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Abstract

This paper models the optimal corporate tax policy of countries in a setting where firms may evade taxes by bribing tax officials. Various country-specific characteristics are shown to affect optimal tax policy, suggesting that a country belongs to one of three possible types and either (i) ignores, (ii) combats, or (iii) tolerates tax evasion. Countries characterized by widespread corruption, weak institutions, and high location-specific rents are likely to set inefficiently high tax rates and to tolerate tax evasion. For these countries, the incentive to improve their tax system is low and they are at risk of getting stuck in a regime of inefficient tax collection. We find robust empirical evidence for this pattern, and, in line with our theory, show that a *big push* – substantial and persistent improvements – towards stricter tax enforcement can help countries to escape this regime, raise sufficient tax revenue, and foster economic growth.

Keywords: Business Tax Evasion; Fiscal Capacity; Corruption; Country Development; Tax Enforcement; Natural Resource Rents; Corporate Tax Revenue

JEL classification: H26; H21; H25; H32

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1 Introduction

Functioning institutions as well as an efficient organization of the government are important preconditions for growth and development. Particularly the activities of the public sector require an efficient system of collecting taxes. This, however, appears to be one of the major problems of poorer countries. Using data from Steinmüller et al. (2019), the 25% poorest countries measured in terms of GDP per capita raise on average about 2.38% of GDP in corporate income tax revenue, whereas corporate income tax revenue amounts to about 3.68% of GDP, on average, in the 25% richest countries; the 10% richest countries even raise more than 4% revenue from taxing business profits. The fact that the average statutory tax rate is about 6 percentage points higher in the 10% poorest countries (an average tax of 32% compares to an average tax of 26%) may be interpreted in two ways. First, countries have implemented inefficiently high tax rates that lead to substantial tax avoidance activity. In other words, these countries might be on the wrong side of the Laffer-Curve, which raises the question of why governments of these countries do not cut taxes.[1] Second, institutions in these countries do not work, irrespective of the tax level, so that significant amounts of tax revenue are lost through different forms of tax evasion or informal market activity.[2]

It is the goal of this paper to shed light on the corporate tax policy of countries operating under very different conditions with respect to a variety of aspects such as the level of corruption, the quality of fiscal institutions and tax enforcement or location-specific rents (the latter may be high in resource-abundant countries). We particularly aim at understanding (i) why some (often it seems poor) countries set comparatively high corporate tax rates and do not cut taxes to reduce inefficiencies and raise more tax revenue; (ii) why countries do not take action and fix institutions to facilitate the collection of taxes; (iii) how a substantial and permanent improvement of tax revenue collection may be achieved.

As a possible explanation for this pattern, we first propose a theory predicting that countries operate in one of three "tax-setting regimes". Tax-setting behavior is endogenously determined and crucially depends on the respective regime: under the first one, countries can ignore tax evasion; countries in the second regime will implement

[1] The concept of the Laffer-Curve implies the notion of an inverse-U-shaped relationship between statutory taxes and tax revenue. Thus, there exists a tax rate between 0% and 100% which maximizes tax revenue.

[2] However, this argument suggests that tax revenue is lower at all potential tax levels (a downward-shift of the Laffer-Curve). As highlighted by Abbas and Klemm (2013) and Abramovsky et al. (2014), generous special tax regimes and incentives may also play an important role in this regard.

measures against tax evasion; countries operating in the third regime will tolerate tax evasion. To which of these regimes a country is assigned to specifically depends on the level of corruption, the quality of fiscal institutions, and on country-specific rents (e.g., associated with natural resource abundance).

In our theory model, we assume a government whose objective it is to maximize revenue from taxing firm profits. Firms, however, have an incentive to avoid taxation by the government. For this purpose, two strategies are at their disposal: they can either refrain from investing in the country's (formal) economy entirely, or evade taxes by paying a bribe to the tax agent in charge.[3] Whether it is worthwhile for firms to opt for one of these activities depends on their tax burden. Thus, the government is limited in its tax setting by firms' implicit threats to evade taxes or to leave the formal economy, and the extent to which the government is able, and willing, to prevent firms from doing so depends on a number of country characteristics. More precisely, the government's ability to detect and punish tax evasion hinges on the corruption level and the quality of fiscal institutions, while country-specific rents determine firms' gross profits and, as a consequence, their incentives to enter the economy and to evade taxes. Accordingly, these country characteristics affect optimal tax policy, suggesting that a country belongs to one of three possible country types and either (i) ignores, (ii) combats, or (iii) tolerates tax evasion. We demonstrate that countries characterized by widespread bureaucratic corruption, weak institutions, and high resource rents are very likely to be in the 'tolerating-tax-evasion' regime. In the latter regime, countries will set relatively high tax rates, thus inducing firms to evade taxes, as fines from convicted evaders contribute to total tax revenue.

Our theory further suggests that the relationship between revenue collection and tax enforcement is non-monotonic. In particular, small improvements on tax enforcement usually do not translate into higher revenue for countries operating under the 'tolerating-tax-evasion' regime. Therefore, these (often resource-rich, developing) countries lack the incentives to improve their current tax system and are stuck in a regime of inefficient tax collection, widespread evasion, and far-reaching corruption. It is only

[3]Several studies suggest that such bribes are relatively common in many countries, especially in less developed ones. In the countries included in the World Enterprise Survey, for example, 18% of the surveyed firms have experienced at least one bribe payment request, and 13.3% expect to make informal payments in meetings with tax officials. Conducting a field experiment in Pakistan, Khan et al. (2015) demonstrate that tax collector compensation crucially affects the scope of tax evasion and the level of bribe payments, and Alm et al. (2016) identify corruption of tax officials as a significant determinant of tax evasion behavior of firms. Anecdotal evidence on the topic is provided by Besley and McLaren (1993), as well as Cheung et al. (2012).

through a *big push* – that is, substantial and persistent improvements of institutions – towards stricter tax enforcement that such countries may escape the 'tolerating-tax-evasion' regime.

We then present an empirical assessment of our theoretical findings, using a large dataset on 128 countries and the time period from 2005 to 2014. We find evidence for an empirical pattern which reinforces our theoretical predictions and their policy implications: if countries want to increase tax revenue, they should aim for a stricter enforcement of tax law. In this regard, our empirical results confirm that the relationship between tax revenue and more rigorous tax enforcement is non-monotonic. In fact, and in line with the theoretical findings, our results show that it is precisely through a *big push* towards stricter tax enforcement that countries benefit substantially in terms of increased tax revenue. We find that, for the greater part, the countries putting in considerable and persistent efforts in improving tax collection are newly-industrialized countries, which is evidence for the notion that favorable economic development often goes hand in hand with improvements in tax enforcement. This finding is consistent with our theoretical model: induced by a *big push* in terms of tax enforcement and revenue collection, these countries seem to have succeeded in switching the tax-setting regime and eventually increased their capability to generate tax revenue. By contrast, we do not find any countries with very low levels of development among the ones experiencing a *big push* towards stricter tax enforcement. This is in line with our theoretical finding that the least developed countries are likely to be the ones which lack the incentive to implement changes to tax policy and tax enforcement. As a consequence, the least developed countries may be at risk of never being able to escape the regime of inefficient revenue collection and widespread evasion. Only if institutions are fixed in a *big push*, these countries will be able to raise significantly more tax revenue.

Our paper relates to several strands of literature. In line with previous contributions on the topic, we highlight the differences between developed and developing countries with respect to optimal tax policy.[4] There are several obstacles, like, e.g., weak institutions, bureaucratic corruption, and lacking expertise of tax agents, that may hinder revenue collection and lead to widespread tax evasion and the persistence of substantial informal sectors, especially in less developed countries. For instance, La Porta and Shleifer (2014) find that economic development is associated with a decline of the informal sector, which should make it easier to raise tax revenue. Exploiting

[4]General analyses of (optimal) tax policies for developing countries are provided by Besley and Persson (2014) and Tanzi and Zee (2000), while Abbas and Klemm (2013) and Abramovsky et al. (2014) discuss corporate taxation in this context.

a large formalization program in Brazil, Rachter et al. (2018) demonstrate that lowering taxes reduces firm informality, yet only at the cost of lower net tax revenue. Gokalp et al. (2017) find that competition from the informal sector may induce formal firms to evade taxes, especially if institutions and regulations are inefficient and burdensome. Similarly, Schneider and Torgler (2007) identify governance and institutional quality as well as tax morale as limiting factors of informal activity, and Dreher et al. (2009) provide evidence that institutional quality reduces both the size of the shadow economy and the corruption level. Bird et al. (2008) suggest that tax revenue could be significantly higher if corruption was reduced and 'voice and accountability' were improved. Especially the share of firms not paying any taxes seems to be substantial in developing countries. Rachter et al. (2018) show that almost 75% of Brazilian entrepreneurs are informal. Lediga et al. (2019) suggest that for 64% of the population of all South African businesses included in the tax registry, reported tax payments are zero. Furthermore, several studies analyze governments' optimal tax policy in a setting where tax collection and enforcement are imperfect, which should be particularly true in less developed countries. For instance, Best et al. (2015) show that charging taxes on turnover, rather than profits, may reduce tax evasion by firms, which explains why many developing countries rely on such a production inefficient tax policy.[5] Dharmapala et al. (2011) demonstrate how administrative costs of tax collection can justify the exemption of firms from taxation if their output level is below a certain threshold, although such a policy leads to tax avoidance behavior by firms and may induce a "missing middle". The latter suggests that only small tax-exempted and large firms exist, a phenomenon commonly observed in developing countries. Carrillo et al. (2017) stress the importance of tax authorities' enforcement capacity for revenue collection, by highlighting the limited influence of third-party reporting on tax compliance in developing countries. Finally, Gordon and Li (2009) set up a model where firms are able to evade taxes if they conduct all business in cash and avoid using the financial sector. Such a strategy seems to be more applicable in developing countries, as the value of financial intermediation tends to be smaller there. Accordingly, the threat of corporate tax evasion has a larger impact on developing countries' optimal tax policy, compared to more developed ones.

How well a country can cope with the aforementioned problems depends on the effectiveness of its tax system, or, in a broader sense, on its fiscal capacity. Following Besley and Persson (2013), the concept of fiscal capacity refers to a government's

[5]Production inefficiencies arise in this case as a turnover tax puts a wedge between the social and private returns to output.

capability to generate tax revenue. The higher a country's fiscal capacity, the more tax revenue the country can potentially generate. Accordingly, differing tax policies of industrialized and developing countries may well be justified, as they are likely to result from the lower fiscal capacity of the latter type of countries. In order to increase its fiscal capacity, a country has to make investments targeted to improve, e.g., the structure of the tax system, the quality of institutions, the enforcement power of tax authorities, and the expertise of tax agents. To measure fiscal capacity, previous contributions have used various indicators of political institutions to proxy for fiscal capacity and tax enforcement. This should reflect that higher levels of political stability and cohesion as well as more inclusive political institutions are strongly correlated with a country's fiscal capacity (Besley and Persson, 2009; Besley et al., 2013). On a more specific level and with a distinct focus on tax enforcement, Besley et al. (2013) analyze investments in administrative structures that support tax revenue collection. Historically, these investments are mainly related to the implementation and, henceforth, the increasing enforcement of different types of taxes. In recent years, more and more countries have concluded Double Taxation Treaties (DTTs), which are mostly based on the OECD Model Tax Convention. The latter points out two main objectives of DTTs. While the first one is concerned with alleviating double taxation of foreign-earned income, the second major objective behind DTTs is to restrict tax avoidance and tax evasion (Blonigen and Davies, 2004; Egger et al., 2006). Blonigen and Davies (2004) argue that DTTs can reduce both tax evasion and administration costs related to tax enforcement and revenue collection. To the extent that this is the case, the number of DTTs concluded by a country may serve as a valid proxy for the strictness of a country's tax law enforcement. In the particular context of developing countries, Brumby and Keen (2016) as well as Hofmann and Riedel (2018) state that it is questionable whether less developed countries benefit from DTTs. On the one hand, these concerns are related to compliance costs for firms and uncertainty on the part of taxpayers. On the other hand, high administration costs associated with the negotiation and enforcement of DTTs may also harm developing countries or, at least, outweigh the positive revenue effects. The empirical part of this paper will use the number of DTTs as a proxy for a country's effort (strictness) in tax-law enforcement.

Concerning the interplay of improvements on tax enforcement and other dimensions of institutional progress, Besley and Persson (2013, 2014) argue that an adjustment of the tax system should be accompanied by, and be part of, a broader economic development. This reasoning is in line with Acemoglu et al. (2005), who reason that institutions are a fundamental cause of economic growth. Similarly, Mehlum et al.

(2006) show that countries suffer from natural resources in terms of lower growth rates if institutions are weak and bureaucratic corruption is widespread. By contrast, resource-rich countries with good institutions experience higher growth rates than countries with less resources.[6] Note, though, that natural resources (implying high location-specific rents) by themselves constitute a main determinant of countries' tax policy and investment in fiscal capacity. Besley and Persson (2013) and Jensen (2011) argue that natural resource abundance reduces a country's non-resource tax effort and, as a consequence, its investment in fiscal capacity. Jensen (2011) estimates that a 1% increase in the ratio of resource revenue to total revenue is associated with a 1.4% decrease in fiscal capacity, as measured by non-resource tax effort. This notion is supported by Crivelli and Gupta (2014), who estimate that each additional percentage point of GDP in resource revenue is associated with a reduction of about 0.3 percentage points of GDP in domestic non-resource revenue.

As these studies highlight the impact of corruption, institutional quality, and natural resource abundance on the (optimal) tax policy of countries, they strongly motivate the approach we take in the following. We add to the existing literature by (i) providing a rich theory that allows us to establish three tax-setting regimes in which countries may operate. A country's tax policy, in particular the way how to deal with bureaucratic corruption and tax evasion, crucially depends on the respective regime; (ii) illustrating that the corporate tax-setting behavior of less developed countries is in line with countries maximizing expected revenue, although it may differ fundamentally from the tax-setting behavior of industrialized countries; (iii) explaining why (mainly resource-rich, developing) countries often lack the incentive to improve their inefficient tax system; (iv) demonstrating (theoretically and empirically) that, for these countries, a *big push* towards stricter tax enforcement may be the only way to overcome the problems of widespread corruption and tax evasion, which proves to be an indispensable step in poor countries' economic development.

The remainder of the paper is organized as follows. In Section 2, we propose a theory of optimal tax policy for different country types. Thereafter, Section 3 analyzes the relationship between tax enforcement, revenue collection, and country development. Section 4 provides some basic empirical evidence strongly supporting our theoretical findings, Section 5 concludes.

[6]The negative relationship between natural resource abundance and economic performance observed for many countries is referred to as 'resource curse' in the literature (cf. Sachs and Warner, 2001; Mehlum et al., 2006, among others). In line with Mehlum et al. (2006), several studies (e.g., Kolstad and Søreide, 2009; Leite and Weidmann, 1999; van der Ploeg, 2011) identify corruption and weak institutions as driving forces behind this pattern.

2 Theoretical model

Let us consider a country hosting a continuum of identical, risk-neutral firms of mass one. Each firm can initiate an investment project generating payoff $\Pi \geq 0$ if successful (with probability p_s). In case of failure (with probability $1 - p_s$), the payoff is zero. Thus, a firm's expected gross profit when realizing the project is $E[\Pi] = p_s\Pi$. Alternatively, firms can settle for the exogenously given outside option $\pi^o \geq 0$. We assume that π^o cannot be taxed by the country.[7] The probability of success p_s as well as the respective profit levels are assumed to be common knowledge. By contrast, the outcome of the investment project (i.e., whether the firm is successful or not) is private information to the firm and the respective tax agent in charge, while it remains unknown to the government of the country. Profits that arise from the investment project are taxed at rate t. However, a firm can try to evade the tax by paying a bribe B to the assigned tax agent. The latter reports a failure of the firm's investment, and hence profits of zero, to the government if he accepts the bribe. Thus, a firm does not have to pay taxes at all if the bribe payment B is accepted by the tax agent (with probability $0 \leq 1 - s \leq 1$) and not detected by the government afterwards (with probability $0 \leq 1 - p \leq 1$). If the bribe attempt is rejected by the agent (with probability s) or detected by the government (with probability p), the tax burden of the firm increases by factor $\lambda > 1$, instead of being reduced.[8]

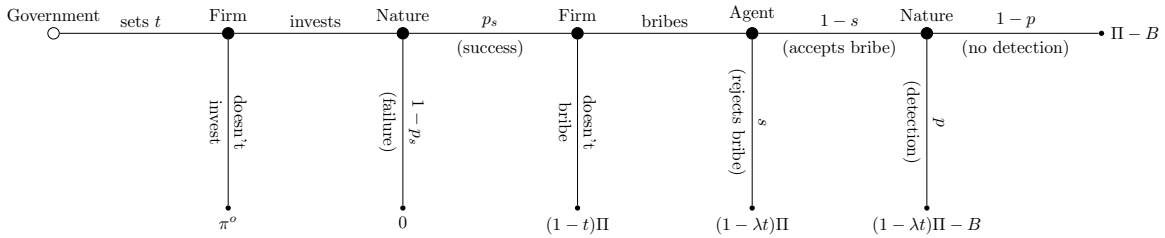
The structure of the game, which we depict in more detail in Figure 1, is as follows. In the first stage, the government decides about the corporate tax rate t. Afterwards, firms make their choices about investment projects. The gross profits of investing firms are realized in the third stage. Subsequently, firms attempt bribery or they behave tax-compliant. After that, tax agents account for a potential bribe offer and report firm

[7] We can think of π^o as a firm's net profit after relocation to a neighboring country, for example. The outside option π^o may also represent a firm's payoff when operating in the informal sector.

[8] While our study focuses on tax evasion, it should be noted that both legal tax avoidance and illegal evasion pose serious problems to revenue collection in developing countries, as shown by Cobham (2005). Similar to our model, several papers (Gauthier and Goyette, 2014, 2016; Sanyal et al., 2000, among others) analyze a government's optimal behavior when it has to deal with corrupt tax agents that may allow firms or individuals to cheat on their tax payments in exchange for bribes. While these models differ with respect to the government's main policy instrument, which may be the optimal public sector wage scheme (Besley and McLaren, 1993), degree of monitoring activity (Gauthier and Goyette, 2016), auditing (Sanyal et al., 2000), or tax rate (the present paper), they all share the common finding that it may be optimal for a government to tolerate tax evasion, at least to some extent. Hindriks et al. (1999) examine optimal private income taxation in the presence of corrupt inspectors and evasion. A more general analysis of the interaction between governmental policy and bureaucratic corruption is provided by Acemoglu and Verdier (2000).

profits to the government. Finally, tax revenue (government) as well as (net) payoffs (agents and firms) are realized. The model is solved via backward induction.

Figure 1: Game structure



2.1 Tax agents

In the last stage before outcomes are realized, tax agents, who are randomly assigned to firms, decide on whether or not to accept a bribe. We assume two types of risk-neutral agents. The first type is susceptible to bribery, whereas the second type is not. Accordingly, we call agents of the first type *pliable* and agents of the second type *steadfast*. An agent's type is his private information. Firms and the government only know that a fraction s of all agents is steadfast. Bribery is detected afterwards with probability p, in which case the agent loses his job and the associated wage payment w, but nevertheless gets the bribe B.[9] For simplicity, we set the opportunity wage of the agents to zero. Furthermore, corrupt behavior is associated with personal cost $m > 0$ for a tax agent.[10] This cost is assumed to be the same for all pliable agents who accept the bribe if

$$B + (1-p)w - m \geq w \quad \Leftrightarrow \quad B \geq B^* = pw + m.^{11} \tag{1}$$

[9]The results of the model are qualitatively the same if bribe payments accrue to the government and become tax revenue in case of detection.

[10]We may interpret m as moral concerns or remorse associated with corrupt behavior. As a consequence, we assume m to arise even in case of non-detection. Note, however, that in some contributions (like, e.g., Ades and Di Tella, 1999), corrupt agents face personal cost only in case of detection. Adopting this premise does not alter the qualitative results.

[11]For convenience, we assume that agents accept the bribe in case of indifference, while firms prefer honest behavior over evasion, as well as initiating the project over their outside option in case of indifference. Moreover, we suppose that no (further) bargaining between agent and firm takes place. Cheung et al. (2012) provide empirical evidence that supports this notion. Their findings suggest

Thus, bribe payments are accepted if the net payoff exceeds opportunity cost w. B^* defines the lowest bribe offer that is accepted by a pliable agent. The existence of steadfast agents may represent the fact that the personal cost m is infinitely high for a fraction s of all agents. For these agents, inequality (1) is never satisfied. We assume p, w, m, and, consequently B^*, to be common knowledge.

2.2 Firms

The behavior of firms is determined in the second, third, and fourth stage of the game.[12] In the fourth stage, firms decide whether to attempt bribery. If the responsible tax agent accepts the bribe, he reports a failure and zero profits of the firm to the government, implying that the firm does not have to pay taxes at all. Accordingly, failed firms, as well as firms which reject the investment project and choose the outside option, have no incentive to bribe as they do not pay taxes. Given the distribution of tax agents and the fact that firms know B^*, a bribe attempt fails and is reported with probability s. Even in case of a successful bribe attempt, tax evasion and the associated bribery are discovered with probability p. The corresponding penalty on the firm is assumed to be the same in both cases. In particular, we assume that a firm's payment to the tax authorities (i.e., the government) is increased by a factor of λ if attempted or

that lower-level government officials are far less able to expropriate bribery-related rents from firms, as opposed to high-ranked officials. In line with inequality (1), Khan et al. (2015) show that the scope of tax evasion and the level of bribe payments crucially depend on tax collector pay. However, as demonstrated by Fjeldstad (2003), higher public wages may simply improve the bargaining power of corrupt agents and lead to higher bribes instead of lower corruption if control mechanisms and sanctions are weak.

[12] Our model primarily applies to small- and medium-sized firms. Large multinational companies tend to rely on profit shifting in order to reduce their tax burden, and the associated losses in revenue seem to be even larger in developing countries, compared to advanced ones (Cobham and Janskỳ, 2018; Crivelli et al., 2016; Johannesen et al., 2017). By contrast, smaller firms often lack the possibility to legally avoid taxes and may, therefore, engage in tax evasion or migrate into informality (Djankov et al., 2010; Slemrod et al., 2017; Waseem, 2018). Consistently, Gokalp et al. (2017) find a negative relationship between firm size and tax evasion. Using data on Ugandan firms, Gauthier and Reinikka (2006) provide evidence that large companies benefit from tax exemptions, while smaller firms tend to evade taxes. In line with these findings, Campos and Giovannoni (2007) and Harstad and Svensson (2011) argue that lobbying and bribery are substitutes, with bribery being far more common for rather small firms (Campos and Giovannoni, 2007) and in less developed countries (Harstad and Svensson, 2011). Supporting this notion, Ayyagari et al. (2007) report that small- and medium-sized firms constitute most of the private sector in these countries.

accomplished bribery is exposed. We assume p and λ to be exogenous.[13] Accordingly, a bribe attempt is associated with the following expected net profit $\hat{\pi}^e$ for an *e*vading firm:[14]

$$\hat{\pi}^e = (1 - q\lambda t)\Pi - (1 - s)B^*, \tag{2}$$

where $q \equiv (1 - s)p + s$ denotes the overall probability of detection and, consequently, $q\lambda$ denotes the expected penalty rate.[15] In case of compliant (or *h*onest) behavior, a firm's net profit is

$$\pi^h = (1 - t)\Pi. \tag{3}$$

Consequently, a firm attempts bribery if

$$\hat{\pi}^e > \pi^h \quad \Leftrightarrow \quad t > t^{eh} \geq 0, \tag{4}$$

where

$$t^{eh} \equiv \frac{(1 - s)B^*}{(1 - q\lambda)\Pi} \tag{5}$$

defines the tax rate for which a firm is indifferent between *e*vading and *h*onest behavior.[16]

When deciding about the investment project in the second stage, firms anticipate their subsequent compliance behavior in case of success. The necessary condition for initiating the project is given by

$$p_s\hat{\pi}^e \geq \pi^o \Leftrightarrow t \leq t^{oe} = \frac{1}{q\lambda}\left(1 - \frac{\pi^o + p_s(1 - s)B^*}{p_s\Pi}\right) \tag{6}$$

for evading firms and

$$p_s\pi^h \geq \pi^o \quad \Leftrightarrow \quad t \leq t^{oh} = 1 - \frac{\pi^o}{p_s\Pi} \tag{7}$$

[13] Allowing for endogenous p and λ should not alter the qualitative results of the model. Even if the government was able to choose these variables optimally, it is reasonable (and common in the literature) to assume that it would be limited in doing so by monitoring or auditing cost (regarding p) and legal and political obstacles (regarding λ). Consequently, firms may have an incentive to evade taxes, at least in some countries, even if p and λ are optimally chosen.

[14] We refer to all firms that attempt bribery as *evading*, although actual tax evasion only takes place if the bribe attempt is successful.

[15] Note that tax evasion is never worthwhile if the expected penalty rate is at least one: $q\lambda \geq 1$. Therefore, $q\lambda < 1$, is often assumed in the literature. By contrast, we generally allow for $q\lambda \geq 1$. Thus, the expected penalty may be sufficiently high in some (but not all) countries to fully deter tax evasion.

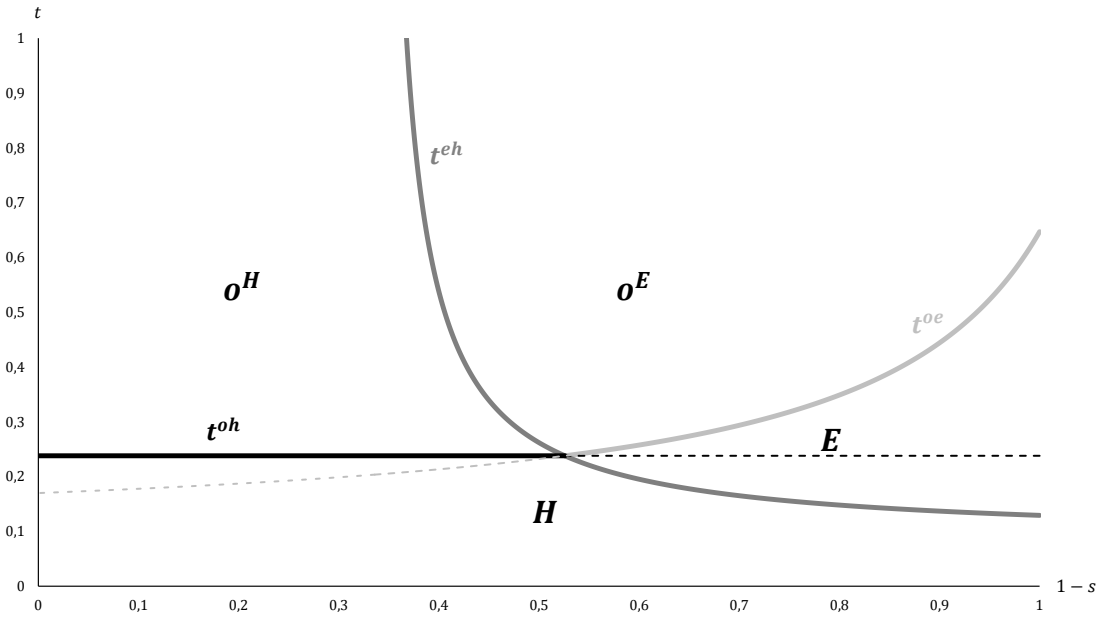
[16] Note that the threshold t^{eh} only constitutes an upper limit to taxation of compliant firms if its value is positive, i.e. for $q\lambda < 1$. If $q\lambda > 1$ (implying $t^{eh} < 0$), tax evasion is never worthwhile for firms.

for honest firms. t^{oe} (t^{oh}) defines the maximum tax rate for which an *e*vading (*h*onest) firm just prefers the investment project over its *o*utside option.[17]

2.3 Government behavior

At the first stage of the game, the government sets the tax rate to maximize expected revenue. It is limited by firms' alternatives, which are evasion and the outside option. The attractiveness of these alternatives and the corresponding threshold values of the tax rate are defined by inequalities (4), (6), and (7). In order to understand the mechanisms of the model, it proves helpful to depict t^{eh}, t^{oe}, and t^{oh} as functions of $1-s$, the share of pliable agents. Recall that t^{eh} corresponds to the tax rate for which a firm is indifferent between evading and honest behavior, t^{oe} is the maximum tax rate for which an evading firm just prefers the investment project over its outside option, and t^{oh} is the maximum tax rate for which an honest firm just prefers the investment project over its outside option. Let us map firms' optimal behavior for different combinations of $1-s$ and t in Figure 2. We may think of $1-s$ as a proxy for corruption and, thus, interpret a high value of this variable as a high corruption level in the following.

Figure 2: Threshold tax rates and possible firm behavior.



[17] If t^{oe} (t^{oh}) is negative, $t < 0$ (i.e., a subsidy) is necessary to induce evading (honest) firms to start the investment project. However, $t < 0$ cannot be optimal in our model for a revenue-maximizing government. The latter then simply refrains from taxing the respective firms.

From the perspective of the government, we can distinguish between four different areas in Figure 2, each representing a certain behavior of firms.

The lower area denoted by H captures all combinations of $1-s$ and t for which it is optimal for firms to initiate the project and behave compliant in case of success. Formally, $t \leq t^{oh}, t^{eh}$ holds in this area.

The right area denoted by E captures all combinations of $1-s$ and t for which it is optimal for firms to initiate the project, but attempt bribery in case of success. Formally, $t^{eh} < t \leq t^{oe}$ and $t^{eh} < t^{oh}$ hold in this area.

The upper left (o^H) and upper right area (o^E) capture combinations of $1-s$ and t for which it is optimal for firms not to pursue a project and resort to their outside option instead. More precisely, the o^H-area depicts combinations for which firms would prefer paying taxes over attempting bribery if they successfully undertook the project. Formally, $t^{oh} < t \leq t^{eh}$ holds in this case. By contrast, the o^E-area depicts combinations for which firms would prefer tax evasion over compliant behavior if they successfully undertook the project. Formally, $t > t^{eh}, t^{oe}$ holds in that case.

As the considered firms are homogeneous, they all behave in the same way. The government can influence firm behavior through its tax setting. Firms invest and behave compliant in the country if t is set sufficiently low, i.e. for $t \leq t^{oh}, t^{eh}$. Graphically, the black t^{oh}- and the dark grey t^{eh}-curves determine the upper boundary of the H-area in Figure 2.

Depending on the value of $1-s$ (and on the other determinants of t^{eh} (5) and t^{oh} (7)), either the outside option or the possibility to evade is more attractive to firms. Thus, either the t^{oh}- or the t^{eh}-threshold defines the maximum tax rate the country can implement while still inducing firms to initiate the investment project and subsequently behave compliant. In particular, firms prefer evasion over the outside option if $t^{oh} > t^{eh}$, which holds if $1-s$ is sufficiently high. In Figure 2, this applies to all points lying to the right of the intersection of the t^{oh}- and the t^{eh}-curve. The reason is obvious: the higher the corruption level $1-s$, the higher the expected profit in case of evasion $\hat{\pi}^e$ (2). That is, a high value of $1-s$ makes investment with subsequent tax evasion in the country more attractive to firms. Accordingly, t^{eh} is decreasing in $1-s$, while t^{oh} is independent of this parameter. As a consequence, the E-area in Figure 2 emerges once $t^{oh} > t^{eh}$ holds and (then) becomes larger for higher values of $1-s$.

A key result of our analysis is the following. If $t^{oh} > t^{eh}$ holds, it may be optimal for a country (the government) to *tolerate evasion* if the expected revenue from fines on detected bribery is sufficiently high. Accordingly, we may distinguish between three different tax policies, or country types. The first type, type 1, refers to all cases where

$t^{oh} \leq t^{eh}$. Then, tax evasion is no relevant alternative for firms and, hence, can be *ignored* by the country's government when setting the tax rate. Instead, the maximum attainable tax rate depends on firms' outside option and equals t^{oh}.[18] By contrast, firms' possibility to evade affects the tax setting of the second and third country type, for which $t^{oh} > t^{eh}$ holds. In such countries, firms will engage in evasion if the tax rate is too high. A country's government may implement a maximum tax rate equal to t^{eh}, making evasion unprofitable and, thus, inducing firms to behave compliant (cf. equation (4)). We refer to such a country that *combats* evasion as type 2. Alternatively, a country's government can *tolerate* tax evasion and settle for revenue from fines on detected bribery. When doing so, it is able to set a tax rate higher than t^{eh}. However, it has to make sure that firms' expected profit from attempted bribery in the country is at least as high as their outside option (cf. equation (6)). Therefore, the tax rate in a type 3 country must not exceed the threshold value t^{oe}. To summarize, the three country types are

1. **Ignoring tax evasion**[19] (since it is not a serious problem): Outside option of compliant firms as limiting factor ($t^{oh} \leq t^{eh}$). The (limit) tax rate is t^{oh} (7) and increasing (decreasing) in Π, p_s (π^o), and independent of w, m, s, p, λ.

2. **Combating tax evasion**: Tax evasion as limiting factor. (Limit) tax rate is t^{eh} (5) and increasing (decreasing) in w, m, s, p, λ (Π), and independent of p_s, π^o.

3. **Tolerating tax evasion**: Outside option of evading (!) firms as limiting factor. Government tolerates evasion, (expected) revenue stems from fines on detected evaders. (Limit) tax rate is t^{oe} (6), and increasing (decreasing) in Π, p_s ($\pi^o, w, m, s, p, \lambda$).

It is worthwhile for a country to combat evasion if

$$E[R]^{eh} \geq E[R]^{oe}, \tag{8}$$

where $E[R]^{eh}$ ($E[R]^{oe}$) denotes the expected tax revenue of a type 2 (3) country. As mentioned above, tax revenue stems from fines on detected bribery in type 3 countries. Thus, tax revenue depends directly on the expected penalty $q\lambda$. In particular, the

[18] Suppose that firms are internationally mobile. Then, their outside option is determined by other countries' tax rates and we may state that type 1 countries engage in "ordinary" tax competition. See Letsche (2019), for more details.

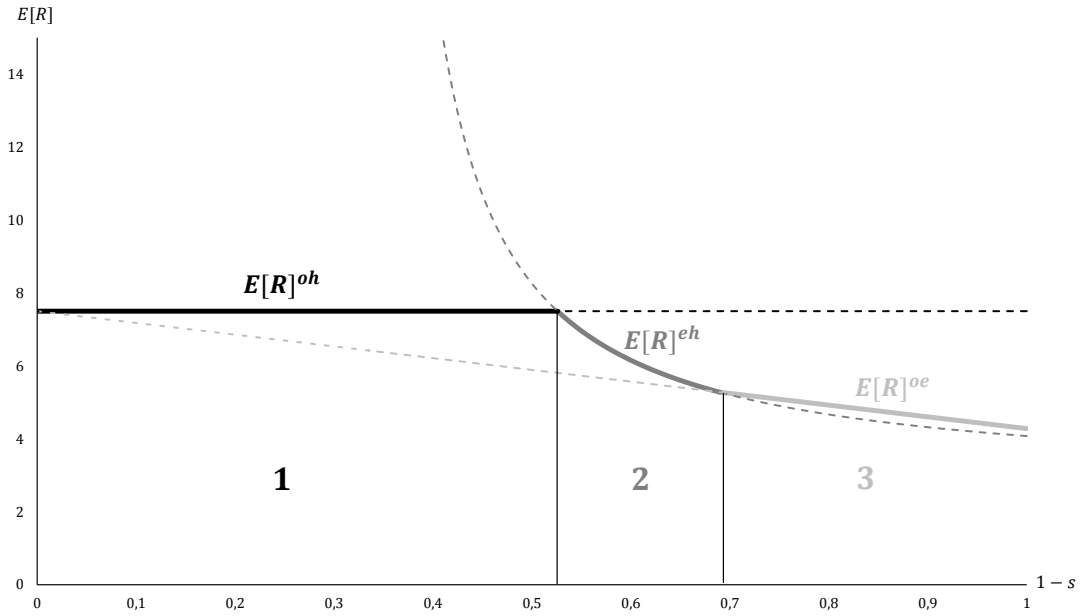
[19] Note that such countries may of course take measures to combat corruption. If this is successful, it would reflect in s, for example.

expected tax revenue is

$$E[R] = \begin{cases} E[R]^{oh} = \max\{t^{oh}E[\Pi], 0\} = \max\{p_s\Pi - \pi^o, 0\} & \text{for type 1} \\ E[R]^{eh} = t^{eh}E[\Pi] = \frac{p_s(1-s)B^*}{1-q\lambda} & \text{for type 2} \\ E[R]^{oe} = q\lambda t^{oe}E[\Pi] = p_s(\Pi - (1-s)B^*) - \pi^o & \text{for type 3.}[20] \end{cases} \tag{9}$$

Figure 3 plots $E[R]$ against $1-s$ and illustrates, together with Figure 2, how corruption influences tax rate, expected revenue, and type of a country.

Figure 3: Country types and corresponding expected tax revenue.



The expected tax revenue is, c.p., lower and decreasing in $1-s$ for country types 2 and 3. This can be seen from equation (9) and Figure 3. In such countries, evasion constitutes an obstacle to tax policy and limits governments' ability to raise revenue. This problem is more severe, the more widespread corruption is.

Note, however, that the optimal tax policies of type 2 and type 3 countries differ fundamentally. As argued above, type 2 countries combat evasion by setting their tax rate low enough to induce compliant behavior by firms. By contrast, type 3 countries tolerate evasion to some extent, which allows them to charge a relatively high tax rate. Consequently, as tax evasion is more attractive to firms if the corruption level is high ($\partial\hat{\pi}^e/\partial(1-s) > 0$), the tax rate t^{eh} (t^{oe}) is decreasing (increasing) in $1-s$ in type 2 (3) countries (cf. Table 1).

[20] Given the definition of the three country types, $q\lambda t^{oe}E[\Pi] > 0$ always holds for country type 3.

2.4 Tax-setting behavior of different countries in light of the theory

Table 1 summarizes the effects of different tax determinants for each country type. The impact of the respective variable on the tax rate depends on the specific tax-setting regime and, thus, may differ across countries.

Table 1: *Tax rate determinants*

	1. ignore	2. combat	3. tolerate
	t^{oh}	t^{eh}	t^{oe}
Π	+	-	+
π^o	-	o	-
s	o	+	-
p	o	+	-
λ	o	+	-

Given our model setup, investment in a country is more attractive to firms if the associated gross profit Π is relatively large, compared to the outside option π^o. Thus, t^{oh} (7) and t^{oe} (6), the maximum tax rates that can be charged in regimes 1 and 3 (under which the government is limited by firms' outside option), respectively, are increasing (decreasing) in Π (π^o). By contrast, firms' incentives to evade limits the tax rate t^{eh} (5) in the 'combating-tax-evasion' regime. Accordingly, we find a positive relationship between country-specific rents Π and the tax rate for regimes 1 and 3, whereas a higher rent implies larger tax savings in case of evasion and a lower threshold t^{eh} for the second regime. By contrast, we expect the impact of π^o on the tax rate to be negative (for country types 1 and 3) or zero (for country type 2).

It is worth noting that countries operating under the 'tolerating-tax-evasion' regime tend to be characterized by rather large location-specific rents. This follows from (5) and (8). Making use of (8), we can determine the maximum gross profit level for which a country prefers the 'combating-tax-evasion' regime over the 'tolerating-tax-evasion' regime, $\overline{\Pi}$, as

$$E[R]^{eh} \leq E[R]^{oe} \;\Leftrightarrow\; \Pi \leq \overline{\Pi} \equiv \frac{\pi^o}{p_s} + \left(1 + \frac{1}{1 - q\lambda}\right)(1 - s)B^*. \tag{10}$$

Thus, for a country to operate under the 'tolerating-tax-evasion' regime, its location-specific rents Π must exceed the threshold level $\overline{\Pi}$.

The remaining parameters in Table 1, s, p, and λ, affect the expected net profit $\hat{\pi}^e$ (2) in case of tax evasion and, thus, firms' incentives to attempt bribery. High values of s and p mean that a bribe attempt is very likely to be rejected by a steadfast agent (with probability s) or discovered by the government (with probability p), and a high value of λ implies a harsh penalty in both cases. Accordingly, $\hat{\pi}^e$ (2) is decreasing in s, p, and λ. The associated effect on the tax rate is different for each tax-setting regime. Tax evasion and, consequently, (small) changes in $\hat{\pi}^e$ can be ignored by countries operating under the first regime. By contrast, countries in the second regime combat tax evasion. This means that they have to adjust their tax rate whenever firms' incentives to evade changes. If $\hat{\pi}^e$ is reduced (due to an increase of s, p, or λ), the threshold tax rate t^{eh} (5), for which firms still behave compliant, becomes higher and the government can charge a higher tax. In sharp contrast to the first and, in particular, the second regime, the third one is characterized by a tax policy that tolerates evasion. Countries operating in this regime are limited in their tax setting by evading firms' outside option π^0. Thus, an increase of s, p, or λ, implying that tax evasion becomes less worthwhile as $\hat{\pi}^e$ is reduced, forces such countries to reduce their tax rate t^{oe} (6) in order to prevent evading firms from choosing the outside option.

In sum, our theory indicates that the influence of s, p, and λ on the tax rate differs fundamentally across the three tax-setting regimes. This strongly suggests that country characteristics and, eventually, the tax-setting regime a country operates in should be taken into consideration when conducting tax-policy analysis.

3 The role of tax enforcement in revenue collection and country development

We have just argued that countries operating under the 'tolerating-tax-evasion' regime are forced to reduce their tax rate if s, p, or λ increase – in order to induce firms to invest (and evade taxes later on). The tax rate is given by t^{oe} (6) in this case. Nevertheless, as can be seen from Figure 3 and equation (9), the expected revenue $E[R]^{oe}$ of these countries depends negatively on the corruption level $1-s$ (i.e., $E[R]^{oe}$ is increasing in s). Hence, if the goal of a government is to maximize $E[R]^{oe}$, it has an incentive to reduce the corruption level $1-s$. However, doing so seems to be a challenging long-term task (at least if we think of s as being determined by moral values towards corruption within society). Instead, it seems more natural and promising for governments whose goal it is to increase revenue to make tax collection more efficient by increasing the detection probability p.

Following (9) and the definition of B^* in (1), it becomes apparent that the effect of p on a country's expected revenue $E[R]$ is different for each country type. Most notably, expected revenue of a country operating in the third regime, $E[R]^{oe}$, is decreasing in p. This means that such a country has no incentive to increase p by, for example, taking measures to improve tax enforcement or increase transparency, unless these improvements allow the country to switch the tax-setting regime it operates in.[21] By changing its tax-setting regime from 3 to 1 or 2, a country may be able to reach a higher expected revenue level $E[R]$ (9).

To see how an increase of p may allow a country of type 2 or 3 (for which $t^{oh} > t^{eh}$) to switch regime, recall that a firm's expected net profit in case of evasion, $\hat{\pi}^e$, is reduced as p rises. Tax evasion then becomes less attractive and it may no longer be the limiting factor of a country's tax setting. Formally, t^{eh} (5) rises if p is increased and it may be that $t^{oh} > t^{eh}$ no longer holds. If this is the case, the country switches from regime 2 or 3 to 1.

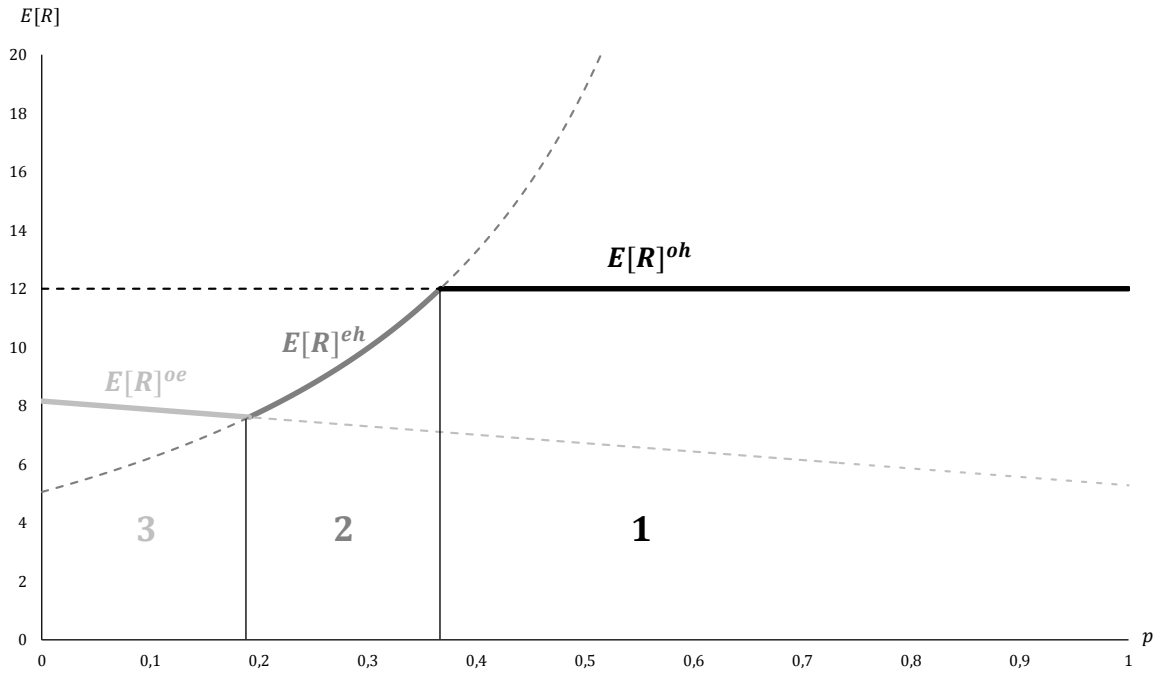
Furthermore, for a country of type 2 or 3, tax enforcement becomes stricter if p is increased, allowing the country to charge a higher tax and generate more revenue under the 'combating-tax-evasion' regime (t^{eh} (5) and $E[R]^{eh}$ (9) both increase). As a consequence, the condition for a country to operate in the second (instead of the third) regime, $E[R]^{eh} \geq E[R]^{oe}$ (8), may then be satisfied and a type 3 country may switch to the second regime and start to combat tax evasion. This is also shown by the fact that the maximum gross profit level for which a country combats evasion, $\overline{\Pi}$ (10), becomes larger as p increases ($\partial\overline{\Pi}/\partial p > 0$).

Figure 4 illustrates the effect of an increase in p on $E[R]$. The figure can be interpreted as follows. For low values of p, tax enforcement is too weak to make combating evasion worthwhile: the country is in the 'tolerating-tax-evasion' regime. As argued above, $E[R]$ (9) is decreasing in p for this part of the function, i.e. for countries in the third regime. Better tax enforcement (a higher level of p) does not translate into higher expected revenue for these countries because they are forced to reduce their tax rate as the threshold t^{oe} (6) declines (cf. Table 1). Instead, a higher detection probability p reduces the expected tax revenue $E[R]^{oe}$.[22]

[21] Mardan (2018) obtains a similar result in the context of corporate profit shifting.

[22] An increase in p reduces t^{oe} (6) in two ways: by increasing the expected penalty $q\lambda$ and the bribe payment B^*. Given that the expected revenue of type 3 countries $E[R]^{oe} = q\lambda t^{oe} E[\Pi]$ is proportional to both $q\lambda$ and t^{oe}, the direct increase of $E[R]^{oe}$ and the indirect reduction via t^{oe} that are induced by a raise of $q\lambda$ offset each other, implying that $E[R]^{oe}$ declines as p increases (due to the additional reduction of t^{oe} via a higher B^*).

Figure 4: Probability of detection and expected revenue



While $E[R]^{oe}$ is decreasing in p, t^{eh} (5) and $E[R]^{eh}$ (9) are increasing in this variable. That is, combating evasion becomes more rewarding as tax enforcement becomes stricter. Once p is sufficiently high for $E[R]^{eh} \geq E[R]^{oe}$ (8) to hold, the country switches from tolerating to combating evasion, i.e. from regime 3 to 2. This is illustrated by the first kink of the $E[R]$-function in Figure 4.

Unlike countries operating under the 'tolerating-tax-evasion' regime, countries in the 'combating-tax-evasion' regime have a clear incentive to take measures in order to improve tax enforcement, as t^{eh} and $E[R]^{eh}$ are increasing in p. Accordingly, the second, dark grey part of the $E[R]$-function, which captures all values of p for which the country operates in regime 2, is upward-sloping in Figure 4.

The second kink point of the $E[R]$-function in Figure 4 describes the level of p for which

$$E[R]^{eh} = E[R]^{oh} \;\Leftrightarrow\; t^{eh}E[\Pi] = t^{oh}E[\Pi] \;\Leftrightarrow\; t^{eh} = t^{oh} \tag{11}$$

holds. From this point, evasion is no longer the limiting factor of taxation and the country switches from regime 2 to 1, i.e. from combating to ignoring tax evasion.[23]

[23] As p rises, t^{eh} and $E[R]^{eh}$ rise as well, while t^{oh} and $E[R]^{oh}$ remain constant (cf. Table 1 and equation (9)). Thus, eventually, $E[R]^{eh} = E[R]^{oh}$ (11) is satisfied.

Under the 'ignoring-tax-evasion' regime, the country's tax rate t^{oh} (7) and expected revenue $E[R]^{oh}$ (9) are independent of the detection probability p. Therefore, the third, black part of the $E[R]$-function is parallel to the x-axis in Figure 4. The figure also shows that expected revenue $E[R]$ is always higher under regime 1, compared to regime 2 and 3. The same holds true, to a large extent, for regime 2 (compared to regime 3).

This highlights the importance of strict tax enforcement for raising sufficient revenue, as it shows that establishing a system of efficient tax collection is an essential part of a country's economic development. However, the above findings also suggest a lack of incentive for countries operating under the 'tolerating-tax-evasion' regime to increase tax enforcement. The reason is that, for these countries, improvements on tax enforcement (implying an increase in p) do not translate into higher expected tax revenue $E[R]$ (9), unless they are associated with a change of the tax-setting regime (from regime 3 to 2). To achieve this, however, it may take several costly steps, or a *big push*, towards better tax enforcement until a country eventually benefits from such an improvement (that is, until (8) holds). Thus, countries operating under the third regime may be unwilling to adjust their current system of tax collection and, therefore, are in danger of never being able to effectively combat tax evasion, raise sufficient revenue, and limit bureaucratic corruption. Such an outcome seems to be particularly likely for resource-abundant developing countries. The latter are often characterized by weak institutions, widespread corruption, and high location-specific rents, making them very likely to be, and get stuck, in the 'tolerating-tax-evasion' regime.

Taken together, our results suggest that, above all, it is through a *big push* in terms of tax enforcement that these countries will have the best prospects of escaping the curse of the 'tolerating-tax-evasion' regime. In this sense, our analysis provides an optimal tax perspective on the resource curse of developing countries.

4 Empirical assessment

In light of the insights presented in Section 3, we now proceed to an empirical assessment of some core predictions of our theoretical model and particulary the *big push* hypothesis stated above. In this regard, it is important to note that our empirical results should be interpreted as suggestive evidence only. While we do not claim to capture causal relations, we do find robust evidence for an empirical pattern which reinforces the theoretical predictions and their policy implications: if countries want to increase tax revenue, they should aim for improved institutional quality and more efficient tax collection in general, and stricter enforcement of tax law in particular.

As for the latter, and consistent with our theoretical results, we find that a potentially positive relationship between tax revenue and more rigorous tax enforcement is non-monotonic. Our results indicate that only those countries which put in great (and persistent) efforts in improving tax collection benefit in terms of substantially increased tax revenue.

4.1 Data and empirical specification

We base our empirical analysis on a comprehensive dataset containing information on 128 countries and the time period 2005 to 2014. We combine data from various sources. Corporate income tax revenue in % of GDP ($TAX\ REVENUE_{c,t}$) is taken from the IMF's World Revenue Longitudinal Data (WoRLD); statutory tax rates ($TAX_{c,t}$) are taken from Steinmüller et al. (2019). Moreover, we use the number of DTTs ($NDTT_{c,t}$) concluded in a country for a given year as a measure of tax enforcement. In the spirit of our theoretical framework, this variable should capture the probability of detecting tax evasion. $NDTT_{c,t}$ is based on own calculations, the respective information is taken from UNCTAD.[24] Further country-specific determinants of tax revenue are taken from two sources: (i) the World Bank's World Development Indicator (WDI) database: the share of total natural resource rents in % of GDP ($TORS_{c,t}$), (log of) GDP per capita ($log\ GDPPC_{c,t}$), (log of) GDP ($log\ GDP_{c,t}$), GDP growth per capita ($GROWTH_{c,t}$), and (ii), the IMF's World Economic Outlook (WEO) database: government debt in % of GDP ($DEBTRATIO_{c,t}$) and total public expenditure in % of GDP ($PUBLICEXP_{c,t}$).

We estimate the following linear regression model:

$$TAX\ REVENUE_{c,t} = \alpha + \beta TAX_{c,t} + \gamma TAX_{c,t}^2 + \delta TORS_{c,t} + \zeta NDTT_{c,t} + \eta BIGPUSH_{c,t} + \boldsymbol{\theta}\mathbf{X}_{c,t} + Y_t + \epsilon_{c,t}. \quad (12)$$

Equation (12) implies that, in all specifications, we assume tax revenue to depend on the tax rate, the squared term of the tax rate,[25] natural resource rents and the number of DTTs concluded. Moreover, we include the vector $\mathbf{X}_{c,t}$, which contains different

[24] Information on the number of DTTs concluded is available for a large number of countries. Moreover, compared to other measures of institutional quality such as the various corruption indices and rule-of-law estimates frequently used in the literature, we prefer the number of DTTs as a proxy because (i) it can be directly influenced by policy-makers' decisions and (ii) it is a variable which is not based on individual perceptions and judgments.

[25] This captures the notion of the Laffer-Curve, which suggests an inverse-U-shaped relationship between the statutory corporate tax rate and tax revenue (Steinmüller et al., 2019).

country-specific determinants of tax revenue, depending on the respective specification (see Tables 2, 3 and 4 below), and aggregate year effects (Y_t).

The main variable of interest for our purpose is $BIGPUSH_{c,t}$. The latter is an interaction of a dummy for countries with a high (above median) share of natural resource rents ($HIGH\,TORS_{c,t}$) and a dummy for being in the upper 15 percent of the distribution of the change in the number of DTTs, $\Delta NDTT_{c,t}$ ($HIGH\;\Delta NDTT_{c,t}$):[26]

$$BIGPUSH_{c,t} = HIGH\,TORS_{c,t} \times HIGH\;\Delta NDTT_{c,t} \tag{13}$$

Hence, the coefficient η reflects the additional revenue effect for the subset of resource-rich countries which have newly concluded a disproportionately high number of DTTs in the past year. In other words, we interpret $BIGPUSH_{c,t}$ as a variable that captures those resource-rich countries that are likely in the 'tolerating-tax-evasion' regime and have put a lot of effort in fixing institutions and particularly tax-law enforcement.

4.2 Results

Our estimation results are displayed in Table 2. In all specifications, we employ corporate income tax revenue in % of GDP as dependent variable and relate it to various sets of determinants.[27]

[26] Note that in Table 4 below, we prove the robustness of our results against using alternative definitions of the *big push* indicator, employing (i) a dummy for being in the upper 25 rather than 15 percent of the $\Delta NDTT_{c,t}$ distribution, and (ii) a dummy for countries with natural resource rents in the upper 40 (30) rather than 50 percent of the $TORS_{c,t}$ distribution.

[27] Moreover, in all specifications presented in Tables 2, 3 and 4, we (i) cluster the standard errors of the coefficients at the country level, and (ii) account for outliers potentially biasing the estimation results by omitting the observations with the 3% largest values of $TAX\,REVENUE_{c,t}$ and $TORS_{c,t}$, respectively. In this regard, however, our results prove robust against a 1% and 2% outlier treatment.

Table 2: Determinants of tax revenue: main results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$TAX_{c,t}$	14.99***	15.18***	19.12***	15.15***	19.33***	19.44***	19.68***	20.01***
	(5.354)	(5.277)	(6.283)	(5.267)	(6.213)	(6.364)	(6.180)	(6.386)
$TAX^2_{c,t}$	-24.63**	-25.24**	-31.18**	-24.52**	-30.40**	-30.37**	-31.56**	-32.24**
	(11.50)	(11.28)	(12.96)	(11.69)	(13.01)	(13.20)	(13.00)	(13.34)
$TORS_{c,t}$	0.0431*	0.0447*	0.0592**	0.0475*	0.0608**	0.0621**	0.0628**	0.0656**
	(0.0250)	(0.0247)	(0.0242)	(0.0264)	(0.0241)	(0.0242)	(0.0253)	(0.0257)
$NDTT_{c,t}$	0.00448	0.00414	-0.00750	0.00643	-0.00423	-0.00154	-0.00446	-0.00145
	(0.00356)	(0.00376)	(0.00471)	(0.00612)	(0.00622)	(0.00710)	(0.00623)	(0.00717)
$BIGPUSH_{c,t}$	0.897**	0.908**	0.850**	0.905**	0.843**	0.817**	0.848**	0.821**
	(0.434)	(0.432)	(0.427)	(0.426)	(0.410)	(0.396)	(0.410)	(0.395)
$GROWTH_{c,t}$		-0.0120			0.0360	0.0271	0.0390	0.0304
		(0.0293)			(0.0274)	(0.0257)	(0.0252)	(0.0241)
$log\, GDPPC_{c,t}$			0.668***		0.716***	0.740***	0.721***	0.752***
			(0.167)		(0.170)	(0.177)	(0.171)	(0.180)
$log\, GDP_{c,t}$				-0.0498	-0.0820	-0.116	-0.0833	-0.124
				(0.118)	(0.100)	(0.109)	(0.101)	(0.113)
$PUBLICEXP_{c,t}$						-0.0116		-0.0136
						(0.0142)		(0.0150)
$DEBTRATIO_{c,t}$							0.00146	0.00237
							(0.0045)	(0.0046)
Constant	0.4414	0.5046	-6.0552***	1.5816	-4.8392*	-3.9142	-4.9354*	-3.9134
	(0.7399)	(0.7999)	(1.7317)	(2.7917)	(2.9143)	(2.9976)	(2.8718)	(3.0194)
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	947	947	947	947	947	947	947	947
Adj. R-squared	0.1076	0.1074	0.2015	0.1094	0.2073	0.2095	0.2070	0.2100

Standard errors clustered at the country level in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% level.

Table 2 provides three main insights, which are in line with some key predictions from our theoretical framework. First, we see that tax rates are a very important determinant of tax revenue. The coefficients of both $TAX_{c,t}$ and $TAX^2_{c,t}$ are highly significant throughout all specifications, with signs suggesting an inverse-U-shaped Laffer-Curve relationship between statutory tax rate and revenue. Second, our estimates indicate that there is a positive link between tax revenue and a country's level of natural resource rents ($TORS_{c,t}$). This pattern in the data seems to be very robust against the inclusion of a wide range of different control variables. Third, and most importantly, the results reinforce our theoretical finding that the role of tax enforcement is non-monotonic: significant revenue effects are only discernible if a country has experienced a *big push* towards improved tax enforcement. Moreover, the latter should

be considered in its interplay with resource rents.

In all specifications of Table 2, we include the variable $BIGPUSH_{c,t}$. In column 1, we present a parsimonious specification, only controlling for $TAX_{c,t}$, $TAX^2_{c,t}$, $TORS_{c,t}$ and $NDTT_{c,t}$. Including $NDTT_{c,t}$ allows us to assess whether there is a universal, linear effect of the number of concluded DTTs on tax revenue. In the next four columns, we gradually include $GROWTH_{c,t}$, $log\ GDPPC_{c,t}$ and $log\ GDP_{c,t}$. We do so to capture (i) time-variant determinants of tax revenue and (ii) cross-sectional differences between countries, which may both be significant drivers of corporate tax revenue. Last, in columns 6 to 8, we additionally control for two fundamentals of public sector activity: the level of public expenditures ($PUBLICEXP_{c,t}$) and government debt ($DEBTRATIO_{c,t}$), both measured in % of GDP.

Considering our estimation results on the role of tax enforcement, we do not find a significant effect of $NDTT_{c,t}$ on tax revenue in any of the specifications in Table 2. This means that there is no evidence for a positive impact of a *marginal* increase in the number of DTTs concluded. Rather than that, we find robust evidence for significant and positive revenue effects of a *big push* with respect to tax enforcement. More specifically, we estimate that being in the subset of resource-abundant countries which have concluded disproportionately many DTTs in the past year is, on average, associated with an increase in the corporate-tax-revenue-to-GDP-ratio by 0.817 to 0.908 percentage points compared to those countries which have not experienced a *big push*. In absolute numbers, given an average GDP of 1.38 trillion USD and a corporate tax revenue of 47.6 billion USD in this subset of countries, this amounts to additional revenue of 11.27 to 12.53 billion USD.

We assess the robustness of our main results in Table 2 in a series of alternative specifications, addressing two potential concerns about how to identify the effect of stricter tax enforcement. First, we consider the estimations where we control for a wide range of country-specific economic fundamentals, presented in columns 5 to 8 in Table 2. However, instead of controlling for the number of DTTs in place in a country ($NDTT_{c,t}$) as in Table 2, we now control for the change in the number of DTTs, $\Delta NDTT_{c,t}$ (columns 1 to 4 in Table 3). Doing so, we are able to analyze whether marginal changes in $\Delta NDTT_{c,t}$ rather than in the level of DTTs concluded have a significant effect on tax revenue.

The estimation results in Table 3 show, however, that there is no distinct revenue effect of a marginal increase in $\Delta NDTT_{c,t}$. This result also holds if we control for both the level of and the change in the number of DTTs in place (columns 5 to 8 in Table 3). Moreover, these alternative specifications prove the robustness of the coefficient on

$BIGPUSH_{c,t}$. The estimates indicate that we maintain a positive revenue effect of a *big push* towards stricter tax enforcement (significant at the 10% level). Note that this is strong evidence for a '*big-push* effect', as $BIGPUSH_{c,t}$ is a function of $\Delta NDTT_{c,t}$.

Table 3: Determinants of tax revenue: robustness ($\Delta NDTT_{c,t}$)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$TAX_{c,t}$	20.17***	20.65***	20.51***	21.48***	20.48***	20.67***	20.92***	21.48***
	(6.077)	(6.445)	(5.994)	(6.477)	(6.246)	(6.426)	(6.212)	(6.463)
$TAX^2_{c,t}$	-32.52**	-33.39**	-33.66***	-36.07***	-33.45**	-33.45**	-34.94***	-36.09***
	(12.96)	(13.51)	(12.77)	(13.65)	(13.26)	(13.47)	(13.24)	(13.62)
$TORS_{c,t}$	0.0661***	0.0652***	0.0684***	0.0703***	0.0629**	0.0650**	0.0656**	0.0702***
	(0.0244)	(0.0239)	(0.0258)	(0.0254)	(0.0251)	(0.0249)	(0.0264)	(0.0266)
$\Delta NDTT_{c,t}$	0.0379	0.0550	0.0382	0.0584	0.0480	0.0554	0.0490	0.0586
	(0.0450)	(0.0427)	(0.0447)	(0.0414)	(0.0439)	(0.0421)	(0.0432)	(0.0407)
$NDTT_{c,t}$					-0.00433	-0.000354	-0.00462	-0.000180
					(0.00641)	(0.00728)	(0.00643)	(0.00740)
$BIGPUSH_{c,t}$	0.759*	0.703*	0.762*	0.700*	0.757*	0.704*	0.761*	0.701*
	(0.425)	(0.417)	(0.425)	(0.414)	(0.433)	(0.413)	(0.432)	(0.410)
$log\, GDP_{c,t}$	-0.117	-0.128	-0.121	-0.139*	-0.0740	-0.124	-0.0761	-0.137
	(0.0790)	(0.0798)	(0.0816)	(0.0819)	(0.105)	(0.113)	(0.106)	(0.117)
$GROWTH_{c,t}$	0.0422	0.0239	0.0457*	0.0288	0.0381	0.0240	0.0422	0.0288
	(0.0275)	(0.0260)	(0.0251)	(0.0248)	(0.0281)	(0.0258)	(0.0262)	(0.0245)
$log\, GDPPC_{c,t}$	0.630***	0.710***	0.632***	0.727***	0.678***	0.712***	0.684***	0.728***
	(0.152)	(0.177)	(0.152)	(0.182)	(0.177)	(0.185)	(0.179)	(0.189)
$PUBLICEXP_{c,t}$		-0.0180		-0.0209		-0.0176		-0.0207
		(0.0126)		(0.0133)		(0.0145)		(0.0155)
$DEBTRATIO_{c,t}$			0.00151	0.00337			0.00189	0.00337
			(0.0046)	(0.0045)			(0.0044)	(0.0045)
Constant	-3.310	-3.1827	-3.3249	-3.1962	-4.0796	-3.2977	-4.7924	-3.2546
	(2.1495)	(2.1587)	(2.1263)	(2.1363)	(3.0796)	(3.1535)	(3.0502)	(3.2002)
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	835	835	835	835	835	835	835	835
Adj. R-squared	0.2016	0.2104	0.2013	0.2126	0.2035	0.2095	0.2036	0.2116

Standard errors clustered at the country level in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% level.

Second, we prove that our main results are robust against alternative definitions of our *big push* indicator. To this end, we construct $BIGPUSH^{A1}_{c,t}$ (Alternative 1, A1), $BIGPUSH^{A2}_{c,t}$ (Alternative 2, A2), and $BIGPUSH^{A3}_{c,t}$ (Alternative 3, A3). $BIGPUSH^{A1}_{c,t}$ defines the subset of countries (i) with an above median share of natural resource rents; (ii) which are in the upper 25 (rather than 15) percent of the $\Delta NDTT_{c,t}$ distribution. Hence, this can be seen as a less restrictive way of identifying countries which have experienced a *big push*, i.e., countries pursuing enhanced efforts

in improving tax collection. In addition to this modification, in $BIGPUSH^{A2}_{c,t}$ and $BIGPUSH^{A3}_{c,t}$, we alter the definition of a resource-abundant country. More precisely, $BIGPUSH^{A2}_{c,t}$ ($BIGPUSH^{A3}_{c,t}$) determines the subset of countries with natural resource rents in the upper 40 (30) percent of the resource rents distribution and $\Delta NDTT_{c,t}$ in the upper 25 percent. We use our preferred specifications from the last three columns of Table 2 and employ the alternative *big push* definitions explained above. Table 4 presents the estimation results in this regard.

Table 4: Determinants of tax revenue: robustness (alternative *big push* definitions)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$TAX_{c,t}$	19.74***	20.00***	20.33***	19.59***	19.82***	20.15***	19.20***	19.39***	19.72***
	(6.520)	(6.341)	(6.544)	(6.501)	(6.321)	(6.521)	(6.419)	(6.238)	(6.429)
$TAX^2_{c,t}$	-30.90**	-32.15**	-32.82**	-30.70**	-31.83**	-32.52**	-29.83**	-30.84**	-31.51**
	(13.49)	(13.28)	(13.61)	(13.44)	(13.22)	(13.55)	(13.29)	(13.05)	(13.37)
$TORS_{c,t}$	0.0601**	0.0607**	0.0636**	0.0589**	0.0593**	0.0623**	0.0550**	0.0552**	0.0582**
	(0.0246)	(0.0257)	(0.0261)	(0.0246)	(0.0256)	(0.0261)	(0.0244)	(0.0253)	(0.0258)
$NDTT_{c,t}$	-0.00112	-0.00405	-0.00104	-0.000866	-0.00380	-0.000782	-0.00109	-0.00378	-0.00101
	(0.00710)	(0.00624)	(0.00717)	(0.00713)	(0.00626)	(0.00719)	(0.00706)	(0.00624)	(0.00712)
$BIGPUSH^{A1}_{c,t}$	0.543**	0.566**	0.548**						
	(0.253)	(0.259)	(0.253)						
$BIGPUSH^{A2}_{c,t}$				0.587*	0.607*	0.586*			
				(0.317)	(0.324)	(0.316)			
$BIGPUSH^{A3}_{c,t}$							0.815**	0.845**	0.808**
							(0.336)	(0.347)	(0.333)
$GROWTH_{c,t}$	0.0269	0.0388	0.0302	0.0266	0.0385	0.0298	0.0273	0.0381	0.0302
	(0.0254)	(0.0249)	(0.0238)	(0.0254)	(0.0248)	(0.0237)	(0.0255)	(0.0247)	(0.0238)
$log\, GDPPC_{c,t}$	0.751***	0.732***	0.763***	0.746***	0.726***	0.758***	0.733***	0.714***	0.744***
	(0.179)	(0.172)	(0.182)	(0.178)	(0.172)	(0.181)	(0.179)	(0.172)	(0.181)
$log\, GDP_{c,t}$	-0.129	-0.0959	-0.137	-0.131	-0.0973	-0.138	-0.128	-0.0975	-0.135
	(0.108)	(0.101)	(0.112)	(0.109)	(0.101)	(0.112)	(0.108)	(0.101)	(0.112)
$PUBLICEXP_{c,t}$	-0.0116		-0.0136	-0.0118		-0.0137	-0.0108		-0.0126
	(0.0142)		(0.0151)	(0.0143)		(0.0152)	(0.0141)		(0.0149)
$DEBTRATIO_{c,t}$		0.00150	0.00242		0.00137	0.00229		0.00127	0.00212
		(0.00446)	(0.00459)		(0.00446)	(0.00458)		(0.00442)	(0.00454)
Constant	-3.7460	-4.7644	-3.7431	-3.6261	-4.6486	-3.6263	-3.541	-4.4719	-3.5455
	(2.9805)	(2.8859)	(3.0022)	(2.9936)	(2.8877)	(3.0123)	(2.9797)	(2.8729)	(2.0964)
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	947	947	947	947	947	947	947	947	947
Adj. R-squared	0.2085	0.2061	0.2092	0.2080	0.2053	0.2085	0.2120	0.2098	0.2124

Standard errors clustered at the country level in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% level.

One can see that the positive, additional revenue effect proves robust against these alternative definitions of the *big push* indicator. Quantitatively, the coefficients on the latter in the first six specifications are lower than before; however, this is due to the less restrictive distinction of the subset of *big push* countries and, hence, the substantially higher share of countries in this subset.[28] Moreover, the results in Table 4 reinforce the impression that there is no linear, monotonic effect of the number of DTTs concluded on tax revenue: the coefficients clearly show that there is no significant marginal effect of a change in $NDTT_{c,t}$ on tax revenue.[29]

The empirical results presented in Table 2 as well as the sensitivity checks (Table 3 and 4) have demonstrated that there is robust evidence for substantial revenue effects of a *big push* towards stricter tax enforcement. Let us finally present some descriptive evidence on the countries which, in terms of our baseline definition above, have experienced such a *big push* and are hence part of the subset for which $BIGPUSH_{c,t}$ takes the value 1. In total, there are 44 country-year observations in this group.[30] As to the latter, two interesting patterns of tax enforcement policy can be distinguished. On the one hand, there are countries for which we observe large one-time increases in the number of DTTs. This is the case, e.g., for Albania (6 newly concluded DTTs in 2010) and Bahrain (5 newly concluded DTTs in 2009). On the other hand, rather than experiencing a one-time *big push*, there are a number of countries which appear several times in the sample period. This means that these countries pursue a persistent tax policy towards stricter enforcement, with at least 2 newly concluded DTTs in several years during the sample period. This applies to, e.g., Malaysia and Mexico (4 appearances), Kazakhstan and North Macedonia (3 appearances), as well as Armenia, Bulgaria, Chile, India and Morocco (2 appearances).

It should be noted that, regardless of which of the two tax enforcement policy strategies these countries pursue, they have one thing in common. They can be characterized as newly-industrialized countries, having made a first transition from developing countries to more developed economies. In this regard, we may argue that this positive

[28] With the baseline definition of $BIGPUSH_{c,t}$ used in Table 2, there are 44 (4.6%) observations in this subset. Compared to this, using the less restrictive 75th percentile of the $\Delta NDTT_{c,t}$ distribution as in $BIGPUSH^{A1}_{c,t}$, we have 112 (11.78%) observations. Strengthening the restrictions with respect to the resource rents distribution as in $BIGPUSH^{A2}_{c,t}$ and $BIGPUSH^{A3}_{c,t}$, we have 89 (9.4%) and 67 (7.1%) observations, respectively, in the subset of *big push* countries.

[29] Similar to Tables 2 and 3, the Laffer-Curve relationship between tax rates and revenue as well as the link between natural resource rents and tax revenue is very robust throughout all specifications.

[30] Note that, as described above and illustrated in Table 4, we have also employed alternative, less restrictive definitions of the *big push* indicator, implying a higher share of countries for which we identify a *big push* in terms of tax enforcement.

economic development is often accompanied by tax-policy (including tax-enforcement regulation) reforms.[31] Note that this is perfectly consistent with our theoretical findings. From an ex-post perspective, these countries might have managed to switch the tax-setting regime and, in the end, benefit from more efficient tax collection and stricter tax enforcement in terms of increased tax revenue.

In contrast, countries with a very low level of development are not part of the subset of countries experiencing a *big push*. The least developed countries are those which, particularly from a short-run perspective, have a lack of incentive to improve tax enforcement and are therefore at risk of never being able to raise sufficient tax revenue. The example of the newly-industrialized countries clearly reveals that if countries engage in the long and costly process of improving tax enforcement, they can ultimately benefit from such an improvement. We may therefore refer to these countries as best-practice examples, demonstrating that economic development often goes hand in hand with changes in tax policy.

5 Conclusions

Bureaucratic corruption and weak fiscal institutions may encourage firms to evade taxes and limit a country's ability to raise revenue. We examine how the threat of corporate tax evasion affects a government's tax-setting behavior and demonstrate that there may be fundamental differences across countries. More precisely, we first develop a theoretical model which suggests the existence of three country types, or tax-setting regimes. Depending on the corruption level, institutional quality, and location-specific rents, a country will follow a tax policy that either (i) ignores, (ii) combats, or (iii) tolerates tax evasion. In particular, we expect countries characterized by widespread corruption, weak institutions, and high location-specific rents (e.g., due to natural resource abundance) to charge a relatively high tax and to tolerate tax evasion (to a large degree).

Furthermore, our theoretical findings demonstrate that functioning institutions and powerful tax enforcement are essential preconditions not only for raising adequate tax revenue, but also for country development as a whole. Countries characterized by widespread corruption and tax evasion may never be able to overcome these problems,

[31] However, it is important to highlight that our empirical analysis allows us to disentangle these two aspects. We control for (i) cross-sectional differences between countries with respect to a wide range of economic fundamentals and (ii) time-varying determinants of tax revenue. Hence, we are confident that the positive revenue effect of a *big push* in terms of tax enforcement is not confounded by the effect of the general economic development on tax revenue.

unless they fix the setting in which tax collection takes place, i.e., unless they put in great effort towards stricter tax enforcement. This seems to be particularly important for developing countries, especially for those with high location-specific rents, as these countries are very likely in the 'tolerating-tax-evasion' regime. Countries operating in this regime may have no incentive to increase the efficiency of tax collection, as small (but costly) improvements on tax enforcement usually do not translate into higher revenue. Thus, our model can explain why some, often resource-rich, developing countries are stuck in a regime of inefficient tax collection, widespread evasion, and a high corruption level.

We provide robust evidence for an empirical pattern which reinforces some core predictions of our theoretical model and, in particular, their policy implications. If countries want to increase tax revenue, they should aim for stricter enforcement of tax law. In line with our theoretical findings, we show that the relationship between tax revenue and more rigorous tax enforcement is non-monotonic. Our estimates show that marginal improvements on tax enforcement do not lead to a significant increase in tax revenue. Rather than that, it is only through a *big push* – substantial and/or persistent improvements towards stricter tax enforcement – that a country, in the end, benefits in terms of a sizable increase in tax revenue.

We finally illustrate which countries have experienced such a *big push* in terms of tax enforcement. Most of them are newly-industrialized countries, suggesting that a favorable economic development can and should be accompanied by improvements on tax enforcement and revenue collection. Again, this is fully consistent with our theoretical findings: these countries might have managed to switch the tax-setting regime – induced by a *big push* towards stricter tax enforcement – and finally benefit in terms of increased tax revenue. In contrast to this, in our sample, countries with a very low level of development do not experience such a *big push*. However, from a tax policy perspective, overcoming the problems related to poor tax enforcement and inefficient revenue collection proves to be an indispensable step on a country's way towards persistent growth and economic development.

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A Appendix

Table A.1: Variable definitions and sources

Variable	Definition and Source
$TAX\ REVENUE_{c,t}$	Corporate income tax revenue in % of GDP of country c in period t;
	Source: *IMF; World Revenue Longitudinal Data (WoRLD)*
$TAX_{c,t}$	Statutory corporate income tax rate of country c in period t;
	Source: Steinmüller et al. (2019)
$TORS_{c,t}$	Total natural resource rents in % of GDP of country c in period t;
	Source: *World Bank, World Development Indicator (WDI) database*
$NDTT_{c,t}$	Number of double taxation treaties concluded by country c in period t;
	Source: *United Nations Conference on Trade and Development (UNCTAD) database*
$\Delta NDTT_{c,t}$	Change in the number of double taxation treaties concluded by country c in period t;
	Source: *UNCTAD database*
$HIGH\ TORS_{c,t}$	Dummy variable equal to 1 if $TORS_{c,t}$ is above median, and 0 otherwise;
	Source: *World Bank, WDI database*
$HIGH\ \Delta NDTT_{c,t}$	Dummy variable equal to 1 if $\Delta NDTT_{c,t}$ is above the $85th$ percentile, and 0 otherwise
	Source: *UNCTAD database*
$BIGPUSH_{c,t}$	Interaction between $HIGH\ TORS_{c,t}$ and $HIGH\ \Delta NDTT_{c,t}$
	Source: *World Bank, WDI database* and *UNCTAD database*
$GROWTH_{c,t}$	GDP growth (in %) per capita of country c in period t;
	Source: *World Bank, WDI database*
$log\ GDP_{c,t}$	(log of) GDP of country c in period t;
	Source: *World Bank, WDI database*
$log\ GDPPC_{c,t}$	(log) GDP per capita of country c in period t;
	Source: *World Bank, WDI database*
$PUBLICEXP_{c,t}$	Total public expenditure in % of GDP of country c in period t;
	Source: *IMF World Economic Outlook (WEO) database*
$DEBTRATIO_{c,t}$	Government debt in % of GDP of country c in period t;
	Source: *IMF WEO database*