regard MTs as tools for achieving horizontal equity across countries.

Furthermore, an MT is also likely to be more effective in improving the horizontal equity of the corporate tax system within a country, particularly if the aim is to counter tax avoidance, and not distort the competitive allocation of resources – therefore ensuring tax neutrality and increasing overall economic surplus. The first two rationales for introducing an MT—to restrict use of tax preferences, and to limit tax avoidance behavior—can both be viewed as addressing inequitable treatment of taxpayers with similar economic incomes under the CIT. The combination of varying generosity of tax depreciation allowances by asset type and varying asset intensities across sectors can lead to different effective tax rates for firms earning the same rate of return in different sectors. In addition to undermining the horizontal equity of the tax system, these differing tax rates can distort the allocation of capital. Perhaps more persuasive is the use of an MT to tackle horizontal inequities caused by tax avoidance—especially, as noted before, MNEs have greater opportunities to lower their effective tax rate through use of profit shifting than purely domestic firms.

An assessment of the vertical equity impact of an MT should also ideally account for its final incidence, suggesting that an MT will have ambiguous effects on progressivity. The final incidence of corporate taxes must ultimately be borne by investors, consumers and workers. The incidence is the subject of academic debate but the standard assumption is that corporate income taxes are borne by shareholders and owners of firms. The impact of an MT on the progressivity of the overall corporate tax system will therefore depend upon whether investors in

companies paying MT are typically wealthier than those who invest in companies subject to the standard CIT (Chorvat and Knoll 2003). However, an alternative perspective is to view an MT as an increase in the aggregate taxation of capital, which is typically owned by wealthy individuals. An MT can then be argued to improve the progressivity of the tax system in much the same way as increasing the standard CIT rate.

However, the equity impact of an MT will also be influenced by its base and an MT based on assets is likely to be more equitable. In general, assets are likely to be a better predictor of economic income than turnover. Firms with high turnover may earn negligible profits or even losses, while firms with low turnover may be highly profitable. By contrast, if capital markets function efficiently, then the rate of return on assets should be equalized across firms. However, van Wijnbergen and Estache (1999) simulate the introduction of a 2 percent assets-based MT in Brazil and find that it would increase the dispersion of marginal effective tax rates across sectors. This reflects differences across sectors in the ratio of profits to capital, but the result is not general and is specific to the sample of Brazilian firms studied.

By enhancing the perceived fairness of the tax system, an MT may help to improve taxpayer morale and trust, boosting overall compliance. Traditional economic models of taxpayer compliance have stressed the role of the probability of detection and severity of punishment in predicting compliance behavior. However, more recent literature has stressed the importance of intrinsic motivations including taxpayers' perceptions of the extent of tax avoidance and evasion and the fairness of the tax burden distribution (Etzioni, 1986; Murphy, 2008).The perception that large and highly visible corporate taxpayers achieve low effective tax rates, despite having large book assets and profits, is likely to undermine the inclination of small businesses and individuals to comply. In these circumstances, an MT can provide visible reassurance that large corporate taxpayers will pay a minimum average tax rate, with potential benefits for the level of compliance in the wider taxpayer population.

IV.   ASSESSING THE IMPACT OF MINIMUM TAXES

In the next few sections, we attempt to quantify the impact of MTs on tax revenue collection and characteristics of corporate performance. We start at the macro level to understand if the impact of MTs shows up in aggregate country-level revenue statistics before moving on to more micro-level firm data.

A.   A Novel Database

In this section, we set out some stylized facts about MTs, drawing on a new dataset that identifies LMTs across 196 countries since 1980 by base and rate. We compiled this dataset manually by reading through annual publicly available international tax law reports from various organizations (such as IBFD and Deloitte), as well as directly digitized national legislation whenever enough details were not available from third party reports. We then recorded the applicable benchmark MT rate (which can change over the years even as the base remains the same), and binned MT regimes according to their applicable base, in line with the categories described in section II.   A.   A fourth category relates to MTs that worked as flat or step-wise fees (such as in Austria), but it is not separately identified in the figures below given the negligible number of instances it encompasses. We then merge it with time series of CIT revenues in percent of GDP from the IMF's World Economic Outlook (WEO) database ("taxes on income, profits, and capital gains, payable by corporations"), and corporate income tax statutory rates outside of the minimum tax system from an internal IMF Fiscal Affairs Department database based largely on IBFD's Tax Research Platform historical archives.

We start with some simple aggregate statistics on the average CIT rate across those countries without MTs and those with different types of MT (Figure 3). What is clear is that turnover-based MTs are not only the most popular in recent years but the most popular in the past as well—the number of countries opting for turnover-based MTs is more than double those for other MTs (Figure 2). More generally, the number of countries without MTs continues to dwarf those without.[15]

We see that on average over the past 25 years, we also find that CIT rates tend to be higher on average in countries with MTs (Figure 3). CIT rates also tend to be highest on average in countries with turnover-based MTs, while those with modified income bases—which may not deviate too far from the standard CIT base—tend to be closer to the average CIT rate of those countries without MTs.

We can also look at average CIT revenues across countries with different types of MTs (Figure 4). Only countries with turnover-based MTs have outperformed those without MTs since 2000, collecting CIT revenues of up to almost 1 percentage point of GDP more on average. However, countries with assets-based MTs have broadly performed in line with those countries without

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[15] Note however that in these charts there is overall sample accretion, since the data is based on the merger between our novel database, WEO and the FAD rates database, and there is therefore no mirror reduction in the absolute number of countries without a minimum tax over time.

MTs (only more recently outperforming), while countries with modified income-based MTs have tended to underperform in terms of revenues.

Figure 2. Number of Countries with or without Minimum Taxes
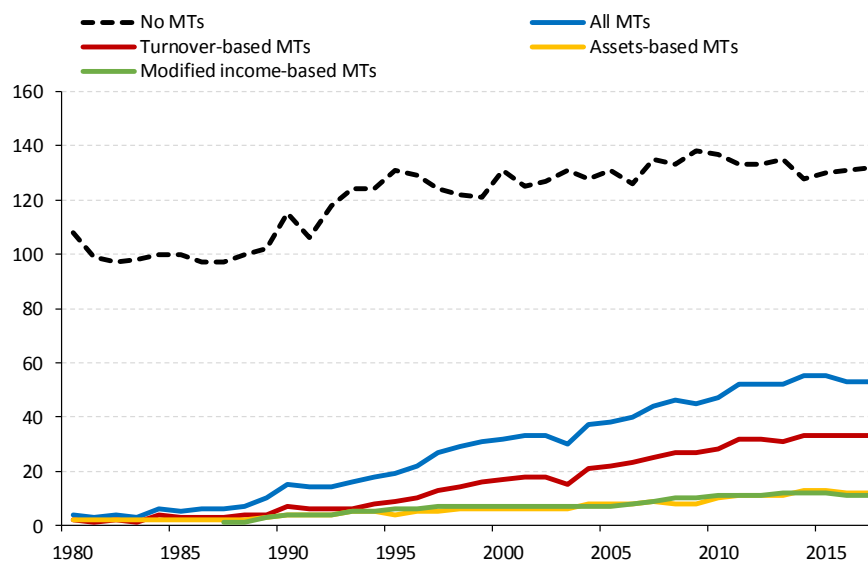
Figure 3. Average CIT Rates Across Countries with or without Minimum Taxes
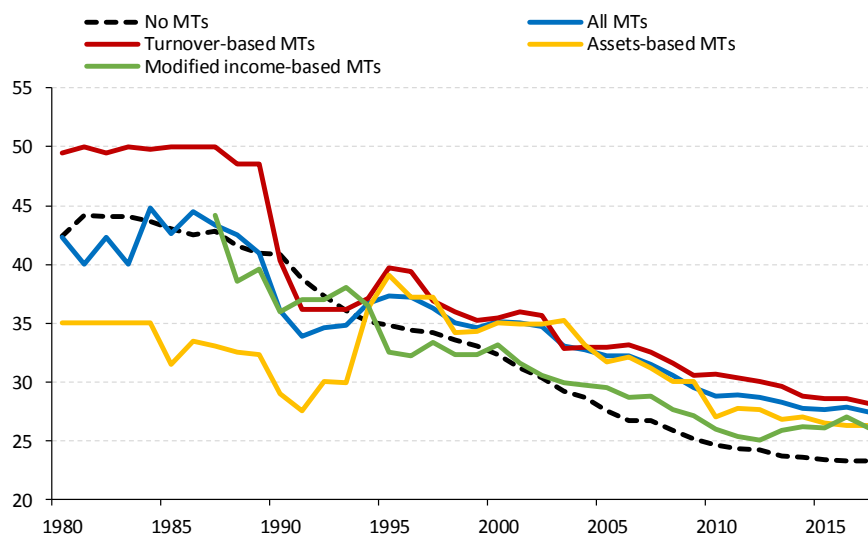
Figure 4. Average CIT Revenues Across Countries with and without Minimum Taxes (percent of GDP)
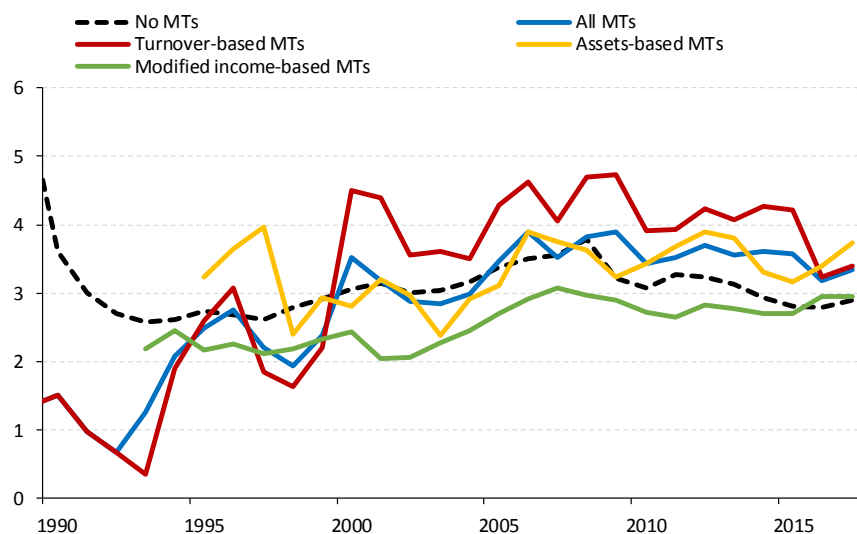
Despite having touched on the incidence of MTs earlier in Section II, we summarize their prevalence next. Of the 63 countries that were identified as operating an MT as of end-2018, 31 countries use turnover as the favored tax base; 10 have an assets base, and 9 have a modified income base (Table 3).[16] The reasons for the choice of base and rate vary from country to country, with some applying differential MT rates or segmenting the MT base to incentivize tax compliance or in recognition of sectoral differences. For example, Morocco differentiates the rates of the MT by sector. Ecuador's (recently repealed) MT was used as a form of advance tax for the following year and nonrefundable if not taxable income was generated. Argentina up until recently restricted their MT base to 20 percent of gross assets for financial sector firms, while Colombia exempts financial sector firms from its MT, as the massive financial liabilities of banks and insurance companies make gross assets a poor predictor of income-earning potential.

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[16] Countries are counted separately in each category in cases where they operate parallel systems using multiple bases, for example, Pakistan. A small number of countries opting for a turnover base also include a minimum fixed charge (patent) payment alongside the tax on turnover.

Table 3. Summary of Minimum Tax Rates by Base, 2018

	Turnover base		Assets base		Modified income base	
	No. of countries	Average Tax Rate	No. of countries	Average Tax Rate	No. of countries	Average Tax Rate
High-income countries	1	0.60	4	0.39	6	10.12
Upper-middle-income countries	4	1.78	4	1.14	1	3.00
Lower-middle-income countries	15	1.07	2	1.00	2	17.75
Low-income countries	11	1.25	.	.	.	.
Total	**31**	**1.23**	**10**	**0.81**	**9**	**11.02**

Sources: Authors' calculations.
Notes: Country income follow the World Bank's classification of the world's economies into four income groups—high, upper-middle, lower-middle, and low—using gross national income (GNI) per capita (current US$) calculated using the Atlas method.

MT rates on turnover typically range between 0.1 and 3 percent, while asset-based MTs are typically levied at a rate of 1 percent (Table 3). A one percent MT rate on turnover is equivalent to a 30 percent tax on profits for a firm with a gross margin of around 3 percent. Similarly, a one percent MT on gross assets is equivalent to a 30 percent profits tax for a firm with a rate of return of three percent. While this comparison might suggest that there is scope to increase MT rates, firms incurring losses for reasons unconnected to excessive use of tax preferences or tax planning—for example, startups—can still be liable to pay MT. Hence it is important to acknowledge that the MT is indifferent when it comes to the impact on investment incentives when setting the rate.

B.   Do Minimum Taxes have any Impact on Corporate Income Tax Revenues?

In this section, we attempt to quantify the impact of the imposition of a local MT on CIT revenue. It is important to note that many factors can determine the impact of MTs on revenues. The decision to implement a MT is not an exogenous random variable, as countries are likely to choose to impose MTs for reasons that are not always observable but correlated with the level of corporate income tax revenues and the economic cycle.

With this potential endogeneity in mind, we use available macroeconomic data to estimate an unidentified response of CIT revenues to the introduction (and reform) and repeal of an MT using local projection methods (Jordà 2005; Kilian & Lütkepohl 2017; Nakamura and Steinsson 2018; Ramey 2016; Stock and Watson 2018; Teulings and Zubanov 2014). This method provides a flexible alternative to traditional vector autoregression techniques and is robust to misspecification of the data-generating process. Local projections use separate horizon-specific regressions of the variable of interest on a shock variable and a series of control variables. Specifically, we regress contemporaneous and future changes in CIT revenue growth on changes in MT rates to estimate an impulse response function at various horizons, controlling for country and time fixed effects, lags and forwards of MT shocks, and lagged revenue growth.[17] The

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[17] Additional specifications also control for other factors such as changes in personal and corporate income tax rates, and real house prices.

sequence of coefficient estimates for the various horizons provides a nonparametric estimate of the impulse-response function.

The local projection method estimates the following equation:

$$\Delta^h y_{i,t} = \alpha_i^h + \gamma_t^h + \beta^h \Delta s_{i,t} + \sum_{j=1}^{p} \beta_1^h \Delta s_{i,t-j} + \sum_{j=1}^{p} \theta_1^h \Delta y_{i,t-j} + \sum_{j=0}^{p} \theta_2^h x_{i,t-j} + \varepsilon_{i,t}^h$$

where the i subscripts index countries; the t subscripts index years; the h superscripts index the horizon of the projection after time t; p is the number of lags for each variable; $y_{i,t}$ is the natural logarithm of the variable of interest; and $s_{i,t}$ is the natural logarithm of the shock variable of interest:

$$\Delta^h y_{i,t} \equiv y_{i,t+h} - y_{i,t-1}$$
$$\Delta s_{i,t} \equiv s_{i,t} - s_{i,t-1}$$
$$y_{i,t} \equiv \ln(CITrev_{i,t}); \; s_{i,t} \equiv \ln(MT_{i,t})$$

The equation also includes controls for additional factors, $x_{i,t}$, such as the trade-weighted output growth of trading partners, political regime transition, and conflict in the domestic economy. Regressions include country fixed effects, α_i^h, as well as time fixed effects, γ_t^h to control for common economic developments facing all countries in a given year. β_1^h is the contribution to the cumulative increase in (i.e., the level of) $y_{i,t}$ at horizon h from a 1 percentage point increase in $\Delta s_{i,t}$ in year t:

$$\frac{\partial \Delta^h y_{i,t}}{\partial \Delta s_{i,t}} = \beta^h$$

We estimate this specification using time series data from the IMF's WEO database, which contains country-level aggregate series on "taxes on income, profits, and capital gains, payable by corporations" (CIT revenues) and a broader "taxes on income, profits, and capital gains" (IT revenues) which includes revenues from both corporations and individuals. While the IMF's WEO data provides the broadest sample, it does not provide data for all economies—both developed and developing—that either currently have, or in the past have had, MTs. For instance, looking at just the 86 country-year observations for when an MT has been introduced or reformed in a country (the shock variable), we have data for only 48 under the broader WEO income tax revenue variable and only 25 under the CIT revenue variables.

Figure 5 plots the response of three revenue variables (total tax revenues-to-GDP, IT revenues-to-GDP, and CIT revenues-to-GDP) to: (i) the introduction and reforms of MTs; and (ii) the repeal of MTs. On average, across advanced economies, CIT revenues fall marginally on impact before increasing by the second year by almost two percentage points and remaining positive (Figure 5, panels 5 and 6). By contrast, the response of CIT revenues to the repeal of the MT is largely negative—averaging around 5 percentage points before falling more dramatically—over the following years. The responses also differ on the basis of magnitude, with CIT revenues falling

proportionately more when MTs are repealed than when they are introduced. In other words, repealing an MT can more than offset the gains from its introduction.

However, ultimately, what the results show is that even though the responses of revenue-to-GDP to an introduction or repeal of an MT are asymmetric, they are not statistically different from zero—as illustrated by the fact that the confidence intervals encompass the x-axis. Alternative specifications with additional regressors and subsamples of the data (e.g., focusing just on turnover-based MTs) were used but also found similar results.

Figure 5. Impulse Responses of CIT Revenues-to-GDP to the Introduction and Repeal of MTs

A. Total tax revenues

1. MT introduction/reform

5. MT repeal

B. Income tax revenues

3. MT introduction/reform

4. MT repeal

C. Corporate income tax revenues

5. MT introduction/reform

6. MT repeal
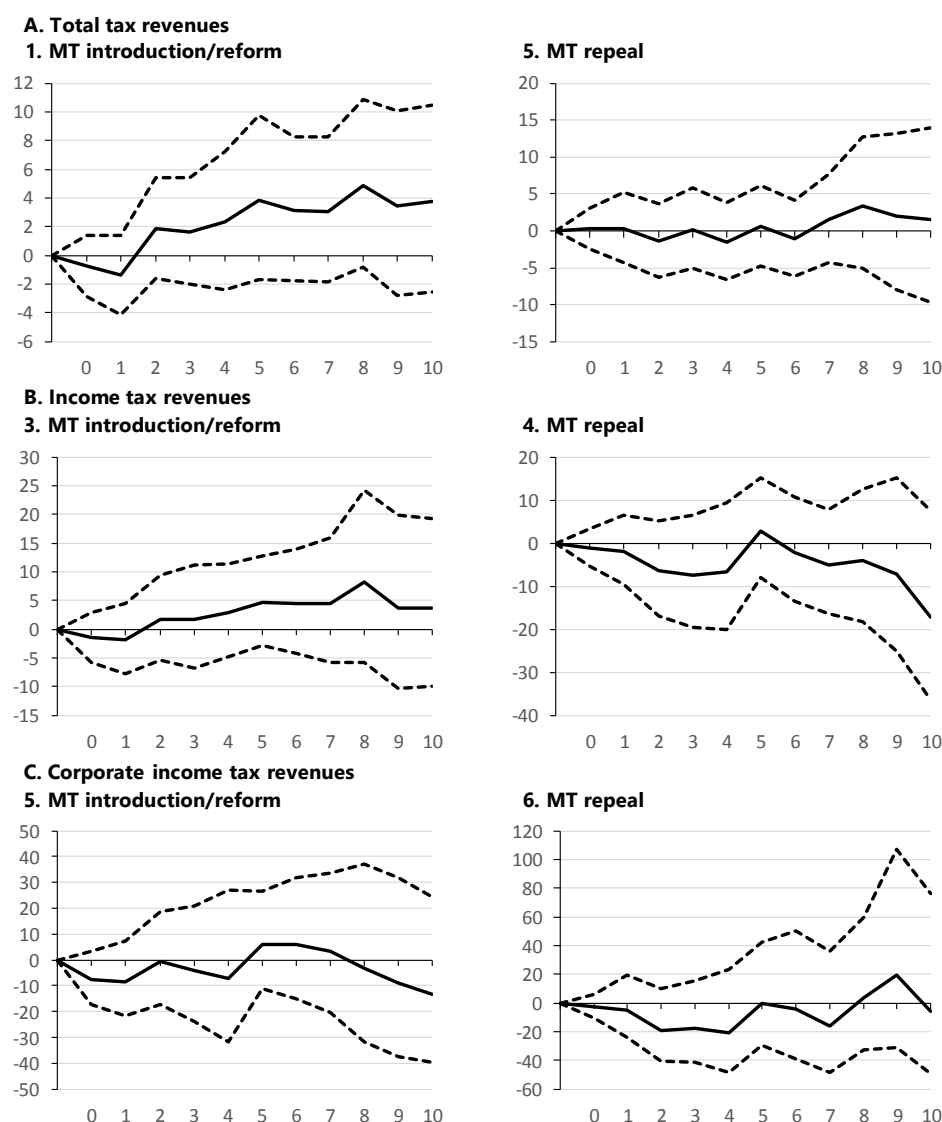
As noted earlier, these regression results are unable to fully correct for the possible endogeneity between revenues and the introduction (and repeal) of country specific MTs. In particular, we are estimating the marginal impact (over time) of MTs on CIT revenues-to-GDP when, in reality, changes in the latter—on account of both variation in the business cycle as well as purely exogenous policy changes—are likely to have driven the introduction/repeal of the former. In

this way, we are unable to fully disentangle the impact of the MT on both the numerator (revenues) and denominator (GDP)—and vice versa—which could be biasing the results.[18] With little available evidence at the macro-level using national annual data, we turn to the firm-level to see if we can tease out the impact of MTs on revenues and activity.

C. Using Firm-Level Data to Describe the Relationship of Minimum Taxes with Corporate Activity

In this section, we assess the relationship of MT reforms with firm tax liability, profitability and investment behavior using microdata. While qualitatively similar to the local projection approach using macroeconomic data described in section IV. B. , exploiting microdata allows us to delve into the impact of MTs on corporate behavior indicators (such as investment in fixed assets and employment), that are otherwise missing from the aggregate approach above. Data was taken from Bureau Van Dijk's Orbis database on historical industry financials. Given data and identification constraints, what follows should not be interpreted as a causal relationship between the introduction or repeal of a MT and corporate activity, as the parameter estimates presented do not control for any endogeneity in the timing of reforms or unobserved variables that could influence both firm behavior and tax liability. Therefore, they are intended to be illustrative of the *correlation* between the variables of interest, opening the floor for further investigative work.[19]

The core variables used include U.S. dollar values for gross sales, operating profit before taxes, taxes payable, total assets, number of employees and various descriptors of primary sector of activity for each firm. Only unconsolidated accounts were used (not integrating the statements of controlled entities) drawing from unbalanced panels of cashflow and global financials sub-databases for 176 countries from 1980 to 2018. This data was merged with data on statutory corporate income tax rates, as well as the novel historical dataset created by the authors and described in section IV. A. that included historical information on the base and rates of minimum corporate income taxes and their dates of introduction and repeal, including dates at which applicable rates were changed, while maintaining the same system.

For the purposes of the subsequent analysis, we define average effective tax rate (AETR) primarily as the ratio of taxes payable (taken from the income statement) to operating revenues from sales. This contrasts with the more traditional definition of AETR, where the denominator is typically operating profits before tax, and is also different from the METR measure we discussed in section III. We do this for a number of reasons, including: (i) comparability of tax burden across systems with and without MTs that are not always based on measures of corporate income; (ii) facilitating interpretation of AETRs in cases where reported profits are negative and assessed tax liability is positive; (iii) minimizing variability in measured effects on tax payments arising from manipulation of reported profits, as revenues tend to be more consistently reported across firms and countries.

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[18] The responses are re-estimated with the inclusion of an instrument for the introduction of MTs that is uncorrelated with tax revenues. The instrument we use is a measure of tax evasion related to informality in the economy taken from the International Labor Organization. Even after inclusion of this variable, the impulse response functions remain statistically not significant.

[19] In future research, we intend to expand this analysis by exploiting the variation in impact across industries as an instrument to address the endogeneity problem inherent in this exercise.

We consider changes in the variables of interest one year on either side of the year, *t*, when the MT was introduced, reformed, or repealed, i.e., years *t* − 1, *t*, and *t* + 1—for economies with a firm count of more than 70 in those years. The rationale behind the restriction to years immediately before and after a reform event is to minimize the amount of potential confounding factors beyond the MT reform itself. In addition, we keep only those companies with (i) at least 3 years of non-missing observations in Orbis; (ii) AETRs with respect to turnover between 0 and 1; (iii) profit margins smaller than one in *absolute* value, and (iv) operating revenues from sales greater than USD 10,000. Sample size was restricted by the fact that taxpayer data quality in countries with MTs (especially in "pre-treatment" years) is poor and often inconsistent across years in Orbis.

Tables 4 and 5 list the countries by type of MT that satisfy these criteria, and present median values for each of the key variables by country. Tables 6 and 7 present further summary statistics for the full sample of firms used separately for each of the two types of event analysis conducted (introduction vs repeal/downward reform of a minimum tax). Once the data cleaning and truncation described in the previous paragraph is applied, we are left with a total of 17 MT introduction events (country-year instances) and 12 MT repeal events spanning 1993-2018.

Table 4. Sample of Countries in which Minimum Taxes were Introduced

Country	Number of Firm-Year Observations	Total Assets (USD thousand)	Employees	Operating Revenue (USD thousand)	Before-Tax Profit Margin (%)	Effective Tax Rate (w.r.t. turnover, %)	Effective Tax Rate (w.r.t operating income, %)	Reform Year	Type
AUT	634	29,541	214	35,290	3.1	0.9	23.5	1997	Fixed
BEL	75,822	2,682	10	2,908	3.5	0.9	26.0	2013/2018	Modified Income
COL	252,351	581	5	522	8.2	2.7	31.8	2013/2017	Assets
DZA	3,168	502 .		419	7.1	2.0	26.1	2007	Fixed
IND	1213	3,946	202	2,856	1.5	0.3	9.1	1997	Modified Income
ITA	65,608	3,660	19	5,194	0.8	0.5	38.4	1994	Assets
LUX	16,176	2,478	40	1,730	4.4	0.8	10.8	2011/2016	Assets
MAR	102,339	199 .		152	2.5	0.6	15.0	2011	Turnover
MEX	587	31,508	93	39,439	6.0	1.8	24.9	2008	Modified Income
PAK	1,398	29,729	529	30,932	5.2	1.3	26.5	2009/2014	Turnover
PER	216	68,658	266	49,643	14.4	3.6	28.1	2006	Assets
SVK	319,956	88	2	109	3.2	1.3	22.0	2014	Turnover
TWN	6,339	50,081	224	39,089	7.1	1.2	17.8	2006	Modified Income
Total	**252,351**	**502**	**5**	**419**	**3.2**	**1.3**	**22.0**		

Includes only firms with a minimum of 3 years of non-missing observations in sample, revenues greater than USD 10,000, profit margins smaller than 100% of revenues in absolute value, and effective tax rates w.r.t. revenues smaller than 100%.

Includes only countries with minimum taxes introduced during the sample period.

Source: ORBIS

Table 5. Sample of Countries in which Minimum Taxes were Repealed/Reduced

Country	Number of Firm-Year Observations	Total Assets (USD thousand)	Employees	Operating Revenue (USD thousand)	Before-Tax Profit Margin (%)	Effective Tax Rate (w.r.t. turnover, %)	Effective Tax Rate (w.r.t operating income, %)	Reform Year	Type
BEL	38286	62001	78	43730	8.18	2.75	26.01	2017	Modified Income
COL	280,638	14,259	31	7,920	12.11	5.38	43.86	2012/2016	Assets
LUX	8,401	84,256	104	44,224	8.7	3.44	55.87	2015	Assets
MEX	1,294	2,451,364	3448	1,647,376	7.87	2.55	39.02	2007/2013	Modified Income
MUS	496	36,902 .		17,962	15.29	2.06	17.26	2015	Modified Income
PAK	1,708	124,160	1143	151,572	8.12	3.08	78.1	2008/2013/2017	Turnover
PER	292	252,269	1047	176,373	21.15	5.77	27.18	2011/2016	Assets
Total	**242,511**	**31,890**	**59**	**20,293**	**11.55**	**5.00**	**42.2**		

Includes only firms with a minimum of 3 years of non-missing observations in sample, revenues greater than USD 10,000, profit margins smaller than 100% of revenues in absolute value, and effective tax rates w.r.t. revenues smaller than 100%.

Includes only countries with minimum taxes repealed/reduced during the sample period.

Source: ORBIS

**Table 6. Full Sample Statistics: Minimum Tax Introduction**

Full Sample Summary Statistics, Minimum Tax Introduction 1993-2018						
	Total Assets (USD thousand)	**Employees**	**Operating Revenue (USD thousand)**	**Before-Tax Profit Margin (%)**	**Effective Tax Rate (w.r.t. turnover, %)**	**Effective Tax Rate (w.r.t operating income, %)**
Mean	20,215	53	11,854	6.4	3.3	31.7
Standard Deviation	1,859,593	3,049	707,446	22	6.4	2338.1
Median	342	4	346	4.3	1.4	22.9
Min	-10,587	0	10	-100	0	-733300
Max	1,630,000,000	1,043,531	617,000,000	100	100	1166646
Number of Firm-Year Observations	845,642	367,973	845,807	845,807	845,807	836,384

Includes only firms with a minimum of 3 years of non-missing observations in sample, revenues greater than USD 10,000, profit margins smaller than 100% of revenues in absolute value, and effective tax rates w.r.t. revenues smaller than 100%.

Includes only countries with minimum taxes introduced during the sample period.

Source: ORBIS

Table 7. Full Sample Statistics: Minimum Tax Repeal/Reduction

Full Sample Summary Statistics, Minimum Tax Repeal 1993-2018						
	Total Assets (USD thousand)	**Employees**	**Operating Revenue (USD thousand)**	**Before-Tax Profit Margin (%)**	**Effective Tax Rate (w.r.t. turnover, %)**	**Effective Tax Rate (w.r.t operating income, %)**
Mean	31,889	126	20,293	11.5	5.0	42.2
Standard Deviation	1,108,237	1,748	1,026,876	20	8.7	2361.5
Median	745	10	685	7.5	2.4	31.3
Min	0	0	10	-100	0	-177500
Max	274,000,000	208,000	371,000,000	100	100	1166646
Number of Firm-Year Observations	331,108	53,614	331,115	331,115	331,115	320,959

Includes only firms with a minimum of 3 years of non-missing observations in sample, revenues greater than USD 10,000, profit margins smaller than 100% of revenues in absolute value, and effective tax rates w.r.t. revenues smaller than 100%.

Includes only countries with minimum taxes repealed during the sample period.

Source: ORBIS

While we noted in Section A.   **Error! Reference source not found.**that turnover-based MTs are the prevailing form of existing alternative CIT regime, the only countries within the merged dataset with turnover-based MTs for which data is available are Pakistan and Slovakia. This is for two reasons: the first is that several of the introduction/reforms of turnover based MTs date back to before 2007 (e.g., Bangladesh and Bolivia), when Orbis data received a substantial boost in coverage; the second is that most countries with turnover-based MTs have little coverage within Orbis (e.g., Guatemala and Ecuador). Moreover, often the introduction of reporting requirements alongside a minimum tax implies an increase in taxpayer information coverage for a given country—the year in which the minimum tax was introduced/reformed is often accompanied by a spike in the number of reporting companies. For example, Morocco has very large coverage (over 50,000 firms with non-missing data) starting in 2011, which is precisely the first year of the MT reform. Furthermore, identification of introduction versus repeal events is not always binary: Mexico's introduction of a modified income-based MT in 2008 simultaneously repealed a pre-existing assets-based MT.

In most countries, the bulk of businesses are SMEs (see Figure 6, panels 1 and 2, which provide a fuller picture for a couple of illustrative emerging market and advanced economy examples) with turnover less than US$ 800 million and fewer than 3,000 employees. The average turnover of businesses is typically between US$ 12–20 million; average gross assets between US$ 20–30 million, and average profit margin between 6.5–11.5 percent.

Figure 6. Firm Distributions by Country
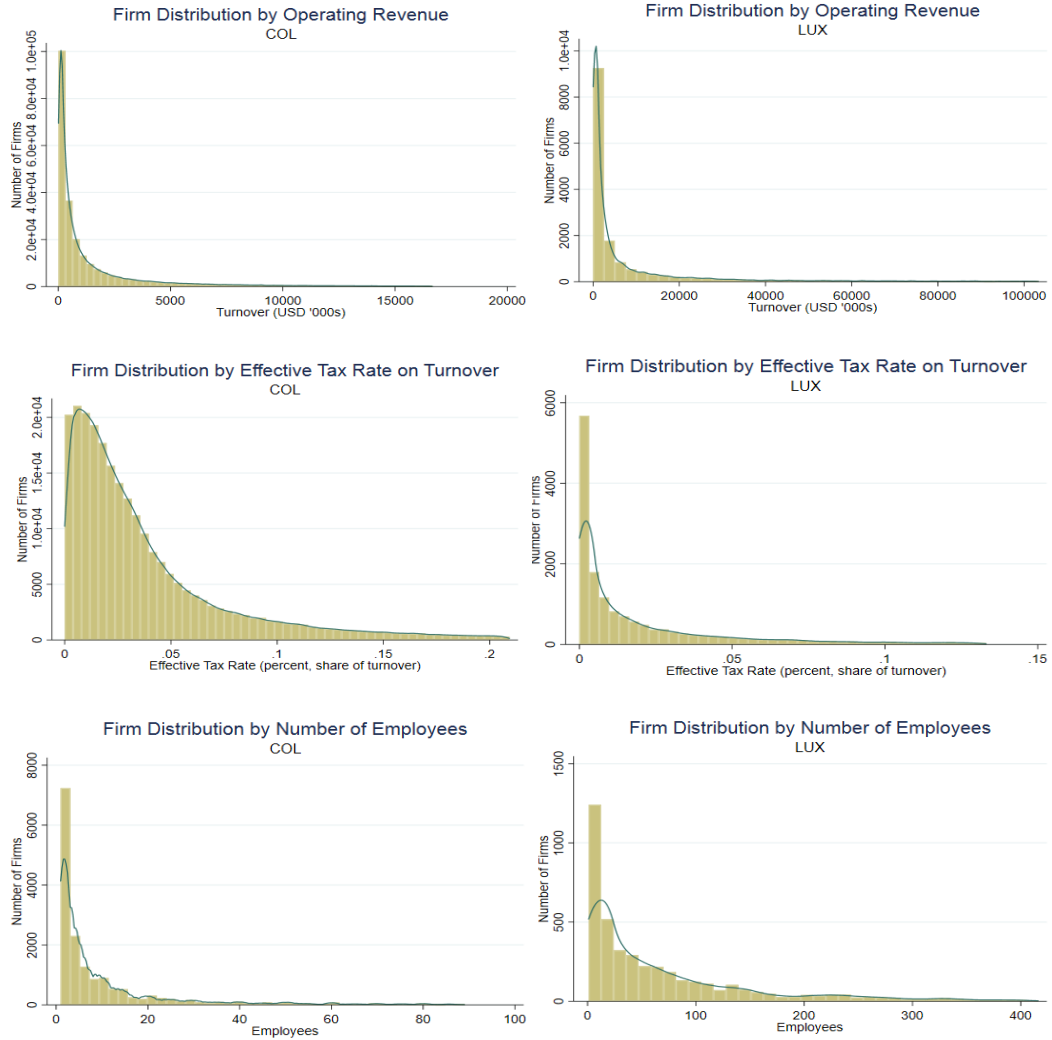
Given the poor data coverage for turnover-based MT countries in the years in which MTs were introduced or reformed, we take multiple approaches to estimate the economic impact of alternative MTs on firms' tax liability, profitability, and investment behavior. The first narrow approach restricts the sample to three years around the date on which the MT reform in a particular country was undertaken.[20] The identifying assumption in this approach is that the only key change affecting the companies in these samples in the years of minimum tax reform was the minimum tax itself. This is unlikely to be the case, as such reforms are often part of larger fiscal and macroeconomic reform packages.

The baseline specification takes the following form:

$$Y_{ik,t} = \beta_1 M_{k,t} + \gamma_i + \varepsilon_{ik,t}, (1)$$

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[20] Here understood as either introduction of a MT or a change in the rate and/or base of an existing MT. We do not consider repealed MTs at this stage, as this does not greatly expand our potential sample size.

where $Y_{ik,t}$ is the outcome variable of interest for a given year, t, for firm i in country k; $M_{k,t}$ is a dummy variable for the presence or not of a minimum tax regime, and γ_i are country fixed effects.[21] Notwithstanding the lack of causal identification, the findings that follow are broadly corroborated by a different approach in a narrower but more tightly identified setting in sub-section D.

Disaggregating the sample of reform episodes for countries with turnover-based MTs, assets-based MTs and modified income-based MTs, we look at whether there is evidence that these different types of MTs are equally as effective at raising revenue (given the relative ease of manipulation of each base for tax purposes, and second order effects on the taxable base through behavioral changes in real economic activity and/or income reporting of taxpaying firms). We do so for (i) a balanced panel of firms—a much smaller sample; and (ii) an unbalanced panel/repeated cross-section where the only requirement is a country have more than 70 non-missing observations in that particular year. In all cases, we exclude firms with reported negative operating revenues, or tax liability greater than 100 percent of operating revenues (in other words, we preserve only firms with an AETR between 0 and 1).

Pooling all countries with a minimum tax of any type at one point in the sample[22] has the advantage of providing us with a larger sample than any of the MT type-specific sub-samples, but implies a much noisier treatment effect, since the base, rate, and implementation of MTs can vary substantially both across country and firm characteristics. Even though with the inclusion of country fixed effects—with standard errors clustered at the country level—this measurement error in treatment biases the results towards the null.

Table 8. Estimates on Impact of MT Introduction on Firm Average ETRs

Repeated Cross-Section and Balanced Panel Key Parameter Estimates at Minimum Tax Introduction Events, 1993-2018

Dependent variable	Full sample		Asset based MTs		Modified-Income based MTs		Turnover based MTs	
	Repeated Cross-Section	Balanced Panel	Repeated Cross-Section	Balanced Panel	Repeated Cross-Section	Balanced Panel	Repeated Cross-Section	Balanced Panel
Effective Tax Rate (w.r.t. turnover, %)	0.0159*	0.0155*	0.0147**	0.0122*	0.0249***	0.0273**	0.0107*	0.0101*
	(0.00521)	(0.00597)	(0.000678)	(0.00179)	(0.00105)	(0.00131)	(0.000758)	(0.000713)
Effective Tax Rate (w.r.t operating income, %)	0.103***	0.0961*	0.334**	0.238**	0.0810***	0.0747***	0.117	0.143*
	(0.0124)	(0.0362)	(0.0161)	(0.0222)	(0.00169)	(0.000344)	(0.0232)	(0.00295)
Log total assets	3.084	2.821	7.867**	7.523*	7.651***	7.918**	-0.0357	0.136
	(2.714)	(2.668)	(0.609)	(1.509)	(0.325)	(0.382)	(0.435)	(0.332)
Log employees	0.998	0.955	2.918***	3.065**	2.367***	2.514***	-0.135	-0.0766
	(0.894)	(0.932)	(0.0614)	(0.203)	(0.0285)	(0.0387)	(0.183)	(0.140)
Profit margin	0.0534***	0.0519*	0.00813*	-0.00726	0.0701***	0.0830**	0.0456*	0.0385*
	(0.00939)	(0.0155)	(0.000860)	(0.00423)	(0.00232)	(0.00346)	(0.00134)	(0.00207)

All specifications include country fixed effects and standard errors clustered at the country level.
Standard errors in parentheses
* p<0.05, ** p<0.01, *** p<0.001

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[21] While systematic variation in profit margins across industries would call for inclusion of sector fixed effects, doing so for many countries would greatly reduce the power of the analysis, given the limited within sector variation.

[22] We exclude Peru and Morocco, since they did not have a large enough number of firms pre-reform for event study estimation.

On average, we estimate that the introduction of MTs in our sample is associated with a 1.6 percent higher average ETR (Table 8). This positive and significant impact is present in both balanced and unbalanced samples. Furthermore, the increase in the average ETR is found to be up to 1 percentage point larger for modified income-based MTs and almost half a percentage point weaker for turnover-based MTs.

The results also suggest an association with *greater* investment and employment for firms that were present before the reform and remained in business after (the balanced firm panel) in cases of introduction of asset or modified income-based MT regimes. This seemingly puzzling estimate may simply be a spurious result of omitted variable bias and/or unaddressed endogeneity present in those sub-samples. In particular, MT regimes may have been introduced at times of broader macroeconomic expansion where investment and employment are growing for reasons orthogonal to the introduction of an MT. However, it is also possible this result reflects the potential reduction in the METR induced by the introduction of a MT when tax preferences under the alternative CIT regime are not too generous and the MT rate is sufficiently low – thus inducing increased investment.

In addition, there also seems to be a positive effect on reported profits. The interpretation of this effect can be at least twofold: (i) as discussed in Best and others (2015), introduction of an MT can often lead to an increase in *truthfully reported* profits, even if the underlying true profit distribution is unchanged, as some firms formerly underreporting for tax purposes now no longer have that incentive in light of the binding constraint imposed by the MT; (ii) increased firm competition due to reduced after-tax rates of return on investment may push less productive firms out of business, leaving more productive and profitable firms in the sample after reform implementation. The latter is consistent with the slightly larger parameter estimate in the repeated cross-section samples relative to the balanced panel (where firms are the same before and after the reform episode).

Looking separately into each type of MT reform event, initial evidence suggests modified income-based MTs seem to be most effective at increasing average ETRs by around 2.7 percentage points, followed by assets- and turnover-based MTs (1.2 and 1.0 percentage points, respectively). To the best of our knowledge, there have been no studies estimating the impact of assets-based MTs, in particular, on investment in fixed assets or average ETRs. This analysis, therefore, provides an initial inroad in this area. Similarly, studies using administrative data to evaluate the impact of turnover-based minimum tax regimes are few and far between, and the empirical evidence presented in this paper (including in Section IV.   D.   ) provides a first pass at assessing a potential association between such policies and economic outcomes.

For Slovakia—the only country with a turnover-based MT other than Pakistan with a sufficiently large firm panel in Orbis around the reform time—we see a 1.5 percent average ETR increase with the introduction of the "tax license" for companies above the largest turnover threshold of

EUR 500,000 (see Table 9).[23] This effect is well distributed across sectors.[24] For companies below that threshold, the effect is much larger, but seems to be concentrated in a handful of sectors (leasing, real estate and retail sales, in that order). The apparent increase in total assets, employees, and reported profitability is puzzling. For smaller companies, there is a smaller positive growth in employees, but a significant—and somewhat more intuitive—contraction in assets, with no effect on pre-tax profitability. While profitability might be a spurious result of truthful reporting post-MT, the magnitude of the effect appears disproportionately high for such a small tax.

Table 9. Slovakia: Impact of Turnover-based MT on Firm Average ETRs

Slovakia Reform Event, Firms with Turnover > EUR 500,000				
	Effective Tax Rate (w.r.t. turnover, %)	Log total assets	Log employees	Profit margin
Introduction of MT	0.0152***	0.349***	2.594***	0.0520***
	(0.000151)	(0.00865)	(0.0129)	(0.00184)
N	43074	43056	38854	43074
adj. R-sq	0.191	0.036	0.511	0.018

Standard errors in parentheses
* p<0.05, ** p<0.01, *** p<0.001

For robustness, we repeat these tests around MT repeal or existing MT rate reduction events (Table 10). In contrast to the introduction of MTs, their removal does not seem to be immediately associated with a deterioration in firm-level AETRs (the coefficient estimate is negative but statistically insignificant), with the exception of the balanced panel for assets-based MTs. This suggests an asymmetric effect of MTs on AETRs, possibly because of improved revenue administration capacity during the years of implementation of the MT (due to increased taxpayer documentation requirements and audit scrutiny), as well as modified taxpayer behavior. Equivalently, it is plausible MTs tend to be introduced when they are likely to be binding for a large share of corporate taxpayers, and then repealed/reduced when they no longer seem to be binding relative to the benchmark CIT regime. Note the sample used for estimation of repeal effects is also much sparser, especially in terms of employee data, so not all parameters are estimable.

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[23] For greater detail on the implementation of this tax (now repealed), see Bukovina and others (2020).

[24] Based on expanding the baseline specification to include sector fixed effects. Available from authors upon request.

Table 10. Estimates on Impact of MT Repeal/Reduction on Firm Average ETRs

	Full sample		Asset based MTs		Modified-Income based MTs		Turnover based MTs	
Dependent variable	Repeated Cross-Section	Balanced Panel	Repeated Cross-Section	Balanced Panel	Repeated Cross-Section	Balanced Panel	Repeated Cross-Section	Balanced Panel
Effective Tax Rate (w.r.t. turnover, %)	-0.00156	-0.0109	-0.00490	-0.0371***	-0.00140	-0.0139	-0.00752	0.00516
	(0.00265)	(0.00926)	(0.0134)	(1.39e-14)	(0.00310)	(0.00402)	(.)	(.)
Effective Tax Rate (w.r.t operating income, %)	-0.0844	-0.678*	0.0601	-0.242***	-0.0871	-0.487	0.379	-1.087
	(0.0680)	(0.257)	(0.0152)	(1.21e-14)	(0.0775)	(0.409)	(.)	(.)
Log total assets	-0.117	0.153	2.080	0.386***	-0.115	-0.215	-0.937	0.403
	(0.0481)	(0.811)	(1.400)	(1.05e-13)	(0.0536)	(2.226)	(.)	(.)
Log employees	0.125	0.549***	1.837***	(.)	0.101	(.)	0.544	0.549
	(0.104)	(4.95e-16)	(1.29e-15)	(.)	(0.109)	(.)	(.)	(.)
Profit margin	0.00405	0.0330	0.0343	-0.0302***	0.00433	0.0877	-0.0634	0.0102
	(0.00408)	(0.0578)	(0.108)	(3.51e-14)	(0.00467)	(0.147)	(.)	(.)

All specifications include country fixed effects and standard errors clustered at the country level.
Standard errors in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Exploiting Structural Sectoral Characteristics

We can also take advantage of the variation in "structural" profit margins across sectors in our sample to determine whether some firms are more heavily impacted than others by a MT reform.[25] For example, firms in sectors with thinner profit margins are likely to be disproportionately burdened by a turnover-based MT. Likewise, firms with a relatively large stock of fixed assets in proportion to operating profits would be penalized more heavily under an assets-based MT. This section excludes countries with modified income MTs, since heterogeneity in structural profit margins does not generate sector specific AETRs when the MT rate is a constant rate of the modified income base across all sectors. Table 11 shows the three largest sectors for each country in the sample used and their corresponding AETRs with respect to structural net operating income (profits) under the minimum tax. What we can see is that AETRs vary substantially across countries and within countries across sectors. This variation is linked to the base of the MT—for example, for those sectors that are assets-intensive, the AETR under the assets-based MT is substantially higher than in other less intensive sectors.

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[25] Data on sectoral profit margins for countries in our sample are obtained from datasets on gross profit margins compiled by Aswath Damodaran. See http://pages.stern.nyu.edu/~adamodar/New_Home_Page/data.html.

Table 11. Summary Statistics for Average ETRs under MTs based on Sectoral Structural Profit Margins

NACE Rev2 Sector (All and Top 3 largest)	Average Effective Tax Rate Under MT (w.r.t. structural operating income) (%)	Number of Firm-Year Observations
COL (Assets-based MT)		
All sectors	*6.2*	*246,424*
Wholesale trade, except of motor vehicles and motorcycles	4.3	32,349
Retail trade, except of motor vehicles and motorcycles	3.3	25,137
Real estate activities	12.4	17,724
LUX (Assets-based MT)		
All sectors	*3.7*	*16,041*
Office administrative, office support and other business support activities	16.6	2,963
Wholesale trade, except of motor vehicles and motorcycles	0.2	1,923
Specialised construction activities	0.2	1,442
MAR (Turnover-based MT)		
All sectors	*2.7*	*84,228*
Wholesale trade, except of motor vehicles and motorcycles	3.7	19,709
Civil engineering	3.9	10,693
Real estate activities	0.8	5,693
MEX (Assets-based MT)		
All sectors	*3.1*	*574*
Wholesale trade, except of motor vehicles and motorcycles	2.8	86
Retail trade, except of motor vehicles and motorcycles	2.3	37
Construction of buildings	1.4	35
PAK (Turnover-based MT)		
All sectors	*2.7*	*1,397*
Manufacture of textiles	3.0	422
Manufacture of food products	2.8	186
Manufacture of chemicals and chemical products	2.6	122
PER (Assets-based MT)		
All sectors	*3.4*	*209*
Electricity, gas, steam and air conditioning supply	10.2	36
Mining of metal ores	2.8	19
Manufacture of basic metals	2.9	14
SVK (Turnover-based MT)		
All sectors	*1.6*	*283,107*
Wholesale trade, except of motor vehicles and motorcycles	1.9	32,815
Retail trade, except of motor vehicles and motorcycles	2.6	32,527
Real estate activities	0.7	16,034

Sources: ORBIS and authors' calculations.
Notes: Sample includes only firms with a minimum of 3 years consecutive non-missing observations, revenues greater than USD10,000, profit margins less than 100 percent of revenues in absolute terms, and effective tax rates with respect to revenues less than 100 percent. Includes only countries with minimum taxes introduced during the sample period.

To exploit this variation, the previous specification in equation (1) is augmented to account for differences by sector j:

$$Y_{ijk,t} = \beta_0 + \beta_1 M_{k,t} + \beta_2 Z_{ijk,t} + \beta_3 \tau_{jk,t}^{MT(AETR)} + \beta_{12} Z_{ijk,t} \cdot M_{k,t} + \beta_{23} Z_{ijk,t} \cdot \tau_{jk,t}^{MT(AETR)} + \beta_{13} \tau_{jk,t}^{MT(AETR)}$$
$$\cdot M_{k,t} + \beta_{123} Z_{ijk,t} \cdot \tau_{jk,t}^{MT(AETR)} \cdot M_{k,t} + \gamma_k + \varepsilon_{ijk,t}$$

where $Y_{ijk,t} = \frac{Profit_{ijkt}}{Revenue_{ijkt}}$ and other outcomes of interest detailed above; $\tau_{jk,t}^{MT(AETR)} = f(X_{jk,t})$ is the structural AETR under the minimum tax based on sectoral profitability, $X_{jk,t} = \frac{\overline{Profit_{jkt}}}{\overline{Revenue_{jkt}}}$. $M_{k,t}$ is an indicator variable that captures the presence of the minimum tax in that country, and $Z_{ijk,t}$ is a firm-specific indicator for liability to the LMT.

The regressor $M_{k,t}$ on the right hand side is no longer a simple binary indicator of a minimum tax, but rather the "shock" induced by the MT *controlling* for the structural characteristics of the sector to which the firm belongs—measured by the sectoral AETR that the firm is subject to under the MT—, and whether we expect the minimum tax to be binding for the specific firm.[26] Table 12 summarizes the β_1 coefficient estimates.

Table 12. Impact of MT reform on Firm-level Characteristics

Turnover-based MTs

	(1) etr	(2) petr	(3) lnassets	(4) lnemployees	(5) profitmargin
MT reform	2.461**	8.956**	-0.414	-0.564	13.36**
	(0.173)	(0.872)	(0.568)	(0.0873)	(1.179)
N	356164	356164	355289	188019	356164
adj. R-sq	0.423	0.002	0.868	0.419	0.375

Assets-based MTs

	(1) etr	(2) petr	(3) lnassets	(4) lnemployees	(5) profitmargin
MT reform	2.653***	15.11***	7.484***	3.594***	9.322**
	(0.136)	(1.081)	(0.0573)	(0.0964)	(0.853)
N	241037	241037	241034	19347	241037
adj. R-sq	0.291	0.007	0.899	0.644	0.368

Notes: Standard errors in parentheses;
* p<0.05   ** p<0.01   *** p<0.001"

Conducting these estimates on repeated cross-section (unbalanced panel) samples, separately for the turnover-based and asset-based country cases, introducing a minimum tax leads to an average increase in the AETR with respect to turnover of around 2.5 percent, controlling for whether a firm's liability is such that they face a binding constraint—i.e. where the liability under the MT is larger than that under the standard CIT—and the AETR implied by the sector's

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[26] The latter can affect coefficient estimates significantly, as firms for whom a MT is binding tend to have much lower profitability, for example.

structural profit margin. This is larger than the previous result from the simple pooled OLS event study, suggesting the correlation between MT regimes and AETRs is robust to variation at the sectoral level. For the profit-based AETR, the coefficients are much larger (as before), since the AETR with respect to profits is several multiples of the same metric with respect to turnover, by construction. In addition, there is a marginally stronger effect on the average firm AETR from an increase in the sectoral AETR for those bound by the MT.[27] This suggests the impact of the MT on AETRs does not appear to be primarily determined by sector-specific variation (after instrumenting for such variation using the structural profit margins).

Revenue Yields

Finally, we conduct back of the envelope estimates of counterfactual potential revenue yields following the introduction of hypothetical (i) 0.5 percent MT on turnover, and (ii) 1 percent MT on total assets. Based on the Orbis population used above, and excluding a list of offshore jurisdictions as classified in Beer et al. (2019), we estimate a turnover-based MT could yield 7 percent additional tax revenues relative to current levels in the latest available year for the median country, and as much as 33 percent for an assets-based MT. We do so by comparing the counterfactual tax liability under a binding MT on either turnover or total assets to the actual tax liability for each company in the sample in the last year of available data for the country in our sample. Scaling Orbis data to that of national accounts (by assuming that the population of firms represented in Orbis would have a similar proportion of the overall corporate tax liability in each country – measured by WEO CIT revenues - under a minimum tax scenario), this translates into an average of 0.2 and 0.9 percent of GDP in median revenue increment in our sample for a turnover-based and an assets-based MT, respectively, for a median corporate income tax to GDP ratio of 2.7 percent. While this assumes no behavioral changes and the maintenance of current compliance levels, it represents a significant potential that should warrant these instruments serious policy consideration going forward, by both advanced and developing economies, in the context of a revision of the international corporate tax architecture. For comparison, Devereux and others (2020) estimate the OECD's income inclusion Pillar 2 proposal implemented on a country-by-country basis[28] could raise around 14 percent of existing corporate taxes paid by foreign controlled corporations – a magnitude halfway between those estimated here for local minimum tax policies that are arguably easier to implement unilaterally and territorially than the income inclusion rule. Implementation of the Pillar 2 proposal using a blended approach by multinationals (rather than country-by-country) is estimated to yield even less at approximately 4 percent of current corporate taxes on average. Similarly, the OECD's (2020) own estimate of revenue potential from Pillar 2 falls within our estimates as a share of CIT revenues currently

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[27] In particular, an increment of 1% in the sectoral AETR for firms that are MT-bound leads to an additional non-significant 0.16% increase in the AETR.

[28] The authors use a mixture of national accounts and cross-sectional firm-level data sources such as Orbis. Note the OECD's own estimates of potential revenue from Pillar 2 as of October 2020 are up to twice as large, between 1.7 and 2.8 percent of total global CIT revenues (which encompass domestic corporations as well, and therefore represent a closer denominator to the one underpinning our back of the envelope calculations above) – between USD 42-70 billion. However, in contrast to our estimates, the OECD's do include low-tax jurisdictions, which are assumed to increase their ETRs towards the minimum tax threshold in order to attract part of the revenue gain.

collected.[29] While reflecting important parallels, it is important to keep in mind that our relevant sample for these back of the envelope calculations is different from that pertaining to the OECD's Pillar 2. In one sense, our affected sample is broader, since the minimum tax would apply to domestic firms in addition to foreign controlled corporations, but in another it is narrower, since we exclude low-tax jurisdictions from our estimate (whereas the OECD includes them).

### D. Case Study: The Impact of the Minimum Tax in Honduras

In this sub-section, we use firm-level administrative panel data for Honduras to determine the impact of their MT. As part of a package of anti-evasion revenue mobilization measures, in 2013 Honduras introduced a dual MT. Companies had to pay either 1.5 percent of their turnover (gross sales) if greater than HNL 10 million or a 1 percent tax on their net assets (NAT) if greater than HNL 3 million.[30] The MT was payable when either of these amounts was greater than their CIT liability, calculated at 25 percent of reported taxable profits. Furthermore, when both the turnover-based MT and NAT were greater than the standard CIT liability, the company must pay the greater of the two. Thus, the ultimate CIT liability for each firm with turnover greater than HNL 10 million and net assets greater than 3 million was determined as:

$$CIT\ liability_t = max(MT_t, NAT_t, CIT_t)$$

We simulate counterfactual tax revenues in 2014–16 using 2013 AETRs as constant for each company continuously present in the administrative data. What this suggests is that tax revenues from firms that became liable to the MT following its introduction increase by almost 1 percent of GDP in 2016. Despite clear bunching of reported profits around the indifference threshold between the MT and the CIT liabilities (a profit margin of 6 percent), firms previously evading taxes (by underreporting taxable profits) faced higher ETRs over 2014–16, and more firms started truthfully reporting higher profit margins (Figures 7 and 8).

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[29] The OECD's latest estimate of yield from Pillar 2 is of a maximum of USD 70 billion, equivalent to 2.8% of all global CIT revenues, or 31% of CIT revenues currently collected from foreign controlled firms, to whom Pillar 2 would apply. The share of global CIT revenues is higher than ours would imply since foreign controlled firms account for a disproportionate share of global profits.

[30] For the turnover-based MT, companies in selected sectors (production and distribution of cement; services provided by public enterprises; pharmaceutical products; production, sale and distribution of oil products; and bakeries) are subject to a lower turnover-based MT rate of 0.75 percent.

**Figure 7. Distribution of Firms' Profit Margins, 2013-2016**
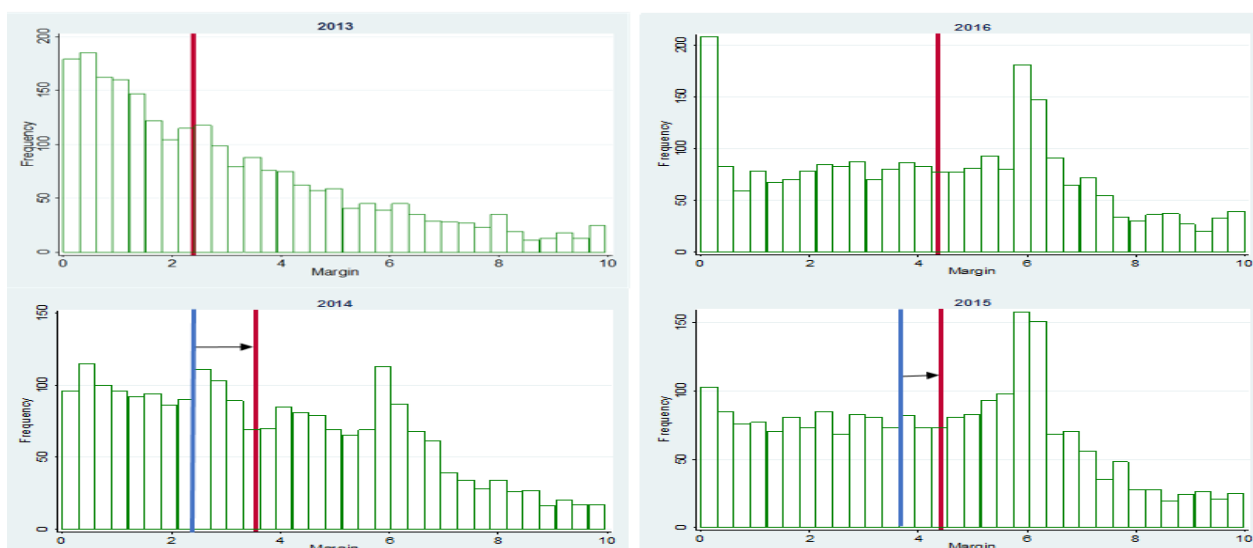
Note: Red vertical lines mark the distribution median for the year represented, and blue lines the median for the previous year.
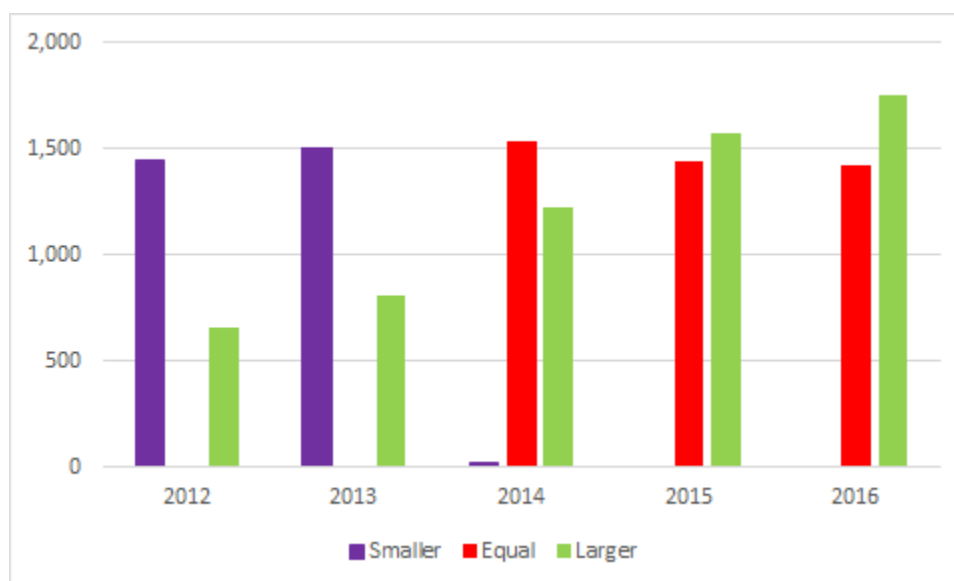
Figure 8. Number of Firms with Category of Effective Tax Rate Relative to 1.5 Percent

While one of the key disadvantages of the implementation of an MT on the basis of gross sales is the disproportionate burden on sectors with structurally lower profit margins (such as food retail sales) relative to sectors with systematically higher profit margins, the data shows that the introduction of the MT induced more truthful declaration of taxable profits, especially in sectors that had previously declared low margins. This suggests that at least part of the lower reported profits for several industries was due to underreporting to tax authorities, rather than truly lower profit margins (Figure 8). Scot and others (2020) corroborate these findings. Though the rates

have been gradually reduced since March 2018 due to high lobbying pressure, the minimum tax remains in place in the country today and is recognized by the revenue administration as having assisted in their efforts to improve tax compliance.

Figure 8. Change in Effective Tax Rates and Reported Profit Margins by Sector
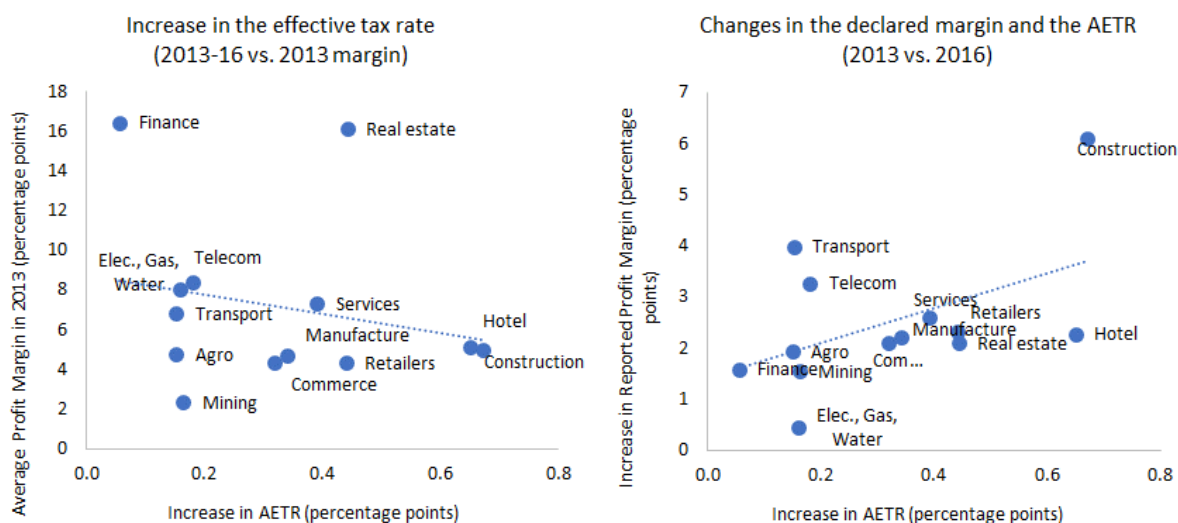
V. CONCLUSION

This paper has examined the rationale and implications of MTs and attempted to quantify their impact on economic activity. An MT can be effective in shoring up the corporate tax base and enhancing the perceived equity of the tax system. When political economy and administrative constraints prevent reforms to the CIT, an MT can protect the corporate tax base against the erosion from tax preferences and avoidance. In addition to its direct impact on revenues, there may also be a positive indirect revenue impact if the MT improves perceptions of a fair distribution of the tax burden and motivates broader taxpayer compliance. However, an MT remains a third-best alternative—on top of existing second-best CIT systems—to policy and administrative reforms that broaden the corporate tax base, given that inefficiencies and low revenue productivity caused by excessive corporate tax preferences and tax avoidance and evasion should be tackled directly wherever possible.

It is clear that the base of the MT can influence its effectiveness. The simplicity of turnover as the base can outweigh its efficiency and equity drawbacks. In circumstances where an MT aims to limit tax avoidance and evasion, turnover provides a simple and readily observable tax base. Its drawback is that turnover may prove a poor predictor of profitability and ability to pay. An MT based on cash flow is likely to be less distortionary, as expensing of investment expenditures is likely to reduce marginal ETRs but may prove too complex for smaller businesses. Both turnover and cash flow also have the disadvantage of base erosion during periods of high inflation, which does not affect an assets-based MT. While automatic indexation is available, it is only possible at the turn of the fiscal year, while throughout the year, businesses are subject to erosion that an assets-based MT would avoid.

An MT for large taxpayers based on assets or modified taxable income will more effectively counter profit shifting and better proxy the regular income tax. An MT based on gross assets is

less susceptible to transfer pricing abuses and can provide an effective check on profit shifting when tax administrations lack sufficient resources and expertise. Furthermore, a modified form of taxable income is the most direct and targeted way in which an MT can limit the excessive use of tax preferences. Assets and modified taxable income are likely to better reflect true economic income than blunt measures such as turnover, with potentially beneficial effects for the neutrality and horizontal equity of the tax system.

The rate of an MT should proxy the effective tax rate under the regular income tax but should be kept relatively low (except for modified income-based MTs). The rate of a turnover-based MT should proxy for the CIT burden on a firm at the lower end of the distribution of gross profit margins. Similarly, the rate of an assets-based MT should mimic the regular tax burden on a firm earning a rate of return sufficient to cover its cost of capital. By targeting the lower end of the possible range of profit margins and returns on investment, the MT should avoid imposing significant distortions to investment. There may be a case for differentiating the rates where margins or rates of return vary significantly by sector. However, the benefits from improved targeting of the MT should be weighed against the increase in complexity and the inevitable ambiguity in classifying multi-activity firms.

MT payments should also be creditable against future CIT liabilities with long carry forward periods to mitigate any negative impact on investment incentives. For firms that temporarily incur taxable losses under the regular for reasons unconnected to tax preferences or avoidance behavior, the ability to carry forward MT payments will mitigate the "rough justice" nature of the MT. Carry forward provisions will also help to offset the increase in marginal effective tax rates from the introduction of an MT. This positive impact on investment incentives will be particularly pronounced when investors face a high degree of uncertainty over future investment returns.

Based on a novel database of minimum tax regimes worldwide, we show a growing prevalence of minimum taxes, particularly turnover-based, which tend to be associated with higher statutory CIT rates and revenue to GDP ratios. In addition, in a partial equilibrium setting (ignoring behavioral implications), data at the firm level suggests that the introduction of the MT is associated with an increase in the average ETR at the firm level of just over 1.5 percentage points, with no evidence of detrimental effect on average firm-level investment or employment. Modified income-based MTs seem to be most effective at increasing average ETRs, followed by assets- and turnover-based MTs. To the best of our knowledge, there have been no studies estimating the impact of assets-based MTs, in particular, on investment in fixed assets or average ETRs. This analysis, therefore, provides an initial inroad in this area. Moreover, our baseline results are even stronger when controlling for variation in sector's profit margins and firm-specific binding constraints – with an estimated increase in the average ETR with respect to turnover of 2.5 percent. Furthermore, studies using administrative data to evaluate the impact of turnover-based minimum tax regimes are few and far between, and the empirical evidence presented in this paper showed how tax revenues from firms in Honduras that became liable to the MT following its introduction increased by almost 1 percent of GDP in 2016. Access to larger panels of firm-level data across countries and MT reform episodes may provide improved identification strategies in future research.
Finally, we provide some simple estimates of the potential revenue yield of turnover or assets-based LMTs – a median of 0.2 and 0.9 percent of GDP, respectively. This represents a significant

potential that should warrant these instruments serious policy consideration going forward. Overall, our findings suggest unilateral and relatively administratively simple local minimum taxes may be effective at raising CIT revenue in source countries without significantly impairing corporate investment or profitability on aggregate. This provides some support to the inbound rule segment of the OECD's recent Pillar 2 proposal but does not go into the value of the outbound rule (which has received much of the weight of the discussions). Notwithstanding, our findings do point to considerable advantages to even the unilateral adoption of LMTs under several settings of imperfect tax capacity and tax competition, as observed historically. Further work on minimum taxes could helpfully explore the novel database created in combination with other tools to explore the empirical impact of these taxes in greater depth, beyond the initial inroads made for the purposes of this paper. Moreover, inasmuch as we have intentionally kept this paper to largely positive economics, future research could elicit more precise normative policy statements through a more structured integration of minimum taxes into optimal taxation models. In particular, their welfare implications should be assessed contingent on particular sources of friction in second-best settings, as well as design specificities.

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APPENDIX I. - THE RATIONALE FOR A CORPORATE MINIMUM TAX

In this Appendix, we provide additional background on the mechanics of the MT to explore the different rationales for their use in a country's fiscal arsenal. As mentioned in the main text, MTs have been justified as a means to limit the extent to which firms can reduce their tax liabilities using incentives and preferential treatments, as well as a means of attenuating CIT revenue volatility. They can also help ensure that foreign-owned businesses—which are often perceived as paying too little tax relative to some measure of their local activity—pay their dues.

A. Restricting the use of corporate tax preferences

By guaranteeing a minimum CIT liability, MTs can help shore up revenues within a domestic tax system that has been undermined by excessive tax incentives, which represent departures from the standard or "benchmark" business income tax system and the elimination of which is often prevented by political constraints. In other words, MTs can increase payments from taxpayers who, under the rules of the regular tax system, are believed to pay too little tax relative to a more standard measure of their income. The floor on the amount of income tax payable also guarantees a minimum average tax rate for all taxpayers.

Corporate tax codes in advanced and developing economies contain numerous preferences that can substantially reduce effective corporate tax rates. While more developed economies tend to use targeted investment incentives, usually embodied in income tax law, developing economies make greater use of general incentives embodied in numerous pieces of legislation or subject to discretion.

Their use appears to have become more widespread in developing economies—for example, 30 years ago no low-income Sub-Saharan African countries had tax free zones, now 50 percent do so; and 80 percent of sub-Saharan African countries offered tax holidays in 2005, compared to 40 percent in 1980 (Keen and Mansour 2008). However, this trend is not universal, as in Latin America and the Caribbean, the average length of tax holidays has declined since the 1980s (Klemm and van Parys 2009).

Nevertheless, special economic zones, which offer fiscal incentives and streamlined regulations to attract foreign direct investment (FDI), are more the norm than not, with nearly 5,400 in operation in 147 countries as of 2018 (UNCTAD 2019). More than 1,000 were established in the last five years and at least another 10 per cent more are expected to open in the coming years.

Eliminating unproductive and cost-ineffective tax preferences offers the first best solution to broadening the base, discourage rent seeking behavior, eliminate opportunities for leakage, and improving the simplicity and transparency of the CIT.[31] However, while there have been

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[31] The revenue cost of corporate tax preferences is difficult to assess but is likely to be substantial in many developing economies. Cubeddu et al. (2008) estimate that corporate tax incentives available in 15 Caribbean countries between 1995 and 2003 cost 5.5 percent of GDP in foregone revenues. Chai and Goyal (2008) estimate that revenue forgone from CIT holidays may have exceeded 4 percent of GDP annually in the Eastern Caribbean Currency Union countries; and that abolishing these tax holidays would increase revenues by 3.3 percent of GDP

(continued…)

successful examples of major reforms to broaden CIT bases in developing economies (e.g., Egypt and Mauritius), political economy factors may often prevent such a first best policy response.

B. Countering tax planning and avoidance

A second popular argument for introducing an MT is that by imposing a floor on a firm's average effective tax rate, an MT can effectively limit the revenue loss caused by tax planning and avoidance behavior, for example, the use of corporate tax shelters. The implicit assumption is that the MT (tax base) is less subject to manipulation than taxable earnings.[32] In this regard, the requirement for large firms to prepare financial statements in accordance with international accounting standards and subject to external audit is assumed to provide an additional check on taxpayer behavior.

Developing economies often struggle to effectively tax complex MNEs. And the fact that the flow of inward FDI to developing economies has remained stable over the years, even if the global flows have fallen overall[33]—means that MNEs will continue to remain important for developing economies. The stock of FDI accounted for just over 30 percent of the GDP of developing economies in 2018, compared to 14 percent in 1990 and 25 percent in 2000 (UNCTAD 2019).

As is well known, these multinational firms engage in sophisticated forms of profit shifting through the use of transfer pricing and intra-group debt, such that the revenue loss for small developing economies may be very substantial. Yet identifying, auditing and successfully prosecuting transfer pricing cases proves challenging for tax administrations and tax administrators in developing economies often lack the necessary resources and expertise.

A turnover-based MT can be effective against tax planning strategies that generate tax-deductible expenses but may be susceptible to manipulation of transfer prices. Multinational firms may seek to capitalize their overseas subsidiaries using high levels of intra-group debt in order to generate tax-deductible interest charges. Charging subsidiaries tax-deductible royalties or management fees in excess of arm's length rates for the use of intellectual property and headquarters services offers additional profit shifting opportunities. The floor on average effective tax rates imposed by a turnover-based MT will be unaffected by these profit shifting strategies, as the base is determined by gross earnings. By contrast, transfer pricing strategies

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after allowing for the impact on investment behavior. Estimates for Latin America put the cost of preferential treatments under the income tax at 0.5–6 percent of GDP (Villela, Lemgruber, and Jorratt, 2010).

[32] Saez and Zucman (2019) propose an effective minimum corporate income tax rate (e.g. 25 percent) that could be applied even without cross country agreement, as individual countries could decide to partially tax foreign companies, up to a limit determined by the proportion of sales in the host country. In addition to curbing corporate income tax avoidance, the authors advocate such a minimum effective rate as one of several tools aimed at reducing income inequality in the United States.

[33] Global FDI flows continued their third consecutive year of decline in 2018, due to large repatriations of accumulated foreign earnings by United States MNEs in the first two quarters of 2018, following the 2017 TCJA.

that reduce earnings – for example, by charging less than the arm's length price on sales to related parties – are likely to reduce the book value of turnover.

Gross assets as a base would be unaffected by profit shifting behavior, but at the expense of horizontal equity between firms with different returns on investment. Transfer pricing strategies, including the use of intra-group debt, will reduce taxable and possibly accounting profits, but will not affect the book value of a firm's gross assets. An MT on net assets, by contrast, introduces a bias toward debt financing and would be vulnerable to the use of related party debt in much the same way as a standard CIT with interest deductibility. However, the attractions of using a firm's balance sheet – as opposed to its income statement – as the MT base to nullify transfer pricing strategies should be weighed against the potential for introducing horizontal inequities.

Developing economies might consider alternative policy and administrative solutions to tackle profit shifting strategies. If excessive use of intra-group debt is the primary concern, then developing economies might consider restrictions on interest deductibility. As an example, many countries impose thin capitalization rules such as a maximum allowable debt-equity ratio under their CIT. More comprehensive reforms to achieve neutrality between debt and equity financing can either disallow interest deductibility (the so-called CBIT system) or include an allowance for corporate equity (ACE). However, there are no real-world examples of CBIT systems, while only a handful of countries currently apply variants of an ACE. The ease with which developing economies can tackle other forms of transfer pricing abuse will depend upon the complexity of the sectors in which multinational firms operate and the capacity of the tax administration to audit transfer pricing cases.

An MT that aims to counter avoidance by small firms might include a lower rate for taxpayers with a strong compliance record and record keeping. The combination of large informal sectors and weak tax administrations can create significant non-compliance among small and medium-sized enterprises. Romania recently repealed its MT of 5 percent of turnover for most firms but maintained the MT in sectors such as gambling and nightclubs where tax non-compliance is prevalent. Countries such as Sierra Leone (before 2013)[34] and Mauritania sought to incentivize compliance by offering reduced MT rates to firms that adopt formal accounting procedures or have a strong track record of tax compliance.

C. Complexity and Compliance Costs

In a first-best world, presumptive taxation of sales (such as the turnover-based MT) is distortionary of production. However, in a second-best world with limited tax capacity, Best and others (2015) suggest that switching from profit to turnover taxation increases revenue collection efficiency without reducing aggregate profits, despite the production inefficiency that it introduces. This finding is corroborated in Section IV. D. , where we review evidence using

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[34] Per the Income Tax Act (2000), Income Tax (Amendment) Act 2004 (No. 6), and Finance Act 2006. A minimum chargeable income of 10 percent of turnover (15 percent where accounts have not been kept) used to apply to all companies. Where a company or business proprietorship had been audited by a "reputable firm of Accountants" and the Commissioner is satisfied with records, no minimum chargeable income will apply and assessment will be on profit basis.

administrative tax data for Honduras. In the long-term, revenue administration reforms would ideally be sufficiently effective at improving compliance (and bringing countries close to a first-best scenario), such that presumptive taxation is no longer welfare enhancing on net. However, in the short-term in the presence of compliance shortcomings, the MT has proven to be an effective means of reducing tax evasion, with no tangible negative effects on the aggregate profitability of firms.

However, introducing an MT in parallel with the regular CIT complicates the tax system and increases compliance costs for taxpayers (Chorvat and Knoll 2003). Such an AMT requires corporate taxpayers to maintain at least two set of tax records: one set for the regular CIT and another for the AMT. The size of the increase will depend on the complexity of the AMT and, in particular, how closely the base resembles either taxable income as calculated under the standard CIT or accounting measures of income or assets.

The complex base of the U.S. AMT is estimated to impose substantial compliance costs on taxpayers. Slemrod and Blumenthal (1996) estimate that it increased tax compliance costs for large corporates by 18 to 26 percent compared to those not subject to the tax. Moreover, this is likely to be an underestimate of the true compliance cost, as the estimates relate only to those firms paying the AMT and hence miss the additional record-keeping requirements for all firms potentially liable for the tax but did not have to pay it. As well as imposing a deadweight cost, these additional compliance costs will also reduce the revenue raising potential of the AMT if they are tax deductible.

Compliance costs tend to be regressive with respect to firm size, suggesting an MT for small and medium sized firms should be based on turnover. Numerous studies have documented the tendency for tax compliance costs to be inversely related to firm size, due to the significant fixed costs involved (European Commission 2018). An MT that applies to small and medium sized firms should use a base that avoids exacerbating this regressivity. Turnover is an obvious candidate, as even small and informal traders are likely to understand their cash receipts. Firms are also likely to record and report some measure of gross receipts for VAT/GST purposes. Larger firms could then be subject to an MT based on more sophisticated measures such as cash flow or modified taxable income that will better proxy for economic income.

D. Reduced Volatility and Cyclicality of Corporate Income Tax Revenues

A fourth rationale is that CIT revenues tend to be highly pro-cyclical in developing economies, contributing to volatile and depressed levels of public investment. Corporate taxes tend to be the most unstable component of government revenues over the business cycle, reflecting the strong pro-cyclicality of corporate profits relative to labor income and consumption. The instability of non-resource CIT revenues has been found to increase the volatility of public spending in sub-Saharan Africa (Ebeke and Ehrhart, 2011). This spending volatility in turn has a negative impact on the level of public investment, to the detriment of long run growth.

An MT with indefinite carryforward will smooth corporate tax payments over the business cycle. With sufficiently long carry forward provisions for excess MT payments, the MT acts as a minimum *payment* rather than as a minimum *tax* (van Wijnbergen and Estache, 1999). Corporate

tax payments are then smoothed across the business cycle, with the MT guaranteeing a minimum payment during economic downturns. van Wijnbergen and Estache (1999) argue that if this revenue smoothing substantially reduces the pro-cyclicality of fiscal policy – and if pro-cyclical fiscal policy is a major cause of macroeconomic instability – then a corporate MT can encourage investment by reducing the aggregate uncertainty facing risk-averse investors.

From one perspective, MTs may be counter-cyclical, such that firms to pay higher effective tax rates than they otherwise would have in periods of low economic activity and lower taxes in periods of high economic activity (Galle and Klick 2011). An example of this counter-cyclical relationship was the dramatic rise in U.S. AMT payments during the 1990–91 recession, which peaked at US$ 20.7 billion dollars or 8.4 percent of total taxes paid that year (Carlson, 2005; Lyon, 1997).

Preferences and adjustments under a corporate MT form a larger share of a firm's income during times of lower profitability. If the firm attempts to maintain the same level of investments and other activities, a firm's MT liability will increase during economic downturns because the MT serves to recapture the preferences as their use (relative to income) increases. As described in the introduction section, this reduces the automatic stabilizer role of the broader CIT.

However, upon closer inspection, MTs can in fact be described as cyclically asymmetric from a firm perspective: counter-cyclical during recessions, but acyclical during an expansion, since they function as a minimum tax only and the standard CIT liability would apply in the latter. In turn, MTs can be perceived as relatively acyclical from a government revenue perspective, providing a stable revenue source in absolute value irrespective of the business cycle.