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MASTER'S THESIS

The Scale of Corporate Profit Shifting out of the United States

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Declaration of Authorship

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Prague, January 5, 2019

Signature

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Abstract

There is a large body of literature indicating that profits are shifted into countries with better conditions, i.e. lower tax rates. It was showed that the problem is nonlinear. However, precise estimates are missing in the available literature. In this thesis we improved the precision by allowing for nonlinearity, time-variant tax semi-elasticity of profits and financial secrecy is a driver of the profit shifting. We showed that all three elements of the estimation are very important. Our analysis suggests that the profit shifting problem started at the turn of millennium and increases since, with some temporal drops. The highest amount of profit shifted out of the United States was almost 300 billion of U.S. dollars with the consequent revenue loss of 62.3 billion of U.S. dolars.

JEL Classification	H25, H26, H73
Keywords	profit shifting, tax base, tax planning, financial secrecy

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Abstrakt

Současná literatura ukazuje, že zisky jsou přesouvány do zemí s lepšími podmínkami, například s nižšími daňovými sazbami. Bylo prokázáno, že problém je nelineární. Přesné odhady ale chybí. V této práci zpřesňujeme odhady používáním nelineárních odhadů, nekonstantní daňové elasticity zisků a modelováním přesunutých zisků pomocí finančního tajemství. Ukázali jsme, že všechny tři prvky odhadů jsou velmi důležité. Naše analýza ukazuje, že problém přesouvái zisků započal na přelomu tisíciletí a od té doby roste, s občasnými poklesy. Nejvíce zisků přesunutých z USA bylo 300 milliard dolarů v roce 2015 s následným poklesem daňových výnosů o 62.3 milliard dolarů.

Klasifikace	H25, H26, H73
Klíčová slova	přesouvání zisků, daňový základ, daňové plánování, finanční tajemství

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Acronyms

BEA	Bureau of Economic Analysis
USDIA	U.S. Direct Investment Abroad
AETR	Average Effective Tax Rates
AETRD	Average Effective Tax Rates Differences with respect to the U.S.
FSI	Financial Secrecy Index
FSID	Financial Secrecy Index Differences with respect to the U.S.
STAXD	Statutory Tax Rates Differences with respect to the U.S.
PPE	Property, Plant and Equipment

Master's Thesis Proposal

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Proposed Topic:

The Effect of Profit Shifting on the Corporate Tax Base Worldwide

Motivation:

Tax planning leading to base erosion and shifting of income by multinational firms to countries with low or no taxes and a high financial secrecy is likely to be a large problem when it comes to collecting taxes. Clausing (2016) estimates that base erosion and profit shifting cost the US government "*between $77 and $111 billion in corporate tax revenue by 2012, and these revenue losses have increased substantially in recent years*". It has to be said that this is very likely not a problem only in the United States but in most developed countries around the world as is shown in the extension for world in Clausing (2016).

Given this tax avoidance is mostly legal, an important tool for fighting it one need to consider are policies and government measures. For purposes of government policy concerning optimal taxation, tax collection and income inequality, the estimates of consequences of profit shifting on the corporate tax base is of principal importance. For example, optimal statutory tax rate can reduce the amount of profit shifted to another countries (mainly so called tax havens) by multinational companies.

This can help collect more taxes in both the developed and developing countries. It is also likely to help create fairer and more competitive market environments and reduce inequalities within and mainly among states. This is another important topic as shifting of profit to tax havens can be a driver of increasing income inequality among states.

The importance of the topic, the importance of impacts of base erosion and profit shifting can be documented for instance by the fact that the Organization for Economic Cooperation and Development has introduced the *Action Plan on Base Erosion and Profit Shifting* in 2012 (OECD, 2017). This is expected to create more transparent international taxation system to reduce the costs of profit shifting by multinational companies.

The last thing I would like to mention is that the empirical literature is not united when it comes to estimating the magnitude of the profit shifting problem. According to Dharmapala (2014) the more recent estimates that use richer data sets find the magnitude to be smaller than is estimated by older empirical literature. In particular, the tax sensitivity of income made in 1990s is almost three times the estimates that used the most recent data. So it will be definitely beneficial to estimate the problem based on the most recent available data.

Hypotheses:

1. The profit shifting problem is steadily increasing since the financial crisis in 2007
2. The percentage share of GDP of the major tax havens made by US affiliate profits is steadily increasing since the financial crisis in 2007

3. The semi-elasticity of U.S. based multinational's profits with respect to the tax differences between an affiliate and its parent is higher than the averages reported in the literature (Dharmapala, 2014)
4. The revenue loss from profit shifting for the US government is higher than reported in the literature (Clausing, 2016)
5. The profit shifting problem is larger in developing countries than in developed ones.

Methodology:

In this thesis, I will follow mainly the methodologies used in Clausing (2016), Dharmapala (2014), Cobham and Janský (2015), Cobham, Janský and Meinzer (2015) and Dowd et al (2017). It is assumed that the profit booked in a affiliate is a sum of the actual profit and the shifted profit (either negative or positive) (as proposed by Hines and Rice (1994)). The actual profit is predicted using the capital and labour inputs and other variables and any profit that is not contributable to these inputs is considered as the shifted profit.

In particular, this is to be estimated using the U.S. Bureau of Economic Analysis data on U.S. based multinational firms and their affiliated firms abroad which is our main dataset (and also the one most often used in the literature), though not without drawbacks (e.g. double counting of some profits).

The first and probably the most critical step is to regress affiliate profits to tax rates. Here I will try to employ the nonlinearity of the effect, the importance of which is stressed in Dowd et al (2017) where higher elasticities are found at lower tax rates. The estimate of magnitude of profit shifting is highly dependent on the correct estimate of profit elasticity. In this regression, the „actual" profit is modelled using the PPE for capital, employment for labour, the size of the economy measured by the GDP and some other characteristics.

During this step, I will also follow the work of Cobham, Janský and Meinzer (2015) who propose a mathematically well-defined index (FSI) to measure financial secrecy of jurisdictions based on a higher number of measures rather than some binomial division of tax havens vs. tax non-havens. This improves the results in the sense that profits are dependent not only on tax differences but also on the whole and broader financial secrecy. I will also employ nonlinearity of the FSI effect because it is probable it has similar characteristics as the tax difference effect.

Based on the semi-elasticities generated by this regression, it is calculated how profits would differ in case there were no differences between tax rates among countries and there was no financial secrecy (i.e. to estimate the shifted profit). Then it is estimated how large share of the lower foreign profits can be associated with the for example United States. This share is estimated using the intra-firm transactions as proposed by Clausing (2016).

Another possibility are so called Orbis data which on one side does not suffer from double counting of some profits but on the other side it does not include all profits. Estimates based on these data are generally smaller than those based on the BEA data and the results are questionable.

Expected Contribution:

The main and important contribution of my thesis will be new and hopefully more precise and correct empirical estimates of the magnitude of profit shifting, tax elasticity of profits and corresponding revenue losses of governments. This is crucial to propose the right policies to correct for this, to optimize international taxation and reduce income inequality within and between countries.

A contribution is also the use of nonlinear elasticities which should produce more correct estimates. During calculations, semi-elasticities of profits with respect to tax differences are to be estimated. In major literature it is assumed that they are linear, though there is non-negligible evidence that it is nonlinear. In my thesis, I would like to use non-linear elasticities to improve the results as this is one of the sources of uncertainty in the available papers. Also I will employ nonlinearity of the FSI index as well which should also be an important improvement and contribution.

Another important contribution is the employment of the FSI index proposed by Cobham, Janský and Meinzer (2015) to measure financial secrecy on a spectrum rather than binary division on tax havens and non-havens. This is important as not only the tax rate differences drive the profit shifting problem but also other legal aspects of jurisdictions.

I would also like to extend the analysis to developing countries and confirm that the profit shifting problem is larger in those countries.

Another field is the accuracy improvement of the effective tax rates used during the calculations which need to be estimated.

In the end, I would like to discuss the policy implications of my results with focus on the 15 points Action Plan proposed by OECD as it is one of the few international cooperations to reduce the revenue costs caused by profit shifting.

Outline:

1) Introduction to the topic. Description of the problem.
2) Literature overview. Summary of what was already discovered and estimated.
3) Description of all the used datasets.
4) Set up of the model and its estimation.
5) Variations of the model based on different data or model specifications (e.g. Orbis data)
6) Interpretation of results.
7) Discussion of policy implications with focus on the OECD Action Plan.
8) Conclusion and identification of weak points of the analysis.

Core Bibliography:

CLAUSING, Kimberly A. *The Effect of Profit Shifting on the Corporate Tax Base in the United States and Beyond*. 2016. Department of Economics, Reed College, Portland, OR, USA (clausing@reed.edu). JEL Codes: H25, H26, H73
DHARMAPALA, Dhammika. *What Do We Know about Base Erosion and Profit Shifting? A Review of the Empirical Literature.* 2014. Fiscal Studies, vol. 35, no. 4, pp. 421-448.
COBHAM, Alex, JANSKÝ, Petr and MEINZER, Markus. *The Financial Secrecy Index: Shedding New Light on the Geography of Secrecy.* 2015. Economic Geography vol. 91, no. 3, pp. 281-303. JEL Codes: F36, F65.
COBHAM, Alex and JANSKÝ, Petr. *Measuring Misalignment: the Location of US Multinationals' Economic Activity Versus the Location of their Profits.* 2015. ICTD Working Paper 42. ISBN: 978-1-78118-276-5
ZUCMAN, Gabriel. *Taxing across Borders: Tracking Personal Wealth and Corporate Profits.*
OECD. *Action Plan on Base Erosion and Profit Shifting*. 2017. Available online: https://www.oecd.org/ctp/BEPSActionPlan.pdf
HINES, James R. "Lessons from Behavioral Responses to International Taxation." 1999. National
Tax Journal 52 (June): 305–22.
HINES, James R., Jrand Rice, E. M. (1994), 'Fiscal paradise: foreign tax havens and American business', Quarterly Journal of Economics, vol. 109, pp. 149–82.
BUREAU VAN DIJK, 2017. Orbis data. Available online: https://www.bvdinfo.com/en-gb/our-products/company-information/international-products/orbis
BUREAU OF ECONOMIC ANALYSIS, 2017: Data on the U.S. Direct Investment Abroad. Available online: https://www.bea.gov/international/di1usdop.htm
DOWD, T.; Landefeld, P. and Moore, A., *Profit shifting of U.S. multinationals*, 2017. Journal of Public Economics 148, 1-13.

Author **Supervisor**

1 Introduction

Profit shifting, corporate tax base erosion and the consecutive government revenue loss is a large and international problem. Multinational corporates make use of the differences between national tax systems and adapt their tax behavior so that they pay as little taxes as possible. Profit is often not taxed where it is earned which is not particularly fair. The reduced government tax revenues create pressure on governments' budgets. Countries with high corporate tax rates have lower tax revenues than they should but their infrastructure is used to produce these profits which, in the end, implies costs.

Moreover, the so-called tax havens provide multinational corporations not only with low or zero tax rates, but also with a high financial secrecy they can achieve there. Their laws may be used, for instance, to hide proprietary structures of multinational corporations or the real amounts of money booked there.

The profit shifting is also important to consider as the income inequality rises recently. A situation in which a foreign affiliate pays no or little taxes in a country where it resides and competes with local businesses that pay taxes properly in the country creates an unfair competition environment.

Based on these consequences, it is important to quantify the problem and analyze it in detail. Then, policymakers can potentially produce more effective ways to deal with this behavior and following consequences. For example, to set proper statutory corporate tax rates or international laws enabling transparency across countries.

In this thesis, the corporate profit shifting problem in the United States is quantified using improved methodology. This includes the usage of relatively new measure of financial secrecy, Financial Secrecy Index, allowing for estimating the impact of financial secrecy on the profit shifting.

The thesis has the following structure: In the second chapter, key terms needed for this analysis are defined and described. In the third chapter, existing literature on this topic is reviewed. In the fourth chapter, we present the main dataset used in this thesis. Then, stylized facts are examined with the dataset in chapter five. After that, methodology used in this analysis is described in chapter six. In chapter seven all

models are estimated, and results are presented in chapter eight. Conclusions are made in chapter nine. Chapter ten contains all references and, finally, there is an appendix at the end of the thesis.

2 Key Definitions and Concepts

In this section, definitions and descriptions of key terms used in this thesis are presented.

Throughout this analysis, profit shifting refers to a situation when a multinational corporation with affiliates in various foreign countries arbitrarily shifts profits from countries where they are earned to countries with more favorable conditions, i.e. with lower tax rates or higher levels of possible financial secrecy. This shifting is done only nominally in financial reports. As a result, profits are booked where they are not earned. Tax base erosion refers to lowering the taxable income due to this profit shifting.

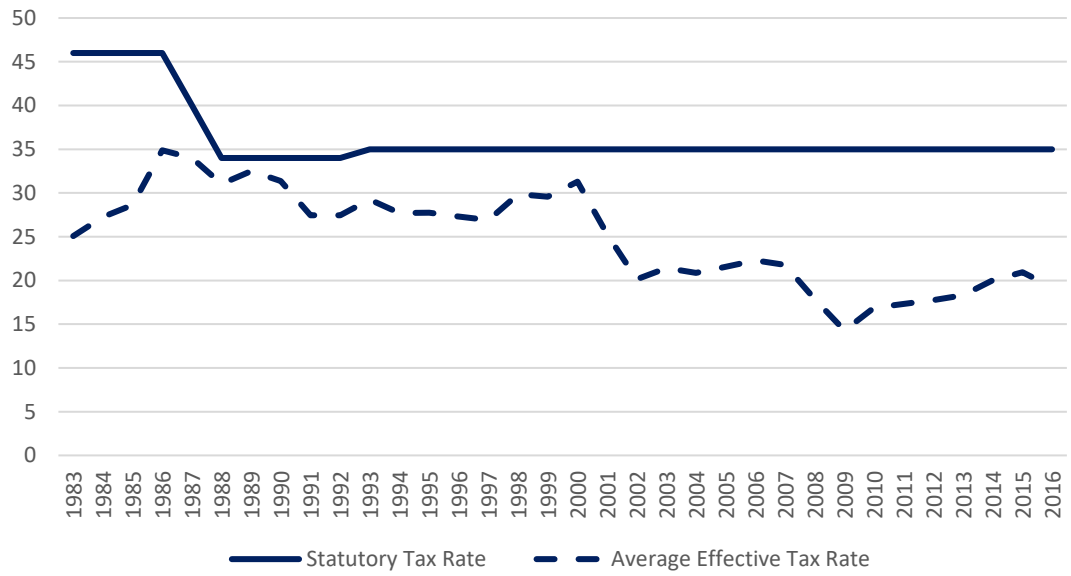
According to Janský (2016), there are three main ways how to shift profit artificially to another jurisdiction with better conditions, i.e. with lower tax rates or a high financial secrecy. All of them shift profits nominally, that means the location of the economic activity that generated the profit is left untouched, all the profit shifting is done from the accounting point of view. All of them are artificial costs a foreign affiliate pays to affiliate in another country to transfer money.

The first possible way is the debt shifting. An affiliate located in a country with low tax rates provide loans with high interest rates to other affiliates from which the profit is to be shifted. The second way is the location of intangible assets and intellectual property. Brands, ownership of patents or research and development are located in tax havens to which all other affiliates pay high service fees if they want to use their patent in the production, for example. Finally, transfer prices of goods and services may be adapted in such a way to transfer money from one affiliate to another. In all cases, the result is money paid from affiliates that generated profit to affiliates located in the so-called tax havens, lowering the taxable income in the original country, usually the one with high tax rates or low financial secrecy.

Average effective tax rate is another key term in this analysis. It is defined as a share of foreign income taxes paid by all affiliates in a given country to their aggregate gross profits. Gross profits are defined net income plus foreign income taxes paid. This variable aims at better approximating the actual tax conditions in countries. The reason is that it may happen in some countries the statutory corporate income taxes are relatively high, but after accounting for various tax deductions, tax exemptions and tax

credits, the actual amount of taxes relative to their gross profit is much smaller than the statutory tax rate. One of the best examples are the United States. As we can see in Figure 1, average effective tax rate in the United States is often as low as a half of the statutory tax rate.

Figure 1: Statutory and Average Effective Corporate Tax Rates in the United States (%)



Sources: FRED (2018 a, b) and https://tradingeconomics.com/united-states/corporate-tax-rate

3 Literature Review

The first work in the topic of profit shifting out of the United States was done by Hines and Rice (1994) who related average effective tax rates, which they defined as aggregate foreign corporate income taxes paid relative to aggregate pre-tax earnings, to aggregate profits booked in countries. They concluded that indeed U.S. multinational corporations shift profit into a small set of countries with very low tax rates, that they defined as tax havens. They calculations suggest that for tax havens countries, the revenue-maximizing tax rate is 5-8%. They also noted that corporations are not only incentivized to arbitrarily shift profit to tax havens, but also to locate their operations to such countries.

In one of more recent studies, Clausing (2016) estimates that the government loss caused by profit shifting and corporate tax base erosion in the United States in 2012 was between $77 and $111 billion. This result is based on the multinational corporations' data of Bureau of Economic Analysis between 1983 and 2012.

The methodology of Clausing (2016) is based on regressions. The first step is to regress profits booked in each country by all multinational corporations on effective taxes. Effective taxes are computed as foreign income taxes divided by gross income. In this regression, a sensitivity of profits to tax rates is estimated. Eight particular options are estimated, depending on which estimator is used (pooled OLS and country-specific individual effects) and which control variables are used. From these eight options, a statistically significant relationship between taxes and profits arises with the tax semi-elasticity of profits ranging between -4.61 to -1.85 with the mean of -2.92.

Based on this semi-elasticity, it is calculated how profits in each country would differ if there was no difference between its own tax rate and the tax rate of the United States. The U.S. effective corporate tax rate is assumed to be 5 percentage points lower than its statutory corporate tax rates, which means 30% for most years of the study.

In the study of Clausing (2016), it is assumed that the relationship between profits and taxes is linear, although she notes that nonlinearity is most probably present and adding nonlinear terms always rises the estimates of total shifted profit. The nonlinearity of the problem was first noted by Hines and rice (1994) and more explored in the recent work by Dowd et al. (2017). This is also a motivation to account for nonlinearity in this thesis.

Clausing (2016) then estimates how much of this excess profit in a foreign country would otherwise be booked in the United States and thus is counted as U.S. revenue loss. This is estimated as a share of intra-firm transactions between foreign affiliates and the United States to the total intra-firm transactions. Finally, the income shifting behavior is most probably done also by foreign multinational corporations (i.e. with parents located in other countries). To account for this, the final estimate of profit shifted by U.S. multinational corporations is scalded up. This scaling is done by the ratio of sales of affiliates of foreign multinationals in the United States to the sales of U.S. affiliates abroad. One of the conclusions is that 82% of the total shifted profit is booked in just 7 main tax havens.

Clausing (2016) then also attempts to extend the results to the rest of the world because the BEA data concern only U.S. based multinational companies. It is indicated that the income shifting is present almost all over the world, more heavily in terms of revenue losses impacting the high-tax countries. One of the other results of this analysis is that 82% of the total shifted profit is booked in just 7 main tax havens.

However, all estimations of Hines and Rice (1994), Clausing (2016) and Dowd et al. (2017) rely on one important assumption, namely that the incentive to shift profit from the location of its earning is driven solely by the lower (effective) tax rates. Though the tax motivation is surely very important, there are other conditions that multinational corporations may seek in foreign countries for their profits. In particular the financial secrecy, allowing for a various discrete manipulation of their profits.

In this sense, an important contribution to the topic of measuring financial secrecy of countries done by Cobham et al. (2015). They note that the binary division of countries on tax havens and non-tax-havens is insufficient with no other available measure being able to cover the complex nature of this problem. Measures using different subcategories of tax havens or based on voting procedures of committees were still found unsatisfactory for most of the research use. It is especially needed in analysis of profit shifting to be able to measure the financial secrecy precisely.

For these purposes, they designed a mathematically well-defined measure, paying more attention to the financial secrecy that can be achieved in countries rather than on taxes which they argue may be misleading. According to Cobham et al. (2015), the focus on financial secrecy rather than on taxes brings higher definitional consistency and more robust results of analyses. Their resulting Financial Secrecy Index is a measure of this financial secrecy, the degree to which a country can be thought of as a tax haven, making it possible to assess each country on the whole spectra of financial secrecy rather than on a binary scale.

The core of the Financial Secrecy Index is the assessment of two criteria. First, the financial secrecy itself, measuring the degree to which a jurisdiction aims at hiding important financial information of nonresidents and providing them with means to escape from regulations of their countries of origin. For this purpose, authors assess 15 objective criteria covering 4 main fields: Knowledge of beneficial ownership, corporate transparency, efficiency of tax and financial regulation, and international standards and cooperation.

The second criterion is the relative weight of a particular jurisdiction in the global financial market. This part is defined as exports of financial services in each country divided by the sum of all world exports of financial services. The incorporation of this weight variable aims at scaling the financial secrecy to get the actual degree of importance of the country in the tax havens problem. The final Financial Secrecy Index is then a weighted average of these two components.

The resulting ranking of countries brings a new insight on the problem. On one hand, small islands with low taxes generally considered as tax havens are found to achieve actually a very little importance because their relative weight in the global market is very low. On the other hand, countries such as the United States, Germany and Japan, usually considered as the opposite to tax havens, are in the top 10 tax havens according to the FSI in 2013 due to their large share on the global market. According to the authors, this result has very important consequences on policies aiming at fighting international corruption because it reveals that the most developed countries play a much higher role in the financial secrecy problem that was previously considered.

Another important work in this field is done by Dowd et al. (2017) who addressed the issue of nonlinearity in the profit-tax relationship. They test various forms of nonlinearity, finding that it indeed is present, important and that one needs to address it in order not to get underestimated results of profit shifting.

Dowd et al (2017) in their study used a biannually collected sample of the corporate tax return in the United States. These are firm-level data on a random sample of foreign corporations owned by a parent firm in the United States, resulting in almost 100 000 observations in 6 years between 2002 and 2012. The main advantage is that this data covers the whole structure of a U.S. based corporations, including affiliates in the so-called tax havens which are the crucial observations in this type of studies, particularly when addressing the nonlinearity since the highest response appears to occur with respect to the lowest tax rates, creating nonlinearity.

Another advantage of these data is that having individual data allows for calculating actual average effective tax rates in each country in a particular year (as an average share of tax payments to gross profits). This variable should capture the tax conditions better but is supplemented by standard statutory rates.

The disadvantage of this kind of data is that it reports data on a consolidated basis. It means that if a U.S. based corporation has an affiliate in a country A and if this affiliate owns another subsidiary in a different country, their financial activities are reported in the country A. As a result, the location of earning the profit and paying taxes may be different to the location where it is reported. This results in tax havens reporting for example much higher wages compensation and capital than countries not considered as tax havens. However, Dowd et al. (2017) analyzed the sensitivity of their results with respect to this mismeasurement by omitting affiliates that report owning foreign firm and the results were not sensitive to this change.

In their methodology, Dowd et al. (2017) analyze the nonlinearity by various means. First, they estimated the basic model following the methodology of Hines and Rice (1994) based on the production function model, explaining the booked profit by capital and labor for the actual profit and by tax rates for the shifted profit.

Second, they omitted countries with the lowest tax rates, arguing that if the profit-tax relationship is linear, the results would not change. Third, they introduced a dummy variable being 1 for a pre-defined list of tax havens and 0 elsewhere, allowing the slope of tax effect of tax havens to be different from the non-tax-havens, again arguing it should be the same under the hypothesis of linearity. Finally, they allowed for a quadratic profit-tax relationship by including a quadratic term.

In all their specifications, they found significant and economically important nonlinearities. For example, after omitting tax havens in the linear specification, the estimated linear tax semi-elasticity of profits dropped from 1.44 to 0.03. Also, in the dummy variable specification, the semi-elasticity of tax havens is estimated to be 0.61 for non-tax-havens and 7.84 for tax havens. This is a striking evidence of first the importance of nonlinearity and second of having observations of so-called tax havens in the dataset. Finally, they found that foreign reported profits in the top 6 tax havens would be between $116 billion and $111 billion lower if their average tax rates increased to the sample average.

The summary of the empirical literature on the topic of measuring profit shifting activities of multinational corporations is presented in the work of Dharmapala

(2014). He summarizes various approaches to identification of the problem and corresponding results. He also discusses potential problems that arise in this topic.

The major finding of this review of empirical literature is that studies using individual firm-level data yield quantitatively much smaller estimates of the profit shifting problem than studies using aggregate country-level data. Dharmapala (2014) suggests that the individual firm-level approach is more accurate as it enables to correct for unobserved individual effects, for example for the allocation of intangible assets.

The most crucial disadvantage of using the firm-level data, as noted by Clausing (2016) is, however, the absence of the most important observations. Affiliates data in so-called tax havens are often missing in these databases, resulting in a significant underestimation of the tax semi-elasticities of profits as shown by Dowd et al. (2017). This may be the source of lower estimates of tax semi-elasticities of profit resulting from individual firm-level data analyses found in Dharmapala (2014).

Finally, Dharmapala (2014) mentions the attempts to assess individual approaches by performing meta-regression, which is an analysis where one regress estimated semi-elasticities from various researches onto specifications and the crucial attributes of used datasets. It was found that for example that the use of panel data and affiliate fixed effects is expected to yield smaller estimates of the profit shifting problem. However, it is not stated whether the control variables include a variable on including tax havens observations.

Nevertheless, based on the meta-regression, it was estimated that an average tax semi-elasticity of profits resulting from empirical literature is -0.8. It is stated by Dharmapala (2016) that though it is smaller in magnitude as compared to the previous studies using country level aggregated data, it is probable that it is still high enough to have significant implications and thus policymakers should be concerned with it.

To sum up the main points of literature review, in the available literature it was found that location of profits strongly depends on tax rates and that nonlinearity is present. Also, new measure of financial secrecy constructed by Cobham et al. (2015) allows for relaxing the assumption that profit shifting is motivated by taxes only. Finally, one of the best datasets for estimating this issue are datasets with aggregate-country level data containing observations on countries with the lowest average effective tax rates.

4 The Data

4.1 The BEA's U.S. Direct Investment Abroad Dataset

For this thesis, the core data we use is the Bureau of Economic Analysis (BEA) dataset on multinational corporations based in the United States and their foreign affiliates. This dataset consists of financial and operational activities and covers individual countries, for each country the aggregate for all affiliates is presented so that identification of individual firms is impossible (plus, where only few firms' values would be aggregated, the whole observation is suppressed to avoid disclosure). The data are available from 1983 to 2016 (although for 2016 only preliminary version is currently available) with benchmark surveys every five years starting in 1989, producing better coverage of firms as well as collecting more detailed information.

The key advantage of this dataset is that it consists of observations on crucial countries, the so-called tax havens with very low or zero tax rates. As noted mainly by Dharmapala (2014) and Dowd et al. (2017), having data on these observations is crucial as most of the profit shifting is done to countries with the smallest tax rates. Observations on these countries are often missing in firms-level datasets, probably causing important bias as noted by Dharmapala (2014). Inclusion of these observation is the key for the analysis to be more accurate and complete.

Regarding the structure of the data, they are divided into two main parts. The first part consists of data on all affiliates of U.S. based multinational corporations, that is on those affiliates in which there is a U.S. direct investment of 10% of the voting securities or the equivalent. The second part consists of data on majority owned affiliates only, that is only on those affiliates in which there is a 50% or more of U.S. direct investment. These data contain more detailed information, including the crucial series needed to perform this analysis (in particular, the foreign income tax payments), so only the dataset on majority owned affiliates is considered in our analysis.

4.2 Problems of the BEA's dataset

Although the BEA's U.S. Direct Investment Abroad dataset contains very useful information that allows for performing this analysis, one of the problems of this data is, however, that it does not avoid double-counting of some series. In particular, income

from equity investments are counted more than once if there is an overlap in the ownership structure within a country.

An alternative that solves this problem is to use individual firm-level dat. On one hand, these data avoid largely the double-counting problem but on the other hand, they lack crucial countries – the so-called tax havens with very small corporate tax rates. Papers using these data report systematically lower estimates of the relationship between profit and taxes as discussed in the work of Dharmapala (2014), which can be attributable to the lack of the most important observations. So, the effect may be systematically underestimated in the firm-level data.

Next problem of the BEA's U.S. Direct Investment Abroad dataset is that the aggregation of individual data onto the country level may hide some underlying heterogeneity. For example, the sum of affiliates' profits in a particular country may be misleading when some affiliate reports a loss.

Another problem is that as they cover relatively large period of 34 years starting in 1983, both the methodology and definitions of series were adjusted during the period. This makes the data not exactly comparable across years in some cases.

There are two main adjustments made to the series. The first adjustment are changes of the threshold for an affiliate's size to fill in the required forms. This was adjusted almost each benchmark year and its main purpose was to minimize the administrative burden for firms. However, its effect on the reported statistics is negligible as the firms that were exempt from reporting had insignificant values of observed variables.

Second and probably the most important change is the inclusion of bank industry from 2009 onwards. In the preceding years, data were collected only for non-bank industries. This may cause a structural change in our model if the effect of average effective tax rates on gross profits is different for bank industry and non-bank industries. This may be the case if, for example, banks had better mechanisms to shift their profits, resulting in their higher ability to exploit the different tax rates among countries.

The inclusion of banking industry is an important change. In our main models, we will model the tax semi-elasticity of profits for each year separately using interaction with years dummy variables to allow for individual changes in this relationship. This adjustment covers also the inclusion of the banking industry. On the other hand, however, it needs to be noted that models that do not consider this change

and assume that the tax semi-elasticity of profits is constant across years, may yield biased results.

Nevertheless, this issue does not apply in our model using also the Financial Secrecy Index because this model covers only the period 2011 forwards.

Despite these stated imperfections, we believe that the BEA's U.S. Direct Investment Abroad dataset is still one of the best databases available for this particular problem and has the potential to analyze the profit shifting in detail.

4.3 Problems of the BEA's dataset

In this section, thorough description and definitions are presented for each variable used in this analysis. All variables measured in dollars (that is, all variables except for Employment) are measured in millions of current U.S. dollars, except for GDP, which is measured in (units) of current U.S. dolalrs. The variable Employment is measured in thousands of workers. For variables that are not included in the main BEA's U.S. Direct Investment Abroad dataset, their source is reported and cited. Variables without citation are a part of the BEA's U.S. Direct Investment Abroad dataset.

Employment and Compensation of Employees: Employment is the number of both part-time and full-time workers at the end of the given fiscal year measured in thousands. However, if there was a strike or a seasonal peak at the end of the year or if the data at the end of the year was not available, a value during the year was used instead. Compensation of Employees is the sum of wages of these employees. The variable controls for the gross profit that is generated by the labor force as the factor of production.

Net Property, Plant and Equipment: The value of property, plant and equipment at a historical cost basis after deducting its depreciation. The variable is a proxy variable for capital and controls for the gross profit that is generated by the capital.

Gross Domestic Product: Current gross domestic product. The variable controls for the fact that affiliate in a bigger market should have an advantage in creating profit over other affiliate in a smaller market (by having more potential consumers). The data are retrieved from World Bank (2018a) and if missing, from United Nations (2018a).

Gross Domestic Product per capita: Current gross domestic product per capita. The variable controls for the fact that affiliate in more developed market should have an advantage in creating profit over other affiliate in a less developed market (by

potentially having richer customers). The data are retrieved from World Bank (2018b) and if missing, from United Nations (2018b).

Net Income: The net income, as reported in income statements.

Foreign Income Taxes: The foreign corporate income taxes as reported in income statements. This is the most important variable in our analysis as it is the base for generating the Average Effective Tax Rate variable.

Gross Profit: The dependent variable used in all models. This variable is the sum of variables Net Income and Foreign Income Taxes. This variable covers the profit shifting as any profit shifted to a country by any channel increases this variable. Unfortunately, this is only an estimate of the true pre-tax profit as taxes paid are often not only the income taxes. However, the tax systems among countries vary and it is difficult to restore the real pre-tax profit. From this reason, the Gross Profit variable may slightly underestimate the true pre-tax profit booked. For our analysis, however, the definition of pre-tax profits as the sum of net income and foreign income taxes is sufficient as it includes the shifted profit. We expect this underestimation to be unimportant for our analysis and neglect it. More importantly, if there are some taxes other than the income taxes that affiliates must pay in a country and if they are time-invariant, the estimation controls for them as the best estimator in all models in our thesis turns up to be the Fixed Effect Estimator, more on that in the Estimation chapter.

Average Effective Tax Rates Differences: This is the most important variable in this analysis as this is the estimate of the effective income tax rate an affiliate must pay in each country minus the effective tax rate in the United States. Thus, the lower (more negative) this variable is, the higher the incentive to shift profit. Average effective tax rate is defined as the Foreign Income Taxes variable divided by the Gross Profit variable. It aims at showing how much of the pre-tax profit is really used to pay income taxes. This approach, as opposed to simply using the statutory tax rates, corrects for the fact that due to tax exemptions, tax credits and tax allowances, the final effective income tax rate is usually (much) lower than the statutory tax rate. The data on the average effective tax rate in the United States are retrieved from FRED (2018 a, b).

Sales to U.S. Parents: The sales of affiliates to their U.S. parents.

Sales to Other Foreign Affiliates: The sales of affiliates to all other foreign countries. All other foreign countries are all countries except for the foreign country the affiliates are resident in and except for the United States.

Statutory Corporate Tax Rates Differences: The statutory corporate income tax rate affiliates must pay in foreign countries minus the U.S. corporate statutory tax rate. In our thesis, this variable is used as an alternative to the Average Effective Tax Rate Differences. Though the statutory tax rates are often much higher than the effective tax rates, the difference in statutory tax rates with respect to the United States may be comparable to differences in average effective tax rates so this variable is a plausible alternative to the effective tax rates. Data are taken mainly from Cobham and Janský (2018). If data are missing here, values are taken from KMPG (2018) and if they are missing, data from the World Bank (2018c) are used.

Financial Secrecy Index Differences: As described in the literature review, the Financial Secrecy Index mathematically correctly assesses the law and informational environment in each country and assigns to it a number from 0 to 100. Higher values mean higher financial secrecy. The inclusion of this variable is motivated by the fact that income is shifted not only due to tax reasons. In addition to differences in tax rates, multinational corporations may benefit from booking their profit in high secrecy countries in terms of hidden information. Data are taken from Financial Secrecy Index (2018) and only the secrecy component is used. Data on the first year of Financial Secrecy Index, 2009, are not taken since they are not comparable with the following years.

Sales of U.S. Affiliates of Foreign-Based Multinational Corporations: This variable represents total sales of U.S. affiliates of foreign-based majority-owned multinational corporations. It is used in the scaling of profit shifted by U.S. corporations to the profit shifted by foreign multinational corporations. Data are taken also from the BEA's Foreign Direct Investment in the United States dataset (Bureau of Economic Analysis, 2018b).

Total Assets: Total Assets as reported in the balance sheet. Inclusion of this variable as the independent variable controls for total assets, as opposed to the fixed assets represented by the Net Property, Plant and Equipment variable. Its main contribution is that it also includes intangible assets.

4.4 Outliers and Missing Values

In this thesis, the raw data were processed before the actual analysis to get rid of obvious outliers and to deal to some extent with missing values of variables. The focus was in both cases to make as few artificial changes to the data as possible in order not to artificially manipulate with the contained information too much. On the other hand, we wanted to get rid of all nonsense values that can make bias in the analysis and to

fill in missing values where reasonably possible, in order to increase the degrees of freedom of estimators. The detailed procedure is described in the following paragraphs.

First, we deal with outliers. In fact, this relates only to the Average Effective Tax Rates Differences variable. Its values that are defined as outliers are deleted. Definitions of outliers follows. It needs to be mentioned that we do not define outliers based on empirical distribution of the variable. If this was the case, we could potentially delete the most precious values. In particular, there is a relatively small group of countries for which values of this variable are far lower than for the rest of the world. Contrary to that, we define outliers as values that do not meet the criteria that they, by definitions, should meet. This is, obviously, that the average effective tax rate should be between 0 and 1. It does not make any sense for a company to pay more than 100% of their profits to the government as taxes. On the other hand, it does not make any sense for governments to pay companies money based on their profits as it would be the case of any negative average effective tax rates.

The Average Effective Tax Rates Differences variable, defined as the Foreign Income Taxes variable divided by the Gross Profits variable, minus the effective tax rate in the United States, is only an estimator for the true effective foreign income taxes. For this reason, we allow for some imprecision in its values. In particular, especially in the case of tax havens, it may happen that some values of the Foreign Income Taxes variable are negative. Relative to the gross profits, however, they are small. In order not to throw away these potentially useful observations, we define the Average Effective Tax Rates Differences variable as 0 for all cases, when the original value is between -0.05 and 0. This way we allow for the estimator to make a small error and use observations when its value is sufficiently close to some sensible value.

On the other hand, we do not allow for any imprecision on the other side, i.e. for values higher than 1. All values higher than 1 are treated as missing observations since there is no clear way how to replace them. In particular, value of 1 (i.e. 100% tax rate) is theoretically valid, however, none country has this high statutory tax rate, so the effective tax rate is very unlikely to be 100% in any country. In fact, the highest value of the statutory tax rate for a country is 95% in Mauritania in 2005-2007. However, this is a clear outlier of the statutory tax rate variable and, most importantly, is not even used in our analysis due to lack of other data.

Among the observations used in the regression, the highest statutory corporate income tax is 61.7% in Finland in 1984 and 1985. Based on this, it is not clear which of these values should be used in case we wanted to “improve” estimates of the Average Effective Tax Rate Differences variable that are higher than 1. So, we take them as

they are and discard only observations for which the values are higher than 1 since they these estimates are obviously wrong and can make bias in our analysis.

Regarding the missing values, in the BEA's U.S. Direct Investment Abroad dataset, there is a lot of incomplete observations. This has two primary reasons. Either the particular values were not reported at all, or they were reported but surprised to avoid disclosure. In order not to throw away these observations that otherwise contain useful information, we linearly interpolated all variables. This was done mainly to close gaps made by the suppressing of data in order to avoid disclosure. The number of interpolated values is very low, so they cannot influence our results in any significant way, but they gained some more degrees of freedom for our estimators to work better. To sum up, we believe that the linear interpolation brings more value that it takes. Actual changes made by this procedure are reported in Table 1.

4.5 Summary Statistics

In this section, summary statistics of all used variables, after outliers are deleted and linear interpolation is done, are presented.

Table 1: Summary Statistics

	Obs.	Mean	St. Dev. Overall	St. Dev. Within	Min	Max	% of Interpol. values
Foreign Income Taxes	1820	1084	1873	1126	-400	18619	4.56
Net Income	1820	7094	19193	15063	-445	185609	0.33
Gross Profits	1820	8178	20061	15594	1	190697	4.67
AETRD	1776	0.0304	0.1921	0.1186	-0.3384	0.7520	4.79
STAXD	1671	-0.0955	0.0998	0.0612	-0.4983	0.2143	0
FSID	233	-3	14	4.007	-29	27	0
PPE	1820	11010	23024	12493	19	230289	0.05
Employ.	1820	141	252	111	0	1750	0
Compen.	1820	5348	11408	5752	8	101894	0
GDP	1820	4.98e11	9.89e11	5.53e11	4.67e8	1.12e13	0
GDPpc	1820	19940	22504	12293	276	146426	0
Sales to Parents	1762	4438	11866	6653	0	118770	7.60
Sales to Others	1788	7867	17198	11456	0	141949	7.05
Total Assets	1820	147672	449185	337896	-1710881	3586278	0.05

Source: Author's computations

The number of observations shown in this table are observations that appear in any of our model throughout this thesis. We can see that the number of linearly interpolated variables is less than 5% for most of the variables. The highest share of interpolated values have the variables Sales to Parents and Sales to Other Foreign Affiliates with 7.6% and 7.05%, respectively. However, even these are not significant numbers of interpolated observations, so we assume the interpolation does not bring any significant bias in our analysis, rather it brings more degrees of freedom for our estimators.

There are still some suspicious observations. For instance, the negative values of the variable Foreign Income Taxes. This does not make any sense as it means that governments actually pay money to affiliates instead of collecting income taxes from them. The number of negative values of the variable Foreign Income Taxes is 12 in the whole dataset, which accounts for 0.66% of observations. Moreover, the total value of foreign income taxes reported as negative is $1.74 billion, which accounts for 0.088% of all foreign income taxes (both positive and negative). For these reasons, we take

these observations as mismeasurements, use them in our analysis and neglect their impact.

Regarding the outliers in Average Effective Tax Rates Difference variable, only 6 negative values of average effective tax rates differences were higher than -0.05 and were adjusted to 0, which accounts for 0.34% of observations. Then, there were 6 more negative values that were discarded as too influential outliers, i.e. that were lower than -0.05. On the other hand, there were 117 values higher than 1 that were also discarded as outliers. The total number of values discarded as outliers was 123 which accounts for 6.48% of all values.

5 Disproportions Analysis

In this chapter, we examine the BEA's U.S. Direct Investment Abroad dataset from the profit-shifting point of view. The aim of this section is to analyze the disproportions in reported gross profits and related statistics among countries.

The most important is the disproportion in locations of profits relative to the location of employment and capital and relative to tax rates distribution. If profits are driven only by labor, capital and technology or human capital, then the profits should be proportional to these variables. In Table 2 we can see top 10 countries in terms gross profits booked in the year 2016. To see the numbers from perspective, all variables (except for the Average Effective Tax Rates and Financial Secrecy Index) are reported relative to their totals in the year 2016. Reported are values of the percentage of gross profits, employment, compensation of employees, property, plant and equipment and gross domestic product reported in countries relative to their totals in 2016.

Other two variables are Average Effective Tax Rates reported in percentages and the Financial Secrecy Index reported in percentile, measuring the percentage of countries that have lower Financial Secrecy Index in 2016.

Table 2: Disproportion Analysis in 2016

	Gross Profits %	AETR	FSI Percentile	Employ. %	Compen. %	PPE %	GDP %
Netherlands	17.70	2.67	33.70	1.76	2.97	2.31	1.39
Ireland	13.98	2.87	16.30	0.85	1.52	5.48	0.54
United Kingdom	9.95	7.68	8.70	10.34	16.85	10.15	4.73
Luxembourg	9.26	1.44	35.87	0.16	0.26	1.02	0.10
Bermuda	7.03	0.97	56.52	0.07	0.19	0.60	0.01
Switzerland	6.37	5.30	70.65	0.72	2.23	1.11	1.19
U.K. Islands, Carib.	5.46	0.78	44.57	0.16	0.24	1.15	0.01
Singapore	3.94	5.42	55.43	1.36	2.35	2.66	0.53
Canada	2.96	14.41	23.91	8.45	10.30	15.89	2.73
China	2.85	15.19	36.96	12.28	4.85	4.75	19.98

All variables except for AETR and FSI are reported as a percentage share on their total in 2016. AETR is reported in percentages and FSI in percentiles. *Source: Author's computations*

We can see that 8 countries out of the reported top 10 countries have their average effective tax rates lower than 8% and 7 of them have average effective tax rates lower than 6%. Moreover, almost 18% of total gross profits of affiliates of U.S. based multinational corporations in the year 2016 were booked in a single country, namely in the Netherlands. At the same time, only 1.8% of employees and 2.3% of fixed capital were located in the Netherlands in 2016. Next, most of the gross profits are booked in very small economies, except for the United Kingdom. On one hand, this does not necessarily need to be an issue, as in general one can achieve high profits also in small economies. On the other hand, higher profits are, on average, probably easily achievable on bigger markets. Moreover, in bigger economies, we expect more affiliates to operate than in smaller economies. From these reasons, we expect that without profit shifting, also the GDP figures should roughly match the booked profits, which they do not.

Regarding the Financial Secrecy Index, there does not appear to be any correlation. In fact, the correlation for the whole dataset between Financial Secrecy Index and Gross Profits is -0.15%, which is very minor. This was not expected.

However, we will see in the further analysis if there is any partial effect while controlling for other variables.

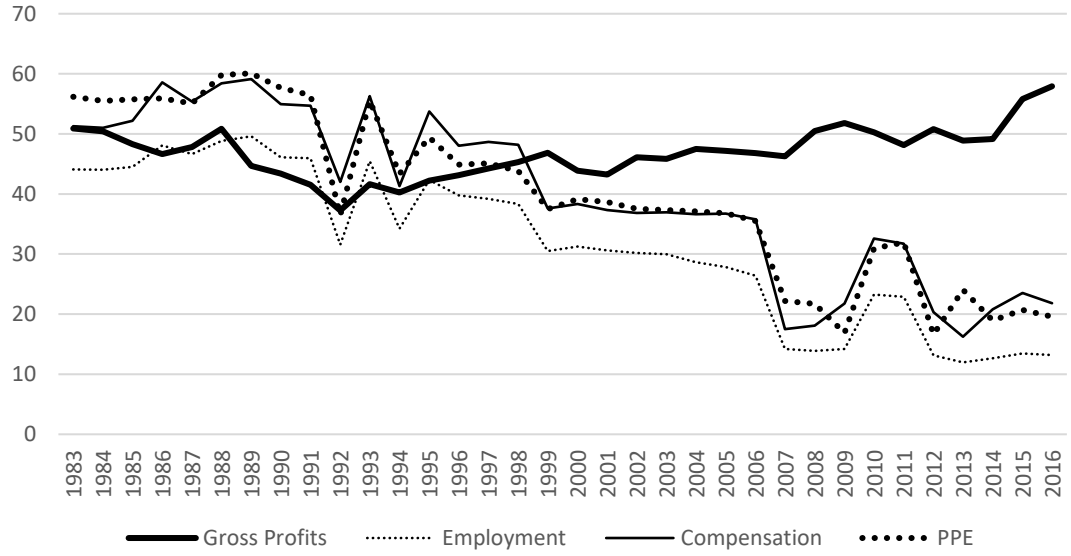
If we look at aggregate results, nearly 65% of all gross profits of foreign affiliates of U.S. based multinational corporations were booked in 7 countries which exhibit an average of 2.7% average effective tax rates. However, only 5% of total employees and 14% of total fixed assets were located in these countries in 2016. This is the most important disproportion as it means that profits are not taxed where they are earned.

Some of the statistics in Table 2 but for the whole examined period of 1983-2016 can be seen in Figure 2. In Figure 2, we can see sums of percentage shares of gross profits, employment, compensation and property, plant and equipment, respectively, for 5 countries with the highest gross profits in each year. The implications of the figure are that there is a clear downward trend of the share of factors of productions that are located in countries where the highest profit is made on one hand. On the other hand, their profits, despite the decrease of factors of production, remain constant or even exhibit a slightly upward trend.

This observation can be explained by two possible answers. The first possibility is that the factors of production begun to be more productive around the turn of the millennium where the divergence appears to start. That means that the human capital or technology become much better. The second possibility is that some profit booked in these countries is not earned there and is shifted from other countries.

We can argue against the first hypothesis by the observation that not only the employment decreases, but also the compensation for these employees. If human capital starts to create more profit, i.e. by sending the most skilled workers to the tax havens, the economic theory predicts that also wages of the skilled workers should rise, on average. This is not the case as compensation of employees decreases while profit remains constant. Of course, the profit may be driven by increased technology, in which case the capital creates the increased profit. While we do not have data on returns on capital, the more probable answer to the divergence seems to be the profit shifting.

Figure 2: Shares of Gross Profits and Factors of Production in Top 5 Countries



Values shown are sums of percentage shares of the variable's totals in each year for the year's top 5 countries with the highest gross profits. *Source: Author's computations*

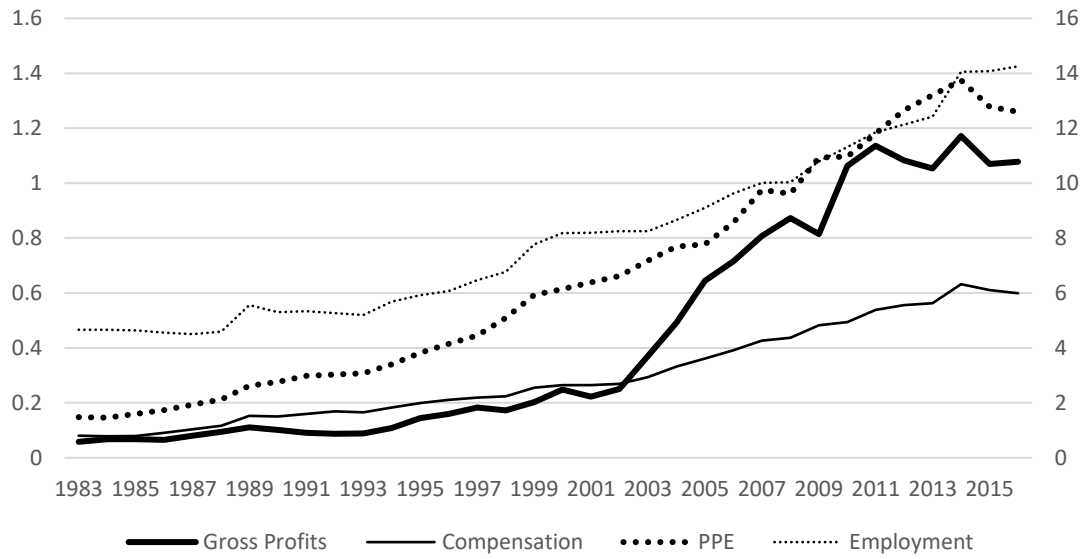
In Figure 3 we can see the total sum of gross profits, compensation of employees and property, plant and equipment in each year across all foreign affiliates. We can see that amount of production factors steadily increases during the period and as do gross profits. However, in the year 2002 there appears to be a change in the speed of increasing of gross profits. They appear to rise much more quickly that the production factors between 2001 and 2011.

Following the same arguments as in the previous figure, the reason may be either sudden increase of technology and/or human capital, or profit is shifted to the foreign affiliates from elsewhere. While technically the excess profit may be shifted to the affiliates from countries that are not United States and do not host any foreign affiliate of U.S. based corporation, the most likely source of this excess profit is the United States.

To sum up observations on the Figure 3, assuming that returns to factors of production are constant, profits start to be shifted most likely from the United States to foreign affiliates around the year 2002. This matches with the previous figure, Figure

2, where the share of profits of top 5 countries suddenly diverges from factors of production inexplicable during the same period.

Figure 3: Totals of Gross Profits, Employment, Compensation and Property, Plant and Equipment



Gross Profits, Compensation and Product, Plant and Equipment are measured in millions of current U.S. dollars on the left axis, Employment in thousands on the right axis. *Source: Author's computations*

This analysis serves also as the motivation for our analysis, proving that indeed there is a significant amount of gross profits that does not seem to be explained by factors of production.

6 Benchmark Methodology

This and the following chapter describe in detail the methodology used in this thesis. It can be divided into two parts. The first methodology is a linear model, similar to that used by Clausing (2016). This has two reasons. First, we want to mimic their procedure in order to have some benchmark model, which we can compare our main model with. A second reason is that we want to re-estimate their results using the newly updated dataset with next four years of observations. Though we know from the literature that the lationship should be nonlinear, we want some benchmark model for comparison.

The goal of this thesis is to estimate revenue loses for the United States government caused by profit shifting of multinational corporations out of the United States. In order to do that, we first need to estimate what the profits of U.S. based multinational corporations booked in foreign countries would be if there was no incentive to shift the profit from the U.S. at all. After that, we calculate what fraction of the shifted profit in each country would be booked in the United States. This is important as not all the shifted profit in each country comes from the United States. Profit is shifted also from one foreign country to another and we need to account for this. After we estimate what part of the total shifted profit comes from the U.S., we scale it up in order to account for profit shifting done by foreign multinational corporations with affiliates in the U.S. Thus, we can divide the analysis into three steps.

6.1 Step One

The first stage is to estimate the relationship between gross profits and effective tax rates. In order to do that, we regress gross profits booked by affiliates of U.S. based multinational corporations in foreign countries on their average effective tax rates and proper control variables. The following model is the most comprehensive model (i.e., including all discussed variables) used by Clausing (2016):

$$\begin{aligned}\ln(Gross\ Profits)_{it} &= \beta_0 + \beta_1 AETRD_{it} + \beta_2 \ln(GDP)_{it} + \beta_3 \ln(GDPpc)_{it} \\ &+ \beta_4 \ln(distance)_{it} + \beta_5 \ln(PPE)_{it} + \beta_6 \ln(Empl)_{it} + \beta_7 D^{1984}{}_t + \cdots \\ &+ \beta_{35} D^{2012}{}_t + a_i + e_{it}, \qquad t = 1983, \dots, 2012\end{aligned}$$

where “distance” is the distance of the country from United States and “D” for the year dummies. Two estimators were used to estimate this model, the Pooled OLS Estimator (assuming the time-invariant effect a_i is not present) and the Fixed Effects Estimator.

This the single most important step in our analysis since we expect the estimation of the relationship between profits and tax rates to be sensitive to assumptions, omitted variable bias and other related problems. Moreover, small changes in this relationship may lead to large differences in the aggregate results. This step is also one of the most important sources of uncertainty since first, we have a limited and far-from-perfect data and second, we need to address a handful of technical problems in the estimation.

Another improvement we make is that we control not only for Property, Plant and Equipment but also for Total Assets variable, which has the important feature of containing information also on intangible assets.

If we have the relationship between profits and average effective tax rates differences, i.e. the tax semi elasticity of profits, we can use it to calculate what the profits would be in a foreign country, if the average effective tax rate in the country was equal to the U.S. tax rate by plugging in to the model’s equation 0 for Average Effective Tax Rates variable.

Finally, we can compute the difference between the profit actually booked in a particular country and the estimated profit under equal tax rates to obtain the shifted profit. For most countries, the profit under equal average effective tax rates is expected to be lower than the booked profit. In other words, the profit shifted to most countries is expected to be positive.text text.

6.2 Step One

The next step is to estimate how much of this shifted profit is shifted out of the U.S. We can naturally assume that if a country has favorable tax conditions, not only U.S. firms but also affiliates of multinational corporations based in other countries arbitrarily shift their profit there to benefit from such conditions. Therefore, the estimated shifted profit in a particular country is assumed to consist of profits shifted from all other countries.

To calculate the fraction of this shifted profit that comes from the United States, Clausing (2016) proposes for each year to scale the shifted profit by the share of intrafirm transactions that are made with their U.S. parents.

This approach is based on the idea that in order to shift profit, one needs to make (or at least to report) some economic activity, for example to sale goods or services within the multinational corporation using transfer prices. The more profit one needs to shift, the more economic activity is expected to be reported. This also assumes that the share of profit shifting transactions with the United States to all transaction with the United States is the same as the share of profit shifting transactions with other foreign countries to all transactions with other foreign countries. In other words, the fraction of intrafirm transactions that are intended to shift profit is the same regardless on from which destination the profit is shifted. This appears to be a roughly plausible assumption although it does not have to be. Nevertheless, this is the only reasonable way we can estimate this fraction with our data.

Other issue is, however, that using this scaling on aggregate level, we also assume that the fraction of profit shifted from the U.S. is constant for all countries in the given year. This is possibly an unnecessarily strong assumption. Some countries make most of their transactions with the United States, so most of the estimated profit shifted there should be attributed to the United States. On the other hand, there are countries which almost do not trade with the United States at all so almost none of their estimated shifted profit should be attributed to the United States. We relax this assumption by calculating the fraction of shifted profit that comes from the United States for each country separately.

The second step is surely another source of uncertainty in our methodology, mainly because the fraction of profit shifted transactions may be different relative to all transactions with the United States and relative to all transactions with all other foreign countries. For example, some affiliate's purpose may be almost solely to "hide" profits from the United States, but it can trade with other affiliates without any intention to shift profit from them. However, we expect this to be an extreme example and the fraction of profit shifting transactions to be roughly the same regardless on the destination. Anyway, this is probably the only possibility how to estimate the share of profit shifted out of the United States with the available data.

6.3 Step Three

The third and final step in the benchmark methodology is to estimate how much is the profit shifted out of the U.S. by foreign based multinational corporations. We have data only on U.S. based firms, but we can quite safely assume that also firms based in other countries involve in profit shifting out of the United States to avoid high taxes. To do

it more accurately, we again need similar data as we have on the United States on all countries in the world. However, we can approximate it with available data.

Clausing (2016) proposes scaling total profit shifted out of the United States by U.S. based firms with the fraction of sales of affiliates of foreign based multinational firms in the United States to sales of foreign affiliates of U.S. based multinational firms in all foreign countries. This approach assumes that the fraction of profit shifting transactions to all transactions is the same for U.S. based firms and for foreign based firms. This is another important source of uncertainty, since this fraction is rather a proxy for the real situation.

7 Main Methodology

To a large extent, this section describes the main contributions of this thesis to the topic. None of these adjustments have been used in available literature on computing the scale profit shifting out of the United States yet.

This is a modified version of the benchmark methodology. It incorporates mainly the ideas of Cobham et al. (2015) and Dowd et al. (2017). Also, there are some other changes that have the potential to improve the results. Plus, a part of the modified methodology is focused to bringing another point of view on the profit shifting problem (i.e. using actual statutory corporate tax rates in the analysis

7.1 Step One

The most important modifications of the benchmark model concern the first step, i.e. estimating the relationship between gross profits booked and average effective tax rates. The basic model is to regress gross profits on the average effective tax rates and proper control variables. However, there are two important issues.

First, the effect of average effective tax rates on gross profits appears to be nonlinear. This was the conclusion mainly of Dowd et al. (2017) and confirmed by Clausing (2016). The relationship appears to be strongly nonlinear, i.e. one percentage point change in average effective tax rate is expected to have much higher effect on gross profits for small tax rates than for high tax rates, where the effect is relatively small. For instance, Dowd et al. (2017) found that for average corporate tax rates of 5%, the tax semi-elasticity of gross profits is -4.7 and for average corporate tax rates of 30%, the tax semi-elasticity is -0.6. This example shows how different effects tax rates have at different levels. Thus, we consider this nonlinearity to be very important to account for in order to produce as accurate results as possible.

To solve this issue, we add a quadratic term of average effective tax rates in our regression to allow for this nonlinearity. Although the underlying true nonlinearity does not have to be strictly quadratic, we assume that the quadratic form captures it sufficiently enough. Adding more polynomial terms does not make much sense as we know from the above literature that the effect is high for low tax rates and low for high tax rates and we can expect it smoothly changes in between. This behavior may be well captured by a quadratic term.

Second improvement of the tax semi-elasticity of profits is the use of actual average effective in the United States instead of the assumption that it is five percentage points lower than the statutory tax rate, as was assumed by Clausing (2016). This improvement turns out to have significant impact on results as the average effective tax rate in the United States is much more than the five percentage points lower than the statutory tax rate. Their comparison is shown in Figure 1.

The real effect of this improvement is that the tax incentives to shift profit to foreign countries are lower and there is a higher number of countries from which U.S. multinational corporations have tax incentives to shift profit to the United States. The resulting total shifted profit is expected to be lower due to this change since the average effective tax rate in the United States is more competitive.

Third very important modification is to relax the assumption that profit shifting is made solely due to tax reasons. In the basic model, we model the profit shifting based only on the difference between average effective taxes in a country and the United States. This is surely very important, but tax reason may not be the only motivation to shift profit. Another important reason may be the ability to hide important financial information. In countries generally referred to as tax havens, it is possible to hide some financial information. For instance, it is possible to hide the information about the amount of funds booked there from responsible institutions, or to hide the true ownership structure.

Up to now, this source of profit shifting was excluded from research in this field mainly because there was no way to measure such secrecy precisely in mathematically well-defined way. It was impossible to differentiate between levels countries can be thought of as tax havens. This has changed by the work of Cobham et al. (2015) who constructed the Financial Secrecy Index. As discussed in the Literature Review section, the Financial Secrecy Index allows to precisely define the degree each country can be thought of as a tax haven on a scale from 0 to 100. In other words, it precisely measures the financial secrecy achievable in countries.

This variable can be easily added into the regression to allow also for the secrecy-motivated profit shifting. There are two drawbacks of this application. The first is the lack of data. The Financial Secrecy Index comparable across years starts in 2011. The second is low variance in time of the Financial Secrecy Index, making it hard to estimate its effect using Fixed Effects estimation.

Fourth and last modification of the first step of the benchmark methodology is the use of statutory corporate tax rates instead of average effective tax rates to see what effects this will have on estimates of the shifted profit.

The purpose of this is to complete the picture of profit shifting with this point of view. In theory, the average effective tax rate should be more accurate in estimating the shifted profit as they reflect the true taxes firms must pay. Statutory tax rates should overestimate the true taxes paid as they do not account for various tax deductions, exemptions and credits. However, average effective corporate tax rates are also lower for the United States. So, the difference between United States and foreign countries may be roughly equal in either case of tax rates.

7.2 Step Two

We also modify the second step in our analysis, i.e. estimating the portion of the total shifted profit that comes from the United States. In the work of Clausing (2016), this is done on the aggregate level. It means the shifted profit is calculated for all countries, added together and then scaled down using the fraction of intrafirm transactions made with the parents in U.S. to all intrafirm transactions. We try to improve this calculation using country-by-country approach. For example, if a country has relatively small share of transactions with U.S. parents, then the share of profit shifted there from the U.S. should be not that high (although the total profit shifted to the country could be high). On the other hand, if a country's share of transactions with U.S. parents is high, say close to 100%, i.e. it almost only trades with the United States, all its estimated shifted profit should be counted towards the U.S. tax base.

This approach should bring some more precision in the estimates of profit shifted from the United States as it accounts for individual variations of profit shifted out of U.S. This approach is basically a weighting of the estimated shifted profit in countries according to their share of transactions with U.S. parents to transactions with all other foreign countries. It should account better for cases when a country has a high estimated shifted profit but trades with the U.S. relatively little, indicating that the profit is shifted there mainly from other countries than from the U.S., and vice versa.

Although it is not specified explicitly in the work of Clausing (2016), we define intrafirm transactions as intrafirm sales. Thus, the share of intrafirm transactions with the U.S. parent to all intrafirm transactions is represented by the share of total sales to U.S. parents relative to total sales to U.S. parents plus total sales to affiliates in all other foreign countries. Intrafirm sales to affiliates in the same countries are excluded as it

does not make any sense to shift profit within country, either for a tax or financial secrecy reasons.

7.3 Step Three

There is not much room for modification of the third step, i.e. to account for profit shifting made by U.S. affiliates of foreign based multinational corporations. With the available data, the only method we can use the scaling of estimated profit done by U.S. based firms by share of total sales of U.S. based affiliates of foreign based firms relative to share of total sales of foreign affiliates of U.S. based firms.

8 Estimation

In the first step of our every model in our analysis we need to estimate the relationship between gross profits booked in a country and its average effective tax rates. We have panel data set at hand, so we can make use of it and estimate our model using panel data regression techniques. The two methods we are concerning are the Fixed Effects Estimator and the Random Effects Estimator. Of course, we can also use the Pooled OLS Estimator, but the Random Effects Estimator is generally more efficient.

The use of these two estimators is motivated mainly by the fact that they allow for controlling for unobserved time-invariant characteristics of countries. These may be, among others, the distance from the United States, whether the country is landlocked and, most importantly, the institutional characteristics of countries, level of democracy etc. Although the institutional setup of countries is often not precisely constant in time, they are usually roughly constant, and the fixed effects may capture them well enough.

Moreover, larger changes in institutional characteristics of countries are often accompanied with changes in their names and are thus treated in our model as two separate countries with two separate roughly constant fixed characteristics, however different from each other. Two examples of this is for instance the reunification of Germany in 1990 and the division of Czechoslovakia in 1993.

The Fixed Effects Estimator and the Random Effects Estimator both require slightly different assumptions to be consistent and efficient. The main concern is whether the unobserved time-invariant characteristics of countries are correlated with other (observed) independent variables or not. If the are correlated, then the Fixed Effects Estimator is consistent, but the Random Effects Estimator is not. If they are not correlated, the Random Effects Estimator is more efficient than the Fixed Effects Estimator.

The correlation may occur if, for example, institutional setup is correlated with GDP per capita (which is one of the control variables). Or, institutional setup may correlate with lower average effective tax rates. The Hausman test that formally statistically tests for this correlation is performed prior to every model estimated in this thesis. Based on this, we decide between the Fixed Effects Estimator and the Random Effects Estimator for each model.

8.1 Linear Model

This is benchmark model and it is the variation on main model used in the study of Clausing (2016). The purpose of its estimation in this thesis is to re-estimate the investigated relationship using also the 4 more years of available data and to get a benchmark model with linear relationship between gross profits and tax rates.

In order to estimate the tax semi-elasticity of gross profits, we regress these profits on the Average Effective Tax Rates Difference, which is the difference between average effective tax rates in each country and the United States in percentage points, and on control variables. The purpose of control variables is to model the true profit actually generated in each country, that is why mainly factors of production are used. The shifted profit is then modelled using the difference in average effective tax rates differences.

Following the methodology of Clausing (2016) and the basic economic theory, for the purpose of control variables, we use the property, plant and equipment, employment and compensation of employees as factors of production. We also add GDP and GDP per capita as the size of an economy and its productivity may also be important factors for creating profits. Based on this, after inclusion for year dummies to control for individual years' effects, the following model was estimated:

$$\begin{aligned}\ln(Gross\ Profits)_{it} &= \beta_0 + \beta_1 AETRD_{it} + \beta_2 \ln(PPE)_{it} + \beta_3 \ln(Employment)_{it} \\ &+ \beta_4 \ln(Compensation)_{it} + \beta_5 \ln(GDP)_{it} + \beta_6 \ln(GDPpc)_{it} \\ &+ \beta_7 D^{1984}{}_t + \cdots + \beta_{39} D^{2016}{}_t + a_i + e_{it}, t = 1983, \dots, 2016\end{aligned}$$

where "D" stands for a year dummy for the particular year, and "a" stands for time-invariant countries' unobserved fixed effects.

However, it turns out that this model does not pass the Ramsey RESET test for functional form misspecification. In particular, second and third powers of fitted values have jointly statistically significant power in explaining gross profits, indicating that more powers of some regressors are needed. In fact, in order for this model to pass the Ramsey RESET test, the variable ln(GDPpc) must be added in its second, third, fourth and fifth power, at least. Also, the variable ln(GDP) must be added all the way up to its third power. This does not make any sense and cannot be meaningfully justified by any theory.

A possible way to solve this issue turns out to be addition of another control variable, namely total assets (in natural logarithm). The addition of this variable can be

justified by the consideration that tangible assets, as approximated by production, plant and equipment variable, do not sufficiently control for capital as the factor of production. Fixed assets are not the only type of capital to produce profits. There are also intangible assets that may do so, in particular by the ownership of patents, internet domains, patents, copyrights or trademarks. We can hypothesize that in the era of modern global digital economy these assets become more and more important in creating profits.

The implications are that the Total Assets variable may control for more forms of capital that creates the truly generated profit, making the model correctly specified. Moreover, the Total Assets variable turns out to be statistically significant in our model, so not including it in the analysis may lead to omitting variable bias. To conclude this discussion, the following modified benchmark model was estimated:

$$\begin{aligned}\ln(Gross\ Profits)_{it} &= \beta_0 + \beta_1 AETRD_{it} + \beta_2 \ln(PPE)_{it} + \beta_3 \ln(Employment)_{it} \\ &+ \beta_4 \ln(Compensation)_{it} + \beta_5 \ln(Total\ Assets)_{it} + \beta_5 \ln(GDP)_{it} \\ &+ \beta_6 \ln(GDPpc)_{it} + \beta_7 D^{1984}{}_t + \cdots + \beta_{39} D^{2016}{}_t + a_i + e_{it}, \\ &t = 1983, \ldots, 2016\end{aligned}$$

It needs to be mentioned that we do not need a precise information about standard errors of coefficients for our analysis. The only assumption that we need to fulfill is the unbiasedness assumption so that estimates of coefficients are unbiased. This mainly concerns the functional form of our models. To sum up, what is needed for our analysis is the coefficient on Average Effective Tax Rates Differences variable. Even though it is interesting and relevant to know that the relationship is statistically significant, for the purpose of our analysis we do not necessarily need precise information about standard errors.

Prior estimation, we do several checks. First, we compute correlations between used variables to check for possible multicollinearity problem. Second, we use the Breusch Pagan Lagrange Multiplier Test for Random Effects in order to test if there are some unobserved time-invariant random effects or if they are the same for each country (so that we can run the Pooled OLS Estimator). Third, if non-constant time-invariant random effects are confirmed to be present, we use the Hausman test to assess whether they are correlated with observed independent variables or not in order to choose between the Fixed Effects Estimator and the Random Effects Estimator.

The correlations are reported in Table 3. We can see that our main variable of interest, the Average Effective Tax Rates Difference, is not correlated too much with

any of the other independent variable (the highest correlation is -35% with ln(Total Assets and ln(GDP per capita).

On the other hand, other independent variables are substantially correlated with each other, mainly the factors of production – PPE, total assets, employment and compensation of employees. Because of this, their estimates may be affected by each other. In the case of this analysis, this is not a large issue as we are interested in the effect of AETRD variable only. We include the control variables so that they control for important characteristics of countries so the estimate of AETRD is unbiased, but we are not interested in their individual effects on gross profits.

Table 3: Correlation Table of the Linear Model

	AETRD	ln(PPE)	ln(Empl.)	ln(Comp.)	ln(TA)	ln(GDP)	ln(GDPpc)
AETRD	1						
ln(PPE)	0.03	1					
ln(Employment)	0.04	0.84	1				
ln(Compensation)	-0.02	0.89	0.91	1			
ln(Total Assets)	-0.26	0.82	0.61	0.80	1		
ln(GDP)	0.23	0.74	0.81	0.85	0.54	1	
ln(GDP per capita)	-0.30	0.33	0.12	0.47	0.62	0.21	1

Source: Author's computations

Regarding the Breusch-Pagan Lagrange Multiplier Test for Random Effects, its p-value is lower than 10^{-4} so we strongly reject the null hypothesis of null variance of the a_i component of the error. That means that only the Random Effects Estimator or the Fixed Effects Estimator will be unbiased. The Hausman test's p-value is also lower than 10^{-4}, so we strongly reject the null hypothesis that both estimators are consistent in favor of the alternative hypothesis that only the Fixed Effects Estimator is consistent. Finally, based on this discussion, our preferred estimator is the Fixed Effects Estimator.

The F-test's p-value of joint significant of variables ln(PPE), ln(Empl), ln(Comp) and ln(GDP) is 0.23, so all four variables were removed from the final estimation. We are left with model summarized in Table 4.

Table 4: Linear Model

	Coefficient	Std. Err.	t statistics	p-value	95% Conf. Interval	
AETRD	-1.2272	0.22	-5.68	$<10^{-4}$	-1.66	-0.80
ln(Total Assets)	0.86	0.05	18.27	$<10^{-4}$	0.77	0.95
ln(GDPpc)	0.41	0.10	4.13	$<10^{-4}$	0.21	0.60
R^2 within	0.88				N	1780
R^2 between	0.80				Countries	64
R^2 overall	0.81				F-test p-value	$<10^{-4}$

Dependent variable: ln(Gross profits), Fixed Effects Estimator, autocorrelation- and heteroscedasticity-robust standard errors reported, year dummies' results not reported. *Source: Author's computations*

We can see that there is an estimated -1.2272 tax semi-elasticity of profits which means that if the average effective tax rate increases in a country by 1 percentage point, the gross profits booked this country by foreign affiliates of U.S. based corporations decrease by 1.23%. The order of this estimate corresponds to the results broadly reported in literature, however, it is lower than any estimate reported by Clausing (2016). This may be caused by the fact that the total assets control variable probably controls better for factors of production, leaving less (but true) amount of variation of gross profit for the average effective tax rates differences.

Both other variables exhibit expected signs of their effect, i.e. with higher amount of total assets, the booked gross profits are higher. Also, higher productivity of economy foreign affiliate operates in results in higher gross profits.

As the post-estimation test, we perform the Ramsey RESET test for functional specification error. The test for functional specification is the most relevant test for our analysis since the unbiasedness is the single most relevant and important assumption needed for this analysis. The p-value for this test is 0.88 so we cannot reject the null hypothesis that second and thirds powers of fitted values have significant explanatory power. Moreover, even this basic model with this low number of explanatory variables explains more than 80% of within, between as well as overall variation in ln(Gross Profits) which is certainly convenient.

8.2 Quadratic Model

In this section, we estimate two models. First, we allow the effect of average effective tax rates differences on gross profits to be nonlinear by adding a quadratic term. As discussed in the Methodology section, adding the more powers is not

meaningful since we expect, based on the discussed literature, the effect to be high for low tax countries, low for high tax countries and to smoothly change in between. The purpose of this model is to see how the quadratic specification of tax semi-elasticity of profits compares to the benchmark, linear model.

Second, we add interactions with year dummy variables for both the linear and quadratic term of Average Effective Tax Rates Difference variable. This is done in order to estimate the shifted profit more accurately for each year, not assuming that the effect of tax rates on profits is (although being quadratic) constant over time. For example, we expect the profit-shifting pattern to change around the global financial crisis in 2007-2009 or around the end of the Cold war in 1989. The two following models are estimated:

$$\begin{aligned}\ln(Gross\ Profits)_{it} &= \beta_0 + \beta_1 AETRD_{it} + \beta_2 AETRD^2{}_{it} + \beta_3 \ln(PPE)_{it} \\ &+ \beta_4 \ln(Employment)_{it} + \beta_5 \ln(Compensation)_{it} \\ &+ \beta_6 \ln(Total\ Assets)_{it} + \beta_7 \ln(GDP)_{it} + \beta_8 \ln(GDPpc)_{it} \\ &+ \beta_9 D^{1984}{}_t + \cdots + \beta_{41} D^{2016}{}_t + a_i + e_{it}, \qquad t = 1983, \dots, 2016\end{aligned}$$

$$\begin{aligned}\ln(Gross\ Profits)_{it} &= \beta_0 + \beta_1 AETRD_{it} + \beta_2 AETRD\_D^{1984}{}_{it} + \cdots + \beta_{34} AETRD\_D^{2016}{}_{it} \\ &+ \beta_{35} AETRD^2{}_{it} + \beta_{35} AETRD^2\_D^{1984}{}_{it} + \cdots + \beta_{67} AETRD^2\_D^{2016}{}_{it} \\ &+ \beta_{68} \ln(PPE)_{it} + \beta_{69} \ln(Employment)_{it} \\ &+ \beta_{70} \ln(Compensation)_{it} + \beta_{72} \ln(Total\ Assets)_{it} \\ &+ \beta_{73} \ln(GDP)_{it} + \beta_{74} \ln(GDPpc)_{it} + \beta_{75} D^{1984}{}_t + \cdots + \beta_{107} D^{2016}{}_t \\ &+ a_i + e_{it}, \qquad t = 1983, \dots, 2016\end{aligned}$$

The p-value of Breusch-Pagan Lagrange Multiplier test for random effects is lower than 10^{-4}, so the null hypothesis of the same constant time-invariant effects across countries can be strongly rejected. Then, the Hausman test's p-value is also lower than 10^{-4}, too, so the preferred estimation is the same as for the benchmark model. These conclusions apply to both the basic model without year interaction terms and to the model with year interaction terms – their tests results were the same.

The F-test's p-value of joint significance of variables ln(PPE), ln(Employment), ln(Compensation) and ln(GDP) is 0.22 so they are jointly insignificant, and we remove them from our model. Its final estimation results can be seen in Table 5.

Table 5: Quadratic Model without Year Interaction Terms

	Coefficient	Std. Err.	t statistics	p-value	95% Conf. Interval	
AETRD	-1.3755	0.31	-4.4	$<10^{-4}$	-2.00	-0.75
$AETRD^2$	0.46	0.73	0.63	0.53	-1.00	1.91
ln(Total Assets)	0.86	0.05	18.67	$<10^{-4}$	0.77	0.95
ln(GDPpc)	0.41	0.10	4.12	$<10^{-4}$	0.21	0.60
R^2 within	0.88				N	1780
R^2 between	0.80				Countries	64
R^2 overall	0.81				F-test p-value	$<10^{-4}$

Dependent variable: ln(Gross profits), Fixed Effects Estimator, autocorrelation- and heteroscedasticity-robust standard errors reported, year dummies' results not reported. *Source: Author's computations*

We can see that the coefficients of control variables remained the same as in the benchmark, linear model when rounded to the second decimal place. The only relationship that changed is the tax semi-elasticity of profits which increased in the linear term (in absolute value) but a positive quadratic term was added.

The quadratic term is not statistically significant. However, it is economically significant as it magnitude is almost a third of the statistically significant linear term. This means that though there is not enough statistical evidence that the coefficient does not equal to zero with heteroscedasticity and autocorrelation robust standard errors, the quadratic effect may make a difference in the total aggregated results.

The model with year interaction terms aims at differentiating between individual years so that we can control for different tax semi-elasticities of gross profits across years. In our previous models we assumed that this relationship is constant, which may not be the case and estimates of total shifted profit computed and compared across years may be biased under this assumption. The drawback of the model is that

it includes a lot of coefficients, so their precision is much lower than in the previous specifications of models. However, with the available data there is not much space for improvement. On the other hand, the standard errors may be large due to the lower number of degrees of freedom, however, we are mainly interested in the coefficients themselves. So, large standard errors are not a problem as long as our estimates are unbiased and consistent.

The variables ln(PPE), ln(Compensation) and ln(GDP) are jointly insignificant with the F-test's p-value of 0.21 so they were removed from the final estimation. Its results are summarized in the following Table 6.

Table 6: Quadratic Model with Year Interaction Terms

	Coefficient	Std. Err.	t statistics	p-value	95% Conf. Interval	
AETRD	-0.92	0.58	-1.57	0.12	-2.08	0.25
$AETRD^2$	0.73	1.69	0.43	0.67	-2.64	4.10
ln(Employment)	0.13	0.08	1.7	0.09	-0.02	0.28
ln(Total Assets)	0.76	0.05	14.11	$<10^{-4}$	0.65	0.87
ln(GDPpc)	0.33	0.11	3.15	$<10^{-2}$	0.12	0.54

Year	$AETRD \times D^{year}$	$AETRD^2 \times D^{year}$
1984	0.03	0.90
1985	-0.10	1.73
1986	0.10	-1.69
1987	0.02	-0.09
1988	-0.78*	0.68
1989	-0.27	-0.91
1990	-0.07	-0.19
1991	0.06	0.30
1992	-0.08	-1.41
1993	0.00	-2.28
1994	-0.50	-0.07
1995	-0.52	-0.66
1996	-0.38	0.44
1997	-0.51	-1.15
1998	-1.57**	-1.81
1999	-1.20*	-1.76
2000	-0.74	2.20
2001	-1.13*	-0.05
2002	-1.38*	-0.48
2003	-1.26*	-0.12
2004	-0.83	0.30
2005	-0.71	1.47
2006	-0.39	0.81
2007	-0.88	1.87
2008	-0.64	-0.49
2009	-0.43	-0.72
2010	-1.81**	1.84
2011	-1.29*	5.95**
2012	-1.41*	0.17
2013	-1.50**	1.04
2014	-2.40***	6.59**
2015	-2.78***	6.50**
2016	-2.60***	5.15*

N	1776
Countries	63
F test's p-value	-
R2 within	0.89
R2 between	0.82
R2 overall	0.84

Dependent variable: ln(Gross profits), Fixed Effects Estimator, autocorrelation- and heteroscedasticity-robust standard errors reported, year dummies' results not reported. *Source: Author's computations*

All non-interaction variables have the expected sign and variables lTA and lGDPpc have comparable magnitude to their magnitude in the model without year interaction terms. Most importantly, some year interaction terms are individually significant for both the linear and quadratic term. Most of them at the end of the sample, which is expected as the most distant years are expected to be the most different form the benchmark year, which is 1983. This significance of some year interaction terms means that indeed the tax semi-elasticity of profits differs across years and we cannot assume it is constant in order to have unbiased estimates of the shifted profit.

The Ramsey RESET test for functional misspecification error yields the p-value of 0.855 so the RESET test is passed, meaning that no other powers of independent variables have statistically significant explanatory power in our model. Also, all our variables explain more than 82% of the between and overall variation in ln(Gross Profits) and almost 90% of its within variation. This is expected as this model includes large amount of regressors.

8.3 Model with Financial Secrecy Index

In this model, the assumption that profits are shifted due to tax reasons only is relaxed. Instead, we allow also for the financial secrecy differences to drive profit shifting alongside with the tax rate differences. The drawback of this approach is that there is a lower number of observations of the Financial Secrecy Index, both in terms of countries covered and in terms of observed years. The data start in the year 2012 and covers 45 countries.

In this model, we stick to the linear relationship between FSID and ln(Gross Profits), as opposed to the quadratic relationship between AETRD and ln(Gross Profits). The reason is that FSID and AETRD are not exactly comparable. The Average Effective Tax Rate Difference variable has a direct meaning in terms of the tax rates. Moreover, the most valuable and interesting for companies are countries with the lowest tax rates.

On the other hand, the Financial Secrecy Index combines values of many different variables defining the financial secrecy scale of a country. For this reason, it

may happen that for a company that searches for some specific form of financial secrecy covered by one underlying variable of the Financial Secrecy Index, the most interesting country may be one with an average value of FSI. Thus, not all companies may benefit from lower Financial Secrecy Index and not all of them search for the highest financial secrecy. From this reason, we assume the relationship between FSID and ln(Gross Profits) is linear.

Correlations among all variables in the sample used in this model are shown in Table 7.

Table 7: Correlation Table of the model with Financial Secrecy Index

	AETRD	$AETRD^2$	FSID	ln(PPE)	ln(Empl.)	ln(Comp.)	ln(TA)	ln(GDP)	ln(GDPpc)
AETRD	1								
$AETRD^2$	0.49	1							
FSID	-0.20	-0.05	1						
ln(PPE)	-0.03	-0.08	-0.30	1					
ln(Empl.)	0.17	-0.20	-0.40	0.76	1				
ln(Comp.)	0.11	-0.09	-0.44	0.84	0.91	1			
ln(Total Assets)	-0.35	0.03	-0.13	0.76	0.41	0.61	1		
ln(GDP)	0.35	-0.11	-0.43	0.60	0.84	0.85	0.23	1	
ln(GDPpc)	-0.28	0.23	-0.03	0.29	-0.21	0.17	0.56	-0.09	1

Source: Author's computations

This model's preferred estimator is the Fixed Effect Estimator, too, as p-values of both the Breusch-Pagan test for random effects and the Hausman test for consistency are lower than 0.05 .

F-test's p-value for joint significance of ln(PPE), ln(Employment) and ln(Compensation) is 0.97, so we exclude them from the model. Its final estimation is summarized in Table 8.

Table 8: Model with FSI without Year Interaction Terms

	Coefficient	Std. Err.	t statistics	p-value	95% Conf. Interval	
AETRD	-3.34	0.45	-7.49	$<10^{-4}$	-4.24	-2.44
$AETRD^2$	5.67	1.89	3	$<10^{-2}$	1.87	9.47
FSID	-0.01	0.01	-1.52	0.14	-0.03	0.00
ln(Total Assets)	1.10	0.28	3.93	$<10^{-4}$	0.53	1.66
ln(GDP)	-3.92	2.03	-1.93	0.06	-8.02	0.18
ln(GDPpc)	4.83	2.14	2.26	0.03	0.52	9.14
R^2 within	0.56				N	226
R^2 between	0.12				Countries	45
R^2 overall	0.14				F-test p-value	$<10^{-4}$

Dependent variable: ln(Gross profits), Fixed Effects Estimator, autocorrelation- and heteroscedasticity-robust standard errors reported, year dummies' results not reported. *Source: Author's computations*

We can see that the FSI coefficient is not statistically significant, however, the probability that its true effect equals to 0 is actually only 13.5%. Its coefficient is also by two orders lower than that of other variables. However, the range of its values is also by two orders wider than that of AETRD so the final effect on the shifted profit may be comparable.

In the specification with the FSID variable we allow for different effects for each year via year interaction terms, too. The variables ln(PPE), ln(Employment) and ln(Compensation) are jointly statistically insignificant with the F-test's p-value of 0.85 and are excluded from the main version. Its estimates are summarized in Table 9.

Table 9: Model with FSI with Year Interaction Terms

	Coefficient	Std. Err.	t statistics	p-value	95% Conf. Interval	
AETRD	-3.56	0.53	-6.66	$<10^{-4}$	-4.64	-2.48
$AETRD^2$	9.19	1.45	6.33	$<10^{-4}$	6.26	12.11
FSID	-0.02	0.01	-1.83	0.07	-0.04	0.00
lTA	1.17	0.30	3.97	$<10^{-4}$	0.58	1.77
lGDP	-4.33	2.21	-1.96	0.06	-8.78	0.13
lGDPpc	5.12	2.30	2.22	0.03	0.48	9.76
Year	**$AETRD\_D^{year}$**		**$AETRD^2\_D^{year}$**		**$FSID\_D^{year}$**	
2012	0.37		-4.34		0.0026	
2013	0.44		-2.35		0.0050	
2014	0.53		-2.38		0.0059	
2015	0.20***		-5.84		0.0052	
2016	0.21		-2.24		-0.0005	
R^2 within	0.59				N	226
R^2 between	0.11				Countries	45
R^2 overall	0.13				F-test p-value	$<10^{-4}$

Source: Author's computations

The Ramsey RESET test is passed with the p-value of 0.19.

8.4 Model with Financial Secrecy Index

The last specification we estimate is the model with statutory corporate income tax rates differences instead of the average effective tax rates differences. The purpose is to see how these two models compare with each other. Tax rates are a crucial part of the estimation of shifted profit as they are its the most influential driver. The problem is that on one hand, the statutory tax rates tend to overestimate the true tax rates since they do not capture tax exemption, allowances, tax credits and other manipulation with the actual tax rate. However, the statutory tax rates overestimate the true tax rates in both the foreign countries and in the United States, so their difference may be sufficiently close to the true difference in true tax rates.

On the other hand, although the Average Effective Tax Rates Differences capture all additional manipulation with the statutory tax rates, they are only estimates of the true effective tax rates, estimated from data reported by multinational corporations themselves. They may be subject to biases, imperfections and mismeasurement. Thus, the purpose of this is to see how estimates of shifted profit differs based on which tax rates are used.

Correlations between individual variables on the sample covered by statutory tax rates is shown in the Table 10.

Table 10: Correlation Table of the Model with Statutory Tax Rates

	STaxD	STaxD^2	ln(PPE)	ln(Empl.)	ln(Comp.)	ln(TA)	ln(GDP)	ln(GDPpc)
STAXD	1							
STAXD^2	-0.67	1						
ln(PPE)	0.00	-0.07	1					
ln(Empl.)	0.07	-0.17	0.89	1				
ln(Comp.)	0.01	-0.09	0.93	0.95	1			
ln(Total Assets)	-0.12	0.06	0.92	0.82	0.91	1		
ln(GDP)	0.04	-0.20	0.76	0.82	0.85	0.72	1	
ln(GDPpc)	-0.29	0.27	0.51	0.39	0.59	0.64	0.43	1

Source: Author's computations.

The Breusch-Pagan test for random effects p-value is lower than 10-4, indicating that indeed random effects are present. The Hausman test's p-value is also lower than 10-4, indicating that yet this model's preferred estimator is the Fixed Effects Estimator. Estimates of the model without year interaction terms are presented in Table 11.

Table 11: Model with Statutory Tax Rates without Year Interaction Terms

	Coefficient	**Std. Err.**	**t statistics**	**p-value**	**95% Conf. Interval**	
STAXD	0.97	0.55	1.76	0.083	-0.13	2.08
STAXD^2	0.24	1.46	0.17	0.869	-2.68	3.16
ln(Total Assets)	0.92	0.07	12.97	0	0.78	1.06
ln(GDPpc)	0.31	0.13	2.35	0.022	0.05	0.57
R^2 within	0.82				N	1675
R^2 between	0.89				Countries	60
R^2 overall	0.86				F-test p-value	$<10^{-4}$

Source: Author's computations

The RESET test is passed at the p-value of 0.41. We can see that the model with statutory tax rates differences instead of differences of average effective tax rates differs from all previous models in a substantial way, namely that the effect of statutory tax rates on profits is positive. In other words, the higher the statutory tax rates in a foreign country, the more gross profits are predicted to be booked there by foreign affiliates of U.S. multinational corporations, holding everything else constant. This is not consistent with any of the results of both this thesis and available literature.

One of explanation of this anomaly is that statutory tax rates do not drive the profit shifting at all and the positive relationship is due to chance. Another possibility is that it is due to the low within variance of statutory tax rates. Their within standard deviation is about a half that of average effective tax rates, so the fixed effect estimator does not have enough power to estimate the relationship well enough and the positive outcome is due to chance. The most probable explanation, however, is that statutory tax rates simply do not reflect true tax rates under which multinational corporations are being taxed.

Anyway, estimates of relationship between profits and tax rates, when statutory corporate income tax rates are used for tax rates, are not in line with neither broad consensus in available literature, nor with other estimates in our thesis.

9 Results

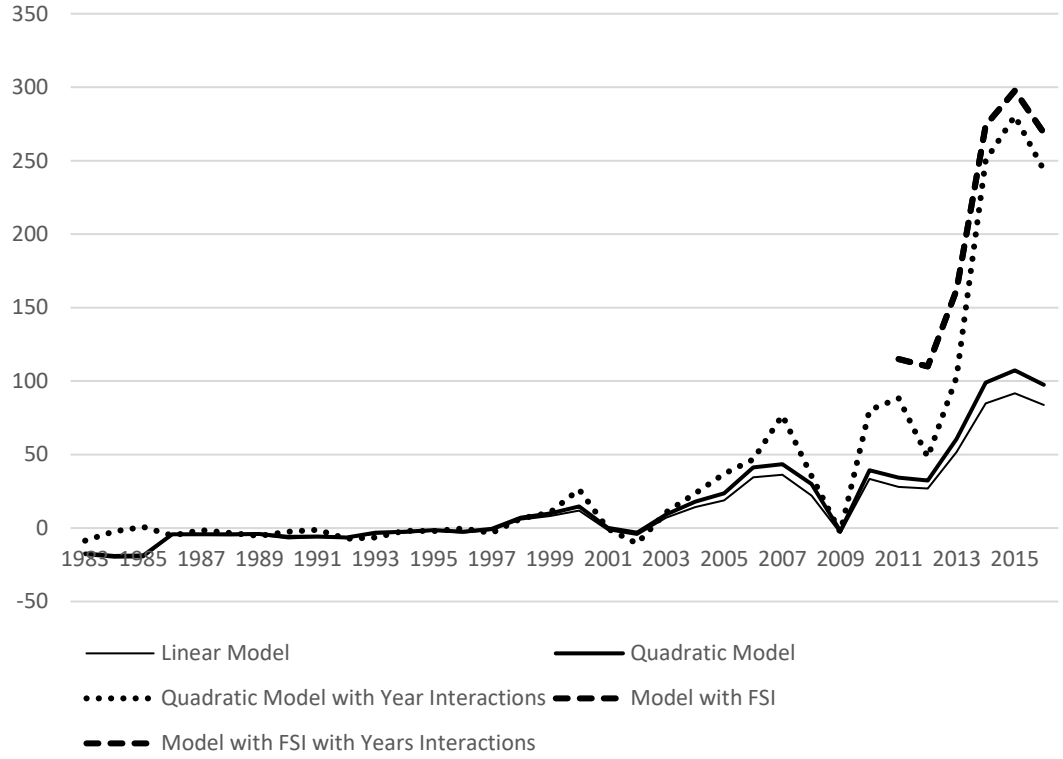
For each model and each year in the period 1983-2016, we computed estimates of the shifted profit predicted by the model as described in the Benchmark and Main Methodology sections. The results are summarized in the Table 12. And to see the results from perspective, they are plotted in Figure 4.

Table 12: Estimated Total Profit Shifted out of the United States

	Linear Model	Quadratic Model	Quadratic Model with YIT	Model with FSI	Model with FSI and YIT
1983	-18	-17	-9		
1984	-20	-19	-2		
1985	-20	-19	1		
1986	-5	-4	-5		
1987	-5	-4	-1		
1988	-5	-4	-3		
1989	-5	-4	-5		
1990	-7	-6	-2		
1991	-6	-6	-1		
1992	-7	-6	-7		
1993	-4	-3	-7		
1994	-3	-3	-2		
1995	-2	-1	-2		
1996	-3	-3	0		
1997	-1	-1	-3		
1998	6	7	6		
1999	8	10	11		
2000	12	15	26		
2001	-1	0	-1		
2002	-5	-3	-11		
2003	7	9	11		
2004	14	18	24		
2005	19	24	37		
2006	35	41	47		
2007	36	43	77		
2008	22	30	35		
2009	-3	-2	-3		
2010	33	39	80		
2011	28	34	88	115	115
2012	27	32	48	110	110
2013	52	61	103	162	162
2014	85	99	250	274	274
2015	92	107	280	298	297
2016	84	98	244	269	269

Billions of current U.S. dollars. YIT= "Year Interaction Terms". *Source: Author's computations*

Figure 4: Estimated Total Profit Shifted out of the United States



Billions of current U.S. dollars. Both models with FSI almost exactly overlap.
Source: Author's computations

In the Figure 4 we can see the shifted profit out of the United States for each year between 1983-2016 for each of our models. The main findings are the following.

First, we can see that the linear model yields the lowest estimates. This is the confirmation of findings of available literature (Dowd et al., 2017 or Clausing, 2016). We proved that tax semi-elasticities of profits are nonlinear and omitting this fact underestimates the results.

Second, adding year interaction terms to the quadratic model substantially increases the estimates mainly after the year 2007, when the global economic crisis took place. This means than the responsiveness of profits to tax rates is much larger in recent years than in the past, meaning that multinational corporations are much more sensitive to tax rates in the recent years. Thus, tax semi-elasticity of profits is not constant, and the general trend appears to be increasing. However, it is not true as we hypothesized in the thesis proposal that the profit shifting problem is steadily

increasing since the global financial crisis in 2007-2009. Though it indeed is generally increasing, there are two drops, in years 2012 and 2016.

Third, we can see that allowing for the profit to be shifted also due to financial secrecy reason by modelling it by the Financial Secrecy Index substantially increases the estimates of total shifted profit. This has consequences for future research as the financial secrecy part of the problem cannot be omitted.

The Financial Secrecy Index proved to be economically significant, although its effect is statistically insignificant. This may be due to the lack of data since we have limited sample of both countries and years covered. However, the model with Financial Secrecy Index yields estimates that are by on average 35% higher than a comparable model without the Financial Secrecy Index, which is a large increase.

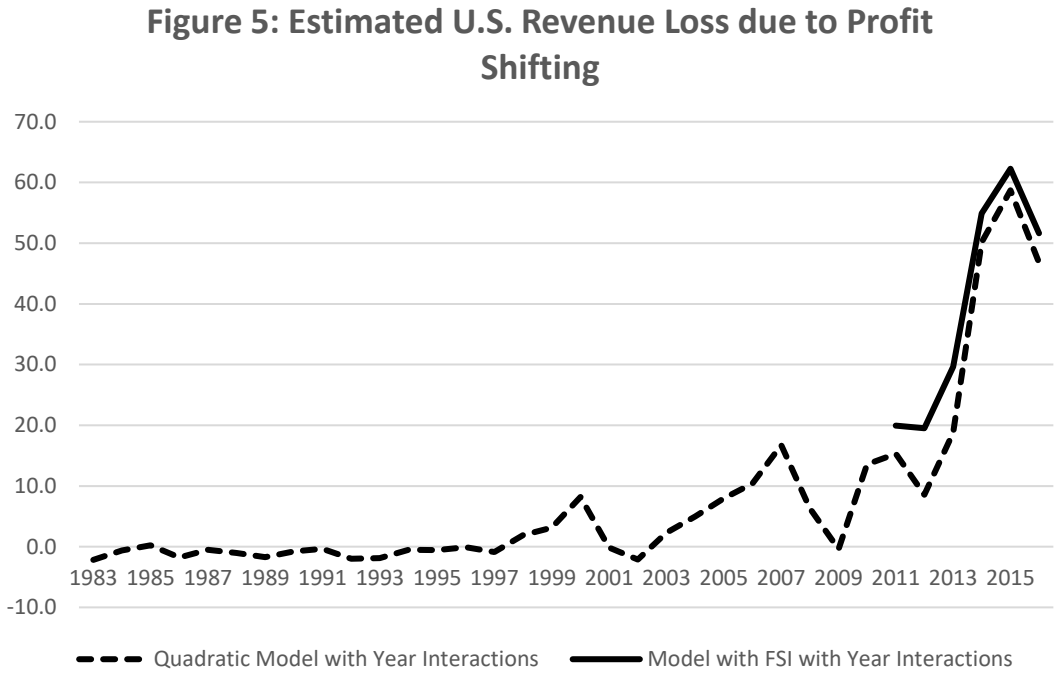
Fourth, all our models suggest that the profit shifting problems started at the turn of the millennium. Prior to that, profit was shifted rather into the United States, although in relatively low amounts.

Based on the estimates of shifted profit produced by our two most meaningful and comprehensive models, i.e. the quadratic model with year interaction terms and the model with Financial Secrecy Index, we compute the revenue loss for the U.S. government for each year in the period by applying the average effective tax rates to the shifted profit. These results can be seen in Table 13 and in Figure 5.

Table 13: Estimated Revenue Loss due to Profit Shifting

	Quadratic Model with Year Interactions	Model with FSI with Year Interactions
1983	-2.2	
1984	-0.6	
1985	0.2	
1986	-1.8	
1987	-0.5	
1988	-1.1	
1989	-1.7	
1990	-0.8	
1991	-0.3	
1992	-2.0	
1993	-1.9	
1994	-0.5	
1995	-0.6	
1996	-0.1	
1997	-0.9	
1998	1.9	
1999	3.1	
2000	8.2	
2001	-0.2	
2002	-2.1	
2003	2.3	
2004	5.0	
2005	8.0	
2006	10.4	
2007	16.7	
2008	6.3	
2009	-0.4	
2010	13.6	
2011	15.3	19.9
2012	8.6	19.5
2013	18.8	29.6
2014	50.1	54.9
2015	58.7	62.3
2016	46.8	51.6

Billions of current U.S. dollars. *Source: Author's computations*



Billions of current U.S. dollars. *Source: Author's computations*

We can see that the reenue loss in generally increasing in the long run, although it decreased in the last two years. Also, model with Financial Secrecy Index yields larger estimates of the profit shifting problem.

10 Conclusion

In this thesis, the scale of profit shifting by U.S. based multinational corporations out of the United States is estimated. Based on the previous literature, we allowed for nonlinearity, which made the estimates generally larger. Also, we relaxed the assumption that the tax semi-elasticity of profit is constant over time by adding year interaction terms. This resulted in a massive increase in the estimate of shifted profit and the consequent revenue loss in the recent year.

Our study suggests that the profit shifting problem appeard first at the turn of the millennium. Prior to that, the profit wa shifted rather into the United States, however in relatively small amounts. After that, the amounts of shifted profit are estimated to increase almost exponentially (with some temporal drops), reaching maximum of almost 300 billion of U.S. dollars in 2015. In the same year, the estimates of revenue loss were the highest with the value of 62.3 billion of U.S. dollars. Opposite to that, a sharp decrease of both estimates is reported for the year 2009, when the shifted profit and the revenue loss dropped to almost zero. We can hypothesize that in a global financial crisis, profit shifting occurs less.

In this thesis, we proved that the tax semi-elasticity of profits is not constant in time and differs extensively across the period 1983 – 2016. Also, we showed that modelling the profit shifting using also a measure of financial secrecy achievable in countries increases the estimate of shifted profit and the consequent revenue loss.

Finally, we showed that statutory tax rates are not very useful when estimating the shifted profit, as they relationship with pre-tax income, holding factors of production constant, is positive, indicating that higher statutory tax rates attract profits. This is not consistent with any findings with both this thesis and available literature and more research needs to be done to explain this behavior.

To sum up, we found that indeed there is a large and increasing profit shifting problem with the peak of 60 billion of U.S. dollars in revenue loss in 2015. Moreover, nonlinearity, financial secrecy and time-variant tax semi-elasticity of profits are crucial for the estimation to yield more accurate results.

Bibliography

Bureau of Economic Analysis (2018a): "U.S. Direct Investment Abroad (USDIA)" Bureau of Economic Analysis, datasets 1983 – 2016 (preliminary); available online at: https://www.bea.gov/international/di1usdop, cited 9. 11. 2018

Bureau of Economic Analysis (2018b): "Foreign Direct Investment in the United States (FDIUS)", Bureau of Economic Analysis, datasets 1983 – 2016 (preliminary); available online at: https://www.bea.gov/international/di1fdiop, cited 28. 12. 2018

Clausing, Kimberly A. (2016): "The Effect of Profit Shifting on the Corporate Tax Base in the United States and Beyond", *National Tax Journal*, volume 69 (4), pages 905-934

Dharmapala, Dhammika (2014): "What Do We Know about Base Erosion and Profit Shifting? A Review of the Empirical Literature", *Fiscal Studies*, volume 35 (4), pages 421-448

Cobham, Alex, Petr Janský & Markus Meizner (2015): "The Financial Secrecy Index – Shedding New Light on the Geography of Secrecy", *Economic Geography*, volume 91 (3), pages 281-303

Dowd, Tim, Paul Landefeld & Anne More (2017): "Profit shifting of U.S. multinationals", *Journal of Public Economics*, volume 148, pages 1-13

Hines, James & Eric M. Rice (1994): "Fiscal Paradise: Foreign Tax Havens and American Business", *The Quarterly Journal of Economics*, volume 109 (1), pages 149-182

Janský, Petr (2016): "Estimating the Costs of International Corporate Tax Avoidance: The Case of the Czech Republic", *Institute of Economic Studies, Faculty of Social Sciences, Charles University in Prague*, Working Paper 21/2016

Financial Secrecy Index (2018): "Financial Secrecy Index", Tax Justice Network; available online at: https://financialsecrecyindex.com, cited 15. 11. 2018

Cobham, Alex & Petr Janský (2018): "Global distribution of revenue loss from corporate tax avoidance: re-estimation and country results", *Journal of International Development*, volume 30 (2), pages 206-232

FRED (2018a): “Corporate Profits After Tax (without IVA and CCAdj) [CP]”, U.S. Bureau of Economic Analysis, retrieved from FRED, Federal Reserve Bank of St. Louis; available online at: https://fred.stlouisfed.org/series/CP, cited 21. 7. 2018

FRED (2018b): “Tax Receipts on Corporate Income [FCTAX]”, U.S. Bureau of Economic Analysis, Federal Government, retrieved from FRED, Federal Reserve Bank of St. Louis; available online at: https://fred.stlouisfed.org/series/FCTAX, cited 21. 7. 2018

World Bank (2018a): “GDP per capita (current US$)”, The World Bank; available online at: https://data.worldbank.org/indicator/NY.GDP.MKTP.CD, cited 23. 11. 2018

United Nations (2018a): “GDP by Type of Expenditure at current prices - US dollars”, United Nations Data, available online at: http://data.un.org/Data.aspx?q=gdp+current+2010&d=SNAAMA&f=grID:101;currID:USD;pcFlag:0;yr:2010&c=2,3,5,6&s=_crEngNameOrderBy:asc,yr:desc&v=1, cited 30. 11. 2018

World Bank (2018b): “GDP (current US$)”, The World Bank; available online at: https://data.worldbank.org/indicator/NY.GDP.PCAP.CD, cited 23. 11. 2018

United Nations (2018b): “Per capita GDP at current prices - US dollars”, United Nations Data, available online at: http://data.un.org/Data.aspx?q=gdp+per+capita+current+2010&d=SNAAMA&f=grID%3a101%3bcurrID%3aUSD%3bpcFlag%3a1%3byr%3a2010, cited 30. 11. 2018

KPMG (2018): “Corporate tax rates table”, available online at: https://home.kpmg/xx/en/home/services/tax/tax-tools-and-resources/tax-rates-online/corporate-tax-rates-table.html, cited 3. 12. 2018

World Bank (2018b): “GDP (current US$)”, The World Bank; available online at: https://data.worldbank.org/indicator/IC.TAX.TOTL.CP.ZS, cited 3. 12. 2018

Wooldridge, Jeffrey M. (2012): “Introductory Econometrics: A Modern Approach, 5th Edition”, Cengage South-Western, 912 pages, ISBN: 978-1-111-53104-1