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MASTER'S THESIS

Base erosion and profit shifting by multinational firms: re-estimation of firm-level evidence

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Declaration of Authorship

The author hereby declares that he compiled this thesis independently; using only the listed resources and literature, and the thesis has not been used to obtain a different or the same degree.

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Abstract

The thesis focuses on base erosion and profit shifting (BEPS) and resulting corporate income tax gains or losses. I first estimated profit shifting semi-elasticity using database of firm-level financial data. Subsequently I used these estimates to calculate corporate income tax gains or losses for individual countries. I estimate several models to see how much the semi-elasticity depends on specification and what affects it. The evidence suggests that companies do shift profits to countries with lower tax rate. The estimated overall profit shifting semi-elasticity ranges from 1.524 to 3.695 for different specifications of the benchmark model. Semi-elasticity of individual countries increases with financial secrecy score. Using statutory tax rate yields stronger results than using country-level effective tax rates calculated from the financial data. The estimated effect on government revenue ranges from 12% loss to 23% gain of corporate income tax revenues. In the sample of 53 countries with sufficient number of observations this translates to overall loss 48 billion US dollars.

JEL Classification	F23, F68, G38, H25, H26, H87
Keywords	base erosion, profit shifting, corporate income tax, financial secrecy

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Abstrakt

Práce se zabývá erozí daňového základu a přesouváním zisku (BEPS) a výslednými zisky nebo ztrátami na dani z příjmu právnických osob. Nejdříve jsem odhadl semi-elasticitu přesouvání zisku pomocí databáze dat na firemní úrovni. Následně jsem použil tyto odhady pro výpočet zisku nebo ztráty na dani z příjmu právnických osob pro jednotlivé země. Odhadl jsem několik modelů abych zjistil jak moc semi-elasticita závisí na specifikaci a co ji ovlivňuje. Výsledky naznačují, že firmy převádějí zisky do zemí s nižšími daňovými sazbami. Odhad celkové semi-elasticity je v rozmezí od 1.524 do 3.695 pro různé specifikace základního modelu. Semi-elasticita jednotlivých zemí roste s ukazatelem finančního tajemství. Při použití statutární daňové sazby jsou závěry silnější než při použití efektivní daňové sazby na úrovni zemí spočítané z finančních dat. Odhadnutý vliv na státní příjmy je v rozmezí od 12% ztráty po 23% zisk z daně z příjmu právnických osob. Ve vzorku 53 zemí s dostatečným množstvím pozorování z toho vyplývá celková ztráta 48 miliard amerických dolarů.

Klasifikace	F23, F68, G38, H25, H26, H87
Klíčová slova	eroze daňového základu, přesouvání zisku, daň z příjmu právnických osob, finanční tajemství

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Acronyms

BEPS	Base Erosion and Profit Shifting
CIT	Corporate Income Tax
CPI	Consumer Price Index
EBIT	Earnings Before Interest and Taxes
EPRS	European Parliamentary Research Service
GDP	Gross Domestic Product
IMF	International Monetary Fund
MNE	Multinational Enterprise
OECD	Organization for Economic Co-operation and Development
UNCTAD	United Nations Conference on Trade and Development

Master's Thesis Proposal

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Proposed Topic:

Base erosion and profit shifting by multinational firms: re-estimation of firm-level evidence

Motivation:

Corporate tax is an important source of income for governments. Some multinational companies shift their profits from countries where activities creating the profit take place to countries with lower corporate tax rate. These activities referred to as base erosion and profit shifting (BEPS) are becoming easier with globalization (OECD, 2015). Consequently, governments have to seek other sources of income or increase government budget deficits. Before implementing any potentially disruptive measures to prevent profit shifting, it is desirable to determine the tax revenue loss from these activities. Current studies usually estimate the loss in terms of percentage of corporate income tax for a group of countries covered in them. The goal of my work would be to reach more precise estimates for individual countries.

There have been numerous studies trying to estimate tax revenue losses. Overview of the data sources and empirical approaches had been done by Dharmapala (2014). Current trend is to use company level data instead of country level data used before. The most common approach to empirical estimation, pioneered by Hines & Rice (1994), is to distinguish between company's true profit generated by its assets and labor and profit shifted due to tax reasons. For the shifted profit, semi-elasticity is estimated (impact on profit of a one percentage point tax rate differential). Heckmeyer & Overesch (2013) conducted a meta-analysis and estimated the semi-elasticity to be 0.8. More recently Johansson et al. (2016a) improved the methodology of previous studies by identifying not only direct subsidiaries but entire multinational groups of companies and reached semi-elasticity of 1.

Fiscal effects from BEPS have been estimated for example by Johansson et al. (2016a), Crivelli et al. (2015), UNCTAD (2015), IMF (2014), EPRS (2015). The estimated loss for OECD countries is $100-240 billion (Johansson et al., 2016a) and $400 billion in the long run (Crivelli et al., 2015). However, the above-mentioned studies do not provide country level estimates. Johansson et al. (2016a) mention that this is because the sample may not be representative for some countries.

Hypotheses:

1. Hypothesis #1: Multinational companies use profit shifting techniques to reduce their taxes.
2. Hypothesis #2: Profit shifting elasticity estimated by Johansson et al. (2016a) is robust to changes in specification and time range.
3. Hypothesis #3: Share of corporate income tax lost due to BEPS differs significantly between countries.

Methodology:

I will use data from Orbis database compiled by Bureau van Dijk, which is currently widely considered to be the best available database of unconsolidated financial statements and firm ownership. I will identify multinational groups and for each company compute difference to average and the lowest tax rate in the group. To test hypothesis #1, I will follow methodology of Johansson et al. (2016a) with more up-to-date dataset covering

more countries. If the estimated profit shifting semi-elasticity is significantly different from zero, then multinational companies shift their profits. To address hypothesis #2, I will find out whether the results hold with more up-to-date dataset and with changes in specifications such as using estimates of effective tax rate instead of statutory tax rate or addition of difference to the lowest tax rate in the group. To account for the fact that profit shifting semi-elasticity may differ in individual countries, I will estimate another specification with interaction term between country dummy variables and difference in tax rate. In this specification, every country would have its own semi-elasticity which will be used to compute the tax loss.

Subsequently, I will estimate corporate income tax loss. Firstly, I will use the estimated semi-elasticities to compute shifted profits by all companies in the sample. Then I will sum the shifted profits for individual countries. To mitigate representativeness problem mentioned for example in Ribeiro et al. (2010), I will increase weight of companies from underrepresented industries or weights of smaller companies. Then I will compute shifted profit for entire population. I will assume that the share, which shifted profit in the sample represents in total shifted profit in the country, is the same as the share that companies in the sample represent in the whole economy (i.e. the sample is representative of the underlying population after weighting). The estimated tax loss is then the shifted profit multiplied by effective tax rate. To address hypothesis #3, I will compare the estimated tax losses between countries. Finally, I will discuss why profit shifting may be more common in some countries and if it is related to strength of anti-avoidance rules. I will estimate the results specifically for years 2005 and 2014 (or the latest available) to discuss whether countries which strengthened anti-avoidance rules, assessed for these two years by Johansson et al. (2016b), reduced their tax loss between these years.

Expected Contribution:

I will estimate how much do multinational companies shift their profits to countries with lower tax rates. In contrast to previous studies on this topic, I will use more up-to-date dataset, include tax loss estimates for individual countries and I will include all countries with reasonable amount of data. The differences in estimated loss might be big. The results will show, whether countries which strengthened their anti-avoidance rules over the time range, reduced their tax loss. The estimates can be used to determine whether potentially disruptive policy actions in this area are desirable.

Outline:

1. Introduction and Motivation: I will describe the main tax planning channels and policy actions to stop profit-shifting such as anti-avoidance laws or steps in OECD action plan on BEPS.
2. Literature review: I will discuss the most relevant literature and its methodology.
3. Data: I will work with Orbis database. It is necessary to clean the data and identify multi-national groups. I will also discuss if the sample may not be representative for some countries and if this problem can be mitigated by weighting.
4. Methods: I will explain methods used to estimate profit-shifting semi-elasticity and differences between individual specifications such as difference to the lowest tax rate in the group instead of or in addition to difference to the average tax rate in the group.
5. Results: I will present my estimates of tax losses for individual countries.
6. Conclusion: I will summarize my findings and possible shortcomings and their implications for policy and future research.

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Author **Supervisor**

Introduction

Corporate income tax is an important source of revenue for governments. Part of this revenue is lost due to profit shifting. The profits should be reported, and corporate taxes should be paid in country, where the related economic activity takes place. Some multinational companies shift their profits from countries where activities creating the profit take place to countries with lower corporate tax rate. These activities are part of what is called base erosion and profit shifting (BEPS) and are becoming easier with globalization (OECD, 2015). Consequently, governments must seek other sources of income or increase government budget deficits.

The three main channels for profit shifting are: Transfer prices on intragroup transactions, charging for use of intangible assets and concentrating debt in high tax countries. Higher transfer price increases the profit of the selling company and decreases for the buying company. To prevent profit shifting by this channel, countries require transactions between companies in the same group to be priced based on so called "arm's length" principle, i.e. at market prices. However, for some goods the market price is not clear which enables manipulation from companies. Intangible assets can be transferred to or registered in countries with low tax rates. The company then charges other companies from the same group for the right to use these intangible assets. In case of intangible assets, it is difficult both to price the asset and to price the royalties for using it. By concentrating debt in high tax countries, the multinational enterprise reduces profit in these countries by interest payments. The debt may also be intragroup. In that case, the interest shifts profit to the low tax country. Heckemeyer & Overesch (2013) conclude that the first two channels are much more important than the third one.

Countries with very low corporate income tax rates and high degree of financial secrecy are usually referred to as tax havens. There countries often have statutory corporate income tax rate equal to zero. Examples are the Bahamas, Bermuda, the Cayman Islands, or Isle of Man. However, even some European countries such as Ireland, Luxembourg or Switzerland are considered as tax havens due to legislation enabling low taxation despite non-zero tax rates. Even though these countries are criticized, tax havens may not want to lose their status. For example, in December 2017, European Commission ordered Ireland to collect EUR 13bn of taxes that Ireland did not want from Apple (France-Presse, 2017). Overall, profit shifting represents a

loss for governments. However, for countries with low but non-zero tax rates, receiving shifted profit might represent gain. Big multinational enterprises such as Google, Apple or Netflix have also been criticized for avoiding corporate taxes and having extremely low effective tax rates. The case of Google is described in Zucman (2014). The fact that the biggest and richest companies in the world can avoid taxes may contribute to social tension.

The topic attracts lot of public and political attention. Countries are trying to reduce the profit shifting by implementing anti-avoidance laws and improving measurement and monitoring of BEPS. To improve the measurement and introduce best practices OECD established initiative called Inclusive Framework on BEPS. Among other things, OECD and G20 countries adopted Action plan to address BEPS in September 2013. The action plan consists of 15 items including limiting base erosion via interest deductions, assuring that transfer pricing outcomes are in line with value creation and reexamining transfer pricing documentation. Before implementing any potentially disruptive measures to prevent profit shifting, it is desirable to determine the tax revenue loss from these activities.

In this thesis, I estimate how much multinational companies shift their profits to countries with lower tax rates. Current studies usually estimate the loss in terms of percentage of corporate income tax for a group of countries covered in them or for one single country. The goal of my work is to reach estimates for individual countries using more up-to-date dataset compared with previous studies on this topic. The estimates can be used to determine whether potentially disruptive policy actions in this area are desirable.

BEPS activities can be divided into two categories. The first category is profit shifting to countries with lower tax rate by manipulating transfer prices and intra-group debt. This may be done by all multinational companies. The second category is exploitation of mismatches between tax regimes resulting in non-taxation of some profits. This is done mainly by large enterprises. It often involves complex schemes to avoid taxes and is therefore more difficult to identify from financial data. Analysis of the mismatches between tax systems and their consequences are not subject of this thesis.

Propensity to shift profits is usually quantified by stating the so-called profit shifting semi-elasticity. The semi-elasticity tells us, by how many percent does the reported profit decrease with one percentage point increase in tax rate. In this thesis I estimate the semi-elasticity using firm-level data from Orbis database compiled by Bureau van Dijk, which is currently widely considered to be the best available database of unconsolidated financial statements and firm ownership. I identified multinational

groups and for each company computed difference to average tax rate in its group. The logic of the model is that two companies which are identical should have the same profitability. If the only difference between two companies is that one of them has links to low or high tax countries, then the difference in profitability is caused by profit shifted to or from this company. With this approach it is not important which channel is used for profit shifting, only the resulting change in profitability.

Besides presenting estimates of corporate income tax gains or losses for individual countries, I contribute to the current knowledge by three things. Firstly, by estimating the semi-elasticity based on the financial secrecy score which enables me to calculate different semi-elasticities across countries and reach better country estimates of corporate income tax gains or losses. Secondly, it is not clear whether statutory or effective tax rates should be used to estimate the profit shifting semi-elasticity. In previous studies some authors preferred using statutory and some effective tax rates. I contribute to this debate by estimating different specifications for the two rates and determining which rate better explains the data. Finally, missing data introduce bias to the estimates of profit shifting semi-elasticity. I simulate how much missing observations influence the estimated semi-elasticities.

The thesis has the following structure. In the first chapter I review current literature on the topic of profit shifting and methodology used in these studies. In the second chapter I describe the dataset used in this thesis and the variables used in the models, explain the adjustments I made to the data and assess limitations of these data. In the third chapter, I estimate profit shifting semi-elasticity. I estimate several different models, present results and assess their robustness. I also discuss possible sources of bias. In the fourth chapter, I use my estimates of semi-elasticity to calculate corporate income tax losses or gains for individual countries. I present the results and again list possible sources of inaccuracies.

1 Literature review

In this chapter, I review literature regarding the most common approaches to estimating profit shifting, profit shifting semi-elasticities estimated in previous studies, data sources used and advantages of micro-level data, using statutory of effective tax rate for estimation of profit shifting, specification of models used for estimation with firm-level data, classification of strength of anti-avoidance rules and tax losses from profit shifting. I also state the approach I chose for this thesis where appropriate.

There have been numerous studies trying to estimate profit shifting semi-elasticity and tax revenue losses. Overview of the data sources and empirical approaches had been done by Dharmapala (2014). The most common approach to empirical estimation, pioneered by Hines & Rice (1994), is to distinguish between company's true profit generated by its assets and labor and profit shifted due to tax reasons. For the shifted profit, semi-elasticity is estimated (impact on reported profit of a one percentage point tax rate differential). The authors agree that the profit shifting takes place but they differ significantly in their estimates of scale. Heckemeyer & Overesch (2013) conducted a meta-analysis and estimated the semi-elasticity to be 0.8. More recently Johansson et al. (2017) improved the methodology of previous studies by identifying not only direct subsidiaries but entire multinational groups of companies and reached semi-elasticity of 1. Dowd et al. (2017) accounted for nonlinearity in profit shifting of US multinationational corporations and estimated the semi-elasticity to be 1.44 using statutory and 1.08 using effective tax rate.

An alternative approach was proposed by Dharmapala & Riedel (2013). The authors estimate what share of extra dollar earned by a parent company is shifted to its affiliate with lower tax rate regardless of the tax rate difference. In other words, they add unexpected profit of the parent company to the regression instead of tax rate difference. The affiliates facing higher tax rate than the parent company serve as control group. This approach leads to smaller estimates of BEPS than the Hines & Rice approach.

Most studies focus only on profit shifting between parent and its subsidiary. The profit shifting does not have the same magnitude in both directions. According to Dischinger et al. (2014), the profit shifting semi-elasticity from affiliate to parent is much larger than from parent to affiliate. Johansson et al. (2017) improved the methodology of previous studies by identifying not only direct subsidiaries but entire multinational groups of companies which is the approach I chose in this thesis as well. However, this

approach also has its drawbacks as foreign subsidiaries have little opportunities for profit shifting between them as they often engage in similar activities such as sales (Huizinga & Laeven, 2008).

The abovementioned studies examine effect of tax rates on some measure of profitability. This is called indirect evidence of profit shifting. There are also numerous studies concentrating on effect of corporate taxes on other than profit measures, but these approaches are not of importance for this thesis.

Researchers estimating profit shifting use different data sources. The study which introduced the currently prevalent approach, Hines & Rice (1994), used data from Bureau of Economic Analysis which represented the aggregate profit, capital and labor inputs of all US affiliates in a certain country. Current trend is to use company level data instead of country-level data used before. The most notable examples are Huizinga & Laeven (2008) and Johansson et al. (2017). The advantage of micro or firm-level data is that it allows to control for characteristics such as industry or size of the company. The estimated semi-elasticities are much smaller than in the earlier studies. This is indeed caused by omitting influence of taxes on real economic activity in the older studies (Heckemeyer & Overesch, 2013). Additionally, the micro-level data allow to use panel data techniques controlling for unobservable determinants of profit (Dharmapala, 2014). Some studies use data only about European companies from Amadeus database, while other studies use Orbis database which consists of company data from around the world. The advantage of using only European data is that the coverage of European companies is better than of companies outside Europe and there is also greater availability of information about bilateral tax treaties among European countries. Another source of data for estimating profit shifting is Compustat used for example by Collins et al. (1998) and Dyreng & Markle (2013). German central bank collected data about affiliates of German-based multinational enterprises known as Mikrodaten Direktinvestitionen. This dataset was used for example by Weichenrieder (2009). All authors of the abovementioned studies identified statistically significant profit shifting. However, the number of observations in these studies is substantially smaller than in Orbis or Amadeus databases. In this thesis I use data from Orbis database which was also used for example by Johansson et al. (2017). Some disadvantages and limitations of Orbis database are stated in Ribeiro et al. (2010).

Micro-level panel data, such as data used in this thesis, enable panel data techniques, for example fixed effects. However, it is not clear which fixed effects to use. Dharmapala (2014) suggests using affiliate fixed effects, i.e. fixed effects allowing unobserved determinants of profitability of every subsidiary, and also mentions

possibility to add country-interacted-with-time fixed effects. Johansson et al. (2017) suggest using time and industry fixed effects and in some specifications country fixed effects and country-interacted-with-time fixed effects. Country-interacted-with-time fixed effects are used because changes in a tax rate are often accompanied with other changes in tax policy. If I want to estimate only effect of tax rate differentials, I must control for the other changes.

When analyzing effects of corporate taxes, one can use either statutory or effective tax rates. Johansson et al. (2017) claim that statutory tax rate is more widely used in these profit shifting estimations as most tax deductions and exemptions are based on real activity and are not affected by profit shifting. Dharmapala (2014) also favors using statutory tax rates because effective tax rates depend on company's choices and are therefore not exogenous. On the other hand, companies should consider various tax exemptions in their decision-making, so effective tax rate should drive their decisions about profit shifting as well. Dowd et al. (2017) and Cobham & Janskỳ (2017) argue that incentives for profit shifting are driven by effective tax rates and that future research can further explore this issue and determine which tax rates yield stronger results. This was done for example by Jelínková (2018) who concluded that effective tax rate has no significant effect on profit before tax in contrast to statutory rate. The effective tax rates can be substantially different from the statutory ones. Comparison of effective and statutory tax rates was done for example by Dowd et al. (2017). In this thesis both statutory and effective tax rates are used, and the results compared.

Besides profit shifting, companies may use another way to reduce their corporate taxes. Multinational companies may exploit mismatches between tax regimes resulting in non-taxation of some profits. This behavior results in reduction of effective tax rate. Johansson et al. (2017) describe some possible ways to avoid taxation claim that multinational companies have lower effective tax rate by 4-8.5 percentage points. They claim that the exploitation of mismatches accounts for approximately one third of base erosion and profit shifting. However, analysis of the mismatches between tax systems and their consequences are not subject of this thesis.

As a measure of incentives for profit shifting tax difference is used. Previous studies use different specifications of the tax difference. It is defined either as difference in tax rates between parent and its subsidiary, difference between tax rate and average tax rate in the group or average difference in tax rates between companies in the same group. This average can be either weighted or unweighted. Huizinga & Laeven (2008) used weighted average where profits serve as weights. According to them, higher profits mean higher possibilities to shift profit both in and out of the company.

However, as Johansson et al. (2017) point out, profit can be shifted even to locations with low activity and in case of using profits as weights, there is endogeneity problem. The weights would depend on the shifted profit and the weights of companies receiving shifted profit would overestimate their importance in the group. Additionally, the relationship between tax difference and shifted profit may not be linear. Non-linear relationship between tax difference and profits is examined in Dowd et al. (2017). The authors claim that simple linear model is not able to capture the curvature in the relationship and that more flexible models are needed.

Moreover, different studies use different specifications of profitability. Some studies use profit before tax and some prefer EBIT. Overview of the profitability measures in individual papers can be found in Heckemeyer & Overesch (2013). One of the profit shifting channels are intra group loans. When using EBIT as profitability measure the effect of these loans is disregarded because EBIT represents earnings before interest from these loans. In this work I want to include this channel so I use profit before tax. Johansson et al. (2017) use profit before tax divided by total assets as their main profitability measure while Huizinga & Laeven (2008) use logarithm of profit. In this work I use both these specifications and compare the results.

It is not clear whether to use only firms with positive profits in the analysis. Profitable firms have more incentives to engage in profit shifting. Weichenrieder (2009) included only companies which had on average positive profitability over the sample time period. Huizinga & Laeven (2008) and Dharmapala & Riedel (2013) excluded loss making companies in one of their specifications. On the other hand, Johansson et al. (2017) argue that loss making companies should not be excluded because some initially profitable companies may end up with a loss when the profit is shifted from them and even loss making multinational groups may concentrate losses in high-tax countries to use them to offset future profits and lower future tax payments. In the benchmark model of this work I use observations with positive profit when using logarithm of profit as dependent variable and all observations when using profit to assets.

Authors in previous studies use different approaches to deal with outliers. It is possible to either drop observations with the most extreme values or to winsorize the data. Nevertheless, I can conclude that dealing with outliers is a common practice. Weichenrieder (2009) chose the latter approach. He set the value of top 5% and lowest 5% of observations in terms of profitability equal to the 95th and 5th percentile, respectively. On the other hand, Dharmapala & Riedel (2013) dropped top 1% and Johansson et al. (2017) 2.5% of the most extreme observations.

Profit shifting semi-elasticity can be used to calculate corporate income tax loss. First the semi-elasticity is used to calculate shifted profit in the sample. Then certain weighting is necessary as the sample is not representative of all the firms in the economy. Johansson et al. (2017) use different weights for multinational and non-multinational firms. They use large companies as a proxy for multinational ones. They calculate the share of large firms out of all firms and use this share to calculate weights. In this work I change weights of small and large companies instead of multinationals and non-multinationals.

Countries have different anti-avoidance rules in place to reduce profit-shifting. The most common rules and approaches are classified in OECD (2013). There have been efforts to assess strength of the rules. Most recently, Johansson et al. (2016) rated OECD countries on scale from 1 to 10 based on 5 criteria. Using this classification the authors concluded that stronger anti-avoidance rules are associated with smaller profit shifting in Johansson et al. (2017). The authors also concluded that these rules are associated with lower company profitability which can be attributed to compliance costs. Earlier, the impact of transfer pricing regulations was assessed by Lohse & Riedel (2012). The authors again concluded that the regulation reduces profit shifting. Another measure of strength of anti-avoidance rules is for example Financial secrecy index developed by Meinzer et al. (2018) which assesses countries based on how much they contribute to opacity in global financial flows. The Financial secrecy index does not asses only secrecy but also magnitude of financial flows. However, the secrecy scores can be found on the website of the index. Jelínková (2018) analyzed whether secrecy score is and incentive for banks to shift profits but found no significant evidence.

Fiscal effects from BEPS have been estimated for example by Johansson et al. (2017), Crivelli et al. (2015), Clausing (2016) and Dowd et al. (2017). There are different ways for estimating the tax loss. Johansson et al. (2017) first used estimated semi-elasticity to determine share of profits that multinational companies shift. Subsequently, they used this share and approximate share of multinationals' profit in profit of all companies to determine the share of total corporate tax revenues lost due to profit shifting. They estimated that annual loss for OECD and G20 countries is $100-240 billion. However, only two thirds of this amount are attributable to profit shifting. Crivelli et al. (2015) do not estimate semi-elasticity of profit shifting. They use country-level panel data and specification with corporate income tax base as dependent variable. Their estimated corporate income tax loss is $400 billion in the long run for their sample of 173 countries. However, the abovementioned studies do not provide country-level estimates. Johansson et al. (2017) mention that this is because the sample

may not be representative for some countries and the estimate for the whole group of countries averages out errors. Dowd et al. (2017) made a simulation for a set of countries and concluded that reported profits in Bermuda, the Cayman Islands, Ireland, Luxembourg, the Netherlands, and Switzerland would be lower by more than 100 billion of US dollars if these countries had statutory tax rates of 29% and effective tax rates of 17%. Some studies offer estimates for a single country. For example, Clausing (2016) estimated that US lose approximately $100 billion of taxable income.

2 Data

In this chapter I will describe data used in the estimation, discuss its limitations and assess representativeness. The dataset is used in both parts of this thesis: Estimation of profit shifting semi-elasticity and estimation of corporate income tax gains or losses from profit shifting.

2.1 Data adjustments and description

I use data from Orbis database compiled by Bureau van Dijk, which is currently widely considered to be the best available database of unconsolidated financial statements and firm ownership. The dataset used in this thesis has 22,041,109 observations. After deleting duplicates this represents 2,170,230 companies in years from 2003 to 2012. The full dataset was used to identify multinational groups and tax rates in these groups. However, in the regressions between 1,877,763 and 2,728,751 observations were used in the benchmark model. The other observations had to be excluded because of missing data.

To add macroeconomic data to the financial data I use IMF's World Economic Outlook database to obtain data about GDP per capita, GDP growth and CPI inflation (IMF, 2018a). The data about statutory tax rates come from KPMG Corporate tax rates table (KPMG, 2018). Corporate tax income data for individual countries are taken from World Revenue Longitudinal Dataset (IMF, 2018b) and complemented by Government Revenue Dataset (ICTD/UNU-WIDER, 2017). Data about strength of anti-avoidance rules are taken from Johansson et al. (2016) and data about financial secrecy scores are taken from webpage of this index created by Meinzer et al., (2018).

To conduct the analysis, I adjusted the data to the form needed. To estimate profit shifting inside multinational groups, it is necessary to first identify these groups. The dataset includes variable indicating global owner of the company. I consider all companies with the same global owner as part of the same group. All groups with at least one company in different country than others are considered as multinational groups and all companies in multinational groups are considered as multinational companies. There is information about global owner for all companies in the dataset. However, some global owners are also in the dataset and have their own global owner. In these cases, I replaced global owner of the subsidiary with the global owner of the parent company to get the ultimate global owner.

Observations with negative total assets and negative number of employees were dropped as these numbers obviously do not make sense. Additionally, I dropped 2.5% of observations with the highest profit before tax, profit to assets, total assets and number of employees. Additionally, the dataset consists of both consolidated and unconsolidated data. For the purpose of this analysis, consolidated data were dropped because profit shifting between parent and its subsidiary would not affect consolidated financial data of the parent.

I also used the financial statements data to calculate effective tax rates. It is possible to either calculate the effective tax rate for individual companies or on a country-level. In this thesis, the country-level is used. Effective rates on the company level have large variance between companies and years so using the country-level rates would more precisely reflect reality as it is less affected by one-off tax deductions. The country-level effective tax rates are also exogenous to decisions of one single company. The problem with endogeneity mentioned in literature review is therefore mitigated. Additionally, when using country-level effective tax rates, I can add the tax rate even to observations with no financial data, based on their country and on year of the observation. Owing to this, observations with no financial data can still be used to calculate tax difference described in Variable description.

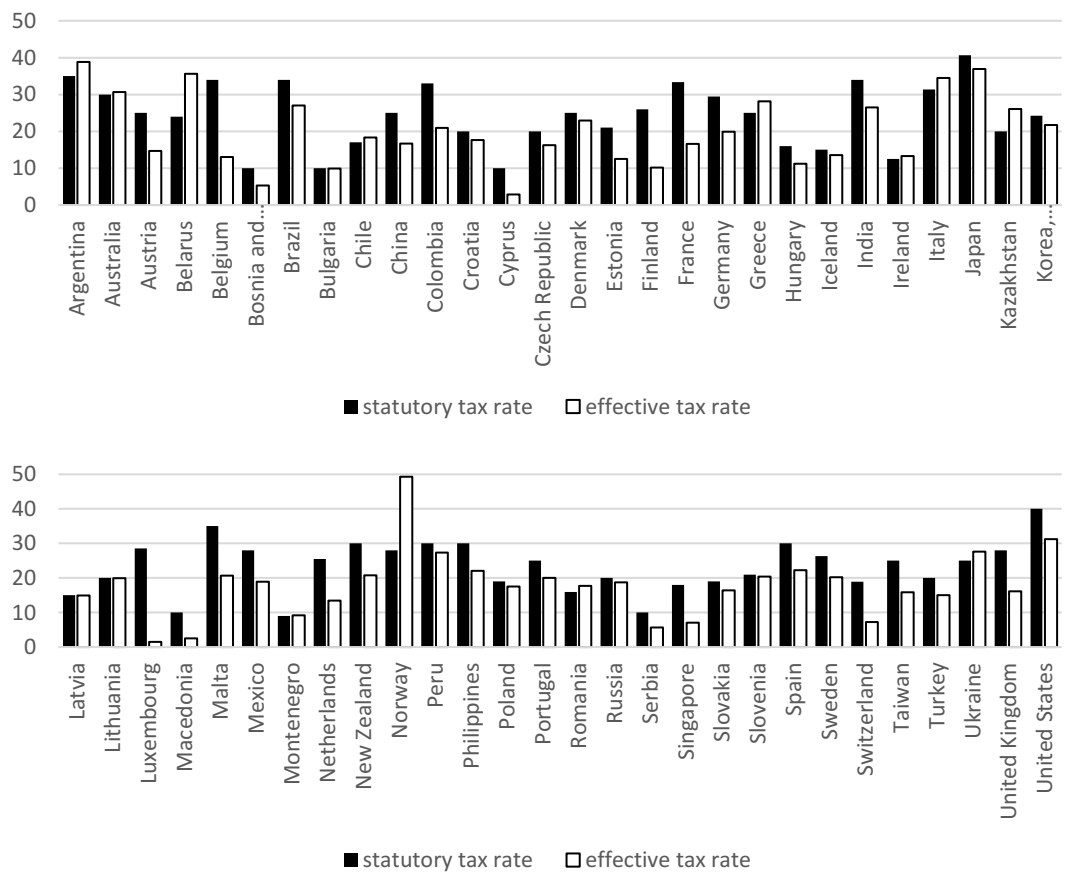
To calculate effective tax rate, only companies with positive profit before tax and positive taxation were taken. Companies with negative profits either do not pay corporate taxes or pay taxes from profits for previous years. Either way the calculation would be biased. Similarly, company with negative taxes due to returns would not be useful in the computation. Finally, I excluded observations in which the taxation was higher than the profit before tax for the purpose of determining effective tax rate. Computation of effective taxes from the data rather than downloading effective tax rates from a different source allows to compute separate rates for multinational companies. As it was mentioned in literature review multinational companies may have lower effective tax rates as they can use differences in tax rules between countries to pay lower taxes. I computed effective tax rates for both multinational and non-multinational companies. On average the multinational companies have lower effective tax rate by 0.4 percentage points. This is much lower that 4-8.5 percentage points estimate calculated by Johansson et al. (2017). However, there are large differences and for some countries the calculated effective tax rate is higher for multinational companies, contrary to intuition. Therefore, I decided to use effective tax rates calculated for all companies in the analysis. This increases number of observations and the rates should be more precise.

Effective tax rate in country c and year y is calculated as:

$$effective\ tax\ rate_{cy} = \frac{total\ taxation_{cy}}{total\ pretax\ profit_{cy}}$$

The tax rate is calculated using reported book pretax profit instead of taxable profit. I calculated the tax rate only when at least 20 companies with data about profit and taxation were available in a given country and year. In result the effective tax rate was calculated only for 57 countries. The calculated effective tax rates for all 57 countries and for entire sample period are in Appendix A: Effective tax rates. The sample contains observations from countries such as the Bahamas, Bermuda, the Cayman Islands, Cyprus, Luxembourg, Lichtenstein, Mauritius, Malta, the Marshall Islands, the Netherlands, Panama, San Marino and Seychelles which are all considered to be tax havens. However, out of these countries I was able to calculate effective tax rate only for Cyprus, Netherlands and Luxembourg. I set effective tax rate equal to zero in countries with zero statutory tax rate where I was not able to calculate effective tax rate by the procedure described above. Again, this is done because otherwise these tax havens would not be considered in calculating tax difference.

Figure 1: Statutory and effective tax rates in 2009



Source: IMF, Orbis, own analysis

In **Error! Reference source not found.** we can see that in most countries the effective tax rate is lower than the statutory tax rate. In Cyprus, Luxembourg and Macedonia the effective tax rate in the sample is almost zero even though the statutory rates are much higher. In Norway the effective tax rate was almost 50% in 2009 and was substantially higher than the statutory tax rate for the entire sample period. This might be caused by the fact that in Norway companies in some industries have to pay special tax besides the ordinary statutory rate (PwC, 2018). In case of Norway, multinational companies in the sample face substantially higher effective tax rate than non-multinationals so I cannot solve the problem by excluding non-multinational companies. I checked the numbers with effective tax rates presented in Dowd et al. (2017). The rates seem believable for most of the countries. However, the authors present very different effective tax rates for Norway. Since my numbers seem to be impossibly high for this country, I decided to exclude Norway from the regressions as an outlier.

For each multinational group I calculated minimal, maximal and mean statutory and effective tax rate. Then for every company and for both statutory and effective tax rates I calculated differences between the tax rate and the minimal, maximal and mean tax rates in its group. For non-multinational companies this is always zero. Therefore, the non-multinational companies would not affect the estimation of profit shifting elasticity where the tax difference is used as the main explanatory variable.

2.2 Variable description

Profitability: The dependent variable Profitability of firm f in year y is in different specifications defined as:

$$lprofit_{fy} = \ln(Profit\ before\ tax_{fy})$$

$$profit\_to\_assets_{fy} = \frac{Profit\ before\ tax_{fy}}{Total\ assets_{fy}}$$

$$profit\_to\_employees_{fy} = \frac{Profit\ before\ tax_{fy}}{Number\ of\ employees_{fy}}$$

Loss making companies are omitted in the first specification because logarithm is not defined for negative numbers. If the specification includes Total assets or Number of employees, these variables are then not used as explanatory variables. The first specification is preferred when calculating the corporate income tax gains or losses.

Tax difference: Tax difference is the main explanatory variable. I use multiple different definitions of tax difference defined as:

$$tax\ diff\ mean_{fy} = tax\ rate_{cy} - \underset{group}{\text{mean}}\left(tax\ rate_{cy}\right)$$

$$tax\ diff\ min_{fy} = tax\ rate_{cy} - \min_{group}\left(tax\ rate_{cy}\right)$$

$$tax\ diff\ max_{fy} = tax\ rate_{cy} - \max_{group}\left(tax\ rate_{cy}\right)$$

The preferred specification is difference between company's tax rate and average tax rate of the companies in its multinational group. In the alternative specification, I include two differences in the regression: difference between company's tax rate and lowest tax rate in the multinational group and difference between company's tax rate and highest tax rate in the multinational group. The first model in this thesis uses only tax rate instead of tax difference to assess influence of tax rate on profitability. I expect negative sign in case of all the specifications indicating that higher taxes result in lower reported profits.

In the preferred specification of tax difference, I use simple average. It is not weighted for two reasons. The first reason for not weighting is that, as it was mentioned in the literature review, there is no clear weighting strategy. The second reason is that some companies in the multinational group may have no financial data available, so it would not be possible to use their size as a weight.

In the analysis I use both effective and statutory tax rates. In case of countries such as the United States which apply different tax rates in different states, only one tax rate is used. The data do not allow users to determine which state the firm is from.

Total assets: I expect positive sign of the respective coefficient as assets are input necessary for activity generating profit. In regressions I use logarithm of total assets. Otherwise the interpretation of this coefficient would be that additional dollar of assets would result in the same percentage increase in profit regardless of current level of assets, which contradicts economic intuition.

Number of employees: I expect positive sign of the respective coefficient as employees generate activity necessary for higher profitability. In regressions I use logarithm of number of employees. Otherwise the interpretation of this coefficient would be that additional employee would result in the same percentage increase in profit regardless of current number of employees, which contradicts economic intuition.

GDP per capita: GDP per capita is defined as GDP over total population in PPP (2011 international dollars). I expect positive sign of the respective coefficient as companies

in richer countries should be more profitable. In regressions I use logarithm of GDP per capita.

GDP growth: GDP growth is defined as percentage change in real GDP from previous year. I expect positive sign of the respective coefficient as favorable economic conditions should improve profitability of companies.

Inflation: Inflation is defined as percentage change in average Consumer price index from previous year. I expect negative sign of the respective coefficient as high inflation brings certain costs associated with it such as menu costs.

Industry: The dataset contains NACE Rev 2 Codes. For the purpose of this analysis, companies were divided into 21 industries labeled A to U based on the codes. This variable is used for group fixed effects.

Country: Country where the company reports its financial data. In the full sample there are 205 countries. However, there are only 53 countries with at least 100 observations without relevant data missing.

Year: This variable is year of the observation. The sample covers 10 years from 2003 to 2012. The representativeness differs between years. For the purpose of regression including interaction with time I created variable year09. This variable is equal to year minus 2003 so it has values from 0 to 9.

Strength of anti-avoidance rules: The authors only presented the values for years 2005 and 2014. There are two possible ways to use this metric. The first way is to use the scale from 0 to 10. The second way is to divide the countries to those with weak, moderate, relatively strong and very strong anti-avoidance rules. I call the variable with the second way of dividing adjusted strength or adj_strength.

Financial secrecy score: The secrecy score is for year 2018. This is outside of the sample period. I use this year because country coverage is better than in the earlier issues of Financial Secrecy Index. The values are between 41.83 and 88.58. I expect that countries with higher secrecy will have higher profit shifting semi-elasticity.

To see if some variables are not too correlated I generated correlation matrix:

Table 1: Correlation matrix

	ltotal assets	lnumber employees	multinational	GDP growth	lGDP per capita	Inflation	eff tax diff mean	stat tax diff mean
ltotal_assets	1	0.48	0.14	-0.07	0.3	-0.27	0	0.02
lnumber_employees	0.48	1	0.09	0.13	-0.16	0.14	0.03	-0.04
multinational	0.14	0.09	1	0	-0.11	-0.06	-0.03	-0.02
GDP_growth	-0.07	0.13	0	1	-0.33	0.25	-0.04	-0.06
lGDP_per_capita	0.3	-0.16	-0.11	-0.33	1	-0.61	-0.01	0.14
Inflation	-0.27	0.14	-0.06	0.25	-0.61	1	0	-0.07
eff_tax_diff_mean	0	0.03	-0.03	-0.04	-0.01	0	1	0.46
stat_tax_diff_mean	0.02	-0.04	-0.02	-0.06	0.14	-0.07	0.46	1

Source: Orbis data, own analysis

The highest correlation in absolute value is between logarithm of GDP per capita and inflation and it is equal to -0.61. No two variables have correlation in absolute value over 0.8. Therefore, I do not have to remove any of the variables from the regression models. The same is true for variables used in complementary models such as strength of anti-avoidance rules or financial secrecy. The correlation between effective tax difference and statutory tax difference is only 0.46 which suggests that the results obtained using effective tax rate may be different from results obtained using statutory tax rate. Statutory tax difference is positively correlated with logarithm of GDP per capita while the Effective tax difference is negatively correlated with it. This means that for multinational companies in richer countries links to lower statutory tax countries will play higher role in the model.

2.3 Data limitations

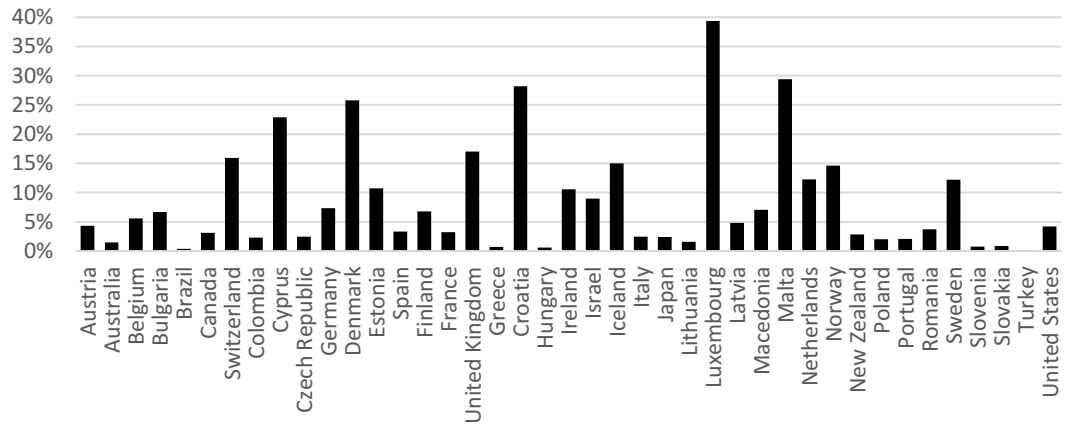
The database does not include all companies in the word. This may potentially cause bias discussed in part about possible sources of bias. Data are collected from different sources which do not collect data primarily for research purposes. Most of the data are collected by public institutions because of legal and administrative purposes. Some types of companies are underrepresented in the database. This is caused by different legal requirements for different types of companies. For example, in many countries only companies with certain size have obligation to report their results. This causes small companies to be underrepresented. This can be accounted for by increasing weights of small companies when calculating shifted profit. Also, the requirements and consequently coverage of companies differ across countries and years.

Additionally, accounting profit before tax reported in Orbis database can differ from taxable profit. However, profit shifting affects both profits in the same direction and

the difference should not create any substantial bias. If there was supposed to be a bias in certain direction it should be reduced using effective tax rate calculated from the data. The effective tax rate is calculated using actual corporate taxes paid.

I compare number of enterprises from my dataset with OECD's Structural and Demographic Business Statistics. Share of the number of companies in the sample from the total number of companies is shown in Figure 2.

Figure 2: Representativeness of the sample



Source: Orbis, OECD's Structural and Demographic Business Statistics in 2012, own analysis

The best coverage is for Luxembourg with almost 40% of all companies being in the sample. On the other hand, countries such as Brazil, Greece, Hungary, Slovenia and Turkey have very low coverage. The coverage for non-OECD and non-G20 countries is also considered to be relatively weak.

The data are from financial statements. The figures may differ from figures used for tax purposes. For example, losses from previous years may sometimes be used to decrease tax base and there may be different depreciation rules. However, profit shifting activities should affect the profit reported in financial statements in the same way as the profit reported for tax reasons. Even though the data come from different sources, the definitions of items in financial statements should be almost the same across countries.

One of the variables in the dataset is global owner. This variable does not change for individual companies throughout the sample period. This would mean that no company in the dataset changed its owner during the sample period. I consider this quite unlikely and suppose that this is an error in the data. However, the error should not be large as companies do not change their ownership very often.

3 Profit shifting semi-elasticity

In this part, profit shifting semi-elasticity is estimated. This semi-elasticity will firstly be compared with semi-elasticities estimated in previous studies and secondly it will be necessary to estimate corporate tax losses or gains in the next chapter.

3.1 Methodology

To determine the semi-elasticity, I estimated several models. I started with the simplest model, continued with benchmark model and then estimated several deviations from the benchmark model.

3.1.1 Model without tax differences

The tax differences described in part Variable description depend on proper identification of multinational groups and may not be precise. For that reason, I firstly examine the relationship between tax rate in individual countries and profitability of their firms disregarding differences in tax rates in multinational groups. The relationship will be estimated by the following basic model:

$$Profitability_{fy} = \beta * tax\ rate_{cy} + \gamma * F_{fy} + \delta * M_{cy} + \varphi_i + \varphi_y + \varepsilon_{fy}$$

F represents characteristics of the firm: total assets, number of employees and dummy variable for multinational companies. M includes macroeconomic variables GDP per capita, GDP growth and inflation. φ_i and φ_y are industry and year fixed effects, respectively. The fixed effects reflect differences in profitability between industries and years. f, c and y are firm, country and year indexes. These explanations are applicable to all subsequent equations.

The coefficient β_3 tells me if profit before tax depends on tax rate in the country. The profitability should be higher in countries with lower tax rates. However, this specification does not take into account whether the companies have opportunity and incentives to shift profits. To address this, tax rate differences between firms in multinational group must be used instead of simple tax rates.

3.1.2 Benchmark model

The methodology in this and all the following modes is derived from proposition by Hines & Rice (1994) that the reported profit of multinational companies consists of the

'true' and shifted profit. The true profit should be generated by company's activities and should therefore be a function of its characteristics determining economic activity. The shifted profit can only occur in companies which are part of multinational group and depends on the tax rate of the company and tax rates of companies from the same group. The benchmark equation used for estimation is:

$$Profitability_{fy} = \beta * tax\ difference_{fy} + \gamma * F_{fy} + \delta * M_{cy} + \varphi_i + \varphi_y + \varepsilon_{fy}$$

So, the true profit depends on assets, number of employees, dummy variable for multinational companies, macroeconomic variables, industry and year. The shifted profit depends on tax difference which represents incentive for profit shifting. The tax difference is defined as difference from mean tax rate in multinational group. I use observations with positive profit when using logarithm of profit as dependent variable and all observations when using profit to assets.

The logic of this model is that two companies which are identical should have the same profitability. If the only difference between two companies is that one of them has links to low or high tax countries, then the difference in profitability is caused by profit shifted to or from this company.

In case of logarithm of profit before tax used as dependent variable, the coefficient β is directly profit shifting semi-elasticity. In case of profitability defined as profit before tax over total assets, the semi-elasticity must be calculated as:

$$profit\ shifting\ semi\text{-}elasticity = \frac{\beta}{average_{MNEs}\left(\frac{profit\ before\ tax_{fy}}{total\ assets_{fy}}\right)}$$

For example, if the average profit before tax to assets ratio is 0.04 then increasing this ratio by 0.001 equals to increase in profit by 0.001/0.04=2.5%.

If the estimated semi-elasticity is negative and significantly different from zero, then multinational companies shift their profits to countries with lower tax rates. All following models are based on the benchmark model.

3.1.3 Model with country fixed effects

In this model I include country fixed effect. The equation used for this model is:

$$Profitability_{fy} = \beta * tax\ difference_{fy} + \gamma * F_{fy} + \delta * M_{cy} + \varphi_i + \varphi_y + \varphi_c + \varepsilon_{fy}$$

Where, φ_c are the country fixed effects. Johansson et al. (2017) do not use country fixed effects in their baseline model and argue that the country fixed effects absorb part of the profit shifting behavior. On the other hand, the country fixed effects reflect differences in profitability between countries for both multinational and non-multinational companies and are, therefore, able to isolate the profit shifting behavior of the multinationals. The estimated semi-elasticities should be lower than in case of the benchmark model.

3.1.4 Model with lowest and highest tax rate in group

To see whether the results are robust, I estimated several other specifications. I use difference from lowest and highest tax rate in multinational group instead of average. The equation used for estimation is:

$$Profitability_{fy} = \beta_1 * tax\ difference\ min_{fy} + \beta_2 * tax\ difference\ max_{fy} +$$

$$+\gamma * F_{fy} + \delta * M_{cy} + \varphi_i + \varphi_y + \varepsilon_{fy}$$

Correlation between the two tax differences is -0.51 for effective and -0.62 for statutory tax rate which does not seem to be too high. I decided to use these alternative definitions of tax difference because the benchmark specification has certain disadvantages. When using the average as in the benchmark model, there is no distinction between groups with different variance in the tax rates. For example, companies A and B with tax rates close to their group averages have different opportunities for profit shifting if all companies in the group with company A have tax rates close to the group average and the tax rates of companies in group with company B range from very low to very high. Company B has opportunity to shift profits to the companies with very low tax rates from the same group. Similarly, in case of using only lowest tax rate, company with the lowest tax rate would be prone to receive shifted profit only in case other companies in the group have much higher tax rates. Therefore, difference from both highest and lowest tax rate in group must be included in the model.

In this model difference form lowest tax rate represents opportunity and incentive to shift profit out of the company to country with lower tax rate. Difference form highest tax rate represents opportunity and incentive to shift profit to the company from country with higher tax rate.

3.1.5 Model with tax difference interacted with year

To see whether profit shifting increases over time I include model with interaction between tax difference and time. The equation used for this model is:

$$Profitability_{fy} = \beta_1 * tax\ difference_{fy} + \beta_2 * tax\ difference_{fy} * year +$$

$$+\gamma * F_{fy} + \delta * M_{cy} + \varphi_i + \varepsilon_{fy}$$

Change in profitability with the change in tax difference is then equal to:

$$\frac{\partial profitability}{\partial tax\ difference} = \beta_1 + \beta_2 * year$$

3.1.6 Models with tax difference interacted with strength of anti-avoidance rules and financial secrecy

To see whether anti-avoidance rules reduce profit shifting, I include Interaction between tax difference and strength of these rules. The equation used for estimation is:

$$Profitability_{fy} =$$
$$= \beta_1 * tax\ difference_{fy} + \beta_2 * tax\ difference_{fy} * strength_c +$$

$$+\gamma * F_{fy} + \delta * M_{cy} + \varphi_i + \varphi_y + \varepsilon_{fy}$$

I use strength for year 2005 for the entire sample period. The anti-avoidance rules are aimed to prevent profit shifting from the country. Therefore, when estimating this model, I use only observations with positive tax difference which, according to the model, have incentives to shift profits to other companies in their group.

Change in profitability with the change in tax difference is then equal to:

$$\frac{\partial profitability}{\partial tax\ difference} = \beta_1 + \beta_2 * strength$$

The profit shifting semi-elasticity should be lower in absolute value in countries with strong anti-avoidance rules, which means that the coefficient β_2 should be positive.

To see whether financial secrecy affects profit shifting, I estimate one additional model with interaction between tax difference and the secrecy score. The equation used for estimation is:

$$Profitability_{fy} =$$
$$= \beta_1 * tax\ difference_{fy} + \beta_2 * tax\ difference_{fy} * secrecy_c +$$

$$+\gamma * F_{fy} + \delta * M_{cy} + \varphi_i + \varphi_y + \varepsilon_{fy}$$

I use secrecy for year 2018 for the entire sample period. Change in profitability with the change in tax difference is then equal to:

$$\frac{\partial profitability}{\partial tax\ difference} = \beta_1 + \beta_2 * secrecy$$

The secrecy allows companies to hide profit shifting. The profit shifting semi-elasticity should be higher in absolute value in countries with high secrecy, which means that the coefficient β_2 should be negative.

3.1.7 Model with semi-elasticities for individual countries

To account for the fact that profit shifting semi-elasticity may differ in individual countries, I estimate another model with interaction term between country dummy variables and difference in tax rate. In this specification, every country has its own semi-elasticity.

$$Profitability_{fy} = \beta * tax\ difference_{fy} * C + \gamma * F_{fy} + \delta * M_{cy} + \varphi_i + \varphi_y + \varepsilon_{fy}$$

C is vector of dummy variables for individual countries and β now represents vector of coefficients instead of a single coefficient. I excluded countries with fewer than 100 observations due to low representativeness.

3.2 Results

For all models I estimate four different specifications. The dependent variable is either logarithm of profit before tax or profit before tax to total assets and the tax rate used is either effective or statutory.

The models were estimated in statistical software R. I used felm command from lfe package enabling to do regression analysis with multiple group fixed effects. The tables with results were generated by Stargazer package created by Hlaváč (2018).

I used F test to compare models with and without fixed effects. In all cases I rejected the null hypothesis that the fixed effects are jointly zero on 1% level. Therefore, I left the fixed effects in the models. Additionally, I used Breusch–Pagan test to see if heteroskedasticity is present. For all models I rejected the null hypothesis of homoskedasticity on 1% level meaning that there is heteroskedasticity in the model which means that standard errors may be too low. To deal with heteroskedasticity I use heteroskedasticity robust standard errors. All results are presented with these robust standard errors.

3.2.1 Model without tax differences

I first present results from the basic models with tax rates and no tax differences.

Table 2: Regression results for model without tax differences

	Dependent variable:			
	lprofit		profit_to_assets	
	(1)	(2)	(3)	(4)
eff_tax	-1.408***		-0.078***	
	(0.014)		(0.001)	
stat_tax		-0.002		0.024***
		(0.022)		(0.002)
ltotal_assets	0.815***	0.810***		
	(0.001)	(0.001)		
lnumber_employees	0.144***	0.136***	0.007***	0.007***
	(0.001)	(0.001)	(0.0001)	(0.0001)
multinational	0.183***	0.205***	-0.008***	-0.006***
	(0.002)	(0.002)	(0.0002)	(0.0002)
GDP_growth	0.018***	0.026***	0.002***	0.002***
	(0.001)	(0.001)	(0.00004)	(0.00004)
lGDP_per_capita	0.650***	0.642***	0.034***	0.031***
	(0.004)	(0.004)	(0.0003)	(0.0003)
Inflation	-0.010***	-0.011***	-0.0004***	-0.0004***
	(0.0005)	(0.0005)	(0.00004)	(0.00004)
Observations	1,876,907	1,878,330	2,726,870	2,728,605
R^2	0.676	0.674	0.024	0.023
Adjusted R^2	0.676	0.674	0.024	0.023
Residual Std. Error	1.375 (df = 1876870)	1.379 (df = 1878293)	0.156 (df = 2726834)	0.156 (df = 2728569)

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

Source: own analysis

In the specifications with effective tax rate the coefficients of the tax rate are negative and significant on 1% level. In the second specification the coefficient of statutory tax rate is negative again, but this time it is not significant. The result from the fourth model are somewhat puzzling. The coefficient of statutory tax rate is positive and significant indicating higher profit to assets in countries with higher tax rate. The R-squared is higher for models with effective tax rate. Overall, it seems that companies in low-tax countries are more profitable and that effective tax rate is what their decisions are based on.

Coefficients of other variables have mostly the expected signs. The exception is variable multinational. In first two specifications it has positive sign meaning that multinational companies are more profitable. In the last two specifications the coefficients are negative. The same situation is true for all following models. It may be caused by the fact that multinational companies are on average more asset heavy.

However, as mentioned, this might not be caused by profit shifting. Multinational groups may decide to have their most profitable activities in low-tax countries. The profit shifting behavior is identified in the benchmark model.

3.2.2 Benchmark model

The benchmark model includes differences in tax rates in multinational groups.

Table 3: Regression results for benchmark model

	Dependent variable:			
	Lprofit		profit_to_assets	
	(1)	(2)	(3)	(4)
eff_tax_diff_mean	-1.524***		-0.066***	
	(0.027)		(0.003)	
stat_tax_diff_mean		-2.415***		-0.119***
		(0.035)		(0.004)
ltotal_assets	0.809***	0.809***		
	(0.001)	(0.001)		
lnumber_employees	0.138***	0.136***	0.007***	0.007***
	(0.001)	(0.001)	(0.0001)	(0.0001)
multinational	0.200***	0.205***	-0.007***	-0.006***
	(0.002)	(0.002)	(0.0002)	(0.0002)
GDP_growth	0.024***	0.025***	0.002***	0.002***
	(0.001)	(0.001)	(0.00004)	(0.00004)
lGDP_per_capita	0.637***	0.667***	0.032***	0.034***
	(0.004)	(0.004)	(0.0003)	(0.0003)
Inflation	-0.012***	-0.011***	-0.0005***	-0.0004***
	(0.0005)	(0.0005)	(0.00004)	(0.00004)
Observations	1,877,763	1,878,456	2,727,884	2,728,751
R^2	0.675	0.675	0.023	0.024
Adjusted R^2	0.675	0.675	0.023	0.024
Residual Std. Error	1.378 (df = 1877726)	1.377 (df = 1878419)	0.156 (df = 2727848)	0.156 (df = 2728715)

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

Source: own analysis

In all four specifications the coefficient of tax difference is negative and significant on 1% level. The coefficients of statutory tax difference are higher in absolute value than coefficients of effective tax difference. Based on R-squared the fourth model also has higher goodness of fit than the third model. This suggests that using statutory tax rate is preferable.

In the specification with logarithm of profit as dependent variable, the estimated semi-elasticity is 1.524 for effective tax rate and 2.415 percent for statutory. This means that

one percentage point increase in the effective and statutory corporate income tax rate reduces profit of multinational companies by 1.524% and 2.415%, respectively. In the specification with share of profit to assets the coefficients are -0.066 and -0.119. Mean profit before tax to assets ratio for multinational companies is 0.03221 so coefficients in third and fourth model result in semi-elasticities of 2.05 and 3.695, respectively. The estimated semi-elasticities are higher than estimates of Johansson et al. (2017), who reached semi-elasticities around 1 using similar data.

Additionally, I estimated specification with profit to assets using only observations with positive profit. The estimated coefficients of tax difference for specifications with effective and statutory tax rate are: -0.112 and -0.177, respectively. These estimates are higher than estimates in Table 3. The corresponding profit shifting semi-elasticities are 3.48 and 5.5. I also estimated specification with profit to employees. The estimated coefficients of tax difference for specifications with effective and statutory tax rate are: -78,905.85 and -55,684.86, respectively. When I divide this by average profit per employees for multinational company which is 14,324.91, I get profit shifting semi-elasticities of -5.51 and -3.89. These semi-elasticities are higher than those obtained using profit to assets specification. The full results of these additional models are presented in Appendix B: Robustness analysis.

3.2.3 Model with country fixed effects

After adding country fixed effects, the results are following:

Table 4: Regression results for model with country fixed effects

	Dependent variable:			
	lprofit		profit_to_assets	
	(1)	(2)	(3)	(4)
eff_tax_diff_mean	0.042		0.016***	
	(0.031)		(0.003)	
stat_tax_diff_mean		-2.056***		-0.163***
		(0.040)		(0.004)
ltotal_assets	0.780***	0.778***		
	(0.001)	(0.001)		
lnumber_employees	0.157***	0.158***	0.008***	0.008***
	(0.001)	(0.001)	(0.0001)	(0.0001)
multinational	0.236***	0.242***	-0.007***	-0.006***
	(0.002)	(0.002)	(0.0002)	(0.0002)
GDP_growth	0.010***	0.010***	0.001***	0.001***
	(0.001)	(0.001)	(0.0001)	(0.0001)
lGDP_per_capita	0.438***	0.440***	0.001	0.001
	(0.024)	(0.024)	(0.002)	(0.002)
Inflation	0.007***	0.007***	0.001***	0.001***
	(0.001)	(0.001)	(0.0001)	(0.0001)
Observations	1,877,763	1,878,456	2,727,884	2,728,751
R^2	0.682	0.683	0.029	0.030
Adjusted R^2	0.682	0.683	0.029	0.030
Residual Std. Error	1.361 (df = 1877631)	1.360 (df = 1878305)	0.156 (df = 2727753)	0.156 (df = 2728599)
Note:				*p<0.1**p<0.05***p<0.01

Source: own analysis

Adding country fixed effects substantially reduced the absolute value of estimated semi-elasticities in the model, except for the fourth specification, where the coefficient increased in the absolute value compared with the benchmark model. It is especially notable in specifications with effective tax rate, where the coefficients of tax difference are positive and in case of specification with profit to assets even significant, which is in contradiction with economic intuition. R-squared is higher for specifications with statutory rates. Therefore, using statutory tax rate gives stronger and more meaningful results.

As already mentioned, country fixed effects may absorb part of the profit shifting behavior. The tax difference may not be calculated precisely. The coverage for non-OECD countries is poor so some links of multinational groups to low tax countries might be missing. Put differently, multinational companies in high-tax countries can be expected to have high tax difference even in cases when the methodology did not identify them and vice versa. This causes downward bias of the coefficient. This is

further explained in part 3.3.1. Using the model without country fixed effects affects the coefficient in the opposite direction which at least theoretically reduces the bias. Interestingly, the coefficients of variable inflation are positive in this model while in the previous two models they were negative.

3.2.4 Model with lowest and highest tax rate in group

After replacing tax difference from mean tax rate in the group with difference from lowest and highest tax rate in the group the results are following:

Table 5: Regression results for model with difference from lowest and highest tax rate in group

	Dependent variable:			
	lprofit		profit_to_assets	
	(1)	(2)	(3)	(4)
eff_tax_diff_min	0.049***		-0.003**	
	(0.015)		(0.001)	
eff_tax_diff_max	-1.480***		-0.048***	
	(0.012)		(0.001)	
stat_tax_diff_min		0.370***		-0.004**
		(0.015)		(0.001)
stat_tax_diff_max		-1.423***		-0.057***
		(0.017)		(0.002)
ltotal_assets	0.798***	0.799***		
	(0.001)	(0.001)		
lnumber_employees	0.136***	0.134***	0.007***	0.007***
	(0.001)	(0.001)	(0.0001)	(0.0001)
multinational	0.049***	0.068***	-0.011***	-0.010***
	(0.003)	(0.003)	(0.0003)	(0.0002)
GDP_growth	0.022***	0.024***	0.002***	0.002***
	(0.001)	(0.001)	(0.00004)	(0.00004)
lGDP_per_capita	0.560***	0.592***	0.030***	0.031***
	(0.004)	(0.004)	(0.0003)	(0.0003)
Inflation	-0.014***	-0.015***	-0.0005***	-0.0005***
	(0.0005)	(0.0005)	(0.00004)	(0.00004)
Observations	1,877,763	1,878,456	2,727,884	2,728,751
R^2	0.677	0.676	0.024	0.024
Adjusted R^2	0.677	0.676	0.024	0.024
Residual Std. Error	1.373 (df = 1877725)	1.374 (df = 1878418)	0.156 (df = 2727847)	0.156 (df = 2728714)

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

Source: own analysis

Both coefficients are expected to be negative. For the first two models this is not true. In the third and fourth model, the coefficient of difference from highest tax rate is

substantially higher than the coefficient of difference from lowest tax rate. This would mean that with change in tax rate there is bigger change in profit shifted to the company than in profit shifted out of the company. It causes companies closer to the minimum tax rate to have higher expected profitability. This is in line with the intuition. Coefficients of the other variables have all the same signs as in the benchmark model. To conclude, I do not think that this model improved identification of profit shifting, mainly because the results for models with logarithm of profit before tax contradict the economic intuition.

3.2.5 Model with tax difference interacted with year

After adding interaction of the tax difference with the year the results are following:

Table 6: Regression results for model with tax difference interacted with time

	Dependent variable:			
	lprofit		profit_to_assets	
	(1)	(2)	(3)	(4)
eff_tax_diff_mean	-1.304***		-0.044***	
	(0.051)		(0.005)	
stat_tax_diff_mean		-2.964***		-0.165***
		(0.074)		(0.008)
year09	-0.011***	-0.011***	-0.003***	-0.003***
	(0.0004)	(0.0004)	(0.00004)	(0.00004)
ltotal_assets	0.811***	0.812***		
	(0.001)	(0.001)		
lnumber_employees	0.137***	0.136***	0.007***	0.007***
	(0.001)	(0.001)	(0.0001)	(0.0001)
multinational	0.198***	0.203***	-0.007***	-0.006***
	(0.002)	(0.002)	(0.0002)	(0.0002)
GDP_growth	0.015***	0.015***	0.002***	0.002***
	(0.0003)	(0.0003)	(0.00003)	(0.00003)
lGDP_per_capita	0.617***	0.644***	0.034***	0.035***
	(0.004)	(0.004)	(0.0003)	(0.0003)
Inflation	-0.010***	-0.009***	-0.0004***	-0.0004***
	(0.0004)	(0.0004)	(0.00003)	(0.00003)
eff_tax_diff_mean:year09	-0.069***		-0.005***	
	(0.011)		(0.001)	
stat_tax_diff_mean:year09		0.103***		0.009***
		(0.014)		(0.002)
Observations	1,877,763	1,878,456	2,727,884	2,728,751
R^2	0.674	0.674	0.023	0.023
Adjusted R^2	0.674	0.674	0.023	0.023
Residual Std. Error	1.379 (df = 1877733)	1.378 (df = 1878426)	0.156 (df = 2727855)	0.156 (df = 2728722)

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

Source: own analysis

For the two specifications using effective tax rate the coefficient of interaction between tax difference and year is negative. For the two specifications using statutory tax rate the coefficient is positive. This means that I cannot decisively say whether profit shifting elasticity increases or decreases over time. Year is defined as a number between 0 and 9 so, for example in the case of the first specification, the semi-elasticity is -1.304 in 2003 and then lower by 0.069 every year.

The coefficient of year alone is negative which suggests decreasing profitability over time. This might be affected by the Great recession which started in the middle of the

sample period. I also estimated model with interaction between tax difference and year dummy variables. The results are in Appendix B: Robustness analysis.

3.2.6 Models with tax difference interacted with strength of anti-avoidance rules and financial secrecy

After adding interaction of the tax difference with the strength of anti-avoidance rules the results are following:

Table 7: Model with strength of anti-avoidance rules

	Dependent variable:			
	lprofit		profit_to_assets	
	(1)	(2)	(3)	(4)
eff_tax_diff_mean	3.387***		-0.130***	
	(0.316)		(0.031)	
stat_tax_diff_mean		0.088		-0.183***
		(0.298)		(0.028)
strength_05	-0.001	0.006***	-0.002***	-0.002***
	(0.003)	(0.002)	(0.0003)	(0.0002)
ltotal_assets	0.800***	0.829***		
	(0.002)	(0.002)		
lnumber_employees	0.167***	0.110***	0.008***	0.007***
	(0.002)	(0.002)	(0.0002)	(0.0001)
GDP_growth	0.035***	0.049***	0.003***	0.004***
	(0.002)	(0.002)	(0.0002)	(0.0002)
lGDP_per_capita	0.455***	0.575***	0.021***	0.029***
	(0.017)	(0.015)	(0.002)	(0.001)
Inflation	-0.013***	-0.006***	-0.0002	-0.001***
	(0.001)	(0.001)	(0.0001)	(0.0001)
eff_tax_diff_mean:strength_05	-0.547***		0.020***	
	(0.054)		(0.005)	
stat_tax_diff_mean:strength_05		0.075		0.025***
		(0.057)		(0.005)
Observations	269,742	374,383	375,940	527,153
R^2	0.612	0.596	0.020	0.017
Adjusted R^2	0.612	0.596	0.020	0.017
Residual Std. Error	1.295 (df = 269704)	1.298 (df = 374345)	0.149 (df = 375903)	0.150 (df = 527116)
Note:				*p<0.1**p<0.05***p<0.01

Source: own analysis

The coefficient of the interaction term should be positive indicating that higher strength of anti-avoidance rules means lower absolute value of the profit shifting semi-elasticity. In the first specification the coefficient is negative and significant which

contradicts this intuition. In the second specification the coefficient is positive but insignificant. In case of the last two models the coefficients are negative and significant which is in line with the expectation. Coefficient of strength alone should theoretically reflect costs of anti-avoidance rules. Negative coefficient means that stronger rules result in lower profitability of the firms. In the second model, however, the coefficient of strength is positive and significant on 1% level which again contradicts economic intuition. For the remaining three models the signs are as expected. Therefore, I would not conclude that the anti-avoidance rules reduce profitability or try to estimate the losses resulting from these rules. The number of observations is substantially lower than in case of the benchmark model because of missing data. Maybe I would get better results if the strength was calculated for more countries. Coefficients of the other variables have all the same signs as in the benchmark model.

When I add interaction of the tax difference with the secrecy score the results are following:

Table 8: Model with secrecy score

	Dependent variable:			
	lprofit		profit_to_assets	
	(1)	(2)	(3)	(4)
eff_tax_diff_mean	-0.998***		-0.105***	
	(0.239)		(0.024)	
stat_tax_diff_mean		3.348***		-0.060*
		(0.283)		(0.031)
Secrecy	-0.005***	-0.005***	0.0001***	0.0001***
	(0.0002)	(0.0002)	(0.00002)	(0.00002)
ltotal_assets	0.808***	0.807***		
	(0.001)	(0.001)		
lnumber_employees	0.140***	0.139***	0.007***	0.007***
	(0.001)	(0.001)	(0.0001)	(0.0001)
Multinational	0.190***	0.194***	-0.008***	-0.007***
	(0.002)	(0.002)	(0.0002)	(0.0002)
GDP_growth	0.024***	0.025***	0.002***	0.002***
	(0.001)	(0.001)	(0.00004)	(0.00004)
lGDP_per_capita	0.591***	0.622***	0.030***	0.031***
	(0.004)	(0.005)	(0.0004)	(0.0004)
Inflation	-0.010***	-0.009***	-0.001***	-0.001***
	(0.0005)	(0.0005)	(0.00004)	(0.00004)
eff_tax_diff_mean:secrecy	-0.008*		0.001	
	(0.005)		(0.0005)	
stat_tax_diff_mean:secrecy		-0.104***		-0.001**
		(0.005)		(0.001)
Observations	1,833,589	1,834,050	2,650,558	2,651,127
R^2	0.676	0.676	0.023	0.023
Adjusted R^2	0.676	0.676	0.023	0.023
Residual Std. Error	1.375 (df = 1833550)	1.374 (df = 1834011)	0.156 (df = 2650520)	0.156 (df = 2651089)

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

Source: own analysis

The coefficient of the interaction term should be negative indicating that higher financial secrecy means higher absolute value of the profit shifting semi-elasticity. Only in the third model this is not true. Coefficients of the other variables have all the same signs as in the benchmark model. The results of this model seem to be much more reasonable than the results of the previous model. Using statutory tax rate again gives more meaningful results than effective tax rate.

3.2.7 Model with semi-elasticities for individual countries

The last estimated model is with interaction between countries and tax difference. The full results of this specification are presented in Appendix B: Robustness analysis. The results for individual countries make very little sense. The signs as well as magnitudes are extremely different across countries. Therefore, it will not be possible to use these results to calculate tax loss in the next chapter. Signs of the other coefficients are in line with the benchmark model.

3.3 Possible sources of bias

3.3.1 Missing data

Companies missing in the database cause downward bias in the semi-elasticity. For example, when company A shifts part of its profit to company B and is not included in the database, the unusually high profit of company B will not be attributed to profit shifting by the model. If company B is missing, the same applies to the unusually low profit of company A. The profit shifting semi-elasticity will appear smaller than it really is.

This possible bias is mentioned by Johansson et al. (2017). However, they did not mention what magnitude the bias might have. To estimate the size of this bias, I randomly dropped 90% of companies from the sample before calculation of tax difference in multinational groups. This causes some links between companies from different countries to be missing and reduces values of the tax difference variable. The share of dropped companies is equivalent to the share missing in the original sample compared to all companies in the economy. I re-ran the calculations of tax difference and re-estimated the model. The results are presented in Appendix B: Robustness analysis. The estimated profit shifting semi-elasticities are on average 7% lower. Surprisingly the coefficient in the fourth specification is higher. I assume that this 7% decrease in estimated profit shifting semi-elasticity is the same as the decrease caused by companies missing in the full database. Therefore, the true semi-elasticity should be approximately 7% higher.

If companies engaged in profit shifting are more likely to be missing and are underrepresented in the sample, the true bias would be even higher. This seems plausible as the fine or other punishment for not disclosing information about a company may be smaller than the benefit from concealing the profit shifting (Johansson et al., 2017).

Additionally, dropping outliers may mean dropping the most extreme cases of profit shifting. Therefore, I also estimated benchmark model with data without dropping the outliers. The results for specifications with logarithm of profit are not substantially different from the results presented here. On the other hand, results for specifications with profit to total assets are completely different with extreme profit shifting semi-elasticities. This is caused by companies which have very little assets. When their profit is divided by this small number, their profitability is several orders of magnitude larger than in case of common companies. The full results are presented in Appendix B: Robustness analysis.

3.3.2 Endogeneity

There are two kinds of endogeneity in the data: endogeneity of decisions about group structure and endogeneity of true profitability. Companies with higher profitability may gain more from engaging in profit shifting activities. Therefore, they are more likely to set up a subsidiary in low corporate income tax country. Even after shifting part of the profit to its subsidiary, the reported profit in the parent company may still be above average. This would cause downward bias in the estimate of profit shifting semi-elasticity. However, in this case the reported profit should be unusually high in the subsidiary as well which has the opposite effect on the estimated semi-elasticity. The resulting sign of the bias is therefore not clear.

Multinational companies may set up their most profitable activities in countries with low tax rates. This should not be considered as profit shifting if the activity truly takes place in the low tax country. Nevertheless, it might cause upward bias in my models. On the other hand, Loretz & Mokkas (2015) show on a model, that before tax profitability in high tax countries has to be higher if investors demand the same level of after tax profitability. Additionally, profit shifting activities are costly and consequently reduce profit. According to Huizinga & Laeven (2008), the costs are estimated to be 1.6% of the tax base of the company to which the profit is shifted. These costs cause downward bias in the semi-elasticity.

3.3.3 Specification

In all specifications either profitability is defined as profit before tax to assets or total assets are used as an explanatory variable. Two out of three most common channels for profit shifting involve creating assets in the company receiving shifted profit. Intangible assets may be transferred to low tax country and intragroup loan is an asset for the lending company. Therefore, the shifted profit would not be estimated to the full extent as these assets would influence the estimate of true profitability. This causes downward bias.

Additionally, all the estimated semi-elasticities are slightly imprecise because of definition of tax difference. The semi-elasticity is based on percentage point change in tax difference but one percentage point increase in tax rate is not the same as one percentage point increase in tax difference. The tax difference is calculated from mean tax rate in the multinational group which is also affected by the change in the tax rate of one or more companies in it.

4 Corporate income tax implications

Using estimated semi-elasticity from the previous part, I can now estimate Corporate income tax loss or gain. To estimate corporate income tax change, many simplifying assumptions must be made. Therefore, the results are only rough estimates. These assumptions will be described in the methodology.

4.1 Methodology

The methodology is different from the one used by Johansson et al. (2017) and it allows me to use fewer assumptions. Firstly, I use the estimated semi-elasticities to compute shifted profits by all multinational companies in the sample. The calculation depends on the specification of profitability measure. In case of profitability defined as profit before tax to assets it is:

$$Shifted\ profit = (\beta * tax\_difference) * Total\ assets$$

β is negative and total assets is positive. The sigh of shifted profit depends on tax difference. Positive shifted profit means that the company receives shifted profit and negative number that the company shifts profit away. The model assumes that all companies with positive tax difference shift profit away and vice versa. For the specification with logarithm of profit before tax the calculation is slightly more complicated:

$$Reported\ profit = e^{A+\beta*tax\ difference} = e^{A} * e^{\beta*tax\ difference}$$

$$True\ profit = e^{A} = \frac{Reported\ profit}{e^{\beta*tax\ difference}}$$

We know that:

$$Reported\ profit = True\ profit + Shifted\ profit$$

So:

$$Shifted\ profit = Reported\ profit - True\ profit$$

$$Shifted\ profit = Reported\ profit - \frac{Reported\ profit}{e^{\beta*tax\ difference}}$$

This calculation is meaningful only for profitable companies. When reported profit before tax is positive, the sign of shifted profit depends on the exponential in the denominator. If it is greater than one, shifted profit is positive and vice versa. β is negative so the exponential is greater than one for negative tax difference. Again, the model assumes that all companies with positive tax difference shift profit away and vice versa.

The β is not the same for all countries. Based on results from different models in part 3.2, I decided to calculate β from coefficients of the model with financial secrecy. It allows me to have different β for different countries and the results are in meaningful range unlike to country dummy variable coefficients from part 3.2.7. The formula for calculation of β is following:

$$\beta = \beta_1 + \beta_2 * secrecy_c$$

Based on the discussion in part 3.2, I decided to use statutory tax rate differences. In the models, coefficients of statutory tax rates had expected signs and were more significant than coefficients of effective tax rate.

Now I can sum the shifted profits for all companies in a given country.

$$share\ of\ shifted\ profit_{cy} = \frac{total\ shifted\ profit_{cy}}{total\ profit_{cy}}$$

I calculate this share using only profitable companies. Loss making companies should not pay corporate income tax for the year and change in the magnitude of their loss does not change the taxes they should pay. In the specification with profit before tax to total assets this means that I omit companies that might be reporting a loss but would be profitable without profit shifting and include companies which report profit but would have a loss without profit shifting. In case of specification with logarithm of profit before tax this does not happen. The true profitability is defined as exponential and therefore cannot be negative for company with positive reported profit. The shifted profit comes only from multinational companies while the total profit is for all companies. To mitigate representativeness problem mentioned in part about data limitations, I use weighting.

$$weighted\ shifted\ profit_{fy} = w_f * shifted\ profit_{fy}$$

$$weighted\ reported\ profit_{fy} = w_f * reported\ profit_{fy}$$

Large enterprises are overrepresented in the sample, so I use lower weight than weight of small enterprises. By large I mean companies with 250 employees or more. The weights are defined as:

$$weight\ large_c = \frac{\frac{\#\ number\ of\ large\ enterprises\ in\ country\ c}{total\ \#\ of\ enterprises\ in\ country\ c}}{\frac{sample\ \#\ of\ large\ enterprises\ in\ country\ c}{total\ sample\ \#\ of\ enterprises\ in\ country\ c}}$$

$$weight\ small = \frac{\frac{\#\ number\ of\ small\ enterprises\ in\ country\ c}{total\ \#\ of\ enterprises\ in\ country\ c}}{\frac{sample\ \#\ of\ small\ enterprises\ in\ country\ c}{total\ sample\ \#\ of\ enterprises\ in\ country\ c}}$$

Total number of enterprises is taken from OECD's Structural and Demographic Business Statistics. I use data from year 2012 which is the last year of my sample. Data for earlier years is available for fewer countries. The share of large companies in the economy is relatively stable over time so this should not affect the results substantially. For countries where number of large and total number of enterprises are not available, I use average weight for large and average for small across countries. I decided not to weight based on industries because data about number of companies in individual industries is often unavailable even for OECD countries.

I assume that after the weighting the share of shifted profit in the country is the same as the share I calculated in the sample. Additionally, I assume that the extra profit would be taxed with the same effective tax rate as the current reported profit. Put differently, I assume that 10% of extra profit translates into 10% of extra revenue from corporate income tax and losing 10% of profit means losing 10% of the revenue. With these assumptions, the share of shifted profit can also be interpreted as additional revenue or loss in percentage of corporate income tax revenue. Positive share means additional revenue, negative share means loss. There is a difference between book and taxable profit. However, if the ratio book/tax ratio remains stable than the previous conclusion holds.

Data for CIT revenues are taken from IMF which reports CIT revenues in percentage of GDP. The estimated tax loss in percentage of GDP is then:

$$tax\ loss\ in\ \%\ of\ GDP_c = \\ = share\ of\ shifted\ profit_c * CIT\ revenue\ in\ \%\ of\ GDP_c$$

And finally, the tax loss is:

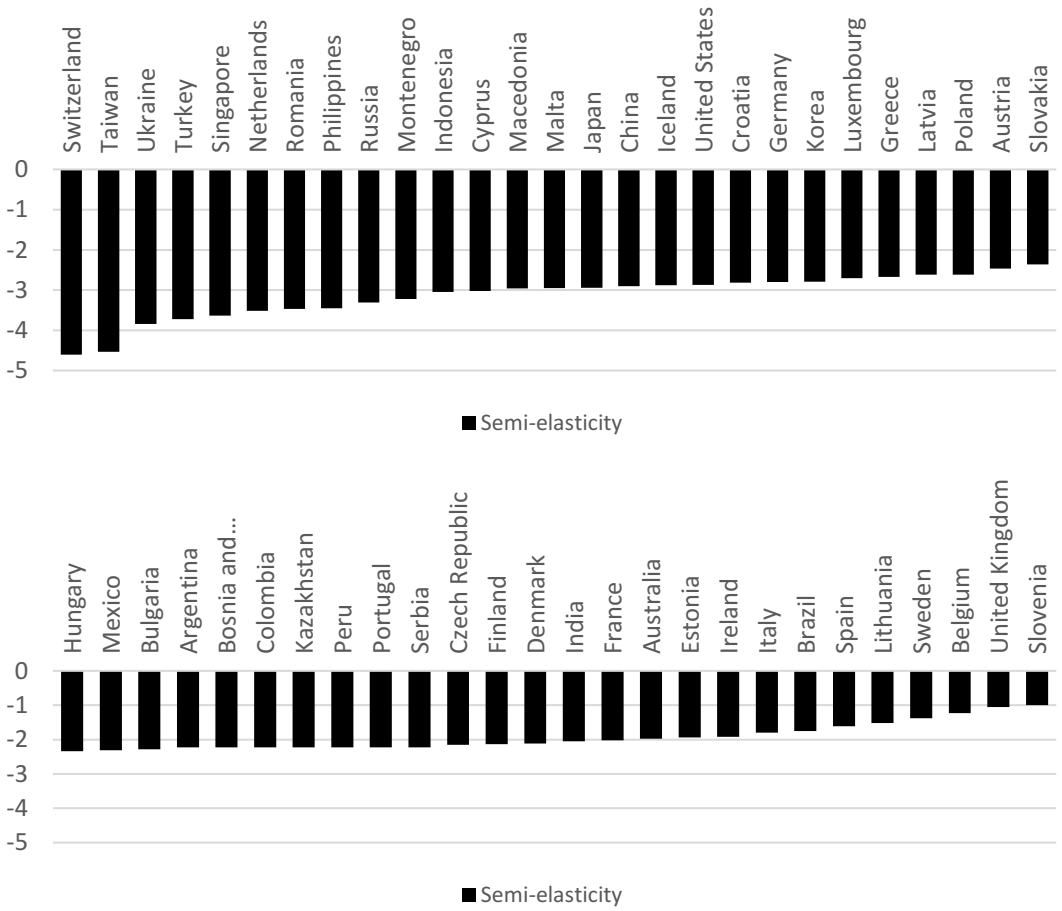
$$CIT\ loss = country\ c\ tax\ loss\ in\ \%\ of\ GDP * GDP$$

As I used only profit-making companies in the calculations, we

4.2 Results

Results from the second specification of **Error! Reference source not found.** in part **Error! Reference source not found.** were used to calculate semi-elasticities for individual countries. Results obtained using the fourth specification of the benchmark model, i.e. using profit before tax to assets are presented in Appendix C: CIT Gains and losses.

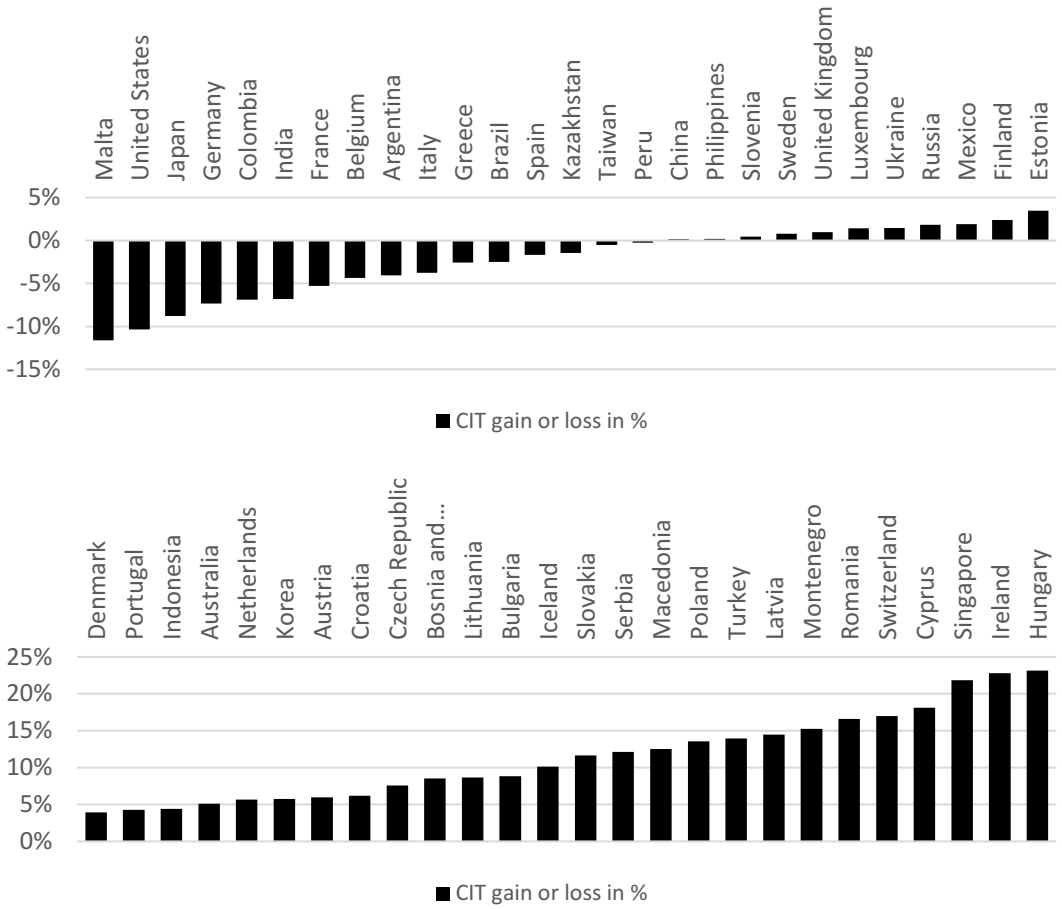
Figure 3: Semi-elasticities in individual countries



Source: own analysis

The countries are basically ordered according to their secrecy scores. Switzerland has the highest secrecy score and therefore has the highest profit shifting semi-elasticity. The profit shifting semi-elasticities for some countries are extremely high. However, the mean value of the semi-elasticity is -2.5 which is in line with the profit shifting semi-elasticity from the second specification of the benchmark model. The following data are for year 2012 which is the last year of the sample.

Figure 4: CIT gain (+) or loss (-) from profit shifting in % of CIT

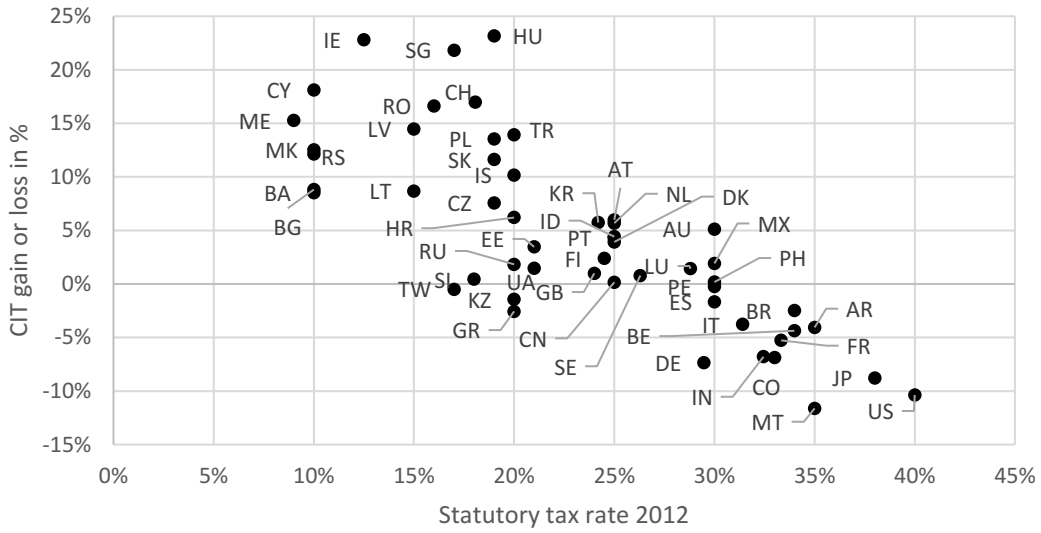


Source: own analysis

Figure 4 shows gain or loss from profit shifting in percentage of total Corporate income tax revenue. We can see that countries such as Malta, United States or Japan lose from profit shifting while countries such as Singapore, Ireland or Hungary gain from it. Gains from profit shifting are caused by the fact that based on my estimates, profit shifted to these countries is higher than profit shifted out of them. We can see that that out of 53 countries for which we have at least 100 relevant observations, 16 countries lose corporate income tax revenue due to profit shifting according to my estimates. In all countries there may be companies with both positive and negative tax difference. According to the model, countries with negative tax difference receive shifted profit and companies with positive tax difference shift profit to other companies in their group. So, the overall sign depends on tax differences of the companies in the sample and their size. Malta is suffering the highest relative losses which is caused by the fact that it has the highest statutory tax rate. Among the losing countries are some of the biggest world economies such as United states, Japan, Germany, France, Italy or India. On the other side of the figure we can find countries such as Switzerland, Cyprus or Ireland which are often mentioned in connection with illicit financial flows. Quite surprisingly, the highest gain in terms of CIT percentage has Hungary. It does not have

the lowest statutory tax rate and its secrecy score is not among highest. The reason for this is that in the sample, most of Hungarian multinational companies are linked to higher tax countries which might be only coincidence. As mentioned in part Data limitations, Hungary has very low coverage in the sample.

Figure 5: Statutory tax rate vs. CIT loss in %



Source: KPMG corporate tax rates table, own analysis

Figure 5 shows correlation between statutory tax rate and percentage gains of losses in corporate income taxes. Multinational companies from countries with high tax rate are more likely to have links to countries with lower tax rate because virtually all other countries have lower tax rate. For multinational companies from low tax rate countries the situation is opposite. However, the correlation between tax rate and mean tax difference is not perfect as we have seen on the example of Hungary.

Figure 6: Total CIT gains or losses from profit shifting

Source: own analysis

Bars in Figure 6 illustrate where absolute majority of shifted profit comes from. As mentioned, United States and Japan both have high losses in terms of percentage of CIT revenue. In combination with their high GDP, these countries account for more shifted profit than all other countries in this sample combined. The line shows how important for individual countries the gains or losses are. Unfortunately, no country with zero statutory tax rate made it to this sample. What we would see is that countries with zero tax rate have no corporate income tax gains or losses because any profit which is shifted to them is taxed by zero tax rate. In relative terms, the highest corporate income tax loss to GDP is in Malta where it accounts for 0.7%. Relative gains are the highest in Cyprus followed by Singapore with 1% and 0.9% of GDP, respectively. Hungary is no longer first due to its low share of corporate income tax revenue to GDP.

Overall, losing countries lose 75 billion US dollars and gaining countries gain 27 billion US dollars. Together profit shifting causes annual corporate income tax losses of 48 billion US dollars in the sample which represents 0.08% of the sample GDP and 2.6% of the sample corporate income tax revenue. This is lower than the 4 to 10% of corporate tax revenues estimated by Johansson et al. (2017).

I have calculated the overall tax loss using lower and upper bounds of 95% confidence interval for profit shifting semi-elasticity. The resulting numbers are 35 billion US dollars for lower bound and 61 billion US dollars for upper bound which is substantially lower number than estimate of 100 to 240 billion dollars for OECD and G20 countries while total GDP of my sample is virtually the same as total GDP of the OECD and G20 group.

4.3 Possible sources of inaccuracy

There are four main reasons why the estimated gains or losses may be inaccurate. Firstly, the results are calculated using the semi-elasticity from the previous chapter which might be inaccurate. I have showed that the estimated semi-elasticity changes substantially with specification of the model. Additionally, the relationship between tax difference and shifted profit may not be linear as was mentioned in Literature review.

Secondly, the share of shifted profit in the total profit is calculated for the companies in the sample. However, the available sample does not represent the whole economy perfectly. In case of Hungary which has very low coverage, I have estimated surprisingly high gain.

Thirdly, some simplifying assumptions were made. Some companies may have positive profit but be in a loss without their estimated shifted profit. The taxation does not become negative with negative profit so in this case the tax would not decrease proportionately with profit as the computation would suggest. The calculations are based only on profitable companies, so the opposite case is not a problem. Additionally, I assume that that shifted profit would be taxed with the statutory or effective tax rate. However, marginal tax rate can be different from the overall tax rate. This means that increasing pretax profit by one percent does not increase corporate income tax paid by one percent.

Lastly, I assume that the increase in reported profit results in the same percentage increase in corporate income tax revenue. However, this additional profit might be taxed by marginal rate different from the rate at which other profits are taxed.

Conclusion

This thesis analyzes profit shifting and resulting corporate income tax gains and losses. I first estimated profit shifting elasticity using Orbis database of firm-level data. Subsequently I used these estimates to calculate corporate income tax revenue gains or losses for individual countries.

The estimated profit shifting semi-elasticity for the entire sample ranges from 1.524 to 3.695 for different specifications of the benchmark model. This means that one percentage point increase in the corporate tax rate reduces reported profit before tax of companies by 1.524 to 3.695%. My estimates are higher than the semi-elasticities estimated in the most relevant previous studies which estimate the profit shifting semi-elasticity to be between 0.8 and 1.

The results are sensitive to the choice of specification. For example, after including country fixed effects the profit shifting semi-elasticity obtained using effective tax rate virtually disappears and stops being significant. The results contradict economic intuition when the model is estimated using difference from highest and lowest tax rate in multinational group instead of difference from mean tax rate. Based on the results of model with interaction of tax difference with year I cannot say whether the profit shifting semi-elasticity is increasing or decreasing in time because the results differ for statutory and for effective tax rate. I also estimated whether legal environment has effect. Strength of anti-avoidance rules has ambiguous effect on the semi-elasticity. It seems that the semi-elasticity is much more affected by financial secrecy. Higher financial secrecy results in higher profit shifting semi-elasticity. This means that financial secrecy is making profit shifting easier.

To estimate the size of bias caused by missing data in the sample, I randomly dropped 90% of companies from the sample which causes some links between companies from different countries to be missing. I re-ran the calculations of tax difference and re-estimated the model. The estimated profit shifting semi-elasticities are on average 7% lower.

Results from model without tax differences in multinational groups show that companies in lower tax rate countries are more profitable and that effective tax rate is better predictor of profitability that statutory. However, once I include tax differences, using statutory tax rate yields stronger results than using country-level effective tax

rates calculated from the financial data in Orbis. Coefficients in the estimated models have the expected signs and are more significant. However, calculation of effective tax rate from the sample with accounting data may be imprecise. Therefore, I cannot conclude that my analysis proved that using statutory tax rate is superior.

To assess corporate income tax implications, I estimated semi-elasticities for individual countries using interaction terms between country dummy variables and tax rate differences. However, for some countries the coefficient is a positive and significant number which contradicts economic intuition and the differences in estimated semi-elasticities are extremely high. Therefore, these results cannot be used as country-level estimates of semi-elasticity and results from the model including financial secrecy were used instead.

Using the country estimates of profit shifting semi-elasticity I calculated shifted profit for companies in the sample and aggregated them on the country-level. Gains or losses from profit shifting were estimated for 53 countries with at least 100 observations without missing data. They range from -12% to +23% of corporate income tax revenues. Overall, in 2012 losing countries lost 75 billion US dollars and gaining countries gained 27 billion US dollars. Together profit shifting causes annual corporate income tax losses of 48 billion US dollars in the sample which represents 0.08% of the sample GDP and 2.6% of the sample corporate income tax revenue. This is lower than the 4 to 10% of corporate tax revenues estimated by Johansson et al. (2017). Majority of the loss comes from the United States and Japan. To estimate corporate income tax loss, many simplifying assumptions were made. Therefore, the results are only rough estimates.

There are four areas on which future research should focus in my opinion. As my findings are rather inconclusive, one of the goals should be determining whether using statutory or effective tax rate is more suitable for estimating profit-shifting. Future research may also try to reach better estimates of profit shifting semi-elasticities for individual countries. Furthermore, my simulation for estimation of bias caused by missing data is extremely simple. It could be improved for example by simulating missing data about ownership instead of entire observations or by increasing probability of certain observation being missing. Thirdly, Johansson et al. (2017) calculated their strength of anti-avoidance rules score for years 2005 and 2014. With more up-to-date dataset containing year 2014 it would be possible to test effects of changes in this measure between the two years for example using some sort of difference in differences method.

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Appendix A: Effective tax rates

Table 9: Effective tax rates

Country	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Argentina	43.4%	40.1%	37.7%	26.2%	24.8%	37.9%	38.9%	36.8%		
Austria	20.2%	22.1%	17.9%	15.6%	15.3%	15.2%	14.7%	14.9%	11.1%	7.5%
Australia				30.2%	28.5%	27.0%	30.7%	29.2%	25.1%	
Bosnia and Herzegovina	0.6%	4.6%	4.4%	4.3%	6.3%	7.3%	5.3%	5.9%	7.4%	
Belgium	17.6%	16.9%	17.2%	14.5%	15.1%	11.9%	13.1%	15.5%	16.0%	18.9%
Bulgaria	21.7%	18.3%	14.4%	13.9%	9.7%	9.0%	9.9%	9.8%	10.3%	
Brazil	32.6%	30.7%	29.9%	26.4%	29.6%	27.7%	27.1%	27.7%	27.4%	
Belarus	32.5%	35.7%	39.3%	38.8%		36.3%	35.7%	28.6%	22.1%	
Chile	15.5%	17.3%	17.1%	18.9%	18.3%	19.8%	18.4%	14.4%		
China			14.3%	11.6%	14.6%	12.1%	16.7%	18.1%	18.2%	
Colombia		31.3%	15.5%	16.9%	19.3%	18.7%	20.9%	12.6%	11.0%	26.7%
Cyprus					1.0%	4.7%	2.8%			
Czech Republic	20.7%	23.0%	21.9%	22.4%	19.2%	17.9%	16.2%	16.0%	16.5%	18.7%
Germany	25.6%	25.4%	23.6%	24.0%	25.0%	20.1%	19.9%	20.3%	17.6%	14.1%
Denmark					26.8%	28.6%	23.0%	20.4%	24.4%	16.5%
Estonia	4.1%	5.2%	3.8%	3.4%	3.3%	4.7%	12.5%	8.9%	10.1%	19.2%
Spain	26.1%	26.0%	27.1%	29.7%	26.5%	24.9%	22.3%	24.2%	19.7%	29.5%
Finland	18.1%	14.3%	11.6%	12.2%	11.8%	13.0%	10.2%	12.5%	11.6%	11.0%
France	19.6%	20.7%	18.6%	19.5%	17.9%	19.1%	16.6%	14.4%	17.2%	19.1%
United Kingdom	20.3%	18.3%	19.1%	18.6%	19.3%	19.4%	16.1%	15.9%	18.2%	16.2%
Greece	32.5%	33.3%	29.8%	27.8%	26.8%	25.1%	28.1%	31.8%	21.6%	21.6%
Croatia	11.7%	12.2%	12.1%	14.6%	15.1%	17.7%	17.7%	18.1%	14.7%	
Hungary	1.5%	11.6%	8.6%	8.4%	10.2%	10.0%	11.2%	12.9%	11.9%	
Switzerland	7.5%	7.8%	9.2%	8.6%	9.5%	9.9%	7.2%	11.8%	13.1%	
Ireland	10.5%	11.2%	10.0%	10.8%	12.2%	11.0%	13.3%	11.9%	13.5%	13.1%
India	19.9%	21.3%	24.0%	25.9%	25.8%	25.4%	26.5%	27.8%	26.7%	31.1%
Iceland	16.8%	15.3%	14.4%	13.1%	16.4%	12.8%	13.6%	18.8%	15.1%	16.2%
Italy	45.4%	41.6%	42.5%	42.6%	38.5%	31.2%	34.5%	36.1%	37.9%	34.7%
Japan	38.5%	35.4%	39.9%	39.8%	39.5%	37.5%	36.9%	35.6%	39.3%	39.0%
Korea	26.1%	25.9%	25.0%	23.2%	24.9%	26.1%	21.7%	20.8%	22.7%	20.6%
Kazakhstan					35.8%	10.2%	26.1%	26.4%	19.5%	
Lithuania	16.9%	17.3%	14.7%	18.5%	12.7%	15.1%	20.0%	13.5%	11.6%	12.4%
Luxembourg	9.5%	2.3%	1.3%	4.0%	3.2%	10.8%	1.5%	2.0%	2.9%	12.6%
Latvia	20.4%	16.7%	15.3%	16.1%	14.8%	15.6%	14.9%	14.3%	14.8%	12.8%
Moldova	9.3%	12.3%	10.1%	15.5%	15.7%	1.7%	0.0%	0.0%	0.0%	
Montenegro							9.2%	8.7%		
Macedonia		5.7%		11.9%	5.5%	10.9%	2.6%	4.6%		
Malta	21.0%	22.7%	23.3%	24.9%	17.3%	20.0%	20.7%	20.7%	14.3%	23.5%

Mexico	32.3%	37.2%	22.6%	20.1%	24.6%	22.8%	18.9%	24.8%	20.7%	
Netherlands	13.7%	8.5%	11.8%	19.1%	12.9%	16.9%	13.4%	8.7%	13.8%	7.3%
Norway	47.2%	49.5%	46.8%	49.2%	45.1%	51.5%	49.3%	47.0%	53.2%	62.7%
New Zealand				33.6%	21.0%	29.5%	20.8%	28.9%	21.3%	30.6%
Peru	27.3%	27.7%	27.5%	25.5%	27.6%	27.7%	27.4%	28.2%	31.7%	34.7%
Philippines	23.0%	11.2%	22.1%	27.6%	22.0%	25.3%	22.1%	25.9%		
Poland	26.2%	17.9%	18.7%	19.1%	18.8%	19.0%	17.5%	17.3%	17.7%	20.8%
Portugal	30.3%	24.8%	23.3%	23.4%	20.3%	20.6%	20.1%	8.1%	22.4%	
Romania	21.1%	21.4%	15.4%	16.2%	15.0%	18.1%	17.7%	17.4%	15.8%	
Serbia	5.1%	5.9%	6.7%	6.6%	6.2%	6.7%	5.7%	6.9%	7.5%	9.2%
Russia	24.7%	25.3%	23.5%	24.9%	24.4%	22.1%	18.8%	18.7%	18.6%	18.0%
Sweden	19.2%	18.9%	19.5%	20.6%	17.8%	16.4%	20.2%	19.0%	16.4%	15.3%
Singapore	9.2%	9.2%	7.0%	7.5%	6.0%	6.9%	7.0%	6.4%	6.6%	6.8%
Slovenia	17.1%	19.1%	20.4%	21.8%	21.6%	20.7%	20.4%	19.4%	19.6%	
Slovakia	25.1%	19.5%	17.7%	16.9%	15.2%	16.7%	16.5%	15.9%	17.5%	21.9%
Turkey	13.1%	24.2%	21.1%	10.9%	12.8%	1.7%	15.0%	14.1%	13.2%	14.6%
Taiwan	18.3%	17.9%	14.7%	15.1%	15.6%	14.1%	15.9%	15.6%	14.6%	24.6%
Ukraine	37.0%	24.0%	25.7%	26.1%	24.4%	16.3%	27.6%	25.5%	21.7%	
United States	22.6%	20.2%	31.0%	26.9%	26.7%	28.9%	31.3%	29.2%	25.4%	

Source: own analysis based on Orbis data

Appendix B: Robustness analysis

Table 10: Model with profit to assets using only profitable companies

	Dependent variable:	
	profit_to_assets	
	(1)	(2)
eff_tax_diff_mean	-0.112***	
	(0.002)	
stat_tax_diff_mean		-0.177***
		(0.003)
lnumber_employees	-0.003***	-0.003***
	(0.00005)	(0.00005)
multinational	0.009***	0.010***
	(0.0002)	(0.0002)
GDP_growth	0.002***	0.002***
	(0.00004)	(0.00004)
lGDP_per_capita	0.017***	0.020***
	(0.0003)	(0.0003)
Inflation	0.002***	0.002***
	(0.00003)	(0.00003)
Observations	1,877,567	1,878,260
R^2	0.024	0.025
Adjusted R^2	0.024	0.025
Residual Std. Error	0.104 (df = 1877531)	0.104 (df = 1878224)
Note:		*p<0.1**p<0.05***p<0.01

Source: own analysis

Table 11: Model with profit to employees

	Dependent variable:	
	profit_to_employees	
	(1)	(2)
eff_tax_diff_mean	-78,905.850***	
	(14,113.320)	
stat_tax_diff_mean		-55,684.860***
		(17,523.840)
ltotal_assets	2,843.870***	2,830.574***
	(313.420)	(312.601)
multinational	931.016	1,046.503
	(717.705)	(725.043)
GDP_growth	205.959*	283.908**
	(121.320)	(121.434)
lGDP_per_capita	15,566.380***	16,316.500***
	(872.029)	(907.155)
Inflation	-437.296***	-419.590***
	(74.874)	(75.139)
Observations	2,441,807	2,442,658
R^2	0.001	0.001
Adjusted R^2	0.001	0.001
Residual Std. Error	611,434.000 (df = 2441771)	611,423.500 (df = 2442622)
Note:		*p<0.1**p<0.05***p<0.01

Source: own analysis

Table 12: Benchmark model without dropping outliers

	Dependent variable:			
	lprofit		profit_to_assets	
	(1)	(2)	(3)	(4)
eff_tax_diff_mean	-1.556***		-35.619	
	(0.027)		(82.878)	
stat_tax_diff_mean		-2.278***		-88.311
		(0.034)		(97.241)
ltotal_assets	0.777***	0.778***		
	(0.001)	(0.001)		
lnumber_employees	0.145***	0.143***	-5.528**	-5.548**
	(0.001)	(0.001)	(2.770)	(2.800)
multinational	0.267***	0.272***	19.574	19.669
	(0.002)	(0.002)	(12.839)	(12.917)
GDP_growth	0.029***	0.030***	-1.374	-1.360
	(0.0005)	(0.0005)	(0.880)	(0.850)
lGDP_per_capita	0.630***	0.655***	19.350**	20.104**
	(0.004)	(0.004)	(9.142)	(9.343)
Inflation	-0.008***	-0.007***	1.944***	1.946***
	(0.0004)	(0.0004)	(0.724)	(0.722)
Observations	2,058,831	2,060,259	3,011,689	3,013,368
R^2	0.694	0.694	0.00002	0.00002
Adjusted R^2	0.694	0.694	0.00001	0.00001
Residual Std. Error	1.446 (df = 2058794)	1.446 (df = 2060222)	10,247.640 (df = 3011653)	10,244.780 (df = 3013332)
Note:				*p<0.1**p<0.05***p<0.01

Source: own analysis

Table 13: Model with year dummy variables

	Dependent variable:			
	lprofit		profit_to_assets	
	(1)	(2)	(3)	(4)
ltotal_assets	0.810***	0.811***		
	(0.001)	(0.001)		
lnumber_employees	0.137***	0.135***	0.007***	0.007***
	(0.001)	(0.001)	(0.0001)	(0.0001)
multinational	0.197***	0.203***	-0.007***	-0.006***
	(0.002)	(0.002)	(0.0002)	(0.0002)
GDP_growth	0.018***	0.018***	0.003***	0.003***
	(0.0003)	(0.0003)	(0.00003)	(0.00003)
lGDP_per_capita	0.619***	0.646***	0.034***	0.035***
	(0.004)	(0.004)	(0.0003)	(0.0003)
Inflation	-0.010***	-0.009***	-0.0004***	-0.0004***
	(0.0004)	(0.0004)	(0.00003)	(0.00003)
eff_tax_diff_mean:year_f2003	-1.018***		-0.022***	
	(0.088)		(0.009)	
eff_tax_diff_mean:year_f2004	-0.994***		-0.040***	
	(0.090)		(0.009)	
eff_tax_diff_mean:year_f2005	-1.458***		-0.057***	
	(0.079)		(0.008)	
eff_tax_diff_mean:year_f2006	-1.528***		-0.057***	
	(0.072)		(0.007)	
eff_tax_diff_mean:year_f2007	-1.638***		-0.074***	
	(0.076)		(0.008)	
eff_tax_diff_mean:year_f2008	-2.618***		-0.115***	
	(0.092)		(0.010)	
eff_tax_diff_mean:year_f2009	-2.059***		-0.044***	
	(0.088)		(0.009)	
eff_tax_diff_mean:year_f2010	-1.567***		-0.041***	
	(0.077)		(0.008)	
eff_tax_diff_mean:year_f2011	-1.255***		-0.067***	
	(0.080)		(0.008)	
eff_tax_diff_mean:year_f2012	-1.104***		-0.067***	
	(0.209)		(0.022)	
stat_tax_diff_mean:year_f2003		-2.783***		-0.080***
		(0.154)		(0.016)
stat_tax_diff_mean:year_f2004		-3.036***		-0.191***
		(0.128)		(0.014)
stat_tax_diff_mean:year_f2005		-2.992***		-0.164***
		(0.108)		(0.012)
stat_tax_diff_mean:year_f2006		-2.484***		-0.147***

		(0.095)		(0.010)
stat_tax_diff_mean:year_f2007		-2.103***		-0.105***
		(0.088)		(0.009)
stat_tax_diff_mean:year_f2008		-2.526***		-0.070***
		(0.100)		(0.011)
stat_tax_diff_mean:year_f2009		-2.511***		-0.078***
		(0.103)		(0.011)
stat_tax_diff_mean:year_f2010		-1.936***		-0.090***
		(0.095)		(0.010)
stat_tax_diff_mean:year_f2011		-2.269***		-0.108***
		(0.096)		(0.010)
stat_tax_diff_mean:year_f2012		-2.474***		-0.158***
		(0.284)		(0.031)
Observations	1,877,763	1,878,456	2,727,884	2,728,751
R^2	0.674	0.674	0.021	0.022
Adjusted R^2	0.674	0.674	0.021	0.022
Residual Std. Error	1.379 (df = 1877726)	1.379 (df = 1878419)	0.157 (df = 2727848)	0.156 (df = 2728715)

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

Source: own analysis

Table 14: Model with adjusted strength

	Dependent variable:			
	lprofit		profit_to_assets	
	(1)	(2)	(3)	(4)
eff_tax_diff_mean	2.366***		-0.090***	
	(0.258)		(0.025)	
stat_tax_diff_mean		-0.272		-0.167***
		(0.237)		(0.023)
adj_strength_05	0.012**	-0.001	-0.003***	-0.006***
	(0.006)	(0.005)	(0.001)	(0.0005)
ltotal_assets	0.800***	0.829***		
	(0.002)	(0.002)		
lnumber_employees	0.168***	0.109***	0.008***	0.007***
	(0.002)	(0.002)	(0.0002)	(0.0001)
multinational				
	(0.000)	(0.000)	(0.000)	(0.000)
GDP_growth	0.036***	0.048***	0.003***	0.004***
	(0.002)	(0.002)	(0.0002)	(0.0002)
lGDP_per_capita	0.457***	0.569***	0.021***	0.030***
	(0.017)	(0.015)	(0.002)	(0.001)
Inflation	-0.011***	-0.007***	-0.0003*	-0.001***
	(0.001)	(0.001)	(0.0001)	(0.0001)
eff_tax_diff_mean:adj_strength_05	-1.127***		0.036***	
	(0.132)		(0.013)	
stat_tax_diff_mean:adj_strength_05		0.453***		0.065***
		(0.133)		(0.013)
Observations	269,742	374,383	375,940	527,153
R^2	0.612	0.596	0.020	0.017
Adjusted R^2	0.612	0.596	0.020	0.017
Residual Std. Error	1.296 (df = 269704)	1.298 (df = 374345)	0.149 (df = 375903)	0.150 (df = 527116)

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

Source: own analysis

Table 15: Model with country dummy variables interacted with tax difference

	Dependent variable:			
	lprofit		profit_to_assets	
	(1)	(2)	(3)	(4)
ltotal_assets	0.805***	0.804***		
	(0.001)	(0.001)		
lnumber_employees	0.140***	0.140***	0.007***	0.007***
	(0.001)	(0.001)	(0.0001)	(0.0001)
multinational	0.176***	0.167***	-0.007***	-0.007***
	(0.002)	(0.002)	(0.0002)	(0.0002)
GDP_growth	0.025***	0.024***	0.002***	0.002***
	(0.001)	(0.001)	(0.00004)	(0.00004)
lGDP_per_capita	0.666***	0.675***	0.034***	0.034***
	(0.004)	(0.004)	(0.0003)	(0.0003)
Inflation	-0.011***	-0.011***	-0.0003***	-0.0003***
	(0.0005)	(0.0005)	(0.00004)	(0.00004)
eff_tax_diff_mean:cAR	6.166***		0.313***	
	(0.883)		(0.094)	
eff_tax_diff_mean:cAT	-1.675***		-0.157***	
	(0.293)		(0.028)	
eff_tax_diff_mean:cAU	1.555		-0.128	
	(1.050)		(0.105)	
eff_tax_diff_mean:cBA	-3.098***		-0.141***	
	(0.519)		(0.035)	
eff_tax_diff_mean:cBE	-0.077		-0.013	
	(0.133)		(0.014)	
eff_tax_diff_mean:cBG	-5.159***		-0.171***	
	(0.393)		(0.037)	
eff_tax_diff_mean:cBR	13.849***		0.464***	
	(0.950)		(0.115)	
eff_tax_diff_mean:cCN	-9.662***		-0.437***	
	(0.271)		(0.025)	
eff_tax_diff_mean:cCO	-6.443***		-0.134	
	(2.045)		(0.202)	
eff_tax_diff_mean:cCY	1.224		-0.136	
	(3.817)		(0.239)	
eff_tax_diff_mean:cCZ	-3.457***		-0.235***	
	(0.293)		(0.029)	
eff_tax_diff_mean:cDE	-0.763***		-0.092***	
	(0.197)		(0.021)	
eff_tax_diff_mean:cDK	1.335***		-0.022	
	(0.235)		(0.028)	
eff_tax_diff_mean:cEE	-3.154***		-0.333***	

	(0.132)	(0.016)
eff_tax_diff_mean:cES	0.254*	-0.058***
	(0.141)	(0.013)
eff_tax_diff_mean:cFI	-3.494***	-0.309***
	(0.134)	(0.018)
eff_tax_diff_mean:cFR	-3.614***	0.059***
	(0.108)	(0.010)
eff_tax_diff_mean:cGB	-3.083***	-0.001
	(0.094)	(0.011)
eff_tax_diff_mean:cGR	2.679***	-0.022
	(0.253)	(0.026)
eff_tax_diff_mean:cHR	-3.957***	-0.217***
	(0.359)	(0.036)
eff_tax_diff_mean:cHU	-4.352***	-0.145***
	(0.275)	(0.028)
eff_tax_diff_mean:cCH	4.400***	0.137***
	(0.534)	(0.027)
eff_tax_diff_mean:cIE	-1.465***	-0.010
	(0.217)	(0.026)
eff_tax_diff_mean:cIN	22.481***	1.094***
	(6.923)	(0.405)
eff_tax_diff_mean:cIS	-2.273***	-0.304**
	(0.805)	(0.145)
eff_tax_diff_mean:cIT	-0.410***	-0.058***
	(0.047)	(0.005)
eff_tax_diff_mean:cJP	-1.272***	0.061***
	(0.092)	(0.008)
eff_tax_diff_mean:cKR	2.419***	0.002
	(0.455)	(0.047)
eff_tax_diff_mean:cKZ	-7.844**	-0.343
	(3.388)	(0.272)
eff_tax_diff_mean:cLT	-3.466***	-0.249***
	(0.383)	(0.040)
eff_tax_diff_mean:cLU	2.493***	0.084***
	(0.281)	(0.030)
eff_tax_diff_mean:cLV	-4.113***	-0.160***
	(0.405)	(0.041)
eff_tax_diff_mean:cME	-4.601	-0.053
	(3.430)	(0.360)
eff_tax_diff_mean:cMK	-1.303	-0.082
	(1.806)	(0.165)
eff_tax_diff_mean:cMT	0.546	-0.561
	(5.366)	(0.549)

eff_tax_diff_mean:cMX	-1.847		0.044	
	(1.601)		(0.159)	
eff_tax_diff_mean:cNL	-0.983***		-0.040***	
	(0.158)		(0.015)	
eff_tax_diff_mean:cPE	17.104***		1.255***	
	(1.646)		(0.214)	
eff_tax_diff_mean:cPH	8.184***		0.347*	
	(2.330)		(0.181)	
eff_tax_diff_mean:cPL	-7.259***		-0.472***	
	(0.256)		(0.029)	
eff_tax_diff_mean:cPT	-0.718**		-0.022	
	(0.279)		(0.027)	
eff_tax_diff_mean:cRO	-4.021***		-0.130***	
	(0.253)		(0.023)	
eff_tax_diff_mean:cRS	-5.693***		-0.051**	
	(0.239)		(0.023)	
eff_tax_diff_mean:cRU	0.097		0.116***	
	(0.433)		(0.039)	
eff_tax_diff_mean:cSE	-2.923***		-0.211***	
	(0.184)		(0.017)	
eff_tax_diff_mean:cSG	0.993**		0.066	
	(0.411)		(0.042)	
eff_tax_diff_mean:cSI	-4.438***		-0.301***	
	(0.990)		(0.074)	
eff_tax_diff_mean:cSK	-3.720***		-0.209***	
	(0.494)		(0.047)	
eff_tax_diff_mean:cTR	-7.216***		-0.242***	
	(0.819)		(0.084)	
eff_tax_diff_mean:cTW	-4.598***		0.153	
	(1.606)		(0.254)	
eff_tax_diff_mean:cUA	10.056***		0.309***	
	(0.523)		(0.046)	
eff_tax_diff_mean:cUS	2.481***		0.289***	
	(0.447)		(0.050)	
stat_tax_diff_mean:cAR		11.066***		0.650***
		(2.158)		(0.222)
stat_tax_diff_mean:cAT		-2.716***		-0.169***
		(0.389)		(0.036)
stat_tax_diff_mean:cAU		1.142		0.162
		(2.255)		(0.196)
stat_tax_diff_mean:cBA		-3.133***		-0.134***
		(0.434)		(0.032)
stat_tax_diff_mean:cBE		-0.250		0.081***

	(0.188)	(0.018)
stat_tax_diff_mean:cBG	-3.659***	-0.174***
	(0.215)	(0.022)
stat_tax_diff_mean:cBR	17.563***	0.564***
	(1.318)	(0.157)
stat_tax_diff_mean:cCN	-8.624***	-0.410***
	(0.538)	(0.047)
stat_tax_diff_mean:cCO	26.841***	1.990***
	(2.432)	(0.282)
stat_tax_diff_mean:cCY	-1.185	-0.273*
	(1.806)	(0.166)
stat_tax_diff_mean:cCZ	-3.638***	-0.309***
	(0.152)	(0.016)
stat_tax_diff_mean:cDE	1.335***	0.056***
	(0.169)	(0.018)
stat_tax_diff_mean:cDK	-3.848***	-0.055
	(0.338)	(0.037)
stat_tax_diff_mean:cEE	-5.911***	-0.643***
	(0.330)	(0.038)
stat_tax_diff_mean:cES	-0.608***	-0.173***
	(0.215)	(0.020)
stat_tax_diff_mean:cFI	-4.151***	-0.318***
	(0.348)	(0.045)
stat_tax_diff_mean:cFR	4.390***	-0.073***
	(0.133)	(0.013)
stat_tax_diff_mean:cGB	-3.158***	-0.031**
	(0.118)	(0.014)
stat_tax_diff_mean:cGR	-2.285***	-0.080**
	(0.373)	(0.038)
stat_tax_diff_mean:cHR	-4.144***	-0.185***
	(0.283)	(0.030)
stat_tax_diff_mean:cHU	-3.663***	-0.133***
	(0.221)	(0.023)
stat_tax_diff_mean:cCH	4.815***	0.137***
	(0.745)	(0.043)
stat_tax_diff_mean:cIE	-0.863***	0.004
	(0.116)	(0.014)
stat_tax_diff_mean:cIN	32.685***	1.583***
	(4.675)	(0.387)
stat_tax_diff_mean:cIS	-1.045	0.138
	(2.179)	(0.241)
stat_tax_diff_mean:cIT	-1.929***	-0.187***
	(0.150)	(0.014)

stat_tax_diff_mean:cJP	-1.804***	0.097***
	(0.142)	(0.012)
stat_tax_diff_mean:cKR	-8.875***	-0.559***
	(0.307)	(0.034)
stat_tax_diff_mean:cKZ	-6.593	0.683
	(4.514)	(0.416)
stat_tax_diff_mean:cLT	-3.394***	-0.209***
	(0.231)	(0.027)
stat_tax_diff_mean:cLU	2.324	0.189
	(1.426)	(0.131)
stat_tax_diff_mean:cLV	-4.659***	-0.189***
	(0.222)	(0.029)
stat_tax_diff_mean:cME	1.280	0.207*
	(1.957)	(0.120)
stat_tax_diff_mean:cMK	-1.443	-0.176
	(1.542)	(0.113)
stat_tax_diff_mean:cMT	8.184***	0.736***
	(2.458)	(0.245)
stat_tax_diff_mean:cMX	-11.080***	-0.423***
	(1.408)	(0.156)
stat_tax_diff_mean:cNL	-1.170***	-0.084***
	(0.322)	(0.032)
stat_tax_diff_mean:cPE	-4.955	-0.767
	(6.236)	(0.508)
stat_tax_diff_mean:cPH	20.643***	1.020***
	(3.839)	(0.304)
stat_tax_diff_mean:cPL	-5.619***	-0.324***
	(0.100)	(0.012)
stat_tax_diff_mean:cPT	-3.434***	-0.002
	(0.329)	(0.033)
stat_tax_diff_mean:cRO	-4.223***	-0.053***
	(0.124)	(0.013)
stat_tax_diff_mean:cRS	-5.146***	-0.076***
	(0.186)	(0.020)
stat_tax_diff_mean:cRU	-5.282***	-0.297***
	(0.270)	(0.028)
stat_tax_diff_mean:cSE	-3.500***	-0.108***
	(0.359)	(0.036)
stat_tax_diff_mean:cSG	1.369***	0.096*
	(0.528)	(0.056)
stat_tax_diff_mean:cSI	-3.869***	-0.432***
	(0.713)	(0.061)
stat_tax_diff_mean:cSK	-3.795***	-0.254***

		(0.226)		(0.024)
stat_tax_diff_mean:cTR		-8.447***		-0.280***
		(0.839)		(0.092)
stat_tax_diff_mean:cTW		-2.466**		0.101
		(1.039)		(0.153)
stat_tax_diff_mean:cUA		-7.341***		-0.374***
		(0.741)		(0.061)
stat_tax_diff_mean:cUS		2.042***		0.279***
		(0.415)		(0.040)
Observations	1,877,457	1,877,694	2,727,533	2,727,848
R^2	0.676	0.676	0.024	0.024
Adjusted R^2	0.676	0.676	0.024	0.024
Residual Std. Error	1.376 (df = 1877369)	1.375 (df = 1877606)	0.156 (df = 2727446)	0.156 (df = 2727761)
Note:				*p<0.1**p<0.05***p<0.01

Source: own analysis

Appendix C: CIT Gains and losses

Table 16: CIT gains and losses from specification with logarithm of profit

Country	# of companies	CIT gain or loss in %	Gain or loss in % of GDP	Gain or loss in USD milion
Argentina	224	-4.06%	-0.12%	-696
Australia	499	5.11%	0.27%	4,189
Austria	9,964	5.99%	0.12%	494
Belgium	115,257	-4.37%	-0.13%	-654
Bosnia and Herzegovina	2,563	8.52%	0.10%	17
Brazil	1,736	-2.48%	-0.08%	-1,889
Bulgaria	17,710	8.81%	0.15%	83
China	35,794	0.15%	0.01%	477
Colombia	929	-6.87%	-0.37%	-1,363
Croatia	122,199	6.20%	0.14%	82
Cyprus	159	18.12%	1.04%	261
Czech Republic	42,461	7.56%	0.25%	524
Denmark	60,954	3.92%	0.10%	333
Estonia	15,638	3.46%	0.05%	11
Finland	29,715	2.39%	0.05%	129
France	433,153	-5.27%	-0.13%	-3,510
Germany	70,416	-7.35%	-0.13%	-4,492
Greece	9,654	-2.56%	-0.03%	-76
Hungary	3,308	23.16%	0.30%	380
Iceland	874	10.15%	0.19%	28
India	374	-6.80%	-0.25%	-4,644
Indonesia	185	4.42%	0.20%	1,871
Ireland	8,759	22.79%	0.52%	1,165
Italy	153,631	-3.77%	-0.11%	-2,306
Japan	65,051	-8.78%	-0.32%	-19,942
Kazakhstan	925	-1.45%	-0.11%	-238
Korea	13,272	5.73%	0.21%	2,584
Latvia	6,456	14.47%	0.23%	65
Lithuania	5,233	8.66%	0.11%	48
Luxembourg	2,039	1.43%	0.07%	42
Macedonia	204	12.51%	0.10%	10
Malta	772	-11.62%	-0.68%	-63
Mexico	1,111	1.92%	0.04%	424
Montenegro	137	15.26%	0.31%	13
Netherlands	27,058	5.68%	0.10%	866
Peru	313	-0.25%	-0.01%	-28

Philippines	232	0.18%	0.01%	16
Poland	43,196	13.55%	0.28%	1,411
Portugal	31,888	4.29%	0.12%	269
Romania	41,351	16.61%	0.32%	544
Russia	234,779	1.83%	0.07%	1,590
Serbia	12,116	12.13%	0.19%	76
Singapore	611	21.82%	0.88%	2,567
Slovakia	7,615	11.63%	0.28%	257
Slovenia	2,322	0.44%	0.01%	3
Spain	162,829	-1.67%	-0.03%	-463
Sweden	45,303	0.78%	0.02%	109
Switzerland	1,675	16.98%	0.48%	3,186
Taiwan	596	-0.50%	0.00%	0
Turkey	1,122	13.93%	0.29%	2,494
Ukraine	58,025	1.46%	0.06%	102
United Kingdom	199,348	0.99%	0.03%	702
United States	19,609	-10.37%	-0.21%	-34,647

Source: own analysis

Table 17: CIT gains and losses from specification with profit to assets

Country	# of companies	CIT gain or loss in %	Gain or loss in % of GDP	Gain or loss in USD milion
Argentina	224	-0.88%	-0.03%	-151
Australia	499	1.15%	0.06%	939
Austria	9,964	3.64%	0.07%	300
Belgium	115,257	-9.28%	-0.28%	-1,389
Bosnia and Herzegovina	2,563	13.79%	0.16%	27
Brazil	1,736	-5.80%	-0.18%	-4,413
Bulgaria	17,710	7.41%	0.13%	69
China	35,794	-0.14%	-0.01%	-451
Colombia	929	-3.93%	-0.21%	-780
Croatia	122,199	4.14%	0.10%	54
Cyprus	159	8.63%	0.50%	124
Czech Republic	42,461	5.04%	0.17%	350
Denmark	60,954	1.78%	0.05%	151
Estonia	15,638	2.15%	0.03%	7
Finland	29,715	0.98%	0.02%	53
France	433,153	-4.25%	-0.11%	-2,830
Germany	70,416	-7.16%	-0.12%	-4,377
Greece	9,654	-3.15%	-0.04%	-94
Hungary	3,308	22.47%	0.29%	369
Iceland	874	15.04%	0.29%	41
India	374	-8.72%	-0.33%	-5,953
Indonesia	185	6.84%	0.31%	2,894
Ireland	8,759	74.92%	1.70%	3,831
Italy	153,631	-4.53%	-0.13%	-2,772
Japan	65,051	-8.38%	-0.31%	-19,026
Kazakhstan	925	-0.74%	-0.06%	-121
Korea	13,272	2.31%	0.09%	1,041
Latvia	6,456	12.35%	0.20%	56
Lithuania	5,233	6.74%	0.09%	38
Luxembourg	2,039	3.23%	0.17%	95
Macedonia	204	16.88%	0.13%	13
Malta	772	-10.59%	-0.62%	-57
Mexico	1,111	0.98%	0.02%	218
Montenegro	137	24.63%	0.50%	20
Netherlands	27,058	3.98%	0.07%	606
Peru	313	0.48%	0.03%	54
Philippines	232	-2.33%	-0.08%	-204
Poland	43,196	6.76%	0.14%	704
Portugal	31,888	3.52%	0.10%	220
Romania	41,351	6.39%	0.12%	209
Russia	234,779	0.55%	0.02%	478
Serbia	12,116	8.42%	0.13%	52
Singapore	611	16.25%	0.66%	1,911

Slovakia	7,615	6.76%	0.16%	150
Slovenia	2,322	-25.15%	-0.31%	-145
Spain	162,829	-1.44%	-0.03%	-399
Sweden	45,303	0.91%	0.02%	127
Switzerland	1,675	41.03%	1.15%	7,700
Taiwan	596	-0.50%	0.00%	0
Turkey	1,122	7.63%	0.16%	1,365
Ukraine	58,025	0.03%	0.00%	2
United Kingdom	199,348	1.78%	0.05%	1,267
United States	19,609	-11.78%	-0.24%	-39,370

Source: own analysis