CHARLES UNIVERSITY

FACULTY OF SOCIAL SCIENCES

Institute of Economic Studies

Impact of tax rate differences on profits of US multinationals

Bachelor's thesis

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Academic Year: 2020/2021

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Prague, May 3, 2021

Matej Kvorka

Acknowledgments

I wish to express my deepest gratitude to doc. Petr Janský, M.Sc., Ph.D. for providing me with the necessary support and helpful insights. I would like to recognize the indispensable assistance of my parents during my studies.

Abstract

Profit shifting has become a global issue over the last decades. Multinational enterprises' profit-maximizing strategies negatively impact government revenues. In the model, we capture profit shifting incentives through international tax rate differences, considering the extent of economic activities and profit shifting costs. In this thesis, we exploit the country-by-country reporting data recently published by the Organisation for Economic Co-operation and Development. We estimate a semi-elasticity of reported profits with respect to the tax rate difference of 1.44. We calculate that US-based multinational enterprises shift between 74 and 186.7 billion dollars out of the United States. Contrary to our expectations, we do not find US-based multinational enterprises to be more sensitive to tax rate differences compared to other countries covered in the dataset. Finally, we express the need for the transformation of our tax variable to account for non-linearities.

JEL Classification	F65, H20, H22, H26
Keywords	tax havens, effective tax rate, tax avoidance, gravity model, multinational enterprises

Title	Impact of tax rate differences on profits of US multinationals

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Abstrakt

Presun ziskov sa stal v minulých desaťročiach celosvetovým problémom. Stratégie na maximalizáciu ziskov medzinárodných spoločností negatívne ovplyvňujú vládne príjmy. V modeli zachytávame dopad medzinárodných rozdielov v daňovej sadzbe na ziskovosť podnikov, berúc do úvahy mieru ekonomickej aktivity spoločností a náklady presunu ziskov. V tejto práci využívame dáta publikované Organizáciou pre hospodársku spoluprácu a rozvoj. Vzhľadom na rozdiel daňových sadzieb odhadujeme semielasticitu vykázaného zisku na 1.44. To nám umožní vypočítať, že americké nadnárodné spoločnosti presunuli 74 až 186.7 miliárd dolárov z Ameriky. Napriek našim očakávaniam nezisťujeme zvýšenú citlivosť ziskov amerických nadnárodných spoločností na rozdiel daňových sadzieb v porovnaní s ostatnými krajinami v našich dátach. Nakoniec vyjadrujeme potrebu transformovať daňovú premennú aby zachytávala nelineárne závislosti.

Klasifikácia JEL	F65, H20, H22, H26
Kľúčové slová	daňové raje, efektívna daňová sadzba, daňové úniky, gravitačný model, medzinárodné spoločnosti

Názov práce	Vplyv rozdielu daňových sadzieb na zisky amerických medzinárodných spoločností

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Acronyms

BEA Bureau of Economic Analysis

BEPS Base Erosion and Profit Shifting

BIC Bayesian Information Criterion

BLS Bureau of Labor Statistics

CbCR Country by Country Reporting

CEPII Centre d'Etudes Prospectives et d'Informations Internationales

DOC Department of Commerce

ETR Effective Tax Rate

G20 Group of Twenty

MNE Multinational Enterprise

IMF International Monetary Fund

IRS Internal Revenue Service

OECD Organisation for Economic Co-operation and Development

OLS Ordinary Least Squares

SOI Statistics of Income

WTO World Trade Organization

Chapter 1

Introduction

Globalization has two faces. On the one hand, it has increased productivity and well-being in most countries. On the other, there are more incentives and tools for companies to exploit the international tax system by shifting profits to low tax jurisdictions to boost their global after-tax income.

There are several ways for corporations to avoid taxation. Beer et al. (2019) suggested various international channels of tax avoidance. As the most important, we consider inflating transfer prices from low tax to high tax jurisdictions, locating intellectual property such as trademarks, copyrights, and patents into countries where they are taxed at lower rates, and debt shifting via intracompany loans. These methods are known as profit shifting. As a result of these practices, affiliates in tax havens are far more profitable than their peers located in the rest of the world. However, as Hines and Rice (1994) pointed out, minimizing the tax burden is not the same as maximizing profits, which is the ultimate goal of corporations. Only a combination of low taxes with a high degree of financial secrecy and advanced technological infrastructure is desired to attract businesses with profit shifting incentives. Thus in this thesis, we use the list of tax havens classified by Gravelle (2009) that combines these factors and has become a flagship categorization in the current literature.

The presence of profit shifting has been acknowledged for decades. However, the financial crisis, which forced global companies to be bailed out by local governments, combined with the presence of scandals (Panama papers, LuxLeaks and Swiss Leaks), which uncovered sheltering of corporate and private wealth in low tax jurisdictions, raised public attention and caused outrage around the world. In October 2015, the Organisation for Economic Cooperation and Development (OECD) responded with the Base Erosion and Profit Shifting Project (BEPS) that tackles international tax avoidance. BEPS consists of 15 Action plans. BEPS Action 13 requires every large multinational enterprise (MNE) to compose a country-by-country report (CbCR) with aggregated data about economic activity in tax jurisdictions where it operates. These reports are shared with tax administrators for internal usage. However, the Internal Revenue Service (IRS) published aggregated country-level data of the majority MNEs headquartered in the USA.

The following year, the OECD published the data of its members with the same structure as IRS's. This data, taking into account its limitations, are of excellent quality. Recent papers by Dowd et al. (2017), Clausing (2020), and Garcia-Bernardo et al. (2021) conducted rigorous analyses with different methodologies and came to the conclusion that the level of tax rates is associated with the profitability of MNEs.

As regards the structure of this thesis, chapter two dispenses an exhaustive overview of the current literature and existing methodologies related to the topic. Chapter three provides the theoretical background to the used methodology, which was developed by Hines and Rice (1994) and adjusted by Huizinga and Laeven (2008). We describe step by step the way we constructed variables used in the model. Chapter four provides the description of the data, its limitations as well as our adjustments to mitigate the impact of outliers. In the fifth chapter, we estimate the model, conduct sensitivity and robustness checks and use our estimates to calculate the value of profits shifted by US MNEs. We will not calculate the tax revenue loss due to the complexity of the tax system of the United States. Chapter six concludes.

Chapter 2

Literature Review

The primary data source of this thesis is a result of the Base Erosion and Profit Shifting project, whose final report was published in 2015. Section one of this chapter describes the needs of this project as well as its most important stages. Section one is followed by the description of models used in studies of profit shifting and tax policies.

As a flagship model, we consider the model introduced by Hines and Rice (1994). Section 2 of this chapter summarises their work as well as consequent studies whose empirical benchmark is this model and its modifications. As opposed to this method, we chose the misalignment model, which has been used recently by Cobham and Janský (2018). This approach is based on a comparison of the relative size of economic activity to the relative profit reported in each jurisdiction. The selection of this model in this thesis rests on its different computation method compared to the model proposed by Hines and Rice (1994) and robustness to outliers due to its linear nature. Moreover, its concept is used in this thesis for redistribution of misaligned profits back to tax jurisdictions, where they are supposed to be initially created, based on real economic activity of large multinationals enterprises there.

2.1 OECD BEPS Project

The effects of globalization on the world economy are apparent. It has encouraged international trade, created new investment opportunities, boosted the world's GDP, and raised the standard of living of millions of people. Although globalization is not a new concept, technological development has accelerated this process over the last decades and created new challenges for governments, corporations, and individuals. Corporations have found new ways to minimize the tax burden in a race of maximizing their after-tax profit, but at what cost. Tax avoidance has become a global issue and harms all parties. Governments lose tax revenues and lack resources to invest and stimulate economic growth as well as redistribute social welfare. Individuals must pay greater taxes to offset this loss of tax revenue caused by profit shifting of corporations. Moreover, companies are affected as well due to the reputational risk they take (OECD, 2013). Recent scandals (LuxLeaks, Panama Papers, SwissLeaks), which have shown the extent of the tax avoidance of both personal and corporate income, have stressed the need to step in.

Base erosion and profit shifting (BEPS) indicates tax planning strategies of multinational corporations to exploit international tax rules in order to minimize their tax burden. According to the OECD, countries lose from 100 to 240 billion dollars in tax revenue due to profit shifting activities. However, it should be noted that these activities are mostly legal. As a response, finance ministers of the group of twenty (G20) delegated the OECD to establish an Action plan to equip countries with tools to cope with BEPS in a coordinated manner (OECD, 2013). More than 135 countries have been part of this project so far. This project consists of 15 Actions to address gaps in international taxation rules, prevent double non-taxation and help to align paid taxes with countries where real economic activity takes place.

Although all action plans cope with several issues of international taxation, the role of third countries in bilateral tax treaties, channels of profit shifting, and misinterpreting of arm's length principle, the main focus of this thesis is pointed at Action 13, which requires multinational enterprises to share relevant information about the allocation of their economic activity and income with tax administrators.

The data about economic activity (number of employees, revenues, tangible assets, etc.), reported profit, and taxes should be aggregated on a country level basis where a multinational corporation operates. Although these documents are shared only with tax administrators and are not disclosed to the public, some corporations (Royal Dutch Shell, Vodafone, Eni, Repsol, etc.) release country-by-country reports (CbCR) as part of their public relations campaigns and might be a source for further research.

Nevertheless, our thesis conducts an analysis of the aggregated data from 2016 published by the Organisation for Economic Co-operation and Development about its 20 member and seven non-member countries. We complement this data with the report from 2017 published by the Internal Revenue Service (IRS), which covers more American MNEs and is more suitable for analysis compared to its forerunner from 2016.

2.2 The model

The model used in this thesis was developed by Hines and Rice (1994), who studied to what extent low tax rates explain abnormal reported profits of American corporations in tax havens. They question the sustainability of US tax policy with the presence of tax havens and means of American businesses to shift profits offshore. They suggest that assets may not be a good proxy of physical activity. They underline this statement by comparing the share of assets and employment of US affiliates in tax havens. They state that tax havens account for almost 27 percent of US affiliates' gross assets compared to a 4.3 percent share of employees there.

According to Gumpert et al. (2016), revenue might be another variable that poorly approximates real economic activity because it may be inflated through intrafirm transaction and transfer pricing during profit shifting activities. Clausing (2003) inspected the effect of taxes on the intrafirm import and export prices using the data gathered by the Bureau of Labor Statistics (BLS) from 1997 to 1999. She estimated that a one percent difference of effective tax rates (ETRs) between two countries caused an intrafirm export price from the country with a higher effective tax rate to be lower by 1.8 percent compared to non-intrafirm trade, holding other things constant.

On the other hand, import prices of intrafirm trades were inflated by two percent, contrasted to non-intrafirm transactions. She followed her previous work, Clausing (1998), where she showed that the USA has unfavourable intrafirm balances of trade with countries where is a lower tax rate. These operations boost firms' sales without underlying real economic activity. Hence we do not consider related party revenue nor total revenue as a good proxy of economic activity.

Hines and Rise (1994) conducted an analysis of the data published by the Department of Commerce (DOC) in 1982. Their model, whose development is with slight adjustments described in Chapter 3, is based on a profit-maximizing behaviour of corporate's after-tax global income. They incorporate the Cobb-Douglas production function:

$$Y = kA^{\alpha}L^{\beta}K^{\gamma}\epsilon^{\delta} \tag{2.1}$$

Where k is a constant term, A measures level of productivity of a country, L states labour, and K is capital input. δ is a stochastic term with normal distribution and zero mean. The model developed by Hines and Rice (1994) takes the form:

$$ln(P_j^r) = \beta_1 + \beta_2 ln(A_j) + \beta_3 ln(L_j) + \beta_4 ln(K_j) + \beta_5 t_j + \beta_6 t_j^2 + \delta_j \tag{2.2}$$

Where coefficients β_5 and β_6 reflect a linear and a quadratic semi-elasticity of reported profits with respect to tax rates, respectively. Let us give an example of the interpretation of these coefficients. For simplicity, we assume that β_6 equals zero. If β_5 is -0.8, then with a decrease of the tax rate by 1 percent, the reported profit rise by 0.8 percent, ceteris paribus. Although Hines and Rice included a quadratic term for tax rate in their equation, consequent studies were focused on the linear semi-elastic relationship of reported profits and tax rates.

However, Dowd et al. (2017) suggested that estimated elasticities based only upon log-linear specification may severely understate the sensitivity of reported profits with respect to tax rates in low tax jurisdictions and, in contrast, overstate its effect in high tax jurisdictions. His equation took structure as (2.2) with minor changes in proxy variables and the addition of country-level controls. He chose a tax variable of the form (1-t), which implies a different sign of coefficient estimate. The equation proposed by Dowd et al. (2017):

$$\begin{aligned} ln(P^r_{jt}) = \beta_1 + \beta_2 ln(K_{jt}) + \beta_3 ln(W_{jt}) + \beta_4 GPC_{jt} \\ + \beta_5 GPC^2_{jt} + \beta_6 POP_{jt} + \beta_7 POP^2_{jt} + (1-t)_{tj} + \mu_t + \delta_{jt} \end{aligned} \tag{2.3}$$

Where GPC states gross domestic product per capita and POP is population. He ran a regression on the entire dataset, which took the form of an unbalanced panel of a random sample of controlled foreign corporations of American multinationals, contributed by the Statistics of Income Division (SOI) and the IRS. Then he excluded tax havens and low-tax countries and re-estimated the same equation again. The coefficient of both statutory and average tax rate variables decreased significantly, caused by a possible non-linear semi-elasticity of reported profits and tax rates. Therefore he included a quadratic term $(1-Tax\ Rate)^2$ in the equation (2.3) to form a model that accounts for non-linear semi-elasticities:

$$\begin{aligned} ln(P_{jt}) = \beta_1 + \beta_2 ln(K_{jt}) + \beta_3 ln(W_{jt}) + \beta_4 GPC_{jt} \\ + \beta_5 GPC^2_{jt} + \beta_6 POP_{jt} + \beta_7 POP^2_{jt} + \beta_8(1-t_j) + \beta_9(1-t)^2_{tj} + \mu_t + \delta_{jt} \end{aligned} \tag{2.4}$$

Table 2.1: Estimation of the semi-elasticity of reported profits with respect to tax rates according to Dowd et al. (2017)

	$Equation$ 2.3	$Equation$ 2.4
$1 - TaxRate$	1.44	-10.73
$(1 - TaxRate)^2$	–	8.09

His estimates of the responsiveness of reported profits with respect to statutory tax rates from equations (2.3) and (2.4) are presented in the table (2.1).

Other researchers, Dharmapala and Riedel (2013), estimate a semi-elasticity of 1.13 using panel data for 25 European countries. Heckemeyer and Overesch (2013) conducted a meta-analysis of several studies to find a semi-elasticity of 0.8.

According to Dowd et al. (2017) estimates in the table (2.1), there is a different impact of a one percentage change in tax rates on reported net income in low and high tax countries, holding other factors constant. For example, let us assume three hypothetical countries with statutory tax rates of 3, 15, and 30 percent, respectively. In all of them, holding other factors constant, let us propose a one percentage point decrease in the statutory tax rate. What will be the expected effect on reported profits in hypothetical countries according to estimates in the table (2.1)?

If we assume only a linear semi-elasticity relationship between reported profits and statutory tax rates, an increase of 1.44 percentage points in reported profits would be expected for all mentioned countries. However, if we allow for a quadratic semi-elasticity, the estimated outcome is quite different. For a country with the lowest statutory tax rate, a decrease from 3 to 2 percentage points would boost reported profits by 5.04 percent. For the country with the 15 percent statutory tax rate, a similar policy would lead to an increase in reported profits by 3.1 percent. Finally, the country with the highest statutory tax rate would increase its reported profits by only 0.68 percent. It must be noted that this example is conducted under ceteris paribus condition and expected outcomes are "on average".

Garcia-Bernardo et al. (2021) accounted for an even more extreme non-linear relationship between reported profits and tax rates. They assumed that costs of profit shifting are more or less fixed. As a consequence, corporations seek countries with the lowest tax rates as a destination of shifted profits. Hence, Garcia-Bernardo et al. (2021) introduced the logarithmic designation of the semi-elasticity model and applied modified equation (2.2) on the aggregated cross-sectional CbCR data published by the OECD and the IRS. The equation proposed by Garcia-Bernardo et al. (2021) took the form:

$$\begin{aligned} ln(P_j^r) = \beta_1 + \beta_2 ln(POP_j) + \beta_3 ln(GPC_j) \\ +\beta_4 ln(TA_j) + \beta_5 ln(W_j) + \beta_6 t_j + \beta_7 ln(m + t_j) + \delta_j \end{aligned} \tag{2.5}$$

where TA states tangible assets and m is an offset parameter that minimizes the effects of extremely low tax rates. They get an optimal value of m by minimizing the Bayesian Information Criterion (BIC). They chose the effective tax rate (ETR) as a proxy component of the tax rate. They regarded the ETR as a better representation of the reality than the statutory tax rate. In each tax jurisdiction, the ETR is computed as a fraction of taxes accrued and reported profits. They ran an OLS regression on 2017 data of US MNEs and estimated the impact of ETRs on reported net profits. As an alternative, they estimated the equation (2.5), substituting the logarithmic term ln(m+t) by the quadratic term t^2. However, the equation with the logarithmic specification seemed to better explain the variation in reported profits (R^2=0.90) compared to the quadratic term (R^2=0.86) and had a lower BIC (222.58 and 253.21, respectively). In consideration of the results, they moved to quantify the influence of the tax rate on the whole dataset, consisting of several countries, which were part of the BEPS project. They estimated equation (2.5) modified by the inclusion of the interaction of country dummies with effective tax rates to determine which countries' MNEs are the most sensitive to ETRs. They found out that reported profits of US-based multinationals are the most sensitive to the tax rate under the logarithmic specification, as opposed to South African and Mexican corporations, which are the least. Thus they empirically confirmed suggestions of previous studies (Clausing, 2020) on the aggressiveness of tax planning strategies of US-based multinationals.

2.3 The composite tax variable

Huizinga and Laeven (2008) developed a new proxy of the tax variable, which took the form of a weighted tax rate difference between the countries where multinational corporations operate as an alternative to the level of the statutory and the effective tax rate. As a weighting structure, they formulated real economic activity, which is clearly not observed. They used a dataset from the Amadeus database containing information at the firm level on European multinational corporations combined by the top statutory tax rates. They followed Hines and Rice (1994) and built their model under the assumption of increasing marginal cost of profit shifting by the rate of $\frac{S_j}{B_j}$, where S_j states total shifted profit to a foreign tax jurisdiction and B_j is a "real" profit generated by economic activity in the country. It means that it is less costly to shift profits to or out of the country where multinational corporation actually operates, by minimization of costs on lawyers and tax advisors, who are hired to find tax policy loopholes and to allocate shifted profits without raising red flags at the tax administrator office. They followed Hines and Rice (1994) and assumed the global after-tax profit-maximizing behaviour of multinationals. However, they proposed that in addition to the level of the tax rate in a foreign jurisdiction, multinational corporations take into account the weighted tax difference of countries where they have actual economic activity. Huizinga and Laeven (2008), therefore proposed a composite tax variable, which summarized all of the information discussed above and took the form:

$$C_j = \frac{1}{1-t_j} \frac{\sum_{k=1}^{n} (\frac{B_k}{1-t_k})(t_j - t_k)}{(\frac{B_k}{1-t_k})} \tag{2.6}$$

Where real economic activity in a country (B_k) is not observed and must be approximated by a proxy variable. They used the firm's sales as a weighting scheme to construct C.

However, Grumpert et al. (2016) stressed that sales might be manipulated by related party transactions, especially transfer pricing policies. As opposed to the weighting scheme proposed by Huizinga and Laeven (2008), Fatica and Gregori (2020) used a number of employees as a proxy of "true" profits. By "true" they meant profits generated by real economic activity. They discussed other possible proxies of economic activity, for example, fixed assets, but due to the lack of data quality, they abandoned their implementation.

Nevertheless, both Huizinga and Laeven (2008) and Fatica and Gregori (2020) were concerned about the endogeneity of the weighting structure. As was previously shown by Hines and Rice (1994), tax rates seemed to have a non-negligible impact on the allocation of factors of production (Hines and Rice inspected the impact of tax rates on employment, equipment, and employee compensation). Fatica, who was motivated by the method used by Frankel and Romer (1999), dealt with a potential endogeneity problem by estimating a gravity model with turnover as a dependent variable. As a set of explanatory variables, he took geographic factors (population, the distance between tax jurisdictions, etc.), which are exogenous. As a new weighting structure for the composite tax variable he took predicted values for turnover from this regression. Nevertheless, estimates with the new weighting scheme were consistent with their previous results, leaving aside a potential endogeneity problem. On the other hand, Huizinga and Laeven (2008) tested several weighting schemes. They used a constant under the assumption of no relationship between profit shifting costs and real economic activity in the country, where the profit is being shifted. Consequently, they approximated real economic activity by total assets. Both alternatives yielded similar results to their estimate with sales as a proxy variable. Huizinga et al. (2008) and Fatica et al. (2020) benchmark estimates for the semi-elasticity of reported profits to the composite tax rate difference are 1.77 and 3.11, respectively. It must be taken into account that researchers worked with the different data. Fatica et al. (2020) restricted his dataset to banks, which they suspected to be more sensitive to the tax rate difference.

2.4 The misalignment model

The idea behind the misalignment model is that in the hypothetical world where corporations do not shift their profits to foreign tax jurisdiction, real economic activity would be perfectly correlated with reported profits. Although this assumption is non-realistic, it is a satisfactory empirical background for the development of an alternative measure of profit shifting activities. Compared to Hines' model, it does not necessarily need tax rates, only if an analysis of a tax revenue loss is conducted. Due to its linear nature, the misalignment model is preserved from the impact of outliers, and it is used in this thesis as an alternative method of measuring shifted profit to the main model. Moreover, following Garcia-Bernardo et al. (2021), we used the misalignment method for redistribution of shifted profits calculated via the main model. The misalignment model has been recently used by Cobham and Janský (2018) on the data of US multinational groups published by the BEA. As Cobham and Janský pointed out, a misaligned profit could be estimated in both relative and absolute terms. They proposed a formula for a relative measure:

$$\begin{aligned} &The\, relative\, intensity\, of\, distortion\, for\, profit\, misalignment \\ &= 1 - Correlation(Reported\, Profit,\; Economic\, Activity) \end{aligned} \tag{2.7}$$

In the world of the perfect alignment of profit, the relative intensity equals zero. According to Cobham and Janský, the relative intensity of distortion had been rising since 1994 and peaked during the financial crisis.

As for the main model, economic activity is not observed and must be approximated by a reasonable indicator. Cobham and Janský used several variables ranging from assets, employees, sales, and wages to a linear combination of sales, tangible assets, a number of employees, and compensation costs, originally proposed by the European Commission (2011). The formula for an estimation of the misaligned profit, according to Cobham and Janský (2018), takes the form:

$$\begin{aligned} &An\,estimate\,of\,Shifted\,Profit_j \\ &= Share\,of\,Economic\,Activity_j \times Global\,Reported\,Profit_j \\ &-Local\,Reported\,Profit_j \end{aligned} \tag{2.8}$$

If the estimate of the shifted profit is negative, then a country is a net receiver of the global misaligned profit. On the other hand, if it is positive, then there is an outflow of the profit out of the country. Using the misalignment model, Cobham and Janský estimated that the global misaligned profit of US multinationals ranges between 600 and 800 billion dollars in 2012. These results are consistent with previous studies conducted by researchers of the IMF, Crivelli et al. (2016).

Chapter 3

Model development

The model used in this thesis was proposed by Hines and Rise (1994) and extended to a multilateral environment by Huizinga and Laeven (2008). The main assumption is the possibility of separation of the reported profit in each country into the profit generated by real economic activity and the shifted profit. Each multinational enterprise then maximizes its global profit, consisting of the sum of the after-tax profit reported in each country where MNE operates. However, without an assumption of the cost of profit shifting, companies would shift all of their profits to a tax jurisdiction with the lowest tax rate.

Hence, we follow Hines and Rice (1994) and assume the marginal cost of profit shifting to each country: $cost_i = \gamma \frac{S_i}{B_i}$, where γ is a factor of proportionality, S_i are shifted profits and B_i are true profits generated by real economic activity. Hence, the cost of profit shifting rises with the total amount being shifted and decreases with the size of economic activity. The total cost of profit shifting then takes the form:

$$Cost_i = \gamma \frac{(S_i)^2}{2B_i} \tag{3.1}$$

Following Hines and Rice (1994), we assume the cost of profit shifting to be non-negative, nevertheless it is inward or outward. Finally, reported profit in each country consists of the sum of "real" profit and profit shifted, subtracted by the cost of profit shifting:

$$P_i = B_i + S_i - \gamma \frac{(S_i)^2}{2B_i} \tag{3.2}$$

Multinational enterprises maximize global after-tax profit given by the sum of reported profit in each country where they operate (3.2) multiplied by $(1 - t_i)$, where t_i states the tax rate of the country. We come to an optimization problem we solve with the method of Lagrange multiplier:

$$\begin{aligned} max \sum_{i=1}^{n} (1 - t_i) \left(B_i + S_i - \gamma \frac{(S_i)^2}{2B_i} \right) \\ subject\, to : \sum_{i=1}^{n} S_i \leq 0 \end{aligned} \tag{3.3}$$

Guided by Hines and Rice (1994) we arrive at the first-order condition with respect to S_i:

$$(1 - t_i) \left(1 - \gamma \frac{S_i}{B_i} \right) = \lambda, \quad for\, \forall\, i = 1, ..., n \tag{3.4}$$

Equations 3.3 and 3.4 state that marginal after-tax profits adjusted for profit shifting costs are equalized across all countries where the multinational enterprise operates. Hines and Rice (1994), from this point, derived equation (2.2) which takes into account the level of tax rates in tax jurisdictions. However, in this thesis, we follow Huizinga and Laeven (2008), who used equation (3.4) to derive the optimal amount of shifted profit for each country.

$$S_i = (B_i) \left(-\frac{1}{\gamma} \right) \left(\frac{1}{1 - t_i} \right) \left(\frac{\sum_{k=1}^{n} \left(\frac{B_k}{1 - t_k} \right) (t_i - t_k)}{\sum_{k=1}^{n} \left(\frac{B_k}{1 - t_k} \right)} \right) \tag{3.5}$$

Under assumptions that true profits are non-negative and tax rates $\in \langle 0,1\rangle$ is outward or inward profit shifting ($S_i < 0$ and $S_i > 0$, respectively) determined by weighted difference of tax rates: $\sum_{k=1}^{n}\left(\frac{B_k}{1-t_k}\right)(t_i - t_k)$. The third and the fourth term in equation (3.5) define the composite tax variable discussed in (2.6) and it is the key aspect of interest: $C_i = \left(\frac{1}{1-t_i}\right)\left(\frac{\sum_{k=1}^{n}\left(\frac{B_k}{1-t_k}\right)(t_i - t_k)}{\sum_{k=1}^{n}\left(\frac{B_k}{1-t_k}\right)}\right)$. As pointed out by Huizinga and Laeven (2008) tax jurisdictions where multinational has greater economic activity B_k have a bigger impact on the composite tax variable (C_i) and consequently shifted profit (S_i) because it is less difficult to shift profit in or out of this tax jurisdiction, ceteris paribus. Given that we assumed that reported profits are the sum of true and shifted profits (3.5) we can express them in the form:

$$P_i^r = B_i\left(1 - \frac{1}{\gamma}C_i\right) \tag{3.6}$$

Due to the fact that true profits B_i are unobserved, Hines and Rice (1994) incorporated the Cobb-Douglass production function as their approximation. Under these settings, true profits are the value of output minus the costs of labour: $B_i = Y_i - w_i L_i$. They substituted the output with Cobb-Douglas production function $Y_i = kA_i^{\epsilon}L_i^{\alpha}K_i^{\sigma}e^{u_i}$, where A_i^{ϵ} states the level productivity in each country. L_i^{α} and K_i^{σ} are levels of labour and capital, respectively. The last term in the Cobb-Douglas production function declares the error term. To maximize profit, a company hires labour until the marginal product of labour equals labour costs. Hence, we substitute wages (w_i) with the first derivative of the Cobb-Douglas production function with respect to labour. Finally, our approximation of true profits takes the form:

$$B_i = (1-\alpha)kA_i^{\epsilon}L_i^{\alpha}K_i^{\sigma}e^{u_i} \tag{3.7}$$

We plug B_i from (3.7) into (3.6). We take the logarithm of both sides of resulted equation yielding the expression $ln(P_i^r) = ln\left[(1-\alpha)kA_i^{\epsilon}L_i^{\alpha}K_i^{\sigma}e^{u_i}\left(1-\frac{1}{\gamma}C_i\right)\right]$. Using the product rule of the logarithm and the first-order Taylor polynomial for the linear approximation of the expression $\ln\left(1-\frac{1}{\gamma}C_i\right)$ we derive our benchmark equation:

$$ln(P_i^r) = \beta_1 + \beta_2 ln(A_i) + \beta_3 ln(L_i) + \beta_4 ln(K_i) + \beta_5 C_i + u_i \quad (3.8)$$

Where $\beta_1 = ln(k(1-\alpha))$, $\beta_2 = \epsilon$, $\beta_3 = \alpha$, $\beta_4 = \sigma \; and \, \beta_5 = -\frac{1}{\gamma}$. In the next chapter we state variables we used to estimate the equation (3.8) and describe the construction of the composite tax variable which is not directly observable nor accessible in public databases.

Chapter 4

Data

This chapter aims to summarize data sources, provides descriptive statistics of the data, as well as a consequent construction of the composite tax variable needed in our main model. This thesis works primarily with country-by-country data (CbCR) published by the OECD. It contains information from 2016 about headquarters and foreign subsidiaries of multinational enterprises of several countries participating the BEPS project, aggregated on the country level.

We discuss substantial and weak parts of this newly available dataset and complement it with additional variables needed for this thesis from credible sources (World Bank, CEPII and major consultancy companies). One of critical objects of this chapter is to construct the composite tax variable proposed by Huizinga and Laeven (2008) using both effective and statutory tax rates, which is discussed in the methodology part of this thesis.

4.1 The effective tax rate

CbCR dataset, which was published in July 2020 as the result of OECD BEPS Action 13, contains information about accrued taxes, profit before income tax as well as indicators of economic activity of multinational enterprises with at least 750 million euros in consolidated annual revenues, headquartered in one of the member states of the project.

The most significant advantage of the CbCR dataset is its completeness. For example, it covers 163 tax jurisdictions where MNEs headquartered in India operate, including low-income African countries whose data is scarce in most public datasets (BEA). Having this advantage, Garcia-Bernardo et al. (2021) suggested that low-income countries are the biggest losers of tax revenue relative to the size of their economy.

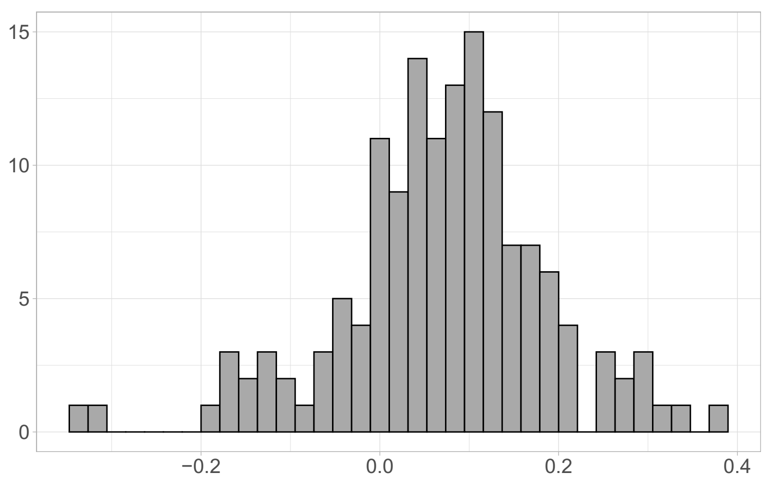
However, our primary concerns are data limitations for our analysis. As mentioned above, the CbCR data provide information on an aggregated level for tax jurisdictions. According to the disclaimer of the OECD (OECD, 2020), in order to provide some level of confidentiality for MNEs, information from tax jurisdictions, where does not operate enough number of MNEs, is aggregated to greater geographic regions consisting of several tax jurisdiction. This lack of detail leads to problems in the calculation of the composite tax variable, which key inputs are tax rates and suitable indicators of economic activity. Another problem might be possible double-counting of revenues and profits due to inclusion of stateless entities by some tax jurisdictions. To deal with this issue, we follow the approach of Clausing (2020) and exclude stateless entities from further analysis.

There is a possibility of splitting the CbCR data into subsamples with positive and negative profits. Subsample with positive profits contains only subsidiaries that reported positive profits. We follow the established approach and estimate ETRs on corporations reporting positive profits because the inclusion of ones with losses might bias ETRs upward. We substitute the data of US-based multinationals from 2016 with the data from 2017 already published by the IRS. It covers more MNEs and provides a better picture for further analysis. To estimate the ETR in each country, we use the formula:

$$ETR_j = \sum_{i=1}^{n} \left[\left(\frac{Tax\,Accrued\,Windsorized_{ij}}{Profit\,before\,Income\,Tax_{ij}} \right) \left(\frac{Profit\,before\,Income\,Tax_{ij}}{\sum_{k=1}^{n} Profit\,before\,Income\,Tax_{kj}} \right) \right] \tag{4.1}$$

Where the first index states headquarter country that reports operations in country j (the second index). Formula declares the ETR as an average tax rate weighted by profit before income tax. Although we included only subsidiaries with positive profit, some headquarter countries have jurisdictions that report negative aggregated accrued tax or accrued tax tops profit before income tax. Hence, we windsorize tax accrued to be equal to zero if its reported value is negative. On the other hand, if tax accrued is greater than profit before income tax, we windsorize it, so both terms are equal. Table (6.5) in the appendix shows calculated ETRs. However, we do not have enough information to calculate the ETR precisely enough for some countries. Therefore we substitute ETRs calculated on less than 5 million dollars profit or less than 4 MNEs with statutory tax rates. Observations with the substituted rate we use only for the construction of the composite tax variable. As an alternative to ETRs, we use statutory tax rates. Statutory tax rates are shown in the table (6.6) in the appendix. We conduct two separate analyses using both measures. We use tax summaries of KPMG, Deloitte, and the OECD as a primary source. Figure (5.1) is a histogram of the difference between the statutory and the effective tax rate. As expected, most values are positive because of the fact that MNEs might be exempted from some tax payments, which is not accounted for in the statutory tax rate.

Figure 4.1: Histogram of the difference between the statutory tax rate and the effective tax rate based on our sample.



Source: Author on the basis of the OECD data

4.2 The composite tax variable

A key variable of interest in this thesis is the composite tax variable proposed by Huizinga and Laeven (2008):

$$C_{ij} = \frac{1}{1-t_j} \frac{\sum_{k=1}^{n} (\frac{B_{ik}}{1-t_k})(t_j - t_k)}{\sum_{k=1}^{n} (\frac{B_{ik}}{1-t_k})} \tag{4.2}$$

Where n is a number of tax jurisdictions where corporations headquartered in the country i operate. It means that the value of n depends on i. For example, if India reports operations of its MNEs in 163 tax jurisdictions, then B_{ik} states the share of economic activity of subsidiaries of India-based multinational corporations in the country k, relatively to the total economic activity in all tax jurisdictions, including India.

However, as a proxy variable of economic activity, we do not use total revenue due to its connection with transfer pricing activities, Gumpert et al. (2016). As an alternative to sales, we propose the linear combination of the share of unrelated party revenues, number of employees, and tangible assets of tax jurisdiction k:

$$B_{ij} = \frac{1}{3} \left(\frac{Rev_{ij}}{\sum_{k=1}^{n} Rev_{ik}} + \frac{Emp_{ij}}{\sum_{k=1}^{n} Emp_{ik}} + \frac{Assets_{ij}}{\sum_{k=1}^{n} Assets_{ik}} \right) \tag{4.3}$$

The structure of the CBCR dataset causes the main problem for the calculation of C. For confidentiality issues, some reporting countries are aggregating tax jurisdictions with the low number of operating multinationals into bigger groups. For example, Finland provided information in disaggregated form only for domestic operations. All other tax jurisdictions are covered in "Foreign Jurisdiction Total". For the precise calculation of C, we need to know which countries are in these groups to link them with corresponding tax rate and the distribution of economic activity, neither of which we can directly access.

Let us come with an extreme example to show the severity of this problem. Let us assume that half of economic activity of MNEs is centered in Finland and the other half in foreign jurisdictions. For simplicity, this group covers only two countries with tax rates 0 percent and 25 percent, respectively. Figure (4.1) summarizes the effect of the distribution of real economic activity between these countries on the composite tax variable of Finland:

Table 4.1: Example of the problem of uncertainty in calculation of Cs

	Finland	Country A	Country B	Finland's C
Tax Rate	8.30%	0%	25%	-
Share of Economic Activity (Option 1)	50%	0%	50%	-9%
Share of Economic Activity (Option 2)	50%	50%	0%	5%

Source: Author

Apparently, it is crucial to have enough information about the distribution of tax rates and economic activity to estimate Cs precisely. There are two possible ways to cope with this problem. Firstly, we can take aggregated observations as independent tax jurisdictions and calculate effective tax rates (statutory tax rates are unavailable for obvious reasons). We find this approach too uncertain to use in the main part of this thesis. Alternatively, we may ignore aggregated observations and exclude them from the calculation of the composite tax variable.

To minimize the adverse effect of this approach on calculated Cs, we center our analysis on reporting countries, which publish the majority of economic activity in the disintegrated form. Until now, our dataset has included 26 reporting countries. The table below summarizes them with share economic activity in a non-aggregated form according to (4.3).

Table 4.2: Share of Economic Activity published in a non-aggregated form by country

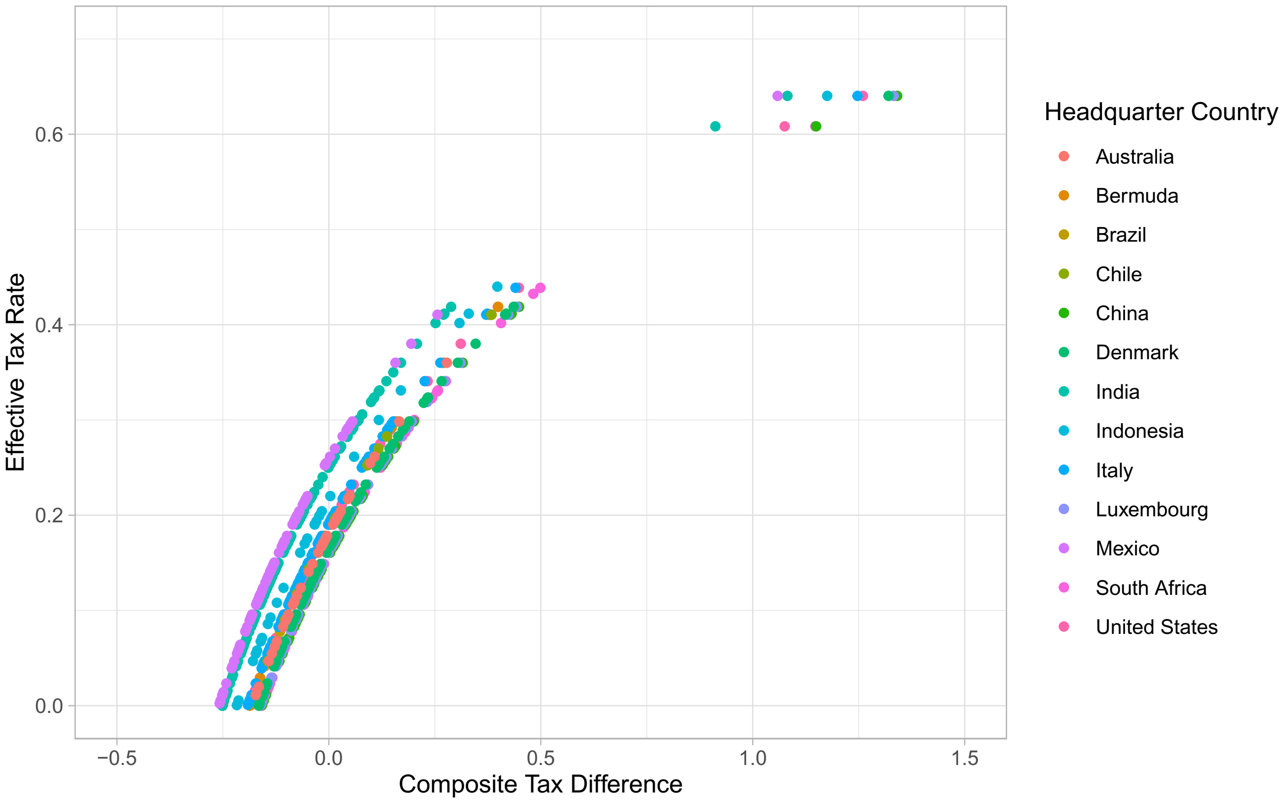
Tax Jurisdiction	Number of reported countries	Share of Economic Activity in a non-aggregated form
Australia	**39**	**96.4%**
Austria	1	39.2%
Belgium	32	86.4%
Canada	10	83.4%
Chile	**14**	**98.0%**
Denmark	**93**	**99.0%**
Finland	1	37.3%
France	32	75.6%
Ireland	1	26.6%
Italy	**77**	**97.7%**
Japan	12	79.6%
Korea	1	68.3%
Luxembourg	**79**	**97.5%**
Mexico	**73**	**100.0%**
Netherlands	1	18.3%
Norway	1	62.0%
Slovenia	5	87.1%
Sweden	1	27.1%
Bermuda	**57**	**98.0%**
Brazil	**41**	**96.1%**
China	**53**	**99.1%**
India	**134**	**100.0%**
Indonesia	**26**	**100.0%**
Singapore	22	91.8%
South Africa	**87**	**100.0%**
United States	**93**	**99.3%**

Source: Author on the basis of the OECD data

We select tax jurisdictions that report at least 95 percent of economic activity declared by (4.3) in the disaggregated form. We use both effective and statutory tax rates separately to construct two distinct composite tax variables. However, we substitute effective tax rates derived from less than four MNEs or less than 5 million dollars in reported profit. The idea behind it is that we use the effective rate because we believe that it better reflects the reality MNEs are facing. The substitution of rates that we calculated on a too small sample of corporations or profits is set to limit the presence outliers. In the end, out of 174 calculated effective tax rates, we substitute 28 of them, affecting approximately three percent of observations for construction of the composite tax variable.

Figure (4.2) shows the relationship between the effective tax rate and the composite tax variable. There seem to be different levels caused by the effective tax rate of headquarter country where a significant part of economic activity takes place.

Figure 4.2: The relationship between the effective tax rate and the composite tax variable



Source: Author on the basis of the OECD data

The relationship is clearly non-linear due to the term $\frac{1}{1-t_j}$ in (4.2). The figure (6.1) in the appendix shows the relationship between the statutory tax rate and the composite tax difference.

Chapter 5

Results

This chapter is composed of four parts. In the first part, we estimate the semi-elasticity of reported profit to the composite tax variable. As a benchmark model, we take (3.8) and, as a method of estimation, we use ordinary least squares (OLS). As an alternative to (4.3) we test a different weighting scheme for the computation of the composite tax variables. In the second part, we provide robustness checks of baseline estimates. We try to overcome the possibility of the endogeneity problem of our weighting structure. Following Fatica and Gregori (2020), who were motivated by Frakel and Romer (1999) we implement a two-step methodology to construct an exogenous weighting scheme. In the third part, we find out whether American-based MNEs are more sensitive to tax rate differences across countries where they operate. To do so, we include an interaction of a dummy variable for the USA and the composite tax variable. Finally, we employ our estimates to locate shifted profit of American-based MNEs. Inspired by Garcia-Bernardo et al. (2021) we utilize the misalignment methodology to redistribute shifted profit back to the location of its origin to calculate relative and absolute loss of the American tax base. To overcome possible non-linearities, we split the data into to two sub-samples indicating whether the tax jurisdiction is considered to be a tax haven or not. We re-estimate coefficients and calculate the shifted profit.

5.1 Baseline Results

Table (5.1) summarises estimates. As a dependent variable, we take the logarithm of reported profit before taxes. The sample is restricted to tax jurisdictions where the reported profit exceeds 10 million dollars, tangible assets, and number of employees are positive. We also limit our sample to observations with effective tax rates of no more than 55 percent. These steps are incorporated to limit the presence of outliers in the data. All regressions are comprised of approximations of terms in the Cobb-Douglas production function. The difference is in the selection of the weighting structure and inclusion of dummy variables for countries which accounts for country-level specifics of headquarters.

In regressions (1) and (3), C is calculated on effective tax rates and as a proxy for B we take (4.3). Following Fatica and Gregori (2020), we take a number of employees as a weighting structure in regressions (2) and (4). Due to the fact that an analysis conducted by Fatica and Gregori was focused on banks, they preferred tangible assets as the most appropriate approximation of economic activity. However, the lack of the data caused an abandonment of this method. As the main activity of MNEs is not specified in our data, we consider weighting structure (4.3) as the best alternative, allowing different specialisations of MNEs. There seems to be no inconsistency in our results. More specifically, the estimated coefficient of the composite tax difference calculated using effective tax rates ranges from -1.371 to -1.283, and are statistically significant at 1 percent level. It should not be surprising, because of a high correlation between the number of employees and components of our weighting structure (unrelated party revenues, number of employees and tangible assets). Our results are comparable to -1.77 and -0.94, which were estimated by Huizinga and Laeven (2008) and Markle (2012), respectively.

Table 5.1: Baseline Results

	Dependent variable:			
	log(Reported Profit)			
	(1)	(2)	(3)	(4)
log(Number of Employees)	0.223***	0.223***	0.202***	0.202***
	(0.049)	(0.049)	(0.049)	(0.049)
log(Tangible Assets)	0.475***	0.475***	0.426***	0.426***
	(0.059)	(0.059)	(0.058)	(0.058)
log(GDP per Capita)	0.308***	0.309***	0.297***	0.297***
	(0.045)	(0.045)	(0.046)	(0.046)
C	−1.313***		−1.367***	
	(0.370)		(0.386)	
C (Number of Employees)		−1.283***		−1.371***
		(0.370)		(0.386)
Country Dummies	No	No	Yes	Yes
Constant	4.752***	4.736***	6.974***	6.979***
	(0.749)	(0.749)	(0.815)	(0.815)
Observations	623	623	623	623
BIC	2033.215	2033.739	2016.170	2016.124
Adjusted R^2	0.659	0.659	0.701	0.701
Note:				*p<0.1; **p<0.05; ***p<0.01

In regressions (1) and (3), calculation of the weighting structure B is based on (4.3). As a weighting structure in regressions (2) and (4) we take a number of employees. Heteroskedasticity-robust standard errors are shown in brackets.

Table (6.1) in the appendix shows the very same regressions, although the calculation of Cs is based on statutory tax rates. Without country-level dummies we estimate a greater effect of the composite tax difference. However, after the inclusion of country-level dummies, the estimated coefficient dropped significantly (in absolute values) to -1.256. It seems that C calculated with effective tax rates fits our data better and we are able to estimate it with a higher precision. Hence, in further analyses we use only C based on effective tax rates.

Although we included in our analysis only countries that report at least 95 percent of the ecocomic activity in an ungrouped form, we test the sensitivity of the inclusion of grouped tax jurisdictions in the calculation of the composite tax difference on our coefficients estimates. Table (6.2) in the appendix shows the results. Coefficient estimates ranging from -1.549 to -1.458 indicate a stronger impact of the composite tax variable on the reported profit compared to previous results.

5.2 Robustness Checks

In this section we test the potential endogeneity problem of the weighting structure of the composite tax variable. As discussed by Fatica and Gregori (2020), components of weighting structure (in our case unrelated party revenues, number of employees and tangible assets) might be correlated with factors that have impact on reported profit causing potential endogeneity. To deal with this issue, we follow Fatica and Gregori (2020) who was inspired by Frankel and Romer (1999) and implement a two-step approach. At first, we estimate a gravity model using the Quassi-Poisson regression with the total revenue as a dependent variable. As independent variables we take only geographic features such as population, the distance between countries, whether the country is a member of the European Union (EU) or the World Trade Organisation (WTO) and historical dependency between countries, which are exogenous. However, to deal with the fact that our data are on the aggregated basis and headquarter countries report different number of MNEs, we rescale the dependent variable. The procedure is as follows. We calculate the total profit reported by each headquarter country. Then the rescaled revenue equals reported revenue multiplied by the factor $\frac{Total\ Revenue\ Reported\ by\ Headquarter\ Country}{Total\ Revenue\ Reported\ by\ the\ USA}$. We choose the USA as a benchmark country because it reports the greatest revenue, ensuring that the factor for each headquarter country is at least 1. Table (6.3) in the appendix shows the results of the model. Then we predict revenue for each tax jurisdiction using only these geographic features. Predicted values we employ for the calculation of exogenous weights. Weights are used for the construction of "endogeneity robust" composite tax variables. Table (6.4) in appendix shows results of regressions using this new variable. There seems to be no inconsistency compared to previous results.

5.3 Sensitivity of US-based multinationals

In this section we discuss the tax aggressiveness of US-based MNE's compared to the rest of the countries in the dataset. Clausing (2020) assumed similar aggressiveness of non-American MNEs compared to US-based counterpart to estimate the total tax revenue loss of the USA.

To test the tax aggressiveness of MNEs headquartered in various countries, Garcia-Bernardo et al. (2021) included the interaction of dummy variables representing headquarter countries and effective tax rates. Using the logarithmic specification for the semi-elasticity, they showed that profitability of US-based MNEs is the most sensitive to effective tax rates. However, with the linear specification of the semi-elasticity the results are not so straightforward, containing both more and less sensitive non-US based MNEs to effective tax rates compared to the ones headquartered in the USA. It should be noted that coefficients of countries with higher sensitivity to effective tax rates were not statistically significant at 10 percent level. In our approach we follow Huizinga and Laeven (2008) who tested the tax sensitivity of the reported profit to the composite tax variable in the Eastern Europe by inclusion of an interaction of the C with the dummy variable indicating the Eastern Europe.

Table (5.2) shows regressions that include variables which were already discussed in the table (5.1) plus the interaction of the composite tax variable and the US dummy variable . It indicates, whether US-based MNEs are on average more sensitive to the composite tax difference, compared to the MNEs headquartered in other countries that are contained in our dataset. Although the coefficient is negative, we did not estimate it with the precision and it is not statistically significant at 10 percent level. After an inclusion of country-level dummies, the effect is even smaller and statistically less significant.

Hence, we do not reject the null hypothesis at the 10 percent level that the reported profit of US-based multinationals is as much sensitive to the composite tax difference as the reported profit of the multinationals headquartered in the rest of the countries, based on our model and the data.

Table 5.2: Tax policy aggressiveness of US-based MNEs

	Dependent variable:	
	log(Reported Profit)	
	(1)	(2)
log(Number of Employees)	0.220***	0.202***
	(0.049)	(0.049)
log(Tangible Assets)	0.475***	0.426***
	(0.059)	(0.058)
log(GDP per Capita)	0.308***	0.298***
	(0.045)	(0.046)
C*USA	−1.231	−0.446
	(1.482)	(1.014)
C	−1.120**	−1.288***
	(0.382)	(0.432)
Country Dummies	No	Yes
Constant	4.778***	6.973***
	(0.523)	(0.558)
Observations	623	623
Adjusted R^2	0.659	0.701
Note:	*p<0.1; **p<0.05; ***p<0.01	

5.4 Estimation of shifted profits for US-based multinationals

To estimate the total shifted profit, we follow Huizinga and Laeven (2008). We start from the point that the reported profit is equal to the sum of "true" profits and the shifted profit:

$$P_i^r = B_i + S_i \tag{5.1}$$

Then profits shifted are derived as a difference of reported profits and true profits. To approximate true profits, we incorporate the equation (3.6). Thus, the profit shifted in or out of the country takes the form:

$$S_i = P_i^r \left(1 - \frac{1}{1 - \frac{1}{\gamma} C_i}\right) \tag{5.2}$$

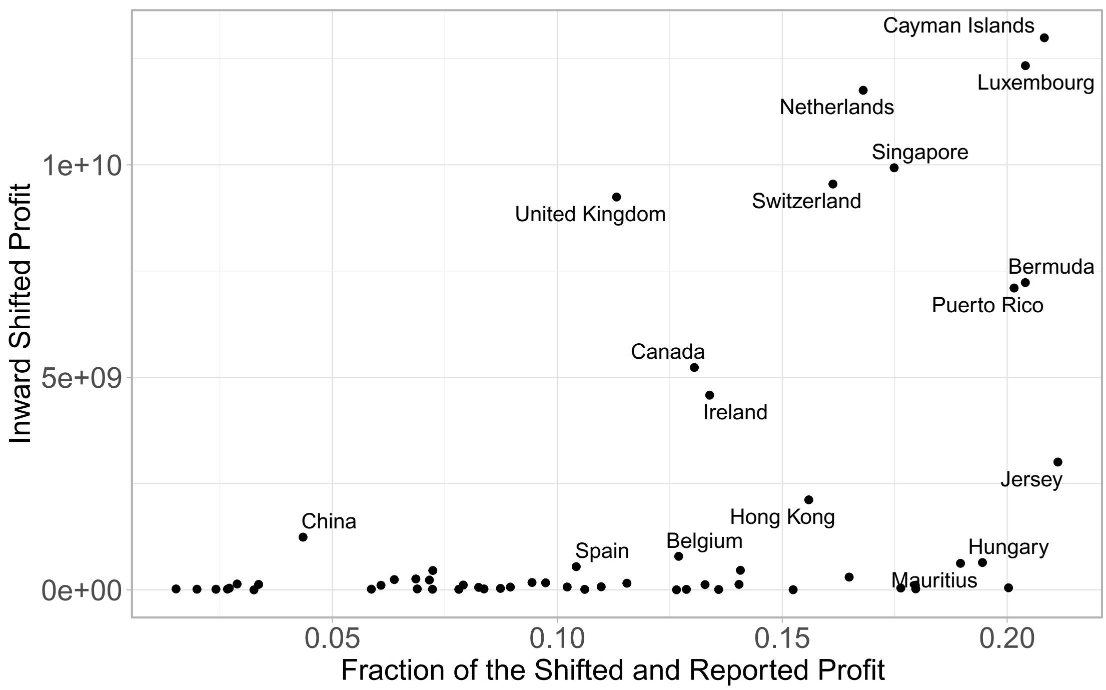
Where $-\frac{1}{\gamma}$ is the estimated coefficient of the composite tax difference from equation (3.8). The composite tax difference with the value less then zero indicates inward profit shifting because of the implied positiveness of the term S_i in equation (5.2). Tables (5.3) summarises countries with the greatest estimated inward profit shifted for US-based multinationals. As a point estimate of $-\frac{1}{\gamma}$ we take -1.441 from regression (2) in table (6.4).

Table 5.3: Summary of profit shifting activities of US-based MNEs

	Country	Reported Profit ($mil)	Shifted Profit ($mil)	Ratio between Shifted and Reported Profit
1	Cayman Islands	62369.2	12989.3	0.21
2	Luxembourg	60437.7	12332.9	0.20
3	Netherlands	69963.9	11753.5	0.17
4	Singapore	56788.5	9931.1	0.17
5	Switzerland	59204.5	9547.9	0.16
6	United Kingdom	81669.7	9242.8	0.11
7	Bermuda	35433.8	7230.0	0.20
8	Puerto Rico	35236.9	7101.8	0.20
9	Canada	40102.4	5232.1	0.13
10	Ireland	34221.4	4581.2	0.13
11	Jersey	14238.2	3008.2	0.21
12	Hong Kong	13591.3	2118.9	0.16
13	China	28544.4	1241.1	0.04
14	Belgium	6221.0	789.9	0.13
15	Hungary	3308.1	643.5	0.19

Source: Author on the basis of the OECD data. Cs based on the effective tax rate.

Figure 5.1: Graphical representation of profit shifting activities of US-based MNEs



According to the effective tax rate specification of the composite tax variable, the total estimated shifted profit of US-based multinationals amounts to 103 billion dollars. In relative terms it accounts for 4.8 percent of global reported profit of US-based multinational corporations and 12.3 percent of non-US reported profit.

If we allow the coefficient estimate to vary between -1.549 and -1.367 according to different specifications, the estimate of the shifted profit ranges between 98 and 109 billion dollars. Moreover, if we include grouped tax jurisdictions in the calculation, the estimated range rises to between 104.2 and 118 billion dollars.

To estimate how much of this shifted profit might belong to the USA we follow an approach of Garcia-Bernardo et al. (2021) and employ the misalignment method. Hence, the amount of the shifted profit which belongs to the USA is equal to the share of the global economic activity in the USA:

$$S^{USA} = Share\,of\,the\,Economic\,activity^{USA} * The\,Global\,Shifted\,Profit \quad (5.3)$$

Where as a measure of economic activity we take (4.3). According to (5.3), the USA tax base loss amounts from 69.7 to 77.5 billion dollars (from 74 to 83.9 billions dollars if we include grouped tax jurisdictions).

As an alternative to this approach, we incorporate pure misalignment model from chapter 2 and estimate the profit shifted out of the USA according to (2.8). For consistency we employ the same measure of the economic activity. We arrive at an estimate of 215 billion dollars (243 billion dollars if we include grouped tax jurisdictions) which is significantly more than our base estimate.

However, as discussed in chapter 2, our results may severely underestimate the total shifted profits due to the linear semi-elastic nature of our specification of the C in the equation (3.8) we estimated. For example, in Cayman Islands US-based MNEs report almost 3 percent of the profits. On the other hand, according to measure (4.3), only 0.14 percent of economic activity is located there. To cope with this issue, we cannot simply include a quadratic term of C in the equation because C ranges by definition from -1 to 1.

Hence, we follow Fatica and Gregori (2020) and split the dataset into two sub-samples representing tax and non-tax havens. As expected, estimated coefficients of the semi-elasticity vary significantly for tax havens and non-tax havens, indicating the need for the transformation of the C to take into account these non-linearities. If we recalculate the US tax base loss using results from regressions (1) and (3) in the table (5.4), the estimate rises to 186.7 billion dollars.

Table 5.4: Splitting the dataset into tax havens and non-tax havens

	Dependent variable:			
	log(Reported Profit)			
	(1)	(2)	(3)	(4)
	Tax Havens	Tax Havens	Non-Havens	Non-Havens
log(Number of Employees)	0.316***	0.318***	0.202***	0.201***
	(0.102)	(0.102)	(0.030)	(0.030)
log(Tangible Assets)	0.145***	0.145***	0.547***	0.548***
	(0.051)	(0.051)	(0.027)	(0.027)
log(GDP per Capita)	0.424	0.427	0.154***	0.140***
	(0.298)	(0.298)	(0.037)	(0.035)
Country Dummies	Yes	Yes	Yes	Yes
C	−14.939**	−15.236**	−0.755**	−0.827**
	(7.376)	(7.431)	(0.356)	(0.356)
Constant	10.454***	10.372***	5.438***	5.529***
	(3.788)	(3.794)	(0.523)	(0.515)
Observations	73	73	550	550
Adjusted R^2	0.714	0.714	0.780	0.780

Note: *p<0.1; **p<0.05; ***p<0.01

In regressions (1) and (3), calculation of weighting structure B is based on (4.3). As a weighting structure in regressions (2) and (4) we take a number of employees. Heteroskedasticity-robust standard errors are shown in brackets.

Chapter 6

Conclusion

The tax avoidance of MNEs has become undoubtedly a global issue. Data limitations has made it nearly impossible to quantify the scale of profit shifting. Hovewer, thanks to the newly available data published by the OECD and the IRS, several researchers have conducted analyses using diverse methodologies.
Clausing (2020) estimated the relationship between profit and tax rates using quadratic specification for semi-elasticity to approximate the total profit shifted out of the USA by US MNEs. Her estimates ranged from 213 to 265 billion dollars. Garcia-Bernardo et al. (2021) included the logarithmic specification to cope with the assumed extreme non-linear relationship between the reported profit and the tax rate. Their point estimate of the profit shifted out of the USA by MNEs in 2017 is 365 billion dollars.

In this thesis, we replicated the model proposed by Huizinga and Laeven (2008), which as opposed to previous studies, takes weighted tax rate differences as a measure of the tax variable. As a weighting scheme we take a linear combination of unrelated party revenue, number of employees and tangible assets. We found that tax rate differences affect the international allocation of profits. The estimated semi-elasticity of reported profits with respect to the tax rate difference is 1.44 and 1.36, using the effective and the statutory tax rate as a benchmark for the calculation of tax rate differences, respectively. We conducted several sensitivity and robustness checks of our estimates, showing no inconsistency.

We did not showed that US-based MNEs are more aggressive in profit shifting, as opposed to previous research conducted by Garcia-Bernardo et al. (2021).

We estimated that the profit shifted out of the US ranges between 74 and 83.9 billion dollars. However, the linear specification of the composite tax variable may severely underestimate the sensitivity of reported profits to taxes in tax havens, as was showed by Dowd et al. (2017) and Garcia-Bernardo et al. (2021). To account for this issue, we followed Fatica and Gregori (2020) and split the dataset to countries considered to be tax havens according to Gravelle (2009) and re-estimated the coefficients on two sub-samples. Using new estimates of coefficients, we calculated the US tax base loss to be 186.7 billion dollars. Nevertheless, the appropriate transformation of the tax variable and adjustment of the methodology might be a better approach to account for possible non-linearities. We leave that problem as a suggestion for further research.

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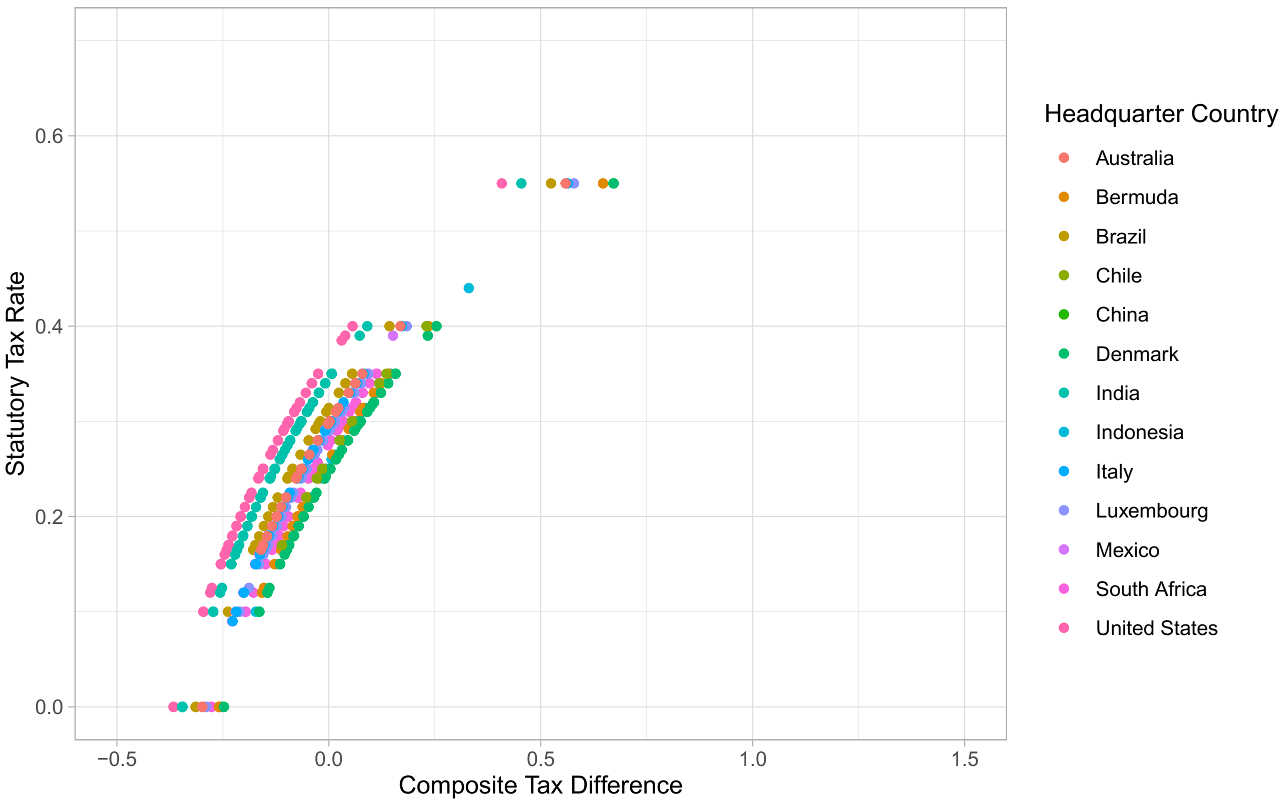
Appendix

Figure 6.1: The relationship between the statutory tax rate and the composite tax variable



Source: Author on the basis of the OECD data

Table 6.1: Baseline Results: Statutory tax rate specification

	Dependent variable:			
	log(Reported Profit)			
	(1)	(2)	(3)	(4)
log(Number of Employees)	0.235***	0.235***	0.212***	0.212***
	(0.048)	(0.048)	(0.049)	(0.048
log(Tangible Assets)	0.466***	0.466***	0.422***	0.422***
	(0.059)	(0.059)	(0.058)	(0.058)
log(GDP per Capita)	0.343***	0.343***	0.343***	0.343***
	(0.046)	(0.046)	(0.045)	(0.045)
C	−2.274***		−1.256***	
	(0.454)		(0.441)	
C (Employees)		−2.253***		−1.254***
		(0.456)		(0.441)
Country Dummies	No	No	Yes	Yes
Constant	4.398***	4.392***	6.352***	6.359***
	(0.730)	(0.731)	(0.809)	(0.809)
Observations	623	623	623	623
BIC	2008.200	2009.185	2018.174	2018.185
Adjusted R^2	0.672	0.672	0.700	0.700

Note: *p<0.1; **p<0.05; ***p<0.01

In regressions (1) and (2) calculation of weighting structure B is based on (4.3). As a weighting structure in regression (2) and (4) we take a number of employees. Heteroskedasticity-robust standard errors are shown in brackets.

Table 6.2: Sensitivity check

	Dependent variable:			
	log(Reported Profit)			
	(1)	(2)	(3)	(4)
log(Number of Employees)	0.222***	0.221***	0.200***	0.200***
	(0.049)	(0.049)	(0.049)	(0.049)
log(Tangible Assets)	0.476***	0.476***	0.429***	0.429***
	(0.059)	(0.059)	(0.058)	(0.058)
log(GDP per Capita)	0.288***	0.288***	0.269***	0.269***
	(0.045)	(0.045)	(0.048)	(0.049)
C	−1.474***		−1.549***	
	(0.372)		(0.410)	
C (Employees)		−1.458***		−1.533***
		(0.372)		(0.407)
Country Dummies	No	No	Yes	Yes
Constant	4.915***	4.915***	7.166***	7.172***
	(0.765)	(0.767)	(0.843)	(0.845)
Observations	623	623	623	623
BIC	2033.173	2033.644	2019.868	2020.334
Adjusted R^2	0.659	0.659	0.699	0.699

Note: *p<0.1; **p<0.05; ***p<0.01

In regression (1), calculation of weighting structure B is based on (4.3). As a weighting structure in regression (2) we take a number of employees. Heteroskedasticity-robust standard errors are shown in brackets.

Table 6.3: Gravity model for total revenue

	Dependent variable:
	Total Revenue
log(Population)	0.645***
	(0.066)
log(Distance)	-1.277***
	(0.101)
WTO	3.431**
	(0.948)
EU	-1.017***
	(0.335)
Historic Connection	0.698
	(0.534)
Constant	21.985***
	(0.989)
Observations	860
R^2	0.611
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 6.4: Endogeneity check

	Dependent variable:	
	log(Reported Profit)	
	(1)	(2)
log(Number of Employees)	0.222***	0.203***
	(0.030)	(0.030)
log(Tangible Assets)	0.476***	0.426***
	(0.026)	(0.025)
log(GDP per Capita)	0.307***	0.296***
	(0.042)	(0.041)
C	−1.462***	−1.441***
	(0.432)	(0.426)
Country Dummies	No	Yes
Constant	4.702***	6.928***
	(0.519)	(0.555)
Observations	623	623
Adjusted R^2	0.660	0.701
BIC	2032.016	2015.728
Note:	*p<0.1; **p<0.05; ***p<0.01	

Weighting scheme of composite tax variable in regressions (1) and (2) is based on predicted values of total revenue from Quasi-Poisson model presented in 6.3. Heteroskedasticity-robust standard errors are shown in brackets.

Table 6.5: Effective tax rates by country

ISO	ETR	ISO	ETR	ISO	ETR	ISO	ETR	ISO	ETR
ABW	0.187987	CZE	0.106077	JEY	0.00135	NOR	0.360058	UGA	0.167658
AFG	0.080053	DEU	0.217174	JOR	0.000867	NPL	0.305874	UKR	0.129231
AGO	0.438795	DNK	0.148851	JPN	0.199349	NZL	0.171093	URY	0.117346
ALB	0.157594	DOM	0.132968	KAZ	0.127507	OMN	0.289328	USA	0.195924
ANT	0	DZA	0.411636	KEN	0.418821	PAK	0.253379	VEN	0.136299
ARE	0.298455	ECU	0.269953	KHM	0.08639	PAN	0.090339	VGB	0.000538
ARG	0.282775	EGY	0.340726	KOR	0.19741	PER	0.252414	VIR	0.096223
ASM	0.127483	ESP	0.115675	KWT	0.032386	PHL	0.204187	VNM	0.17549
AUS	0.190196	EST	0.002388	LAO	0.175638	PNG	0.019854	VUT	0
AUT	0.057961	ETH	0.257337	LBN	0.087481	POL	0.141139	WSM	0.292704
AZE	0.086007	FIN	0.083127	LBR	0	PRI	0.014343	YEM	0.232792
BEL	0.095788	FJI	0.109932	LBY	0	PRT	0.171343	ZAF	0.123697
BEN	0	FRA	0.196056	LKA	0.143323	PRY	0.077722	ZMB	0.272261
BFA	0.056476	FRO	0.009437	LSO	0.165483	QAT	0.232089	ZWE	0.432456
BGD	0.38003	GAB	0.224368	LTU	0.140639	ROU	0.110998		
BGR	0.045131	GBR	0.108073	LUX	0.011047	RUS	0.199933		
BHR	0.015949	GGY	0.012614	LVA	0.115248	RWA	0.23447		
BHS	0	GHA	0.132058	MAC	0.109347	SAU	0.135558		
BIH	0.078627	GIB	7.05E-06	MAR	0.291987	SEN	0.211261		
BLR	0.214659	GIN	0.287223	MCO	0.006293	SGP	0.046828		
BMU	0.01107	GNB	0	MDG	0.193757	SLB	0.027002		
BOL	0.291859	GRC	0.25792	MDV	0.321274	SLE	0.187327		
BRA	0.197444	GRL	0.056966	MEX	0.254648	SLV	0.203154		
BRB	0.063981	GTM	0.143103	MHL	0	SRB	0.114095		
BRN	0.091589	GUM	0.157495	MKD	0.137163	SSD	0.010484		
BTN	0.162894	GUY	0.380594	MLI	0.143368	SVK	0.172922		
BVT	0	HKG	0.067518	MLT	0.054671	SVN	0.094207		
BWA	0.107333	HND	0.150344	MMR	0.071107	SWE	0.082823		
CAN	0.092566	HRV	0.041296	MNE	0.03921	SWZ	0.267095		
CHE	0.061849	HUN	0.023333	MNG	0	SYC	0.40177		
CHL	0.143327	IDN	0.220097	MOZ	0.323583	SYR	0.003364		
CHN	0.160621	IMN	0	MRT	0.246775	THA	0.140584		
CIV	0.318864	IND	0.261413	MUS	0.029394	TJK	0.42835		
CMR	0.898734	IRL	0.089379	MWI	0.322375	TLS	0.085771		
COD	0.061232	IRN	0.223989	MYS	0.170009	TON	0.556634		
COL	0.410523	IRQ	0.331045	NAM	0.193572	TTO	0.28225		
CRI	0.12127	ISL	0.274888	NER	0.017332	TUN	0.844524		
CUW	0	ISR	0.146758	NGA	0.640296	TUR	0.178281		
CYM	0.005439	ITA	0.193645	NIC	0.295838	TWN	0.166999		
CYP	0.041409	JAM	0.211053	NLD	0.054548	TZA	0.608321		

Source: Author on the basis of the OECD data.

Table 6.6: Statutory tax rates by country

ISO	Statutory	ISO	Statutory	ISO	Statutory	ISO	Statutory	ISO	Statutory
ABW	0.25	CZE	0.19	JEY	0.2	NOR	0.25	UGA	0.3
AFG	0.2	DEU	0.3	JOR	0.2	NPL	0.25	UKR	0.18
AGO	0.3	DNK	0.22	JPN	0.31	NZL	0.28	URY	0.25
ALB	0.15	DOM	0.27	KAZ	0.2	OMN	0.12	USA	0.4
ANT	0.25	DZA	0.26	KEN	0.3	PAK	0.32	VEN	0.34
ARE	0.55	ECU	0.22	KHM	0.2	PAN	0.25	VGB	0
ARG	0.35	EGY	0.23	KOR	0.24	PER	0.28	VIR	0.39
ASM	0.44	ESP	0.25	KWT	0.15	PHL	0.3	VNM	0.22
AUS	0.3	EST	0.2	LAO	0.24	PNG	0.3	VUT	0
AUT	0.25	ETH	0.3	LBN	0.15	POL	0.19	WSM	0.27
AZE	0.2	FIN	0.2	LBR	0.25	PRI	0.39	YEM	0.2
BEL	0.34	FJI	0.2	LBY	0.2	PRT	0.21	ZAF	0.28
BEN	0.3	FRA	0.33	LKA	0.15	PRY	0.1	ZMB	0.35
BFA	0.28	FRO	0.18	LSO	0.25	QAT	0.1	ZWE	0.26
BGD	0.25	GAB	0.3	LTU	0.15	ROU	0.16		
BGR	0.1	GBR	0.2	LUX	0.29	RUS	0.2		
BHR	0	GGY	0	LVA	0.15	RWA	0.3		
BHS	0	GHA	0.25	MAC	0.12	SAU	0.2		
BIH	0.1	GIB	0.1	MAR	0.31	SEN	0.3		
BLR	0.18	GIN	0.35	MCO	0.33	SGP	0.17		
BMU	0	GNB	0.25	MDG	0.2	SLB	0.3		
BOL	0.25	GRC	0.29	MDV	0.15	SLE	0.3		
BRA	0.34	GRL	0.32	MEX	0.3	SLV	0.3		
BRB	0.25	GTM	0.25	MHL	0	SRB	0.15		
BRN	0.19	GUM	0.35	MKD	0.1	SSD	0.35		
BTN	0.3	GUY	0.3	MLI	0.3	SVK	0.22		
BVT	0	HKG	0.17	MLT	0.35	SVN	0.17		
BWA	0.22	HND	0.3	MMR	0.25	SWE	0.22		
CAN	0.27	HRV	0.2	MNE	0.09	SWZ	0.28		
CHE	0.18	HUN	0.19	MNG	0.25	SYC	0.33		
CHL	0.24	IDN	0.25	MOZ	0.32	SYR	0.22		
CHN	0.25	IMN	0	MRT	0.25	THA	0.2		
CIV	0.25	IND	0.35	MUS	0.15	TJK	0.24		
CMR	0.33	IRL	0.2	MWI	0.3	TLS	0.1		
COD	0.35	IRN	0.25	MYS	0.24	TON	0.25		
COL	0.25	IRQ	0.15	NAM	0.32	TTO	0.25		
CRI	0.3	ISL	0.2	NER	0.3	TUN	0.25		
CUW	0.22	ISR	0.25	NGA	0.3	TUR	0.2		
CYM	0	ITA	0.31	NIC	0.3	TWN	0.17		
CYP	0.13	JAM	0.25	NLD	0.25	TZA	0.3		

Source: Deloitte, KMPG, World Bank

Table 6.7: List of data sources

Statutory tax rates		Deloitte, KMPG, World Bank
Reported Profit	Profit before Income tax	OECD BEPS
Number of Employees		OECD BEPS
Tangible Assets	Tangible Assets other than Cash and Cash Equivalents	OECD BEPS
Total Revenues		OECD BEPS
Unrelated Party Revenues		OECD BEPS
GDP per Capita		CEPII GravData
Tax Haven indicator		Gravelle (2009)
Population		CEPII GravData
Distance	Distance between capital cities	CEPII GravData
WTO	Dummy, member of WTO	CEPII GravData
EU	Dummy, member of EU	CEPII GravData
Historic Connection	Dummy, countries were in colonial or dependency relationship	CEPII GravData