Tax competition in developed, emerging and developing regions - same same but different?*

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24 May 2018

Abstract

This paper analyzes tax competition between countries which differ in their country-specific risk. We show that the outcome of asymmetric tax competition crucially depends on the ability of multinational firms to shift profits. With high costs of profit shifting, higher-risk countries set lower tax rates than lower-risk countries whereas the opposite is true if the costs of profit shifting are low. The results provide an explanation for the patterns observed in the corporate income tax policies across countries and regions differing in their level of development. Moreover, for intermediate costs of profit shifting, we show that also a country's absolute risk level affects countries' tax rate setting. These results carry important implication for the empirical tax competition literature.

Keywords: tax competition, country risk, developing countries, asymmetric countries.

JEL Classification: H25, O23, F23

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*We are grateful to David Agrawal, Andreas Haufler, Marko Köthenbürger, Yukihiro Nishimura and Marco Runkel as well as participants at the 73rd annual congress of the International Institute of Public Finance, the 4th MaTax Conference, the 2017 NoCeT Fall Conference, and the 2018 CESifo Area Conference on Public Sector Economics for valuable discussions.

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"In the process of development, states (...) undergo pronounced changes in *patterns* of taxation (...)."

– Besley and Persson (2013), p.51.

1 Introduction

In practice, tax policies differ substantially between rich and poor countries. On average, advanced economies are able to raise a higher fraction of tax revenues relative to their gross domestic product (GDP) than developing countries,[1] and also the composition of tax revenues differs between developed and developing countries. In advanced economies, a large fraction of revenues is attributed to the collections from the personal income tax, while developing countries are more reliant on the corporate income tax as a source of revenue (Crivelli et al., 2016).

Despite the fact that the revenue from taxing corporations is an important source of income for developing countries, the literature on corporate tax competition has paid only little attention to emerging and developing countries. Especially, the exposure of firms to country-specific risks, an aspect of major relevance in the context of emerging and developing countries, has so far mostly remained out of scope of the existing studies. Because multinational firms operate in many countries they have to respond to different economic and political environments. This may not only affect their incentives to investment in a country, but also the incentives to shift profits in or out of a country.[2] It is therefore a priori unclear how country risk affects the outcome of tax competition and whether the outcome between developing or emerging countries is similar to the one between developed countries.

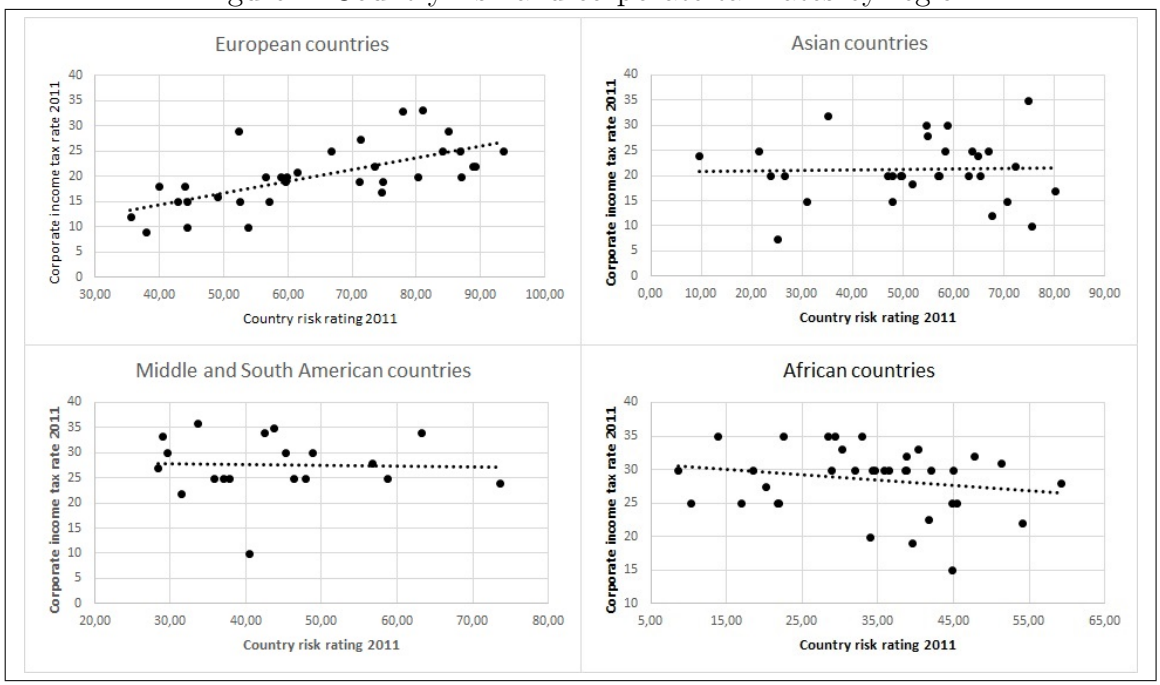
While the quote by Besley and Persson (2013) refers to specific features of a single

[1] Tax ratios have been surprisingly stable over time. While tax revenues relative to GDP have been the highest in high-income countries with roughly 30% between 1980-2009, this share is reduced when looking at less developed countries. For countries in the upper-middle income class, the tax-to-GDP ratio drops to roughly 23%, and it further declines for the group of lower-middle income and low-income countries to about 18%, respectively 15%, see IMF (2011).

[2] Wei (2000), for example, shows that corruption significantly reduces inward foreign direct investment, while Fuest et al. 2011 find that the sensitivity of intra-company loans to changes in the tax rate is twice as large in developing countries as compared to developed countries.

country's tax structure, Figure 1 shows the relationship between corporate income tax rates and countries' risk rating for a cross-section of countries, covering the four regions Europe, Asia, Middle and South America, and Africa.[3] Specifically, it shows the relationship between countries' risk rating and the corporate income tax rates for four regions including Europe, Asia, Middle and South America, and Africa.[4]

Figure 1: Country risk and corporate tax rates by region



Sources: Euromoneycountryrisk.com, Ernst & Young Worldwide Corporate Tax Guide, KPMG's corporate tax table.

From Figure 1 it becomes evident that, for European countries, a negative relationship (positive slope) prevails between the corporate income tax rate and the level of country risk. That is, higher-risk countries in Europe levy on average lower corporate income tax rates compared to lower-risk countries. For the Asian countries, the negative rela-

[3]Figure 1 comprises a total of 132 countries, of which 38 of them are European countries, 37 are Asian countries, 22 are Middle and South American countries and 35 are African countries. We excluded countries classified as tax havens according to Hines (2005). A list of the countries of the four regions can be found in Appendix A.3.

[4]Data on country risk ratings are provided by euromoneycountryrisk (ECR) only for the year 2011 (available at `https://www.euromoneycountryrisk.com/`). The ECR index is a composite measure of economic, political and structural factors as well as other factors like access to capital or credit ratings and ranges from 0 (maximum risk) to 100 (no risk) where higher values indicate lower risk. For corporate income tax rates, we retrieve data from the Ernst & Young Worldwide Corporate Tax Guide (2011) and when not available from KPMG's corporate tax table or from more recent issues.

tionship gets weaker and it turns slightly positive for the region of Middle and South America. For Africa, the relationship between corporate income tax rates and country risk is clearly positive (negative slope), i.e., in Africa higher-risk countries levy, on average, a higher corporate income tax rate.[5]

Inspired by the different patterns displayed in Figure 1, a primary purpose of this paper is to explore why the relationship between corporate income tax rates and country risk varies between regions. In this paper, we show that countries' ability to curb profit shifting – and reversely, the multinational firms' ability to shift profits – plays an important role in explaining the insights of Figure 1.

Table 1: Government effectiveness by regions

Region	**Avg. Government effectiveness**
Europe	0.87
Asia	0.14
Middle and South America	-0.10
Africa	-0.59

Source: World Bank World Governance Indicators.

As can be seen from Table 1, the level of development substantially affects countries' ability to curb profit shifting.[6] That is, while in the developing region of Africa the ability to impede multinational firms' profit shifting is the lowest, it is the highest in Europe, the relatively most developed region. The stylized facts in Table 1 are also

[5]The correlation between corporate income tax rates and country risk rating among European countries amounts to 0.66, respectively 0.03, -0.03 and -0.20 among Asian, Middle and South American or African countries. Obviously, the correlations depicted in Figure 1 are only based on countries within a specific region although countries can compete across regions. However, empirically, the bulk of multinational firms owns only a small number of foreign affiliates which are usually located in nearby countries and hence within the same region. See Egger and Pfaffermayr (2004) for evidence that outward FDI is negatively affected by distance.

[6]Table 1 displays the measure for government effectiveness provided by the World Bank and averaged over the four regions depicted in Figure 1. The government effectiveness index captures perceptions of the quality of institutions, which comprise, e.g., the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies, and ranges from approximately -2.5 to 2.5 where higher values indicate a higher quality. Although the government effectiveness index is just a rough measure for a government's ability to curb profit shifting, there are no other measures available with a broad coverage also for developing countries.

in line with empirical studies showing that base erosion and profit shifting is more of a concern for developing countries than for advanced economies (Fuest et al., 2011; Crivelli et al., 2016; Johannesen et al., 2017).

To highlight the role of profit shifting in explaining the different patterns of corporate income taxation displayed in Figure 1, we set up a model of two small but asymmetric countries and consider a multinational firm, which has one affiliate in each country. The country asymmetry stems from the fact that countries differ in their country-specific risks firms are exposed to. The multinational firm decides on the size of a risky investment in both affiliates and the transfer price for an intangible asset required for production. Governments in each country maximize tax revenues by non-cooperatively setting their tax rates.

The pivotal question of our analysis is whether the higher- or lower-risk country sets the lower tax rate. We show that the answer depends on the multinational firm's ability to shift profits. If the costs related to profit shifting are sufficiently high, that is, a situation where institutions are sufficiently well-established to curb profit shifting, the higher-risk country sets the lower tax rate. Instead, if profit shifting is sufficiently easy for the multinational firm, the exact opposite holds, that is, the higher-risk country sets the higher tax rate.

The explanation for the polar findings rests on two opposing effects which determine the optimal tax rate setting when a country's risk level changes. First, a decline of a country's riskiness exerts a positive impact on investment incentives and, in turn, on a country's taxing incentives. Second, a lower level of country risk increases the expected tax burden and thus the sensitivity of profit shifting, which implies an incentive to lower the tax rate. For countries with good abilities to curb profit shifting, the first effect dominates whereas for countries with only limited abilities to fight profit shifting the second effect dominates. When countries have some opportunities to limit profit shifting, the outcome of tax competition is a convex combination of the two cases. These results integrate smoothly with corporate income tax setting in practice and provide a sound explanation for the observed differences in corporate income tax rate policies among the various countries belonging to one of the four regions displayed in

Figure 1.

Moreover, for the case of intermediate costs of profit shifting, we show that, besides the relative risk level between the competing countries, the absolute country risk level crucially shapes the outcome of the tax competition game. The result originates from the hump-shaped relationship between a country's own risk level and its optimal tax rate. If the risk level of one country is sufficiently low and the difference in the risk levels between the two countries is not too pronounced, the higher-risk country levies the higher tax rates. If, however, the difference in risk levels becomes substantial, the higher-risk country sets the lower tax rate. For situations where the absolute risk level of one of the two countries is sufficiently high, the reverse outcome is true. The results are critical for the empirical literature on tax competition which is concerned with emerging and developing countries. Essentially, our results show that it is not sufficient in to just run separate regression analyses for developed, emerging and developing countries. Instead, it is critical to account for that taxing incentives may qualitatively change depending on countries' risk levels.

The paper is organized as follows. Section 2 provides a discussion of the related literature. In section 3, the theoretical framework is introduced and in section 4 the tax competition game is analyzed. In section 5 we relate our results to the empirical literature on tax competition and in section 6 we discuss to what extent other channels may explain the observed pattern in corporate income tax policies across regions. In section 7 we conclude.

2 Related Literature

Our paper covers three strands of literature. The first strand embodies studies on (asymmetric) tax competition and the second strand deals with firm behavior and macroeconomic risk. Additionally, our paper relates to the literature on taxation and development. While the third strand directly confronts with studies relating to developing countries, our approach when discussing the first two strands is similar in that we highlight possible difference between developed, emerging and developing countries.

By now there exists a substantial theoretical and empirical body of literature on corporate income tax competition.[7] Although there is not yet a clear consensus on whether tax competition is beneficial or harmful, the outcome of tax competition is clearly visible in the real world. Over time and across countries, corporate income tax rates have significantly declined from a global average of 27.5% in 2006 to roughly 23.6% in 2016.[8] While many studies have empirically verified this downward trend in corporate tax rates for developed countries, see, e.g., Devereux et al. (2008), much less weight has been put on the analysis of this issue in the context of emerging and developing countries. Exception are, for instance, Keen and Mansour (2010) or Abbas and Klemm (2013). Both studies conclude that corporate income tax reductions have followed a similar pattern in advanced and developing countries. Hence, developing economies have been exposed to a downward pressure of the corporate income tax rates in a similar way as advanced economies. However, a primary difference lies in the use of tax incentives among developing countries which, on average, led to a narrowing of the tax base.

While it seems that tax competition has not affected corporate income tax rates in developed and developing countries differently, theoretical studies suggest that country characteristics do shape the outcome of the tax competition game. The seminal works by Bucovetsky (1991) and Wilson (1991) show that country size plays an important role in explaining difference in corporate income tax rates. Smaller countries levy lower tax rates because their tax base elasticity is larger than those of larger countries.[9] In a similar vein, but with a focus on the location of foreign direct investment (FDI), studies have shown that low taxes can offset the disadvantage of low market potential (Haufler and Stähler, 2013; Raff and Srinivasan, 1997; as well as Bénassy-Quéré et al., 2005 for empirical evidence on OECD countries).

[7] See, for instance, Wilson (1999) and Fuest et al. (2005) for a survey of the literature.

[8] See KPMG's corporate tax table available at `https://home.kpmg.com/xx/en/home/services/tax/tax-tools-and-resources/tax-rates-online/corporate-tax-rates-table.html`.

[9] This results is consistent with the observed tax rate setting by the EU-15 countries. Whereas the average corporate income tax rate of larger countries (countries with a population over 20 million) in the year 2016 is around 27.0%, the average corporate income tax rate of smaller countries (countries with a population less than 20 million) is 23.9%, see Ernst & Young Worldwide Corporate Tax Guide (2016).

Related to the context of our model, some contributions highlight the relevance of country risk in the competition for FDI, e.g., Lucas (1990), Mody and Srinivasan (1998), Janeba (2002), Abadie and Gardeazabal (2008) or Sanjo (2012). Generally, the literature finds that country risk negatively affects the ability to attract FDI. Regarding international capital flows, FDI, however, seems to be less volatile to changes in country risk than other financial flows (Albuquerque, 2003).

Moreover, country-specific risks do not only affect the location decision of MNEs, but also their behavior once they have decided to invest in a specific country. Several studies highlight the relation between political risk and firms' capital structure. Desai et al. (2004) find that multinational firms hedge political risk through greater use of external debt instead of parental debt. In contrast, Desai et al. (2008) show that multinational firms reduce their leverage in response to these political risks because returns on investment in politically risky countries are more volatile. Reconciling the ambiguous results found in the two previously mentioned studies, Kesternich and Schnitzer (2010) show that whether leverage increases or decreases depends on the type of risk. Moreover, they also show that higher political risk is associated with lower ownership shares of multinational firms in foreign affiliates.

Broadly speaking, our study relates to the theme of taxation and development.[10] Several papers have made important contributions to highlight the differences in tax practices between developed and developing countries. Giavazzi et al. (2000) analyze the response of the private sector to fiscal policy and confirm previous studies that the effect is non-linear but differs between developed and developing countries. Emran and Stiglitz (2005) and Keen (2008) highlight the importance of the informal economy for understanding optimal VAT policy. Taking into consideration that firms can operate in the shadow economy, Gordon and Li (2009) explain seemingly puzzling tax practices of developing countries.

Specifically focusing on corporate taxation and development, we are aware of only three other contributions. Similar to Gordon and Li (2009), Auriol and Warlters (2005)

[10]For a more general overview, see Tanzi and Zee (2000) and Fuest and Riedel (2013) for a specific focus on base erosion and profit shifting in developing countries.

relate the differently observed tax policies in developing countries to the existence of the informal sector. They argue that governments in developing countries have an incentive to raise the barriers for firms to enter the formal sector to keep rents in the formal sector high, which are then expropriated via entrance fees and taxes. In Gresik et al. (2015) as well as Mardan (2017) the focus is rather on the tax base than on the corporate income tax rate. Gresik et. al (2015) investigate whether attracting FDI is beneficial for a potential host country in the light of profit shifting opportunities by multinational firms. They show that a lenient control of profit shifting, i.e., a lax thin capitalization rule, might be needed in developing countries to attract FDI, but it can lead to lower welfare. Mardan (2017) shows that governments in developing countries, i.e., countries with a low financial development, set on average more generous thin capitalization rules to compensate firms for restricted access to external finance despite increase opportunities of profit shifting.

3 The basic framework

We consider a simple one-period model with two small countries, a and b, which levy corporate income tax rates t_a and t_b. There is one representative multinational enterprise (MNE) with one subsidiary in each of the two countries.[11] Both subsidiaries produce a homogeneous output good resorting to the production technology $f(k_i)$, with positive but decreasing returns, i.e., $f'(k_i) > 0 > f''(k_i)$. Decreasing returns to scale in production imply the existence of a fixed factor, that is, a firm-specific asset which is related to, e.g., a patent, giving rise to positive pure profits. The goods produced are sold at the world market at a price normalized to one. We assume that mobile capital, k_i, is the only input factor and we focus on the case where all investment is financed

[11] In the set-up, we abstract from purely national firms when analyzing governments' corporate income tax policies. The approach is justified by the importance of multinational firms for generating tax revenues in emerging and developing countries, whereas a significant portion of smaller and purely national firms in these countries tend to operate in the informal sector (see, e.g., Baer et al., 2002 and Auriol and Warlters, 2005). The IMF has also recognized this phenomenon and has encouraged the establishment of large taxpayer units on which scarce tax administration resources should be concentrated (Keen, 2012).

by external debt.[12] Furthermore, we normalize the exogenously given interest rate to one.

By assumption, the subsidiary in country a owns an intangible asset, i.e., a patent right, and claims license fees for the use of the patent. Subsidiary b has to buy one unit of the intangible asset to enable production. For simplicity, we normalize the arm's-length price of the intangible asset to zero. The MNE may shift profits from one subsidiary to the other by overpricing or underpricing the license fee for the intangible asset to minimize its overall tax payments. We denote by g the actual transfer price charged by subsidiary a. If the MNE overstates the transfer price, i.e., $g > 0$, profits are shifted from subsidiary b to subsidiary a and vice versa.[13] However, any deviation from the arm's-length price is costly for the MNE because additional effort is needed to conceal the mispricing of the license fee. We account for this by specifying a quadratic cost function of the form $C(\delta, g) = \frac{\delta}{2}g^2$. The concealment cost function implies that the MNE's costs of profit shifting do not only depend on the deviation of the transfer price from the arm's-length price (as usually assumed) but also on how effective the government is in curbing profit shifting. Thus, if the government is very effective in preventing MNEs profit shifting, i.e., if δ is large, the MNE's costs of manipulating the transfer price are high and profit shifting is low. Instead, if the government is not very effective in curtailing the erosion of the tax base, i.e., if δ is low, the costs for manipulating the transfer price are only modest and profit shifting is extensive. The structure of the concealment cost function enables us to account for the facts observed in Table 1 that more developed countries have more advanced institutions and are thus better equipped to deal with the problem of profit relocation by MNEs.[14]

Given our interest in the question how a country's risk level affects the MNE's and governments' decisions, we assume that the outcome of the MNE's investment is uncertain.

[12] This assumption is immaterial for our analysis. Allowing firms to deduct only a fraction γ of their capital costs won't affect the MNE's incentives to shift profits qualitatively and hence also not governments' incentives to compete for profits.

[13] All of our following results are robust to the inclusion of a tax haven in the model. However, with a tax haven, a more complex concealment cost function becomes necessary, i.e., concealment costs need to have an affiliate-pair specific component to sustain the fiscal link (shifting channel) between the MNE's non-tax haven subsidiaries.

[14] See also Gresik et al. (2015) for a similar approach.

The uncertainty stems from the risk the MNE is confronted with when investing in a specific country and is out of the MNE's sphere of influence, i.e., the risk is exogenous to the MNE. Hence, with an exogenous probability p_i the MNE can reap the benefits of its investment. Instead, with probability $(1-p_i)$ the MNE still bears the investment cost but has no return from its investment. We thus interpret the probability p_i as country risk which encompasses any dimension, such as political or economic risks, which negatively affect the profitability of MNEs.[15]

Pre-tax profit of subsidiary i is given by the expected revenue from the investment less the user cost of capital and plus/minus the license cost for the intangible asset

$$\pi_i^e = p_i f(k_i) - k_i + \mathbf{1}g, \tag{1}$$

where $\mathbf{1}$ is an indicator function that takes on the value of 1 for subsidiary a and -1 for subsidiary b.

We assume that taxes are imposed by the source country where the investment is carried out. Accordingly, the host country taxes the profits of the subsidiary, whereas the parent country of the MNE exempts this income from taxation.[16] Without loss of generality, we assume that concealment costs are not deductible from the tax base.[17] Taxable profits of subsidiary i are given by

$$\pi_i^t = p_i[f(k_i) - k_i + \mathbf{1}g]. \tag{2}$$

Equation (2) states that the MNE can only deduct the cost of capital and the expenses for the license fee if the investment is successful which happens with probability p_i.

[15] In our model, country risk can also be interpreted as the likelihood of unexpected costs the MNE has to incur after it has settled its investment decision (and which therefore do not affect the MNE's investment decision). Examples for economic risks are weak stability of the currency, bad government finances or a negative economic outlook. Political risks comprise, for instance, corruption, regulatory policy or weak government stability. However, we abstract from any risks which generate additional governmental income like the expropriation of firm profits or assets because such government behavior can be driven by different motives than taxation, while the latter is the main focus of our analysis.

[16] This scheme is applied by almost all OECD countries including, since 2018, also the United States. See Becker and Fuest (2010) for a discussion and analysis.

[17] The assumption that concealment costs are non-deductible is immaterial for our analysis. The governments' incentive to lower their tax rate to attract profits still prevails even if concealment costs are tax-deductible.

Using equations (1) and (2), after-tax profits of subsidiary i amount to

$$\pi_i = p_i(1-t_i)[f(k_i)-k_i] - (1-p_i)k_i + \mathbf{1}(1-p_i t_i)g. \tag{3}$$

The MNE maximizes the sum of its subsidiaries' profits minus the costs for concealing profit shifting

$$\pi = \pi_a + \pi_b - C(\delta, g), \tag{4}$$

by choosing the optimal levels of capital investment, k_i, and the transfer price, g. Optimal capital investments are given by

$$f'(k_i) = \frac{1-p_i t_i}{p_i(1-t_i)}. \tag{5}$$

In the absence of country risk ($p_i = 1$), the optimal investment level is determined by the standard condition that the marginal product of capital, $f'(k_i)$, equals the world interest rate, which, in our case, is exogenously given and set equal to one. The presence of country risk makes the MNE sensitive to corporate taxation because, from a tax perspective, profits and losses are treated asymmetrically. If profitable, the MNE has to pay taxes, while no tax rebate is granted if the MNE is in a loss position. The MNE has to bear the full investment costs.

From (5), the effects of corporate tax rates and country risk on a subsidiary's optimal investment choice are

$$\begin{aligned} \frac{\partial k_i}{\partial t_i} &= \frac{1-p_i}{p_i(1-t_i)^2 f''(k_i)} < 0, \qquad & \frac{\partial k_i}{\partial t_j} &= 0, \\ \frac{\partial k_i}{\partial p_i} &= -\frac{1}{p_i^2(1-t_i)f''(k_i)} > 0, \qquad & \frac{\partial k_i}{\partial p_j} &= 0. \end{aligned} \tag{6}$$

The first two derivatives in (6) show the standard tax effects in a model of small countries. A higher tax rate in country i reduces capital investment in country i but does not affect capital investment in country j. The last two derivatives illustrate the effect of country risk on capital investment. While country j's level of risk has no effect on the optimal capital investment in i, a lower country risk in country i (higher

p_i) increases capital investment in i.[18] This is in line with the findings of Abadie and Gardeazabal (2008) who show that higher levels of terrorist risks are associated with lower levels of net FDI positions because terrorism reduces the expected return to investment.

The optimal level of the transfer price for the intangible asset is determined by

$$g = \frac{p_b t_b - p_a t_a}{\delta}. \tag{7}$$

From (7), the effects of the tax rates and country risk on the MNE's optimal transfer price are

$$\begin{aligned} \frac{\partial g}{\partial t_a} &= -\frac{p_a}{\delta} < 0, \qquad \frac{\partial g}{\partial t_b} = \frac{p_b}{\delta} > 0, \\ \frac{\partial g}{\partial p_a} &= -\frac{t_a}{\delta} < 0, \qquad \frac{\partial g}{\partial p_b} = \frac{t_b}{\delta} > 0. \end{aligned} \tag{8}$$

The effects emerging from (8) are straightforward. A higher tax rate or a lower country risk (higher p_i) in one country increases the incentives to shift profits to the other country because the expected tax payments of the MNE in the respective country increase.

4 Tax competition and development

In this section, we provide an explanation for the observed differences in the pattern of corporate income tax policies across regions. For the tax competition game analyzed, we assume that governments maximize tax revenues. Several reasons can be brought forward to justify this assumption. First, a Leviathan government is a common assumption, especially in the international tax literature. Second, tax revenue considerations play a particularly important role in the context of developing countries where corporate tax revenues usually account for a substantial fraction of total tax revenues.

[18] Our results will not change qualitatively if governments also compete for capital investment. With capital tax competition, governments have a second motive for reducing their tax rate and this motive also affects the tax externalities. However, as it will become clear in section 4, the mechanism relevant for our results is that a reduced risk in country i positively impacts the MNE's capital investment in country i and simultaneously leads to increased profit shifting to country j. These incentives remain intact even if we additional consider competition for mobile capital.

Even in the context of developed countries, tax revenue maximization is a reasonable assumption because low tax payments by MNEs not only cause revenue shortfalls, but also equality-of-treatment concerns exerting strong political and practical pressure to increase revenues from this source.[19] Finally, the primary purpose of this study is to explore why the relationship between corporate income tax rates and country risk changes with the level of development of a country. Although a more general welfare function, which also accounts for firm profits, will affect governments' optimal tax policy, there is no reason to believe that the inclusion of firm profits provides additional insights to explain the insights of Figure 1.

Tax revenues of government i are given by

$$T_i = t_i \pi_i^t = t_i p_i \left[f(k_i) - k_i + \mathbf{1} g \right]. \tag{9}$$

Differentiating (9) yields government i's optimal tax rate in implicit form

$$\frac{\partial T_i}{\partial t_i} = p_i \left[f(k_i) - k_i + \mathbf{1} g \right] + p_i t_i \left[[f'(k_i) - 1] \frac{\partial k_i}{\partial t_i} + \mathbf{1} \frac{\partial g}{\partial t_i} \right] = 0. \tag{10}$$

The optimal tax rate is determined by the standard trade off between the additional revenue generated by a marginal increase in the tax rate, the first term in (10), and the negative tax base effects defined by the terms in squared brackets in (10). Evaluating equation (10) at $t_i = 0$ implies that the negative second term is zero. Because the expected tax base is always positive at $t_i = 0$, countries always levy a positive tax rate in equilibrium, i.e. $t_i^* > 0$. Equation (10) illustrates that taxing incentives are qualitatively the *same* between any countries because the incentive to attract profits and thus to lower the tax rate prevails irrespective of a country's level of development. However, in the following we show that the MNE's ability to shift profits indeed qualitatively affects the outcome of the tax competition game and thus that countries *differ* in how aggressively they attract profits.

From the first-order condition in (10), we derive how a change in country i's and j's

[19] See, for example, the motivation for the OECD's base erosion and profit shifting (BEPS) initiative (OECD, 2013, Chapters 1 and 2).

risk level affect the optimal tax rate in country i. Totally differentiating (10) yields[20]

$$\frac{\partial t_i}{\partial p_i} = \frac{\frac{(1-p_i)\left[1+t_i-\frac{t_i(1-p_i)f'''(k_i)}{p_i(1-t_i)[f''(k_i)]^2}\right]}{p_i^3(1-t_i)^3f''(k_i)} + \frac{2t_i}{C_{gg}}}{SOC_{t_i}}, \tag{11}$$

$$\frac{\partial t_i}{\partial p_j} = -\frac{\frac{t_j}{C_{gg}}}{SOC_{t_i}} \geq 0, \tag{12}$$

where $SOC_{t_i} = \frac{(1-p_i)^2\left[2+t_i-\frac{t_i(1-p_i)f'''(k_i)}{p_i(1-t_i)[f''(k_i)]^2}\right]}{p_i^2(1-t_i)^4f''(k_i)} - \frac{2p_i}{C_{gg}} < 0$ is the second-order condition for the optimal tax rate in country i. The effect of a country i's own risk level has an ambiguous effect on its corporate income tax rate. The reason is that a reduction in country i's risk level (an increase in p_i) exerts two opposing effects on country i's tax base. First, it increases the marginal product of capital and thus features a positive impact on country i's tax base due to larger investment. This implies a reduced tax sensitivity of investments if $f'''(k_i)$ is not too large, which we assume in the following (first term in the numerator of (11)).[21] Second, an increase in p_i also increases the MNE's incentive to shift profit to country j because of the higher expected tax burden in country i (second term in the numerator of (11)).

Equation (12) states that an increase in p_j exerts a non-negative effect on country i's tax rate. This is because a change in p_j has no effect on capital investment in country i, cf. (6), and hence, only the effect emerging through profit shifting matters. A decline in country j's risk level (a rise in p_j) increases the MNE's incentive to shift profit from country j to country i due to the higher expected tax burden in country j. This augments the tax base in country i and, in turn, country i's taxing incentives.

Because we are interested in whether the tax rate setting changes with the countries' level of development, we focus in the following analysis on two distinct cases. For

[20] A full derivation can be found in Appendix A.1.

[21] Obviously, this holds for the case of a quadratic production function, which implies $f'''(k_i) = 0$. For the case of a logarithmic function of the form $f(k_i) = \alpha ln(1+k_i)$, we get, after inserting optimal investment, $\frac{t_i(1-p_i)f'''(k_i)}{p_i(1-t_i)[f''(k_i)]^2} = \frac{t_i(1-p_i)}{1-p_it_i} \leq 1$, which is always smaller than $1+t_i$. For the case of a Cobb-Douglas function of the form $f(k_i) = \alpha(k_i)^\varepsilon$, we get, after inserting optimal investment, $\frac{t_i(1-p_i)f'''(k_i)}{p_i(1-t_i)[f''(k_i)]^2} = \frac{(2-\varepsilon)p_i(1-t_i)}{(1-\varepsilon)(1-p_it_i)}$. The latter term decreases in p_i, and thus a sufficient condition for $\frac{\partial t_i}{\partial p_i} > 0$ to hold globally is $\varepsilon < 1-t_i$. Because $\varepsilon = \frac{f'(k_i)k_i}{f(k_i)}$, this condition implies that the production function has to be sufficiently inelastic.

the first case we assume that governments have extensive abilities to control profit shifting, which translates into very high concealment costs for multinational firms. The scenario best reflects the situation of developed countries, which usually have well-established institutions and therefore several measures at their disposal to limit the outflow of paper profits. Instead, in the second case we assume that governments have only limited abilities to prevent firms from profit shifting and to curb the outflow of paper profits. The second case refers to developing countries, which usually have only weak administrative capacities to curtail MNEs' profit shifting activities.

In the following, we analyze how asymmetries in countries' level of riskiness affect the tax competition game. Specifically, we evaluate how a change in the relative riskiness of a country impacts its optimal tax rate setting.

The first case of developed countries with well-established institutions and effective means to limit the outflow of paper profits is captured in our model by applying a high value for the δ parameter in the concealment cost function which implies

$$\frac{\partial t_i}{\partial p_i}|_{\delta\to\infty} = \frac{(1-t_i)\left[1+t_i-\frac{t_i(1-p_i)f'''(k_i)}{p_i(1-t_i)[f''(k_i)]^2}\right]}{p_i(1-p_i)\left[2+t_i-\frac{t_i(1-p_i)f'''(k_i)}{p_i(1-t_i)[f''(k_i)]^2}\right]} > 0, \tag{13}$$

$$\frac{\partial t_i}{\partial p_j}|_{\delta\to\infty} = 0. \tag{14}$$

Equations (13) and (14) define country i's taxing incentives if the risk level of either country changes and the profit shifting channel is eliminated. A decline in county i's risk level (a rise in p_i) has a positive impact on the country's taxing incentives (increases t_i) due to of the positive investment effect. The latter effect is the only one which prevails in the setting of prohibitively high concealment costs. An increase in country j's risk level has no effect on the optimal corporate income tax rate levied in county i because the MNE is unable to shift profits between countries if concealment costs are very high.

Equations (13) and (14) imply that the country with the lower risk level levies a higher tax rate than the country with the higher risk level. This can easily be seen by looking at the symmetric equilibrium in which both countries' risk levels and tax rates are equivalent. Starting from the symmetric equilibrium an increases in p_i (such that $p_i > p_j$) implies by equations (13) and (14) that country i will levy a higher tax rate

than country j. Essentially, only country i benefits from its lower country risk because of higher investments.

In the second case, we instead assume that governments have only very limited capabilities to fight firms' profit shifting behavior. That is, we assume that δ is very low. This set-up reflects the situation of developing countries best, which generally have only weak administrative structures and therefore are limited in their opportunities to prevent the MNEs' profit shifting activities. In a situation where concealment costs are negligible, profit shifting becomes the dominant channel determining countries' tax rate setting

$$\frac{\partial t_i}{\partial p_i}|_{\delta \to 0} = -\frac{t_i}{p_i} < 0, \tag{15}$$

$$\frac{\partial t_i}{\partial p_j}|_{\delta \to 0} = \frac{t_j}{2p_i} > 0. \tag{16}$$

A decline in country i's risk level (a rise in p_i) reduces country i's taxing incentives if the competition for paper profits is intense. The lower risk level in country i increases the MNE's expected tax payments in country i and in response the MNE shifts profits to country j. In contrast, a decline in country j's risk level (an increase in p_j) exerts positive taxing incentives for country i because the increase in the MNE's expected tax payments in country j induce the MNE to shift profits to country i.

Equations (15) and (16) imply that the country with the lower risk level levies a higher tax rate than the country with the higher risk level. Again this can be seen by looking at the symmetric equilibrium. Starting from a situation where $p_i = p_j$ and $t_i = t_j$, an increases in p_i (such that $p_i > p_j$) implies that country i will levy a lower tax rate than country j. Essentially, a relatively higher level of country risk allows the government to also levy a relatively higher tax rate because the tax elasticity of profit shifting is lower the higher the riskiness of the country (cf. (8)).

Finally, emerging economies are characterized by some capabilities to prevent an erosion of their tax base. In our set-up, emerging economies may be modeled by assuming an intermediate size for the costs of profit shifting, i.e. an intermediate level of δ. Accordingly, emerging economies face both types of taxing incentives, those faced by

well-developed and developing countries. This implies that the results for emerging economies are a convex combination of the results for developed and developing countries relatively weighted by the governments ability to curb profit shifting.

We summarize our findings in:

Proposition 1 *If competing countries are asymmetric in their risk profiles and the costs of profit shifting are sufficiently high (low), the country with the higher level of risk levies the lower (higher) tax rate. For intermediate costs of profit shifting whether the higher-risk or the lower-risk country sets the higher tax rate is ambiguous and depends on the magnitude of profit shifting.*

Proposition 1 is matched one-to-one by the descriptive evidence presented in Figure 1. For European countries, which have the highest quality institutions to curb profit shifting of MNEs (see Table 1), Figure 1 shows that lower-risk European countries (countries with a higher CRR value) levy, on average, a higher corporate income tax rate compared to higher-risk European countries (countries with a lower CRR value). For African countries, which have, on average, the weakest institutions and thus the weakest administrative capacities to prevent an erosion of their tax base (see Table 1), Figure 1 shows that lower-risk African countries levy, on average, a lower corporate income tax rate than higher-risk African countries.

Proposition 1 also helps to explain tax policies in emerging economies. Asian countries have, on average, better opportunities to curb profit shifting than Middle and South American countries (see Table 1). Therefore, the profit shifting effect should be more pronounced among Middle and South American countries and hence the correlation between corporate income tax rates and country risk should be less negative respectively more positive. Indeed, this result coincides with the observations in Figure 1 which shows that the correlation is slightly negative among Asian countries (a slight positive slope in Figure 1) while it turns positive for Middle and South American countries (a slight negative slope in Figure 1).

5 Implications for empirical tax competition research

In the previous section, we analyzed how country risk and corporate income tax rates are, on average, related to each other. In doing so, the analysis focused solely on the relative riskiness of countries. In this section, we investigate whether absolute risk levels are also relevant for determining country-by-country corporate tax incentives. The section is thus informative for the empirical literature on tax competition, which considers tax competition not exclusively between developed countries but also among emerging and developing economies.

Proposition 1 highlights that the relationship between corporate income tax rates and country risk can be determined unambiguously if the costs of profit shifting are either sufficiently high or low. In these two polar cases, the absolute level of country risk has no impact on the qualitative outcome of the tax competition game. For sufficiently high costs of profit shifting, the higher-risk country always sets a lower tax rate than the lower-risk country. This holds irrespective of the magnitude of the difference in risk levels between the two countries. Analogously, the magnitude of the risk difference between countries has no impact on the correlation between corporate income tax rates and countries' risk levels when the costs of profit shifting are sufficiently low.[22]

However, the case of intermediate costs of profit shifting differs from the two above cases with either sufficiently high or low concealment costs. With intermediate costs of profit shifting not only the relative riskiness between countries i and j determines whether country j sets the higher or lower tax rate, but also the absolute risk level of the country i matters. The explanation rests on the fact that the tax rate in country i is affected in a non-monotonic way if the risk level in country i, that is p_i, changes (cf. (11)). For high levels of country risk (low values of p_i) the tax rate in country i

[22]In our analysis we have assumed that governments' ability to curb profit shifting, δ, and country-risk, p_i, are uncorrelated. From Tables 2 to 5 in Appendix A.3 it becomes evident that δ and p_i are positively correlated. This relationship does not affect our results or Proposition 1 because only the relative riskiness of countries is relevant for them to hold. Moreover, a correlation between δ and p_i also has no qualitative impact on our subsequent results since competing countries' absolute risk level will change the outcome of the tax competition game even if δ and p_i are uncorrelated.

increases with p_i because the investment effect, i.e., the first term in the numerator of (11), dominates. Instead, for low levels of country risk (high values of p_i) the tax rate in country i decreases with p_i because the profit shifting effect, i.e., the second term in the numerator of (11), dominates.

In the following we highlight the relevance of the absolute risk level of a country by distinguishing between two scenarios. In the first scenario, we assume that country j's risk level is low (p_j is relatively high). Starting from a symmetric equilibrium, which implies that the risk level in country i is also low (p_i is also high), we show in Appendix A.2 that $\frac{\partial t_i}{\partial p_j} > 0$ and $\frac{\partial t_i}{\partial p_i} < 0$. Thus, the tax rate in country i (j) increases (decreases) when p_i declines because the profit shifting effect dominates when p_i is high initially. Hence, around the symmetric equilibrium of absolute low risk levels, a decline in country i's risk level (increase in p_i) implies $t_i > t_j$. Because $\frac{\partial t_i}{\partial p_i}$ changes its sign at some point as p_i decreases further (cf. (11)), the optimal tax rate in country i starts to decline and falls below t_i. This happens if the risk asymmetry between the two countries becomes sufficiently large. To summarize, if the risk level in one country remains low in absolute terms, the higher-risk country sets the higher (lower) tax rate if the asymmetry in country risk levels is small (sufficiently large).

In the second scenario, we assume that country j's risk level is high (p_j is relatively low) in absolute terms. Again, starting from a symmetric equilibrium, that is, a situation where the risk level in country i is high as well, we show in Appendix A.2 that an increase in p_i raises t_i at a faster rate than t_j. However, and similar to before, t_i starts to decline at some point as p_i increases due to the inverted U-shaped pattern of $\frac{\partial t_i}{\partial p_i}$ and falls below t_j. Again, this happens if the asymmetry in the risk profiles of the two countries gets sufficiently large. The major difference to the first scenario is that the lower-risk country sets the higher (lower) tax rate if the risk asymmetry is small (sufficiently large).

To illustrate our findings, we run simulations for the case of intermediate costs of profit shifting. We specify subsidiaries' production function as $f(k_i) = (\alpha - k_i)k_i$, with $\alpha = 10$ and evaluate the two scenarios analyzed above by assuming a low risk level for country a of $p_a = 0.75$ in the first scenario and a high risk level for country a of $p_a = 0.25$ in

the second scenario. We compute the optimal tax rates levied by country a and b for a variation in the risk level of country b, i.e., for varying p_b. In all simulations, the solid line represents the equilibrium tax rate of country a, t_a, whereas the dashed curves represent the equilibrium tax rate of country b, t_b. Moreover, we specify two values for the concealment cost parameter by fixing $\delta = 0.02$ and $\delta = 0.03$ to investigate how a change in the profit shifting incentives affects governments' taxing incentives.

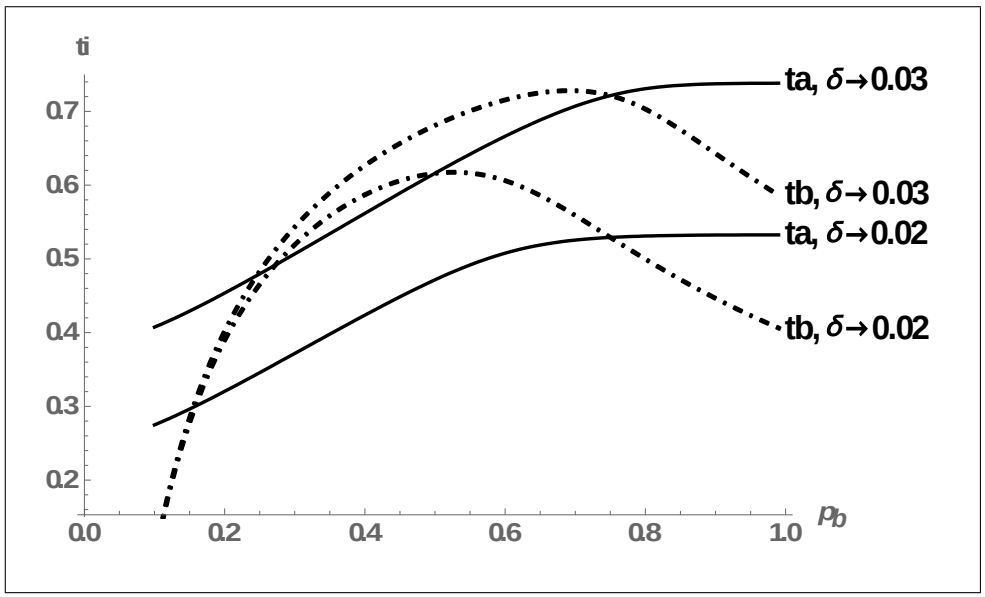


Figure 2: Optimal tax rates for $p_a = 0.75$

Figure 2 illustrates the results for the case when country a is a low-risk country (high p_a). The simulations shows an inverted U-shaped pattern of the equilibrium tax rate in country b as its level of riskiness varies as indicated by equation (11). Starting from a situation where the difference in the risk level of the two countries is relatively low (p_b close to 0.75), the country with the lower risk level (higher p_i) levies the lower tax rate. However, if the asymmetry in the risk profile between the two countries becomes very large, that is country b's risk level becomes sufficiently high, country b will levy the lower tax rate. In addition, if the costs of profit shifting decline, the asymmetry in the countries' risk profiles has to rise such that country b levies the lower tax rate.

Figure 3 provides an illustration of the optimal tax rates if country a is a high-risk country (low p_a). As before the relation between country b's risk level and its optimal tax rate is inverted U-shaped. Contrary to the case where country a is a relatively

low-risk country, the country with the higher risk level sets the lower tax rate when countries are not too asymmetric in their risk levels (p_b close to 0.25). However, if countries become very different in their risk levels, i.e., when p_b is substantially larger than p_a, it is optimal for country b to levy a lower tax rate than country a. Moreover, and contrary to the above case, a decline in the costs of profit shifting implies that country asymmetries become less relevant and the lower-risk country b will levy a lower tax rate even if countries become less asymmetric.

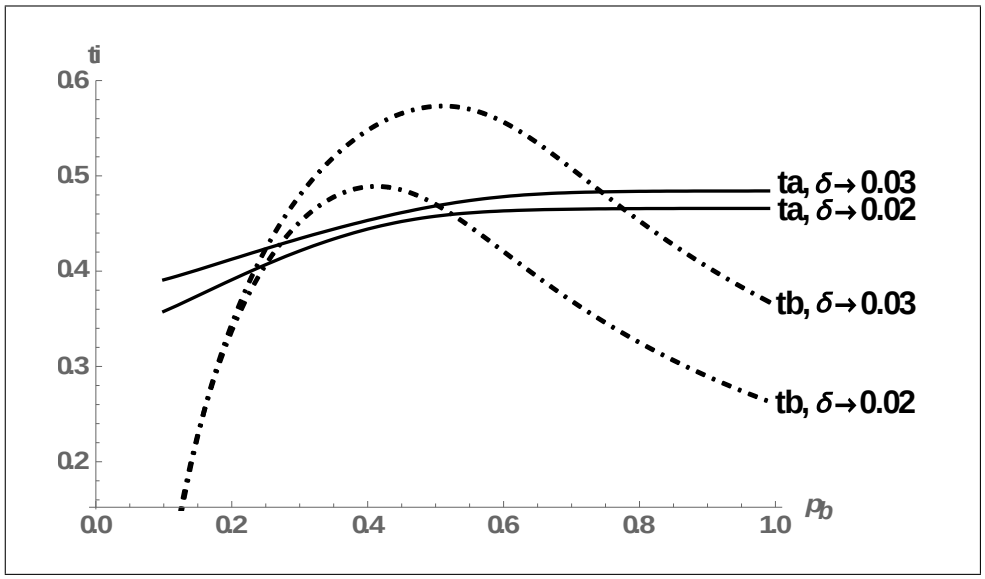


Figure 3: Optimal tax rates for $p_a = 0.25$

We summarize our findings in:

Proposition 2 *When competing countries are asymmetric in their risk profiles and the costs of profit shifting are of intermediate size,*

(i) the higher-risk country sets the higher (lower) tax rate if the risk asymmetry is small (sufficiently large) and the risk level in one country is low,

(ii) the lower-risk country sets the higher (lower) tax rate if the risk asymmetry is small (sufficiently large) and the risk level in one country is high.

Proposition 2 highlights that, besides countries' relative risk level, the absolute risk levels matter for the outcome of tax competition if MNEs have some leeway to engage

in profit shifting. Emerging countries are arguably characterized by institutions of intermediate quality and thus they may have some means to prevent an erosion of their tax base. Ultimately, Proposition 2 shows that the optimal tax policy of emerging countries crucially depends on the absolute level of country risk of their competing counterparts.

Against this background, we can relate Proposition 2 to the empirical literature on tax competition. In their meta-study, de Mooij and Ederveen (2003) find that a 1%-point reduction in the host-country's tax rate raises foreign direct investment (FDI) in that country by 3.3%. However, the variation of this effect varies drastically across the studies de Mooij and Ederveen consider in their meta-study. This may suggest that, among other things, sample selection plays a crucial role when quantifying the effect of corporate taxation on FDI.

In Proposition 1 we show that a country's level of development has a crucial impact on its tax setting behavior in tax competition. Thus, pooling countries with different stages of development in a single regression, as for instance done in earlier studies like Grubert and Mutti (1991) or Hines and Rice (1994), may produce confound estimates. Controlling for country risk is also not a cure since country risk affects tax competition in a qualitative manner. Following Proposition 1, it is sufficient to add an interaction term between the tax rate and country risk if solely developed or developing countries are considered because for these countries only the relative riskiness of the competitor is relevant. However, whenever emerging economies are involved in tax competition, Proposition 2 highlights that the absolute country risk levels are also a major determinant in the tax competition game. Therefore, it is not sufficient to simply include region dummies, to run separate regression analyses for countries with a different level of development, or to add an interaction term between country risk and tax rate. Instead, the interaction term between country risk and tax rate has to be conditioned on whether the competing country has a similar or a substantially different level of risk.

6 Discussion

In this section, we consider whether other channels could potentially explain the observed patterns of corporate income tax setting among countries and across regions displayed in Figure 1. In the spirit of Rincke and Mittermaier (2013), a first channel might be that countries compensate firms for country-specific risks by adjusting their tax rate. Rincke and Mittermaier (2013) show that governments compensate firms for the disadvantage of relatively high labor costs by setting lower tax rates. Resorting to the lift of the Iron Curtain as a natural experiment, they find that an increase in the the (labor) cost differential by one dollar induces governments to reduce their corporate income tax rate, on average, by one percentage point. A similar argument can be made in the context of country risk. Because governments need to compensate firms for the disadvantage of higher risk, higher-risk countries have to set lower corporate income tax rates to attract investment. Indeed, this argument can be brought forward to rationalize corporate income tax rate setting among European or even Asian countries as displayed in Figure 1. However, this channel in isolation is unable to explain why the relationship between corporate income tax rates and country risk becomes positive for Middle and South American as well as African countries. Specifically, among African countries it is the higher-risk countries which set, on average, the higher tax rate. Thus, the argument of compensating firms with lower tax rates in exchange for higher country risk cannot explain the broad picture of corporate tax patterns found in Figure 1.

Another channel through which country risk and corporate income tax rates might be connected is the existence of an informal sector, which is generally larger in developing than in developed economies. Auriol and Warlters (2005) argue that the informal sector is particularly large in developing countries because in these countries governments have an incentive to increases the firms' cost of entering the formal sector. Thereby, governments may reduce competition and generate rents in the formal sector, which they then confiscate through entry fees and taxes. Applying the argument to the context of our model, countries with weaker institutions have lower abilities to raise tax

revenues and thus have a higher need for tax revenue collection. As can be seen from the Tables in Appendix A.3, country risk is usually negatively correlated with the quality of institutions, i.e., lower-risk countries have, on average, better institutions. Against the background of our model, the argument of Auriol and Warlters would imply that higher-risk countries should, on average, have a higher need for tax revenues and thus set the higher tax rates. Indeed, corporate income tax rate setting among African or even Middle and South American countries can be rationalized using this argument. However, it is less obvious that this argument is also relevant in the context of more developed economies. Compared to the average size of the shadow economy in developing economies, which is estimated to be 39% relative to GDP, the shadow economy in OECD countries accounts for only 16.3% (see Schneider, 2004). Even if governments in developed countries abuse their tax policies to confiscate rents, the argument cannot explain why, among European or to a smaller extent among Asian countries, the *lower*-risk countries set, on average, higher tax rates.

In contrast, our analysis provides a single mechanism, which may explain the different patterns of corporate income taxation among countries with a varying level of development. In particular, we emphasize that the ability of MNEs to shift profits may constitute a major force driving countries' actual corporate income tax policies.

7 Conclusion

In this paper we analyze tax competition between two asymmetric countries. The asymmetry between countries culminates in country-specific risks multinational firms are exposed to and which affect both the firms' investment and profit shifting strategies. We show that a country's optimal tax rate setting crucially depends on the ability of multinational firms to shift profits. In developed regions where governments have good capabilities to curb firms' profit shifting activities, higher-risk countries set lower tax rates than lower-risk countries. The opposite is true for regions with limited opportunities to curb firms' profit shifting behavior, which likely reflects the situation of most developing countries. Our results highlight that tax competition among devel-

oping countries results in an outcome where higher-risk countries set higher tax rates than lower-risk countries. The different findings of our model integrate smoothly with the actual patterns of corporate income tax setting observed for developing, emerging and developed countries. Thus, we claim that our model provides a sound explanation for the observed differences in corporate income tax rate policies of countries differing in their level of development.

Finally, our results may be informative for future research in empirical tax competition. We argue that because country risk qualitatively affects taxing incentives, previous studies may suffer from a potential bias in the tax sensitivity of FDI. This implies that running separate analysis for developed, emerging and developing countries may not be sufficient. Moreover, whenever emerging countries are involved in tax competition, absolute risk levels between competing countries are a major determinant in shaping optimal tax policies.

A Appendix

A.1 Change in optimal tax rates with country risk

Totally differentiating the government's first-order condition yields

$$\begin{aligned}
&\left\{2\left[[f'(k_i)-1]\frac{\partial k_i}{\partial t_i}+\mathbf{1}\frac{\partial g}{\partial t_i}\right]+t_i\left[f''(k_i)\left(\frac{\partial k_i}{\partial t_i}\right)^2+[f'(k_i)-1]\frac{\partial^2 k_i}{\partial (t_i)^2}+\mathbf{1}\frac{\partial^2 g}{\partial (t_i)^2}\right]\right\}dt_i\\
&+\left\{[f'(k_i)-1]\frac{\partial k_i}{\partial p_i}+\mathbf{1}\frac{\partial g}{\partial p_i}+t_i\left[f''(k_i)\frac{\partial k_i}{\partial p_i}\frac{\partial k_i}{\partial t_i}+[f'(k_i)-1]\frac{\partial^2 k_i}{\partial t_i \partial p_i}+\mathbf{1}\frac{\partial^2 g}{\partial t_i \partial p_i}\right]\right\}dp_i\\
&+\left\{[f'(k_i)-1]\frac{\partial k_i}{\partial p_j}+\mathbf{1}\frac{\partial g}{\partial p_j}+t_i\left[f''(k_i)\frac{\partial k_i}{\partial p_j}\frac{\partial k_i}{\partial t_i}+[f'(k_i)-1]\frac{\partial^2 k_i}{\partial t_i \partial p_j}+\mathbf{1}\frac{\partial^2 g}{\partial t_i \partial p_j}\right]\right\}dp_j=0.
\end{aligned} \tag{A.1}$$

Using equations (5), (6), (8), and the simplifying assumption that the third derivatives of the concealment cost function are zero, the expression in (A.1) simplifies to

$$\begin{aligned}
&\left\{\frac{(1-p_i)^2\left[2+t_i-\frac{t_i(1-p_i)f'''(k_i)}{p_i(1-t_i)[f''(k_i)]^2}\right]}{p_i^2(1-t_i)^4 f''(k_i)}-\frac{2p_i}{\delta}\right\}dt_i\\
&-\left\{\frac{(1-p_i)\left[1+t_i-\frac{t_i(1-p_i)f'''(k_i)}{p_i(1-t_i)[f''(k_i)]^2}\right]}{p_i^3(1-t_i)^3 f''(k_i)}+\frac{2t_i}{\delta}\right\}dp_i+\frac{t_j}{C_{gg}}dp_j=0
\end{aligned} \tag{A.2}$$

Finally, the effect of a change in a country's risk level on tax rate t_i are given by

$$\frac{\partial t_i}{\partial p_i} = \frac{\frac{(1-p_i)\left[1+t_i-\frac{t_i(1-p_i)f'''(k_i)}{p_i(1-t_i)[f''(k_i)]^2}\right]}{p_i^3(1-t_i)^3 f''(k_i)}+\frac{2t_i}{\delta}}{\frac{(1-p_i)^2\left[2+t_i-\frac{t_i(1-p_i)f'''(k_i)}{p_i(1-t_i)[f''(k_i)]^2}\right]}{p_i^2(1-t_i)^4 f''(k_i)}-\frac{2p_i}{\delta}}, \tag{A.3}$$

$$\frac{\partial t_i}{\partial p_j} = -\frac{\frac{t_j}{C_{gg}}}{\frac{(1-p_i)^2\left[2+t_i-\frac{t_i(1-p_i)f'''(k_i)}{p_i(1-t_i)[f''(k_i)]^2}\right]}{p_i^2(1-t_i)^4 f''(k_i)}-\frac{2p_i}{\delta}}. \tag{A.4}$$

A.2 Tax rates and country risk with intermediate costs of profit shifting

Starting from a symmetric equilibrium where $p_i = p_j = p$ is high, using equations (A.3) and (A.4), a change in p_i and p_j will affect t_i by

$$\begin{aligned}
\frac{\partial t_i}{\partial p_i}|_{p\to 1} &\to -t<0,\\
\frac{\partial t_i}{\partial p_j}|_{p\to 1} &\to \frac{t}{2}>0.
\end{aligned} \tag{A.5}$$

Hence, in a symmetric equilibrium a change in a country's own risk level exerts a negative effect on its tax rate whereas a change in the other country's risk level exerts a positive effect on its tax rate. Therefore, a rise in country i's risk level leads to a decrease in t_i and an increase in t_j if the countries' initial risk level is very low. Starting from a symmetric equilibrium, a rise in p_i results in $t_j > t_i$ for countries with low levels of risk.

Doing the same exercise, but for an evaluation of high risk levels yields

$$\begin{aligned} \frac{\partial t_i}{\partial p_i}|_{p\to 0} &\to \infty, \\ \frac{\partial t_i}{\partial p_j}|_{p\to 0} &\to 0. \end{aligned} \tag{A.6}$$

For countries with high levels of risk, a change in a country's own risk level exerts a stronger effect on its own tax rate than a change in the other country's risk level. This result is based on the assumption that $f'''(k_i)$ is not too large and positive, implying a positive numerator in (A.3). Hence, a change in country i's risk level leads to a stronger increase t_i as compared to t_j if the countries' initial risk level is very high. Starting from a symmetric equilibrium, a rise in p_i results in $t_i > t_j$ for countries with high levels of risk.

A.3 Tables

Table 2: Country risk and corporate income tax rates of European countries

Country	**Country risk rating**	**Corporate tax rate**	**Gov. eff.**
Norway	93.44	28	1.84
Luxembourg[a]	91.69	28.80	1.74
Switzerland[a]	90.31	18.31	1.87
Denmark	89.21	25	2.11
Sweden	88.74	26.30	1.97
Finland	86.96	26	2.26
Netherlands	86.67	25	1.79
Germany[a]	84.98	29.37	1.55
Austria	84.01	25	1.61
France	80.90	33.33	1.37
United Kingdom	80.22	26	1.55
Belgium	77.81	33	1.66
Cyprus	77.02	10	1.57
Malta	75.27	35	1.21
Czech Republic	74.77	19	0.93
Slovenia	74.45	20	0.99
Slovakia	73.42	19	0.83
Italy[a]	71.20	31.4	0.38
Poland	70.99	19	0.62
Spain	66.71	30	1.03
Ireland	62.33	12.5	1.45
Portugal	61.35	25	0.96
Iceland	59.84	18	1.58
Hungary	59.67	19	0.67
Estonia	58.79	21	1.10
Lithuania	57.05	15	0.72
Croatia	56.51	20	0.56
Bulgaria	53.82	10	0.11
Latvia	52.47	15	0.71
Greece	52.38	20	0.50
Romania	49.09	16	-0.31
Serbia	44.34	10	-0.10
Macedonia	44.23	10	-0.11
Ukraine	43.97	23	-0.81
Albania	42.77	10	-0.20
Belarus	39.84	24	-1.10
Montenegro	37.97	9	0.10
Moldova	35.46	0	-0.60

Table 3: Country risk and corporate income tax rates of Asian countries

Country	**Country risk rating**	**Corporate tax rate**	**Gov. eff.**
Singapore	87.48	17	2.17
Hong Kong	84.84	16.5	1.67
Taiwan	80.04	17	1.15
Qatar	75.53	10	0.78
Macau	75.52	12	1.31
Japan[a]	74.66	40.69	1.47
South Korea	72.28	22	1.26
Kuwait	70.47	15	0.02
Oman	67.65	12	0.27
Israel	66.83	24	1.33
Bahrain	65.65	0	0.55
Saudi Arabia	65.12	20	-0.32
Malaysia	64.75	25	1.03
China	63.55	25	0.10
Thailand	63.00	30	0.21
India	58.60	30	0.00
Indonesia	58.27	25	-0.25
Turkey	57.07	20	0.36
Russia[a]	56.83	20	-0.46
Sri Lanka	54.86	28	-0.10
Philippines	54.46	30	0.08
Brunai Darussalam	51.81	22	0.89
Jordan	50.42	14	0.09
Armenia	49.66	20	-0.10
Vietnam	49.46	25	-0.23
Kazakhstan	47.91	20	-0.43
Georgia	47.77	15	0.55
Azerbaijan	46.95	25	-0.76
Lebanon	43.53	15	-0.26
Pakistan	34.94	35	-0.81
Bangladesh[a]	33.26	27.5	-0.76
Iraq	30.95	15	-1.15
Cambodia	26.45	20	-0.85
Uzbekistan	25.10	9	-0.72
Afghanistan	23.65	20	-1.46
Myanmar[d]	21.38	30	-1.63
Laos	9.52	35	-0.85

Table 4: Country risk and corporate income tax rates of African countries

Country	**Country risk rating**	**Corporate tax rate**	**Gov. eff.**
South Africa	59.20	28	0.41
Botswana[a]	54.00	22	0.48
Morocco	51.28	30	-0.15
Namibia	47.65	34	0.07
Tunisia	45.41	30	0.03
Gabon	44.85	35	-0.81
Mauritius	44.78	15	0.86
Ghana	44.71	25	-0.05
Nigeria	42.05	30	-1.08
Egypt	41.63	20	-0.57
Seychelles	40.27	33	0.26
Algeria[b]	39.50	25	-0.57
Mozambique	38.79	32	-0.62
Kenya	38.71	30	-0.57
Ethiopia	38.52	30	-0.47
Tanzania	36.36	30	-0.63
Uganda	35.77	30	-0.51
Angola	34.53	35	-1.15
Malawi	34.31	30	-0.44
Madagascar	33.97	22	-1.02
Zambia	32.83	35	-0.64
Senegal	31.84	25	-0.47
Cameroon	30.18	38.5	0.88
Sudan[a]	29.33	35	-1.39
Congo, Rep. of	28.89	36	-1.20
Guinea	28.31	35	-1.15
Congo, Dem. Rep. of	22.51	40	-1.68
Côte d'Ivoire	21.88	25	-1.13
Lesotho	21.73	35	-0.30
Swaziland	20.15	30	-0.67
Rwanda	18.36	30	0.07
Zimbabwe	16.87	25	-1.36
Chad[c]	13.72	40	-1.35
Mauritania	10.25	25	-0.93
Equatorial Guinea	8.53	35	-1.64

Table 5: Country risk and corporate income tax rates of Middle and South American countries countries

Country	**Country risk rating**	**Corporate tax rate**	**Gov. eff.**
Chile	73.61	20	1.25
Brazil[a]	63.22	34	-0.12
Panama	60.42	25	0.09
Colombia	58.72	33	0.06
Mexico	58.13	30	0.31
Peru	56.70	30	-0.15
Costa Rica	48.81	30	0.34
Uruguay	47.79	25	0.56
Honduras	46.34	25	-0.55
El Salvador	45.16	25	-0.11
Argentina	43.73	35	-0.14
Venezuela	42.47	34	-1.20
Paraguay	40.33	10	-0.84
Bolivia	37.76	25	-0.47
Trinidad and Tobago	37.02	25	0.32
Guatemala	35.72	31	-0.70
Barbados	35.13	25	1.46
Suriname[c]	33.57	36	-0.11
Ecuador	31.41	24	-0.59
Nicaragua	29.59	30	-0.90
Jamaica	29.02	33.33	0.22
Dominican Republic	28.33	25	-0.58

Notes to all tables:

[a] Data retrieve from KPMG's corporate tax table for the year 2011.

[b] Data retrieve from KPMG's corporate tax table for the year 2013.

[c] Data retrieved from EY worldwide corporate tax guide 2013.

[d] Data retrieved from EY worldwide corporate tax guide 2014.

References

Abadie A. and J. Gardeazabal, 2008. Terrorism and the world economy. European Economic Review 52, 1-27.

Abbas S.M.A. and A. Klemm, 2013. A partial race to the bottom: corporate tax developments in emerging and developing economies. International Tax and Public Finance 20, 596-617.

Auriol E. and M. Warlters, 2005. Taxation base in developing countries. Journal of Public Economics 89, 625-646.

Albuquerque R., 2003. The composition of international capital flows: Risk sharing through foreign direct investment. Journal of International Economics 61, 353-383.

Baer K., O. Benon and J. Toro, 2002. Improving large taxpayers' compliance: A review of country experience. IMF Occasional Paper No. 215, International Monetary Fund.

Becker J., C. Fuest, 2010. Taxing foreign profits with international mergers and acquisitions. International Economic Review 51, 171-186.

Besley T. and T Persson, 2011. Taxation and development. Handbook of Public Economics 5, 51-110.

Bucovetsky S., 1991. Asymmetric tax competition. Journal of Urban Economics 30, 167-181.

Crivelli E., R. De Mooij and M. Keen, 2016. Base erosion, profit shifting and developing countries. FinanzArchiv/Public Finance Analysis 72, 268-301.

de Mooij R.A. and S. Ederveen, 2003. Taxation and foreign direct investment: A synthesis of empirical research. International Tax and Public Finance 10, 673-693.

Desai M.A., C.F. Foley, J.R. Hines, 2004. A multinational perspective on capital structure choice and internal capital markets. Journal of Finance 59, 2451-2488.

Desai M.A., C.F. Foley, J.R. Hines, 2008. Capital structure with risky foreign investment. Journal of Financial Economics 88, 534-553.

Devereux M.P., B. Lockwood and M. Redoano, 2008. Do countries compete over corporate tax rates? Journal of Public Economics 92, 1210-1235.

Egger P. and M. Pfaffermayr, 2004. Distance, trade and FDI: A SUR Hausman-Taylor approach. Journal of Applied Econometrics 19, 227-246.

Emran M.S. and J.E. Stiglitz, 2005. On selective indirect tax reform in developing countries. Journal of Public Economics 89, 599-623.

Fuest C., S. Hebous and N. Riedel, 2011. International debt shifting and multinational firms in developing economies. Economics letters 13, 135-138.

Fuest C., B. Huber and J. Mintz, 2005. Capital mobility and tax competition, Foundations and Trends in Microeconomics 1, 1-62.

Fuest C. and N. Riedel, 2012. Tax evasion and tax avoidance in developing countries: The role of international profit shifting. In: Reuter P. (editor): Draining development? The sources, consequences and control of flows of illicit funds from developing countries, The World Bank.

Giavazzi F. T. Jappelli and M. Pagano, 2000. Searching for non-linear effects of fiscal policy: Evidence from industrial and developing countries. European Economic Review 44, 1259-1289.

Gordon R. and W. Li, 2009. Tax structures in developing countries: Many puzzles and a possible explanation. Journal of Public Economics 93, 855-866.

Gresik T.A., D. Schindler and G. Schjelderup, 2015.The effect of tax havens on host country welfare. CESifo Working Paper No. 5314.

Grubert H. and J. Mutti, 1991. Taxes, tariffs and transfer pricing in multinational corporate decision making. Review of Economics and Statistics 73, 283-285.

Haufler A. and F. Stähler, 2013. Tax competition in a simple model with heterogeneous firms: How larger markets reduce profit taxes. International Economic Review 54, 665-692.

Hines J.R. and E. Rice, 1994. Fiscal paradise: Foreign tax havens and American business. Quarterly Journal of Economics 109, 149-182.

Hines J.R., 2005. Do tax havens flourish? in: Poterba J.M. (ed.), Tax policy and the economy 19, Cambridge: MIT Press.

IMF, 2011. Revenue mobilization in developing countries. The International Monetary Fund, Washington D.C..

Janeba, E., 2002. Attracting FDI in a politically risky world. International Economic Review 43, 1127-1155.

Johannesen N., T. Tørsløv and L. Wier. Are less developed countries more exposed to multinational tax avoidance? WIDER Working Paper 2016/10, revised version May 2017.

Keen M., 2008. VAT, tariffs, and withholding: Border taxes and informality in developing countries. Journal of Public Economics 92, 1892-1906.

Keen M., 2012. Taxation and development – again. IMF Working Paper WP/12/220.

Keen M. and M. Mansour, 2010. Revenue mobilisation in Sub-Saharan Africa: Challenges from globalisation II - Corporate taxation. Development Policy Review 28, 573-596.

Lucas, R. E., 1990. Why Doesn't Capital Flow from Rich to Poor Countries?. American Economic Review 80, 92–96.

Mardan M., 2017. Why countries differ in thin capitalization rules: The role of financial development. European Economic Review 91, 1-14.

Mody A. and K. Srinivasan, 1998. Japanese and US firms as foreign investors: do they march to the same tune? Canadian Journal of Economics 31, 778-799.

OECD, 2013. Action plan on base erosion and profit shifting. OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264202719-en.

Raff H. and K. Srinivasan, 1997. Tax incentives for import-substituting foreign investment: Does signaling play a role? Journal of Public Economics 67, 167-193.

Rincke J. and F. Mittermaier, 2013. Do countries compensate firms for international wage differentials? Journal of Public Economics 102, 23-36.

Sanjo Y., 2012. Country risk, country size, and tax competition for foreign direct investment. International Review of Economics and Finance 21, 292-301.

Schneider F.G., 2004. The size of the shadow economies of 145 countries all over the world: First results over the period 1999 to 2003. IZA Discussion paper series No. 1431.

Tanzi V. and H.H. Zee, 2000. Tax policy for emerging markets: Developing countries. National Tax Journal 53, 299-322.

Wei S.-J., 2000. How taxing is corruption on international investors? The Review of economics and statistics 82, 1-11.

Wilson J.D., 1991. Tax competition with interregional differences in factor endowments. Regional Science and Urban Economics 21, 423-451.

Wilson J.D., 1999. Theories of tax competition. National Tax Journal 52, 269-304.