Charles University
Faculty of Social Sciences
Institute of Economic Studies

MASTER'S THESIS

Corporate Tax Competition:
A Meta-Analysis

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Academic Year: 2016/2017
Declaration of Authorship

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Prague, January 6, 2017

Signature
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Abstract

This thesis provides the first meta-analysis investigating the effect of corporate tax competition among states, with special focus on the effect of the corporate tax rate change in competing country on the corporate tax rate in the home country. It examines 523 estimates from 20 published studies and working papers. Results of the meta-analysis show an evidence of substantial publication selectivity: researchers tend to discard negative and insignificant estimates, which overvalues the estimated effect size. Conducted precision effect test failed to find the evidence for the existence of a genuine effect of corporate tax competition. Empirical analysis shows that differences in the measurement of statutory and effective tax rate matter, thus the analysis was conducted on two separate sub-samples. Meta-regression analysis have found significant impact of variables related to publication bias for both sub-samples. Next to it, the results provide an evidence of significant influence of politically orientated controls, especially of the variable controlling whether or not there were elections in the particular year and state in case when the corporate tax rate changed.

**JEL Classification**  
H25, H77, C83, C12

**Keywords**  
meta-analysis, tax competition, corporate taxes, publication bias

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Abstrakt


Klasifikace JEL

H25, H77, C83, C12

Klíčová slova

meta-analýza, daňová konkurence, korporátní daně, publikační selektivita

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Acronyms

ANOVA Analysis of Variance
BACH Bank of the Accounts of Companies Harmonized
BEPS Base erosion and profit shifting
CITR Corporate income tax rate
EMTR Effective marginal tax rate
ETR Effective tax rate
FAT Funnel asymmetry test
FAIVE Funnel asymmetry instrumental variable estimator
FAIVEHR Funnel-asymmetry-heteroskedasticity-robust-instrumental variables estimator
FDI Foreign Direct Investment
FES Fixed effects model
GATCA Global Account Tax Compliance Act
GDP Gross Domestic Product
IV Instrumental variable
ME Mixed effects model
MNC Multinational Corporation
MRA Meta-regression analysis
NE Nash Equilibrium
OECD Organisation for Economic Co-operation and Development
OLS Ordinary Least Squares
PCC Partial correlation coefficients
PEESE Precision-effect estimate with standard errors
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PET</td>
<td>Precision Effect Test</td>
</tr>
<tr>
<td>RES</td>
<td>Random effects model</td>
</tr>
<tr>
<td>SE</td>
<td>Standard Error</td>
</tr>
<tr>
<td>STR</td>
<td>Statutory tax rate</td>
</tr>
<tr>
<td>WLS</td>
<td>Weighted Least Squares</td>
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</table>
Motivation  Tax rates are important for companies to meet decisions about location of their seat, subsidiaries and place of their production. Corporate taxes have declined since 80s and one of the explanation is mobility of the capital and competition between countries caused by the opening of the markets, easier currency convertibility and decrease in transaction costs because of new technologies and common market within the European Union and other unions such as e.g. NAFTA. Thus empirical literature examining this phenomena emerged, which forms a good background for meta-analysis.

So far meta-analytical literature dealing with corporate taxes was mainly focused on FDI. I will follow paper by Leibrecht and Hochgatterer (2012), who made a survey of empirical literature, yet conducted no meta-analysis, which is proper technique how to summarize empirical literature.

In the thesis I will focus on the decrease of corporate taxes caused by tax competition among countries, where the tax competition is considered to be the uncooperative setting of tax rates by governments aimed on the affecting of the allocation of the mobile tax bases (see Leibrecht and Hochgatterer, 2012, p.616). As changes of tax rates are results of more factors than only tax competition, it is needed to isolate the influence of the tax competition from others as for example changes in the political climate. For separation of the impact of tax competition on the fall of tax rates, various definitions of weighting matrix are used.
I will investigate also publication bias, since I also believe, that this kind of a topic, which is closely related to decisions of policy makers, can have biased results.

Hypotheses

Hypothesis #1: Corporate tax rates indeed fall due to tax competition.

Hypothesis #2: There is a publication bias within literature examining corporate tax competition

Hypothesis #3: Modelling techniques have significant effect on the effect size.

Methodology  The steps to conduct the meta-analysis will be as follows: first I will undertake the literature review with focus on the available literature about the corporate tax competition, the narrative or summarizing studies as well as the ones providing empirical research. From these I will choose empirical studies for my meta-analysis. Primarily I will follow the paper by Leibrecht and Hochgatterer (2012) and I will extend their research by new available literature on this topic using EconLit, Scopus or Google Scholar database. I will use up to date meta-analytical tools, which are used in most recent MRAs (using papers by Stanley and his followers). Specifically mixed effect multi-level model for the MRA and funnel plots and WLS for publication bias detection. Based on so far conducted literature review proposed variables will be: author, date of publication, number of observations, sample size, medium where the article was published and also the variables used for the descriptive study by Leibrecht and Hochgatterer (2012) as the openness of the country, estimation technique, tax rate definition, tax base definition and political system of the country. I will divide the collected studies into the groups with the same characteristics as e.g. similarity of variables or method used and code gathered variables for the regressions. The dependent variable – effect size taken from studies – is measured as elasticity, therefore I will follow methodology as in Havranek and Irsova (2015).

Expected Contribution  Several meta-analysis were conducted in this area of research, yet mainly with focus on relation between corporate taxes and FDIs. This should be the first meta-analysis focusing on topic of corporate tax competition. Leibrecht and Hochgatterer (2012) provide the study summarizing the
literature available on the topic of corporate tax competition and they use descriptive statistics to compare the studies. The aim of the thesis is to extend their research and provide the empirical study. They state that: “in any case, it is extremely difficult to isolate the role that tax competition plays in the drop in corporate tax rates.” However, they assume that tax rates decrease because of tax competition. I believe, that meta-analysis will provide reliable results and as authors propose in the end of the study, the meta-analysis provided in the thesis will help to identify the adequate modelling of important preconditions for tax competition. The aim of this meta-analysis is also to check for the publication bias in the large amount of summarizing studies on this topic.

Outline

1. Introduction to the topic of corporate tax competition
2. Literature overview and summary of key findings of the literature
3. Approaches used for examining tax competition
4. Empirical analysis
   - Model description
   - Description of results
5. Discussion of the results

Core bibliography


Chapter 1

Introduction

There are two things which are affecting the decision of companies in today’s world: taxes and globalization. Benjamin Franklin once said: ”In this world nothing can be said to be certain except death and taxes”. Despite an obligation to pay taxes, the possibility to decide how much and where we are going to pay them exists. This possibility is given by the ever-expanding trend of globalization and internationalization of today’s world. As there is a growing number of trade oriented unions in the world, companies have more and more opportunities to go multinational, to choose where the parent company and its subsidiaries will be seated. Borders within these unions are more and more relaxed which is offering companies a possibility to choose the most lucrative place for their business regarding taxes, customers, costs, etc. Also, thanks to the modern technology and omnipresent electronization, the transaction costs for the firms are lower and lower.

As the tax burden is very important for the business decisions of the companies, countries all over the world are trying to attract investors (companies from foreign countries) by decreasing tax rates or by other tax related incentives. This causes the existence of so called tax competition between countries. Some of them are because of these incentives considered as tax havens. These are countries where no or very low tax obligation is to be held by companies.
Organisation for Economic Co-operation and Development (OECD) considers tax havens countries with:

- Zero or very low tax rates,
- Personal financial data protection
- Lack of transparency

Tax havens are mainly small countries which want to attract companies to start their business in that country, because those small countries do not have any other option to gain money. Some of the tax havens in Europe are e.g. Lichtenstein, Monaco, or Andorra. (Danarionline 2010)

Except the three above mentioned criteria stated by OECD, tax havens bring also other advantages like no inheritance or gift taxes, no audit obligation, low cost bureaucracy requirements, low operating cost, support from local government, discreet banking institutions, flexible legislation and property protection. However, tax havens can also bring some risks. For instance distrust of business partners, negative perception of tax havens by society, small number of banks that accept as clients firms located in tax haven, increased attention of 'domestic' fiscal administration bodies, extra costs incurred in managing and implementing foreign headquarters.

Companies in today’s world do not have to be seated in tax havens. States are competing in offering favourable conditions for foreign investors, which might be in some cases almost as good as in ‘real’ tax havens. Thus, companies are using this opportunity and they optimize their business decisions in order to run their businesses in the most efficient way.

VanDenburgh (2012) explains the problem of tax avoidance (or 'tax optimization' as everything happens in the frames given by laws): more and more multinational companies are investing into the employment of tax consultants which should help them find a way how to reduce corporate tax. However, OECD considers such practices as immoral and harmful and therefore created an action plan, which should help avoid those practices.

The existence of tax competition is affecting business decisions of big multinational corporations as well as political and economic decisions of govern-
ments and, last but not least, it is affecting the life of all ordinary people through the social and economic welfare of their home country. Thus, corporate tax competition is a hot topic in worldwide political and economic debates. Therefore, there are many reasons why it is important to analyse this topic in more detail. Firstly, there are moral reasons: discussions about tax competition accuse large multinational companies of immoral behaviour because they use the existence of tax competition and they are shift their profits into the countries, where they pay low or no taxes. Secondly are social reasons: as companies shift their profits, some countries may benefit from such behaviour, however, there is an empirical evidence that developing countries may suffer a lot from this course of action. Thirdly are also fiscal policy reasons: for policy makers it is important to know which effect does the tax competition have, how big it is and which implication it may have for the domestic tax revenues.

This thesis analyses the topic of corporate tax competition from 2 different points of view. First it summarizes conclusions, findings and results of various political discussions and empirical papers. Secondly it provides a systemic review of available literature in form of meta-analysis and seeks the answer to following research questions:

- Do corporate tax rates fall due to the tax competition?
- Is there a publication bias within literature examining corporate tax competition?
- Do modelling techniques have significant impact on the effect size and what is the true value of effect size?

The thesis is further organized as follows: In the Chapter 2 I am shortly defining important terms of the topic of corporate tax competition. I introduce the measure of tax competition used by Taxfoundation (2015a) and I describe the Action plan which was developed by OECD. The Chapter 2 also summarises the contradicting opinions, critiques and research analysing the OECD Action plan. Further the available meta-analysis investigating the effect of tax competition, is introduced.
The Chapter 3 describes the standard methodology used when conducting meta-analysis and recommended by Stanley et al. (2013). The Chapter 4 introduces the methodology used in primary studies. The Chapter 5 provides an empirical analysis of collected primary studies analysing the impact of the tax rate change in one country on the tax rate in another country. The Chapter 6 concludes.
Chapter 2

Tax competition and corporate tax rate

2.1 Corporate tax

At the beginning of this thesis few definitions should be stated. The first expression which should be defined is corporate tax, because it is the variable of the main interest in this work. As there are various types of taxes and even corporate taxes might be called and understood differently in different countries, it is important to define clearly what our key variable stands for. It is a type of tax which must be paid by a company (corporation) and the amount depends on the generated profit earned during the given taxable period. The tax rate and calculation of the final value of tax obligation depends on the country where the company is located.\(^1\)

2.2 Tax competition in general

Leibrecht & Hochgatterer (2012, p.616) define tax competition as: “any non-cooperative tax setting by governments, under which each government’s policy choices influence the allocation of mobile tax bases among the regions.”

\(^1\)www.investopedia.com
represented by those governments Horizontal tax competition therefore implies a strategic interdependence of government tax policies.”

Due to the fact that governments can independently set their tax rates which provides them a possibility to persuade new firms to start their business in the particular country, tax competition arises. It means that states have the opportunity to compete for investments of already existing companies. Finally the country is able to keep the taxes from the profits earned in one country but shifted to another, for example by using encouraging transfer pricing agreements. (Devereux & Maffini 2007)

Zodrow & Mieszkowski (1986) explain the mechanism of tax competition on the case of property taxes. They assume a model of two countries, which are sharing one internationally mobile tax base and which have interdependent tax policies, hence one state’s revenue is influenced by other country’s tax rate. It means that if A is the country with higher tax rate, country B will reach higher value of revenues because of shifting larger share of mobile tax base to this country. This shifting leads to the decrease of tax rates in both countries to obtain the larger portion of mobile tax base, hence in the equilibrium, tax rates of both countries are lower with tax competition than without tax competition, thus tax-financed public goods is supplied under the optimal level.

The basic model defined above has been extended in several ways. For instance Kanbur & Keen (1993) considers also country size as an important variable. It has been shown that predictions change significantly for countries with different size. When both countries are of equal size, we are talking about ‘symmetric tax competition’ where both countries face the same incentives to decrease taxes and experience equal welfare losses (in the non-cooperative equilibrium), whereas when investigating countries with different sizes (so called ‘Asymmetric tax competition’).

Smaller country is motivated more strongly to decrease tax rates but in the competitive equilibrium it does not have such devastating effect. If the difference in country sizes is sufficient, the tax competition is more advantageous for smaller country than its absence, because as the tax revenues are initially low for the small country it does not reflect such revenue loss from
tax cut in comparison to the revenue gain from foreign tax base of the larger country. This explains, why previously mentioned tax havens are mostly small countries.

Another extension of the basic model is considering domestic constraints. This model suggests, that international tax competition is not the only factor affecting the national tax rate choices, but governments in real world have to respect institutional restrictions (as for instance policy maker’s ideology, budget rigidities etc.) which makes it more difficult to adjust tax systems according to competitive pressure (Hallerberg & Basinger 1998). This assumption is translated into the usage of different control variables in empirical studies as described in the Section 5.1.

### 2.2.1 Starting and stopping the tax competition

Naturally there are factors which can intentionally initiate tax competition as well as the approaches for its stopping. The radical ones include national border’s closures in case of an economic transactions or to harmonize taxes by common international institution which would obtain all the taxing power. Non of these approaches should be used in practice because economic openness and national taxation give the governments some kind of independence and sovereignty. Topic of starting and stopping tax competition is rather the issue of political debates than the matter for empirical analysis as it is merely a theoretical concept, which would be difficult to quantify. It would be necessary to define specifically benefits and costs of tax harmonization, as for example how much time, labour and money would it cost to set up such system, which would fit to all the states in the EU, how would be the implementation made, what would be the attitude towards third countries etc.

Due to the expected costs and fear of losing sovereignty, the EU member states decided not to harmonize all tax systems, and not to give the power to one common European institution. The harmonisation was to some extend made only on the field of value added tax, where closer cooperation among states due to exports and imports is required. However, they decided that
2. Tax competition and corporate tax rate

it is better when the national tax system gives policy makers the power to change or influence the situation in the country.

2.2.2 Drivers of tax competition

From the previous text it is obvious that there are many reasons which caused the existence of tax competition in today’s world. As already mentioned, it is the ever expanding multinationalisation and globalisation, which allows companies to choose the best and most advantageous location for their business. Governments are able and willing to adjust the rules in order to persuade companies to come to their country. In this respect few questions arise: where is the starting point, who decided first to try to compete for investments and why? We can see the clear motivation of small countries to compete for the investments through attractive tax incentives as it is often the only possible way how to earn money, because small countries usually cannot offer rich resources or large amount of workforce.

Genschel & Schwarz (2011) provide an empirical evidence that country size matters a lot. Small countries benefit from cutting the taxes more than lager states. Authors found out, that there is a positive correlation between corporate tax rates and country size, however this relationship does not hold when considering other types of taxes. Authors further state that empirical studies generally agreed that the tax competition is driven by the corporate tax cuts, because it is the most visible way how to attract foreign investors.

Even though the tax competition can bring comparative advantage to some countries (mainly to small ones as discussed previously), for many states it can be very harmful. Countries are offering public goods as for instance the social and security system, legal background, qualified and educated workers, infrastructure, institutional background and much more, however they receive almost no taxes from the companies who widely use these goods, because they tax their profits in another country. That is why they started to work on tools which could restrict the possibilities of tax arbitrage.

At the beginning of financial crisis in 2008 almost all core OECD countries adopted transfer pricing regulations (transfer pricing generally deals with
setting prices between related parties; in order to set them similarly as the market prices would be set. It means for example: when parent company is lending money to its subsidiary, some rules have to be followed to avoid illegal profit shifting from high tax countries to low tax countries). Intuitively from above mentioned we can conclude that large states are more willing to adopt anti-avoidance legislation than small countries.

Genschel & Schwarz (2011) expect two scenarios of future development driven by the domestic constraints: firstly they expect slowdown of the capital and corporate tax competition (which partly are the result of the financial crisis. They assume that recent corporate and capital income tax rates are already at so low level that their further reduction would not be easy. Secondly authors expect increase in international tax cooperation. As large economies such as China, India and Brazil have also decided to support the tax cooperation proposed by OECD, small countries and tax havens are forced to join this quest as well. Authors presume that rise of tax cooperation will mostly mean reduction of corporate tax arbitrage in the sense of profit shifting and thereby it will cause increase of competitive pressure on FDI, hence companies will move their production.

### 2.3 International tax competitiveness index

Taxes form an important decision-making factor when answering the questions if and where to start business and which types of operations will be made. Because of opportunity to choose the location, it is no more possible to indefinitely rise tax rates. Countries have to and tend to increase their competitiveness by various means. Nevertheless there are countries which do not follow this scheme, for instance United States, Italy or France who have the highest corporate tax rates from 34 OECD countries. According to Taxfoundation (2015a)\(^2\) United States did the last big tax reform 29 years ago.

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\(^2\)Tax foundation was found in 1937 as an independent research organization on tax policy issues. It is a non-profit organization which does not receive or apply for any financial support from government. The revenue consists of support from philanthropic foundations, business contributions, donations from individuals and events revenues. Thus statistics and analyses provided by foundation are not influenced by interests of governments, however it is important to take into account that published research may reflect
ago in 1988 when the corporate income tax rate was reduced from 46% to 34% (OECD decreased the corporate income tax rate from 47.5% in 1980’s to recent 25%), but then increased again to 35% in 1993. On the other hand New Zealand tries hard to improve its competitiveness. Its government cuts the individual income tax rate from 38% to 33%, and its corporate tax rate from 30% to 28% in 2011, they have no inheritance tax, no general capital gains tax (but they have tax on gains from foreign debt and equity investment) and no payroll taxes.

Corporate income tax rate is an important indicator of economic growth. Other determinants of competitive tax code are e.g. its structure, property taxes, income taxes and tax rules for foreign earnings. (Taxfoundation 2015a)

Tax foundation provides every year the ranking of OECD countries based on International Tax Competitiveness Index (ITCI). This index measures competitiveness of national tax systems. The analysis includes 40 tax policy variables such as corporate income taxes, property taxes and treatment of foreign earnings. Variables are divided into 5 categories. The statistics contains data about 34 OECD countries. The Ranking for 2015 is shown in the Table 2.1 below.

2.4 Tax competition and BEPS

Base Erosion and Profit Shifting is the term which refers to the effect when multinational companies, thanks to the worldwide globalization, integration of markets, establishments of trade unions with free movement of capital and internationalization, try to “optimize their corporate tax obligations using various mechanisms. OECD defines the BEPS like “shift of profits across borders to take advantage of tax rates that are lower than in the country where the profit is made. Three popular mechanisms used are hybrid mismatches, special purpose entities (SPE), and transfer pricing.” OECD (2015)

Hence, firms which are worth billions of dollars invest into the optimization and they pay low or almost no taxes in the country where they have made interests of the corporations who provide funding. (Taxfoundation 2015b; taxfoundation 2015c)
### Table 2.1: 2015 International Tax Competitiveness Index Rankings

<table>
<thead>
<tr>
<th>Country</th>
<th>Score</th>
<th>Rank</th>
<th>Corp. Rank</th>
<th>Con. Rank</th>
<th>Prop. Rank</th>
<th>Ind. Rank</th>
<th>Int. Rank</th>
</tr>
</thead>
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<tr>
<td>Estonia</td>
<td>100</td>
<td>1</td>
<td>1</td>
<td>9</td>
<td>1</td>
<td>2</td>
<td>17</td>
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<tr>
<td>New Zealand</td>
<td>91.8</td>
<td>2</td>
<td>21</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td>16</td>
</tr>
<tr>
<td>Switzerland</td>
<td>84.9</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>32</td>
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<tr>
<td>Sweden</td>
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<td>4</td>
<td>6</td>
<td>11</td>
<td>6</td>
<td>21</td>
<td>5</td>
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<tr>
<td>Netherlands</td>
<td>82</td>
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<td>16</td>
<td>12</td>
<td>23</td>
<td>6</td>
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<tr>
<td>Luxembourg</td>
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<td>29</td>
<td>5</td>
<td>17</td>
<td>13</td>
<td>4</td>
</tr>
<tr>
<td>Australia</td>
<td>78.3</td>
<td>7</td>
<td>25</td>
<td>8</td>
<td>4</td>
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<td>18</td>
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<tr>
<td>Slovak Republic</td>
<td>76</td>
<td>8</td>
<td>17</td>
<td>32</td>
<td>2</td>
<td>7</td>
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<tr>
<td>Turkey</td>
<td>75.5</td>
<td>9</td>
<td>8</td>
<td>25</td>
<td>7</td>
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<td>15</td>
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<tr>
<td>Ireland</td>
<td>71.6</td>
<td>10</td>
<td>2</td>
<td>24</td>
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<td>22</td>
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</tr>
<tr>
<td>United Kingdom</td>
<td>71.5</td>
<td>11</td>
<td>14</td>
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<td>15</td>
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<td>25</td>
<td>5</td>
<td>31</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>69.9</td>
<td>14</td>
<td>7</td>
<td>31</td>
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<tr>
<td>Finland</td>
<td>69.8</td>
<td>15</td>
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<td>Austria</td>
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Source: Taxfoundation (2015a)
their profit. However all the practices they are doing are absolutely legal, they are not defrauding the system, they are only using the gaps in the system, inadequate domestic laws and poor control of foreign companies and the digital economy allow them to use all these practices.

OECD and G20 countries agreed that they were not prepared for such a scenario and did not start to set up any measures, but nowadays OECD and G20 sees in the BEPS a problem and states that this behaviour is immoral, and so it has to be solved. Mainly after the global financial crisis, countries started to notice that some steps have to be made. When Organization for Economic Co-operation and Development came with the Action plan, most of the biggest and influential countries joined this quest. The plan consists of 15 internal and external recommendations to be implemented by national governments in order to avoid the widespread tax evasion or significant reduction of tax obligation using international tax planning by multinational companies. (OECD 2013)

Generally the plan tries to standardize the rules around the world, because otherwise it would not have the desired effect in today’s global world. The plan puts the emphasis on prevention of misuse of agreements on avoidance of double taxation. Specifically the plan wants to avoid double non-taxation.

The most controversial point is number 12, which requires that taxpayers have to disclose their aggressive tax planning arrangements. Specific rules for disclosure have to be set up by individual governments. Also according to point 13 concerning transfer prices, companies should provide to the governments information related to worldwide profit, economic activities and paid taxes in other member states. This should mainly control transfers of profits and intangible assets between connected parties.

Other points focus on deepening of transparency, coherence and substance. Transparency relates to the implementation of agreements on international automatic exchange of information.

Agreement, whose purpose is to prevent tax evasion, legalization of revenues from criminal activities and financing of terrorism, was already signed by more than 50 states over the world (OECD, non-OECD and G20 countries including Cayman Islands, The British Virgin Islands and Switzerland).
Switzerland herewith loses its image of traditional bank jurisdiction. Some countries, such as United Arab Emirates, Singapore or Hong Kong, though refused to join the agreement.\textsuperscript{13}(Danarionline 2015)

Agreement is designed following the already existing agreement "FATCA" (Foreign Account Tax Compliance Act), which is treaty about improvement of international tax compliance. It is a contract between the U.S. and other countries. In the Czech Republic the General Directorate of Finance cooperates with American Internal Revenue Service.

In states who signed the treaty every bank and financial institution have to provide information about the accounts of its non-residents to the Tax Office in the state of the owner’s residence.

At the same principal works new "GATCA" (Global Account Tax Compliance Act) Agreement, which was designed because in nowadays global world broader cooperation is needed. In the Czech Republic Central register of bank accounts will be created. It will be the complex database of all bank accounts.

Banks and financial institutions will provide information about the bank but also about asset accounts, which have balance of more than 250 000 USD. They will provide account number, information about its owner and deposited and transferred finance. The first automatic information exchange should occur in 2017. The Global Account Tax Compliance Act (GATCA) was not signed by Seychelles Islands, Belize, Marshal Islands, Panama and Hong Kong.\textsuperscript{13}(Danarionline 2015; MFCR 2015)

With international automatic exchange of information are related many threats as for instance possible incompatibility with the EU law or national laws, increase of administrative cost, increase of bureaucracy, time-consumption, possibility of discrimination, limiting the optimal allocation of resources, economically inefficient use of rules.

The study by Dharmapala (2014) surveys the empirical literature on tax-motivated shifting of profits within multinational corporations. It tries to identify the role of the government and potential role of OECD initiative. The paper investigates the magnitude of BEPS (base erosion and profit
shifting) and its aim is to create a framework, to find a general concept of this magnitude and its implications for policy. It stresses out the importance of establishment of legal and economic frictions in order to prevent on BEPS. The estimates of tax sensitivities (BEPS magnitudes) found by authors are three times smaller than in the previously conducted studies.

Dharmapala (2014) focuses on five topics relating to BEPS which are discussed in recent policy debates and academic discourse:

- Relative magnitude of profit shifting from parents to foreign affiliates as opposed to profit shifting among foreign affiliates
- The role of intellectual property and intangible assets in BEPS and how income interacts with location of real economic activity across jurisdictions
- Impact on income shifting of the existence of territorial versus worldwide tax systems in the residence country of the parent
- Has profit shifting increased in recent years?
- Consequence of income shifting for tax revenue

The study provides comparison of widespread descriptive studies about the fraction of net income reported by Multinational Corporation (MNC)’s in tax heavens with magnitude of BEPS. Other analyses found out that the magnitude of BEPS of profit shifting in the case parent-to-foreign is significantly lower than by any other type of profit shifting. Dischinger et al. (2014) were investigating if there is any difference between the profit shifting from parent to the low-tax affiliate and to the high –tax affiliate. They found out, that the semi-elasticity by shifting to low-tax affiliate is 0.5, hence if the tax incentive to shift income from parent to its affiliate rises by a 10 percentage points it causes a 5% rise in the income which the affiliate reports. However by profit shifting to the high-tax affiliate the magnitude is much larger. This asymmetry leads to an assumption that agency costs, repatriation tax could discourage the firm to shift income away from parent company. (Dharmapala 2014)
Janský & Prats (2015) investigate the relationship between tax evasion, tax avoidance by MNC’s and tax havens. They study the case of India and provide conclusion that existence of tax havens causes to the government high revenue losses which could be otherwise invested into a human development. However, in my opinion, the possibility of income shifting to tax havens highly influences the decision of corporations to make business in some country, hence it invests into the human capital as well and it also helps to fairer redistribution of income than what would the government do.

Crivelli et al. (2015) in the paper analyse Base erosion and profit shifting from another point of view. They focus on the impact on developing countries, because while for advanced countries there are many empirical papers discussing this topics, there is no evidence on developing countries. They study the fact, that increasing awareness about tax competition may cause that countries will try to make its tax system attractive, which can be harmful and lead to loss of revenues. They use panel data from 173 countries over 33 years and they put attention on two distinct types of cross-border fiscal spillovers: “base” and “strategic” spillovers. They found out that so called BEPS and international tax competition indeed matter for developing countries and sometimes even more than for advanced countries.

Although BEPS is a hot topic in recent political debates, it seems that there is a publication bias in the available literature, which is all written in favor of the Action Plan introduced by OECD. Except the report by Davidson (2014) and paper by Hong & Smart (2010) I did not find any other constructive critique.

Davidson (2014) has published the report in which he criticizes the Action plan by OECD and describes the problem from the opposite point of view. First he describes the reason, why governments actually started to work on the action plan. He states that the cause was: “the public outrage over the low corporate taxes paid” by big multinational corporations such as Apple, Google or Starbucks. These companies do not pay as much as governments are expecting, however they pay exactly the minimal possible amount required by law. Davidson points out the ignored fact, that even though those companies are trying to optimize their tax obligations, they still bring to the state other “benefits”. These companies engage in the job market by
creating jobs, provide investments, furthermore they play important role in the innovation process of economy, they are producers of goods and services and the indeed pay taxes. Next to payments of corporate income taxes, they pay payroll taxes, local rates and other fees. Possibility to optimize the tax obligation may be sometimes the only reason why companies even start the business in highly taxed countries, but these companies have to spend big amounts of money on financing specialists and experts to plan taxes optimally, thus they give job to lawyer and tax advisers who pay income taxes.

In the report he also mentions the definition of tax competition that says: “Tax competition is the use by governments of low effective tax rates to attract capital and business activity to their country”. This means that favourable tax conditions in the country could attract investors and help to improve the economic situation, nevertheless government began to fear that tax competition may actually reduce their ability to raise tax revenues when needed. Author mentions also the possibility that the decline in corporate tax income might be caused by general decrease of corporate revenues after the financial crisis rather than by tax competition. (Davidson 2014)

Hong & Smart (2010) in the article investigate implications of multinationalisation of corporate investment in recent world and thus increasing number of international tax avoidance arrangements. They study the recently discussed issue that the increased mobility of capital leads to erosion of corporate tax bases and profit shifting to low-tax countries, hence countries are losing their revenues and have to reduce tax rates in order to attract investors and receive the same amount of taxes as they would receive without the capital mobility. However authors came with different, new results: contrary to other studies and political debates. Authors emphasize that also Desai & Dharmapala (2006) have shown that US multinational corporations that have an affiliate in tax haven tend to invest more in neighbouring non-haven countries.

However, Genschel & Schwarz (2011) state in their paper that in comparison to capital income taxation, there is no major enforcement problem with the corporate tax collection as multinational companies operate under strict accounting requirements and control. Study provides an evidence that there is a significant pressure towards source-based taxation caused firstly
by credit limitations. It means that the country where the company has its residence, usually allow the tax credit only till the level of the domestic tax rate and foreign incomes are taxed later as they have to be actually repatriated first. This could cause significant tax advantage for parent companies in high-tax countries which have subsidiaries in low-tax countries. In the paper two possibilities of tax arbitrage are discussed. The first option involves shift of profit generating activities to low-tax countries, the second strategy includes “transfer pricing, thin capitalization and other ‘tax planning’ techniques for allocating deductible expenses to subsidiaries in high-tax and taxable profit to affiliates in low-tax countries.”

Although these tax arbitrage possibilities are considered to be harmful and there are generally attempts to avoid such tax planning by controlling for corporate tax competition institutionally, Hong & Smart (2010) found out that tax competition and associated tax planning can even increase the wealth of citizens in high-tax countries.

They suggest that according to their model, governments should not try to find the way how to prevent the international tax planning, because investment-enhancing effect of international tax planning may offset the revenue-erosion effect. Their results suggest that profit shifting to tax havens may on one hand reduce revenues, on the other hand firms are less sensitive to tax rate differential when they are deciding about the location of their real estate investment. They say that harmonization of taxes and elimination of tax planning would be a failure for governments. Because the possibility of profit shifting to low-tax countries or to tax havens may be decisive for the firms when considering the investment and benefits from this investment (firms who can plan create jobs, bring know how and technologies and also pay payroll taxes, property taxes etc.) may significantly outweigh losses. (Hong & Smart 2010)
2. Tax competition and corporate tax rate

2.5 The impact of company taxes on the allocation of FDI

During last decades corporate tax rates have decreased significantly inside and also outside Europe. Generally it is believed, that increasing globalisation makes it possible to compete through the company tax rate decline for the investment inflow, thus the decrease of corporate tax rates is caused by the attempts of governments to attract foreign investors. As it is an important economic and political issue, there is an extensive empirical research analysing the effect of corporate tax rate on the investment decisions of companies.

Literature survey by Hines Jr (1999) and Hines Jr (1996) provides an evidence that investment decisions and other activities of multinational corporations are quite sensitive to the corporate tax rates. Griffith et al. (2003) also provide a literature survey, which concludes that the corporate tax rate does have significant impact on the investment decision of businesses.

Empirical literature on the corporate tax arbitrage analysing tax-sensitivity of FDI assumes the sensitivity to be low because there are other important factors for decision making of multinational companies, like education-level of labour force, quality of public infrastructure, availability of new technology, stability of social and political environment etc. However De Mooij & Ederveen (2003) state that the mean value of the tax rate elasticity in the available literature is -3.3, i.e. that decrease of the host-country tax rate by one percentage points increases the FDI in that country by 3.3%, which is not that insignificant effect. Additionally, literature survey by Genschel & Schwarz (2011) also investigates other empirical literature, nevertheless it concentrates on profit shifting and they came to the conclusion that income shifting exhibited even more responsiveness to corporate taxation than FDI.

Available literature surveys provide only the comparison of available research, evaluation of provided evidence and discuss its implication. However as there is a great heterogeneity in the studies included into those literature surveys: studies use various measures of capital, some use data on FDI some of them data on property, plant and equipment as a measure of investment.
Also they use different measures of tax rates, some of them use statutory tax rate, some of them use effective tax rates. Also the calculation of effective tax rates differs across studies. Some of them use cross-sectional data, some of them use panel data and some even the time series data. And also the investigated effect is defined differently among the studies included into those narrative surveys. Thus it makes it difficult and nearly impossible to interpret those results together in one study.

In order to make those heterogenous findings comparable and to identify the true effect, De Mooij & Ederveen (2003) conducted a meta-analysis investigating the effect of company taxes on the allocation of FDI. They collected 25 studies which used uniform definition of the tax rate elasticity. In their meta-analysis they tried to explain variation among findings of primary studies. They found significant difference in the type of the capital data used. Their results also found evidence that the tax rate type matters, it means that when using the measure of effective tax rate, the estimated elasticity will be higher.

De Mooij & Ederveen (2008) extended few years later the previous meta-analysis by adding 6 new primary studies. This meta-analysis as well as the previous one, tries to identify study characteristics that significantly affect elasticity values. They confirmed the previous conclusion that capital data matter for the magnitude of the estimated elasticity, i.e. the amount of capital invested is affected more by the change in the tax rates than the decision about the location. They also confirmed another finding that there is a difference between studies analysing statutory tax rates and studies which incorporate the effective tax rates. However their results did not find any evidence that using either credit or exemption countries makes a significant difference in the effect size. Thus even when extending the meta-sample, their results remained unchanged. They reported the effect of the effective tax rate decline on the investment to be -0.4.

Feld & Heckemeyer (2011) extend the previous meta-analysis by extending the existing meta-sample to final data set consisting of 45 studies, application of different methodology or by coding new variables as for instance adding variables related to the model specification. They found out that the semi-elasticity for company taxes on FDI is 1.68, thus 1 point cut of corporate tax
increases FDI inflow by 1.68% and they also find out that European countries are more tax sensitive than the rest of the world. Ruding report (1992) also discovered higher sensitivity of investment in financial service operation to taxation than in other types of investment.

2.6 Corporate tax competition

Wide range of literature analysing corporate tax competition from all possible angles exists. This literature analyses the mechanism of corporate tax competition, differences between corporate tax competition and tax competition relating to other tax types. The literature examines, whether tax competition is really the impulse for profit shifting or if there are also other factors in play and what factors it might be. It defines the possible drivers of corporate tax competition and examines their empirical effect and its political and economic impact. One of the objectives of this type of empirical and narrative reviews is to model possible future development of tax competition, identify its main drivers and find ways how to influence tax competition and benefit from it.

Genschel & Schwarz (2011) discuss two problems of basic models concerning tax competition and cooperation. They emphasize that the model does not take into account multiple ways how to cut tax and models does not clearly show which way is going to be used. The second problem is that governments have the power to change rules for the tax competition, for example to restrict tax arbitrage.

Leibrecht & Hochgatterer (2012) also summarize findings from available literature about the corporate tax competition. Authors focus on the fact that corporate tax rates have significantly declined since 1980s in most industrialized countries and they want to find out whether or not is the increasing tax competition the trigger of this effect as this decline may be caused by other economic, institutional or political reasons (other than tax competition). Summary of the existing research it provides an evidence that tax rates indeed decline due to tax competition between countries. In contrast to Genschel & Schwarz (2011), this study does not only want to find other
factors causing the decline of corporate tax rate but tries to isolate the influence of the tax competition.

Leibrecht & Hochgatterer (2012) follow classification by Griffith & Klemm (2005) and investigate two categories of empirical studies: direct and indirect. Indirect studies do not explicitly analyse presence of tax competition but are trying to find the prerequisite for tax competition (they are investigating sensitivity of various types of capital). On the other hand, direct studies allow involvement of tax rates with their most important determinants in the empirical model. Direct as well as indirect studies provide an evidence of the fact that tax competition for profits is a driver of falling tax rates.

2.7 Development of corporate tax rates in time

Figure 2.1 shows the development of corporate income tax rates in the years 1981 till 2016. The time span begins with the year 1981 as it was the oldest data available in the OECD database and ends with the youngest available data in order to see the development of corporate income tax rate until present.

Due to clear visibility of the data, I did not include development of Corporate income tax rate (CITR) in all years during specified time period (table with complete dataset is available in Appendix), nevertheless I decided to include two important milestones: first, year 1993 – the foundation of independent Czech Republic and second, year 2009 as the year of the beginning of financial crisis. I included into the graph European countries and also few big and important economic players as Australia, Canada, Mexico, New Zealand, Japan and United States as they are also part of the analysis in primary studies of my meta-analysis.

From the graph we can clearly observe that corporate income tax rates had decreased significantly during last few decades. In 1981 the average corporate tax rate was around 43%, whereas in some states it was even over
50% – for instance in Austria – 55%, Germany – 56% or United Kingdom – 52%. Already in 1993 (i.e. 13 years later) the average CITR was 10 percentage points lower than in 1981. During those depicted 36 years the average corporate tax rate dropped by staggering 20 percentage points. It is commonly believed that this rapid decline is caused by an expanding process of corporate tax competition among countries, i.e. increasing efforts to attract inward flows of capital investment by reducing statutory corporate tax rates.
Figure 2.1: Development of corporate tax rates in 1981–2016
Chapter 3

Methodology of the meta-analysis

This chapter briefly introduces meta-analysis in general. It describes the reason, why the meta-analysis is conducted, its benefits and weaknesses. After this introduction into the meta-analysis, standard approach for conducting Meta-regression analysis (MRA) is defined. When describing the process of conducting the MRA, I followed standard methodology used by Stanley & Doucouliagos (2012); Polák (2011) and Havranek & Irsova (2015); Havranek et al. (2012)

3.1 What is meta-analysis

Nowadays we are experiencing huge boom in economic research. A lot of new surveys are made, new topics are investigated and various new methods were invented in last few decades. As the amount of new research is published and each topic is analysed from all the possible angles, researchers come to many different results. These results vary in terms of the effect sizes and precision, but one is more interested in some sort of general conclusion and summary. Therefore the need of objective assessment for identification of correct effect size arises.
Analysis of individual papers available on specific topic might supply distinct results due to usage of different time-spans, variety of samples, diverse controls etc. We may find out that effect size may depend on various factors. When summarizing results from available studies, one possibility is to make a narrative review in order to provide context, however narrative reviews are based on interpretation of p-values and forget on confidence intervals. Next to it, narrative reviews are subjective as only selected characteristics of studies are evaluated. When a narrative summary makes a conclusion about some effect, studies are usually put at equal level and it is merely counting votes (significant vs. not-significant or positive vs. negative results). As the number of empirical studies emerges, more rigorous approach is necessary to derive robust conclusions.

Meta-analysis is a useful tool which focuses on the interpretation of effect sizes rather than p-values, thus it allows us to summarize empirical results more objectively.

Meta-analysis provides context and makes it possible to compare subgroups. Individual studies look at one particular sample in one specific time period, however, when looking at higher amount of studies, we get more robust idea about the effect size. The result might show that the effect depends on many other factors, which have to be explained. It is also possible to divide the whole sample into two or more sub-samples, as in this thesis into the sub-sample for statutory tax rate and for effective tax rate. Sub-sampling can be also applied on different time spans, various regions etc. This is possible only in meta-analysis, because primary studies have too little variants.

Meta-analysis helps to summarize all available “knowledge” on one topic and get one interpretation of the true effect. As in the story about the elephant and blind men, in which blind men touched an elephant in order to get the idea, how the elephant looks like. However, each man touched only one part of an elephant. Then they compared notes to find out, how the whole animal looks like, but they came to complete disagreement. It shows that while one subjective experience might be true, it might not be the totality truth. Meta-analysis collects all the available pieces of knowledge and from them builds the whole picture.
Despite its many advantages, MRA is not absolutely perfect and of course it has its weaknesses, which are mostly dependent on the human factor and amount of information that is possible to gather from primary studies. The main goal of any MRA is to find the most objective and genuine information about the previously analysed effect, finding or policy intervention. Nevertheless the objectivity degree of any MRA is influenced by the experience of meta-analyst and by the choice of explanatory variables for modelling heterogeneity, quality of included papers, method of primary studies selection and last but not least by the time available for processing MRA, possible ways of obtaining primary studies, language skills of the MRA’s author etc.

Before commencement of the whole meta-analytical process, the effect investigated in our meta-analysis needs to be specified. In the field of tax competition there is wide range of literature analysing various effects available: effect of the country specific tax structure and international tax harmonisation on the tax competition (Razin & Sadka 1991); effects of population differences, i.e. the jurisdiction’s size differences on the tax rate equilibrium (Bucovetsky 1991); effect of the tax rate on the public spending (Keen & Marchand 1997); effect of taxation on FDI (Feld & Heckemeyer 2011) etc.

Once desired effect is specified, we need to examine the method of its analysis. For the purposes of meta-analysis the papers analysing chosen effects should ideally use the same model for effect estimation. Moreover, primary papers are required to use identical definition of an effect, i.e. the effect has to be measured in absolute value, percentages etc. in order to be able to interpret the effect from all collected studies in the same way and compare them. In case the literature available is not consistent in terms of modelling and estimating the effect, Doucouliagos & Laroche (2003) suggest using the partial correlation coefficients (PCC) as there are unitless measures of the relation between two variables, when other variables stay constant. Partial correlation coefficients (PCC) can be also computed for a larger set of studies. Use of PCC’s might decrease the informational value of meta-analysis due to its non-normal distribution for values close to −1 and 1, nevertheless it is the only way how to compare incomparable.
3. Methodology of the meta-analysis

3.2 How to conduct a meta-analysis

Any meta-analysis is carried out with the intention to investigate two main issues: first, to examine the existence of publication bias, i.e. to test whether the result is affected by any subjective selection or intention of the author of primary study. Second issue is to explain the heterogeneity, i.e. to clarify the differences among studies and to describe factors which affect the direction and magnitude of investigated empirical finding.

Testing for publication bias is done firstly by simple plotting of the data, which helps us to get the first basic idea about the dataset. There are several ways how to illustrate data in meta-analysis including Galbraith plot, forest plot or funnel plot. For more empirical assessment of the presence of publication bias and for verification of the actual effect size funnel asymmetry test and precision effect test are used. Explaining heterogeneity is done by constructing various MRA-models using different sets of explanatory variables and testing for the robustness of those models. These methods are described in more detail further in this chapter.

3.2.1 Funnel plot

Funnel plot is the scatter plot formed by all the collected effect estimates. It has the estimated effect size on the horizontal axis and on the vertical axis there is a precision of the effect (i.e. the inverse value of the estimates’ standard errors, 1/se). It is an useful tool used for visualization of the collected data, identification of possible outliers or typing errors, identification of heterogeneity and last but not least for identification of publication bias that will be discussed further in more detail.

Funnel plot is considered to be the most useful graph for plotting the collected data (see e.g. Stanley & Doucouliagos (2010); Havranek & Irsova (2015)). The name of this plot comes from its appearance as an inverted funnel (in ideal case). Figure 3.1 depicts the expected funnel plot shape. It is the shape, which we should get when analysing unbiased research findings as in the optimal case estimates are randomly and symmetrically distributed
around the real effect size. Thus any deviation from this shape should be re-checked and verified.

**Figure 3.1:** Symmetric funnel plot showing effect estimates without publication bias

![Symmetric funnel plot](image)


Mostly, though, we do not get the expected funnel shape. Figure 3.2, which shows the reported common currency elasticities, is more common funnel plot shape. We can clearly see the asymmetry of the funnel (missing estimates on the left side of the funnel), which is caused by the reporting only preferred results and dropping out those, which did not fulfil author’s expectations, because of his believe that they are wrong or not desired.

Looking at the funnel serves only for the visual check. Thus using the funnel plot we can formulate first data evaluation, i.e. we can use it for detection of errors and outliers in our data, however more exact methods should be employed.
3. Methodology of the meta-analysis

3.2.2 Publication bias

As in the story of an elephant and bind men, many authors publish their findings to the best of their knowledge and belief that the effect is true, however they might have seen only one part of an elephant. Each study might be biased from various reasons. Meta-analysis tries to identify this bias and find the unbiased assessment of the underlying analysed empirical question.

Publication of biased results may be caused by having only limited/specific data sample, however it may be caused also by other factors. Authors are motivated to publish as many research papers as possible, which pushes them to produce papers which will be most probably accepted by reviewers, cited by other researchers or which will be in accordance with generally accepted economic theory. Publication selectivity is also called the file-drawer problem as the publication selectivity is a process when only significant and generally accepted results are published. Throwing away insignificant results, which

Figure 3.2: Asymmetric funnel plot showing effect estimates with positive publication bias

are however statistically probable, leads to the overvalued estimates and more significant and larger effects. Nevertheless, as publication selection mostly arises from “unintended consequence from good intention” to publish the correct results, the publication bias is a problem of the majority of the empirical research and basically cannot be avoided. However, it is important to be aware of this problem and its distortion effects in literature should be corrected (Stanley & Doucouliagos 2012).

Two types of publication selectivity might be present in the literature: the first type (type I) is defined as searching for results which are in accordance with the theory. It means that researcher is searching for the results with the correct sign, which correspond to his previously defined theory or which confirm his hypothesis and the rest of results ends up in his file drawer. For instance when the researcher expects that companies are more willing to invest to the countries with low tax rate, i.e. the lower the tax rate of the country, the higher the FDI flow into the country, he is not willing to report estimates with the opposite sign, which do not confirm this theory. However when statistically testing, those results are also probable to occur. When they are not reported, the true effect size might be overstated.

The type II publication selectivity is defined as looking for the statistical significance. It means that statistically insignificant and inaccurate results are not reported, thus the final funnel plot is going to be hollow. Presence of the publication selectivity is tested by looking at the dependence between estimates and their variance, ceteris paribus (Polák 2011) as described further in more details.

3.2.3 Empirical testing of publication bias

Funnel plot is a useful tool for assessment of publication selectivity, nevertheless formal and more precise statistical methods for testing the presence of publication bias have to be employed. In case when some estimates are not published due to their insignificance or sign, reported estimates will be correlated with their standard errors (Havranek et al. 2012).

This dependency is in general tested by estimating the Equation 3.1, which
is the model where the explained variable $b_i$ is the estimated effect size, $\beta_0$ measures the effect corrected for the publication bias and $\beta_1$ measures the publication bias. (Ashenfelter et al. 1999; Stanley & Doucouliagos 2012; Polák 2011)

$$b_i = \beta_0 + \beta_1 SE_i + u_i$$

(3.1)

This method of examination is called funnel asymmetry test and it describes the symmetry of estimates’ distribution around the true effect.

Testing the $H_0 : \beta_1 = 0$ provides the evidence whether or not the publication bias is present. Nevertheless due to the use of various datasets, control variables or different sample sizes, the regression 3.1 is likely to be heteroskedastic. As Stanley & Doucouliagos (2012) suggest in their book, in order not to lose the efficiency, weighted least squares estimation should be used. It is done by using the variance rather than the standard error, i.e. the Equation 3.1 is divided by its standard error and then estimated by Ordinary Least Squares (OLS).

$$t_i = \frac{b_i}{SE_i} = \frac{\beta_0 1}{SE_i} + \beta_1 + e_i$$

(3.2)

The inverted value of standard error stands for the precision of the effect, hence testing $H_0 : \beta_0 = 0$ assesses whether or not there is genuine empirical effect present even if the results are biased due to publication selectivity. This method is called Precision-effect testing.

Funnel asymmetry test (FAT) examines formally the presence of publication bias, i.e. whether the estimates are symmetrically distributed in the funnel plot, however it has its weaknesses. Its low power when estimated by OLS is caused by the fact, that the error is estimated in the primary study, hence in the FAT this error is estimated with error. As Stanley (2005) suggests, to solve this issue, we can use Instrumental variable (IV) in the form of sample size or degrees of freedom, which will be highly correlated with the standard error, however exogenous in the model. FAT using IV is called Funnel asymmetry instrumental variable estimator (FAIVE) (or Funnel-asymmetry-
3. Methodology of the meta-analysis

hetroskedasticity-robust-instrumental variables estimator (FAIVEHR) when using methods consistent with heteroscedasticity).

In case we reject the \( H_0 : \beta_0 = 0 \), the Precision-effect estimate with standard errors (PEESE) should be employed. PEESE provides a better estimate of the genuine effect in case when there is some evidence that one exists. However important limitations of this test have to be mentioned – when dealing with strong publication bias or strong heterogeneity, PEESE’s statistical power and reliability is rapidly reduced. When conducting meta-analysis on the sample composed from only small studies, PEESE has almost no power to find the true effect. (Moreno et al. 2009; Stanley 2016)

When conducting a meta-analysis Stanley & Doucouliagos (2012) provide a decision schema (see Figure 3.3 below) with the steps to be conducted according to the results of the FAT/PET. When we reject the null hypothesis of the Precision Effect Test (PET), thus we find the evidence for the underlying genuine effect, we should proceed to the PEESE, otherwise we failed to provide an evidence for existence of an effect. In that case we should continue with explaining the causes of publication bias which has caused the ’illusion’ of the existence of the effect.

**Figure 3.3:** Decision diagram for investigating and correcting the publication bias

```
1: Conduct FAT; \( H_0: \beta_1 = 0 \) in
\[ t_i = \beta_1 + \beta_0 \left( \frac{1}{SE_i} \right) + v_i \]

2: Conduct PET; \( H_0: \beta_0 = 0 \) in
\[ t_i = \beta_1 + \beta_0 \left( \frac{1}{SE_i} \right) + v_i \]

Accept \( H_0 \)

Reject \( H_0 \)

4: We fail to find sufficient evidence of an empirical effect

3: Estimate \( \beta_0 \) using PEESE:
\[ t_i = \beta_1 SE_i + \beta_0 \left( \frac{1}{SE_i} \right) + v_i \]
```

3. Methodology of the meta-analysis

3.2.4 Explaining heterogeneity

Primary studies included into the meta-analytical sample use different methods of estimation, different datasets, different controls used or e.g. different time-spans and therefore between-study heterogeneity is a serious issue to be looked at in any meta-analytical model.

Conventionally, methods for testing the homogeneity are employed. There are few methods used for the homogeneity testing as for instance: Analysis of Variance (ANOVA) model or F-test (Dalhuisen et al. 2001). The most common method is calculation of the Cochran’s Q-test. (Thoma 2012/2013). The Q-test is based on the calculation of the ratio of the variance among studies and variance inside studies. (Polák 2011)

\[
Q = \sum_{i=1}^{L} \frac{(b_i - \bar{b})^2}{v_i}
\]  

(3.3)

However, there is a simpler form of the Q-test, which is given by the sum of squared errors coming from the meta-regression analysis, which is run with t-values on precision and with no intercept and is distributed as a chi-squared with L-1 degrees of freedom. (Stanley & Doucouliagos 2012)

Although testing for homogeneity is common econometric approach, as Stanley & Doucouliagos (2012) state in their book: based on the meta-analytical experience, in spite of his low power, Q-test always indicates heterogeneity. Even in the case, when Q-test does not indicate heterogeneity, it is highly probable that the heterogeneity is present, however Q-test only failed to find it. Thus, results have to be confirmed by running multiple regressions to explain potential heterogeneity.

Explaining variation of results is one of the basic goals of meta-analysis. Explaining of this heterogeneity is done based on diverse characteristics of individual primary studies and control variables used in those studies. Generally there are two types of heterogeneity: factual and methodological. The factual one is based on differences caused by use of different controls (and omission of some of them), time period, country or region. Methodological type is based on the usage of different model specification, estimation
method etc. (Christensen 2003) For instance when analysing tax rates, the methods for the measurement and archiving information about tax rates might be obsolete, inefficient, wrong or we might not even find the data for some years or countries. For example effective tax rate might be determined using different methodologies, which make the results incomparable, effects might be different for different data samples – e.g. developing countries will have low tax rates regardless on the tax competition as when the tax rates were higher, taxes would not be paid at all.

Models without heterogeneity

First let us imagine the model with no heterogeneity, i.e. the model when all the studies included analysed completely the same effect using the same method of measurement, same methodology, same data. Assume the analysis of an effect, which is the same everywhere as for instance the gravitational acceleration on Earth, which has value of about 9.81 m/s\(^2\) and it would differ only due to the different measurement method applied. For this estimation the simple model in form of Equation 3.4 would be used.

\[
\tilde{\beta}_i = \beta_i + e_i \quad (i = 1, 2, \ldots N)
\] (3.4)

Where \( \tilde{\beta}_i \) is the estimate in the i-th primary study and \( \beta_i \) is the value of the genuine effect and \( e_i \) is the error term. In this simple model, all betas measuring the true effect are equal, thus the differences in the estimates are given by the error term, i.e. on our example of gravitational acceleration it is the error in measurement. (Nelson & Kennedy 2009)
Models with heterogeneity

Economics, nevertheless, does not analyse effects which are unbiased and of the same magnitude. Generally, the reason of an ubiquitous large variation in estimated empirical results has to be clarified, thus we are interested in the differences among studies and we try to describe them and justify final results based on the heterogeneity analysis.

Standard approach how to proceed when explaining heterogeneity is to explain the disparities in the estimated results is to estimate the meta-regression in form of the Equation 3.5.

\[ t_{ij} = \frac{b_{ij}}{SE_{ij}} = \beta_0 \frac{1}{SE_{ij}} + \beta_1 + \sum_{k=1}^{K} \alpha_k \frac{X_{ijk}}{SE_{ij}} + e_{ij} \]  

(3.5)

This equation is basically just extension of the Equation 3.2, where the study characteristics are added. In order to normalize effects and make them comparable, the dependent variable is the t-statistics \( t_{ij} \), which is the t-statistics of the \( i \)-th effect estimate from the \( j \)-th study. Explained variables are the precision measure \( \beta_0 \), measure of the publication bias \( \beta_1 \) and the sum stands for the influences of study specific effects. Specifically, \( X_{ijk} \) is the variable depicting the characteristics of the results, which are the causes of the diversity of effect estimates. \( X_{ijk} \) is commonly a dummy variable capturing for example the fact whether the specific control variable is included into the study or not. \( \alpha_k \) stands for the actual effect of the study characteristic \( X_{ijk} \) on the estimate we are interested in. (Polák 2016)

Methods used for estimation of meta-regression model

Based on the recommendation of Stanley & Doucouliagos (2012), for my meta-regression analysis I am going to use fixed effects method of estimation and the mixed effects model MRA as those methods fits the best to the nature of the data included into the meta-analysis. In comparison to the pooled OLS method, fixed effects are able to deal with the data in form of unbalanced panel and are able to deal with unobserved heterogeneity. When using the
random effects method, the assumption that all added random effects need to be independent of all of the explanatory variables, however when conducting a meta-analysis, it is probable that there will be correlation present. Thus the fixed effects model is commonly used and recommended method when conducting the meta-analysis.
Chapter 4

Methodology of tax competition

In this section I am going to describe the methodology used in primary studies, which are included into my meta-sample. When defining the effect of interest of my meta-analysis, I came out of the study by Leibrecht & Hochgatterer (2012). They collected studies available on the topic of corporate tax competition and divided these studies into the three sub-groups according to the analysed effect.

Studies on tax corporate tax competition assess the impact of tax competition on the statutory tax rate in the examined state using three different methods. Leibrecht & Hochgatterer (2012) divided them into groups of indirect studies and direct first generation studies and direct second generation studies.

The indirect studies analyse the effect of a change in tax rate of competing countries on the amount of foreign capital from competing countries in home country, i.e. whether the lower tax rate actually attracts foreign companies to invest into the country. The intuition behind is pretty clear. Many empirical studies were made and even few meta-analyses were conducted (e.g. De Mooij & Ederveen (2003; 2008); Feld & Heckemeyer (2011)) All the meta-analyses confirmed the existence of the relationship between tax rate and FDI.
First generation direct studies examine the effect of the country’s openness in the tax rate of the country. There are many different definitions of openness and various measures exist, for instance studies focus on a country’s laws wrt. capital, goods and service mobility (current accounts, number of bilateral treaties or trade and FDI flows). The literature on the effect of country openness on the other hand is not that wide and the measure of openness differs across studies. For instance Adam & Kammas (2007) uses the Quinn index on capital market integration which is the sum of imports and exports divided by GDP, Bretschger (2010) uses combined measure if capital market restrictions, Clausing (2008) uses FDI outflows in percentage of GDP or Garretsen & Peeters (2007) uses a sum of FDI in- and outflows in percentage of gross fixed capital formation.

The second generation direct studies examine the effect of the change of average tax rates of competitor countries on the tax rate in the home country, which is the key effect of the interest of this thesis. I am going to collect papers which focus on the impact of tax rate change in one country on the tax rate change in another country. Analysed papers study strategic interactions in tax setting, i.e. how tax policy towards capital attraction in one country affects the welfare in other country and how does the other country’s policy respond to the change. Most researches use the data on corporate tax rates, however some of the studies which I am going to include into my analysis use broadened data on capital tax rates (which is the category which contains not only corporate tax but also other tax types as for example business tax).

Most of the studies are based on the theory of Nash equilibrium, however there are few paper which use mixed Nash and Stackelberg model.

Nash equilibrium is defined as “…a stable state of a system that involves several interacting participants in which no participant can gain by a change of strategy as long as all the other participants remain unchanged.”

As it is apparent from the nature of ‘Nash equilibrium’ theory, reaction of one country affects the reaction of another country and vice versa, hence authors have to solve the endogeneity problem. Generally they construct a new variable that consist of the weighted average tax rates of all the competitor

\footnote{www.khanacademy.org}
Methodology of tax competition  

Countries and they also use lagged dependent variable as an instrument. For the newly constructed variable the term ‘Spatial Lag’ is frequently used. The lagged tax rate is used due to the fact that one country makes the policy change first and the other country reacts to the change afterwards.

When creating the model for estimation, the fundamental step in the Nash game models is the specification of weights. Redoano (2007) summarize the most common weights as follows: (1) uniform weights; (2) geographic and economic distance weights; (3) size weights; (4) weights capturing economic ties between a country pair and (5) openness weights.

- Uniform weights are giving the same weight to all the country’s competitors independently on any specific country features or relations.
- Geographic and economic distance weights stand for the situation when the neighbouring countries (geographic distance) and countries with similar capital endowment (GDP per capita distance) have stronger impact on the home country tax rate.
- Size weights refer to the fact, that large countries (based on the GDP-level) are likely to play the role of the leader in tax setting.
- Weights based on the economic ties capture trade linkages between countries.
- Openness weights stand for the fact that open countries are more likely to participate in tax competition.

Studies which are further analysed in the meta-analysis use the methodological framework based on Nash Equilibrium (NE). To derive the model which is estimated in the primary studies, I will follow the paper by Devereux et al. (2008) The reason why I have chosen this paper is its complex explanation of the methodology and furthermore the paper is considered to be one of the leading papers regarding the analysis of corporate tax competition.

Authors model interactions between countries using statutory tax rates (STR) as well as effective marginal tax rates (EMTR) on corporate income. Effective tax rate should basically give us an idea how high is the actual tax
burden, i.e. how much will the company have to pay when looking not only on the percent of statutory tax rate, but also on the tax deductible and tax non-deductible expenses, taxable and non-taxable income and other tax discounts and bonuses. Thus, on the first sight, statutory tax rate gives us some rough idea about the tax obligation, however effective tax rate tells us, how much we are really going to pay and it can be very different amount from what statutory tax rate tells us.

As already mentioned above, modelling is based on the theory of Nash equilibrium, from which two symmetric reaction functions are derived. These reaction functions are specified as follows:

\[
\begin{align*}
\tau &= T (\tau^*, z^*, X), \\
z &= T (\tau^*, z^*, X)
\end{align*}
\]  

(4.1) \hspace{1cm} (4.2)

where \( \tau \) is the Statutory tax rate (STR) and \( \tau^* \) is the STR in foreign country, \( z \) is Effective marginal tax rate (EMTR) and \( z^* \) is the EMTR in foreign country. \( X \) stands for vector of variables affecting public spending (something what would influence domestic tax rate in case when no tax competition exist). But they have to take into account \( n \) countries that may be different and exclude the home country denoted by \( i \).

For finding the optimum, the linear approximation is used, hence we are summarizing changes in all the surveyed countries. The reaction functions look as follows:

\[
\begin{align*}
\tau_{i,t} &= \hat{\tau}_i + \sum_{j \neq i} \frac{\partial T_i}{\partial \tau_j} \tau_j + \sum_{j \neq i} \frac{\partial T_i}{\partial z_j} z_j + \mu_{1i} X_i, \quad i = 1, \ldots, n \\
z_{i,t} &= \hat{z}_i + \sum_{j \neq i} \frac{\partial Z_i}{\partial \tau_j} \tau_j + \sum_{j \neq i} \frac{\partial Z_i}{\partial z_j} z_j + \mu_{2i} X_i, \quad i = 1, \ldots, n
\end{align*}
\]  

(4.3)

Where \( \hat{\tau}_j \) stands for the linear approximation of the function in Nash equilibrium and \( \tau_j \) and \( z_j \) stand for the tax rates in all the countries excluding home country, \( \mu_1 \) and \( \mu_2 \) are vectors of coefficients. However, as each country respond differently to the tax rates in every other country, it would lead to large number of parameters to be estimated, hence the functions have to be
4. Methodology of tax competition

simplified. For that purpose weights, which are not estimated, but imposed ex ante are used, see the Equation 4.4

\[
\frac{\partial T_i}{\partial \tau_j} = \beta_1 \omega_{ij}, \quad \frac{\partial T_i}{\partial z_j} = \gamma_1 \omega_{ij}, \quad \frac{\partial Z_i}{\partial \tau_j} = \beta_2 \omega_{ij}, \quad \frac{\partial Z_i}{\partial z_j} = \gamma_2 \omega_{ij}, \tag{4.4}
\]

Based on the assumption that every country reacts the same to the weighted average tax rates \( \bar{\tau}_i, \bar{z}_i \) of other countries, we get:

\[
\tau_{i,t} = \hat{\tau}_i + \beta_1 \bar{\tau}_i + \gamma_1 \bar{z}_i + \mu'_1 X_{i,t} + \phi_1 + T_{1it} + \epsilon_{1it} \quad i = 1, \ldots, n
\]
\[
z_{i,t} = \hat{z}_i + \beta_2 \bar{\tau}_i + \gamma_2 \bar{z}_i + \mu'_2 X_{i,t} + \phi_2 + T_{2it} + \epsilon_{2it} \quad i = 1, \ldots, n \tag{4.5}
\]

As Nash equilibrium values are not observable, they are replaced by country fixed effects \( \phi_1 \) and \( \phi_2 \). When adding country-specific time trends \( T_{1it} \) and \( T_{2it} \) and error terms into the previous equation, system of equations to be estimated arises:

\[
\tau_{i,t} = \beta_1 \bar{\tau}_{i,t} + \gamma_1 \bar{z}_{i,t} + \mu'_1 X_{it} + \phi_{1i} + T_{1it} + \epsilon_{1it} \quad i = 1, \ldots, n
\]
\[
z_{i,t} = \beta_2 \bar{\tau}_{i,t} + \gamma_2 \bar{z}_{i,t} + \mu'_2 X_{it} + \phi_{2i} + T_{2it} + \epsilon_{2it} \quad i = 1, \ldots, n \tag{4.6}
\]

The coefficient \( \beta \) is the coefficient of our interest and will be collected from the primary studies together with its precision measured by Standard Error (SE) (or t-statistics or p-value when SE is not published).

4.1 Statutory vs. effective tax rate

Primary papers analysed in this thesis use for their estimations two basic types of tax rates: statutory and effective. Although they are both measures of corporate tax rate, there are significant differences between them. Corporate income tax rate is an important factor affecting investment decisions of corporations. For examination of the tax burden, companies often use the statutory tax rate. It is the nominal tax rate set by government and determined in the tax rules of individual countries. It is easily observable and comparable as it is exactly given percentage of taxes to be paid. It is
neither accurate nor objective as it does not reflect important factors which affect the final tax expense to be paid by the company.

From those reasons the measure of effective corporate tax rate is used for comparing the real tax burden. Effective tax rate takes into account the differences in the determination of tax base in particular countries and it also reflects other factors influencing the final tax burden, as for instance tax deductible items, non-deductible expenses, non-taxable income and other tax allowances. Finally, after taking all these factors into account, effective tax rate might be lower than in another country, even if the statutory tax rate is higher, i.e. in reality the company will pay less.

There are different approaches for measurement of effective tax rate. Devereux et al. (2008) compute the effective marginal tax rate by calculating the hypothetical investment payments when using the available information on the tax rules in 21 OECD countries. Ruiz & Gerard (2008) compute the effective tax rate using three different approaches. The first Martinez-Mongay approach computes the effective tax rate from the corporate tax revenue and uses OECD data. It is calculated as the ratio between corporate income over the total taxes on income (individual, corporate and property taxes) and multiplied by the value of total direct taxes on income and wealth from the AMECO database. The second ”Bank of the Accounts of Companies Harmonized (BACH) approach” (database for the Bank of the Accounts of Companies Harmonized) is following Nicodème (2001), who computes the effective tax rate as the ratio of taxes paid on gross operating profit. The third methodology, used by Ruiz & Gerard (2008) for computation of Effective tax rate (ETR), is the methodology following Devereux et al. (2002). They calculate the ETR for manufacturing sectors as the difference between pre and post net present values of an investment in plant and machinery decreased by the pre-tax income stream adjusted for depreciation.
Chapter 5

Meta-analysis of corporate tax competition

5.1 Collecting and coding the data

When collecting primary studies the first set of papers was taken from the narrative study by Leibrecht & Hochgatterer (2012) about the corporate tax competition. This set of primary studies was extended by studies cited in references of previously collected papers and also by additional papers found in standard databases as Google Scholar, RePEc and EconLit using key phrases “corporate tax” and “tax competition”. When selecting studies for my meta-analysis I used following inclusion criteria.

Firstly the study had to contain information about estimated effect size and its standard error or t-statistics. Because of the lack of studies available on this topic, I included also studies reporting only accurate p-values (study by Pitlik et al. (2005); Hayashi & Boadway (2001); Ruiz & Gerard (2008)) which were converted into standard errors.

Second criterion was the analysis of corporate (or business) tax rate. Studies focusing on different types of tax rates as for example property tax (Brueckner & Saavedra 2001) or excise tax (Devereux et al. 2007) were not included into the dataset. Most researches in my dataset use the data on corporate tax rates, however some of the studies which I am also going to include into
my analysis use broadened data on capital tax rates (e.g. (Ruiz & Gerard 2008)), which is the category which contains not only corporate tax but also other types of tax on capital of companies. An we include also the the study by Altshuler & Goodspeed (2015), who uses as the corporate tax rate measure total corporate income tax revenues divided by Gross Domestic Product (GDP).

Thirdly, as I decided to focus on the tax competition among states, I excluded studies analysing the effect within smaller administrative areas as it is completely different dataset and datatype. I excluded study analysing only French local taxes (Charlot & Paty 2005) and study by Ollé (2003) which analyses corporate tax competition only in the municipal regions in Spain, because additionally to the minimum tax rate harmonized within the state, municipalities are able to set higher tax rate according to the population size.

Last criterion for the inclusion of primary study into the meta-dataset was the effect analysed. As already discussed before in the methodology, this meta-analysis is focused on the effect of change of the tax rate in one country on the tax rate in another country. Studies analysing different effects (Grubert & Mutti 2000; Bretschger & Hettich 2002) were already subject of different meta-analysis or the literature on this effect is not enough wide for meta-analysis.

In total I collected 20 studies issued since 2001. Because there are only few studies analysing this effect, I included both published studies and working papers following Stanley & Doucouliagos (2012) and Stanley et al. (2013).

From all the primary studies I collected 523 coefficient estimates (I collected the coefficient $\beta$ from the Equation 4.6) and their standard errors and for each reported coefficient several additional characteristics were recorded. I collected five groups of additional characteristics and the information about the tax rate type used for all the studies. Complete list of characteristics with their description is summarized in the Table 5.1 below.
### Table 5.1: Description of regression variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I. STUDY CHARACTERISTICS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model type</td>
<td>=1 if the different than Nash equilibrium model was used</td>
<td>0.1</td>
<td>0.3</td>
</tr>
<tr>
<td>Observations</td>
<td>the logarithm of the number of observations per study</td>
<td>395.7</td>
<td>160.66</td>
</tr>
<tr>
<td>Estimation type</td>
<td>=1 if the model was estimated by different method than IV</td>
<td>0.57</td>
<td>0.49</td>
</tr>
<tr>
<td>Tax rate type</td>
<td>=1 when effective tax rate was used</td>
<td>0.4</td>
<td>0.49</td>
</tr>
<tr>
<td>Weights</td>
<td></td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>W.Trade</td>
<td>=1 if the trade based weight was used</td>
<td>0.06</td>
<td>0.24</td>
</tr>
<tr>
<td>W.Distance</td>
<td>=1 if the distance based weight was used</td>
<td>0.34</td>
<td>0.48</td>
</tr>
<tr>
<td>W.GDP</td>
<td>=1 if the GDP based weight was used</td>
<td>0.23</td>
<td>0.42</td>
</tr>
<tr>
<td><strong>II. CONTROL VARIABLES</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>65 plus</td>
<td>=1 if the analysed study uses variable which controls the share of the population in the age 65 and more</td>
<td>0.63</td>
<td>0.48</td>
</tr>
<tr>
<td>Politics</td>
<td>=1 if the analysed study uses variable controlling for the political party affiliation</td>
<td>0.2</td>
<td>0.4</td>
</tr>
<tr>
<td>Election</td>
<td>=1 if the analysed study controls, whether there were elections in the studied year</td>
<td>0.23</td>
<td>0.42</td>
</tr>
<tr>
<td>Openness</td>
<td>=1 if the analysed study uses the variable which controls for the country’s trade openness</td>
<td>0.4</td>
<td>0.49</td>
</tr>
<tr>
<td>GDP</td>
<td>=1 if the analysed study uses the variable which controls for the country’s GDP</td>
<td>0.98</td>
<td>0.14</td>
</tr>
<tr>
<td><strong>III. DATASET CHARACTERISTICS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Used variables nr.</td>
<td>Number of variables included in the estimated equation</td>
<td>9.79</td>
<td>3.72</td>
</tr>
<tr>
<td>Mid year</td>
<td>The midpoint of the data sample on which the model is estimated.(Sample minimum is the year 1976 and sample maximum is 2004. The oldest data estimated come from the year 1963 and the youngest from 2012.)</td>
<td>1994.11</td>
<td>6.97</td>
</tr>
</tbody>
</table>
Table 5.1: Description of regression variables (continued)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years</td>
<td>Number of years for which the equation was estimated</td>
<td>19.82</td>
<td>7.16</td>
</tr>
<tr>
<td>Country group</td>
<td>=0 if the data sample includes only EU countries</td>
<td>0.63</td>
<td>0.48</td>
</tr>
<tr>
<td>Number of countries</td>
<td>Number of countries included into the estimated data sample</td>
<td>23.43</td>
<td>8.84</td>
</tr>
</tbody>
</table>

**IV. VARIABLES RELATED TO PUBLICATION BIAS**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Publication year</td>
<td>The year when the study was published in Google Scholar</td>
<td>2010.44</td>
<td>3.53</td>
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<tr>
<td>Impact factor</td>
<td>The recursive discounted impact factor from the RePEc database (collected in September 2016)</td>
<td>0.18</td>
<td>0.22</td>
</tr>
<tr>
<td>Working paper</td>
<td>=1 when the study is an unpublished working paper</td>
<td>0.44</td>
<td>0.5</td>
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<tr>
<td>Citation</td>
<td>The logarithm of the mean number of citations of the study in Google Scholar (collected in September 2016)</td>
<td>72.74</td>
<td>157.94</td>
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<tr>
<td>Data source</td>
<td>=0 if the data on the tax rates were collected from the OECD database</td>
<td>0.63</td>
<td>0.48</td>
</tr>
</tbody>
</table>

Notes: SD = standard deviation. All variables except for citations and the impact factor are collected from studies estimating the tax competition (the search for studies was terminated on June 1, 2016, and the list of studies is available in Appendix). Citations are collected from Google Scholar; the impact factor from RePEc.

5.2 Data graphical modelling – funnel plot

Figure 5.1 depicts all collected estimates. The funnel does not show 3 observations with precision over 40 and 3 observations with higher value than 2.5 because of the axes range’s setting in order to show the shape of the funnel plot more clearly (the whole funnel Figure A.3 with all estimates is provided in Appendix). The horizontal axis shows the estimated effect sizes collected from primary studies (change of the corporate tax rate in the "home country" when the corporate tax rate changes in the neighbouring country), vertical axis represents the measure of precision (inverted value of SE.
Graphical modelling of the data using the scatter plot in the form of funnel serves several purposes. First, as described in Subsection 3.2.1, when looking at the funnel plot, we are able only by simple look identify possible typing errors or outliers just based on the shape of the graph. I identified two inaccuracies, which had arisen during the collection of the data and thus had to be corrected. I also dropped 5 outliers with low effect value and low precision and I decided to drop one estimate with the effect of -0.001 and extremely high precision (standard error equal to 0.0001) due to the fact that when looking at another estimates from the same study (Crabbé & Vandenbussche 2009), this estimate was a complete outlier.

Secondly, the shape of the plot allows us to formulate initial assumptions about the presence of publication selectivity. As we can see on the Figure 5.1, the funnel indeed looks as a desired inverted funnel, nevertheless on the first sight, positive estimates on the right-hand side of the funnel outnumber negative estimates on left-hand side. Thus it makes us suspicious about the existence of publication selectivity caused by motivation of authors to discard unwanted results, which do not confirm their theory that decrease of the corporate tax rate in one country leads to the decrease of the corporate tax rate in neighbouring countries.

Due to significant differences in the specification and properties of the statutory and effective tax rate, I divided the whole sample into two sub-samples:
5. Meta-analysis of corporate tax competition

studies analysing the effect of change in the statutory tax rate and studies investigating corporate tax competition in effective tax rates.

The Figure 5.2 shows scatter plot of the estimates from the subsample of studies using only corporate statutory tax rate. As statutory tax rate is the percentage value of the corporate tax rate, the change is easily observable, thus there can be strong and clear expectation of the researcher, how the effect estimates should look like. As the shape of the funnel reveals, negative estimates are overweighted by the positive, "expected" effect estimates, i.e. authors are looking for the desired sign of an effect estimate. From this observation we assume that type I publication selectivity is present in the literature examining the topic of corporate tax competition.

Figure 5.2: Funnel plot for statutory tax rate

The funnel on the Figure 5.3 shows estimates of studies analysing effective tax rates. The depicted funnel looks much more symmetric than the funnel for statutory tax rate. We can observe that even-thought the funnel looks symmetric, there are very few estimates with low precision (bottom of the funnel plot), thus the funnel plot looks hollow, which suggests the publication bias of type II. It means that researchers are searching for significant results.

In all three funnel plots we can observe that values are quite symmetrically dispersed around the zero mean value which suggests, that the effect either does not exist at all or is very small, close to zero. However in order to
5.3 Empirical testing of publication bias – FAT/PET

Formal test for publication selectivity follows directly from the funnel plot and is called Funnel Asymmetry Test (FAT). It examines the relationship between the effect estimates and their standard errors. (Havranek & Irsova 2015; Card & Krueger 1995; Stanley & Doucouliagos 2012) Let us recall the Equation 3.2:

\[ t_i = \frac{b_i}{SE_i} = \beta_0 \frac{1}{SE_i} + \beta_1 + e_i \]

Where \( \beta_1 \) stands for the presence of the publication bias and \( \beta_0 \) represents the coefficient of precision (so called precision effect test – PET) and examines the actual existence and magnitude of the effect. Table 5.2 provides the results of the estimation of the equation above. I estimated the model using standard OLS method (as the whole equation is divided by its SE –
it is actually the Weighted Least Squares (WLS) method which corrects for heteroskedasticity), instrumental variable, where the instrument is the inverse number of observations, fixed effects and as a robustness check also by random effects method.

As the base I take the fixed effects method of estimation. Pooled OLS treats the panel data as one big cross-section and fits the estimates the best fit line, however does not take into account together the time and sectional effect. Compared to that fixed effects method fits better to our unbalanced panel data with significant heterogeneity caused by different number of estimates from individual primary studies, different time-spans, different variables used etc. as it treats individual section separately with respect to the time trend. In meta-analysis we do not have time-effect as in the regular panel data, but we have multiple estimates from one study and various numbers of estimates from each individual study. Fixed effect method takes into account the idiosyncratic properties of studies and deals with unobserved heterogeneity.

Results in the Table 5.2 confirmed our conclusions from looking at the funnel plot and provide an evidence of quite strong publication bias in the analysed primary studies on the corporate tax competition by all the methods used. Also the value of $\beta_1$, i.e. of the publication bias, is robust across all four estimation methods.

A bit surprising is the fact that the precision effect test did not confirm the existence of an underlying effect. However as the Figure 2.1 shows, corporate income tax rates had indeed recorded significant decrease in most analysed countries during the years 1981–2016.

Results of the FAT/PET test suggests that the decrease of corporate income tax rates is caused not only by tax competition as discussed in all political debates, but by other factors.

For more detail analysis I divided the whole sample into the two sub-samples: Studies using statutory and studies using effective tax rate. Funnels in the Section 5.2 have provided first pieces of evidence about the existence of publication bias in the analysed literature. Table 5.3 shows the empirical results confirming the conclusions made from graphical tests. Similarly as the funnel plot for statutory tax rate have shown previously, the FAT/PET test
Table 5.2: FAT/PET The whole dataset

<table>
<thead>
<tr>
<th></th>
<th>OLS</th>
<th>IV</th>
<th>FES</th>
<th>RES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precision – 1/se</td>
<td>0.00393</td>
<td>0.00464</td>
<td>-0.0267</td>
<td>-0.0169</td>
</tr>
<tr>
<td></td>
<td>(0.15)</td>
<td>(0.18)</td>
<td>(-0.91)</td>
<td>(-0.65)</td>
</tr>
<tr>
<td>Constant</td>
<td>1.179**</td>
<td>1.162**</td>
<td>1.385**</td>
<td>1.563**</td>
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<tr>
<td></td>
<td>(3.43)</td>
<td>(3.42)</td>
<td>(7.04)</td>
<td>(4.31)</td>
</tr>
<tr>
<td>Observations</td>
<td>517</td>
<td>517</td>
<td>517</td>
<td>517</td>
</tr>
<tr>
<td>No. of Studies</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

\( t \) statistics in parentheses

* \( p < 0.10 \), ** \( p < 0.05 \), *** \( p < 0.01 \)

Dependent variable: tstat

results verify our hypothesis that the literature is biased. When taking the fixed effects method as the base, the literature suffers by the ‘substantial’ publication selectivity as defined by Doucouliagos & Stanley (2013). Likewise the results of FAT/PET for the whole sample, results shown in the Table 5.3 did not find the evidence of an effect of corporate tax competition among states.

Table 5.3: FAT/PET Statutory tax rate

<table>
<thead>
<tr>
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<th>FES</th>
<th>RES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precision – 1/se</td>
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<td>0.0339</td>
<td>0.00138</td>
<td>0.0125</td>
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<tr>
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<td>(1.28)</td>
<td>(1.31)</td>
<td>(0.06)</td>
<td>(0.55)</td>
</tr>
<tr>
<td>Constant</td>
<td>1.452**</td>
<td>1.446**</td>
<td>1.665**</td>
<td>1.523**</td>
</tr>
<tr>
<td></td>
<td>(4.54)</td>
<td>(4.69)</td>
<td>(10.61)</td>
<td>(3.77)</td>
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<tr>
<td>Observations</td>
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<td>308</td>
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<tr>
<td>No. of Studies</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>16</td>
</tr>
</tbody>
</table>

\( t \) statistics in parentheses

* \( p < 0.10 \), ** \( p < 0.05 \), *** \( p < 0.01 \)

Dependent variable: tstat

Table 5.4 provides empirical results for the second sub-sample: effective tax rate. In the Figure 5.3 we observed slight predominance of positive estimates. The fixed effects estimation confirmed the existence of publication bias, however not very strong. As the \( \beta_1 < 1 \), Doucouliagos & Stanley (2013) denote the publication bias as ‘modest’. Similarly to previous results, non of the results of Table 5.4 did find the evidence of existence of underlying effect.
As we did not reject the null hypothesis that $\beta_0 = 0$, thus results of the FAT/PET did not achieve to find the evidence of the genuine effect. We did not conduct the PEESE test (following the methodology by Stanley & Doucouliagos (2012)). Due to the empirical evidence of the publications selectivity, our next steps leads to explanation of the causes of publication bias. For those purposes explanatory meta-regression analysis is used.

5.4 Explanatory meta-regression analysis

This section focuses on explaining the heterogeneity of estimates, explaining relations between the analysed effect and variables included in estimated models and explains relationship between the estimated effect size. Further, it examines author’s motivation to publish such selection of results, i.e. this section tries to find and explain causes of publication bias in the literature investigating corporate tax competition.

First let us recall an Equation 3.5 described in detail in the Subsection 3.2.4.

$$ t_{ij} = \frac{b_{ij}}{SE_{ij}} = \beta_0 \frac{1}{SE_{ij}} + \beta_1 + \sum_{k=1}^{K} \alpha_k \frac{X_{ijk}}{SE_{ij}} + e_{ij} $$

Following meta-regression analysis focuses on the description of influences of study specific variables $X_{ijk}$. My preferred methodology is the fixed effects
estimation as it is commonly used for the estimation of the unbalanced panel data and is able to deal with heterogeneity. As a robustness check I am using the mixed effect model, which is able to deal with correlated estimates among individual studies as it adds the study-level effects to capture within-study heterogeneity.

As the dependent variable is the t-statistics, it is not possible to determine the degree of impact of individual variables on the final effect of the corporate tax rate change in one country on the corporate tax rate in another competing country. Consequent MRA serves merely for identification of variables which do affect the size of the final published empirical estimate and for determination of the significance and direction of their influence (i.e. we are looking at the significance and sign of the estimated coefficient). The effect of inclusion of particular studies is investigated as a comparison to the baseline model. Our benchmark model is the published paper using Nash equilibrium model with uniform weights estimated by IV with no control variables (all dummy variables are zeros) and data from OECD.

Table 5.5 depicts results of the regression for statutory tax rate. The first column of the table contains results of the regression, which consist of all the collected variables. The second column captures the final model, which was obtained using so called generic to specific approach (gen-spec), which means that we excluded the least significant variables until only significant estimates remained. (Stanley & Doucouliagos 2012) Columns 3 and 4 depict the same models as the first and the second column, however estimated using the mixed effect model and serves as a robustness check. In this robustness check we examine, whether when using another estimation method, the size of estimates (when it is significant) does not change substantially and whether the direction of the effect remains unchanged or not (i.e. we look at the sign of the estimated coefficient).

When looking at the results from the Table 5.5 we can draw several conclusions. First, methodology-connected variables matter in general. For the specific model, increasing number of observations gives smaller estimates. It may be caused by the fact that with increasing number of observation, estimates become more precise, thus we get more real estimate of the effect size. Including the mixed Nash and Stackelberg leader model rather than
### Table 5.5: Explanatory MRA – Statutory tax rate

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<th>gen-spec FE</th>
<th>All ME</th>
<th>gen-spec ME</th>
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<tr>
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<td>Election</td>
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<td>(6.72)</td>
<td>(2.82)</td>
<td>(2.04)</td>
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<td>(13.81)</td>
<td>(13.72)</td>
<td>(3.19)</td>
<td>(3.05)</td>
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Observations 308 308 308 308
No. of Studies 16 16 16 16

\( t \) statistics in parentheses
Dependent variable: tstat

\* \( p < 0.10 \), \*\* \( p < 0.05 \), \*\*\* \( p < 0.01 \)
only commonly used Nash Equilibrium, also leads to smaller effect estimates. Choice of weights also matters: when including the distance weight, the final effect will be higher, on the other hand including GDP weight decreases the final effect value. Effects of weights are robust across specification.

Next, let us look at the results connected to the usage of different control variables. We can see that only three of them have significant impact on the effect size and all of them increase the value of the final estimated effect of corporate tax competition among states. The ratio of the population older than 65 and the openness measure does not affect the effect size. However politically oriented controls do have significant impact and both increase the resulting effect size, yet politics only in the specific model.

We did not find any evidence of the empirical effect in previous PET analysis in Section 5.3. The possible explanation of such finding might be that if the decrease of corporate tax rate in the competing country does not affect the tax rate in the home country, however politically oriented variables do. Decrease of corporate tax rate might be caused not by the everywhere discussed tax competition, but by the internal political situation of the particular state (mainly the variable Election plays significant role). Thus the left-wing political parties will increase the corporate tax rates in order to obtain funds for the generous social system. Similarly politicians will decrease corporate tax rates mostly before the elections at the end of their governmental period in order to persuade people to give them their votes. These political decisions are made no matter how high the tax rates in the neighbouring or another state are.

The last set of results is built from the variables, which are related to the publication bias. Studies that include higher number of variables into the model report lower estimate of the effect of corporate tax competition. From the results of specific model, we can also observe that Impact factor, number of citations and data source play role in the size of the final effect estimate. It means that high quality journals prefer estimates with higher effect size, thus authors might be motivated to find higher effect in their results in order to publish their article in the journal with better impact factor. Also the higher the estimate, the higher the number of citations, thus there might be a desire to find higher effect.
The significance of the variable *Data source* shows that when using different database than OECD, authors record smaller estimates of an underlying effect. Possible explanation of this result might be that authors who did not use the OECD database, used usually some more specific database. Thus, they cared more about the data included into the model and also used the data which were not so general, hence there was lower probability of some error and in the end they got more precise results.

Table 5.6 shows results of the meta-regression for the sub-sample of effective corporate tax rates. In comparison to the Table 5.5 there are some significant differences. For instance number of observation does not make any change to the final effect size. The choice of weights also have different implications on the final effect size. In comparison to the statutory tax rate, distance weights does not matter and GDP weight have significant impact on the effect size, however in opposite direction.

In contrast to the statutory tax rate, all control variables influence the estimated size of the underlying effect of corporate tax competition among states. Quite interesting finding is that more variables related to publication selection are significantly affecting the estimated effect size. Contrary to the results for the sub-sample of statutory tax rates also variables *Publication year* and *Working paper* matter. The results have also shown that the choice of the *Data source* is important. In contrary to the results for STR, it has opposite influence. Use of the OECD database for the data on effective tax rates increases the resulting magnitude of an effect. It might be caused by different calculation of effective tax rate.
Table 5.6: Explanatory MRA – Effective tax rate

<table>
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<tr>
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<th>gen-spec FE</th>
<th>All ME</th>
<th>gen-spec ME</th>
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</thead>
<tbody>
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<td>(-6.77)</td>
<td>(-2.27)</td>
<td>(-2.53)</td>
</tr>
<tr>
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<td>-0.155</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-1.61)</td>
<td>(-1.20)</td>
<td></td>
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</tr>
<tr>
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Observations 209 209 209 209
No. of studies 10 10 10 10

$t$ statistics in parentheses
Dependent variable: tstat
$p < 0.10$, $** p < 0.05$, $*** p < 0.01$
Results for all the sub-samples have shown that the control variable *Election* has significant impact on the effect size across all the model specifications. It might suggest that increasing or decreasing corporate tax competition according to the tax rate of the neighbouring state might not be the case and the CITR changes are dependent on the internal political decisions. It means that political decisions are made independently, no matter what happens around the home country. Because it is quite interesting finding I decided to look at the variable *Election* little bit deeper. The Figure 5.4 and Figure 5.5 below show the development of the corporate tax rate in the Czech Republic and Germany in time (line) together with the years, when elections took place (columns).

**Figure 5.4:** Czech Republic – development of corporate tax rate in relation to elections

![Graph showing the development of corporate tax rate in relation to elections](image)

Graphs show the development since 1981 till 2016. On the Figure 5.4 and Figure 5.5 we can observe that there is a significant decrease of the corporate tax rate in years right before elections and in the meantime there is a stagnation or increase, which suggest that variable election is indeed very important factor affecting the corporate tax rate change.

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1 For data on CITR the OECD database was used; data on elections are from the Voter turnout database available on: [http://www.oldsite.idea.int/vt/introduction.cfm](http://www.oldsite.idea.int/vt/introduction.cfm)
When looking at the other states (figures available in Appendix), the tax rate is generally stagnant or decreasing before elections. There are some cases where the tax rates increase over time. However, also in these cases the tax rate is generally stagnant or decreasing before elections.
Chapter 6

Conclusion

The aim of this thesis was to analyse the topic of corporate tax competition and by empirical synthesis verify the existence of tax competition among countries, in particular, the effect of tax rate change in competing country on the tax rate in the home country. The thesis focused on the empirical testing of the existence of the genuine effect and presence of the publication bias.

In the first part of this thesis I introduced the topic of tax competition in corporate taxes, its drivers and its implications in form of tax havens and tax optimisation activities used by multinational companies. I also discussed the consequent political debate and actions in reaction on such development in today’s world. I described the OECD Action Plan on Base erosion and profit shifting, which is the tool developed by OECD countries to avoid immoral tax optimisation, which is used by big corporations thanks to the ever expanding globalisation and internationalisation and thanks to the existence of gaps in the legal system.

In the second part of this thesis, I introduced the meta-analysis itself. As there is a wide range of empirical literature analysing the topic of corporate tax competition, the summary of available results is the logical step to do in order to push the empirical research further. As there were already few narrative reviews done, I decided to summarize those results using more sophisticated tool: a meta-analysis. Whereas meta-analysis is considered to be more objective than simple literature review. Although it is obviously
not completely free from subjectivity as there is a selection process defined by the author of the meta-analyst and also the methods are used based on the researchers’ decisions. However, the main advantage of meta-analysis is that in comparison to literature survey, the process of selection of primary studies, methods and variables is verifiable: the meta-analyst is required to define explicitly the reasons for such selection.

Also meta-analysis has another added value compared to simple literature review: it makes it possible to investigate non-sampling issues as for instance, the method of estimation or model specification.

The third part of this thesis provides my own empirical research on the topic of corporate tax competition. To my knowledge this is the first meta-analysis investigating the effect of corporate tax rate changes on the corporate tax rates in other states. I conducted the meta-analysis of 20 collected primary studies, which fulfilled the ex-ante defined selection criteria. The meta-analysis contains 517 estimates and 23 explanatory variables characterizing properties of primary studies.

Conducted meta-analysis failed to find the evidence of the underlying empirical effect, however, it confirmed presence of the publication selection bias. I took into account the difference between the statutory and effective tax rates and split the whole dataset into two sub-samples. Nevertheless, neither the visual nor the empirical analysis employing FAT/PET did not provide an evidence of the genuine empirical effect. On the other hand, the analysis confirmed presence of relatively strong publication bias. The results show that there is a significant difference in the strength of the publication bias between the two sub-samples. Statutory tax rate reflects stronger publication bias, which is probably caused by the fact, that statutory tax rates are easily observable as well as are their changes. Thus, researchers are influenced by the exact expectation when conducting the analysis and might be motivated to publish only the results which are in accordance with their pre-defined assumptions.

Although the FAT/PET analysis failed to find the evidence for the existence of an effect, following meta-regression analysis identified some variables influencing the final estimated effect size. Similarly to the FAT/PET analysis,
also the MRA found significant differences between the two sub-samples. It showed that when analysing the statutory tax rates study characteristics as model specification, number of observations, method of estimation or choice of weights matters substantially. However, from control variables only the politically oriented factors were significant. In contrast to these findings, not all study characteristics were significant for effective tax rates. On the other hand controls matter largely as all of them were significant in our specific model. In both sub-samples, variables related to the publication bias were significant, i.e. authors might be motivated to publish higher and positive estimates in order to be published in high quality journals or to be cited more.

To conclude, from the results of this meta-analysis, the first one analysing the particular effect of corporate tax competition in tax rate settings among states, it seems, that tax competition does not exist. Thus we do not determine our corporate tax rates based on the tax rates of our neighbours and the corporate tax rate setting is purely dependent on the internal political decisions.

Even though the results did not find an evidence for the existence of an effect, I believe that the effect itself, although very small, might exist. Primary research is missing some important information for the determination of the true effect size. As we can see from the conducted MRA, the political factors matter greatly, when determining the corporate tax rate. The primary research might need some additional information about the political system in order to find the true effect of tax competition. For instance, the primary research does not take into account the legislative process of adjusting the tax rate. It means that although the home country’s government tends to respond to changes of tax rates in neighbouring states by modifying its own corporate tax rate, it is needed that the proposal goes through the whole approval process. Similarly, the length of governmental period might be important. The composition of parliament changes in the specific time interval, the approach to the tax rate setting might also change.

Also primary studies analyse the aggregated data on corporate tax rates. Nevertheless, there might be some firm- or sector- specific tax incentives in play, which might not appear in the aggregated data.
The question is, whether it is possible to identify and quantify those influences and how many of them are still missing. Further empirical research should concentrate on the verification of the results of this meta-analysis, on identification of other factors influencing corporate tax competition among states and on verification of the methodology used in primary studies.
Bibliography


Chatelais, N. & M. Peyrat (2008): “Are small countries leaders of the european tax competition?”.


## Figure A.1: Development of corporate tax rates in 1981-2016

| Year     | Australia | Austria | Belgium | Canada | Chile | Czech Republic | Denmark | Estonia | Finland | France | Germany | Greece | Hungary | Ireland | Israel | Italy | Japan | Korea | Latvia | Luxembourg | Mexico | Netherlands | New Zealand | Norway | Poland | Portugal | Slovak Republic | Slovenia | Spain | Sweden | Switzerland | Turkey | United Kingdom | United States |
|----------|-----------|---------|---------|--------|-------|---------------|---------|---------|---------|--------|---------|--------|---------|---------|---------|---------|--------|--------|--------|--------|-----------|---------|------------|------------|--------|--------|----------|-------------|---------|-----------|-----------|
| 1981     | 46       | 43      | 45      | 48     | 40    | 0             | 0       | 0       | 0       | 0      | 40      | 40     | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0         | 0       | 0         | 0         | 0      | 0       | 0        | 0       | 0         | 0         |
| 1982     | 46       | 43      | 45      | 48     | 40    | 0             | 0       | 0       | 0       | 0      | 40      | 40     | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0         | 0       | 0         | 0         | 0      | 0       | 0        | 0       | 0         | 0         |
| 1983     | 46       | 43      | 45      | 48     | 40    | 0             | 0       | 0       | 0       | 0      | 40      | 40     | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0         | 0       | 0         | 0         | 0      | 0       | 0        | 0       | 0         | 0         |
| 1984     | 46       | 43      | 45      | 48     | 40    | 0             | 0       | 0       | 0       | 0      | 40      | 40     | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0         | 0       | 0         | 0         | 0      | 0       | 0        | 0       | 0         | 0         |
| 1985     | 46       | 43      | 45      | 48     | 40    | 0             | 0       | 0       | 0       | 0      | 40      | 40     | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0         | 0       | 0         | 0         | 0      | 0       | 0        | 0       | 0         | 0         |
| 1986     | 46       | 43      | 45      | 48     | 40    | 0             | 0       | 0       | 0       | 0      | 40      | 40     | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0         | 0       | 0         | 0         | 0      | 0       | 0        | 0       | 0         | 0         |
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| 1988     | 46       | 43      | 45      | 48     | 40    | 0             | 0       | 0       | 0       | 0      | 40      | 40     | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0         | 0       | 0         | 0         | 0      | 0       | 0        | 0       | 0         | 0         |
| 1989     | 46       | 43      | 45      | 48     | 40    | 0             | 0       | 0       | 0       | 0      | 40      | 40     | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0         | 0       | 0         | 0         | 0      | 0       | 0        | 0       | 0         | 0         |
| 1990     | 46       | 43      | 45      | 48     | 40    | 0             | 0       | 0       | 0       | 0      | 40      | 40     | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0         | 0       | 0         | 0         | 0      | 0       | 0        | 0       | 0         | 0         |
| 1991     | 46       | 43      | 45      | 48     | 40    | 0             | 0       | 0       | 0       | 0      | 40      | 40     | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0         | 0       | 0         | 0         | 0      | 0       | 0        | 0       | 0         | 0         |
| 1992     | 46       | 43      | 45      | 48     | 40    | 0             | 0       | 0       | 0       | 0      | 40      | 40     | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0         | 0       | 0         | 0         | 0      | 0       | 0        | 0       | 0         | 0         |
| 1993     | 46       | 43      | 45      | 48     | 40    | 0             | 0       | 0       | 0       | 0      | 40      | 40     | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0         | 0       | 0         | 0         | 0      | 0       | 0        | 0       | 0         | 0         |
| 1994     | 46       | 43      | 45      | 48     | 40    | 0             | 0       | 0       | 0       | 0      | 40      | 40     | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0         | 0       | 0         | 0         | 0      | 0       | 0        | 0       | 0         | 0         |
| 1995     | 46       | 43      | 45      | 48     | 40    | 0             | 0       | 0       | 0       | 0      | 40      | 40     | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0         | 0       | 0         | 0         | 0      | 0       | 0        | 0       | 0         | 0         |
| 1996     | 46       | 43      | 45      | 48     | 40    | 0             | 0       | 0       | 0       | 0      | 40      | 40     | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0         | 0       | 0         | 0         | 0      | 0       | 0        | 0       | 0         | 0         |
| 1997     | 46       | 43      | 45      | 48     | 40    | 0             | 0       | 0       | 0       | 0      | 40      | 40     | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0         | 0       | 0         | 0         | 0      | 0       | 0        | 0       | 0         | 0         |
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Source: ?.
Figure A.2: Development of corporate tax rates in 1981-2016 cont.
Funnel plot of the whole dataset

Figure A.3: Funnel plot of the whole dataset including outliers
Primary studies included into the meta-sample

Table A.1: List of studies

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Notes: WP = working paper
Table A.2: Robustness check: Explanatory MRA – Publication bias

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Observations 308 209 308 209
No. of Studies 16 10 16 10

$t$ statistics in parentheses
Dependent variable: tstat

*p < 0.10,  **p < 0.05,  ***p < 0.01
*The table shows results of ex ante determined variables, which are related to the publication bias. It serves for the comparison of results on the publication bias for statutory and effective tax rate. In the model for effective tax rate, control variables with significant impact on the effect size are not included, thus there might be problem with the omitted variable.
Analysis of the *Election* variable

**Figure A.4:** Chile – development of corporate tax rate in relation to elections

**Figure A.5:** United Kingdom – development of corporate tax rate in relation to elections
Figure A.6: Portugal – development of corporate tax rate in relation to elections

Figure A.7: Mexico – development of corporate tax rate in relation to elections