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Economic incidence of corporate income tax

Bachelor's Thesis

Author: Václav Petrželka

Study program: Economics and Finance

Supervisor: doc. Petr Janský, M.Sc., Ph.D.

Year of defense: 2020

Declaration of Authorship

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Prague, May 2, 2020

Václav Petrželka

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Abstract

The main objective of this thesis is to determine whether and if there is any incidence of corporate income tax on the level of wages. This topic has been discussed for decades, and the conclusions of empirical analyses vary across available studies. Data on 35 OECD Member States for the period 2000-2018 are examined to verify this impact. Because we believe that our variables affect each other over time and at the same time there is a variable in the model that causes heterogeneity, we use a panel VAR model. Altogether, two models are estimated, as we have demonstrated two datasets. However, the results show that there is no evidence that changes to the corporate income tax rate affect wages in any way. Although this discovery is not very statistically significant, it is a very interesting finding, which is consistent with some of the authors of contemporary scientific literature.

Keywords	incidence of corporate income tax, corporate income tax rate, average wage, panel vector autoregression model

Title	Economic incidence of corporate income tax

Author's e-mail	93260272@fsv.cuni.cz
Supervisor's e-mail	petr.jansky@fsv.cuni.cz

Abstrakt

Hlavním cílem této práce je určit, zda a jestli vůbec existuje nějaký dopad daně z příjmu právnických osob na výši mezd. Toto téma bylo diskutováno po celá desetiletí a zavěry empirických analýz se liší napříč dostupnými studiemi. K ověření tohoto dopadu jsou využita data o 35 členských státech OECD v období 2000-2018. Protože věříme, že se naše promenné navzájem ovlivňují v čase a zároveň je v modelu proměnná, která způsobuje heterogenitu, využíváme panelového VAR modelu. Celkem jsou odhadnuty dva modely, neboť jsme předvedli dva datasety. Výsledky však ukazují, že neexistují žádné důkazy o tom, že by změny sazby daně z příjmu právnických osob jakkoliv ovlivňovaly mzdy. Ačkoliv není tento objev příliš statisticky významný, jde o velice zajímavé zjištění, které je v souladu s některými autory současné věděcké literatury.

Klíčová slova	dopad daně z příjmů právnických osob, průměrná mzda, sazba daně z příjmů právnických osob, panelový vektorový autoregresní model

Název práce	Ekonomický dopad daně z příjmu právnických osob

E-mail autora	93260272@fsv.cuni.cz
E-mail vedoucího práce	petr.jansky@fsv.cuni.cz

Bachelor's Thesis Proposal

Institute of Economic Studies
Faculty of Social Sciences
Charles University in Prague

Author's name and surname: Václav Petrželka

E-mail: 93260272@fsv.cuni.cz

Phone: +420776370540

Supervisor's name: doc. Petr Janský, M.Sc., Ph.D.

Supervisor's email: petr.jansky@fsv.cuni.cz.

Proposed Topic:

Economic incidence of corporate income tax

Preliminary scope of work:

Research question and motivation

I would like to ask a fundamental research question: Who is primarily affected by corporate tax in a global economy?

This specific topic might be important in the sense that most people assume corporate tax harm especially companies themselves. But theoretically the corporate tax has larger impact on labor force (Clausing 2013). Some part or the entire tax burden might be shifted onto labor. This can be done by reducing wages or deteriorating working conditions (Sokolovska 2017). According to earlier research, it was not possible to confirm or disprove this strong statement because these works were not entirely convincing and had many weaknesses. However in a globally integrated world capital moves according to a tax differentials (Devereux et al. 2012). Countries that have a high corporate tax rates may experience a capital outflow to those countries where the corporate tax rates are lower. This increases wages in low-tax countries (Arulampalam et al. 2012). According to other studies workers bear about 50 percent of total tax burden which is quite a significant amount (Fuest et al. 2018). However, this is not about a simple calculation of corporate tax rate. Many factors such as the political situation, the influence of neighboring states and, with globalization, the power of integration are also interfering (Quinn and Kumar 2012).

I would like to focus on new approaches to determine how strong the relationship between corporate taxes and wages is. It is assumed that there is an inversely proportional relationship, namely that wages are decreasing as corporate tax increases (Arulampalam et al. 2012).

Contribution

There is no extensive review of corporate tax incidence in recent years, therefore, I would like to follow up on those which are several years old, using some proven methods and find out what the situation is like today.

The conclusion will certainly not be unambiguous. Workers definitely do not bear a 100 percent of corporate income tax cuts (Serrato and Zidar 2016). And for example Agarwal and Chakraborty (2018) say that corporate tax can affect especially corporations and the effect on labor is not essential. This is supported by their empirical study of India in the period 2000-2015. On the other hand, another empirical study from Germany, which is similarly focused on companies, shows that labor might carry a significant part of tax burden (Fuest et al. 2018). This knowledge, which is rather micro-level, will definitely be beneficial to me and already proves in advance that the difference between developed and developing countries could be significant.

If we focus on the G20 countries, we find that there is a huge difference in corporate tax rates - from 20% in Saudi Arabia to 40.8% in Japan (Bilicka et al. 2011). This can lead us to the question of whether the states are competing in the level of corporate tax rates. Devereux et al. (2012) say that it depends on effective average tax rate and effective marginal tax rate because these are estimates in which governments compete. Of course, investment also plays a major role (Romer 2012). I would also like to take this global perspective, but with the difference that I would examine the impact of corporate tax in the US and the EU with the latest data.

This thesis aims to collect already existing estimates and surely discover some new ones. I would like to contribute to making the corporate tax impact more evident nowadays. Whether its increase will mostly affect owners, employees, or consumers. It might be beneficial for anyone who deals with corporate tax.

Methodology

I would like to focus on a time period of approximately 10 years and first examine the US and the EU corporate taxation through those years. And second study tax fluctuations and whether wages have fallen or risen as a result. As for data on average wages across a given period and the development of corporate income tax, I will draw mainly from the official statistical offices and laws of the countries concerned. Below are the individual institutions:

USA - Bureau of Labor Statistics and EU: Belgium - Statbel, the Belgian Statistical Office, Bulgaria - National Statistical Institute, Czech - Czech statistical office, Denmark - Statistics Denmark, Estonia - Statistics Estonia, Finland - Statistics Finland, France - Insee - National Institute of Statistics and Economic Studies, Croatia - Croatian Bureau of Statistics, Ireland - Central Statistics Office, Italy - Italian National Institute of Statistics, Cyprus - Statistical Office, Lithuania - Statistics Lithuania, Latvia - Central Statistical Bureau of Latvia, Luxembourg - STATEC - Statistics Portal, Hungary - Hungarian Central Statistical Office, Malta - National Statistics Office, Germany - Federal Statistical Office, Netherlands - Statistics Netherlands, Poland - Statistics Poland, Portugal - Statistics Portugal, Austria - Statistics Austria, Romania - National Institute of Statistics, Greece - Hellenic Statistical Authority, Slovakia - Statistical Office of the Slovak Republic, Slovenia - Statistical Office of the Republic of Slovenia, United Kingdom - Office for National Statistics, Spain - National Statistics Institute and Sweden - Statistics Sweden.

All of them provide these macroeconomic information.

Outline

Abstract
Introduction
  a. why is my topic interesting
  b. brief overview of existing knowledge
  c. how I add to existing research
  d. main results and what they mean
  e. how is the thesis organized
Literature review
  a. literature on the economic incidence of corporate income tax
  b. evidence of corporate tax impact on wages
  c. review of existing empirical estimates
Methodology
  a. relevant description of data
Results
  a. a higher corporate tax reduce / does not reduce wages
  b. my interpretation of the results
Conclusion
  a. broader interpretation of results
  b. implications for practice
  c. topics for further research

List of academic literature:

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Contents

List of Tables

List of Figures

Acronyms

AIC Akaike Information Criterion

BIC Bayesian Information Criterion

CPI Consumer Price Index

GDP Gross Domestic Product

GMM Generalized Method of Moments

HQIC Hannan-Quinn Information Criterion

OECD Organisation for Economic Co-operation and Development

PPP Purchasing Power Parity

VAR Vector Autoregression

WB World Bank

Chapter 1

Introduction

The general model of the incidence of the corporate income tax assuming closed economy says that after imposing a tax, consumers' incomes decrease and their demand for a product will depend on the change of their income or the change in price of the product (Harberger 1962). This model therefore does not envisold the impact on the labor. Since then, economists, including Harberger, have shifted this model into a more realistic form that, in the first place, no longer foresees a closed economy. As a result, the issue of the impact of corporate income tax became the subject of many studies that analyse on real data how much the labor is burdened by corporate tax and if at all. Chapter 2, which focuses primarily on review of existing empirical estimates, describes how the conclusions of these studies differ.

When analyzing the incidence of the corporate income tax there are different approaches. In empirical studies it really depends on the size of the region we are going to examine. At the level of one state there would be some local firms seated just in that particular municipality, which would be definitely affected by imposing a corporate tax. On the other hand large firms, which might be foreign owned would not have to be impinged much by the tax burden. Therefore at national level it should be worth examining a representative sample including large corporates as well as small local firms to trace a real impact of corporate tax on labor. However in a globally integrated world it could be more effective to study the impacts in several states at the same time. If we take more or less homogeneous states whose economies are open, then we assume that the effects of corporate taxation might be similar.

In this thesis, we focus on more states with similarly strong open economies, as we examine the impact of corporate tax using data on the 35 OECD Member

States between 2000 and 2018. The panel VAR model defined by Clausing (2012) was chosen as an empirical tool. We determine its optimal number of lags on the basis of scientific literature and try to ensure that the results are as reliable as possible using tools for the stability and robustness of the model. Of course, choosing the right method is not easy in this regard, as countries may follow each other in imposing corporate tax. Then the economy can react differently in each of these states. And finally the overall impact would be different in comparison to a single country imposing a corporate tax. What is more, tax changes are introduced primarily by the will of politicians, not because of the changes in economic variables (Foremny & Riedel 2014). Nevertheless, we still want to contribute our own empirical analysis to make the picture of this impact again a little clearer.

As regards the structure of this work, Chapter 2 therefore provides a detailed overview of the currently available literature on this topic. In Chapter 3, we describe the range of our datasets as well as the individual steps after which the data has been modified into a comparable form. The theoretical background of panel data processing, as well as the panel VAR model and procedures used by us to verify the reliability of the results - Hansen test of overidentification restriction, Andrews-Lu model selection procedure for optimal number of lags and test of stability - are described in Chapter 4, which is followed by Chapter 5 with the results of both models and subsequent discussion. The whole thesis, including commentary on the literature review and the clear conclusion that we could have made based on the results of our empirical analysis, is described in Chapter 6.

Chapter 2

Literature Review

The issue of the incidence of the corporate income tax has been addressed by many authors. From general models that were described in the past to empirical studies of the present day, which use tools capable of processing large amounts of data. This chapter therefore summarizes the available literature up to 2019. In the first part, a general model of corporate income tax impact is presented as well as its development over time, followed by the second part on empirical studies at the global level, whose procedures and knowledge are implemented in the empirical analysis of this thesis. The last part summarizes previous works and findings at national level.

2.1 Theoretical model

The Heckscher-Ohlin model concerning comparative advantages, as one of the classical theories of international trade, was used by Harberger (1962) who reworked it for closed economy into a general model of the incidence of corporate income tax described such that country is divided into corporate sector which is subject to corporate tax and which bears the whole tax burden and non-corporate sector. The following authors already took into account the importance of mobility of factors. In the open economy imposition of higher corporate tax consequently decreases domestic investment which then leads to lower wages (Bradford 1978). The original Harberger's model and earlier analysis had adhered to immobile factors, but also Kotlikoff *et al.* (1987) further extended this model to an open economy where capital and labor can move. Bradford (1978) and Kotlikoff *et al.* (1987) put forward that an increase in the corporate tax in the domestic country causes capital outflow to other countries as the global rate of return on capital falls. Capital outflow consequently leads to a decrease in return to labor in the domestic country and conversely to an increase in the rest of the world. The effect on the global rate of return to capital gradually disappears. Harberger (1995; 2008), Gravelle & Smetters (2006) and Randolph (2006) were able to further improve this model and, assuming an open economy, found that the workforce bears at least part of the tax burden. Using a modified two-state and five-sector model and based on reasonable assumptions, Randolph (2006) concluded that domestic labor bears more than 70% of the corporate tax burden. On the other hand, it might be assumed that domestic and foreign products are not perfect substitutes, which may result in capital bearing a large part of the corporate tax burden (Gravelle & Smetters 2006).

2.2 Cross-country analyses

Considering the fundamental assumption of an open economy, which complicated the simple reasoning that capital carries the entire burden of corporate income tax, led Gordon (1986) to find out that any capital income tax falls fully on fixed local factors such as labor. The assumption of an open economy has in itself brought a reason to examine the impact of corporate tax on cross-country data. If we do not look at older studies, after the turn of the millennium, the impact of corporate tax on cross-country data was examined by Hassett *et al.* (2006), Felix (2007) and Desai *et al.* (2007), whose work brought interesting findings. Recent references include Arulampalam *et al.* (2012), Clausing (2012; 2013), Azémar & Hubbard (2015) and Exbrayat & Geys (2016).

Hassett *et al.* (2006) collected data from 72 states in the period 1981-2005. Their main source for wage data was the International Labor Organization and they used the AEI International Tax Database for the second key variable - the corporate tax rate. Following Rodrik (1999), who proposed wages and democracy regression, Hassett *et al.* (2006) arrived at results that suggest that *"in general, countries with high tax rates tend to have lower wages rates."* A number of other variables such as Effective Marginal and Average Tax Rates, as well as the instrumental variable capital gains tax rate, were used to refine this statement. Using econometric models Spatial, GLS and OLS Estimation, the authors concluded that by raising the corporate tax by 1 percent, wages will be reduced by approximately 1 percent.

The statistically significant negative relationship between the corporate tax rate of high-income countries and mean annual gross wages was discovered by Felix (2007) who joins in the study of the impact of corporate tax with examining panel database covering 30 relatively capital-intensive countries over the period 1979–2002. Focusing on openness and corporate tax rate, as the two main characteristics of each country, the author estimated that an increase of one percentage point in the marginal corporate tax rate leads to a decrease of annual wages by 0.7 percent.

Desai *et al.* (2007) investigated the level of corporate tax burden falling on workers by analyzing the sample of 52 countries. Their empirical work is based on as reliable and comprehensive data as possible about the activities of multinational companies in the USA. Data on the financial and operational characteristics of multinational affiliates in the US from 1989, 1994, 1999 and 2004 was provided by the Bureau of Economic Analysis. Finally, the authors concluded that the burden of corporate taxation is borne with a significantly large extent by the labor force since the part carried by labor is between 45 and 75 percent. The remaining part, according to Desai *et al.* (2007), affects capital.

Arulampalam *et al.* (2012) examined firm-level data of 55,082 companies based in nine European countries from 1996 to 2003. Rather than among cross-country analyses, this work could be included in the following Section 2.3 concerning individual countries' analyses however, the data is multinational-level, so it is included in this part. Arulampalam *et al.* (2012) used several types of regression such as pooled OLS, first-differenced OLS, Within-Groups, etc. and came to the conclusion that labor bears approximately 50 percent of the corporate tax burden in long run.

With surprising findings came Clausing (2012), who also deals with the impact of corporate income tax and whose practices also inspire this thesis to large extent. Unlike previous studies examining a group of states in a globally integrated economy, the author finds that there is no significant linkage between corporate tax rate and wages. Clausing (2012) examines the states of the Organization for Economic Cooperation and Development between 1981 and 2009. As regards wage data, the author uses a total of four sources – first the OECD average annual wage series, the labor market data from the International Labor Organiaztion (ILO), from which she also takes a whole host of other data from their Labor Statistics database and then adjusts this data to be as comparable as possible and finally works with the U.S. Bureau of Labor Statistics worker hourly wage series. The author uses four datasets again for tax rate data, this time from two sources. From the OECD, the top central government statutory rate, the combined statutory corporate tax rate, and the ratio of corporate tax revenues to GDP. Finally, it takes effective tax rate data from the U.S. Bureau of Economic Analysis. Clausing's (2012) analysis is divided into three parts, first examining the basic linkage between the corporate tax rate and average wages. To do this, she exploits all collected data and compares the results with similarly conceived analyses. Secondly, the general equilibrium tax incidence mechanism is investigated and finally, the author chooses a panel vector autoregressive model that includes variables wage, corporate tax rate, capital-to-labor ratio, real GDP and unemployment rate (see Chapter 4 to learn more. All three approaches, and especially for us the crucial panel VAR model, showed almost identical results, which do not demonstrate a significant relationship between corporate income tax rate and wage variables.

A year later comes Clausing (2013) with further work on this topic. However, this time the author merely summarises and refines the results of the previous comprehensive analysis. Among other points, she notes that the OECD's data on average annual wage and data from the U.S. Bureau of Labor Statistics on hourly wages were the most reliable data for wages. Similarly, combined statutory corporate tax rate from the OECD database and an effective tax rate series calculated from the U.S. Bureau of Economic Analysis are highlighted for tax data. Therefore, data is limited to authenticated sources only. The results of the previous study are confirmed in conclusion, meaning there is no significant relationship between the corporate tax rate and wages (Clausing 2013).

The penultimate literature worth mentioning is the extensive study by Azémar & Hubbard (2015), which puts into research 13 OECD countries using data from the Bureau of Labor Statistics. After determining a series of regressions, the authors concluded that *"a one-percentage-point increase in corporate tax rates reduces wages by 0.1 percent in the manufacturing sector for 13 OECD countries over the period 1980-2004."*

The last literature to be mentioned in the cross-country analysis is the empirical study by Exbrayat & Geys (2016). In addition to the incidence of the corporate income tax, the authors also focus on economic integration and fiscal compensation, which in their submission is closely related to the topic of this work. The methodology and data section describes two key variables tax and wage for which data about 24 OECD countries were collected during the period 1982-2007, as well as control variables such as population, the unemployment rate in the country, urbanism, trade openness, ratio dependence (share of non-working to working-age population), education, and others. In the end, Exbrayat & Geys (2016) describe their two pivotal findings. First, that high labor costs are compensated by governments by the lower corporate tax rate and second that the tax burden is passed on to employees by business owners. They also add that these correlations are stronger in a more integrated market. Authors' procedures and implementation of some of their variables are further used in the empirical analysis of this thesis.

2.3 Individual countries' analyses

One of the first empirical studies at the micro-level of one state, which examined the corporate tax incidence on Germany's unique pseudo panel data from 1998 to 2006, was written by Dwenger *et al.* (2011). The German corporate income tax return data, which was used by the authors and which are published every three years, come from the German Federal Statistical Office. On the other hand, data on employed persons were obtained from The Federal Employment Agency. As mentioned above, Dwenger *et al.* (2011) compiled some pseudo panel data by grouping companies and labor market data by industry and region. There are 860 groups and their minimum size is 50 corporations and 20 employees. Using this data, the authors determined that *"a 1 euro decrease of corporate tax revenues results in an increase of the wage bill by 0.47 euro,"* which would imply that the labor carries about 50% of the burden.

According to Liu & Altshuler (2013), who also joined the observation of the corporate tax incidence at the national level, in the two decades before 2013, most countries of the Organization for Economic Cooperation and Development lowered their legal corporate tax rate. And therefore the authors investigated the impact of corporate income taxes on wages within the USA on the individual-level by exploring sample size of 287,111 individuals. Using, inter alia, a first-stage Probit model Liu & Altshuler (2013) concluded that a 10 percent increase in the corporate tax would decrease the average wage rate by 0.28-0.38 percent. They further say that *"labor shares at least 42 percent of the burden of the corporate tax" and that "the average labor share of the corporate tax burden is around 60-80 percent."*

A comprehensive study by Suárez Serrato & Zidar (2016) also addresses the impact of corporate tax. The authors have thoroughly examined the impact of corporate tax cuts on business owners, workers, and landowners in the USA. These estimates are examined theoretically and subsequently empirically on annual county-level data from 1980 to 2012 for more than 3,000 counties and decadal individual-level data for 490 groups of counties. Suárez Serrato & Zidar (2016) came to two essential findings - firstly they fundamentally reject the conventional view that workers bear 100 percent of the tax burden and that business owners do not bear anything and secondly their estimates put approximately 40 percent of the tax burden on business owners, 25-30 percent on landowners and 30-35 percent on workers.

Another relevant study looking for the distribution of corporate income tax incidence is provided, for example, by Agarwal & Chakraborty (2018). This study is performed with firm-level data which are, in this case, from India in the period 2000-2015 taken from the Bombay Stock Exchange and National Stock Exchange of India. The authors examined 5,666 Indian corporate firms by seemingly unrelated regression technique with dynamic panel estimates and came to a strong conclusion that capital bears approximately 99 percent of the corporate tax burden and labor bears only about 1 percent. This is somewhat different from the findings of (Shome 1978), who also examined Indian firm-level data, but during 1971-1972, and uttered that *"part of the corporation's income tax is indeed shifted to laborers. But it can't be that 100 percent of the burden is shifted to laborers."*

Fuest *et al.* (2018) investigated the corporate tax incidence on wages in Germany during 1993-2012. They exploited a large number of changes in the local business tax, as approximately 10 percent of all municipalities adjusted this tax each year, resulting in 17,999 tax changes in 10,001 municipalities between 1993 and 2012. They used methods such as distributed lag model or difference-in-differences model, which were followed by sensitivity checks. They found that for companies subject to local business tax, employees bear about 51 percent of the total tax burden which is similar to the results of Arulampalam *et al.* (2012), Liu & Altshuler (2013) and Suárez Serrato & Zidar (2016). Their results may be relevant for countries where corporate tax is levied at sub-national level.

Chapter 3

Data

The aim of this chapter is to present data sources and explain the selection of variables that will be further used in the empirical analysis of this work. According to Clausing (2012), whose main variables are the corporate tax variable and the average wage variable, we tried to get data on both of these variables from two different sources. For the purpose of this work, the data was obtained mainly from OECD Statistics (2020a), which provided a consistent overview of the data not only for these two variables. Furthermore, we decided to build our own dataset for both main variables, which would correspond as much as possible to real data. For the corporate tax rate, the data was collected from databases of mainly country tax authorities and for average wages from the statistical offices of each country. This data was subsequently adjusted to be as consistent and comparable as possible to the OECD dataset. In view of the above-mentioned study, but also other empirical studies, such as Exbrayat & Geys (2016), which introduce other variables explaining the impact of corporate tax, we again followed Clausing (2012) and implemented three other variables - K/L ratio, real GDP and unemployment. Their explanations and the manner in which they were calculated are contained in Section 3.3.

3.1 Corporate income tax rate

We primarily examined the OECD Statistics (2020a) database, which provides data on most states on the statutory corporate tax rate and the combined statutory corporate tax rate - which is essentially a corporate income tax rate less deductions for sub-national taxes and plus the sub-central rate. For our first dependent variable, we chose the combined statutory corporate tax rate,

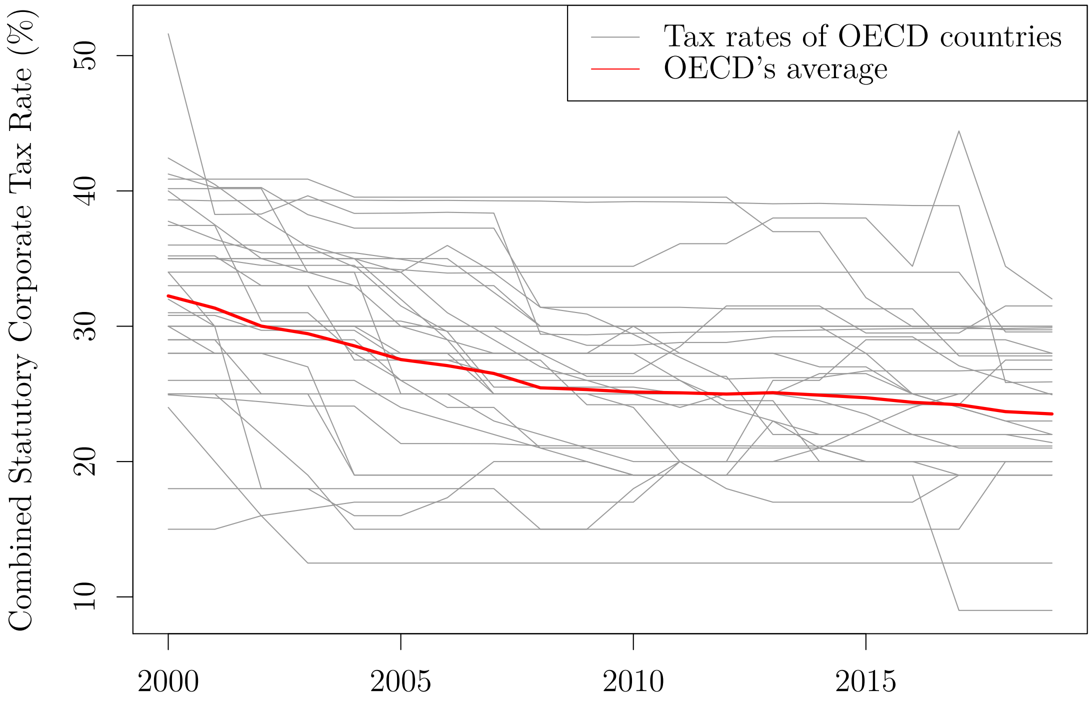

Figure 3.1: Combined Statutory Corporate Tax Rates - OECD data

which was also used by Clausing (2012). Data on all 36 Member States for the period 2000-2019 were collected from the OECD Statistics (2020a). However, as will be described in section 3.2 for the State of Turkey, no relevant wage data were available as well as 2019 data for a significant part of the Member States, which is why we have decided to omit Turkey in our data set and skip 2019. As shown in Figure 3.1, the average corporate tax rate in the countries monitored tends to fall slightly over time.

The advantage of this variable is that it should be rather stable across the different sources from which it was obtained, since the rate of income tax is given legislatively and its definition and calculation can only be changed to a certain extent. However, we have decided to compile our own dataset on the amount of corporate tax in each state. This time, the corporate tax rate, which is not combined, was collected for 30 OECD member states for the period 2000-2018 (see Appendix Table 6.1 for more details on the various sources). We were forced to omit Chile, Greece, South Korea, Portugal, Slovenia and again Turkey, because for these countries we were unable to get our own wage data. As with the OECD dataset, 2019 was skipped. As we can see in Table 3.1 containing the descriptive statistics of both sources, the data is very similar, which may be due to the clear definition of this variable as mentioned above. This fact also supports the fact that the correlation of variables from these two sources is 0.99, as we can see in Appendix Table 6.3.

Table 3.1: Descriptive Statistics for Tax variable

Statistic	Tax - OECD data (%)	Tax - our dataset (%)
N	665	570
Mean	26.7	26.7
St. Dev.	7.12	7.19
Min	9	9
Pctl(25)	21	20
Median	27	28
Pctl(75)	30.9	31.4
Max	51.6	51.6

3.2 Average wage

For all Member States, OECD Statistics (2020a) provides data on the average annual wage at three levels. Firstly, average annual wages at current prices and currencies of individual countries, secondly also values in national currencies, but at constant prices, where the base year is 2018 and finally values at constant prices and also transferred according to PPP =*purchasing parity* USD in 2018. Like Clausing (2012), we decided to use the last mentioned transformation, as the data about it is best comparable. In the period 2000-2018, we obtained data for 35 Member States (OECD Statistics 2020a).[1] Constant prices in PPP of the last reference year have to some extent prevented the impact of other economic factors on the level of wages in our reporting period, however, as shown in Figure 3.2, the average annual wage of the 35 OECD countries examined was a slight upward trend, despite the use of these data.

Labour market data vary greatly depending on the source and a number of other factors. Therefore, it is difficult to create a dataset that is consistent and

[1] Data on Turkey and data for 2019 were not available.

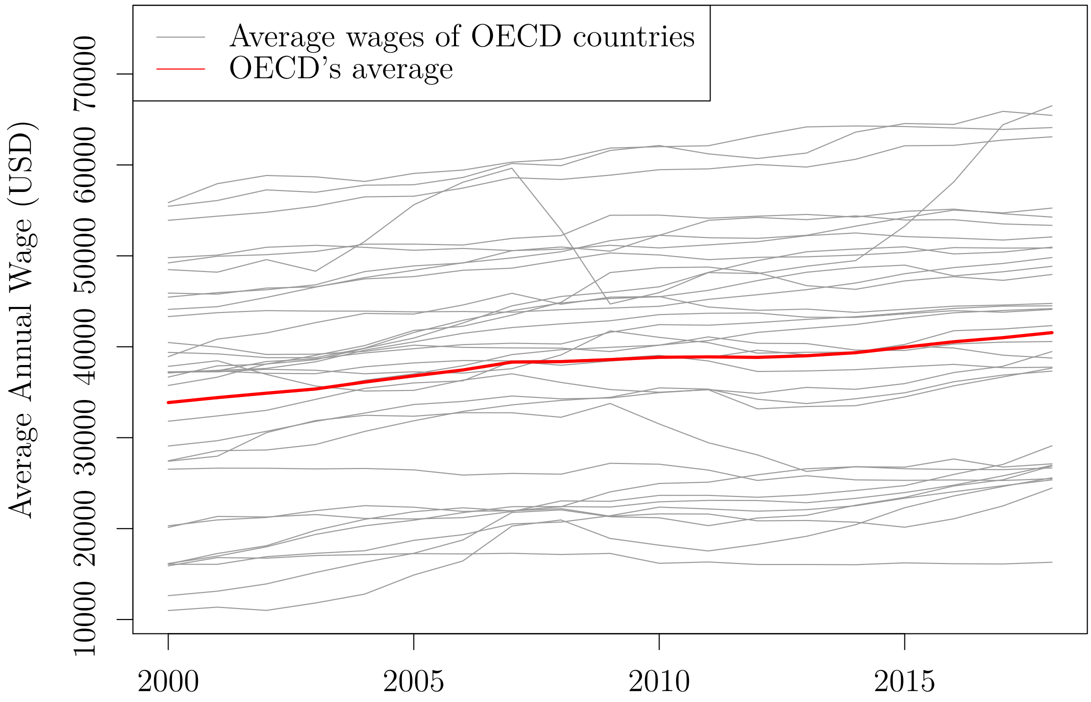

Figure 3.2: Average Annual Wages - OECD data

whose values would be comparable. We tried this in this work, however, it was necessary to deal with many circumstances. OECD Member States are all over the world, and not in all areas it is customary to report average monthly wages, but, for example, hourly wages, daily wages, etc., this was the first discrepancy across the data. It was also necessary to convert the wage data collected in different national currencies into the single currency. Macroeconomic quantities are often compared by converting national data into the common currency at exchange rates, but these may not reflect the relative international prices of all goods and services. By contrast, PPP coefficients correct differences in price levels and are therefore an adequate tool for comparing cross-border data, providing a clearer picture of the relative size of economies (Schulze-Gattas & Gulde 1992). In the end, we cleared the data on inflation, the natural consequence of which is the growing trend in wages.

We are considering those countries that are members of the OECD by

2019, with the exception of Chile, Greece, South Korea, Portugal, Slovenia and Turkey, which we have left out of the file due to unavailable observations. Data on the sources of average wages of the remaining 30 countries are presented in Appendix Table 6.2, mainly from the statistical offices of each country. We have solved all of the above inconsistencies as follows:

- An annual time interval was chosen to compare the dataset with the OECD Statistics (2020a) data. The monthly data were only multiplied by the number of months of the year. Weekly data were multiplied by the number of weeks of the year. Daily data were expected to be 5 working days a week, which was calculated for the weekly interval and subsequently progressed the same way as weekly data, and in the end, for the average hourly wage, we assumed 40 working hours per week, thus adding to a weekly wage and again progressed the same way as for the weekly interval.

- The US dollar was used as the single national currency to which the other data was converted using the above mentioned PPP coefficient. Of the 30 countries under consideration in the period 2000-2018, data on the PPP of the national currency unit to the US dollar were collected from the OECD Database (2020b), which provided a comprehensive set for all countries and for the whole period.

- Finally, wage data for 2000-2017 had to be adjusted for inflation, as most of the state had a positive inflation rate during the period considered, and therefore it is natural that wages have had an upward trend. For the values of the inflation rate for the countries surveyed over the period considered, we used the total annual growth rate calculated using the CPI =*consumer price index*. The OECD Database (2020a) provided a comprehensive set of these values again. We subsequently recalculated the wage data using the following equation 3.1:

$$Wage_{it}(adjusted) = Wage_{it}\left(1 + \frac{Inf\ rate_{i,t+1} + ... + Inf\ rate_{i,2018}}{100}\right);$$

$$\text{for } i = \text{Australia, ... , United States, } t = 2000; ... ; 2017 \qquad (3.1)$$

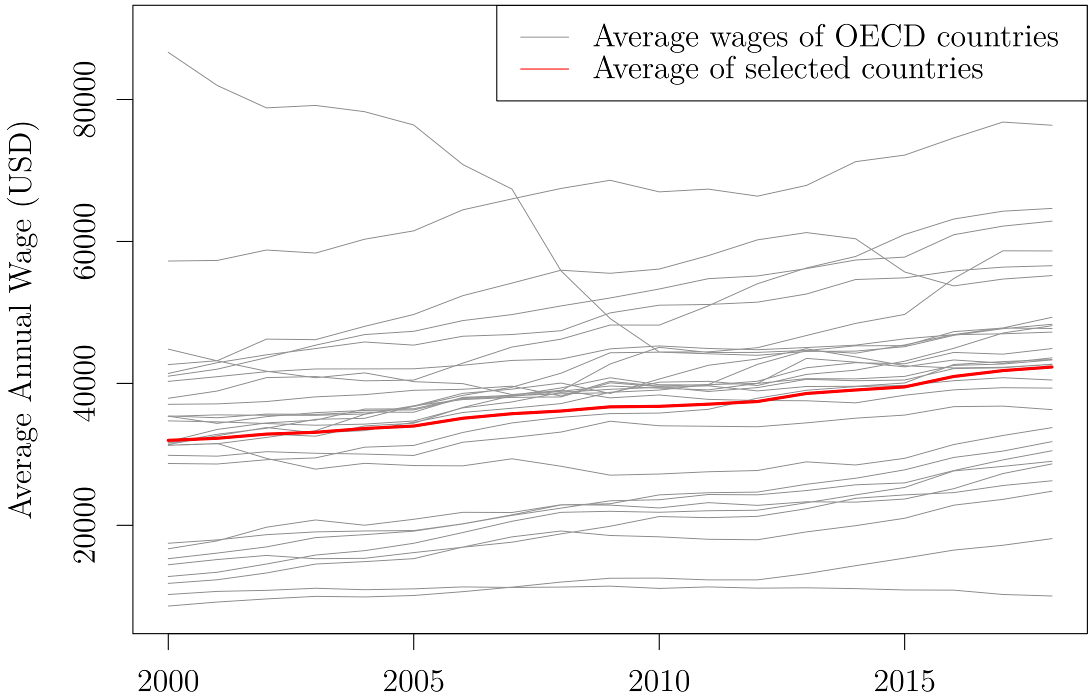

Figure 3.3: Average Annual Wages - our dataset

After all irregularities in the wage data have been resolved, the data was prepared for subsequent examination, as described in Chapter 4. For comparison with OECD Statistics (2020a) data, the following Figure 3.3 is attached. As we can see, despite all the adjustments to the irregularities, average annual wages are on an upward trend in the data set we created.

The wage dataset is complete at this point. For a closer comparison of the two sources, see Table 3.2, which contains descriptive statistics on both sources. Thus, we can see that the data is again largely similar, since their correlation is 0.87, as we can see in Appendix Table 6.3.

Table 3.2: Descriptive Statistics for Wage variable

Statistic	Wage - OECD data (USD)	Wage - our dataset (USD)
N	665	570
Mean	38,006	36,570
St. Dev.	13,250	14,174
Min	10,987	8,615
Pctl(25)	25,915	27,348
Median	39,102	38,059
Pctl(75)	48,247	44,091
Max	66,504	86,647

3.3 Other variables

According to Clausing (2012), we included a variable capital-to-labor ratio defined as:

$$K/L\ Ratio = \frac{Gross\ fixed\ capital\ formation}{Total\ labor\ force}.$$

For the entire referenced period and at the same time for all monitored countries, data on gross fixed capital formation was withdrawn from the World Bank Database (2020b), as well as data for total labor force (World Bank Database 2020c).

Another variable included in our empirical model is real GDP. The necessary GDP data were readily available again in the World Bank Database (2020d), however, it was nominal GDP data (at the current USD). For conversion to real GDP, we used the GDP deflator (World Bank Database 2020a). The problem that needed to be eliminated was that for most states the base year for the deflator was set for 2015, but for Australia, Chile, South Korea, Mexico and Poland the base year was different. Because the 2015 primary year prevailed, we decided to move the base year for these five states to 2015 so that it was the same for all the countries surveyed. We used the following equation 2 (Gans *et al.* 2011) to convert nominal GDP to real GDP:

$$Real\ GDP_{it} = \frac{Nominal\ GDP_{it}}{GDP\ deflator_{it}};$$

$$\text{for } i = \text{Australia, ... , United States, } t = 2000; \ldots ; 2018 \tag{3.2}$$

For our last variable - Unemployment - we once again used data from the OECD Statistics (2020b), where we were provided with a comprehensive overview of the unemployment rates for all OECD Member States for the whole referenced period 2000-2018. After the description of this variable our dataset is completely closed, for more details on the three variables described above, see Table 3.3, which contains descriptive statistics of the remaining variables used in our empirical analysis.

Table 3.3: Descriptive Statistics for variables K/L Ratio, Real GDP and Unemployment

Statistic	K/L Ratio	Real GDP (bil. USD)	Unemployment (%)
N	665	665	665
Mean	15,134	1,270.9	7.51
St. Dev.	9,207	2,837.8	4.13
Min	1,312	11.6	1.81
Pctl(25)	7,830	154.3	4.79
Median	13,719	339.6	6.57
Pctl(75)	20,051	1,279.3	8.84
Max	51,354	19,468.8	27.47

Chapter 4

Methodology

The following chapter gives the theoretical background of our chosen model. The data described above is a panel dataset. Such data is a combination of time and cross-sectional data. Cross-sectional data is generated by observing multiple subjects at a single time, and time data records the development of one subject over time, so panel data is generated by repeated observations of a set of subjects over time. As a rule, a set of data is considered that does not change over time, and this is exactly what our two datasets examined meet. While section 4.1 only describes the standard procedures for processing panel data, section 4.2 determines the scope of our empirical analysis and subsequent steps in determining our model. The main inspiration for empirical analysis of this thesis is the panel VAR model used by Clausing (2012).

4.1 Standard procedures for panel data

As already mentioned, a panel dataset was chosen for the empirical part, for which the analysis did not use a very standard approach. However, we still decided to list these classic approaches according to Wooldridge (2016) and in Chapter 5 further explain why some of these procedures were not used. These include Pooled OLS, First Difference, Random Effects and Fixed Effects Estimators. Panel data analysis enables you to address unobserved heterogeneity that is otherwise unobservable and overall it is more variable and effective in its estimates. The basic model for analysis is defined as follows:

$$y_{it} = \alpha + \beta x_{it} + a_i + u_{it}; \quad i = 1,..., N, \ t = 1,..., \ T \tag{4.1}$$

where i indicates a cross-sectional unit and t time period. α is the intersection, and β represents the vector of coefficients that we estimate. x_{it} is further our explanatory variable and also here we have a fixed effect, a_i, and an idiosyncratic error affecting y_{it} that changes over time and represents unobserved factors, u_{it}.

If we have data for all cross-sectional units over the same time period, we say that our dataset is balanced. Otherwise, the dataset is unbalanced. The standard methods of analysis are as follows:

- **Pooled OLS**
  According to Wooldridge (2016) we use Pooled OLS if we collect a different sample for each time period. The key assumption is that the fixed effect, a_i, is not correlated with the explanatory variable x_{it}. If this assumption is violated, we get the heterogeneity bias.

- **First Difference**
  If we have to address the problem of omitted variables, First Difference estimator should be used. The disadvantage of this approach is that for each cross-sectional unit we lose the first observation. The assumption here is that idiosyncratic errors u_{it} are not serially correlated. This model works by subtracting adjacent time periods from each other when you start Pooled OLS, so that earlier time periods are subtracted from later time periods. First Difference can also be used if we estimate non-stationary data.

- **Random Effects**
  If there are no perfect linear relationships between explanatory variables and if other assumptions are met, this method is asymptotically more effective than other methods. Thus, if the unobserved effect is not correlated with all explanatory variables, we should proceed in this way.

- **Fixed Effects**
  In case we want to eliminate the unobserved effect, we can use fixed effects estimator. This method eliminates any explanatory variable that would be constant over time, which can help us to solve the fixed effect a_i, often correlated with explanatory variables. If we have serially uncorrelated and homoskedastic errors, and at the same time that these errors are not correlated with explanatory variables, then we will receive an unbiased estimate.

As already mentioned, these methods can be effective under certain assumption. Otherwise, it is preferable to find an alternative way to analyze the data, such as in our work and others that address the incidence of corporate income tax.

4.2 Panel VAR

The standard vector autoregressive model (VAR) is defined as a model for two or more time series. Each variable is further defined as a linear function of past values of all variables plus error terms that have a zero mean relative to all past values of the variables examined (Wooldridge 2016). The classic VAR model thus captures dependencies between different variables over time, allowing you to look at causal dependencies. So this is our main motivation for using the VAR model, because we believe that in our data there is a dependency over time and individual variables also affect each other over time. Simultaneous equations and other models are often criticized for classifying exogenous and endogenous variables. Although we can also add exogenous variables to this model, the advantage of the VAR model is that it *"assumes that all variables are endogenous."* (Baltagi 2011). This provides an alternative way of exploring dependent economies, in which most explicit structures are omitted and that captures dynamic interdependencies in data using minimal restrictions - the panel vector autoregressive model (Canova & Ciccarelli 2013). It is simply a combination of described approaches where we have variables that affect each other over time and at the same time there is another variable in the model that causes heterogeneity, in our case, for example, Wage. Furthermore, it has the same structure as the VAR model, in terms of resolution of exogenous and endogenous variables, but a cross-sectional dimension is added. Index i is generic and defines, for example, a country. Then the fundamental panel VAR model is represented by the following equation:

$$y_{it} = \alpha + \beta y_{i,t-1} + u_{it}; \quad i = 1,..., N, \; t = 1,..., T \tag{4.2}$$

This model is also used in the extended specification to analyze our data. As stated in Chapter 3 on data, data collection has brought with it a number of problems that make it difficult to establish the appropriate specifications that the analysis should follow. The results of various analyses can be very sensitive to which wage data or data on other variables are used. Another problem may be the already mentioned distinction between exogenous and endogenous variables. Therefore Clausing (2012) uses this alternative method and defines the panel VAR model which is also used in this thesis:

$$\begin{aligned} Wage_{it} = \sum_{i} \alpha_i + \sum_{n=1}^{5} Wage_{i,t-n} + \sum_{n=1}^{5} Tax_{i,t-n} + \sum_{n=1}^{5} K/LRatio_{i,t-n} \\ + \sum_{n=1}^{5} GDP_{i,t-n} + \sum_{n=1}^{5} Unem_{i,t-n} + \sum_{n=1}^{x} \alpha_i \end{aligned} \tag{4.3}$$

$$\begin{aligned} K/LRatio_{it} = \sum_{i} \alpha_i + \sum_{n=1}^{5} K/LRatio_{i,t-n} + \sum_{n=1}^{5} Tax_{i,t-n} \sum_{n=1}^{5} Wage_{i,t-n} \\ + \sum_{n=1}^{5} GDP_{i,t-n} + \sum_{n=1}^{5} Unem_{i,t-n} + \sum_{n=1}^{x} \alpha_i \end{aligned} \tag{4.4}$$

$$\begin{aligned} Tax_{it} = \sum_{i} \alpha_i + \sum_{n=1}^{5} Tax_{i,t-n} + \sum_{n=1}^{5} Wage_{i,t-n} + \sum_{n=1}^{5} K/LRatio_{i,t-n} \\ + \sum_{n=1}^{5} GDP_{i,t-n} + \sum_{n=1}^{5} Unem_{i,t-n} + \sum_{n=1}^{x} \alpha_i \end{aligned} \tag{4.5}$$

This model is estimated in R using the panelvar package invented and published by Sigmund & Ferstl (2017). This package allows you to estimate the VAR panel model with p lags of endogenous variables using the first difference GMM (Generalized Method of Moments) estimator according to Holtz-Eakin *et al.* (1988) and Arellano & Bond (1991). These authors use lags of endogenous variables as instruments.

As already mentioned GMM estimate uses lags of endogenous variables as instruments and furthermore first difference or forward orthogonal is implemented in order to eliminate fixed effects. Holtz-Eakin *et al.* (1988) introduces the following equation for N cross-sectional units observed during the T period, which allows individual effects and non-stationarity over time:

$$y_{it} = \alpha_{0t} + \sum_{l=1}^{m} \alpha_{lt} y_{i,t-l} + \sum_{l=1}^{m} \delta_{lt} x_{i,t-l} + \Psi_t f_i + u_{it} \tag{4.6}$$

for $i = 1,..., N$, $t = 1,..., T$, where f_i is an unobserved individual effect and the coefficients α_{1t},...,α_{mt}, δ_{1t},...,α_{mt}, Ψ_t are the coefficients of the linear projection of y_{it} on a constant, past values of y_{it} and x_{it}, and the individual effect f_i (Holtz-Eakin *et al.* 1988).

To eliminate fixed effects, first difference or forward orthogonal transformation is applied as follows:

$$\Delta^* y_{it} = \sum_{l=1}^{m} \alpha_{lt} \Delta^* y_{i,t-l} + \sum_{l=1}^{m} \delta_{lt} \Delta^* x_{i,t-l} + \Psi_t \Delta^* f_i + \Delta^* u_{it} \tag{4.7}$$

Δ^* indicates the first difference or the forward orthogonal transformation. In the case of the first difference transformation, $t \in \{m+2,...,T\}$ and the forward orthogonal transformation exists for $t \in \{m+1,...,T-1\}$ (Sigmund & Ferstl 2017).

(Arellano & Bover 1995) say that if all available instruments are used and the transformation matrix meets the definition of the upper triangular matrix, then the GMM estimator is invariant in the transformation selection. By contrast, Hayakawa *et al.* (2009), who compared the two available transformations in different experiments, show that forward orthogonal transformation provides a better estimate in many cases. Therefore, to eliminate fixed effects, we decided to use forward orthogonal transformation.

We have a method of empirical analysis of our panel dataset. It is not usual to state R^2 for the GMM estimate, as it is the ratio of the explained variance in the data, which makes sense, for example, for OLS because the criteria function is based on variation of errors. In contrast, for GMMs, the criteria function is different - it uses moments - so it is necessary to use a different goodness of fit test. That is why instead we are performing a Hansen overidentification test to verify the robustness of the whole process. Clausing (2012) uses for its model 5 lags for all variables, we decided to use the Andrews-Lu model selection procedure according to Andrews & Lu (2001), which should provide us with the ideal number of lags for both the OECD dataset and the data collected by us. Finally, we verify the stability of the entire panel VAR model based on the theory described among others by Lütkepohl (2005). All these procedures are described below.

- **Hansen test**

  To verify the validity of a subset of instruments, we follow Hansen (1982) and its overidentification test. Exogenous instruments are an essential assumption for GMM's estimation of the panelvar package. The model defines:

$$H_0 : \textit{Excluded instruments are exogenous}$$
$$\textit{and independent of the error process.}$$

This statistic follows χ^2 distribution and is accepted if Probability > 0.05. A zero hypothesis is not rejected if the probability meets this criterion. In this case, the instruments are valid and their selection should be correct.

- **Andrews-Lu model selection procedure**
  In determining the optimal number of lags and moment condition for our VAR panel, we follow Andrews & Lu (2001). The essential Model and Moment Selection Criteria (MMSC), which has proposed the criteria for GMM estimates of our panel VAR model, is then applied. MMSC are designed in accordance with the above statistics of Hansen (1982) concerning overidentification restrictions and at the same time resemble criteria based on maximum probability - Akaike information criteria (AIC), Bayesian information criteria (BIC), and Hannan-Quinn information criteria (HQIC), which are widely used.

- **Stability of the panel VAR model**
  The condition that is standard for the stability of the coefficients of the panel VAR model depends on the modulus of each eigenvalue of the estimated model. The panel VAR is stable if all the eigenvalues of companion matrix lie inside the unit circle (Lütkepohl 2005). When this condition is met, the panel VAR is invertible and its vector moving-average representation has infinite-order.

Chapter 5

Results and Discussion

In the penultimate chapter on results and their subsequent commenting, we first summarise the results of the first model for which OECD data was used and then summarise the results of the second model, where the data collected by us was used. The results also include other used apparatuses, which were used exactly according to the theory described in the previous Chapter 4.

In view of the literature mentioned and, above all, the specific approach to data processing, we can confirm the following statement:

"There was found some evidence that suggests that corporate taxation may lower wages, but the preponderance of evidence does not suggest any wage effects from corporate taxation." (Clausing 2012)

As can be seen below, while this discovery is not very statistically significant, and despite other empirical studies at international level, it may be a little surprising, it is necessary to understand the complexity of the question we ask, as well as the fact that many studies may omit important aspects.

5.1 OECD dataset

Although the model taken over was originally defined for 5 lags, it was necessary to verify that the same number of lags could be used for our data. With regard to the R package that we used (Sigmund & Ferstl 2017), as well as the already mentioned Andrews-Lu model selection procedure (Andrews & Lu 2001), was selected a model with one lag compared to models with two, three, four and five lags, based on all three included moment and model selection criteria.[1] This selection is supported by the fact that for models with multiple lags not all the eigenvalues lay inside the unit circle, and therefore these panel VAR models did not satisfy stability condition. By contrast, for a single-lag model, all the eigenvalues lie inside the unit circle, as we can see in Table 5.1 and more clearly in graphically processed Figure 5.1.

Table 5.1: Eigenvalue stability condition for OECD data

	Eigenvalue	Modulus
1	0.9536+0.0000i	0.9536
2	0.7008+0.0736i	0.7047
3	0.7008−0.0736i	0.7047
4	−0.0033+0.0000i	0.0033
5	0.0000+0.0000i	0.0000

All the eigenvalues lie inside the unit circle.
PVAR satisfies stability condition.

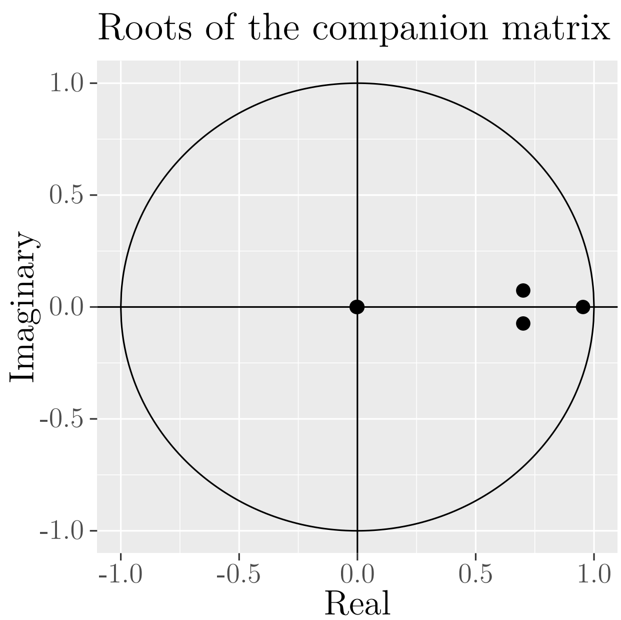

Figure 5.1: Stability condition for 1-lag model with OECD data

[1] lag = 5: BIC = -2428.669, AIC = -780.5503, HQIC = -1502.303
lag = 4: BIC = -2488.176, AIC = -789.4414, HQIC = -1530.453
lag = 3: BIC = -2540.819, AIC = -792.8256, HQIC = -1552.522
lag = 2: BIC = -2588.395, AIC = -792.3012, HQIC = -1570.196
lag = 1: BIC = -2636.452, AIC = -793.2560, HQIC = -1588.933

Table 5.2: Regression results - OECD data

Method of estimation: Dynamic Panel VAR estimation, two-step GMM					
Transformation: Forward orthogonal deviations					
Group variable: Country					
Time variable: Year					
Number of observations = 595					
Number of groups = 35					
Obs per group: min = 17					
avg = 17					
max = 17					
Number of instruments = 425					
	Tax1	Wage1	KLratio1	GDP1	Unem1
lag1_Tax1	−0.0001	0.0016	−0.0027	−0.0037*	0.0000
	(0.0001)	(0.0019)	(0.0014)	(0.0018)	(0.0000)
lag1_Wage1	−0.0381	0.9628***	0.2171*	0.0136	0.1077
	(0.1477)	(0.0580)	(0.0969)	(0.0096)	(0.1356)
lag1_KLratio1	0.0651	0.0160	0.6850***	−0.0005	−0.1973
	(0.2126)	(0.0507)	(0.0599)	(0.0267)	(0.2025)
lag1_GDP1	0.0136	−0.5116	0.6420*	0.7043	−0.0107
	(0.0171)	(0.4976)	(0.3243)	(0.3724)	(0.0120)
lag1_Unem1	0.0004	−0.0076	−0.0029	−0.0142	−0.0001
	(0.0002)	(0.0062)	(0.0017)	(0.0075)	(0.0001)
Note:					*p<0.1; **p<0.05; ***p<0.01
Instruments for equation: Standard					
GMM-type: Dependent vars: L(2, 17)					
Collapse = TRUE					
Hansen test of overid. restrictions: chi2(400) = 46.74 Prob > chi2 = 1					
(Robust, but weakened by many instruments.)					
Reference:					Sigmund & Ferstl (2017)

The coefficients shown in Table 5.2 show how the past values of all variables affect each variable. With the variables assessed by us - Wage, K/L Ratio, and Tax - we can see that the results are not very statistically significant. In the Wage equation its own first lag lag1_Wage1 is statistically significant at 1% significance level, with coefficient being around 0.96. Similarly to the K/L Ratio equation, where its own first lag has coefficient 0.69. However, these are not surprising values on the basis of which the impact of corporate tax on the level of wages can be confirmed. With a 10% significance level, we can confirm the coefficients for the first lag of Wage (lag1_Wage1) and the first lag of GDP (lag1_GDP1), which are 0.22 and 0.64, respectively, in the equation for The K/L Ratio, which is not very decisive for the question we ask. Since the GMM estimator uses lags of endogenous variables as instruments, our model is weakened by many of these instruments, however, this model is still robust based on the Hansen test of overidentification restriction (see Table 5.2).

5.2 Newly built dataset

At our dataset, we proceeded again in accordance with the literature mentioned in Chapter 4. We have always wanted to use the maximum data span that was available, so this second model will be different in the number of lags at the very beginning. Again, according to Andrews & Lu (2001), the preferred model is with two lags compared to one, three, four and five lags based on at least two of the three included moment and model selection criteria.[2] This selection is again supported by the fact that the model with two delays as the only one meets the stability condition, the results of which we can see in Table 5.3 and again in graphic processing in Figure 5.2.

Table 5.3: Eigenvalue stability condition for our dataset

	Eigenvalue	Modulus
1	0.9669+0.0000i	0.9669
2	0.4124+0.3911i	0.5684
3	0.4124−0.3911i	0.5684
4	0.4406+0.0000i	0.4406
5	0.0316+0.3051i	0.3068
6	0.0316−0.3051i	0.3068
7	−0.0606+0.1332i	0.1464
8	−0.0606−0.1332i	0.1464
9	−0.0004+0.0014i	0.0014
10	−0.0004−0.0014i	0.0014

All the eigenvalues lie inside the unit circle.
PVAR satisfies stability condition.

The estimated coefficients for the second model can be seen in Table 5.4. At first glance, we can say that the results are not very different from the previous model. The most statistically significant and at the same time the only ones worth mentioning for this model are again the coefficients of the first lags of

[2] lag = 5: BIC = -2373.212, AIC = -786.7531, HQIC = -1487.078
lag = 4: BIC = -2429.162, AIC = -792.8588, HQIC = -1512.437
lag = 3: BIC = -2481.793, AIC = -797.0013, HQIC = -1535.242
lag = 2: BIC = -2539.760, AIC = -807.6390, HQIC = -1564.041
lag = 1: BIC = -2555.445, AIC = -776.9926, HQIC = -1551.127

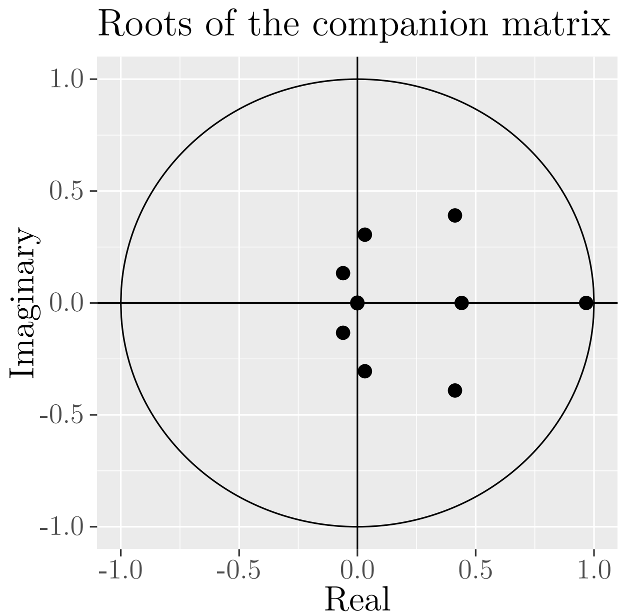

Figure 5.2: Stability condition for 2-lag model with our dataset

variables Wage and K/L Ratio - lag1_Wage2 and lag1_KLratio2, which this time are approximately 1.28 and 0.96, respectively, with a 1% significance level. But it is important to note that the significant first lag of Wage, lag1_Wage2, is 1.2791, while the second lag, lag2_Wage2, is -0.3096. The problem arises with the first lag, as it is greater than one, which would mean that the whole process is explosive (Wooldridge 2016). If we bypass all the assumptions the first and second lag of Wage give a coefficient of 0.9695 in total, which is basically the same value as the first lag of Wage in the previous model, lag1_Wage1. Although the whole process appears stable (see Figure 5.2) and the model is again robust, although it is again weakened by many instruments in the form of individual years (see Table 5.4), we should take this into account and, in general, follow rather the results of the first model in Section 5.1.

Since for us the substantial conclusion of both models is almost identical, there is no reason for their further comparison. To some extent, the results could be expected to be similar, so our analysis was aimed at at least a small difference between the models. These differences in the form of additional dataset, the necessity to omit some observations and, ultimately, the number of lags specified for the second panel VAR model may have produced different results. However, these are very similar, and therefore we can confirm the statement by Clausing (2013), as, on the basis of our empirical analysis, there is no evidence that changes in the corporate income tax rate affect wages in any way. While this discovery is not very statistically significant and may not be in line with the conclusions of some authors of contemporary scientific literature (e.g. Arulampalam *et al.* 2012), we do not have evidence to confirm some of these conclusions.

Table 5.4: Regression results - our dataset

Method of estimation: Dynamic Panel VAR estimation, two-step GMM

Transformation: Forward orthogonal deviations
Group variable: Country
Time variable: Year
Number of observations = 480
Number of groups = 30
Obs per group: min = 16
avg = 16
max = 16
Number of instruments = 425

	Tax2	Wage2	KLratio2	GDP2	Unem2
lag1_Tax2	−0.0000	0.0032	−0.0053	0.0011	−0.0001
	(0.0002)	(0.0208)	(0.0145)	(0.0100)	(0.0001)
lag1_Wage2	−0.2800	1.2791***	0.2928	−0.0846	−0.2468
	(0.2279)	(0.2481)	(0.2296)	(0.3718)	(0.3115)
lag1_KLratio2	0.4196	0.0898	0.9618***	−0.0820	0.4295
	(0.3547)	(0.1053)	(0.1275)	(0.1708)	(0.5455)
lag1_GDP2	0.0222	−0.3980	0.2275	−0.0672	0.0214
	(0.0267)	(0.4325)	(0.3066)	(0.9437)	(0.0265)
lag1_Unem2	0.0002	−0.0055	−0.0011	−0.0065	0.0001
	(0.0004)	(0.0165)	(0.0046)	(0.0259)	(0.0004)
lag2_Tax2	−0.0001	0.0034	−0.0031	0.0030	−0.0002
	(0.0003)	(0.0268)	(0.0114)	(0.0176)	(0.0002)
lag2_Wage2	−0.1835	−0.3096	−0.0788	0.1193	−0.1831
	(0.1858)	(0.2375)	(0.2375)	(0.4507)	(0.2215)
lag2_KLratio2	0.5240	−0.0470	−0.3882**	0.0921	0.5471
	(0.5939)	(0.0650)	(0.1257)	(0.1942)	(0.6743)
lag2_GDP2	0.0245	−0.0046	0.2794	−0.1483	0.0234
	(0.0372)	(0.5056)	(0.3743)	(1.1798)	(0.0322)
lag2_Unem2	0.0002	0.0012	−0.0004	−0.0069	0.0000
	(0.0003)	(0.0050)	(0.0025)	(0.0260)	(0.0003)

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

Instruments for equation: Standard
GMM-type: Dependent vars: L(2, 16)
Collapse = TRUE

Hansen test of overid. restrictions: chi2(375) = 22.36 Prob > chi2 = 1
(Robust, but weakened by many instruments.)

Reference: Sigmund & Ferstl (2017)

Chapter 6

Conclusion

The economic incidence of corporate income tax is undoubtedly a very complex topic that can be viewed from different points of view. From Harberger's (1962) general model, which attached the entire tax burden to capital, through a number of analyses examining this impact both at international level and at the level of one state, to the Clausing's (2013) analysis, which, it may be said, returns to previous perspectives, as it does not find any evidence of the impact of corporate tax on wages. That is why it is important, in addition to its own analysis, to include an overview of existing empirical estimates and the concept of this issue.

Studies conducted 10 or 20 years ago tended to determine at least some of the impact of corporate taxes on wages, which may have been due to the expanding globalization, which entails greater mobility of capital and services. That is why we are seeing many empirical studies of the established impact of the corporate tax, which is often quite significant (e.g. Liu & Altshuler 2013). Our review also shows that studies at a single state level mostly estimate that 50% of the tax burden is shifted onto labor, while analyses at international level often differ in their estimates. This may be due to the list of states which are being explored, but a wide range of tools to access data may also have something to do with it.

Empirical procedures and data are two important factors that can completely alter the answer to this complex question. Data can even vary in many planes, such as the size of the area we are examining, the time interval, or, for example, the differences between the countries examined. Therefore, it is very difficult to obtain a representative sample, which also reinforces the fact that data is often unavailable to countries that are not members of so many international structures. The whole influence across time is undoubtedly influenced by trends and policy decisions (Foremny & Riedel 2014).

Despite the above mentioned complications, we performed an empirical analysis of 35 OECD countries between 2000 and 2018. To make our interesting conclusion a little more convincing, we decided not only to use the easily accessible dataset from OECD Statistics (2020a), but also the dataset we collected from different sources. The corporate tax data was almost the same for both datasets, but the wage data had to be further unified for the same time interval, recalculated for PPP, and eventually adjusted for inflation. For both datasets we also followed the panel VAR model defined by Clausing (2012). This model was further modified because its original number of lags did not match our data, but its key variables remained the same. The main motivation for using the panel VAR model was the combination of these two approaches, because in our case there is a variable in the model that causes heterogeneity, and in addition, we know that we have variables that affect each other over time. The stability check and robustness test were also executed on this model, and although the results of both models should be both stable and robust, they are not very statistically significant. At the same time, the second model, despite the fact that it appears to be stable and robust, could be explosive, implying that we should rather follow the results of the first model which uses OECD data. However the important outputs for us from both models are almost identical, and we can therefore confirm the conclusion of Clausing (2013), who does not attach any impact on wages to corporate income tax. Of course, for the reason that the author does not have enough evidence for it, just like we do. Accordingly, for a similar selection of data and for a similarly long interval, only 10 years shifted, we can say that when using the same procedure, we came close to the same conclusion.

It is very interesting that the current data has not again confirmed the impact of the corporate tax on wages, as this may be contrary to the findings of a number of authors and therefore this topic is definitely not exhausted by this thesis either. The economic impact of the corporate income tax will still be worth further research, because there is a number of approaches to data processing. This work can help those who want to have an overview of this issue today and it will be interesting in any case how this topic will develop in the future and how the conclusions of other empirical studies will change.

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Appendix

Table 6.1: Individual sources for tax variable

Country	Source
Australia	Australian Taxation Office
Austria	Federal Ministry of Finance
Belgium	Service Public Fédéral Finances
Canada	Canada Revenue Agency
Czech Republic	Financial Administration of the Czech Republic
Denmark	Danish Tax Agency
Estonia	Estonian Tax and Customs Board
Finland	Finnish Tax Administration
France	La direction générale des Finances publiques
Germany	Federal Central Tax Office
Hungary	National Tax and Customs Administration of Hungary
Iceland	Directorate of Internal Revenue
Ireland	Office of the Revenue Commissioners
Israel	Israel Tax Authority
Italy	Agenzia delle Entrate, Ministero dell'Economia e delle Finanze
Japan	National Tax Agency
Latvia	State Revenue Service of Latvia
Lithuania	State Tax Inspectorate
Luxembourg	Administration des Contributions Directes
Mexico	Servicio de Administración Tributaria
Netherlands	Tax and Customs Administration
New Zealand	New Zealand Inland Revenue Department
Norway	Norwegian Tax Administration
Poland	Ministry of Finance, Poland
Slovak Republic	Financial Directorate of the Slovak Republic
Spain	Spanish Tax Agency
Sweden	Swedish Tax Agency
Switzerland	Swiss Federal Tax Administration
United Kingdom	HM Revenue and Customs
United States	Internal Revenue Service

Table 6.2: Individual sources for wage variable

Country	Source	Currency	Interval
Australia	Australian Bureau of Statistics	AUD	weekly
Austria	Statistics Austria	EUR	monthly
Belgium	Statbel	EUR	monthly
Canada	Statistics Canada	CAD	weekly
Czech Republic	Czech Statistical Office	CZK	monthly
Denmark	Statistics Denmark	DKK	yearly
Estonia	Statistics Estonia	EUR	monthly
Finland	Statistics Finland	EUR	monthly
France	INSEE	EUR	monthly
Germany	Federal Statistical Office	EUR	monthly
Hungary	Hungarian Central Statistical Office	HUF	monthly
Iceland	Statistics Iceland	ISK	monthly
Ireland	Central Statistics Office Ireland	EUR	weekly
Israel	Israel Central Bureau of Statistics	ILS	monthly
Italy	ISTAT	EUR	monthly
Japan	Ministry of Health, Labor and Welfare	CPY	monthly
Latvia	Central Statistical Bureau of Latvia	EUR	monthly
Lithuania	Statistics Lithuania	EUR	monthly
Luxembourg	STATEC	EUR	monthly
Mexico	Secretariat of Labor and Social Welfare	MXN	daily
Netherlands	Bureau for Economic Policy Analysis	EUR	monthly
New Zealand	Statistics New Zealand	NZD	hourly
Norway	Statistics Norway	NOK	monthly
Poland	Central Statistical Office of Poland	PLN	monthly
Slovak Republic	Statistical Office of the Slovak Republic	EUR	monthly
Spain	National Statistics Institute	EUR	monthly
Sweden	Statistics Sweden	SEK	hourly
Switzerland	Swiss Federal Statistical Office	CHF	monthly
United Kingdom	Office for National Statistics	GBP	weekly
United States	U.S. Bureau of Labor Statistics	USD	hourly

Table 6.3: Correlation Matrix - OECD vs created dataset

	Tax (OECD)	Wage (OECD)	Tax (our dataset)	Wage (our dataset)
Tax (OECD)	1	0.314	0.987	0.220
Wage (OECD)	0.314	1	0.286	0.868
Tax (our dataset)	0.987	0.286	1	0.205
Wage (our dataset)	0.220	0.868	0.205	1

Reference: Hlavac (2018)

Table 6.4: Correlation Matrix - OECD data

	Tax	Wage	K/L Ratio	GDP	Unemployment
Tax	1	0.310	0.116	0.445	-0.113
Wage	0.310	1	0.811	0.323	-0.391
K/L Ratio	0.116	0.811	1	0.129	-0.398
GDP	0.445	0.323	0.129	1	-0.112
Unemployment	-0.113	-0.391	-0.398	-0.112	1

Table 6.5: Correlation Matrix - our dataset

	Tax	Wage	K/L Ratio	GDP	Unemployment
Tax	1	0.205	0.078	0.373	-0.141
Wage	0.205	1	0.792	0.152	-0.396
K/L Ratio	0.078	0.792	1	0.093	-0.408
GDP	0.373	0.152	0.093	1	-0.101
Unemployment	-0.141	-0.396	-0.408	-0.101	1