Tax Administration vs. Tax Rates: Evidence from Corporate Taxation in Indonesia

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Abstract

We compare two approaches to increasing tax revenue: tax administration and tax rates. We show that when Indonesia moved top regional firms into "Medium Taxpayer Offices," with high staff-to-taxpayer ratios, tax revenue more than doubled. Examining non-linear changes to corporate income tax rates, we estimate an elasticity of taxable income of 0.59. Combining these estimates, improved tax administration is equivalent to raising rates on affected firms by 8 percentage points. On net, improved tax administration can have significant returns for developing countries.

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1 Introduction

Low tax revenue is a central challenge in many developing countries. While high-income countries typically collect around 40 percent of their GDP in tax revenue, low and middle-income countries typically collect between 10 and 20 percent. Many features of developing countries' economies, such as the informality of employment relationships, small firms, limited banking systems, and so-on, combine to limit governments' ability to tax more (Gordon and Li, 2009; Kleven et al., 2016; Jensen, 2019).

For such countries, a key question is whether they are constrained in raising revenue primarily by the elasticity of taxable income with respect to the tax rate, or whether increases in tax administration may have direct, first-order effects on the amount of tax collected. The idea is that enhanced tax administration may make evasion and avoidance more difficult, enabling governments to not only collect more, even at current tax rates; moreover, if better tax administration reduces the elasticity of taxable income, governments may be able to raise rates as well (e.g., Besley and Persson, 2014). While an emerging literature focuses on particular pieces of the tax administration puzzle in developing countries (e.g., Pomeranz, 2015; Khan et al., 2016; Naritomi, 2019; see Slemrod, 2019 for a review), there are relatively few studies that examine these types of large-scale tax administrative investments comprehensively, and can contrast these administrative reforms with more conventional attempts to raise revenue by raising tax rates (Keen and Slemrod, 2017; Slemrod, 2019).

In this paper, we study these questions in the context of corporate taxation in Indonesia. We study the introduction of a large corporate tax administration reform in Indonesia, the creation of 'Medium Size Taxpayer Offices' (henceforth, MTOs) throughout the country. These offices can be thought of as more 'intensive' tax administration, as they more than triple the staff-to-taxpayer ratio for firms. The aim is to increase both enforcement and customer service, while holding the *de jure* tax regime and the administrative structure of the tax office constant. We first study how this intensified tax administration affected actual tax filings and payments using a 9-year firm-level panel of administrative tax data. We then compare this with a differential change in the statutory marginal corporate income tax rates enacted several years later, which applied regardless of whether taxpayers were in these special tax offices.

To compare these two approaches – tax administration and tax rates – we build a model of corporate taxation in which firms can chose to keep certain parts of their business 'off the books' – i.e., hidden from the tax authority. We then adapt the framework of Keen and Slemrod (2017) to corporate taxation, showing that the two tax reforms that we consider

– improvements in tax administration and changes in tax rates – can both be analyzed by comparing their effects on net government revenue. Importantly, the fact that we consider both reforms in the same context – corporate taxpayers in Indonesia, analyzed using the same administrative tax records, and even zooming in on the effect of both types of reforms on corporate income tax payments – allows us to compare the marginal returns to both types of policies on an equal footing.

We begin by analyzing improvements in tax administration through the creation of the MTOs. In virtually all countries, corporate income tax revenues are heavily skewed, with a small number of large taxpayers comprising a considerable share of revenues. As such, many countries have created special large taxpayer offices to focus on the largest firms in the country; these are present in at least 62 countries (Lemgruber et al., 2015; Almunia and Lopez-Rodriguez, 2018). Despite being a common policy, there is relatively little evidence on whether these reforms have been effective in the developing world, and if so, on the magnitude of the gains relative to the costs of this increased supervision.[1] We study the introduction of such a reform, introduced at an unusually large scale: In the mid-2000s, Indonesia moved the largest several hundred corporate taxpayers in each of its 19 main tax regions to a special MTO in each region that focused exclusively on them. The MTOs had similar administrative structure to the regular taxpayer offices, but focused exclusively on large corporate taxpayers, and had 4-5 times as many tax staff per corporate taxpayer as regular taxpayer offices.

To identify the MTO's impact, we use a matched difference-in-differences design to examine what happens when firms are moved into the MTO. While we know which firms are in the MTO in which years, the original Excel files used to select firms were not archived, and so we cannot recreate the assignment scores and processes. Instead, we match the set of taxpayers included in the MTOs with similar taxpayers based on the taxpayers' region and based on the two variables that were primarily used for MTO assignment: the level of their pre-period tax payments and gross revenue. We use the value of these variables in 2005, the last unaffected tax year and the last tax year whose data was available to the tax authorities at the time of assignment,[2] for matching. Our preferred specification uses the

[1]There is relatively little evidence on these types of reforms even for developed countries. An important exception is Almunia and Lopez-Rodriguez's (2018) study of Spain. Exploiting the fact that large firms in Spain are monitored by a national large tax office, they show that firms bunch beneath the threshold of inclusion into the LTO, and that those above the threshold report a 20 percent higher valued added tax base than those below.

[2]The assignment occurred between December 2006 and January 2007. Because taxes for 2005 were filed in April 2006, 2005 was the last untreated tax year and tax year 2006 was a partially-treated tax year.

entropy-balancing method of Hainmueller (2012) to create matched treatment and control samples balanced on these covariates, although other matching approaches produce similar results. We show that the treatment and matched control group of taxpayers are on very similar trends prior to the MTOs' establishment, and then identify the impact of being moved into an MTO using a matched difference-in-differences design.

The introduction of enhanced tax administration via the MTOs dramatically increased tax revenue, at a very low cost. Real total taxes paid increased by 128 percent for affected firms; that is, moving firms to the MTOs more than *doubled* average tax collections from these firms over the subsequent six years. The government's increased costs of administering taxes through the MTOs were minuscule – about 1.5 percent of the additional revenue collected – so the net increase in government revenue is almost identical to the gross increase.[3] Put another way, the reform increased net tax revenues by Rp. 517 million per year for an annual investment of Rp. 8 million, or a 64-1 net return. All types of taxes paid by these firms rose dramatically: corporate income tax (CIT) payments rose by 111 percent, VAT payments rose by 137 percent, and other tax payments (primarily withholding taxes remitted by firms on behalf of employees) rose by 113 percent.[4] Examining MTO and non-MTO firms separately, the results suggest that this effect appears to be driven by dramatic increases in revenue from MTO firms, rather than declines for non-MTO firms, whose tax revenues remain on a similar trajectory to what they were in the pre-period.

The estimated net revenue increase from enhanced tax administration, which covered just 4 percent of all firms, amounts to a lower-bound total effect of IDR 40 trillion (USD 4.0 billion at the 2007 exchange rate).[5] Importantly, the MTO effects grow over time: the effects of the MTO on taxes paid and on reported gross incomes 6 years after firms were

Section 4.1 discusses the timing of assignment in mode detail.

[3]This very high ratio of revenues received to additional administration costs makes the MTO tax administration reform distinctively cost-effective compared to tax administration interventions studied elsewhere. For example, Gadenne (2017) finds a near one-to-one cost/benefit ratio from a tax administration program implemented by the Brazilian Development Bank in 1998, which provided municipalities with subsidized loans for investments in items such as improved taxpayer registry systems, streamlining of audit processes, and simplifying taxpayer interactions with authorities.

[4]Throughout the period studied (2003-2011), third-party cross-checking of VAT payments in Indonesia was a manual process conducted by tax office staff, limiting the self-enforcing aspect of VAT, and thus increasing the scope for large VAT effects once taxpayers were moved to a higher enforcement regime.

[5]The large impact of improved tax administration that we find is not mechanical – the fact that the level of tax collection may be low in a developing country like Indonesia does not necessarily imply, a priori, that the *derivative* of tax collections with respect to improved administration would be high. This is in contrast to, for example, the comparison between *de jure* changes in the tax base and *de jure* tax rates, where, as suggested by Suárez Serrato and Zidar (2018), there is a mechanical interaction between tax base and tax rate changes.

transferred into the MTO were between 1.5 and 2.5 times larger than they were 2 years after being moved to the MTO, despite the fact that staffing levels and enforcement actions from the MTO (as well as from Primary Tax Offices, or PTOs) remained essentially constant.

One question raised by our model is whether the impacts come from previously hidden transactions being brought 'on the books,' or instead whether the impacts come from a greater scrutiny of deductions or better tax collection of tax arrears. We find that the creation of the MTOs also led to an increase in reported revenues, reported costs, the reported number of permanent employees, and a higher reported wage bill. The findings that reported costs, revenues, and taxable income all increase at roughly similar rates, with no impacts on reported profit margins or collections as a share of taxes due, suggest that the MTO may have led to more of the business being reported to the tax authority.

While the MTO can affect enforcement in many ways, our model suggests one mechanism in particular that we can investigate in the data: a reduction in size-dependent enforcement. Specifically, primary tax offices, which deal with a large number of firms, concentrate their enforcement on larger firms; this creates a disincentive for smaller firms to grow. MTOs, however, have the resources to treat all firms approximately equally regardless of size, so once a firm has been switched to the MTO, it no longer faces an 'enforcement tax' on additional growth..[6] We show this empirically using detailed data on a few types of enforcement activities tracked consistently by the government – formal audits and letters sent to taxpayers regarding late VAT payments and underpayment. In the standard (i.e., non-MTO) tax administration, with low staff-to-taxpayer ratios, we show that tax staff prioritize their efforts by focusing on the largest taxpayers. Given this, firms may want to avoid growing too large and drawing the attention of the tax authorities. By contrast, we document that the tax offices with more tax staff (i.e., MTOs) pay attention to taxpayers more uniformly, regardless of firm size. Thus, while the effective tax rate may increase for smaller firms who are moved to the MTO – since they face higher enforcement overall – the better tax administration eliminates the additional enforcement tax on firm growth.

How large would a corporate tax increase have to be to raise as much revenue as the administrative improvement? To answer this question, we compare the tax administration reform to a second reform that changed the *de jure* corporate income tax rate schedule. In 2009, Indonesia changed from a system with progressive corporate income tax rates (i.e., a system with three marginal rates, ranging from 15 to 30 percent, with the marginal rate based

[6]These ideas are related to Bigio and Zilberman (2011), who show in a more general setup that this type of size-dependent enforcement can be optimal, even if it leads to distortions.

on a firm's taxable profits) to a flat 28 percent corporate income tax rate, with discounts given as a nonlinear function of a firm's gross revenues. The flat 28 percent corporate income tax rate was then lowered in 2010 to 25 percent, with a proportionate adjustment to the revenue-based discounting scheme. This differential tax change, in which the marginal tax rate moved from being a function of net *profits* to being a function of gross *revenues*, meant that firms faced different marginal tax rate changes as a nonlinear function of the combination of both their gross and net revenues.[7]

We exploit these changes to estimate the elasticity of taxable income (ETI) with respect to the net of tax rate. Following Gruber and Saez (2002) and others, we instrument for the change in a firm's marginal tax rate by applying the new tax formula to gross and net revenue reported by the firm in the pre-period. This approach isolates the variation in changes in marginal tax rates stemming only from the tax schedule change, and has strong predictive power, with a first-stage F-statistic of over 3,000.

We estimate an elasticity of taxable income of 0.59. This implies that, perhaps surprisingly, corporate income taxes for relatively large firms in a developing country setting are not vastly more elastic than in developed countries.[8] We also investigate whether the ETI differs depending on whether firms have been moved to the MTOs or not. While our point estimates suggest that the ETI is lower for firms that are in the MTO than for those that are not, we cannot reject that the ETI under the two different enforcement regimes is the same. The results suggest that the effects of the MTO documented above do not come primarily through a reduction in the ETI.

Finally, we can put our estimates together to compare raising revenue through improvements in tax administration and increases in statutory tax rates. Specifically, we can compute, using our estimated ETI, how much marginal corporate income tax rates would have had to be increased to raise the same amount of revenue that the government obtained from the same corporate income tax by improving tax administration. The answer is substantial: to obtain the increases in corporate income taxes paid by MTO taxpayers alone, top marginal corporate income tax rates on all firms would have had to be raised by 8 percentage points

[7]Corporate tax schedules based on firm revenues, rather than taxable income, are currently used by several other developing countries, including Costa Rica, India, Thailand, and Vietnam (Bachas and Soto, 2018).

[8]The estimated ETI for Indonesia is larger than the estimate from Gruber and Rauh (2007) using Compustat data in the United States (0.2), but close to Dwenger and Steiner's (2012) estimate using a pseudo-panel of German corporate taxpayers' average tax rates (0.6). Our estimate is, however, smaller than Bachas and Soto's (2018) estimates from Costa Rica (3-5), though the firms in their sample are very small, with revenues of only approximately USD100,000 - USD200,000, making them between 8-17 times smaller than the medium-sized firms we consider here.

(i.e., from 30 percent to 38 percent).[9] In fact, even if the ETI was 0 – that is, there was no behavioral response to taxation – the 2006 top marginal income tax rate would have had to be raised by 6 percentage points on all taxpayers to generate revenue equivalent to that of the MTO.

To compare the welfare impacts of tax administration improvements and tax rate changes, one needs an additional component – namely, the change in firms' administrative costs for complying with the new regime. While this change is unobserved, we adapt the framework of Keen and Slemrod (2017) to characterize the conditions under which the welfare gains from raising revenue through improved tax administration exceed those from increased rates. Our results suggest that these conditions are likely to hold unless the additional compliance costs associated with the MTO are extremely high. Since the MTO actually appears to have made compliance for firms easier– firms report higher customer satisfaction when dealing with MTOs than when dealing with PTOs – the conditions seem likely to be satisfied.

In short, our findings suggest that developing country governments may have substantial room to raise revenue through both administrative improvements and raising rates, but that at least in the case of medium-sized firms, the dramatic returns from improved tax administration suggest it is likely to be a particularly important policy tool.

This paper builds on a number of literatures. First, we build on the growing new literature documenting the importance of tax administration in developing countries. Important recent work in the developing world has focused on improvements to third-party reporting (Pomeranz, 2015; Carrillo et al., 2017; Almunia et al., 2017; Naritomi, 2019; Brockmeyer et al., 2019), computerization (Fan et al., 2018), and performance pay (Khan et al., 2016), as well as the role of liquidity constraints in limiting tax ability (Brockmeyer et al., 2020). Importantly, our paper is also closely related to recent work focuses on what to tax, such as Best et al. (2015), who explore whether one should tax profits or revenues in low-information, developing country settings – and show the advantages of taxing things that are more observable. The reform that we study, coupled with an extensive panel of administrative tax data, allows us to contribute to this literature by understanding the impacts of a change in the overall level of tax administration and by understanding how this sustained increase in tax administration over many years affects firms after they are able to adjust to a new

[9] Achieving the total increase in revenue from improved tax administration, including the higher VAT and withholding payments received, would not have been feasible by changing the corporate income tax rates alone (i.e., that would have required raising rates well above the revenue-maximizing rate); likewise, it would not be possible to raise the amount of corporate income tax revenue generated by the MTO from the MTO firms themselves simply by raising the marginal corporate income tax rate.

paradigm.

Second, we build on the recent literature understanding the *de jure* impacts of corporate income taxes. While most recent work in the United States and Europe, such as Suárez Serrato and Zidar (2016) and Fuest et al. (2018), focuses on the impact of corporate income tax changes on investment and wages, our paper follows instead in the tradition of Gruber and Rauh (2007) and Kawano and Slemrod (2016) in estimating the elasticity of taxable income for corporate income tax. Specifically, we contribute to this literature by leveraging the large and differential changes in marginal tax rates stemming from Indonesia's tax reform, which generates substantial variation in marginal tax rates and does not require these additional assumptions.

Finally, and perhaps most importantly, this paper bridges these two literatures to highlight the tradeoffs between tax administration and rate changes. Keen and Slemrod (2017), in particular, theoretically show that the key parameter of interest to study the impact of changes in both tax administration and tax rates is their impact on taxable income, and suggest the importance of studying both changes in the same context for comparison. In fact, they specifically point out that "the new wave of empirical literature on the impact of tax enforcement activities has not yet produced estimates of the elasticities our approach shows to be critical." Part of the reason why this has not been done before is that doing so requires clear, credible natural experiments varying both tax rates and administration in the same setting, as well as access to high quality administrative tax data to evaluate the impacts of these changes. Indonesia's reforms, coupled with its rich administrative data, provide a unique opportunity to bring empirical evidence into this broader theoretical debate, particularly in the developing country context.

The rest of this paper is organized as follows. Section 2 describes the setting, the two reforms that we study, and the data. Section 3 develops a model of corporate tax evasion that guides our empirical approach. Section 4 estimates the impact of improved tax administration. Section 5 presents the estimated elasticity of taxable income from tax rate reform, and uses this to contrast the tax administration reforms with changes to the tax schedule. Section 6 concludes.

2 Setting and Data

2.1 Corporate taxation reforms in Indonesia

Indonesian taxation is administered by the Directorate General of Taxation (DGT). Overall, in 2005 Indonesia had a tax-to-GDP ratio of 14.9%, which puts it at the 42nd percentile of low and middle-income countries (UNU-WIDER, 2021), and comparable to countries such as Philippines (12.4%), Costa Rica (13.6%), Malaysia (14.3%), Senegal (14.6%), and India (16.4%).

Corporate taxpayers must pay both corporate income tax and value-added taxes, as well as file withholding taxes on behalf of their employees. As in most countries, corporate income taxes are levied on net income (profits), with standard depreciation schedules for capital assets. In our study period, the tax schedule moved from a progressive corporate income tax rate, with three brackets ranging from 10 to 30 percent, to a flat 25 percent rate, with discounts based on gross income (see Section 2.1.2). Value-added taxes are assessed at a flat 10 percent rate, with rebates for exports. Taxpayers remit payments for both corporate income tax and individual income taxes monthly. Annual corporate tax returns follow a January - December tax year, and must be filed by the end of April of the following year.

2.1.1 Tax administration reform and the introduction of Medium Tax Offices

Indonesia began comprehensive reforms of its tax administration system in 2002, to improve fiscal balance in the wake of the 1997-1998 Asian Financial Crisis. This was the first year it transitioned to a modern, centralized IT system to handle all tax transactions. It also restructured the organization of its tax offices.

The organizational reform had two main features. First, following typical practice worldwide (Lemgruber et al., 2015), large corporate taxpayers were moved to centralized offices, with higher staff-to-taxpayer ratios to allow for more intensive followup. The largest 200 taxpayers nationwide would be serviced centrally by a Large Taxpayer Office (LTO) based in Jakarta. Analogously, the top several hundred taxpayers in each region would be handled by a special Medium Taxpayer Office (MTO) in their tax regions. All remaining corporate taxpayers, as well as all individual taxpayers, would be handled by the network of about 300 Primary Taxpayer Offices (PTOs).[10] We focus on firms serviced by MTOs and PTOs.[11]

[10]Eight "special" tax offices were also created to handle foreign corporate taxpayers, publicly traded companies, and oil and gas firms.

[11]Since LTO firms and firms in the special tax offices are large and easily identifiable, their data could

Second, the office structure was also reformed. Prior to the reform, tax offices were organized by tax type, such that taxpayers filed different taxes in different locations, and auditing was conducted by a separate network of audit offices (Brondolo et al., 2008). The reorganization centralized all of each taxpayer's payment obligations and auditing into a single office, and put a single contact person, known as an account representative, in charge of each taxpayer. This new centralized organizational structure was identical at LTOs, MTOs, and PTOs.

We study the impact on firms of being assigned to an MTO, as opposed to a PTO. Tax liabilities and procedures are identical for MTO and PTO firms.[12] Instead, the primary difference was that the MTOs had higher staff-to-taxpayer ratios.[13] We focus on the two main types of tax staff who deal with taxpayers: account representatives (ARs), who are the main tax staff responsible for interactions with taxpayers and routine enforcement (including sending letters asking for clarification, calling in taxpayers for meetings, and visiting taxpayers to confirm that firm activities appear commensurate with tax reports); and auditors, who conduct in-depth formal financial audits. Importantly, the MTOs feature a low taxpayer-to-staff ratio: approximately one AR and one auditor for each 17-26 corporate taxpayers. By contrast, at PTOs, each AR and auditor handled between 56 and 125 corporate taxpayers – in addition to hundreds or, in many cases, thousands of individual taxpayers (see Appendix Table A.1). The staff-to-corporate taxpayer ratio was therefore about 4-5 times higher in MTOs compared to PTOs.[14]

Although staff-to-taxpayer ratios were higher, the MTO staff were broadly similar in terms of experience (e.g., account representatives at MTOs had 8.3 years of experience at DGT in 2008, compared with 7.9 at PTOs; see Appendix Table A.1) and had similar scores at baseline on the subjective performance assessments that are explicitly used for promotions

not be shared in a way that would assure anonymity in accordance with Indonesian regulations.

[12]Firms in Indonesia can have multiple branches. Excluding headquarters, the MTO firms in our sample have on average 0.25 branches, while PTO firms have 0.06 branches. The only difference between MTO and PTO treatment of VAT is that PTO firms can file VAT either branch-by-branch or in aggregate; MTO firms report a single aggregated VAT; corporate income taxes are always filed centrally in both PTO and MTO firms. We combine all branches of a given firm to a single observation per firm per year using the common company identifier, so that firms with multiple branches are always treated identically in our analysis.

[13]On net, the MTOs we study have a total taxpayer-to-staff of about 6 as of 2011 (see Appendix Table A.1). These staffing ratios are broadly comparable to other high-intensity tax administration settings in similar countries. For example, large tax offices (LTOs) in other upper-middle countries have a corporate taxpayer-to-FTE ratio of 8-8.5 (Crandall et al. (2019)).

[14]As noted, PTO staff also had to handle individual taxpayers, whereas MTO staff could focus exclusively on corporate taxpayers. While we do not know the precise allocation of effort in PTOs between corporate and individual taxpayers, if one assumes that roughly half of PTO staff time was spent on individual taxpayers, then the taxpayer-to-staff ratio is about 8-10 times higher in the MTO.

(see Appendix Table A.2).

The higher staff-to-taxpayer ratios in the MTO can affect tax revenues in many ways. For example, de facto enforcement levels can increase if ARs handling fewer firms per person in MTOs can spend more time developing detailed firm profiles to help spot evasion. ARs can call in taxpayers for discussions or send letters asking for clarification (both of which are key enforcement activities and are not counted as formal "audits"), and they can do more of these activities per firm in the MTO since they handle fewer firms. The increased ratio of auditors to taxpayers also means that formal audit probabilities may increase at the MTOs, and when audits are conducted, auditors may be able to conduct more detailed audits.

The MTO may also reduce compliance costs, since ARs have more time to answer each firm's questions. In fact, anecdotal evidence suggests that this was the case: a survey of corporate taxpayers in the Jakarta and Banten regions conducted by ACNielsen showed 5 percentage points higher "satisfaction" with tax office interactions at MTOs compared to PTOs.[15] The MTO effects that we estimate should, therefore, be interpreted to include both increased enforcement (through higher ratios of account representatives and formal auditors), as well as potentially easier compliance.

We focus primarily on the wave of MTOs created in 2007, which covered the vast majority (13 out of 19) of tax regions. Prior to this, in 2004-2006, the new organizational structure was piloted in 6 regions, but the primary tax offices were not yet changed to have the same structure as MTOs (i.e., all taxpayer processes centralized into one office and a modern IT system). Hence, in these pilot districts, the MTOs differed from PTOs on a number of different characteristics (see Appendix Table A.3 for a list of these pilot districts). In 2007, two changes occurred. First, MTOs were created in all remaining 13 regions, with the lists of firms assigned to MTOs developed in late 2006 and officially published in January 2007. Second, the PTOs were reorganized in all regions, so that the PTOs and MTOs would have the same responsibilities, IT, and structure, but now the key difference would be that MTOs would have high staff-to-taxpayer ratios. Therefore, we focus on the 13 regions where MTOs were created in 2007, in order to examine the more intensive staff-to-taxpayer ratios that taxpayers were subject to, holding the overall administrative and organizational structure fixed between the MTO and the PTO, though results are strikingly similar using the full set of MTOs (see Section 4.2.4).

Within each region, taxpayers were assigned to the MTO based primarily on a formula in-

[15]Summary statistics from the ACNielsen survey were obtained from an internal DGT presentation dated January 2016; the original microdata have not been retained.

volving pre-period taxpayer size. While neither the exact formula nor the Excel spreadsheets used to assign taxpayers were retained, interviews with tax officials shed light on its inputs. Our understanding is that the formula combined gross income and total taxes paid for the prior three tax years into a score, and the several hundred largest taxpayers in each region were generally included in each MTO. At the time the MTOs were created, the formula was not published, nor were explicit criteria announced as to how the lists would be revised in the future. As of December 2006, when the MTO assignment was conducted, the latest data available to DGT were for tax years 2003-2005, filed in April-May of 2004-2006. On average, about 4 percent of the taxpayers per region – about 330 taxpayers – were initially assigned to each MTO.

Descriptive statistics comparing the taxpayers that are assigned to MTOs vs. remaining in the PTOs are shown in Appendix Tables A.17 through A.20. MTO taxpayers are, as expected, substantially larger than non-MTO firms on almost all dimensions. As such, they account for a large share of taxes even though they are a small number of firms. They are widely represented across sectors and geographies. The manufacturing and mining sectors appear disproportionately likely to be in the MTOs compared to other sectors, likely reflecting the fact that these sectors are more likely to have large firms than other sectors.

2.1.2 The 2009 corporate income tax rate reform

In September 2008, Indonesia passed a new law outlining a restructuring of the corporate income tax rate schedule beginning in tax year 2009. This had two main components: a) corporate tax rates would now be determined according to gross income (i.e., revenues) rather than taxable income (i.e., profits); b) the top marginal tax rate of 30 percent would be cut to 28 percent in 2009, and to 25 percent from 2010 onwards. Other than the change in statutory rates, the other features of the corporate income tax code (e.g., depreciation schedules and allowances) were unaffected by this reform.

Prior to this reform, corporate income tax rates followed a three-tiered schedule defined over taxable income (i.e., bottom-line profits): a rate of 10 percent for the first IDR 50 million (USD 5,000) in taxable income; a rate of 15 percent for the next IDR 50 million; and a rate of 30 percent on all taxable income over IDR 100 million (USD 10,000).

Starting in 2009, however, the system shifted to a flat rate, with discounts given based on gross income (i.e., top-line revenues). For firms with gross income above IDR 50 billion (USD 5 million), a 28 percent rate over all taxable income was applied. For firms with gross income below IDR 4.8 billion (USD 480,000), a 50 percent discount was applied, resulting in a 14

percent rate over all taxable income. For firms with gross income between IDR 4.8 billion and IDR 50 billion, a non-linear schedule was implemented, whereby a taxpayer with IDR g billion in gross income was assessed at a rate of 14 percent over the $(\frac{4.8}{g})$ share of its taxable income, and 28 percent over the remaining share, i.e., the tax rate was $14\frac{4.8}{g} + 28(1 - \frac{4.8}{g})$ percent. In 2010, the 28 percent flat rate was reduced to 25 percent, but the discounts were similar, so the final tax rate in this region became $12.5\frac{4.8}{g} + 25(1 - \frac{4.8}{g})$ percent, with a similar notch at IDR 50 billion in gross income. Note that the tax is still levied on a firm's taxable income; however, the tax rate charged depends on the firm's gross income.

Figure 1 illustrates the marginal tax rate under the original regime (Panel A) and the post-reform regime (Panel B). The x-axis, which determines the marginal tax rate, is different in the two regimes – it is based on taxable income (i.e., profits) in Panel A, and on gross income (i.e., revenues) in Panel B. We exploit this change, which meant that taxpayers with different combinations of gross and taxable income faced different changes in their marginal tax rate, in the empirical analysis below.[16]

2.2 Data

We obtained anonymized microdata covering all corporate taxpayers registered in the regional tax offices where an MTO was ever created, from 2003 through 2011.[17] These data include detailed information on corporate income reporting (from corporate income tax forms), employment and wage bills (from employee income tax withholding forms), daily payments data from the Treasury (separated for corporate income tax, VAT, and withholding), and administrative information of tax audits and VAT tax assessments, including the dates and types of assessment-related letters sent to taxpayers. We use reported income data from original corporate income tax filings only (that is, excluding correction filings). We aggregate tax payments data from all branches of a given corporate taxpayer to a single observation per company-year. See Appendix A for details.

[16]The formula creates a notch at IDR 50 billion in gross revenue, where the tax rate on all taxable income jumps discontinuously from 26.65 to 28 percent. The data confirm that there is bunching at the notch, with the density of taxpayers falling discontinuously by about 30 taxpayers in each IDR 1 billion bin to the right of it (see Appendix Figure A.14). However, since the notch is on gross income, not taxable income, this may understate the true elasticity, since many margins available to taxpayers to affect taxable income (i.e., deductions) may not be available for adjusting gross income.

[17]Since the data are anonymized per DGT regulations, we cannot match it to external datasets – such as surveys of manufacturing – to analyze the effect of MTOs on other outcomes. We also do not observe MTO status in those other datasets, so cannot independently use them for analysis.

3 Theoretical Framework

We build a simple model of corporate tax evasion to examine how the levers empirically assessed in this paper (tax administration and tax rates) might affect corporate taxpayers' business and evasion decisions. Broadly speaking, firms can evade taxes in two ways. They can evade taxes by hiding pieces of business activity from the government, i.e., keeping certain transactions, certain customers, or certain types of its business 'off-the-books.' In this case, the firm pays an evasion cost to keep this piece of its business secret, and then does not report any revenues, costs, or taxes from that piece of its business. This type of extensive margin evasion is akin to what Pomeranz (2015) refers to as 'Omission.' For this type of evasion, the key point is that all revenues and costs associated with the evaded activity are hidden. A second type of evasion is to misreport costs (or revenues) to reduce tax liability on business activities that the government knows about. This type of intensive-margin evasion is central to many models of tax evasion, such as Best et al. (2015); this is referred to as 'Distortions' in Pomeranz (2015).

We build a model in Section 3.1 that focuses on the first type of evasion – omission of complete transactions or even entire business lines – to illustrate key mechanisms. We present a generalized version of the model that includes both types of evasion in Appendix B. Section 3.2 considers changes in tax enforcement and tax rates in this model. Section 3.3 adapts Keen and Slemrod (2017)'s analysis, which generalizes the arguments of Feldstein (1999), Chetty (2009), Saez et al. (2012), and others to allow for changes in tax enforcement in addition to tax rate, to provide conditions for the welfare effects of tax rate and tax administration changes in the corporate taxation setting. Section 3.4 then extends the model to consider what happens when enforcement is not uniform across firms.

3.1 Setup

Suppose a firm has a continuum of business lines indexed from $[0, L]$.[18] Each business line has convex costs of production, so that the revenue from line l is y_l and the costs are given by the convex function $c(y_l)$. We assume that all lines are symmetric, and normalize output prices to 1. Pre-tax profits from line l are, therefore, $\pi(y_l) = y_l - c(y_l)$. With no taxes, the firm sets $c'(y_l) = 1$ and produces equally on all business lines.

[18] We use business 'lines' as the units of analysis here, but one could imagine these 'lines' also refer to specific customer relationships or even specific transactions, where there is heterogeneity among customers or transactions in terms of the ease of keeping various transactions 'off-the-books.'

Following Best et al. (2015), we assume that a proportion μ of costs are deductible from taxes. Setting $\mu = 1$ is therefore a pure, non-distortionary profit tax; setting $\mu = 0$ is a pure output tax. Since we examine firms that pay a mix of VAT (for which labor and many other expenses are not deductible) and corporate income taxes (for which these costs are deductible), we assume $0 < \mu < 1$.[19] Firms pay a tax rate τ on revenues less the deductible component of costs.

For a line on which it pays taxes, the firm therefore solves:

$$\max_{y_l}(1-\tau)y_l - (1-\tau\mu)c(y_l) \tag{1}$$

which yields the optimum conditions:

$$c'(y^p) = 1 - \tau\frac{1-\mu}{1-\tau\mu} = 1 - \tau_E \tag{2}$$

where $\tau_E = \tau\frac{1-\mu}{1-\tau\mu}$ is the firm's effective tax rate and y^p is the optimal level of production y for firms that pay tax.[20]

We now introduce the possibility that firms can hide activity from certain business lines by paying an evasion cost. If a firm evades on line l, it does not report either revenue y_l or costs $c(y_l)$ to the government, and does not pay taxes on this production. Suppose that the cost of hiding line l is given by $\alpha b(y_l)h(l)$, where both $b(y_l)$ and $h(l)$ are increasing and continuous and $b(y_l)$ is convex. The business lines l are implicitly ordered in terms of how difficult they are to evade, from easiest to hardest; this heterogeneity across lines is captured by $h(l)$.[21] We assume that the easiest line can be evaded at cost 0 and that $h'(0) = 0$, so that firms will always evade at least somewhat. The fact that $b(y_l)$ is increasing in output y_l captures the idea that larger business lines are more easily detectable and harder to evade, and more generally, that there may be an interaction between real decisions and evasion costs (Slemrod, 2001). For example, with some probability, each worker in a given business line, or counterparty in a transaction, might reveal information about evasion to the government (as in Kleven et al., 2016). Finally, the parameter α captures the level of enforcement. We assume these evasion costs are real costs, and not transfer costs.[22]

[19] See Best et al. (2015) for a detailed discussion of why setting $0 < \mu < 1$ may be optimal.

[20] In this simple model, conditional on paying taxes, the firms report c truthfully. We generalize the model to allow misreporting of c in Appendix B.

[21] Heterogeneity in $h(l)$ could come from certain customers being more willing to engage in under-the-table transactions, or certain types of businesses being easier to conduct with informal labor, for example.

[22] These evasion costs could take many forms. Grubert and Slemrod (1998), for example, discuss location

Given this setup, the firm will make its evasion and production decisions as follows. If line l is hidden, the firm sets output y to solve:

$$\max_{y_l} y_l - c(y_l) - \alpha b(y_l)h(l) \tag{3}$$

and so sets:

$$c'(y^e) = 1 - \alpha b'(y^e)h(l) \tag{4}$$

where $y_l^e(\alpha)$ is the optimal level of output under evasion.

Firms choose which lines to evade and which to pay taxes on. In particular, the firm chooses the point l^* such that the firm is indifferent between evading on line l^* or not, comparing after tax profits with and without evasion. The indifference point l^* is given by the solution to the equation:

$$y_{l^*}^e(\alpha) - c(y_{l^*}^e(\alpha)) - \alpha b(y_{l^*}^e(\alpha))h(l^*) = (1-\tau)y^p - (1-\tau\mu)c(y^p) \tag{5}$$

Total taxes collected are therefore given by $\tau \int_{l^*}^{L} y_l^p - \mu c(y_l^p)$, where $z \equiv \int_{l^*}^{L} y_l^p - \mu c(y_l^p)$ is the firm's taxable income. The fact that after-tax profits if evasion takes place are strictly decreasing in l gives a unique solution l^*.

3.2 Changes in enforcement and tax rates

There are several remarks worth making about the effects of increasing enforcement (α) in this model.[23] Increasing α leads to more business lines being reported, i.e., a lower optimal level l^*. There are two forces, which go in the same direction. First, even holding y_l^e fixed, increasing α has a direct increase in the costs of evasion for a given line l. Second, from equation (4), increasing α further reduces y_l^e – and hence profits under evasion – for a given business line l. Real output will therefore decrease for those lines that continue to evade,

shifting to lower-tax locations as an example. In this context, it could entail costs to facilitate financial evasion (e.g., using cash instead of banks, or other financial mechanisms); having to pay employees higher wages to compensate them for forgone social security payments; or inefficient production technologies to keep factories from being detected. Fines (which would be transfers, not real costs) are empirically very small in our context, accounting for only 0.08% of tax revenues collected between tax years 2004 and 2011.

[23] While we focus on increased enforcement (α), improved tax administration can also make paying taxes easier. This can be incorporated by modifying the taxpayer's maximization problem in equation (1) to be $\max_{y_l}(1-\tau)y_l - (1-\tau\mu)c(y_l) - \kappa\tau(y_l - \mu c(y_l))$, where κ is the administrative cost associated with filing taxes of size $\tau(y_l - \mu c(y_l))$. The effects of reducing κ would be similar to increasing α for lines induced to start paying taxes by the change; the only difference is that for infra-marginal lines, reducing κ would also increase real output among lines that are already paying taxes, rather than those who are evading.

but firms will evade on fewer lines.

What happens at the margin when a business line switches from being hidden to being reported? First, there is a large and immediate jump in *reported* revenues y, costs c, and taxes paid that comes from the line now being reported to the tax authorities. Note that in this model, reported revenues *and* costs both increase in response to increased enforcement, as all aspects of the new business lines are reported to the government.

The effect on *real* activity of the marginal line l that switches to becoming formal is ambiguous, as there are two offsetting effects. When a business line switches from being hidden to being taxed, the additional 'enforcement tax' – $\alpha b'(y)h(l^*)$ in equation (4) – disappears. However, the firm now has to pay a distortionary tax on that line, given by the effective tax rate $\tau_E = \tau\frac{1-\mu}{1-\tau\mu}$ from equation (2). Real output on that line will increase if and only if the size-dependent 'enforcement cost' effect is greater than the effective tax rate, i.e.:

$$\alpha b'(y)h(l^*) > \tau\frac{1-\mu}{1-\tau\mu} \tag{6}$$

For real activity as a whole to increase with α, equation (6) would need to hold, and the increase in real activity from these marginal lines induced to be reported would need to be larger than the decline in output lines that continue to evade. While the results are ambiguous, the point is that real activity could actually increase at the margin as more activity is brought into the tax net. Figure 2 shows an example of an increase in enforcement α in the case where real activity increases (i.e., where the real distortions from the enforcement tax on the margin are greater than the real distortions from taxation).

Changing statutory tax rates (i.e., increasing τ) in the model has several effects. First, from equation (2), it decreases real activity on all tax-paying business lines as long as $\mu < 1$. Second, because it decreases profits on tax-paying business lines, equation (5) shows that evasion will also increase. The model also implies the possibility of complementarity between tax administration and tax rates, as in Besley and Persson (2014). This is because, from equation (5), a higher level of enforcement α implies that the elasticity of taxable income with respect to tax rates will be smaller in absolute value (i.e., $\frac{\partial^2 z}{\partial\tau\partial\alpha} > 0$), though whether this is quantitatively important is an open empirical question.

3.3 Welfare analysis

Social welfare in this context is given by:

$$W = \underbrace{\int_{l^*}^{L} (y_l^p - c(y_l^p)) - \tau z}_{\text{firm post-tax profits from taxed business lines}} + \underbrace{\int_0^{l^*} y_l^e(\alpha) - c(y_l^e(\alpha)) - \alpha b(y_l^e(\alpha))h(l)}_{\text{firm post-tax profits from evaded business lines}} \quad (7)$$
$$+ \underbrace{v\left(\tau z - a(\alpha)\right)}_{\text{social value of public funds}}$$

where $v \geq 1$ is the marginal value of government funds and $a(\alpha)$ are administration costs.

We can use this expression to calculate the welfare effects of changes in both enforcement levels and tax rates. We define private compliance costs $\gamma = \int_0^{l^*} \alpha b(y_l^e(\alpha))h(l)$ to simplify notation.

To calculate the effect of changing enforcement levels on welfare, we take the derivative of (7) with respect to tax enforcement α and apply the envelope theorem, which yields:

$$W_\alpha = -\frac{d\gamma}{d\alpha} + v\left(\tau\frac{dz}{d\alpha} - \frac{da}{d\alpha}\right) \quad (8)$$

where $\frac{d\gamma}{d\alpha}$ is the change in private compliance costs.

This change in private compliance costs is unobserved. Instead, we estimate the change in net government revenue with respect to improved tax administration (i.e., $\tau\frac{dz}{d\alpha} - \frac{da}{d\alpha}$); see Section 4. This allows us to bound how large the change in private compliance costs would have to be for the change in administration to be welfare-improving.

We can do a similar calculation for the welfare effect of a change in tax rates. Taking the derivative of (7) with respect to τ and applying the envelope theorem yields:

$$W_\tau = -z + v\left(z + \tau\frac{dz}{d\tau}\right) = -z + vz\left(1 - \frac{\tau}{1-\tau}\varepsilon_{1-\tau}\right) \quad (9)$$

where $\varepsilon_{1-\tau}$ is the elasticity of taxable income with respect to the net of tax rate.

This simple framework also allows us to ask whether, if the government is seeking to raise an additional dollar of revenue, it is better to do so through improvements in tax administration or increases in tax rates. We begin by calculating the tax change such that government revenue is the same after a marginal change in tax administration (i.e., a change

in α). Given that net government revenues $R = \tau z - a(\alpha)$, we can write:

$$\frac{dR}{d\tau} = \tau \frac{dz}{d\tau} + z = z\left(1 - \frac{\tau}{1-\tau}\varepsilon_{1-\tau}\right) \tag{10}$$

$$\frac{dR}{d\alpha} = \tau \frac{dz}{d\alpha} - \frac{da}{d\alpha} \tag{11}$$

This implies that:

$$\frac{d\tau}{d\alpha}|_R = -\frac{\tau \frac{dz}{d\alpha} - \frac{da}{d\alpha}}{z\left(1 - \frac{\tau}{1-\tau}\varepsilon_{1-\tau}\right)} \tag{12}$$

Thus, armed with the elasticity of taxable income, we can ask how large a change in tax rates one would need to get the equivalent revenue change from improved tax administration, and vice versa. After estimating the elasticity of taxable income with respect to the net of tax rate in Section 5.2.2, we compute this ratio (i.e., $\frac{d\tau}{d\alpha}|_R$) in Section 5.3.1.

We can use the rate of substitution between tax administration and tax rates in equation (12) to ask whether, if the government seeks to raise more revenue, should it do so via improved tax administration or by changing tax rates? Since we are considering marginal changes, this is equivalent to asking whether a revenue-neutral increase in administration and corresponding cut in rates would be welfare improving or welfare decreasing; that is, by evaluating:

$$dW = W_\tau \frac{d\tau}{d\alpha}|_R + W_\alpha \tag{13}$$

Substituting W_τ, W_α and $\frac{d\tau}{d\alpha}|_R$ from equations (9), (8), and (12) above, this is equal to:

$$dW = \left(\tau \frac{dz}{d\alpha} - \frac{da}{d\alpha}\right) \frac{1}{1 - \frac{\tau}{1-\tau}\varepsilon_{1-\tau}} - \frac{d\gamma}{d\alpha} \tag{14}$$

By estimating the change in net tax revenue with respect to administration (i.e., $\left(\tau \frac{dz}{d\alpha} - \frac{da}{d\alpha}\right)$) and the change in tax revenue with respect to tax rates (i.e., by estimating $\varepsilon_{1-\tau}$), we observe all of the parameters in equation (14) except the change in private compliance costs $\frac{d\gamma}{d\alpha}$. Nevertheless, equation (14) is useful in several respects. First, holding $\frac{d\gamma}{d\alpha}$ fixed, improving tax administration is likely to be a good idea when both $(\tau \frac{dz}{d\alpha} - \frac{da}{d\alpha})$ is large – i.e., gains from improved tax administration are large – and when $\varepsilon_{1-\tau}$ is large – i.e., the behavioral elasticity with respect to tax rates is large. Both will turn out to be true in our empirical context. Second, and more precisely, we can use equation (14) to bound how large $\frac{d\gamma}{d\alpha}$ has to be for a change in tax administration to be welfare-improving relative to an equivalent change in tax rates (see Section 5.3.2).

3.4 Size-dependent enforcement

The government can affect not just the level of enforcement α, but the degree to which enforcement is size-dependent, i.e., the degree to which the government places higher enforcement costs on larger firms.

Suppose the government conditions its enforcement effort on reported income z, i.e., it spends more effort investigating the unreported business lines of firms that appear larger based on their reported income. For example, the government may choose to allocate the effort of tax collection staff to firms that it observes to be larger based on the tax data it collects. In this case, we can write evasion costs as $\alpha m(z)b(y)h(l)$ with $m' > 0$, where z is the total reported taxable income defined above. We write m as a function of taxable income z to simplify notation, but in principle in this model similar logic applies as long as m is a function of any other reported outcomes of the firm (i.e., total reported revenue, total reported employees, etc).[24]

With this new evasion cost that is a function of total reported income z, the indifference condition in equation (5) for the marginal line to evade (l^*) then has an additional term

$$\underbrace{y^e_{l^*}(\alpha) - c(y^e_{l^*}(\alpha)) - \alpha m(z) b(y^e_{l^*}(\alpha))h(l^*)}_{\text{profit from marginal line evading}} = \underbrace{(1-\tau)y^p - (1-\tau\mu)c(y^p)}_{\text{profit from marginal line not evading}} - \underbrace{m'(z)\int_0^{l^*} \alpha b(y^e_l(\alpha))h(l)}_{\text{loss from having higher evasion costs on evaded lines}} \tag{15}$$

We can use equation (15) to consider what happens when the government changes m'. A flattening of the evasion cost (i.e., holding the level of $\alpha m(z)$ fixed, but reducing m') decreases the benefit from evading, and so will lead the marginal firm to evade less than an equivalent amount of enforcement with a flatter m'. Note also that, by the arguments above, this can also lead to a further increase in real activity. This suggests that one may be interested not just in the level of distortion, but also in the degree to which it is dependent on firm size, as increasing enforcement in a way that makes it less size-dependent will be more effective than increasing enforcement in a way that makes it more so.[25] We explore

[24]The government can also potentially alter the slope of the $b(y)$ function, i.e., the degree to which evasion costs increase with the size of unobservable business lines. If these actions increased enforcement activity while making it less size dependent – i.e., increasing α but decreasing $b'(y)$ – the analysis above (e.g., equations (4) and (5)) shows that one can both increase tax payments while reducing distortions on untaxed business lines at the same time.

[25]It important to note that just because size-dependent enforcement creates distortions does not imply

these issues empirically in Section 4.3.

4 The Impact of Improved Tax Administration

4.1 Empirical strategy

We begin by estimating the impact of being assigned to more intensive tax administration in the MTOs. As described in Section 2.1.1, taxpayers were assigned to MTOs in 2007 based on an increasing function of pre-assignment gross income and total taxes paid (see Appendix Figure A.1 which plots the probability of MTO assignment separately by gross income and total taxes paid, and Appendix Figure A.2, which shows this jointly).[26] This implies that the assigned taxpayers were inherently different from other ones: they were larger and paid more taxes. Therefore, we cannot simply compare the two types of taxpayers.

Instead, we compute taxpayer-level balancing weights that match taxpayers assigned to the MTO with other unassigned taxpayers based on their 2005 gross income, total taxes paid, and region. This step brings the pre-assignment outcome levels of the two groups close together via weighting. We then exploit the panel structure of the data to estimate the effect of MTO assignment using a taxpayer-level weighted difference-in-differences design (WDD), with firm fixed effects.

To compute balancing weights, we follow the "entropy-balancing" methodology proposed by Hainmueller (2012). This method computes exact weights (for the untreated group) such that a set of desired pre-treatment characteristics of the untreated group match those of the treated group, and chooses the set of weights that achieves balance that minimally deviates from uniform weights. This methodology is particularly appropriate in a situation where the true functional form of the propensity score is unknown because it does not impose a rigid functional form on the propensity weights, and in this case, this approach provides better pre-treatment balance than standard inverse propensity-score methods (Hainmueller, 2012; see also the related discussion in Athey and Imbens, 2017 and Athey et al., 2018).[27]

As is standard in the matching literature, we impose a common support restriction on

that it is not optimal; in more general models, such size-dependent enforcement may be optimal, even accounting for these additional distortions (see, e.g., Bigio and Zilberman, 2011).

[26] We do not know the precise assignment formula, so we cannot use a regression discontinuity design. While the probability of MTO assignment is strongly increasing in these two variables, we also do not observe a sharp discontinuity. See Appendix Figure A.1.

[27] We replicate all main findings using inverse probability weights (Abadie and Cattaneo, 2018). Results are qualitatively similar and, if anything, generally slightly larger (Appendix Table A.5).

the variables used to match. These distributions are shown in Appendix Figure A.3. In our main specification, we drop firms that fall within the top or bottom 2.5 percent of either the control or treatment distribution of the key matching variables; this implies that we exclude very large firms within the MTO and very small firms not in the MTO. Appendix Table A.6 shows robustness to more or less restrictive common support restrictions.

Since the latest corporate income tax filings available to DGT at the time of the MTO assignment (December 2006) were for tax year 2005, we compute balancing weights by matching on 2005 gross income and total taxes paid.[28] We define treated firms as those who were selected in the initial assignment in 2007. In constructing the variables used for matching, we use corporate income tax filing dates and tax payment dates to discard any data that was neither filed nor paid by December 2006. Columns (1) and (2) of Table 1, as well as columns (1) and (2) of Appendix Tables A.10 and A.11, show that the resulting weights produce weighted samples that are broadly balanced not only on the targeted variables (2005 gross income and total taxes paid), but on other variables as well.

We then estimate the effect of MTO assignment using weighted difference-in-differences. We define a variable M_{iFC} as a dummy for firm i being in the first cohort of MTO assignment.[29] We then estimate the reduced form effect of MTO assignment in 2007 as follows, where each taxpayer is weighted by its respective balancing weight:

$$Y_{it} = \alpha + \beta^{RF} \left(M_{iFC} \times 1_{t>2005} \right) + \delta_t + \delta_i + \epsilon_{it} \tag{16}$$

where Y_{it} is the outcome of interest of taxpayer in year t, δ_i is a taxpayer fixed effect, and δ_t is a year fixed effect. Because corporate income taxes for year 2006 are only filed in April-May 2007, four to five months after DGT announced which taxpayers would be transferred to the MTO, we consider 2005 as the last pre-treatment year, so that any taxes for tax years 2006 or later could have been treated.[30] We estimate equation (16) for taxpayers from the 13

[28] While we believe that data for three baseline tax years (e.g., 2003-2005) were considered to assign taxpayers to MTOs, neither the formula used nor the procedure for handling missing data (e.g., data not yet filed as of December 2006) are available. Matching on the 2005 level, rather than using all three years, allows us to check whether both sets of matched taxpayers are on similar pre-treatment trends. Matching on all three years (2003-2005) instead of just 2005, which also allows us to match on growth rates in addition to levels, produces similar estimates (Appendix Table A.5).

[29] During the first year of the MTO, firms' taxpayer ID codes were gradually converted to reflect the MTO status. We therefore define M_{iFC} as 1 if the firm's corporate income taxes were filed with an MTO code in 2007 or 2008, i.e., prior to the next wave of MTO expansions in 2009. The first tax year affected for this cohort was 2006, for which final tax returns were filed during calendar year 2007.

[30] The creation of the MTOs in the regional tax offices we studied was first announced via Nomor 132/PMK.01/2006 of December 2006. One month later, on January 26, 2007, all regional tax offices si-

regions whose MTOs were created in 2007, using data from tax years 2003-2011.[31] Standard errors are clustered by taxpayer.[32] We also estimate an event study version of equation (16) where we estimate separate β^{RF} coefficients by year, which allows us to assess whether these firms were on similar trends in the pre-period, and to assess changes in the MTO's impact over time.

To account for the fact that some firms in the control group were moved to the MTO starting in 2009, we also estimate an instrumental-variables version of equation (16), i.e.,

$$Y_{it} = \alpha + \beta^{IV} M_{it} + \delta_t + \delta_i + \epsilon_{it} \tag{17}$$

where we instrument for M_{it}, the actual MTO status of firm i at time t, using $(M_{iFC} \times 1_{t>2005})$. This is just a re-scaling of equation (16), but may provide a more accurate magnitude for the treatment effect of treated firms being moved to the MTO. The first-stage of this equation is quite strong, with an F-statistic over 6,000 – see Appendix Table A.8. The first stage is shown year-by-year in Figure 3.

4.2 Results

4.2.1 Impacts on tax collection

As discussed in Section 3, the key parameter needed to estimate the impact of a reform in tax administration is the effect on government revenue. Figure 4 begins by showing the impact of the MTO on total tax payments year-by-year. The left-hand side variable is taxes paid in 2007 billions of Rupiah (IDR 1 billion = USD 100,000 at 2007 exchange rates), where we use the Indonesian GDP deflator to deflate all nominal values to their 2007 equivalents.[33]

multaneously made public which of their taxpayers would be transferred to their newly created MTOs. Because taxes for tax year 2005 were due to be filed at the end of April 2006, several months prior to assignment, we consider 2005 as the last unaffected tax year. Because taxes for tax year 2006 were due to be filed at the end of April 2007, four to five months after treatment assignment occurred and was made public, we consider taxes for tax year 2006 as partially treated.

[31] We end our analysis in 2011 as there were substantial expansions in the number of firms assigned to the LTO in 2012 (which could create attrition), as well as changes in which firms were in MTOs.

[32] Appendix Table A.7 presents robustness to clustering standard errors at the taxpayer's origin tax office level and at the region. Results are very similar.

[33] Note two facts: a) the outcome variable is in levels (billions of Rupiah), not logs, and b) the weights from the entropy weighting match the weights in the treatment group mean. Combined, these two facts imply that our results capture the average effect of the MTO on treated firms within the common support sample. To the extent there is treatment effect heterogeneity among firms in terms of percent increases, we will nevertheless capture the true "average effect" on revenue that the government captures. However, these estimates may underestimate the total extent of revenue increases: if the larger firms that we exclude due

Panel A presents the time series for each of the two groups of taxpayers (those assigned to the MTO 2007 group, and those not assigned), where firms are weighted using the balancing weights. Panel B shows the full estimates using equation (16). In both panels, the year variable is the tax year, and includes payments by all branches of the same firm for that tax year made up to six months following the end of the tax year.[34] Recall that the MTOs were established by a January 2007 decree and took effect a few months thereafter, before the filing date for 2006 tax year tax returns. We therefore consider 2005 as the final pre-period year, 2006 as partially affected, and 2007 as the first full MTO year.

Examining the pre-period – 2003-2005 – shows that the two sets of firms have similar pre-trends. The two groups of firms match almost exactly in Panel A; the regression version in Panel B shows that the pre-period is flat, indicating no differential pre-trends. This is not mechanical, as we only matched on the 2005 data, rather than on the full 2003-2005 period (i.e., the trends).

The MTO had a large impact. There is a large initial effect of the MTO: for firms assigned to the MTO, tax payments increased in 2006 (the first year that could be somewhat affected by the MTO), and tax payments increased by approximately IDR 400 million per firm by 2007, the first year the MTO was fully in effect. The estimated treatment-on-treated effect for the MTO in 2007 represents an increase of 64 percent (over the treated group's counterfactual mean in 2007) for affected firms. The impact continues to grow over time: by 2011, the impact of the MTO increased further, to IDR 605 million (an increase of 129 percent over control firms in the same year). The difference between the effect in 2007 and 2011 is statistically significant (p-value of 0.055). Importantly, the MTO effect is entirely driven by firms actually assigned to an MTO, as tax payments for the control firms remain relatively flat following MTO creation.

Panel A of Table 1 shows the results in regression form, based on estimating equations (16) and (17). For each variable, columns (1) and (2) show the weighted pre-treatment (i.e., 2005) means for the treatment and control group, showing that taxpayers appear balanced not just on the variables that we explicitly match on (total tax payments and gross income),

to our common support restriction had similar percent increases as the firms in our sample, they will have larger impacts in levels than we estimate here. This will not, however, affect the comparison to tax rate changes in Section 5 below, since the samples for both are identical.

[34]Taxpayers typically pay VAT and estimated corporate income taxes monthly, and then are required to file a corporate income tax return by April of the following year. We include all tax payments for a given tax year made during that tax year, and in the six months thereafter; that is, 2007 tax payments include all payments made for tax year 2007 and remitted on or before June 30, 2008. We impose this time limit to focus on payment of each year's taxes due, rather than retrospective payments of delinquent taxes.

but also on various sub-components of taxable income as well.

We show the reduced form and IV estimates, respectively, in columns (5) and (6). On average, total tax payments increased by IDR 525 million (USD 52,500).[35] About two-thirds of the increase comes from higher VAT collections; and the remaining third comes from higher corporate income tax and other income tax (e.g., withholding) payments. Appendix Table A.11 further disaggregates these tax payments.

As a benchmark of magnitude, we compute the counterfactual control complier means by subtracting the estimated treatment effect from the post-period levels in the treatment group (Katz et al., 2001), shown in column (4) for each variable. We then express the estimated impact of the MTOs as a share of the control complier mean (column 7).

The estimated impacts are substantial. We estimate that the MTOs increased annual tax revenues for affected firms by 128 percent. The increases are seen on all types of taxes: 137 percent for VAT, 111 percent for CIT, and 113 percent for other income taxes.[36]

An important question is whether the impact comes from higher revenues on the part of the treated MTO firms, or a reduction in the non-treated PTO firms, who may have increased evasion once they learned they would not be in the MTO. Figure 4, which shows dramatic increases in revenues among MTO firms, but flat revenues for non-MTO firms, suggests that the effects are primarily driven by increases for firms being moved to the MTO, rather than decreases for non-MTO firms.[37] To further investigate the possibility of disincentive effects for PTO firms, Figure 5 subdivides the PTO firms into larger firms, who could plausibly have been on the margin for inclusion in the MTO, and smaller firms, who were further away from the MTO margin. We find that both sets of control firms appear on similar trajectories, suggesting that the effects are not being driven by changes among those firms who learned they would not be assigned to the MTO.

[35]We focus on the IV estimates in the text. The IV estimates adjust for imperfect compliance with the original 2007 MTO list; in particular, some firms were moved to the MTO starting in 2009. By contrast, very few firms were moved out of the MTO during this period: only 44 of the 4,094 firms originally assigned to the MTO were moved to PTOs in 2008-2011 (13 in 2008, 12 in 2009, 11 in 2010, and 8 in 2011). A first stage regression of M_{it} on M_{2007} on our weighted sample (where weights are, as always, determined using 2005 values) yields a first stage coefficient of 0.65 (standard error 0.008; F-statistic is 6,412).

[36]These impacts are not driven by the changes in statutory marginal tax rates: VAT rates are uniform, and Appendix Figure A.12 shows that statutory marginal tax rates (which are a function of firm size, and which change in 2009, as discussed in Section 2.1.2) decrease by only a percentage point or two at most among MTO firms compared with PTO firms, so this cannot explain a 111 percent increase in income tax revenue.

[37]Unlike in Almunia and Lopez-Rodriguez (2018)'s study of Spain, where firms strategically bunch below a cutoff to avoid being placed into the Large Taxpayers' Unit, here there is no clear cutoff, and as shown in Appendix Figure A.4, we find no bunching, either in the pre- or post-period.

To estimate the total effect of the MTOs, we need to extrapolate to the full set of firms served by the MTOs, not just those in the common support set. Since the firms excluded from the analysis set tend to be larger than the firms in the estimation sample, different approaches to extrapolation could yield different results. A reasonable lower bound is to assume that all firms experience the same gains, in rupiah terms, as the treatment firms (since the excluded firms are substantially larger). By contrast, a reasonable upper bound is to assume that all firms experience the same percent increase in tax revenues shown in Table 1. These are not formal bounds, as we only know the LATE on the estimation set, but they seem reasonable for what to expect.[38] Using this approach, we estimate that the MTOs increased total tax revenues by at least USD 4.0 billion over its first 6 years.

While Table 1 presents the effects on gross government revenue, as discussed in Section 3, the relevant parameter for welfare is the effect on *net* government revenue; that is, the effect on tax revenue after subtracting off the additional enforcement costs. These additional costs, however, are small. We obtained budget data, as well as the number of corporate taxpayers, for all MTOs and PTOs in Indonesia from 2016 (the earliest available year with complete data for all regional tax offices). We convert the costs to 2007 rupiah using the Indonesian GDP deflator. Since PTOs also handle individual taxpayers, we assume that half of the PTO costs are associated with corporations. (This assumption is inconsequential; results are similar even if we assign all PTO costs to corporate taxation.) Appendix Table A.9 shows that the difference in government enforcement expenditures, per taxpayer, between an MTO and PTO is about IDR 8 million (US $800) per year. These enforcement costs are thus *almost two orders of magnitude* smaller than the estimated revenue gains (Table 1). That is, given an effect on gross taxes paid of IDR 525 million per taxpayer per year, the effect on net government revenues is IDR 517 million per taxpayer per year. Put another way, the government gained a net return of Rp. 517 million for an investment of Rp. 8 million, or a 64-1 return.

4.2.2 Mechanisms: increases in reported business activity, scrutiny of deductions, or increases in collections?

As outlined in Section 3, better tax administration could increase tax liabilities in several ways. Taxes due could go up if improved administration results in previously hidden business activities being brought onto the tax rolls, or by increasing the scrutiny of deductions. Tax

[38] We can also estimate heterogeneous effects of the MTO within our treated sample. The results, shown in Appendix Table A.12, suggest larger MTO impacts (in rupiah terms) on tax revenue for firms with larger baseline tax revenue. This suggests that the proposed bounds might be reasonable.

revenue could also go up if improved administration increases collections (i.e., the share of tax due collected). To investigate these mechanisms, we focus on corporate income tax, for which we observe line-item by line-item reports on each taxpayer's annual tax returns, as well as actual tax payments from the tax authority's treasury system.

The results are shown in Panel B of Table 1, and graphically in Figure 6. We present results on several key line items – gross incomes, taxable incomes, corporate income tax due, and the profit margin in Table 1. Appendix Table A.10 shows the impact on all major line items of the corporate income tax return in detail, allowing us to decompose how changes in these various line items add up, on net, to a change in taxable income; graphs for many of these additional outcomes, including the costs of sales and other firm expenses, are shown in Appendix Figure A.5.

Several results are worth noting. First, the estimated impact of the MTO on reported corporate income tax due – IDR 0.065 billion – is very similar to the actual increase in corporate income tax payments shown in Panel A – IDR 0.074 billion. This implies that most of the increase in observed corporate income tax payments comes from an increase in reported corporate income due, rather than an increase in collections. In Panel C of Table 1, we explicitly report results where the dependent variable is the recovery rate (corporate income tax paid divided by corporate income tax due), and find no impact of the MTO.

Second, the increase in corporate tax due comes from an increase in gross revenues reported. Costs rise at about the same rate, so profit margins remain roughly unchanged. In particular, reported gross income (i.e., revenues) increase by IDR 9.1 billion (US $910,000), or about 76 percent, so firms report more sales once they move to the MTO. Costs of sales (defined as operating expenses, including both material and labor inputs) also increase by IDR 7.6 billion, or about 82 percent, suggesting that this reflects new business being reported to the government. Other expenses increase as well, at a slightly slower rate, so that on net total reported expenses (costs of sales + other expenses) increase by 77 percent. Since both revenues and total costs increase at about the same rate as revenues, reported profit margins (i.e., net income divided by gross income) remain unchanged. This suggests that the main mechanism through which improved tax administration led to increased revenue is through capturing more top-line business activity on the tax books, as in the theory in Section 3, rather than more scrutiny on deductions or increases in collection rates.[39]

[39] An alternative view, if firms can manipulate costs directly (as suggested by Carrillo et al., 2017, and as discussed in B), is that some costs are not reported if firms are already able to report zero taxable income for other reasons, and so firms report these costs once they are forced to report more revenues. If so, one might expect larger effects on reported costs for these firms with zero taxable income at baseline. To investigate

Third, the pattern of growth in Figure 6 shows that the MTO firms continue to report growth – in both gross income and taxable income – at substantially higher rates than comparable firms that were not assigned to it. Three years after the MTO introduction, these firms had 41 percent higher gross income than comparable firms; this had increased to 120 percent higher six years after the introduction. This difference is statistically meaningful (p-value 0.007). This implies that the large increases in reported tax revenue from MTO firms over time come not from increased effectiveness of the MTO at collecting taxes due, or from increased scrutiny of deductions, but rather that MTO firms reported substantially higher revenues to the government over time. One possibility, consistent with the model, is that once new business lines become formalized, they no longer need to pay the evasion tax $\alpha b'(y)h(l)$, and that output y increases over time.

4.2.3 Changes in reported employment

We also observe each firm's number of reported employees, which comes from the firms' employee income tax withholding reports. Firms are required to report not just their total wage bill, but also the number of temporary and permanent workers.

In Table 2, we examine the effect of the MTO on reported firm employment.[40] We find that the number of permanent employees increases by about 21 percent – an increase of 10 permanent employees per firm (p-value 0.085). These numbers reflect tax withholding payments which are double-reported to workers, so these may be harder for firms to manipulate directly (Kleven et al., 2011). The point estimates suggest that the total number of employees increased by the same amount, but the standard errors increase once we include temporary employees, who have much higher variance. This may reflect either true new additional hiring, or increased formalization of temporary workers (since permanent workers receive more employment protections than temporary ones, firms often try to avoid categorizing workers as permanent).

The wage bill for both permanent and temporary employees increases at a similar rate – about 21 percent for permanent employees, and about 24 percent overall. Average yearly wages (computed as wage bill divided by number of employees) increase by about 16 percent for permanent employees, with no meaningful change for temporary employees. This implies that the increases in taxes paid are not coming at the expense of worker wages.

this, Appendix Figure A.6 examines the MTO effects separately for firms with zero and positive baseline taxable income. Although the results are noisy, we find similar effects on reported costs for both sets of firms, with a more rapid response for those firms with positive taxable income at baseline.

[40] Year-by-year figures for employment are shown in Appendix Figure A.7.

4.2.4 Robustness of MTO effects

We consider robustness checks along multiple dimensions, which indicate that our results are robust to specification choices and are not driven by differential trends among firms that are more likely to be assigned to the MTO. First, Appendix Table A.5 shows that the results are qualitatively robust to alternative weighting strategies. We reproduce our baseline Hainmueller (2012) entropy-balancing weights, and then show results with no weights, using the same matching variables but using a propensity score (estimated both via a logit, in columns 3 and 5, and via a random forest classifier,[41] in column 6) and inverse-propensity score weights (IPW) (see Abadie and Cattaneo, 2018), and using additional years of data for matching, to allow for the possibility that the tax office selected based on growth rates, not just levels. Second, Appendix Table A.6 shows that the common support sample restrictions do not substantively change our qualitative conclusions, though the magnitudes differ somewhat since different samples focus the weights on taxpayers of different sizes, which can matter since all results are in levels. Third, Appendix Table A.7 shows that the main results are robust to the level at which standard errors are clustered.

Fourth, we consider results that include all MTOs started before 2007.[42] As discussed in Section 2.1.1, we focus on the regions where the MTOs started in 2007 in the main specifications, since the PTOs were also reorganized to follow the same administrative structure (albeit with fewer staff per taxpayer) at the same time. We re-estimate equation (17), but instead of using $(M_{iFC} \times 1_{t>2005})$ as an instrument, we allow for the fact that MTOs in different regions started in different years.[43] The results are presented in column (4) of Table A.6; year-by-year reduced form event-study graphs for total taxes paid and firm reported gross

[41] See footnotes to Appendix Table A.5 for a list of the 984 variables included in the random forest algorithm. One potential explanation for the large size of our estimated treatment effects is that tax officials could have assigned taxpayers to the MTO based on additional but unobservable local knowledge about which taxpayers would have the largest treatment effects. While it is possible that this type of information could have been used in the assignment of several taxpayers, we find it unlikely that it could drive our results. That is because our results are nearly identical if we match taxpayers on a much larger number of variables using the random forest algorithm, such that in order to be a key driver of results such unobservable information would need to be both predictive of treatment effects but also uncorrelated with any of the 984 variables included in the prediction of treatment assignment.

[42] We only exclude Central Jakarta's MTO, created in 2004 and thus with no pre-data for matching.

[43] Specifically, for each region r, we define a variable M_{ir} which is a dummy for whether firm i was in the MTO in region r in the first year it was fully operational. For each region r, we define $\tilde{t_r}$ to be the last year unaffected by the MTO. For example, for the MTOs which opened in 2007, which could have affected 2006 tax returns, we define $\tilde{t_r}$, the last unaffected year as 2005. We use data as of year $\tilde{t_r}$ to do the matching in each region, and we construct our instrument for MTO presence in year t as $\left(M_{ir} \times 1_{t>\tilde{t}_r}\right)$. This notation simply generalizes our estimating equations from Section (4.1) to allow for the fact that MTOs started at different times in different regions.

income are also shown in Appendix Figure A.8. The results are qualitatively very similar to the main results, showing quantitatively large and statistically significant increases in tax payments, reported gross incomes, and permanent employees.

Finally, we conduct a placebo analysis among control firms that confirms that our results are not driven by differential trends among firms with characteristics that make them more likely to be assigned to the MTO. We assign placebo firms to mimic the feature that the MTO treatment was assigned as an increasing function of 2005 log gross income and 2005 log total taxes paid.[44] We then reproduce our analysis procedure from Section 4.1 on this 'placebo' assignment. Appendix Figure A.10 shows no treatment effects for placebo firms, suggesting that our empirical strategy properly accounts for any differential trends correlated with observable characteristics that predict MTO assignment.

4.3 Understanding the MTO's enforcement impacts

The theory in Section 3.4 suggests that to understand the impact of improved tax administration, it is important to understand both whether the improved tax administration (the MTOs) increased the *level* of scrutiny of firms, and also how it changed the relationship between firm size and enforcement. In particular, tax administration reforms may be particularly effective to the extent to which they make enforcement less *size-dependent*.

Therefore, we examine both whether the MTOs led to greater enforcement, and how it changed the relationship between firm size and enforcement actions.[45] We have detailed data for three types of enforcement actions: formal audits, VAT collection letters, and VAT underpayment letters. These formal actions account for only a small portion of firm interactions with the tax office: an account representative can summon a taxpayer to explain something on their tax form, they can send them a letter for some other purpose, etc., all of which are unfortunately not tracked in the data department's administrative data. How-

[44] We construct the placebo treatment assignment in three steps. First, we predict the probability $\hat{p_i}$ of MTO treatment for each non-MTO taxpayer i using a logit regression with splines in 2005 log gross income, 2005 log taxes paid, and regional tax office dummies as predictors. We scale these probabilities to match the share of all taxpayers in the analysis sample assigned to MTO (4,181 / 37,629). We then randomly assign non-MTO firms a placebo treatment status according to these scaled probabilities. The resulting probabilities of assignment as a function of baseline taxpayer revenue and taxable income are shown in Appendix Figure A.9, and are similar to the real assignment probabilities shown in Appendix Figure A.1.

[45] In this section, we focus on the fact that larger firms bring higher scrutiny, i.e., $m'(z)$ from the model. In addition, Indonesia's post-2008 CIT regime also has an additional tax on firm size, which comes from the fact that the CIT rates are higher for larger firms, and is applied to all firms regardless of MTO/PTO status. While this type of statutory firm-size could also reduce firm size, since it is not differential based on MTO/ PTO status, we do not focus on it here.

ever, we focus on these three actions because they are a) relatively serious followup actions and b) systematically logged in the tax department's IT systems in the same way for both MTOs and PTOs. We also have data on corrections to corporate income tax returns filed by taxpayers, though we note that this variable may be harder to interpret if taxpayers file returns that are more accurate to begin with, they would have less reason to correct the returns.

We first document whether the MTO led to greater levels of enforcement. Table 3 re-estimates equation (17) for corrections to tax returns (Panel A) and VAT underpayment letters (Panel B).[46] We find that being assigned to an MTO leads firms to revise their corporate tax returns. In particular, we find an increase in corporate income tax revisions for *previous* years: that is, once firms enter an MTO, they revise their previous returns (i.e., returns from years prior to the MTO). For tax years in which the original return was filed after the shift, MTO firms are actually less likely to file an amendment, suggesting that original returns filed in the MTO are likely to be more accurate. We find no change in the average level of VAT assessment letters (Panel B).

We then turn to estimating the relationship between the enforcement actions we observe and firm size – the empirical $m(z)$ function – which we measure both in terms of total taxes paid and the number of permanent employees reported by the firm. Figure 7 presents this non-parametrically. We plot these relationships with locally weighted linear regressions separately for MTO firms (in blue) and PTO firms (in red), using the same weights that we have used throughout, so that we are comparing ex-ante comparable firms.

The results tell a consistent story. In virtually all cases, the *level* of enforcement actions is higher at the MTO than for comparably-sized firms serviced by the PTO. However, the *slope* of enforcement with respect to firm-size – i.e., $m'(z)$ – is substantially flatter at the MTO. Thus, the MTO increased enforcement levels, but made enforcement less size-dependent. Following the logic of Section 3.4, this raises the possibility that the MTO could have reduced the size-dependent "enforcement tax" – i.e., firms no longer have to worry that they will face heavier scrutiny when they grow, since they already face high scrutiny.

We test for a change of slope in the $m(z)$ function by estimating the following regressions. We begin with a cross-sectional regression, using the same weights we used in Section 4 so

[46] We cannot examine audits here, because we do not have audit data prior to 2008. Audits are tracked by DGT using a separate database that began in 2008.

that MTO and non-MTO firms are balanced:

$$Y_{it} = \alpha + \beta_1 M_{iFC} + \beta_2 l_{it} + \beta_3 M_{iFC} \times l_{it} + \delta_y + \epsilon_{it} \tag{18}$$

The key coefficient is β_3, which shows how the slope of enforcement with respect to firm size l changes for firms assigned to the MTO. This is the regression analogue of Figure 7.

For data on VAT enforcement letters, we observe data in the years prior to 2008 as well. For these variables, we can estimate a difference-in-differences version of equation (18):

$$Y_{it} = \alpha + \gamma_1 l_{it} + \gamma_2 M_{iFC} \times l_{it} + \gamma_3 M_{iFC} \times 1_{t>2005} + \gamma_4 M_{iFC} \times l_{it} \times 1_{t>2005} + \delta_y + \delta_i + \epsilon_{it} \tag{19}$$

Here, the key coefficient is γ_4, which investigates how the slope on firm size changes once the firm is moved to the MTO. We continue to use the same weights as above. For each table, we examine three separate measures of firm size l_{it}: total taxes paid, the number of reported permanent employees, and the number of reported total employees.

The results of the cross-sectional version estimated using equation (18) are shown in Table 4; the difference-in-differences results for the VAT enforcement letters estimated using equation (19) are shown in Table 5. Both tables show similar results: the coefficients on the interaction of $M_{iFC} \times l_{it}$ in Table 4, and the coefficients on the interaction of $M_{iFC} \times l_{it} \times 1_{t>2005}$ in Table 5, are negative (and statistically significant) for all three variables considered.

The tables thus reinforce the findings from Figure 7: the MTO increases the level of enforcement (shown by the positive main effects on M_{iFC} in the cross-section and $M_{iFC} \times 1_{t>2005}$ in the difference-in-differences regressions, but also reduces the slope of the $m(z)$ function. Quantitatively, the results in Table 4 suggest that the slope of the $m(z)$ function was reduced considerably, by between 62 - 100 percent in the case of audits, and by 28 - 90 percent in the case of the VAT letters. These results suggest a potential explanation for the magnitude of the MTO effects over the 6 years we examined them, and in particular why these effects grew substantially over time: by raising the level of $m(z)$, while subsequently flattening its slope, the MTO may have been able to increase tax compliance while simultaneously reducing the tax-induced barriers to firm growth.

One implication of these results is that the impacts of improved tax administration might be smaller for the very largest firms in the country, such as those served by the large taxpayer office (LTO) (which are outside our sample). For such firms, it is possible that the derivative of enforcement with respect to firm size may already be low, and so greater enforcement

would increase the level of enforcement without necessarily flattening the slope.

4.4 Summing up

The transition to improved tax administration – characterized by higher staff-to-taxpayer ratios – led to substantially higher tax revenues. This came in the form of higher top-line revenues being reported by firms, rather than decreased deductions or changes in the degree to which taxes due were collected, consistent with the ideas laid out in Section 3. The increases in tax revenues for the government were more than two orders of magnitude larger than the increases in administrative costs associated with the increased enforcement. Surprisingly, the increased tax enforcement did not slow the rate of firm growth; if anything, the results suggest substantially higher revenue growth in the period after being switched to the MTO than that experienced by similar firms that did not move. We document that one reason why the MTOs may have been particularly successful is that they may have reduced the degree to which enforcement is size-dependent, at least for these firms, which may be an important finding for other countries considering such a tax regime shift.

5 Changes in Statutory Tax Rates

5.1 Empirical strategy

The second policy reform we study is the changes in Indonesia's corporate statutory tax rates in 2009 and 2010. We begin by using the differential tax change described in Section 2.1.2 to estimate the elasticity of taxable income (ETI) with respect to the net of tax rate. We then use this estimate to benchmark the impact of improved tax administration against more conventional changes in the statutory tax rate.

We follow the approach in Gruber and Saez (2002), Saez et al. (2012), and others. Specifically, since the marginal tax rate is a function of potentially endogenous variables (gross income, taxable income), we instrument for the change in a firm's marginal tax rate by taking the firm's characteristics (gross income, taxable income) from the tax year before the schedule change, and apply the new statutory tax schedule to these pre-period values.

Our estimating equation follows the standard panel-level specification discussed in Saez et al. (2012) in general, and in Gruber and Rauh (2007) in the corporate tax context, with

the ETI estimated as the ε coefficient in:

$$\ln\left(\frac{z_{it+1}}{z_{it}}\right) = \alpha + \varepsilon \ln\left(\frac{1-\tau_{it+1}}{1-\tau_{it}}\right) + \varphi_1 \ln z_{it} + \varphi_2 \ln g_{it} + \delta_t + \delta_i + \nu_{it} \tag{20}$$

where z_{it} is taxpayer i's reported taxable income for tax year t, g_{it} is taxpayer i's reported gross income for tax year t, τ_{it} is taxpayer i's statutory marginal tax rate for tax year t, and ν_{it} is an error term. The ETI estimates are therefore with respect to the net of tax rate $1-\tau$ (the share of reported taxable income that the taxpayer gets to keep). Importantly, there were two tax changes (2009 and 2010), allowing the inclusion of taxpayer fixed effects (δ_i) in a regression specification that is already estimated in first-differences; we report robustness exercises that drop taxpayer fixed effects and/or only use a single tax change.

We instrument for the change in tax rates, $\ln\left(\frac{1-\tau_{it+1}}{1-\tau_{it}}\right)$, by computing the statutory marginal tax rate τ_{it} for taxpayer i in year t according to the statutory marginal tax rate schedules before and after the reform (described in Section 2.1.2 above), using taxpayer characteristics from the year prior to the reform.[47] We denote by τ^C_{it+1} and τ^C_{it} the marginal tax rate calculated using year $t+1$ and year t tax schedules applied to pre-period (i.e., 2008) values of g_{i2008} and z_{i2008}.

The first stage regression, therefore, is given by:

$$\ln\left(\frac{1-\tau_{it+1}}{1-\tau_{it}}\right) = \alpha + \omega \ln\left(\frac{1-\tau^C_{it+1}}{1-\tau^C_{it}}\right) + \theta_1 \ln z_{it} + \theta_2 \ln g_{it} + \delta_t + \delta_i + \nu_{it} \tag{21}$$

We estimate the first- and second-stage equations using corporate income tax filings for tax years 2008-2010, such that the ETI estimates leverage reform-induced changes in marginal tax rates over the two key years of the rate reform: the move from a taxable income-based to a gross income-based schedule in 2009, and the additional marginal tax rate cuts in 2010. Following the standard practice in the literature, in our main specifications, we exclude taxpayers reporting zero taxable income in years 2008-2010 (and therefore undefined log

[47] The pre-reform marginal tax rates come directly from the schedule. As shown in Figure 1, the 2009 reform introduced a non-linear schedule to determine the total taxes due T_{it} of taxpayers with gross income between IDR 4.8 billion and IDR 50 billion, whereby a taxpayer with g IDR billion in gross income paid $\frac{r^*}{2}$ over a $(4.8/g)$ share of its taxable income, and r^* over the remaining amount:

$$T_{it} = \frac{r^*}{2}\left(\frac{4.8 \text{ billion}}{g_{it}}\right) z_{it} + r^*\left[1 - \left(\frac{4.8 \text{ billion}}{g_{it}}\right)\right] z_{it}$$

The marginal tax rate τ^{Post}_{it} for these taxpayers is therefore obtained by differentiating T_{it} with respect to z_{it}. We calculate the MTR for an additional dollar of taxable income z_{it} holding gross income g_{it} constant.

taxable income).[48] We separately examine extensive margin effects (i.e., moving from 0 taxable income to positive taxable income).

Appendix Figure A.11 presents this reform-induced variation visually with a heat map of the change in predicted marginal tax rates (specifically, $\tau^C_{it+1} - \tau^C_{it}$) as a function of taxpayers' 2008 gross and taxable income, and indicates with a scatter plot where taxpayers fall along this variation. Panel A shows that the 2008-2009 schedule change induced a rich pattern of differential tax rate cuts (light green to blue areas) and differential tax rate increases (yellow to red areas), while the 2009-2010 schedule change induced differential but more tenuous tax rate cuts. Table A.14 presents alternative estimates of the ETI when only the 2008-2009 schedule change is used in estimation, and when we use lagged instruments as suggested by Weber (2014), among other specification robustness.

As the ETI estimates will be used to benchmark the tax administration effects, we use the same sample and balancing weights as in Section 4. In addition to the overall impacts, we also estimate ETIs separately for MTO and PTO taxpayers in order to assess the extent of differential responsiveness to tax rate changes under the different administration regimes. The fact that we are using the entropy-balancing weights implies that the difference in ETIs between MTO and non-MTO firms can be interpreted as the effect of being in the MTO on the firm's ETI, holding characteristics of the firm constant.

5.2 Results

5.2.1 First-stage

Table 6 presents the results. Panel A shows the first stage from estimating equation (21). Column (1) shows the results for all taxpayers. The first stage is quite strong – the coefficient of the actual marginal tax change on the predicted marginal tax change is 0.980, and the first-stage F-statistic is over 3,000. Columns (2) and (3) show that the first-stage is virtually identical for both MTO and non-MTO firms.

5.2.2 The elasticity of taxable income

The second-stage ETI estimates, from estimating equation (20), are shown in Panel B. Overall, for all firms, we estimate an elasticity of taxable income with respect to the net of

[48] Another reason that the literature typically excludes taxpayers with zero taxable income is that marginal tax rates (and therefore any variation in these rates) are based on positive taxable income thresholds (as was the case in Indonesia's pre-2009 ETI schedule). These papers typically also exclude taxpayers with small levels of taxable income altogether (e.g., Auten and Carroll, 1999; Gruber and Saez, 2002; Weber, 2014).

tax rate of 0.59. This estimate is substantially larger than the estimate from Gruber and Rauh (2007) using Compustat data in the United States (0.2), but very close to the net of tax rate estimate from Dwenger and Steiner (2012) using a pseudo-panel of German corporate taxpayers' average tax rates (0.6). It is considerably smaller, however, than Bachas and Soto (2018)'s estimate from Costa Rica, which focuses on much smaller firms.[49][50]

Applying standard formulas, we can calculate the marginal excess burden of raising the top corporate income tax rate using this elasticity. We slightly modify the notation in Section 3 to account for the fact that we have a progressive tax schedule, and so we consider changes to the top marginal rate; derivations largely following Saez et al. (see 2012) and Keen and Slemrod (2017) are provided in Appendix C. The marginal excess burden of taxation is:

$$-\frac{dB}{dR} = \frac{\varepsilon\tau\rho}{1-\tau-\varepsilon\tau\rho} \tag{22}$$

where $\rho = \left(\frac{z^m}{z^m-\bar{z}}\right)$ is the Pareto parameter (which we calculate as 1.33 in our data).[51] This captures the additional loss to the taxpayer above and beyond the taxes paid, for each additional dollar of revenue raised. Our estimates imply that the marginal excess burden per dollar raised is 0.51; that is, each dollar of taxes raised causes an additional burden of 0.51 cents on taxpayers.

We can also return to the welfare framework above to use the estimated ETI to compute optimal marginal tax rates as a function of v, the marginal cost of public funds. Modifying equation (9) to take into account the fact that we are considering a top marginal tax rate change, the top optimal tax rate is given by $\tau^* = \frac{1}{1+\rho\varepsilon\frac{v}{v-1}}$. When $v \to \infty$, this formula yields the revenue maximizing Laffer rate, $\tau^* = \frac{1}{1+\rho\varepsilon}$. Our estimates imply that the revenue-maximizing top rate is 56 percent in this context, substantially higher than the top 30 percent

[49]The tax rate, and variation used, is somewhat different in these studies. Both Gruber and Rauh (2007) and Dwenger and Steiner (2012) estimate the elasticity with respect to the average effective tax rate, generating variation by changes in depreciation schedules and other treatments of capital expenditure, holding the statutory rate fixed. By contrast, our setting is unusual in that we have direct policy variation in statutory marginal rates that differs across firms. We, therefore, estimate the elasticity directly with respect to the statutory marginal rate.

[50]Appendix Table A.13 displays effects of the MTR reform on additional outcomes, showing that the reform had an effect on both the intensive (ETI) and extensive (reports any positive taxable income) margins. Our estimate for the extensive margin elasticity is 0.425 (0.069). The reform also had no effect on VAT payments, employment, or gross income.

[51]In Indonesia's pre-2009 system, with a progressive marginal tax system, this formula applies exactly, and one can calculate $a = \frac{z^m}{z^m-\bar{z}}$, where $\bar{z}$ is the taxable income threshold over which the top rate applies, and z^m is the average taxable income conditional on it being above $\bar{z}$. Our estimates here thus apply to the pre-2009 system. In the 2009-and-after system, this estimate is only approximate since a change in the marginal tax rate applies to everyone, but with discounts depending on gross income.

marginal tax rate observed throughout the period we study. We can reject that Indonesia is above the revenue-maximizing rate (p-value < 0.01). More generally, the 30 percent top rate observed in this period would be optimal if the marginal value of public funds $v = 1.5$, so any higher valuations would suggest that increasing the corporate tax rate is optimal. For example, a value of $v = 2$, so the social value of public funds is twice that of private funds (which could happen if public goods are underprovided in many developing countries), would yield an optimal top tax rate of 39 percent.

5.2.3 Robustness

Appendix Table A.14 shows that estimated ETI is robust to specification choices. In particular, we explore: unweighted estimates (column 2); estimates where balancing weights are re-estimated conditional on the sample of taxpayers with non-zero taxable income throughout 2007-2010 (column 3); estimates restricting the estimation to the sample of taxpayers that have positive taxable income for all years 2007-2010 (column 4); estimates using lagged data for instrument and controls and the same set of firms as in column 4 (column 5);[52] estimates without taxpayer fixed effects but including baseline controls (column 6); estimates with no baseline controls but with taxpayer fixed effects (column 7); and estimates using only the 2008-2009 change in reported income and tax rates (column 8). In the specifications in columns (6) and (8), where we exclude taxpayer fixed effects, we include sector fixed effects instead, since the tax change may differ systematically by sector. We also include a dummy for the firm's MTO status. Finally, in columns (9) and (10), we split the sample by those taxpayers predicted to have a tax cut in 2008-2009 and those taxpayers predicted to have a tax increase in 2008-2009.

Most of these estimates are very similar. Note that the estimates without taxpayer fixed effects (columns 6 and 8) are somewhat larger – the ETI rises to 1.036 and 0.977, respectively.

[52]That is, applying the 2009 and 2010 schedules to 2007 — instead of 2008 — gross and taxable income data when constructing the marginal tax rate change instrument; and controlling for 2007 (instead of 2008) log taxable and log gross income for the 2008–2009 change, and for 2008 (instead of 2009) log taxable and log gross income) for the 2009-2010 change. As argued in Weber (2014), constructing the reform-induced marginal tax rate changes using lagged (rather than base-year) data addresses the possibility that ETI estimates might be inconsistently estimated (in particular, too small) due to mean-reversion in taxpayers' taxable income. As shown in column (4) of Appendix Table A.14, however, if anything this alternative specification produces a slightly *smaller*, although much less precise, ETI point estimate than our main specification, which is the opposite of the finding in Weber (2014). This suggests that either taxable income mean reversion is limited among the Indonesian firms in the analyzed period, or that the variation induced by Indonesia's marginal tax rate schedule reform is so heterogeneous across taxpayers (as seen in Appendix Figure A.11) that it is on average uncorrelated with transitory income shocks that induce mean-reversion in ETI estimates, providing more exogeneity in tax rate changes than typically observed in the literature.

While these are higher, they still indicate that Indonesia is below the Laffer rate on taxes – even using the highest estimate across all our specifications (1.036), the revenue-maximizing tax rate is 42 percent.

Finally, we explore whether tax cuts or tax increases drive our findings. Columns (10) and (11) suggest that our results are largely driven by comparing taxpayers receiving a large tax cut in 2008-2009 with those receiving a smaller tax cut in the same years. For this sample, the estimated ETI is 0.625, almost identical to the full sample effect. Appendix Figure A.13 shows these results in event-study form graphically year-by-year, plotting the change in marginal tax rate (Panel A) and the impacts on taxable income (Panel B) for those predicted to have large vs. small tax cuts. The plotted regression coefficients are conditional on controls that mimic the specification in equation (20) (taxpayer fixed effects, and year dummies interacted with 2008 log gross income and 2008 log taxable income), and similarly weighted by MTO balancing weights. For those predicted to have tax increases, column (11) of Table A.14 shows that results are statistically imprecise, although the point estimated for the ETI is positive. The reason is that there is much less variation in the tax increase for this sample (over 90 percent of taxpayers experiencing an increase face an increase smaller than 4 percentage points), and the sample size is 60 percent smaller.

5.2.4 Complements or substitutes: Does improved tax administration affect the elasticity of taxable income?

We next investigate whether improved tax administration changes the sensitivity of taxable income to the tax rate. As discussed by Slemrod and Kopczuk (2002) and Keen and Slemrod (2017), the sign of the effect is ex-ante ambiguous. For example, improved tax administration may reduce the elasticity of taxable income by making concealment activities more costly. On the other hand, greater tax administration may also make firms more responsive to changes in the tax rate. For example, if firms pay only a share λ of their taxes owed (i.e., pay a tax rate $\lambda\tau$), then the elasticity with respect to the statutory tax rate τ would be higher as λ increases.

We can combine the two sources of variation to estimate this cross-elasticity. Specifically, we weight taxpayers by the weights developed in Section 4.1, so that we are analyzing firms moved to the MTO in 2007 with comparable control firms who were still serviced by regular tax offices. We then estimate equation (20) to calculate the elasticity of taxable income separately for the weighted sample of MTO and non-MTO firms, in order to estimate how improved tax administration affects this elasticity.

Columns (2) and (3) of Table 6 present the results. We find no statistically significant difference in the elasticity of taxable income for firms that have been moved to the MTO, compared to similar firms who remain in primary tax offices, though the point estimates suggest that the elasticity is smaller in firms moved to the MTO.[53] The fact that that the point estimate suggests a lower ETI in a higher enforcement regime is consistent with work in other contexts that documents higher ETIs for self-employed workers, who are not subject to third-party reporting, than for wage earners, who are subject to third-party reporting and hence higher enforcement (Kleven et al., 2011; Kleven and Waseem, 2013)).

5.3 Comparing changes in tax administration and tax rates

Suppose the government wants to raise additional tax revenue. Should it do so by raising tax rates, or improving tax administration? To investigate this, we focus on corporate income taxation in particular, and use our estimates of improved tax administration from Section 4 and our estimates of the elasticity of taxable income to shed some light on this question. First, we can calculate revenue neutral alternatives – that is, we can estimate how much the government would have had to increase the top corporate income marginal tax rate of 30 percent in 2007 in order to achieve the same additional revenue as the MTO tax office reorganization. Second, we can use these estimates, combined with the theory discussed above, to give conditions under which doing so by improving tax administration is likely to be welfare-improving relative to doing so by raising tax rates.

5.3.1 How much would tax rates have to rise to generate the MTO impact?

Recall that in Section 3.1, we derived equation (12), which gives the relationship between marginal tax rate changes and changes in administration holding revenue constant. The key parameters in equation (12) are $\tau \frac{dz}{d\alpha} - \frac{da}{d\alpha}$, the empirically estimated change in tax revenue (net of administration costs) from the introduction of the MTO estimated in Section 4, $\varepsilon_{1-\tau}$, the estimated elasticity of taxable income with respect to the net of tax rate estimated in Section 5.2.2, and τ, the marginal tax rate from which we are starting. To take this to the data, we modify this equation slightly to account for the fact that we have a progressive tax schedule, and therefore are considering changes to the top rates (see Appendix C). We can therefore calculate $\frac{d(1-\tau)}{d\alpha}|_R$ as a function of our estimates of $\tau \frac{dz}{d\alpha} - \frac{da}{d\alpha}$ from Section 4.2, $\varepsilon_{1-\tau}$ from Section 5.2, the Pareto parameter (ρ), and the marginal tax rate (τ). The results

[53] Appendix Table A.15 shows that these results are robust to using actual MTO treatment status, and to whether these elasticities are estimated without MTO balancing weights.

using this calculation are shown in Table 7. We provide the MTO estimate used in column (1), and provide estimates of the tax rate changes needed if applied to MTO firms only in column (2) and all taxpayers in column (3).[54] As shown in column (1), the tax changes needed to match the MTO effect are large. In particular, matching the tax administration effect on corporate income tax revenues could not have been accomplished by raising the marginal corporate income tax rate of MTO taxpayers in our analysis sample only while keeping that rate below the revenue-maximizing rate of 56% (column (2); this is denoted 'Laffer' in the table to denote that doing this would exceed the Laffer rate). Alternatively, if the government were to tax all firms in the analysis sample (including those in PTOs), then matching the MTO effect of corporate income tax revenues would require raising the top marginal corporate income tax rate by 8 percentage points.Appendix Table A.14 presents robustness checks on this calculation corresponding to the various robustness checks on the ETI estimate described above.

As an additional bounding exercise, we consider what would happen if in fact the ETI was zero; that is, if there was no behavioral response whatsoever. In this case, we calculate that to match the MTO CIT revenue effect, the 2006 top marginal income tax rate would have had to be raised by 6 percentage points on all taxpayers (as opposed to by 8 percentage points at our estimated ETI of 0.590).

It is worth emphasizing that these counterfactual tax increases would only replace the additional corporate income tax generated by the MTO. As shown in Table 1, corporate income taxes represent only about 15 percent of the additional tax revenue generated by the MTO. To generate the same amount of total income tax generated by the MTOs (i.e., including individual withholding and other taxes) would have required raising the corporate income tax on *all* taxpayers by 17 percentage points.[55]

5.3.2 Conditions for improving tax administration to be welfare-improving, relative to raising tax rates

The theoretical framework also suggests a related calculation to assess whether raising revenue through improved tax administration is welfare-improving on the margin relative to

[54]The MTO estimates in Table 1 were in real terms (2007 rupiah). However, since the tax changes are in nominal terms, we provide the MTO effect in nominal terms.

[55]Appendix Table A.16 presents alternative counterfactual tax rate increases based on extrapolating the MTO effect and the tax base to all taxpayers in the 19 regions. Since the extrapolated MTO effect is likely a lower bound (that is, it scales linearly with the number of MTO taxpayers rather than proportionally with their size, whereas the income subject to the marginal tax rate — $N\left(z^m - \bar{z}\right)$ in equation 32 — increases proportionally with taxpayer size), the extrapolated counterfactual tax rate changes are also lower bounds.

raising revenue through higher tax rates. Recall that equation (14) gives the welfare change on the margin from shifting to increased tax administration and reducing marginal tax rates, holding government revenue constant. Modifying this equation to account for the fact that the tax increase applies only to the top bracket yields:

$$dW = \left(\tau \frac{dz}{d\alpha} - \frac{da}{d\alpha}\right) \frac{1}{1 - \frac{\tau}{1-\tau}\rho\varepsilon_{1-\tau}} - \frac{d\gamma}{d\alpha} \tag{23}$$

The first term, $\left(\tau \frac{dz}{d\alpha} - \frac{da}{d\alpha}\right) \frac{1}{1-\frac{\tau}{1-\tau}\rho\varepsilon_{1-\tau}}$, is essentially the change in the tax rate given in equation (12) multiplied by average taxable incomes z, which we can estimate (see previous section). We do not, however, observe $\frac{d\gamma}{d\alpha}$, the change in a firm's private compliance costs associated with the MTO.

Nevertheless, there are several reasons to think that, in our context, equation (23) is positive, which implies that the welfare implications from using improved tax administration to raise more revenue on the margin, rather than higher tax rates, would be positive. First, applying our estimates from Section (5.2.2), the $\frac{1}{1-\frac{\tau}{1-\tau}\rho\varepsilon_{1-\tau}}$ term is 1.51 in our context. This term is the marginal efficiency cost of funds, equal to 1 + the excess burden calculated in equation (22). This term captures how much more efficient it is to raise funds via tax administration rather than via tax rates, in terms of lost deadweight-costs of taxation (other than the private costs of compliance $\frac{d\gamma}{d\alpha}$). The fact that $\frac{1}{1-\frac{\tau}{1-\tau}\rho\varepsilon_{1-\tau}}$ is 1.51 implies that equation (23) would be positive even if revenue gains from improved administration were only 63 percent of additional compliance costs. Second, the fact that the net revenue effect of the MTO, $\left(\tau \frac{dz}{d\alpha} - \frac{da}{d\alpha}\right)$, is so large – two orders of magnitude larger than what it costs the government to administer it $(\frac{da}{d\alpha})$ – suggests that it may also be large relative to the *change* in compliance costs associated with the intervention.

Third, the intervention we study was actually an attempt to *reduce* compliance costs, not increase them, by improving customer service for taxpayers (e.g., answering questions, etc). As described in Section 2.1.1, anecdotal evidence from an ACNielsen survey of firms finds higher "satisfaction" with tax office interactions at MTOs compared to PTOs. One might imagine, then, that the MTO intervention raised the marginal costs of evasion while at the same time lowering the *level* of compliance costs. In such a case, the net change in firm compliance costs could be negative even if the marginal cost of evasion increased.

6 Conclusion

There is often a debate on whether to invest limited funds in improving tax administration, and how the returns from doing so differ from other policy levers such as changes to the tax rate. To study this, we estimate the impacts of two nationwide reforms in Indonesia—a cheap but expansive administration reform that differentially affected medium sized firms, and a change in corporate tax rates. We find that increasing the intensity of tax administration by moving the top firms in each region into special "Medium-Sized Taxpayer Offices," with similar structures and procedures, but much higher staff-to-taxpayer ratios, more than *doubled* tax revenue from affected firms. While there are concerns that new reforms may initially have impacts, but then fade over time as firms learn to evade, we actually find the opposite: impacts increase over the subsequent six years.

We find that one reason why these MTOs may have been so successful is that it flattened the relationship between enforcement and firm size, suggesting that governments that are designing tax administration reforms should be concerned not only with the level of enforcement, but also how the enforcement level changes as firms evolve. This finding suggests that differential tax enforcement on larger firms, which could be optimal for a tax authority facing limited resources and trying to maximize its tax intake in a static sense, may also contribute to the large number of very small firms in developing countries (Hsieh and Olken, 2014).

While this was a large-scale reform, its costs as a fraction of increased revenue were minuscule — about 1.5 percent — implying that this investment had a considerable overall return. In fact, the increase in tax rates needed to achieve a similarly sized effect would be quite large. Using non-linear changes to the corporate income tax schedule, we estimate an elasticity of taxable income of 0.59. Using this ETI to compare the two approaches, we calculate that the increased revenue from MTO taxpayers due to improvements in tax administration is equivalent to raising the marginal corporate tax rate on *all* firms by about 8 percentage points. Given these estimates, improved tax administration is likely to be the preferred approach unless the compliance costs imposed on taxpayers are extremely high. These results may also help explain why so many developing countries have been moving the largest taxpayers into separate offices with more intensive tax administration, such as the ones we study here, and more generally, why many developing country governments are increasingly investing in improved tax administration.

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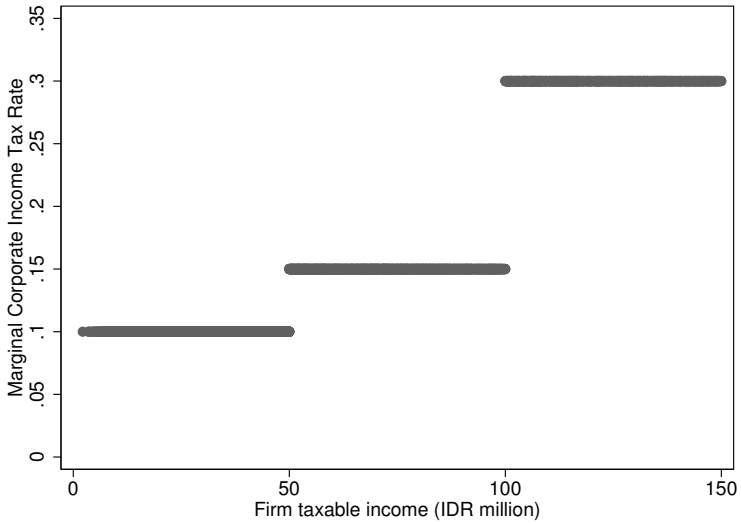
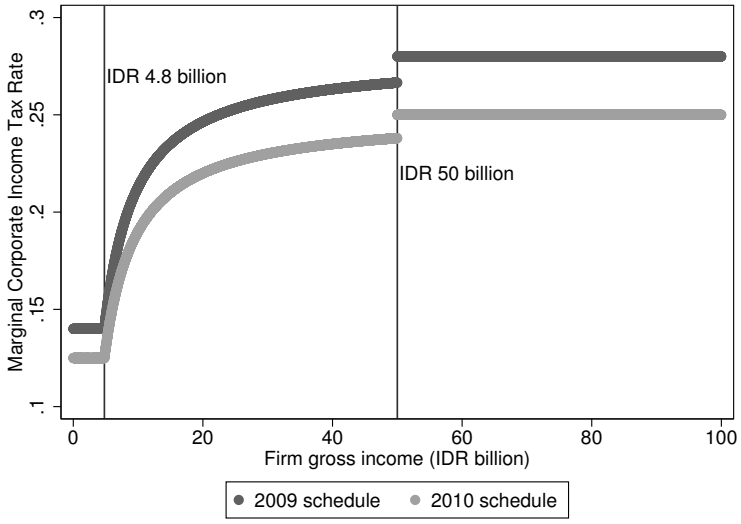
Figure 1: Change in corporate income tax schedule



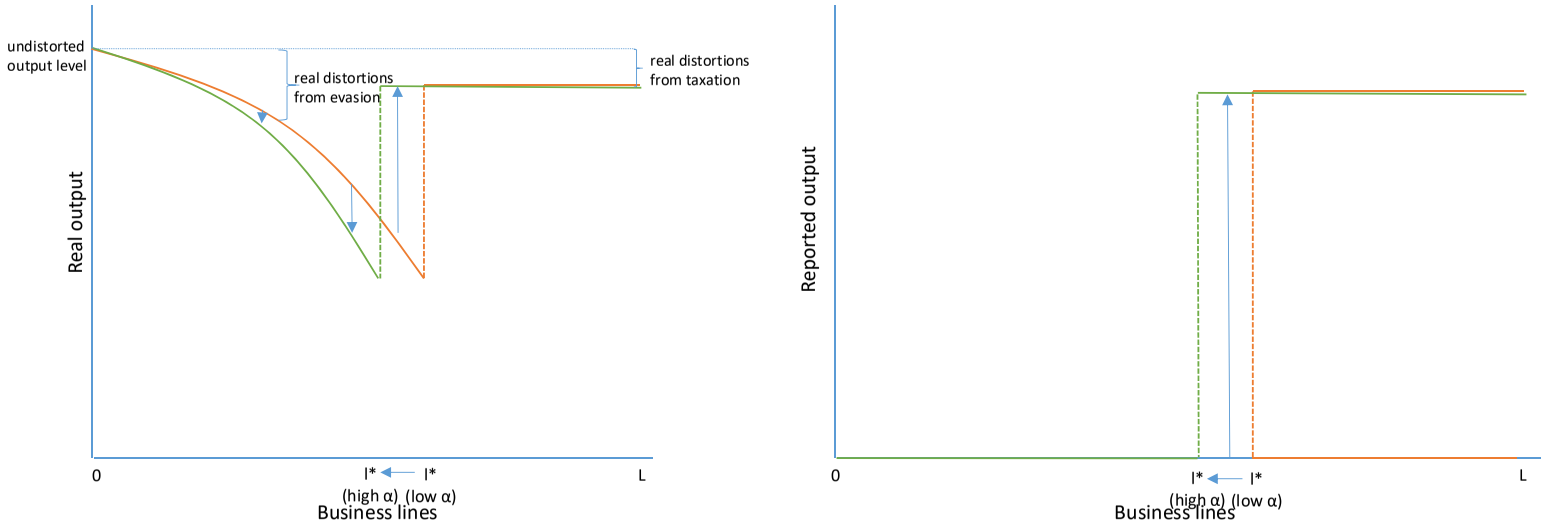
Panel A: Tax schedule prior to 2009
(Marginal tax rates vs. taxable income)



Panel B: Tax schedule 2009 and later
(Marginal tax rates vs. gross income)

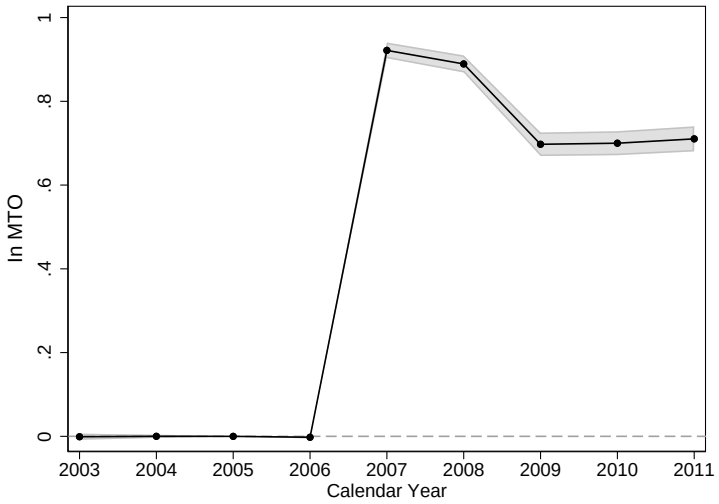
Notes: This figure shows corporate income tax rate schedules from before (Panel A) and after (Panel B) Indonesia's 2009 corporate income tax rate reform. Pre-reform rates were based on taxable income cutoffs. Post-reform rates were based on gross income cutoffs. In both periods, corporate income tax rates were applied to taxable income.

Figure 2: Example of an increase in enforcement α on reported and real output



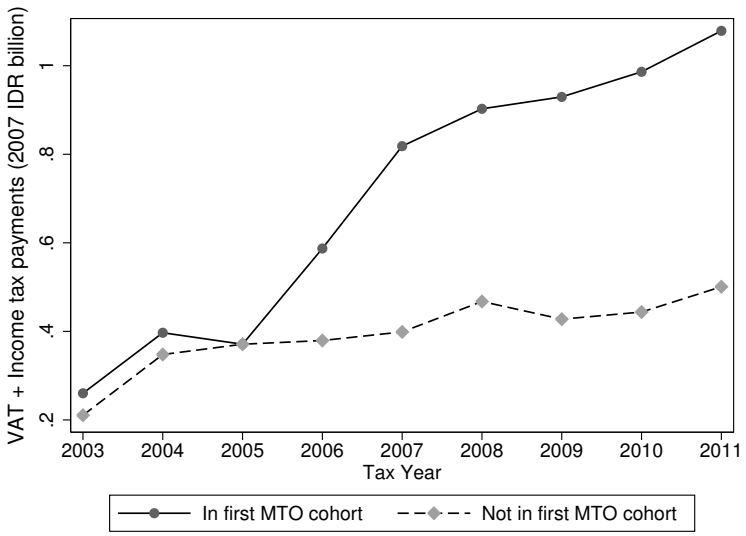
Notes: See Section 3.2.

Figure 3: Effect of MTO first cohort assignment on year-by-year MTO treatment

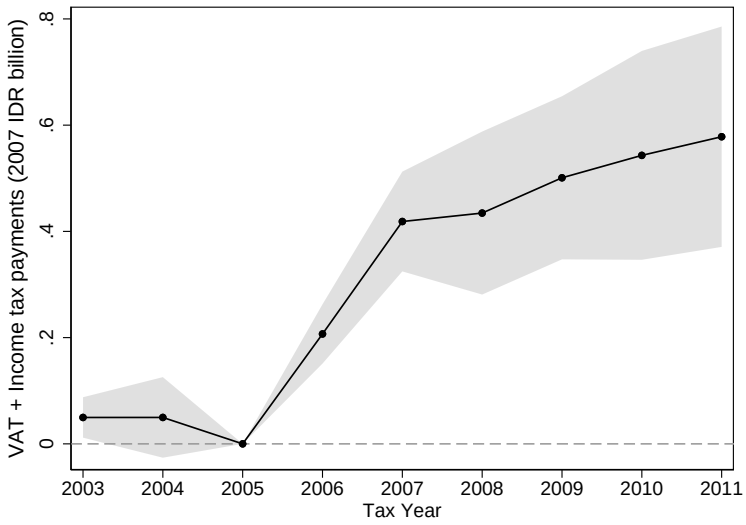


Notes: This figure shows year-by-year weighted regression estimates of the effect of MTO 2007 assignment on MTO treatment. Regression coefficients are estimated by interacting the MTO assignment dummy variable M_{iFC} in equation (16) with year dummies, while omitting the interaction and main effect dummies for base year 2005. The weights used in are taxpayer-specific, fixed across all analyses, and constructed by applying Hainmueller (2012)'s entropy-balancing methodology to the MTO assignment formula inputs (gross income and total taxes paid) for tax year 2005. Solid lines are point estimates; shaded areas are 95% confidence intervals based on standard errors clustered at the taxpayer level.

Figure 4: MTO effect on total taxes paid



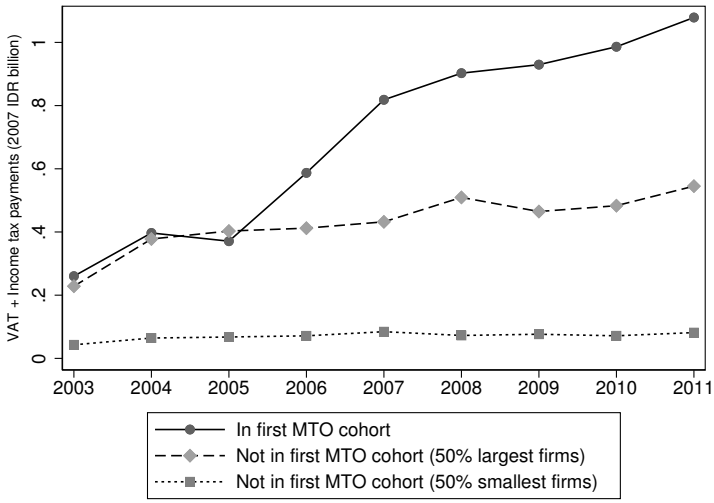
Panel A: MTO vs. non-MTO weighted annual averages



Panel B: Year-by-year estimates

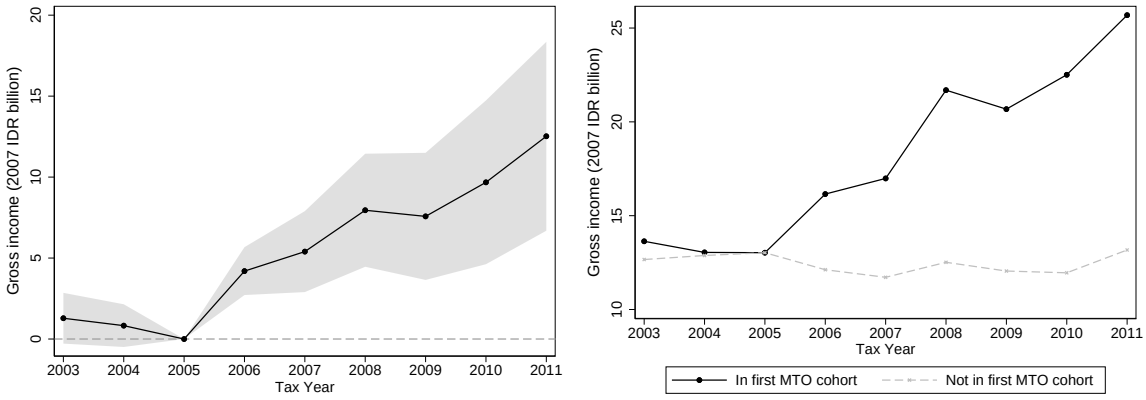
Notes: This figure shows annual weighted averages by MTO 2007 assignment group (Panel A) and year-by-year weighted regression estimates of the effect of MTO 2007 assignment on total taxes paid (Panel B). Regression coefficients are year-by-year reduced form effects of MTO treatment, and are estimated by interacting the MTO assignment dummy variable M_{iFC} in equation (16) with year dummies, while omitting the interaction and main effect dummies for base year 2005. The weights used in both panels are taxpayer-specific, fixed across all analyses, and constructed by applying Hainmueller (2012)'s entropy-balancing methodology to the MTO assignment formula inputs (gross income and total taxes paid) for tax year 2005. Taxpayer-level total taxes paid data are from the Treasury, and include payments from all branches of the same corporate entities. IDR values are deflated to 2007 IDR using Indonesia's GDP deflator. Solid lines are point estimates; shaded areas are 95% confidence intervals based on standard errors clustered at the taxpayer level.

Figure 5: Effects on total taxes paid for MTO, larger non-MTO firms, and smaller non-MTO firms (weighted annual averages)

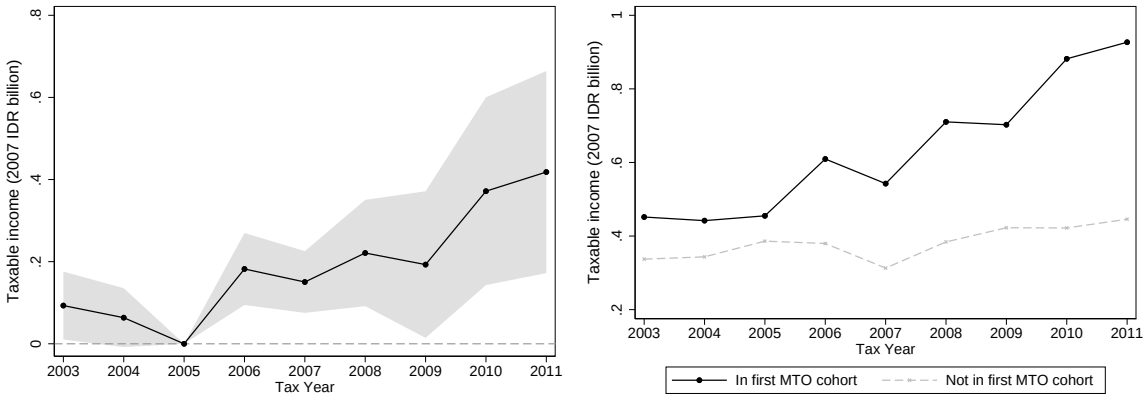


Notes: This figure shows weighted annual averages of total taxes paid, separately by taxpayer's assignment to the first MTO cohort. Data are weighted using entropy-balancing weights.

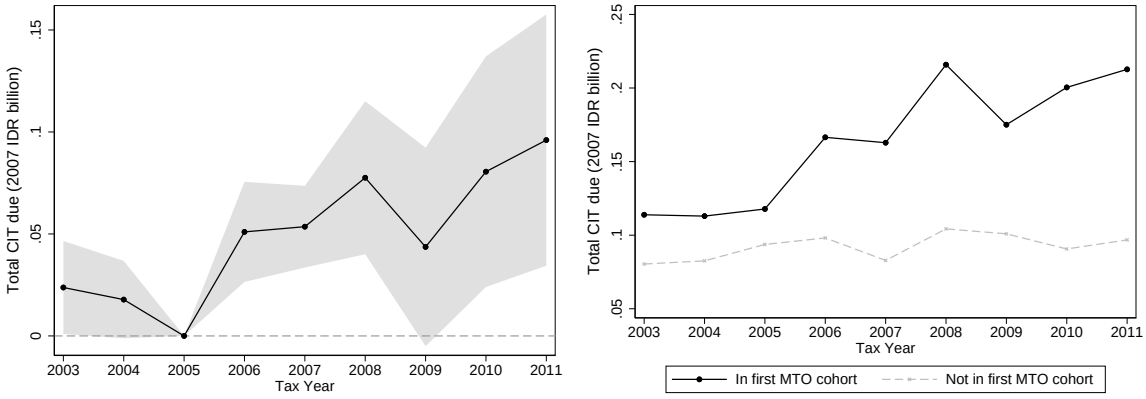
Figure 6: MTO effect on reported income (left: effect; right: averages)



Panel A: Gross income



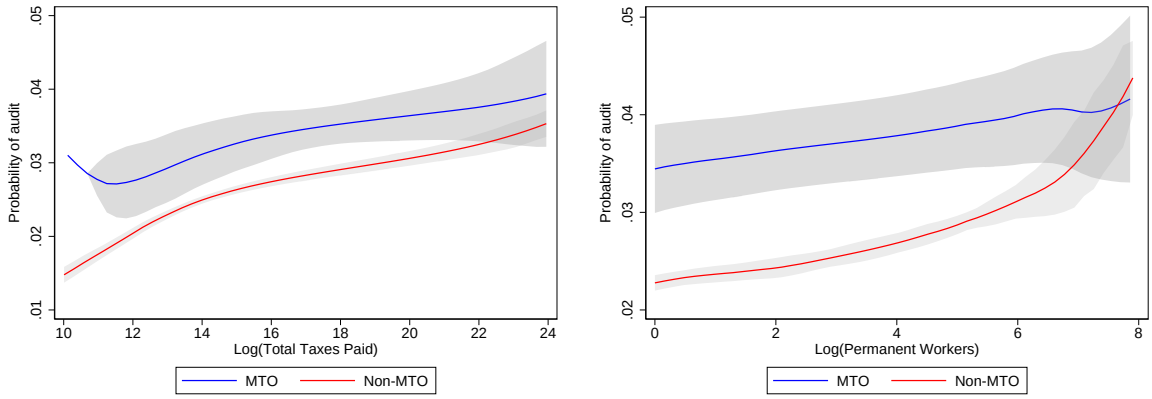
Panel B: Taxable income



Panel C: Corporate income taxes due

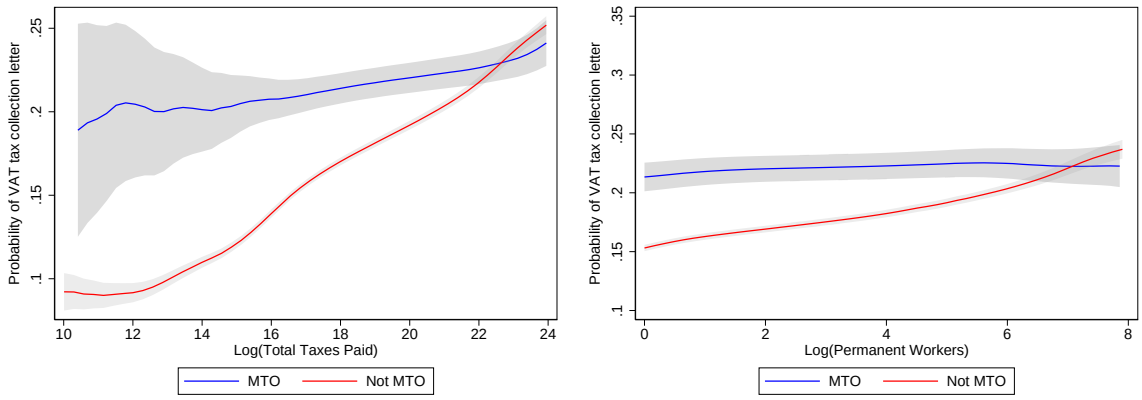
Notes: See notes to Figure 4. Figures on the left panel show reduced form effects of MTO assignment. Figures on the right panel shows weighted annual averages of reported gross income, taxable income, and total corporate income taxes due. Data are weighted using entropy-balancing weights. Reported income data are from tax filing form SPT 1771 (annual corporate income tax return), and are reported by the taxpayer headquarters on behalf of all branches of the same corporate entity.

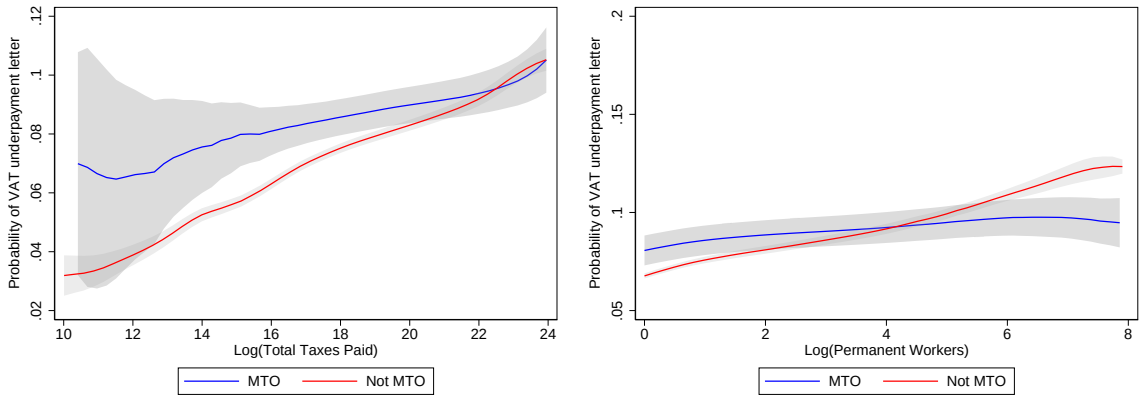
Figure 7: Audit and assessment as a function of total taxes paid and permanent workers



Panel A: As a function of total taxes paid

Panel B: As a function of permanent workers





Notes: This figure shows estimates of the probability of audit and VAT tax assessment (receipt of tax collection letter or underpayment letter) as a function of taxpayer log total taxes paid (left, Panel A) and log permanent workers (right, Panel B). Shaded areas indicate 95% confidence intervals. Panels A and B show local linear regression estimates using an Epanechnikov Kernel of bandwidths 4 and 2, respectively. All plots are based on weighted post-MTO assignment data. Probability of audit is based on 2009-2011 audit data. Probability of VAT collection letter and of VAT underpayment letter are based on 2006-2011 tax assessment letters data. Firm employment data are from corporate employment tax withholding form SPT 1721.

Table 1: MTO treatment effect on tax payments, reported income, and tax collection rate

	Weighted means				MTO treatment effect		
	Pre-treatment			Treated post-treatment			IV as % of post-treatment
	Untreated	Treated	N	counterfactual	Reduced Form	IV	counterfactual
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Tax Payments (2007 IDR billion)							
VAT	0.26	0.26	163,572	0.27	0.240	0.371	137%
					(0.050)	(0.078)	
Corporate Income Tax	0.05	0.06	163,572	0.07	0.048	0.074	111%
					(0.009)	(0.014)	
Other income taxes	0.06	0.06	163,572	0.07	0.052	0.080	113%
					(0.011)	(0.017)	
Total	0.37	0.37	163,572	0.41	0.340	0.525	128%
					(0.062)	(0.096)	
Panel B: Reported Income (2007 IDR billion)							
Gross income	13.03	13.03	136,601	12.04	5.754	9.131	76%
					(1.375)	(2.181)	
Taxable income	0.39	0.46	137,585	0.50	0.150	0.238	47%
					(0.045)	(0.072)	
Corporate Income Tax due	0.09	0.12	137,586	0.13	0.041	0.065	51%
					(0.012)	(0.020)	
Profit margin (net income/ gross income)	0.06	0.07	110,492	0.07	0.001	0.001	--
					(0.002)	(0.003)	
Panel C: Tax Collection Rate							
CIT paid/ CIT due	0.92	0.67	113,480	0.83	0.054	0.088	--
					(0.131)	(0.214)	

Notes: This table presents estimates of the MTO treatment effect on tax payments, reported income, and Corporate Income Tax (CIT) collection rate. Columns (1)-(2) show pre-treatment (specifically, tax year 2005) weighted means for untreated and treated taxpayers, respectively. Column (3) shows number of observations in each regression. Column (4) shows post-treatment weighted means for the treated group absent treatment (that is, counterfactual means), and is computed by subtracting the MTO IV treatment effect in Column (6) from the treated group's realized post-treatment weighted mean. Column (5) presents estimates of the effect of being assigned to MTO in 2007 (that is, the reduced form) according to equation (16), while column (6) presents the IV estimates of MTO treatment as specified in equation (17). Column (7) benchmarks the IV effects in column (6) as a percentage of counterfactual means in column (4). Means in columns (1), (2), and (4) and estimates in columns (5)-(6) are all weighted by the same taxpayer-specific balancing weights. Weights are constructed by applying Hainmueller (2012)'s entropy-balancing methodology to the MTO assignment formula inputs (gross income and total taxes paid) for tax year 2005. Tax payments data are from the Treasury and include payments from all branches of the same corporate entity. Reported income data are from tax filing form SPT 1771 and are reported by the taxpayer headquarters on behalf of all branches of the same corporate entity. IDR values are deflated to 2007 IDR using Indonesia's GDP deflator. Standard errors are clustered at the taxpayer level.

Table 2: MTO treatment effect on reported employment

	Weighted means				MTO treatment effect		
	Pre-treatment			Treated post-treatment	Reduced		IV as % of post-treatment
	Untreated	Treated	N	counterfactual	Form	IV	counterfactual
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Total workers	93.31	167.37	117,049	162.53	6.960	12.646	--
					(12.032)	(21.865)	
Permanent workers	36.36	43.80	117,049	49.19	5.705	10.365	21%
					(3.309)	(6.009)	
Temporary workers	56.95	123.57	117,049	113.34	1.256	2.281	--
					(11.650)	(21.168)	
Total wage bill (2007 IDR billion)	1.11	1.33	117,049	1.37	0.182	0.330	24%
					(0.077)	(0.139)	
Permanent workers	0.69	0.81	117,049	0.92	0.106	0.193	21%
					(0.055)	(0.100)	
Temporary workers	0.41	0.52	117,049	0.44	0.075	0.136	--
					(0.053)	(0.097)	
Average yearly wage (2007 IDR million)	16.26	16.20	117,049	14.99	1.286	2.337	16%
					(0.553)	(1.002)	

Notes: See notes to Table 1. Firm employment and wage data are from corporate employment tax withholding form SPT 1721, and exclude tax year 2008, for which data are not available. Average yearly wage is computed as total wage bill divided by total workers, and is not reported separately for permanent vs. temporary workers as many firms have zero temporary workers. See Data Appendix for details.

Table 3: Impacts of MTO on corporate income tax corrections and VAT underpayment letters

	Weighted means				MTO treatment effect		
	Pre-treatment			Treated post-treatment			IV as % of post-treatment
	Untreated	Treated	N	counterfactual	Reduced Form	IV	counterfactual
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Corporate Income Tax Corrections							
Filed any corrections	0.13	0.06	163,572	0.07	0.076	0.118	177%
					(0.008)	(0.012)	
Corrected this tax year's figures	0.21	0.36	163,572	0.24	-0.052	-0.080	-33%
					(0.012)	(0.019)	
Panel B: VAT tax assessment letters							
Tax collection letter	0.21	0.25	163,572	0.22	-0.004	-0.007	--
					(0.012)	(0.018)	
Underpayment letter	0.12	0.12	163,572	0.08	0.001	0.001	--
					(0.009)	(0.014)	

Notes: See notes to Table 1. This table presents estimates of the MTO treatment effect on tax filing corrections and VAT tax assessments.

Table 4: Enforcement, firm size, and the MTO: cross-sectional evidence

	Outcome		
	Audited	Received VAT Collection Letter	Received VAT Underpayment Letter
	(1)	(2)	(3)
Panel A: Measuring firm size as total taxes paid			
Assigned to MTO in 2007	-0.002	0.001	0.000
	(0.009)	(0.009)	(0.007)
Ln(Total Taxes Paid)	0.012	0.027	0.011
	(0.002)	(0.002)	(0.001)
Ln(Total Taxes Paid) x Assigned to MTO in 2007	-0.008	-0.016	-0.003
	(0.003)	(0.003)	(0.002)
N	52,763	111,940	111,940
Panel B: Measuring firm size as permanent workers			
Assigned to MTO in 2007	0.054	0.106	0.042
	(0.016)	(0.016)	(0.011)
Ln(Permanent Workers)	0.014	0.028	0.023
	(0.005)	(0.004)	(0.003)
Ln(Permanent Workers) x Assigned to MTO in 2007	-0.014	-0.022	-0.013
	(0.006)	(0.006)	(0.004)
N	42,792	73,043	73,043
Panel C: Measuring firm size as total workers			
Assigned to MTO in 2007	0.037	0.115	0.034
	(0.016)	(0.016)	(0.011)
Ln(Total Workers)	0.013	0.024	0.021
	(0.004)	(0.003)	(0.003)
Ln(Total Workers) x Assigned to MTO in 2007	-0.008	-0.021	-0.009
	(0.005)	(0.005)	(0.004)
N	43,202	74,125	74,125
Years	2009-2011	2006-2011	2006-2011
Year FE	Yes	Yes	Yes
Firm FE	No	No	No

Notes: This table presents cross-sectional regression estimates of the effect of MTO 2007 assignment on the slope of several measures of enforcement as a function of several measures of taxpayer size. Regression coefficients for alternative measures of enforcement are presented in columns (1)-(3). Regressions are separately estimated in Panels A through C given alternative measures of taxpayer size, and including the regressors listed on the left-most column of each panel. All regressions are weighted by the same taxpayer-specific balancing weights as in the MTO treatment effect and ETI estimation analyses. Standard errors are heteroskedasticity-robust.

Table 5: Enforcement, firm size, and the MTO: difference-in-differences estimates

	Outcome	
	Received VAT Collection Letter	Received VAT Underpayment Letter
	(1)	(2)
Panel A: Measuring firm size as total taxes paid		
Assigned to MTO in 2007 x (Year>2005)	-0.041	-0.022
	(0.016)	(0.012)
Ln(Total Taxes Paid)	0.016	0.003
	(0.003)	(0.002)
Ln(Total Taxes Paid) x Assigned to MTO in 2007	0.008	0.010
	(0.005)	(0.003)
Ln(Total Taxes Paid) x Assigned to MTO in 2007 x (Year>2005)	-0.018	-0.011
	(0.005)	(0.004)
N	168,541	168,541
Panel B: Measuring firm size as permanent workers		
Assigned to MTO in 2007 x (Year>2005)	0.069	0.067
	(0.024)	(0.016)
Ln(Permanent Workers)	0.042	0.020
	(0.013)	(0.014)
Ln(Permanent Workers) x Assigned to MTO in 2007	-0.004	0.006
	(0.016)	(0.015)
Ln(Permanent Workers) x Assigned to MTO in 2007 x (Year>2005)	-0.026	-0.022
	(0.007)	(0.005)
N	126,417	126,417
Panel C: Measuring firm size as total workers		
Assigned to MTO in 2007 x (Year>2005)	0.068	0.056
	(0.026)	(0.018)
Ln(Total Workers)	0.019	0.008
	(0.006)	(0.005)
Ln(Total Workers) x Assigned to MTO in 2007	0.001	0.003
	(0.009)	(0.007)
Ln(Total Workers) x Assigned to MTO in 2007 x (Year>2005)	-0.020	-0.014
	(0.006)	(0.005)
N	128,553	128,553
Years	2003-2011	2003-2011
Firm FE	Yes	Yes
Year FE	Yes	Yes

Notes: This table presents taxpayer-level difference-in-differences regression estimates of the effect of 2007 MTO assignment on the slope of several measures of enforcement as a function of several measures of taxpayer size. Regression coefficients for alternative measures of enforcement are presented in columns (1)-(2). Regressions are separately estimated in Panels A through C given alternative measures of taxpayer size, and including the regressors listed on the left-most column of each panel. All regressions are weighted by the same taxpayer-specific balancing weights as in the MTO treatment effect and ETI estimation analyses. Standard errors are clustered at the taxpayer level.

Table 6: Estimated elasticity of taxable income w.r.t. the net of tax rate

	Instrument: Reform-induced change in marginal tax rate		
		Separate by MTO status	
	All taxpayers	MTO	Not MTO
	(1)	(2)	(3)
Panel A: First Stage			
Endogenous:	0.980	0.981	0.982
Δ Ln(Net of tax rate)	(0.010)	(0.018)	(0.010)
F-statistic	3,629.32	1,112.23	3,250.73
N	12,790	964	11,826
Panel B: IV (ETI estimates)			
Outcome:	0.590	0.348	0.779
Δ Ln(Taxable Income)	(0.198)	(0.379)	(0.216)
P-value of difference		0.322	
Taxpayer FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Notes: This table presents instrumental variable (IV) estimates of the corporate Elasticity of Taxable Income (ETI) based on Indonesia's 2009 corporate income tax schedule reform and 2010 marginal tax rate cut. Panel A presents first stage effects of the reform-induced predicted change in marginal tax rates on realized marginal tax rates according to equation (21). Realized marginal tax rates are computed according to the schedule rules described in Section 2.1.2. Panel B presents IV estimates of the effect of log marginal net of tax rates on log taxable income (that is, ETI estimates) according to equation (20). The estimation sample is composed of the same taxpayers as in the MTO treatment effect analyses, and consists of data for the years immediately surrounding the reform (2008-2010). All regressions are weighted by the same taxpayer-specific weights as in the MTO treatment effect analyses. In addition to taxpayer and year fixed effects, all regressions control for base year log taxable income and base year log gross income. The p-value of the test for difference between the MTO and Non-MTO ETIs is shown between columns (2) and (3). Standard errors are clustered at the taxpayer level.

Table 7: Counterfactual CIT income tax increases to match MTO effects

		MTR raise needed to generate MTO effect on total revenue	
	MTO IV treatment effect (IDR billion)	Taxing MTO taxpayers	Taxing all taxpayers
	(1)	(2)	(3)
Corporate Income Tax	0.091	Laffer	8 pp
Total Income Taxes	0.180	Laffer	17 pp

Notes: This table presents estimates of by how much Indonesia would have had to raise its 2006 top marginal corporate income tax (CIT) rate of 30 percent in order to generate the same total revenue gains as the MTO effect, following calculations described in the text. Counterfactuals in columns (2)-(3) are computed by plugging the MTO treatment effect in column (1) and the ETI estimate of 0.590 from Table 6 into equation (7). Counterfactuals are displayed as "Laffer" whenever it is not possible to raise the respective amount of tax revenues without exceeding the revenue-maximizing tax rate of 56 percent. Because taxpayers' behavioral response to marginal tax rate increases (and therefore the ETI) are with respect to nominal (not real or IDR-deflated) values, the MTO treatment effect used for the counterfactual and displayed in column (1) is MTO effect on nominal (not real or IDR-deflated) corporate income taxes and total income taxes. The remaining non-schedule inputs of equation (7) are computed from the taxpayer-level data depending on which sample of taxpayers is assumed to received the counterfactual tax rate increase. Column (2) assumes only MTO taxpayers would be taxed; while column (3) assumes all taxpayers in the analysis sample would be taxed. All estimates are conditional on taxpayers who filed SPT 1771 (Corporate Income Tax return form), from where the non-schedule inputs of equation (7) are computed.