PROFIT SHIFTING AND CORRUPTION

Katarzyna Habu* and André Seidel**

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Abstract: This paper introduces heterogeneous profit shifting costs induced by corrupt tax officials to the analysis of profit shifting of multinationals. Using a theoretically derived corruption weighted tax differential, we show that corruption increases profit shifting of European firms. We use our estimates to calculate the implied tax revenue elasticities for European countries and find that countries with otherwise similar tax rates face lower tax revenue elasticities when they are more corrupt. This means that corruption negatively affects the revenue gains that countries could have from increasing their tax rates.

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* NBER and Oxford University Centre for Business Taxation, Saïd Business School, Park End Street, OX1 1HP, Oxford, United Kingdom and Department of Economics, Oxford University; katarzyna.habu@sbs.ox.ac.uk.

**University of Bergen, Department of Economics, P.O. 7802, 5020 Bergen, Norway; andre.seidel@uib.no, corresponding author.

1. INTRODUCTION

The issues of tax evasion and tax avoidance have gained more attention in the political and economic debates since the financial crisis. Governments in developed countries have been trying to claw back the lost tax revenues to help their economies recover. The Base Erosion and Profit Shifting (BEPS) agenda of the OECD and the diverted profits tax in the UK, accurately termed by the media as "the Google Tax", are only the most recent examples of the political interest in profit shifting of multinational companies. Recently, the OECD BEPS initiative has asked questions about the possibility of extending the debate to include the developing countries. However, one of the issues that the OECD will have to face is the presence of weak institutions in developing countries. Especially, the omnipresent corruption within the tax authorities is likely to be a large obstacle in this regard. Corruption may render the implementation of the BEPS initiative fruitless, as national enforcement institutions will simply not comply with international agreements signed by their own governments. Hence, the BEPS action plan[1] for developing countries may have to be adjusted to consider corruption among other possible factors determining the behavior of multinational companies in developing countries.

There exists plenty of anecdotal evidence on how large accounting firms help multinationals shift profits abroad. The recent revelations from Panama Papers and Paradise Papers have shed some light on the elaborate tax avoidance and evasion schemes employed by multinational companies. Especially, the case of Appleby's Mauritius office, revealed by the Paradise papers, makes clear that even developing countries loose substantial tax revenues to tax havens.[2] This is not surprising, as different international organizations have pointed out that comparison between tax administrations in developing countries and accounting divisions of multinational firms is akin to a picture of David and Goliath. They furthermore have repeatedly expressed their concern that corruption[3] and the practice of revolving tax officials[4] are serious threats to the ability of developing countries to enforce the tax liabilities collection of multinational firms. Hence, it would not be surprising that at the end of the ongoing investigation, it comes to light that some of the

[1] https://www.oecd.org/ctp/BEPSActionPlan.pdf
[2] As of today, it seems that Appleby has shifted billions of dollars of profits from firms in various African countries to or through the tax haven - Mauritius. (https://www.icij.org/investigations/paradise-papers/tax-haven-mauritius-africa/)
[3] See for example the joint report of IMF, OECD, UN and World Bank mandated at the G-20 Seoul for the G20 Summit (https://www.oecd.org/g20/summits/seoul/48993634.pdf)
[4] See for example the United Nations. Economic Commission for Africa (2015). Illicit financial flows: report of the High Level Panel on illicit financial flows from Africa. Addis Ababa, page 35.

Appleby's business was facilitated by collusion of Appleby's tax managers with tax officials in the involved African counties.

In the light of the emerging importance of tackling corruption and profit shifting in developing countries, this paper analyzes the effect of corruption in the tax administration on profit shifting of multinational companies. Our findings are novel to the literature on profit shifting and corruption, where most of the contributions analyze either the effects of taxes[5] or the effects of corruption[6] on firms' profits. In this paper we combine both strands of the literature to show how the effects of taxes on profits shifted are affected by the extent of corruption.

We build a theoretical model in which large multinational firms that are involved in profit shifting activities can encounter a corrupt tax official. The model predicts that costs of profit shifting decrease with corruption. Therefore, corruption increases total profit shifting of a multinational. Corruption also amplifies profit-shifting incentives. We find that the size of the effect of corruption on profit shifting depends on the amount of tax that can be saved shifting a unit of profit.

We test the predictions of the theoretical model by deriving a non-linear corruption adjusted tax differential, which we call *CTC*. The model implies that companies with higher corruption adjusted tax differential should report lower profits in a given country. Using a panel of firm-level data on European companies, we show that multinationals report lower profits in affiliates that face higher levels of the CTC parameter. We find that this effect is driven by both corruption and tax rate differences, which we show using the interaction effects model. The higher the corporate tax rate in a given country, the larger is the effect of corruption on profit shifting. Hence, our results confirm that a) corruption amplifies profit shifting and b) that this effect increases in the tax rate differences that define the savings obtained by shifting a unit of profit.

[5] Most of the theoretical contributions use models where a profit-shifting firm has to weight the risk and the cost of hiding profits against the gains from the reduced tax burden (see for example Dischinger and Riedel (2011), Dharmapala and Riedel (2013) or Davies et.al. (2018)). The major bulk of the empirical contributions agree that firms shift profit to affiliates in countries with lower profit tax (for excellent summaries of the literature see Feld and Heckemeyer (2011), Hanlon and Heitzman (2010) and Dharmapala (2014)). The determinants of the detection risk are understudied in the literature (noteworthy exceptions are Bilicka & Fuest (2014) who study information exchange between tax authorities and Johannesen et al (2017) who look at the effect of government quality on profit shifting).

[6] Collusion of tax payers and corrupt tax officials has, until recently, only received the attention in theoretical models focusing on the interaction between income tax evasion and corruption (Chander & Wilde, 1992; Besley & McLaren, 1993; Flatters & Macleod, 1995; Mookherjee & Png, 1995; Hindriks, Keen, & Muthoo, 1999; Marjit, Seidel, & Thum, 2017). Recently, a few studies tried to verify empirically whether these findings carry over to firms. These studies show that small and medium size firms do not necessarily suffer from corruption as they benefit from better tax evasion possibilities resulting from collusion with tax officials (Alm, Martinez-Vazquez, & McClellan, 2016; Gauthier & Goyette, 2014; Jagger & Shively, 2015; Khan, Khwaja, & Olken, 2016).

Further, we use our findings to estimate tax revenue elasticities for European countries in our sample and find that accounting for corruption creates a much higher variation in the tax revenue elasticities then previous studies have indicated. Our empirical results imply that the more corrupt the country is, the larger the effect the tax rate differential will have on the firm's reported profits in this country. For example, in Italy an increase in the statutory tax rate by 1% creates approximately 7% - 12% less tax revenue gain than in Norway. The statutory tax rate is 27.5% in Italy and 28% in Norway. This is a substantial difference, given that, without accounting for corruption, both countries would have almost the same tax revenue elasticity.

In what follows, section 2 outlines a model of profit shifting and corruption, section 3 describes the data and our estimation approach, section 4 presents the results, and section 5 concludes.

2. A SIMPLE THEORY OF PROFIT SHIFTING AND CORRUPTION

2.1. THE COSTS OF PROFIT SHIFTING IN THE PRESENCE OF CORRUPTION

A multinational group operates establishments in n countries. Let us assume that the profit generated by an affiliate of the multinational in country $i \in [0, n]$ is π_i. The profit generated in country i is taxed at the rate t_i. The multinational can shift the amount S_i of profits in and out of country i. When $S_i > 0$ the multinational shifts profits generated in country i out and when $S_i < 0$ it shifts profits generated somewhere else in. Firms are always audited by a domestic tax official after they submit their tax statement. The tax official has to evaluate whether the tax statement is in line with the tax responsibility of the firm defined by the domestic tax law and international transfer pricing agreements.[7] During the auditing process, firms have to cooperate with the tax official and dedicate a substantial amount of time and effort to defend their tax statement. These auditing costs increase considerably when firms shift profits, for example because of increasingly complicated accounting rules and numerous debates on the interpretation of tax law. Following Hines and Rice (1994) and Huizinga and Laeven (2008), we assume that the costs of a tax audit induced by profit shifting are $\gamma \cdot S_i^2/\pi_i$, with γ being a cost parameter. We therefore follow the assumption that "the marginal cost of shifting profits rises in proportion to the ratio of shifted profits to true profits" (Huizinga & Laeve, 2008). Hence, we assume that to accommodate profit

[7] The typical assumption in the literature on profit shifting is that firms manipulate transfer prices to shift profits abroad. Becker and Davies (2014) have argued that firms influence the negotiation on transfer pricing agreements between countries. The model developed in this paper extends this idea by accounting for corruption in the tax administration. However, the model developed in this paper is by far less sophisticated than the model of Becker and Davies.

shifting S_i company's accounts have to be distorted relatively little, if true profits π_i are relatively large. For simplicity, let us assume that a firm that does not shift profits does not face any auditing costs. Hence, auditing costs are always exclusively the result of profit shifting.

The tax official who audits a firm can be honest or corrupt. The corrupt tax official can offer the firm to minimize the auditing cost in exchange for a bribe B_i.[8] Let us assume, for simplicity, that a corrupt tax official can decrease the auditing costs to zero. Therefore, when a firm meets a corrupt tax official the auditing costs can be zero, when the firm and the tax official come to an agreement. In contrast, when a firm that shifts profits encounters an honest tax official, it always faces the full auditing costs. Let us further assume, without loss of generality, that tax officials face no tax auditing costs themselves and that there is no risk of detection and therefore punishment when making a deal with a corrupt official on both sides.

We start the analysis with deriving the cost of profit shifting in the presence of corruption in the tax administration. We can write the payoffs of a multinational affiliate that does not comes to an agreement with a corrupt tax official or encounters an honest tax official as[9]

$$\pi_{NB} = [\pi_i - S_i] \cdot [1 - t_i] - \gamma \cdot \frac{{S_i}^2}{\pi_i}. \qquad [1]$$

We can write the payoffs of an affiliate that comes to an agreement with a corrupt tax official as

$$\pi_B = [\pi_i - S_i] \cdot [1 - t_i] - B_i. \qquad [2]$$

The negotiation between the corrupt tax official and the firm takes place in the form of Nash bargaining, with symmetric bargaining power.[10] The joint optimization problem of a firm and a corrupt tax official is therefore

$$\max_{B_i} [B_i]^{\frac{1}{2}} \cdot [\pi_B - \pi_{NB}]^{\frac{1}{2}}. \qquad [3]$$

[8] Corrupt tax officials could, despite the legality of tax avoidance, harass firms by threatening them to increase auditing costs in the case of non-cooperation. In the case of tax evasion Marjit, Mukherjee, and Mukherjee (2000) have shown that harassment does not influence the level of tax evasion. Harassment only allows corrupt tax official to extract more bribes from firms. Firms still profit from corruption in the tax administration. The same is true, if we allow for harassment in the case of tax avoidance. However, for simplicity of notation we abstain from this effect in our analysis.
[9] As in the previous literature (see for example Huizinga and Laeve (2008)), we assume that profit shifting costs as well as bribery costs are not tax deductible. This assumption helps to reduce the calculus substantially and does not change the main implications of the model.
[10] The main result of the model does not depend on the assumption of the specific form of bargaining or the distribution of the bargaining power. This is the case because for the bargaining to be successful the bribe always has to be smaller than the bureaucracy cost.

The solution to the maximization problem of the firm and the corrupt tax official is

$$B_i^* = \frac{1}{2} \cdot \gamma \cdot \frac{{S_i}^2}{\pi_i}. \qquad [4]$$

The level of bribe increases in the size of auditing costs. From [1], [2] and [4] it follows that there is always a level of bribe a firm and the corrupt tax official can agree on, because $\pi_{NB}(S) < \pi_B(S, B^*)$. Hence, when a firm meets a corrupt tax official, it will always pay a bribe. With probability c_i, a firm meets an honest official and with probability $1 - c_i$ a corrupt tax official. Therefore, we will refer to c_i as control of corruption. The expected costs of profit shifting are

$$\frac{1}{2} \cdot [1 + c_i] \cdot \gamma \cdot \frac{{S_i}^2}{\pi_i}. \qquad [5]$$

From this, we can derive:

Lemma 1. With increasing control of corruption in the tax administration (c_i), the cost of profit shifting increases.

2.2. PROFIT SHIFTING AND CORRUPTION IN THE TAX ADMINISTRATION

Taking the cost of profit shifting in the presence of corruption as given the multinational has to decide how to allocate profits between affiliates, i.e. how much profits to shift in and out of each affiliate. From the previous assumptions and [5] we can derive the worldwide after-tax profits of a multinational.

$$\Pi = \sum_{i=1}^{n} [\pi_i - S_i] \cdot [1 - t_i] - \frac{1}{2} \cdot [1 + c_i] \cdot \gamma \cdot \frac{{S_i}^2}{\pi_i} \qquad [6]$$

The multinational chooses the profit shifted S_i to or from every affiliate to maximize the worldwide after-tax profits. Its maximization problem therefore is

$$\max_{\forall S_i, \lambda} \Pi \sum_{i=1}^{n} \left[[\pi_i - S_i] \cdot [1 - t_i] - \frac{1}{2} \cdot [1 + c_i] \cdot \gamma \cdot \frac{{S_i}^2}{\pi_i} \right] - \lambda \sum_{i=1}^{n} S_i \qquad [7]$$

where λ is the Lagrange multiplier.The first order conditions are given by

$$\frac{\partial \mathcal{L}}{\partial S_i} = \left[-[1 - t_i] - [1 + c_i] \cdot \gamma \cdot \frac{S_i}{\pi_i} \right] - \lambda = 0 \;\; \forall\, S_i. \qquad [8]$$

$$\frac{\partial \mathcal{L}}{\partial \lambda} = \sum_{i=1}^{n} S_i = 0. \tag{9}$$

From [8] and [9] we can derive the amount of profits shifted in or out of affiliate i.[11]

$$S_i = \frac{\pi_i}{\gamma \cdot [1 + c_i]} \cdot \Delta t \tag{10}$$

where $\Delta t \equiv \left[\sum_{k \neq i}^{n} \frac{\pi_k}{[1+c_k]} [t_i - t_k]\right] \cdot \left[\sum_{k=1}^{n} \frac{\pi_k}{[1+c_k]}\right]^{-1}$. From this follows

Proposition 1. *A multinational shifts more profit into (out of) an affiliate the larger (smaller) the weighted average tax differences Δt between the tax rate of the affiliate t_i and the tax rate t_k of all other affiliates.*

Proof: From [10] follows

$$\frac{\partial S_i}{\partial \Delta t} = \frac{\pi_i}{\gamma \cdot [1 + c_i]} > 0$$

More generally, [10] and Proposition 1 tell us that if the tax rate in a country is relatively low, then multinationals shift profits into that country. If the tax in a country is relatively high, then it is likely that multinationals shift profits abroad. This result is a common result in the previous theoretical and empirical literature on profit shifting (e.g. Hines and Rice (1994), Huizinga and Laeve (2008) or Fuest, Hebous, and Riedel (2011)).

The question we are interested in is how corruption in the tax administration in the country where the affiliate is located influences profit-shifting behavior of that firm. Making use of [10], we obtain the following proposition.

Proposition 2. *Increasing control of corruption in the tax administration of a country where an affiliate is located decreases profits shifted.*

Proof: To see this we can derive from [10] the effect of an increase in the control of corruption in the tax administration on profits shifted.

$$\frac{\partial S_i}{\partial c_i} = -\frac{S_i}{[1 + c_i]} \cdot \sum_{k \neq 1}^{n} \frac{\pi_k}{[1 + c_k]} \cdot \left[\sum_{k=i}^{n} \frac{\pi_k}{[1 + c_k]}\right]^{-1} \lesseqgtr 0 \text{ for } S_i \gtreqless 0$$

[11] For a detailed derivation, see Appendix A.

From Proposition 2 it follows that a country with low control of corruption in the tax administration faces more profit shifting than a country with high control of corruption in the tax administration, when both have the same tax on profits. This is the case because the costs of profit shifting decrease with corruption (Lemma 1). As a result, countries that, on average, receive profits from abroad may have no incentive to decrease corruption in the tax administration. On the other hand, countries that, on average, lose profits to foreign countries may have a strong incentive to decrease corruption in the tax administration. This may lead to a tax-enforcement competition between countries that should be addressed in future research.[12]

3. DATA AND ESTIMATION APPROACH

3.1. ESTIMATION APPROACH

Using a panel of firm-level data on European companies, we aim to quantify the joint effect of taxation and corruption on profit shifting, i.e., we test Proposition 2. The challenge, however, is that profit shifting itself is typically[13] not observable. We can only observe the reported profit of firms and therefore only indirectly test Proposition 2. Using [10] we can derive the expected reported profit of a multinational firm.

$$R\pi_i = \pi_i\left[1 - \frac{\Delta t_i}{\gamma \cdot [1 + c_i]}\right] \qquad [11]$$

After taking the logs, we can approximate this to obtain

$$\log(R\pi_i) = log(\pi_i) + log\left[1 - \frac{1}{\gamma} \cdot CTC_i\right] \approx log(\pi_i) - \frac{1}{\gamma} \cdot CTC_i. \qquad [12]$$

where

$$CTC_i \equiv \frac{\Delta t_i}{[1 + c_i]}. \qquad [13]$$

The variable CTC_i is a composite tax and corruption variable that reflects how tax and corruption drive profit shifting. It is a corruption adjusted tax differential. The true profit of a firm π_i as well

[12] For a summary of the discussion on merits of tax competition, see Konrad and Stolper (2016).

[13] Most studies use, as we do, accounting data, hence, they only indirectly study profit shifting. One of the few noteworthy exceptions is the recent study by Davies et. al. (2018) that utilizes very rare and confidential data on transfer prices of French multinationals to look at profit shifting directly.

as the corruption adjusted tax differential CTC_i cannot directly be observed given the data available. Hence, we need to find proxies for both determinants of the reported profit.

Approximating the CTC Parameter

To calculate the composite tax and corruption parameter (CTC) for all affiliates of a multinational firm we have to make some simplifications, mainly because of data availability. For this, we will use the well-known results from the previous empirical literature that are not accounted for by our theoretical analysis.

First, we do not know the true profit of all affiliates of a multinational company[14]. Therefore, we cannot, as the theory suggests, calculate size- or sales- weighted multinational average tax rates. This is a common problem in the empirical literature that focuses on the extent of profit shifting of European firms.[15] Hence, following Dischinger and Riedel, (2011) we make a simplifying assumption that each subsidiary has equal weight, so that Δt becomes $t_i - \frac{1}{n}\sum_{k\neq i}^{n} t_k$.

Second, the profit shifting literature often makes a case that it becomes more difficult to shift profits to affiliates further away in the company ownership tree. This may, for example, arise because a firm has to make several transactions for the profits to reach a distant subsidiary and these transactions may be costlier to the firm. It is likely that firms that are closer have trade relationships, for example, in the form of exchange of upstream products. In such cases profit shifting could occur by manipulating transfer prices of these existing transactions, which may decrease the cost of shifting profits.[16] Hence, firms may be more willing to shift profits to either parent company or closest subsidiary. In the empirical section we use this information to construct three different definitions of what constitutes a group of related affiliates. Subgroup A contains all firms that belong directly to the same Global Ultimate Owner (GUO) and the GUO itself; subgroup B contains all subsidiaries of the firm and its GUO and subgroup C contains all firms that have the

[14] This is the case since we only have firm level data for European firms. We know that this particular firm has affiliates in other countries, but we do not have detailed accounting information for many of those affiliates.

[15] See for example Huizinga and Laeve, (2008); Dischinger and Riedel, (2011); Dharmapala and Riedel, (2013) or Beer and Loeprick (2015). Similar to Huizinga and Laeven (2008) we could construct a sales-weighted or size-weighted corruption adjusted tax rate differential for a subsample of companies for which we have information on sales or assets of majority of their subsdiaries. This substantially limits our sample. However, similarly to Dischinger and Riedel (2011) when doing this, we find that the application of weighted differentials leads to qualitatively comparable results. These are available from the authors upon request.

[16] Davies et.al. (2018) for example shows that the bulk of tax loss form transfer price manipulation in France is coming from the actions of a few closely linked multinational firms.

same GUO as the observed firm. Figure 4 in Appendix C illustrates the definitions of the three subgroups.

Third, and related, previous literature suggests that multinational firms cannot or do not want to shift profits between all their affiliates. For example, there is evidence that multinationals have a tendency to accumulate profits in their headquarters (Dischinger, Knoll, & Riedel, 2014) that cannot be explained by tax differences alone. On the other hand, if a multinational has an affiliate in a tax haven country, profits may always be shifted directly to the tax haven, subject to Controlled Foreign Company (CFC) rules.[17] This would mean that the tax rates of other affiliates of that multinationals are not relevant.[18]

Given these considerations we use three different measures to approximate for Δt_i.[19] First, we define $\Delta t_{AV,m} \equiv t_i - \tau_{AV,m}$, where τ_{AV} is the un-weighted average of the tax rate of all affiliates belonging to subgroups m. Here subgroup m takes values A, B or C as defined above. Second, using the idea that "there is no such place as home", we define $\Delta t_{HQ} \equiv t_i - \tau_{HQ}$ where τ_{HQ} is the tax rate at the multinational firm's headquarter (HQ). Third, given a large discussion in the literature on the existence and use of tax havens we define Δt_{HAVEN} that is 1 when a tax haven is part of the multinational firm structure and is otherwise 0. We define tax haven, following Hines and Rice (1994) as a country on the OECD tax haven list.

Making use of these different definitions of Δt and [13] we obtain five different approximations for the CTC index, $CTC_{HQ}, CTC_{AV.A}, CTC_{AV.B}, CTC_{AV,C}$ and CTC_{HAVEN}. For those CTC parameters, which vary on the firm level, corruption is always measured on the country level. Table 7 in Appendix C shows descriptive statistics related to the tax difference parameters.

Approximating the Profitability of a Firm

Following Hines and Rice (1994) and Huizinga and Laeven (2008), we assume that true profit is the return on capital. Capital K_i and labour L_i are jointly employed by the firm to produce output Q_i. Output generated can be approximated by a Cobb–Douglas production function given

[17] The CFC rules are anti-avoidance provisions designed to prevent diversion of profits to low tax territories. For instance, if the UK profits are diverted to a CFC, those profits are apportioned and charged to a UK corporate interest-holder that holds at least a 25% interest in the CFC.
[18] For a detailed discussion on the use of tax haven affiliates, see for example Desai, Foley and Hines (2004) or more recently Gumpert, Hines and Schnitzer (2016).
[19] Tax rates data are taken from the CBT Tax Database.

by $Q_i = A_i \cdot L_i^{\alpha} \cdot K_i^{\varphi} \cdot e^{u_i}$ where the variable A_i is a productivity parameter and u_i is a random term. The profit generated by the firm is defined as output minus the wages paid, hence $\pi_i = Q_i - w_i \cdot L_i$. We assume that the wage w_i is equal to the marginal product of labour that is $w_i = \alpha \cdot A_i \cdot L_i^{\alpha-1} \cdot K_i^{\varphi} \cdot e^{u_i}$. Therefore the generated profit can be approximated by

$$\pi_i = [1-\alpha] \cdot A_i \cdot L_i^{\alpha} \cdot K_i^{\varphi} \cdot e^{u_i}. \quad [14]$$

Making use of this and taking the logs of [14], we get

$$log(\pi_i) = \log(1-\alpha) + \log(A) + \alpha \cdot \log(L_i) + \varphi \cdot \log(K_i) + u_i. \quad [15]$$

Substituting in [12] $log(\pi_i)$ we get the following equation that we will be estimating

$$\log(R\pi_i) = \beta_1 + \beta_2 \cdot \log(A_i) + \beta_3 \cdot \log(L_i) + \beta_4 \cdot \log(K_i) + \beta_5 \cdot CTC_i + u_i. \quad [16]$$

where $\beta_1 = \log(1-\alpha)$, $\beta_3 = \alpha, \beta_4 = \varphi$ and $\beta_5 = -\frac{1}{\gamma}$. From Proposition 1, Proposition 2 and [10] we expect β_5 to be significant and negative.

We estimate this equation using OLS and we include fixed assets and employment as time variant firm level controls for production function inputs, where the proxy for capital is log of fixed assets and the proxy for labour inputs is log of the number of employees[20]. We further include time variant macro variable characteristics, such as GDP per capita and development level of a country. This enables us to tease out the effects of tax and corruption rather than specific time varying country characteristics. Furthermore, the development level of a country might also influence firm-level productivity.

Finally, in order to account for unobserved time and firm level heterogeneities we include year and firm fixed effects in the estimated equation. Tax differences to headquarters and to average tax within the multinational group vary within firms and between years. This is the variation we explore to identify the effects of the CTC parameter on firm's profits.[21] Only for the estimations with Δt_{HAVEN} we forgo using firm fixed effects and use country fixed effects instead. This is because the tax haven dummy is constant over time within each firm due to the cross-sectional

[20] Alternative robustness specifications include logs of wages instead (results available upon request from authors).

[21] Since our identification comes from differences in tax rates over time our results are not directly comparable to Huizinga and Laeven (2008), who use a cross sectional variation in weighted tax rate differentials to show the effects of those on profit shifting. Our results are more comparable to work of Dischinger and Riedel (2011) who use a similar firm-fixed effects specification. In their estimations, the unweighted avergae tax rate differential affects the ratio of intangible profits to sales negatively, which is what we find as well for profits. The magnitude of the effect is comparable as well; for the results see Table 2, columns 3-6.

nature of the ownership database. Therefore, in those regressions the identification comes from changes in the CTC parameter within countries and over time.

3.2. DATA AND SAMPLE SELECTION

Accounting data

To test the theoretical predictions of the model we use firm level accounting data from the AMADEUS database provided by Bureau van Dijk.[22] The dataset includes unconsolidated and consolidated balance sheets and income statements of European companies in the years 2005 – 2013. We use the accounting data to obtain the firm level reported profits for the main variable of interest in our empirical analysis. Specifically, we use unconsolidated firm level data on profit and loss before tax. We also use fixed assets and employment firm level data as proxies for capital and labour inputs.

Since we consider companies with the ability to shift profits abroad, we limit our sample only to multinational companies, i.e. those firms that have affiliates abroad. Amadeus data provides us with information on ownership structure of companies, which enables us to identify multinational and domestic companies. We define a multinational as a company that has a foreign global ultimate owner or one of its subsidiaries (up to level 10) is located abroad. We also supplement that with the information on whether the global ultimate owner of that company has any foreign subsidiaries even if the company itself might not. To identify multinational companies from the domestic companies, we use ownership information where the affiliate is owned or owns more than 50% of the company.[23] Importantly, even though our data only has detailed accounting information for the European multinational affiliates, we have ownership information on subsidiaries and headquarters located anywhere in the world. The ownership information is time invariant and most of it refers to ownership status as of 2013, i.e. it comes from the most recent version of the AMADEUS dataset we have. We assume that if the company has foreign affiliates now, it had them before as well, which is a limitation of our data.

The whole Amadeus dataset contains information on 29 million firms over the sample period. Out of those 29 million firms, we have unconsolidated firm level information on 400,000 multinational affiliates for which we remove missing observations for all the variables of interest. Furthermore,

[22] Table 5 in Appendix C presents detailed information on all data sources used.
[23] We experiment with 90% and wholly owned thresholds as well, but they do not change the main results of the paper.

we remove top and bottom 1% of the sample distribution to control for the presence of outliers. Implicitly, we will exclude affiliates that have negative profit and loss before tax, fixed assets or cost of employees, since we run all the regressions in natural logarithms. After cleaning, the dataset has 757,127 observations that describe 190,070 firms. Table 6 in Appendix C summarizes the main variables of interest.

Corruption indicators

Measuring corruption is inherently difficult, because corruption captures the extent to which public power is exercised for private gain and that is unobservable. There are several measures of perception of corruption; most notably Transparency International Corruption Perception Index and Worldwide Governance Indicators Control of Corruption. Both are composite indicators, which use a wide range of source survey data and both allow comparisons across countries and over time. There are several other smaller initiatives aimed at collecting measures of more specific corruption parameters, such as for instance World Bank Enterprise Survey (WBES).

In this paper, we use two different types of corruption indicators to approximate for the effects of corruption on profit shifting. In the baseline estimation we use the well-established world governance indicator (WGI) provided by the World Bank, which is a summary measure of control of corruption based on several different sub-indicators. These sub-indicators refer to perceptions of corruption by various groups of respondents, such as individuals, firms, nongovernmental agencies, commercial business information providers and public sector organizations. Hence, among other things, the WGI improves the TI CPI methodology as it draws on substantially more data sources and is therefore less likely to be biased by the perception of a handful of experts (for more details see Kaufmann et al 2005). Using the WGI indicators as opposed to CPI ones will also enable us to discuss whether our results are related to corruption or other governance quality indicators, which are correlated with corruption. In so far as WB provides a broader measure of corruption, it is a preferred corruption indicator.[24]

To complement the general indicator, we use an indicator that more specifically captures corruption in the tax administration. It comes from the World Bank enterprise survey (WBES). The World Bank has been conducting a survey of firms since 2005 with questions related to corruption; the

[24] We have run the main specifications with the CPI indicators and the qualitative results remain unchanged, but the point estimates vary slightly, mostly due to a slightly different sample composition.

question we use as an indicator for corruption in the tax administration is “percent of firms expected to give gifts in meetings with tax officials”.

The WBES indicator captures more closely the specific form of corruption that we discuss in the theoretical model. This means that the results using WB survey indicator as a proxy for corruption can be more directly attributed to control of corruption in the tax administration, rather than corruption outside of tax administration or general quality of the government institutions. However, the disadvantage of using the WB Survey Indicators is that our sample decreases considerably; the indicator is not available for all the countries in our sample and the survey has not been conducted yearly, hence, we do not have a full balanced panel for the indicator. In contrast, the WGI control of corruption index captures all years and countries in our firm level data sample. This is why we provide results using both indicators[25].

3.3. IDENTIFYING VARIATION

Persistency of Corruption and Tax Rates in the Short Run

Using CTC allows us to account for the non-linear joint effect of the tax rate differential and the level of corruption on profit shifting. Since our main specification is a firm fixed effects regression, we rely on the variation in both tax rate differentials and corruption levels over time to identify the effects of the CTC parameter on profit shifting. To convince the reader that the effects we find come from variation in both parameters over time, in this section we discuss how CTC and each of the components of the CTC parameter evolve over time.

Corruption is known to be very persistent over time, which is why there is a debate about the capability of the existing corruption indicators to capture changes in corruption over short time spans.[26] Figure 1 (left) shows the control of corruption as reported by the WGI in 2013 on the

[25] For the list of countries and mean values of corruption indicators see Table 9 in the Appendix C.

[26] As a rule of thumb Kaufman et al (2005) defines a change of corruption as large and meaningful, if the change in control of corruption over the observation period is sufficiently large that the 90% confidence intervals for the governance indicator in subsequent periods do not overlap. In our sample period we find two countries that have recorded a large and substantial change in corruption indicator – Austria and Spain. There are others (Greece, Hungary, Italy, Romania, Serbia, Slovakia and Turkey), but they fall out of the time frame that Amadeus data provides us with. We test whether our results are robust to using only the large changes in corruption over time and we find that the regression of a change in log profits between the year in which the minimum value of corruption estimate is observed and the year in which the maximum value of corruption estimate is observed, yields positive and significant interaction effects between the change in corruption and the change in the tax rate. The estimates of the change in corruption and the change in the tax rate on their own are insignificant, but the direction of the coefficients is the same as in the baseline estimates in the paper. However, the problem is that almost all of the variation is driven by Austria (there are very few observations for Spain).

horizontal axis with the control of corruption reported in 2005 on the vertical axis. We can clearly see that control of corruption has changed in most of the countries over the analyzed time period and that the direction of the change is either for the worse or the better. The further away from the 45 degree line the country is, the larger the change in corruption; countries such as Lithuania or Macedonia have recorded the largest increases in control of corruption between 2005 and 2013, while Greece and Slovakia have recorded largest decreases in control of corruption.

When we consider yearly changes in control of corruption for selected group of countries (Figure 1, right) we can identify several large changes in the control of corruption within these countries between years e.g. Ukraine from 2008 to 2009, Spain from 2012 to 2013, Poland from 2007 to 2008 or Austria from 2007 to 2012. We also see that in some countries the change in corruption is never meaningful; e.g. Germany.[27]

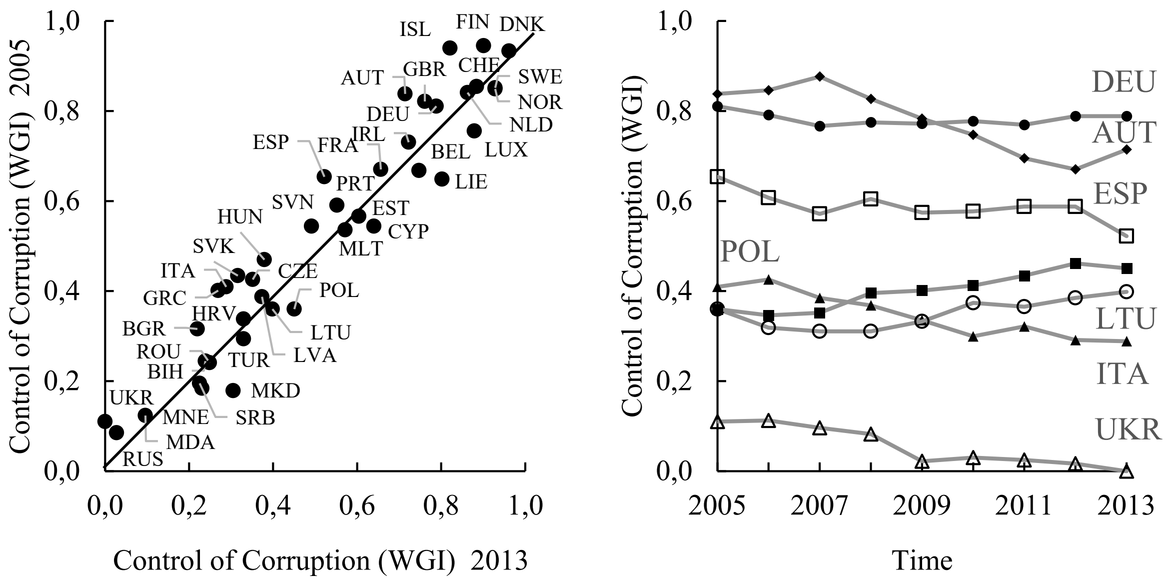

Figure 1 Change of Control of Corruption (WGI) over time

The second source of variation in the CTC parameter comes from changes in tax rate differentials over time. Note that these changes occur at the firm level, while Figure 2 illustrates the evolution over time of the average of tax rate differentials for selected countries in which affiliates of multinational companies are located; $\Delta t_{AV,C}$ (right) and Δt_{HQ} (left). Similar to the corruption

[27] Note that the changes in corruption are often correlated with the reforms effort. For instance, upon EU accession Poland has reformed its Anti-Corruption Policy, which is visible in the increasing control of corruption index from 2004 onwards. Further, Austria has introduced a package of anti-corruption reforms in 2012 in response to the falling levels of control of corruption; this has generated an immediate rebound in the corruption perception index in 2013.

indicator, tax rate differentials are also fairly persistent. For subsidiaries located in some countries, e.g. Italy, the tax rate differentials to headquarters have remained virtually unchanged over the time period. On the other hand, for subsidiaries located in Spain, Poland, Lithuania or Ukraine the tax rate differentials to headquarter have changed substantially over the sample period (Figure 2, left). As expected, the changes in the tax rate differentials over time are more pronounced when we consider the differences to the un-weighted averages of all multinational affiliates (Figure 2, right). Here, we can see yearly tax differential changes for affiliates in all countries. The comparison between the two panels in Figure 2 also highlights the importance of using various definitions of tax rate differentials. For instance, Spanish subsidiaries have on average faced decreasing tax rate differentials when comparing their tax rates to that of their headquarters; when comparing their tax rates differentials to that of the average of where all their affiliates are located, this tax rate differential was more stable (apart from 2013).

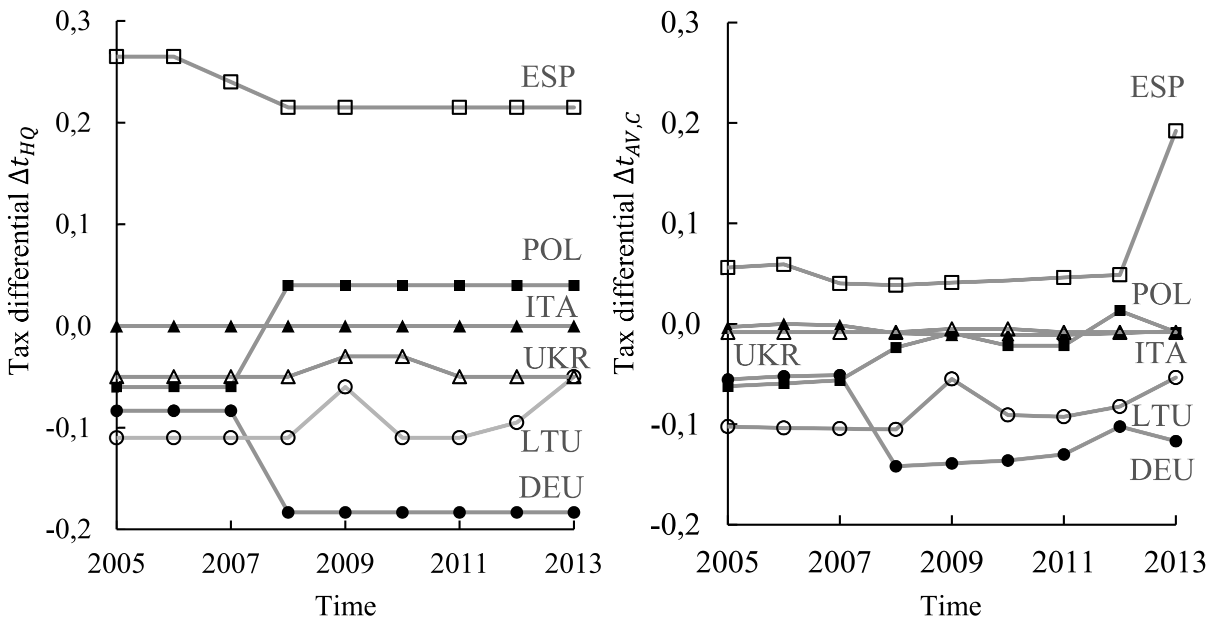

Figure 2 Change in tax rate differentials over time.

Figures 1 and 2 show that there exists a substantial variation in both corruption levels and tax rate differentials for us to be able to identify the effects of the CTC parameter on profit shifting. It is important to note here that tax rate changes on the country level as well as tax rate differential changes over time are not correlated with corruption changes. The correlation between statutory tax rate changes and control of corruption changes in countries where affiliates are located is almost zero (-0.007), similar to the correlation between changes in the tax rate differentials and changes in control of corruption (-0.02 for changes to the average tax rate differentials and -0.006 for changes to the headquarter tax rate differential). This makes us confident that the changes in the CTC parameter are driven by both corruption and tax rate differential changes, rather than strictly by tax rate differentials, as has been shown by the previous literature.

Corruption Vs. Government quality

A further important issue that is often raised when using WGI indicators is that they are a good measure of the overall government quality, but it is difficult to attribute findings specifically to, for example, the control of corruption (Johannesen et al, 2017). In the cross-section the measure of control of corruption is strongly correlated with other government quality indicators (0.75 - 0.9 correlations are typical). However, comparing the development of the governance indicators over time reveals that their movements over time are correlated to a far lower degree than the cross-sectional correlations would suggest. The correlation between changes over time in control of corruption and changes over time in other governance indicators varies from 0.08 for political stability to 0.358 for government effectiveness; these are markedly lower than the cross-section correlations.

To further support our argument that changes in various governance indicators are not correlated over time we calculate the standard deviation of the WGI indicators within countries over time to show that the variation in the control of corruption measure over time displays markedly lower correlations with Regulatory Quality (0.33), Government Effectiveness (0.46), Voice and Accountability (-0.07) and Political Stability (0.30). Since our preferred specification relies on exploring the variation over time in the control of corruption parameter, this suggests that we may actually be picking up the effects attributable specifically to changes in control of corruption and not to changes in other governance indicators.[28]

Further, we complement our estimations by using of the WBES indicator. The WBES indicator is generally far less correlated with general measures of government quality like the Regulatory Quality (0.32), Government Effectiveness (0.29), Voice and Accountability (0.19) and Political

[28] Nevertheless, the WGI indicator proxies for the overall corruption change within the country. This means we have to be careful when interpreting our result in relation to corruption in tax administration as our model suggests. We discuss this in more detail in Appendix B.

Stability (0.24) even in the cross-section. This means that the results obtained using the WBES indicator will further corroborate the ones using the WB control of corruption indicators.

4. RESULTS

4.1. REPORTED PROFITS

Table 1 shows the baseline results using equation [16] and various definitions of the CTC parameter as outlined in section 3.1. Column 1 uses the average tax rate that includes all affiliates linked to the multinational headquarter (definition C), columns 2 looks at the average tax rate defined by the HQ and all of subsidiaries of the observed firm (definition B), while column 3 looks at the average tax rate of all firms with direct link to the HQ (definition A). Column 4 uses the difference in the tax rate of the firm to its HQ and column 5 uses the tax haven dummy as a measure for the extent of profit shifting incentives. From the theory we expect the CTC parameter to be significant and negative and that is the case throughout the estimations, irrespective of what definition of the tax difference we use to construct the parameter.

These results are consistent with Proposition 1 and Proposition 2 under the assumption the corruption index used here is a good proxy for corruption in tax administration. We show that increasing CTC decreases profits reported by an affiliate. The coefficient estimates for CTC are quite stable when comparing the results with firm fixed effects in columns 1 – 4. Unsurprisingly, the estimated effect of the CTC parameter on profits is much smaller in the country fixed effects regressions.

To interpret these coefficients, let us consider the result from Column 1. Here, an increase in the CTC parameter by one unit leads to a decrease in the firm's reported profit by approximately 97%. Considering that the standard deviation in the CTC parameter is 0.027 (see Table 7 in Appendix C), this implies that a standard deviation change in the CTC parameter leads to a 2.6% decrease in the firm's reported profit. This implies a large and highly significant joint effect of taxes and corruption on reported profits.

Further, the theory model tells us that $\hat{\beta}_5$ should proxy for $-1/\gamma$. Hence, using the estimated coefficient on $\hat{\beta}_5$ and the range of $CTC_{AV,C}$ we can calculate the implied maximum and minimum size of the CTC effect (that is identical to the share of true profits shifted) on the profits reported by a firm in our sample. Using [11] and $\hat{\beta}_5 = -0.972$ implies that the effect of CTC parameter on profits varies between -19% and 16%.[29]

TABLE 1 THE EFFECT OF CORRUPTION AND TAXATION ON REPORTED PROFITS.

Definitions of CTC	(1) $CTC_{AV,C}$	(2) $CTC_{AV,B}$	(3) $CTC_{AV,A}$	(4) CTC_{HQ}	(5) CTC_{HAVEN}
capital	0.070***	0.070***	0.070***	0.070***	0.199***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)
labour	0.330***	0.330***	0.330***	0.330***	0.430***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.003)
ln(GDPpc)	1.177***	1.185***	1.177***	1.184***	1.184***
	(0.051)	(0.051)	(0.051)	(0.051)	(0.051)
CTC	-0.972***	-1.649***	-0.986***	-0.981***	-0.129***
	(0.191)	(0.246)	(0.180)	(0.135)	(0.015)
#Obs.	605,399	605,399	605,399	605,543	716,539
#Firms	152,997	152,997	152,997	153,050	181,359
R-squared	0.035	0.035	0.035	0.035	0.506

Note: Dependent variable: ln(pbt), Standard errors are clustered at the firm-country level, (***) p<0.01, (**) p<0.05, (*) p<0.1. Column (1) uses $\Delta t_{AV,C}$, column (2) uses $\Delta t_{AV,B}$, column (3) $\Delta t_{AV,A}$, column (4) Δt_{HQ} and column (5) $d\Delta t_{HAVEN}$ as a proxy for tax rate difference in the calculation of CTC. All estimates include firm and year fixed effects except column (5) that uses country and year fixed effects.

Table 2 addresses several concerns that one may have with the baseline results. Column 1 uses a different measure of corruption, column 2 includes control of corruption as a determinant of profits reported by the firm, columns 3- 6 analyze whether the effect of the CTC parameter on reported profits is driven by both tax and corruption.

The results from Column 1 are directly comparable to those from Column 1 in Table 1 as we use the same measure of tax differential here. The only difference is that we now use the WB Survey indicator to approximate for corruption. Despite the substantial decrease in the samples size, our main result remains significant. The CTC parameter negatively and significantly affects the reported profits of firms. The magnitude of the effect is larger, and in this smaller sample, one

[29] We know that the share of profits shifted should be $\hat{\beta}_5 \cdot$ CTC. Hence $CTC_{AV,C} = .162$ implies a 15.7% profits inflow and $CTC_{AV,C} = -.191$ a 18.6% profits outflow.

standard deviation increase in the CTC parameter (0.0223 see Table 7 in Appendix C) results in 7.1% decrease in the reported profits.

Column 2 accounts for the possibility that corruption might also influence profits generated by the firm directly. To see whether this might explain our results, we include the log of the control of corruption in addition to the CTC parameter the regression in Column 2. Despite the obvious multicollinearity problem, the CTC coefficient remains negative and significant. The magnitude of the coefficient is smaller and implies that one standard deviation (0,027 see Table 7 in Appendix C) increase in the CTC parameter results in the reduction of reported profits by 2.3%. For a more detailed discussion on indirect effects of corruption on profit reporting, see Appendix B.

Finally, the results from columns 3 – 6 show that the results using the CTC parameter are driven jointly by corruption and tax rate differentials. Further, they also address Proposition 2 directly, by showing how taxes affect the relationship between corruption and reported profits. Here, we use an alternative estimation approach, in which, instead of using the CTC parameter as one of the regressors, we use logarithm of control of corruption and tax rate differentials separately and include an interaction effect between the two. Hence, we estimate the following

$$\log(R\pi_i) = \beta_1 + \beta_2 \cdot \log(a) + \beta_3 \cdot \log(L_i) + \beta_4 \cdot \log(K_i) + \beta_5 \cdot \Delta t_i + \beta_6 \cdot c_i + \beta_7 \cdot \Delta t_i \times c_i + u_i \quad [17]$$

The findings presented in columns 3 - 6 in are in line with what our theory model predicts. The larger the difference between tax rates in the country where the firm is located and the tax rates abroad, the lower the profits reported by that particular firm, as predicted by Proposition 1. Further, the interaction between tax and corruption is also statistically significant and suggests that corruption has an effect on how taxes affect reported profits. The more corrupt the country is, the larger the effect the tax differential has on reported profits. In other words, corruption amplifies profit-shifting incentives, as predicted by Proposition 2.

However, we should interpret these results with caution. This is because the theoretical model implies clearly a non-liner joint effect of corruption and taxation on profit shifting. Therefore, separately estimating the effects of corruption and tax rate differentials may mean that the model is miss-specified.

TABLE 2 ROBUSTNESS

Definitions of CTC	(1) $CTC_{AV,C}$	(2) $CTC_{AV,C}$	(3) $CTC_{AV,C}$	(4) CTC_{HQ}	(5) CTC_{HAVEN}	(6) $CTC_{AV,C}$
capital	0.134***	0.069***	0.070***	0.071***	0.198***	0.134***
	(0.009)	(0.003)	(0.003)	(0.003)	(0.002)	(0.009)
labour	0.354***	0.326***	0.330***	0.330***	0.430***	0.351***
	(0.018)	(0.006)	(0.006)	(0.006)	(0.003)	(0.018)
log(GDPpc)	1.331***	1.136***	1.151***	1.143***	1.087***	1.211***
	(0.189)	(0.051)	(0.055)	(0.055)	(0.054)	(0.192)
CTC	-3.205***	-0.842***				
	(0.755)	(0.192)				
ln(control of Corr.)		-0.105***				
		(0.009)				
Δt			-2.188***	-1.229***	-0.213***	-3.798***
			(0.339)	(0.203)	(0.023)	(0.870)
control of Corr.			0.159**	0.180***	0.397***	0.408***
			(0.068)	(0.067)	(0.067)	(0.125)
Δt ×control of Corr.			2.800***	1.066***	0.288***	2.812***
			(0.521)	(0.330)	(0.039)	(0.910)
#Observations	66,354	599,193	605,399	605,543	716,539	66,354
#Firms	44,554	152,741	152,997	153,050	181,359	44,554
R-squared	0.091	0.034	0.035	0.035	0.506	0.091

Note: Dependent variable: ln(pbt). Standard errors are clustered at the firm-country level, (***) p<0.01, (**) p<0.05, (*) p<0.1. Columns (1), (2), (3) and (6) use $\Delta t_{AV,C}$, column (4) Δt_{HQ} and column (5) $d\Delta t_{HAVEN}$ as a proxy for tax rate difference. Columns (1) and (6) use the WB business survey measure of corruption in the tax administration while the others use the WGI corruption indicator. Column (2) ads the level of domestic control of corruption as an additional control. Columns (3) and (6) proxy the CTC by an interaction term between the tax rate difference and the level of domestic control of corruption, hence they estimate [17] instead of [16]. All estimates include firm and year fixed effects except column (5) that uses country and year fixed effects.

4.2. SELECTION MODEL

The empirical and theoretical approaches used in this paper take as given the location choices of a multinational firm. This is a common approach in the profit shifting literature, but it is subject to bias, because the investment locations are choices of the multinational firm and thus endogenous to expected profits. In addition, tax rate differentials as well as corruption levels may affect the firm's location decision. It is usually hard to correct for the selection bias, because the tax rate differential depends on the tax rates at all foreign locations (Δt_{AV}). However, in this paper, in one of the empirical estimations we use the tax rate differential to the headquarter location (Δt_{HQ}). In that case, we can estimate a model in which the firm first chooses where to locate its profits and then, controlling for the location decision, how much profits to locate in that particular jurisdiction. To estimate this type of model we use 2-step Heckman selection approach.

In the first step we estimate the likelihood of a company locating its profits in a particular jurisdiction. Taking into account the constrains of our data, we allow every company headquarter to choose a country from a set of European countries to locate its profits. We estimate this location decision using a probit model for every year in our sample separately. Using the predicted values from those probit models we create 9 inverse mills ratios (2005 – 2013) and use them as explanatory variables in the regression equation we have derived from the theoretical model. We then estimate this equation using OLS controlling for year and country fixed effects.[30] These inverse mills ratios control for the location decision of a multinational company in every year in the sample. Alternatively, we construct an inverse mills ratio that is a panel variable combining all the yearly inverse mills ratios into one variable and estimate firm fixed effects model accordingly, as before.

In the first stage of the Heckman selection model we hypothesize that the location decision of the company depends on the tax rate differential to headquarter, the corruption level in the potential country where the multinational would like to locate its affiliate and the GDP growth rate of the potential location choice.[31] We use data from the World Bank indicators on the costs of starting a business as exclusion restriction in the first stage of the Heckman selection model. The argument here is that the cost of starting business will affect whether the firm locates in a particular jurisdiction, but will not affect the amount of profits reported in that jurisdiction, once the firm is already there.

Table 3 presents results from the second stage estimations running a two-step Heckman selection model. Here, the CTC is defined using a tax rate differential to headquarter as a measure of the tax rate differential in all specifications. In columns 1, 3 and 4 we show results using the WGI corruption index while in column 2 we use the WB business survey corruption measure. Columns 1, 2 and 4 estimate the joint effect of corruption and tax rate differential through the CTC parameter.

[30] Here, we are unable to control for firm fixed effects since the inverse mills ratio does not vary over time at the firm level.
[31] We experiment with multiple additional location decision variables in the spirit of gravity equation, such as distance, common language, size of imports etc. The second stage results are not sensitive to what we include in the first stage.

Columns 1, 2 and 3 control for selectivity bias in every year in the sample including inverse mills ratios estimated in the probit model for each year in the sample. Column 4 results control for inverse mills ratio as a panel variable. We find that the effect of the CTC parameter is negative as the theoretical model predicts, even controlling for the location decision of the multinational company.

Column 3 results show that both tax rate differentials and corruption levels affect profit shifting, even when controlling for selectivity bias. These results again confirm what we found in panel fixed effects regressions; i.e. that the effects shown are driven by both corruption and tax rate differentials equally and that the interaction effect between the two variables significantly affects the extent of profit shifting.

TABLE 3 SELECTIVITY CORRECTION

Definitions of CTC	(1) CTC_{HQ}	(2) CTC_{HQ}	(3) CTC_{HQ}	(4) CTC_{HQ}
capital	0.178*** (0.002)	0.230*** (0.005)	0.178*** (0.002)	0.070*** (0.003)
labour	0.374*** (0.004)	0.371*** (0.008)	0.374*** (0.004)	0.330*** (0.006)
ln(GDPpc)	0.902*** (0.067)	0.849*** (0.206)	0.755*** (0.071)	1.306*** (0.058)
CTC	-0.976*** (0.215)	-0.509 (0.477)		-0.819*** (0.141)
Δt			-0.920*** (0.181)	
control of Corr.			0.509*** (0.084)	
Δt ×control of Corr.			1.077*** (0.254)	
#Obs.	348,712	35,883	348,712	605,300
R-squared	0.300	0.331	0.300	0.035

Note: Dependent variable: ln(pbt) in columns 1, 2, 3 and 4. All equations include inverse mills ratio from a probit model, which determines the location choice of the company. The probit model is run every year and the inverse mills ratio is created for each year in the panel separately. In columns 1-3 9 inverse mills ratios for each year 2005 – 2013 are included. In column 4 inverse mills ratio is included as a time varying panel variable. In columns 1, 3 and 4 we show results using the WGI corruption index while in column 2 we use the WB business survey corruption measure. Standard errors are clustered at the firm-country level, (***) p<0.01, (**) p<0.05, (*) p<0.1. All estimates include country and year fixed effects except column (4) that uses firm and year fixed effects.

4.3. IMPLIED DOMESTIC TAX REVENUE ELASTICITIES

In this section we use the estimated coefficients on the CTC parameter to calculate tax revenue elasticities with respect to the top statutory tax rates for each country in the sample. Using the estimate of the effect of CTC on reported profits from Column 1 in Table 1 we can calculate $\gamma = 1/[-0.972] = 1.03$. This, together with the firm level data for European firms, allows us to simulate the elasticity of reported profits with respect to the top statutory tax rate for different countries. To do so we first calculate the actual profit of each firm. From [11] we obtain

$$\pi_i = \frac{R\pi_i}{\left[1 - \frac{\Delta t_i}{\gamma \cdot [1 + c_i]}\right]}. \quad [18]$$

Then we calculate the profit that would be reported in country j by firm i, if the statutory tax rate increases by one percentage point. From [11] we obtain

$$R\pi_{i,t+0,01} = \pi_i \left[1 - \frac{\Delta t_j + 0.01}{\gamma \cdot \left[1 + c_j\right]}\right]. \quad [19]$$

From this, we can calculate the sum of the changes in reported profit for all firms i that are located in country j as follows

$$dR\pi_j = \sum_i^l \left[R\pi_{i,t+0,01} - R\pi_{i,t}\right] dt_j \quad [20]$$

where l is the number of firms belonging to country j. Using this we calculate the tax revenue elasticity with respect to the top statutory tax to be

$$\frac{dR\pi_j}{dt_j} \frac{t_j}{\sum_i^n \left[R\pi_{i,t}\right]} + 1. \quad [21]$$

The tax revenue elasticity tells us the percentage change in tax collected from all firms in country j, given a one percent change in the tax rate of country j. Hence, the tax revenue elasticities represent revenue gains in response to changes in statutory tax rates. Obtaining correct estimates of tax revenue elasticities is important, especially in the light of the financial crisis recovery and proposals by some countries to raise their tax revenues by increasing their tax rates. Specifically, Greece has suggested that an increase in their statutory tax rate would raise required revenues.

We calculate the tax revenue elasticities for the year 2013 for all European countries in our sample.[32] The results are presented in Figure 3, where each dot represents a country. On the vertical axis we have tax revenue elasticities and on the horizontal axis we have control of corruption. Therefore, the plot shows how tax revenue elasticities change with an increase in control of corruption. The plotted elasticities are grouped into three different clusters, according to their statutory tax rates; triangles represent countries with low statutory tax rates (0.05-0.15), circles represent countries with medium statutory tax rates (0.15-0.25) and squares represent countries with high statutory tax (0.25-0.35).

All countries have absolute elasticities below 1, but larger than zero. Hence, no country has a tax rate that is Laffer inefficient. Within each group of tax rates, the tax revenue elasticities are an increasing function of control of corruption. This means that countries with otherwise similar tax rates face lower tax revenue elasticities when they are more corrupt. Thus, corruption decreases the possible gains that countries could have from tax rate increases. For instance, a tax rate increase of 1% in Portugal increases tax revenue by 0.84%, while a tax rate increase of 1% in Netherlands increases tax revenue by 0.86%. This means that Portugal may loose up to approximately 2% of their tax revenue due to corruption. This effect is even starker when we compare Italy and Norway. A similar 1% increase in tax rate will increase tax revenues by 0.79 percent in Italy and by 0.86 percent in Norway.[33] In other words, a decrease of the level of corruption to the level of Norway might induce a tax revenue gain of over 7% in Italy, absent behavioral effects.

The calculated tax revenue elasticities imply that countries such as Greece and Italy would face the largest difficulties in raising tax revenue through increasing their tax rates on profits. This is the case as both countries already have high tax rates and face high levels of corruption. On the other hand, tax rate cuts by these countries would have less negative effects on the total revenue collected, than in case of countries with lower corruption levels.

Specifically, in the light of the recently proposed reforms to the statutory tax rate in the UK and Italy we will see the UK tax rate decrease from 20% in 2015 to 18% in 2020, whereas the Italian tax rate will decrease from 30% in 2015 to 26% in 2020. Using our elasticity estimates, the cut to

[32] The underlying data for Figure 3 is summarized in Table 8 in Appendix C.

[33] A possible concern here may be that this effect could also be the result of differences in the exposure of firms to profit shifting opportunities and not differences in the level of corruption. We show this is not the case. In Figure 5 in Appendix C we compare tax revenue elasticities that account for corruption, with tax revenue elasticities as calculated by the previous literature. The results show that corruption decreases tax revenue elasticities.

the UK tax rate by 11% will decrease its revenues by 10% while a 15% cut to the tax rate in Italy will reduce its tax revenues by 12%.[34]

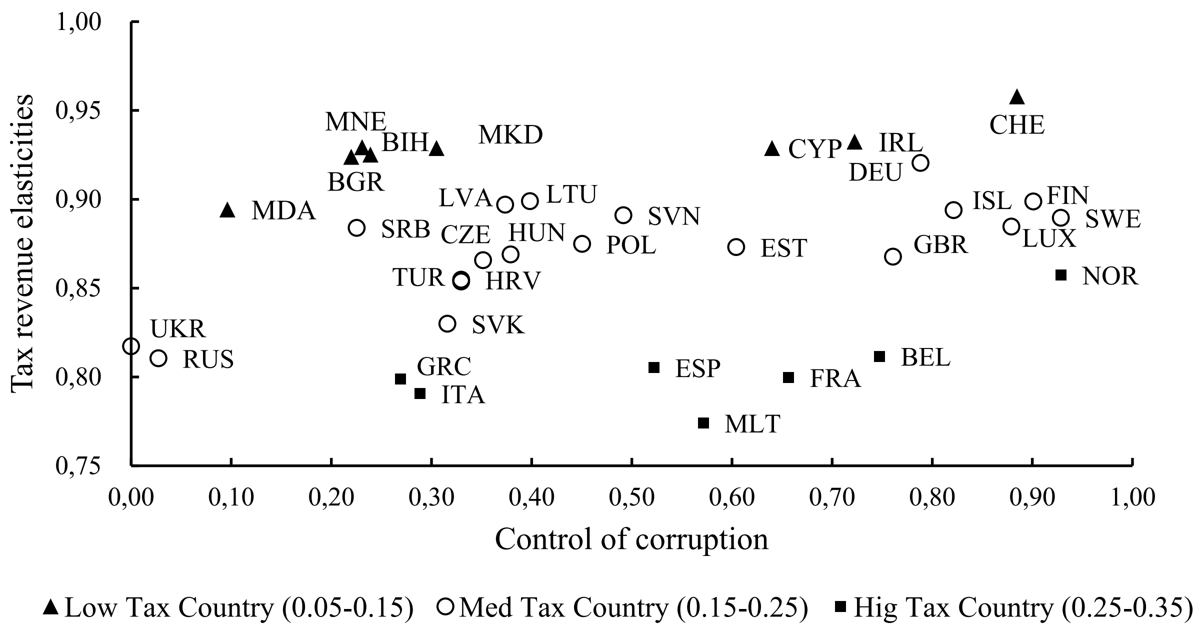

Figure 3 Semi-elasticity of reported profits with respect to the top statutory tax rate

5. CONCLUSION

Our analysis has revealed that corruption amplifies profit shifting. Multinationals that have an incentive to shift profits, will shift more profits with higher corruption in the tax administration. Our theoretical model implies that this is because corruption decreases the cost of profit shifting. Corrupt tax officials have an incentive to collect bribes for reducing the tax auditing costs of firms.

Accounting for the effect of corruption on profit shifting of multinational firms reveals a substantially larger heterogeneity of tax elasticities within Europe. Countries with similar tax rates face considerably different tax elasticities when the extent of corruption differs between them. On average, countries with high levels of corruption face lower tax revenue elasticities with respect to tax rates. Therefore, tax rate increases lead to much smaller tax revenue increases in corrupt countries. These results imply that a country with a persistent corruption problem might be unable

[34] The tax revenue elasticties will differ slightly depending on the definition of the CTC parameter used. Figure 6 in Appendix C shows the mean, maximum and minimum tax revenue elasticities implied by the estimates from Table 1 Columns 1-3. The approximation of CTC by $CTC_{AV,C}$ used to calculate the baseline elasticities in this paper is the lower bound estimate. For instance, tax revenue elasticities can be as low as 0.64 for Italy and 0.76 for Norway. This would imply that Italy may even be losing up to 12% of its tax revenues due to corruption.

to generate large tax revenues by taxing profits of multinational firms. These results highlight that to increase tax revenue, for example in the recently financially unstable Southern European countries, it is best to use a dual approach. An intensified fight against corruption in the tax administration should accompany increases in the tax rates.

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APPENDICES

APPENDIX A. THE MAXIMIZATION PROBLEM OF A MULTINATIONAL

The multinational seeks to maximize

$$\max_{\forall S_i,\lambda} \Pi \sum_{i=1}^{n} \left[[\pi_i - S_i] \cdot [1 - t_i] - \frac{1}{2} \cdot [1 + c_i] \cdot \gamma \cdot \frac{{S_i}^2}{\pi_i} \right] - \lambda \sum_{i=1}^{n} S_i.$$

From this, we obtain the following necessary conditions for a maximum

$$\frac{\partial \mathcal{L}}{\partial S_i} = \left[-[1 - t_i] - [1 + c_i] \cdot \gamma \cdot \frac{S_i}{\pi_i} \right] - \lambda = 0 \ \ \forall S_i,$$

$$\sum_{i=1}^{n} S_i = 0.$$

From $\frac{d\mathcal{L}}{dS_i}$ follows that

$$S_i = -\frac{\pi_i}{\gamma \cdot [1 + c_i]} \cdot [1 - t_i] - \lambda \cdot \frac{\pi_i}{\gamma \cdot [1 + c_i]},$$

$$\lambda = \left[-[1 - t_i] - \gamma \cdot [1 + c_i] \cdot \frac{S_i}{\pi_i} \right].$$

From $\sum_{i=1}^{n} S_i = 0$ and $\frac{d\mathcal{L}}{dS_i}$ follows that

$$S_i = \sum_{k=1}^{n} S_k - \sum_{k \neq i}^{n} S_k = -\sum_{k \neq i}^{n} S_k = \sum_{k \neq i}^{n} \frac{\pi_k}{\gamma \cdot [1 + c_k]} \cdot [1 - t_k] + \lambda \cdot \sum_{k \neq i}^{n} \frac{\pi_k}{\gamma \cdot [1 + c_k]}.$$

Substituting $\lambda = \left[-[1 - t_i] - \gamma \cdot [1 + c_i] \cdot \frac{S_i}{\pi_i} \right]$ we get

$$S_i = \sum_{k \neq i}^{n} \frac{\pi_k}{\gamma \cdot [1 + c_k]} \cdot [1 - t_k] + \left[-[1 - t_i] - \gamma \cdot [1 + c_i] \cdot \frac{S_i}{\pi_i} \right] \cdot \sum_{k \neq i}^{n} \frac{\pi_k}{\gamma \cdot [1 + c_k]}.$$

By expanding this we get

$$S_i = \sum_{k \neq i}^{n} \frac{\pi_k}{\gamma \cdot [1 + c_k]} \cdot [1 - t_k] - [1 - t_i] \cdot \sum_{k \neq i}^{n} \frac{\pi_k}{\gamma \cdot [1 + c_k]} - [1 + c_i] \cdot \frac{S_i}{\pi_i} \cdot \sum_{k \neq i}^{n} \frac{\pi_k}{[1 + c_k]}.$$

When collecting S_i we get

$$S_i \cdot \left[1 + [1 + c_i] \cdot \frac{1}{\pi_i} \cdot \sum_{k \neq i}^{n} \frac{\pi_k}{[1 + c_k]}\right] = \frac{1}{\gamma} \cdot \left[\sum_{k \neq i}^{n} \frac{\pi_k}{[1 + c_k]} \cdot [1 - t_k] - [1 - t_i] \cdot \sum_{k \neq i}^{n} \frac{\pi_k}{[1 + c_k]}\right].$$

Multiplying this by $\frac{\pi_i}{[1+c_i]}$ we get

$$S_i \cdot \left[\frac{\pi_i}{[1 + c_i]} + \sum_{k \neq i}^{n} \frac{\pi_k}{[1 + c_k]}\right] = \frac{\pi_i}{\gamma \cdot [1 + c_i]} \cdot \left[\sum_{k \neq i}^{n} \frac{\pi_k}{[1 + c_k]} \cdot [1 - t_k] - [1 - t_i] \cdot \sum_{k \neq i}^{n} \frac{\pi_k}{[1 + c_k]}\right].$$

After integrating the sums we get

$$S_i \cdot \left[\sum_{k=1}^{n} \frac{\pi_k}{[1 + c_k]}\right] = \frac{\pi_i}{\gamma \cdot [1 + c_i]} \cdot \left[\sum_{k \neq i}^{n} \frac{\pi_k}{[1 + c_k]} [t_i - t_k]\right].$$

By solving for S_i we get

$$S_i = \frac{\pi_i}{\gamma \cdot [1 + c_i]} \cdot \frac{\left[\sum_{k \neq i}^{n} \frac{\pi_k}{[1 + c_k]} [t_i - t_k]\right]}{\left[\sum_{k=1}^{n} \frac{\pi_k}{[1 + c_k]}\right]}.$$

APPENDIX B. THE EFFECT OF CORRUPTION OUTSIDE OF THE TAX ADMINISTRATION ON REPORTED PROFITS

Corruption may influence the reporting of profits directly and indirectly. Corruption inside the tax administration and taxation directly influence profits reported by firms. However, profits reported by firms depend also on the profits generated in the first place. The generation of profits may also be influenced by corruption, for example, if corrupt officials are in control of issuing lucrative government contracts. Thus, corruption outside the tax administration may have an indirect effect on the profit reported by firms.

The most often-discussed form of corruption outside the tax administration is extortion, where a corrupt official misuses its power to extract rents from firms in exchange for no additional advantage except his disappearance (see for example Choi and Thum (2005), Seidel and Thum (2016) or Aidt (2003) for a review of older literature). The typical scenario in the literature is that the official hands out the licenses necessary to operate in the market. A corrupt official will only do so in exchange for a bribe. Therefore, when a firm encounters this form of corrupt official, it is always worse off. The second form of corruption that may influence the generation of profits is collusion, where corrupt officials help firms to avoid costs induced by state regulations, such as safety or environmental regulations (see for example Aidt (2003)). When a firm encounters this form of corrupt official, it is better off. Given these opposite effects, it is not surprising that despite decades of empirical research, findings on the economic consequences of corruption are far from conclusive; for a summary see for example Campos et al. (2010).

To account for a possibility of an indirect effect of corruption on the profits reported by firms, we assume that the production efficiency depends on the control of corruption in a country. Specifically we assume that $A_i = \theta_i \cdot c_i^{\sigma}$ where θ_i is a productivity parameter that may reflect further cross-country differences in technology or factor qualities. Making use of this and taking the logs of [14], we get

$$log(\pi_i) = \log(\theta_i \cdot [1-\alpha]) + \varepsilon \cdot \log(a) + \sigma \cdot \log(c_i) + \alpha \cdot \log(L_i) \\ +\varphi \cdot \log(K_i) + u_i. \qquad [22]$$

Substituting in [12] $\log(\pi_i)$ we get the following alternative equation that we estimate

$$\log(R\pi_i) = \beta_1 + \beta_2 \cdot \log(a) + \beta_3 \cdot \log(L_i) + \beta_4 \cdot \log(K_i) \\ +\beta_5 \cdot CTC_i + \beta_6 \cdot \log(c_i) + u_i. \qquad [23]$$

where $\beta_1 = \log(\theta_i \cdot [1-\alpha])$, $\beta_2 = \varepsilon, \beta_3 = \alpha, \beta_4 = \varphi, \beta_5 = -\frac{1}{\gamma}$ and $\beta_6 = \sigma$. From Proposition 1, Proposition 2 and [10] it follows that we expect β_5 to stay significant and negative. Previous literature does not have a clear answer on the effect of corruption outside the tax administration on the profit reporting of multinationals; hence, our expectation on the sign of the coefficient β_6 is ambiguous.

Table 4 summarizes the main findings from estimating this alternative specification. The results are directly comparable to those from Table 1. The addition of the logarithm of corruption slightly decreases the estimated effect of the CTC parameter on the reported profits across all specifications, but the results remain significant and negative. The logarithm of corruption enters the estimation negatively, implying the larger the control of corruption in a country, the smaller the reported profits will be. This result is in line with the theory of collusive corruption outside tax administration.

TABLE 4 THE DIRECT AND INDIRECT EFFECTS OF CORRUPTION AND TAXATION ON REPORTED PROFITS.

Definitions CTC	(1) $CTC_{AV,C}$	(2) $CTC_{AV,B}$	(3) $CTC_{AV,A}$	(4) CTC_{HQ}	(5) CTC_{HAVEN}
capital	0.069***	0.069***	0.069***	0.069***	0.069***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)
labour	0.326***	0.326***	0.326***	0.325***	0.327***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)
ln(GDPpc)	1.136***	1.145***	1.137***	1.144***	1.213***
	(0.051)	(0.051)	(0.051)	(0.051)	(0.049)
CTC	-0.842***	-1.484***	-0.852***	-0.889***	0.713*
	(0.192)	(0.249)	(0.182)	(0.138)	(0.390)
ln(control of Corr.)	-0.105***	-0.104***	-0.104***	-0.104***	-0.107***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
#Obs.	599,193	599,193	599,193	599,337	714,542
#Firms	152,741	152,741	152,741	152,794	182,814
R-squared	0.034	0.034	0.034	0.034	0.035

Note: Dependent variable: ln(pbt), Standard errors are clustered at the firm-country level, (***) p<0.01, (**) p<0.05, (*) p<0.1. Column (1) uses $\Delta t_{AV,C}$, column (2) uses $\Delta t_{AV,B}$, column (3) $\Delta t_{AV,A}$, column (4) Δt_{HQ} and column (5) $d\Delta t_{HAVEN}$ as a proxy for the tax rate differential in the calculation of CTC. All estimates include firm and year fixed effects except column (5) that uses country and year fixed effects.

APPENDIX C. SUPPLEMENTARY TABLES AND FIGURES

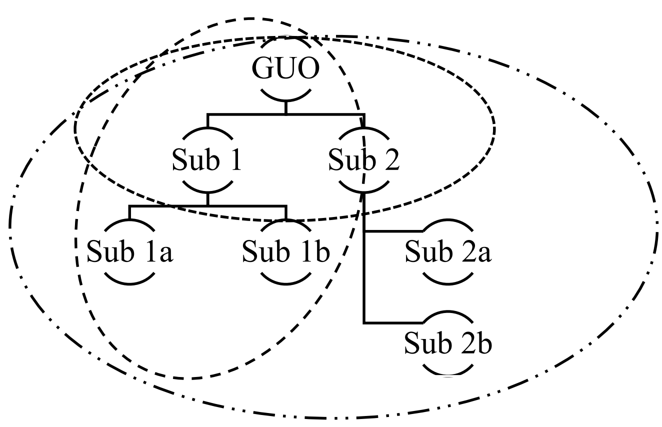

Figure 4 Definition of different relevant profit shifting groups: A -----; B – – –; C — · ·

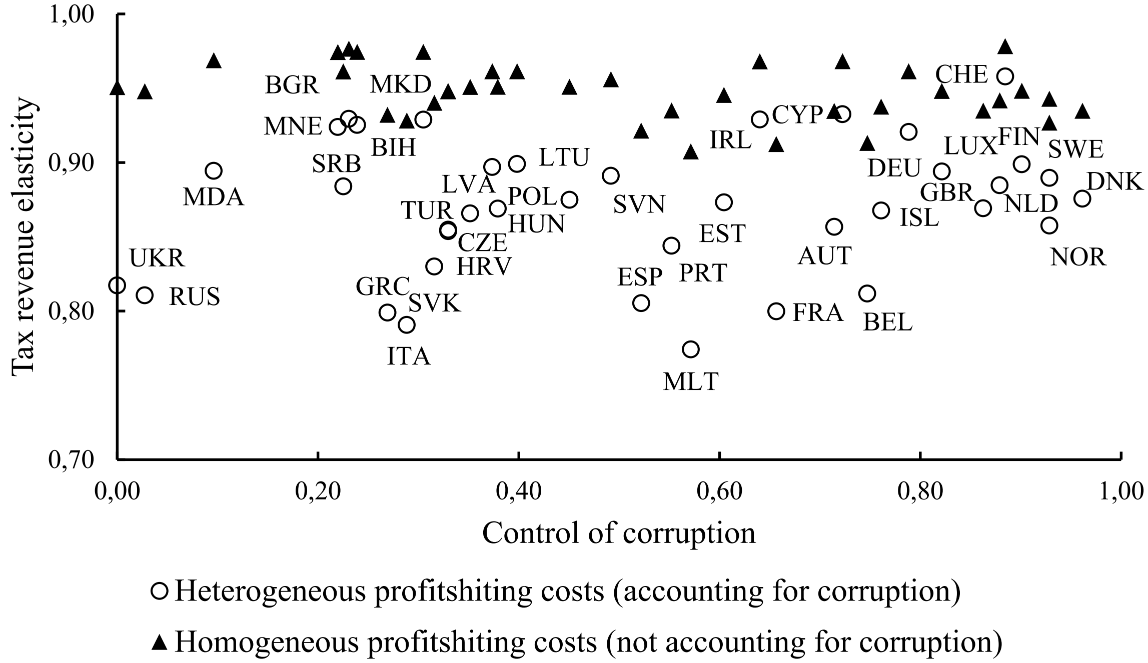

Figure 5 Tax revenue elasticities with respect to the top statutory tax rate.

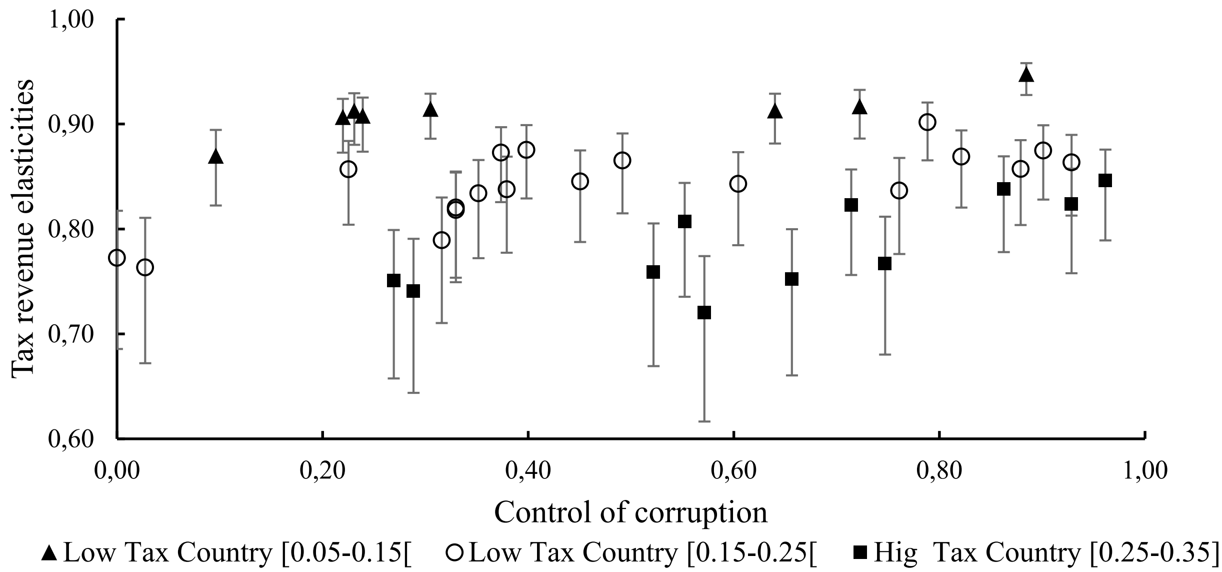

Figure 6 Variation in the implied tax revenue elasticities (Table 1 Colum 1 to 3).

TABLE 5: DATA SOURCES.

Variable	**Data source**	**Data link**
Control of corruption	World Bank Governance Indicators	http://info.worldbank.org/governance/wgi/#home
Control of corruption in tax administration	WBES survey	https://data.worldbank.org/data-catalog/enterprise-surveys
Statutory corporate tax rate	CBT Tax Database	https://www.sbs.ox.ac.uk/faculty-research/tax/publications/data
Profits, capital, labour	AMADEUS	BvD Data link through Oxford library
Costs of starting a business	World Bank Doing Business Survey	http://www.doingbusiness.org/Custom-Query

TABLE 6 DESCRIPTIVE STATISTICS

Variable	#Obs.	Mean	Std. Dev.	Min	Max
statutory tax rate	757,127	0.247	0.063	0	0.350
control of corruption	721,320	0.517	0.254	0	1
corruption in tax admin.	94,285	13.230	15.556	0	67.600
lnGDPpc	730,154	10.656	1.027	7.216	15.533
lnpbt	757,127	4.956	2.005	0	8.005
capital	757,127	5.745	2.536	0	18.475
labor	757,127	2.969	1.589	0	10.942

Note: Source: Firm level data is from BvD AMADEUS, corruption indicators from WB, tax rates from the CBT tax database.

TABLE 7 DESCRIPTIVE STATISTICS ON TAX DIFFERENTIALS

Variable	#Obs.	Mean	Std. Dev.	Min	Max
CTC_{HQ}	605,549	0.002	0.059	-0.267	0.246
CTC_{HAVEN}	721,320	0,065	0.210	0	1
$CTC_{AV.A}$	605,405	0	0.031	-0.191	0.163
$CTC_{AV.B}$	605,405	0.002	0.029	-0.135	0.139
$CTC_{AV,C}$	605,405	0	0.027	-0.191	0.162
$CTC_{AV,C}$ (WB Survey)	66,354	-.007	.023	-0.162	0.128

Note: Source: Tax data from the CBT tax database.

TABLE 8 AGGREGATE TAX REVENUE ELASTICITIES FOR 2013.

Country	Statutory tax rate	Control of corruption	Elasticity	Country	Statutory tax rate	Control of corruption	Elasticity
AUT	0.250	0.714	0,857	ITA	0.275	0.288	0,791
BEL	0.330	0.747	0,812	LTU	0.150	0.398	0,899
BGR	0.100	0.220	0,924	LUX	0.225	0.879	0,885
BIH	0.100	0.239	0,925	LVA	0.150	0.374	0,897
CHE	0.085	0.885	0,958	MDA	0.120	0.096	0,894
CYP	0.125	0.640	0,929	MKD	0.100	0.305	0,929
CZE	0.190	0.352	0,866	MLT	0.350	0.571	0,774
DEU	0.150	0.788	0,921	MNE	0.090	0.231	0,929
DNK	0.250	0.962	0,876	NLD	0.250	0.863	0,869
ESP	0.300	0.522	0,805	NOR	0.280	0.929	0,857
EST	0.210	0.604	0,873	POL	0.190	0.451	0,875
FIN	0.200	0.901	0,899	PRT	0.250	0.552	0,844
FRA	0.333	0.657	0,800	RUS	0.200	0.027	0,811
GBR	0.240	0.761	0,868	SRB	0.150	0.225	0,884
GRC	0.260	0.269	0,799	SVK	0.230	0.316	0,830
HRV	0.200	0.330	0,855	SVN	0.170	0.492	0,891
HUN	0.190	0.379	0,869	SWE	0.220	0.929	0,890
IRL	0.125	0.723	0,933	TUR	0.200	0.330	0,854
ISL	0.200	0.821	0,894	UKR	0.190	0.000	0,817

TABLE 9 LIST OF COUNTRIES AND MEAN VALUES OF CORRUPTION INDICATORS.

Country ISO code	WGI			WBES		
	Mean	Std. Dev.	Freq.	Mean	Std. Dev.	Freq.
AT	0.77	0.07	24,357			
BA	0.21	0.02	6,799	0.85	0.24	2,114
BE	0.70	0.03	121,627			
BG	0.24	0.02	17,108	0.89	0.12	7,067
CH	0.88	0.01	328			
CY	0.59	0.04	166			
CZ	0.38	0.02	80,802	0.92	0.15	24,915
DE	0.78	0.01	96,185	0.85	-	7,456
DK	0.97	0.01	49,250			
EE	0.56	0.02	24,814	0.97	0.06	8,087
ES	0.58	0.03	151,124	0.86	-	13,285
FI	0.93	0.03	34,856			
FR	0.69	0.02	254,699			
GB	0.76	0.03	300,713			
GR	0.31	0.06	11,815	0.44	-	1,118
HR	0.30	0.02	248,047	0.93	0.08	71,373
HU	0.40	0.04	16,411	0.94	0.10	5,670
IE	0.75	0.03	26,691	0.89	-	1,733
IS	0.87	0.06	7,057			
IT	0.34	0.05	242,577			
LI	0.72	0.08	24			
LT	0.35	0.03	6,368	0.84	0.13	1,868
LU	0.86	0.03	16,605			
LV	0.35	0.02	16,763	0.95	0.10	4,939
MD	0.12	0.01	371	0.76	0.14	124
ME	0.23	-	6	0.95	0.05	39
MK	0.27	0.04	192	0.91	0.09	54
MT	0.55	0.02	4,853			
NL	0.88	0.02	45,814			
NO	0.88	0.04	72,332			
PL	0.41	0.04	74,197	0.92	0.10	21,581
PT	0.57	0.02	67,166	0.48	-	2,781
RS	0.22	0.01	18,400	0.83	0.24	6,068
RU	0.03	0.02	123,449	0.81	0.19	43,317
SE	0.92	0.02	114,237	1.00	-	3,827
SI	0.54	0.03	10,484	0.96	0.06	2,887
SK	0.36	0.03	48,871	0.94	0.09	16,738
TR	0.32	0.01	1,739	0.97	0.02	463
UA	0.05	0.04	26,188	0.58	0.10	8,298