The Redistributive Effect of Higher Taxes and the Responses of the Rich

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Mical Jonathan Christer Eklund
aus Filderstadt

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Dekan:	Prof. Dr. rer. soc. Josef Schmid
1. Gutachter:	Prof. Dr. oec. publ. Georg Wamser
2. Gutachter:	Prof. Dr. oec. publ. Valeria Merlo

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Introduction

Inequality has attracted interest in the public as well as among economists for decades. Recently, the key focus in particular involves investigating the shape of the very top of the income distribution and how it evolves over time (e.g., Piketty and Saez, 2003; Piketty, 2014; Alvaredo et al., 2017). Simultaneously, a small but growing literature has emerged that analyzes the ability of income taxes to redistribute from the very top of the income distribution to the bottom, and how top income earners themselves respond to income tax changes. The economic research presented in this dissertation adds to the literature by reporting novel insights on the dynamics of top income taxes around the world, the effect of these taxes on income inequality, and to which degree top income earners attempt to circumvent income taxes.

The group of top income earners is of significant importance for public finances. The top 1% of taxpayers contribute for instance 22% of total income tax revenue in Germany (Bundesministerium der Finanzen, 2017), 26.9% in the UK (Miller and Roantree, 2017) and 39% in the US (York, 2018).[1] These shares underline that not just the upper half of the income distribution is an important target for governments that aim at pursuing redistributive tax policies. In fact, the very top of the distribution is particularly important.

Simultaneously, public authorities are heavily dependent on these taxpayers. If the government takes measures which prompt top income earners to hide their income abroad or to relocate to foreign countries, the public purse could suffer great harm. Hence, for policymakers, it is not only important to know how taxes affect income inequality, but it is also equally important to be aware of evasive responses that pose considerable challenges to the government and eventually render any redistributive policy obsolete.

While there have been increasing efforts to explore income taxes in re-

[1]The statistics are as of 2016 for Germany and the UK and as of 2015 for the US.

cent years (e.g., Egger et al., 2019), the currently available income tax data focuses on regular employees as it covers taxes on earned income. However, capital income constitutes a significant source of income for top income earners.[2] Therefore, in a first step, taxes on earned income, capital income (like dividends or interest), self-employment income, as well as social security contributions were hand-collected for 165 countries covering the years 2006 to 2015 to provide the necessary data for the analysis.

The distributions of the earned income tax rate and the dividend income tax rate[3] are depicted in Figures 1 and 2. What we see is that the tax rates vary considerably across countries. The earned income tax rate ranges from 0% to 72%, the dividend income tax rate from 0% to 59%. However, these differences in the income tax rates do not merely reflect differences in economic development or the quality of institutions. Rather, these large differences are also present among relatively homogeneous countries like members of the OECD (as indicated by the gray bars). Furthermore, there is a significant amount of countries that do not levy any income taxes at all. This pattern is especially pronounced in the case of the dividend income tax.

The substantial differences in the tax rates suggest that governments redistribute to different degrees. However, it remains unclear to what extent these differences translate into differences in the income distributions. Furthermore, these large tax differences between countries might have important implications in the light of ever-increasing mobility of top income earners (OECD, 2011), also considering the fact that these differences persist between very similar countries, as mentioned earlier. Is there a real risk that top income earners would simply move to a nearby country with lower tax rates if the current home country increases its taxes?

This dissertation consists of three self-contained chapters where each is devoted to a different aspect of the questions raised above.

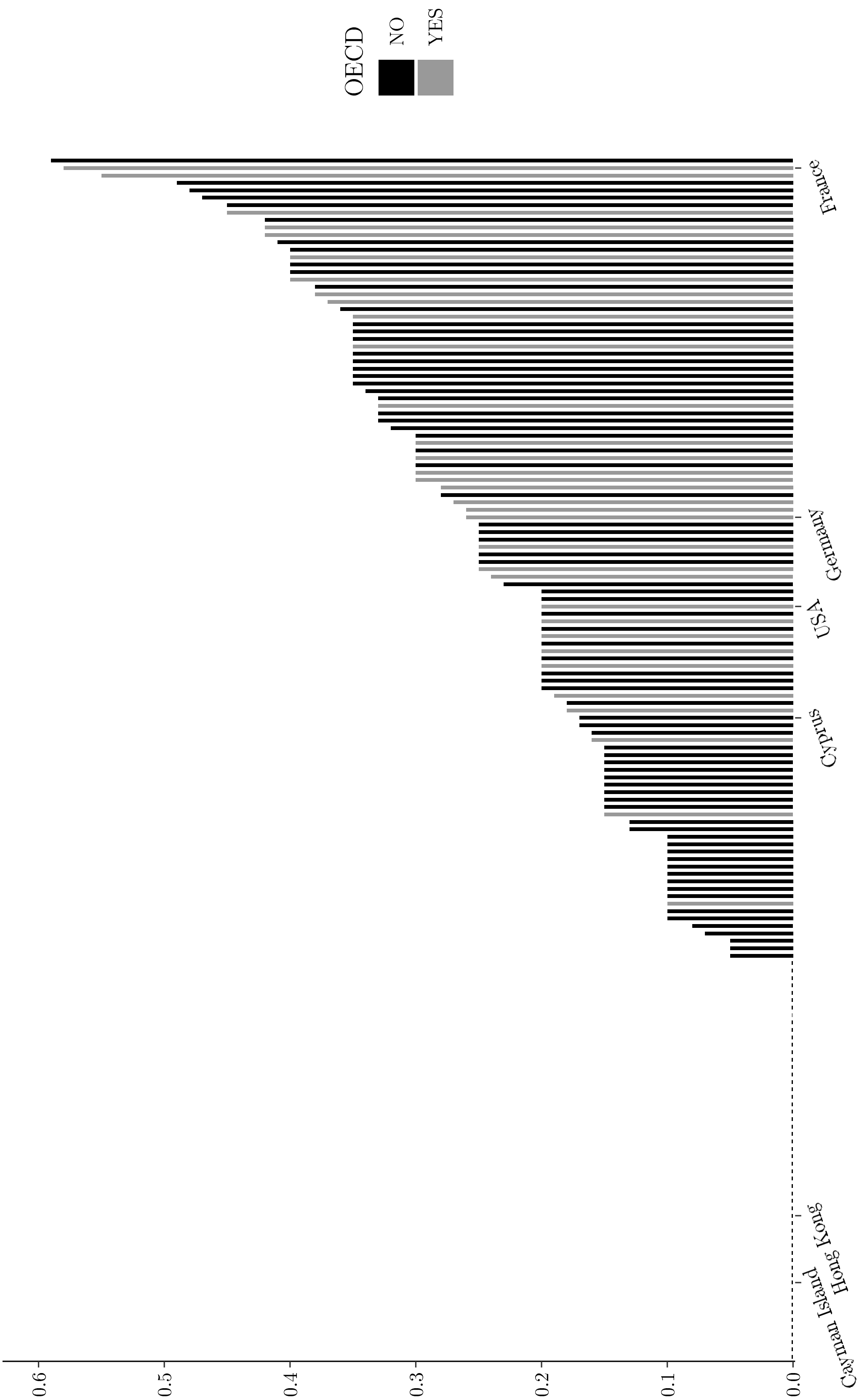
[2]See Chapter 3 for an extensive discussion of the different income sources of firm managers.

[3]The results are very similar if taxes on other capital incomes like capital gains are considered.

Figure 1: Earned income tax rate

Notes: Figure 1 depicts the distribution of the top earned income tax rate as of 2015. Gray bars indicate OECD member countries.

Figure 2: Dividend income tax rate



Notes: Figure 2 depicts the distribution of the top dividend income tax rate as of 2015. Gray bars indicate OECD member countries.

The first chapter provides a comprehensive overview of the different tax instruments. This overview includes comparisons of the different tax rates, their trends, and a discussion of country characteristics that are associated with higher or lower tax rates. In a next step, the redistributive effect of income taxes is investigated. The econometric analysis includes an extensive range of different income shares (e.g., the income share of the top 0.5% income earners) to capture potential heterogeneous effects at different income levels. Building on previous publications, the distribution of *gross* income is considered. The main idea is that taxes might be able to redistribute primary assets which are important determinants of inequality, beyond merely transferring income from the rich to the poor. The results suggest that higher taxes indeed increase the share of low income earners' share in total gross income and reduce the respective share of top income earners. Consistent with the literature on tax avoidance, the effect decreases at the very top of the income distribution.

The second chapter examines the effect of dividend income taxes on dividend payments of multinational firms. First evidence in favor of a nexus between taxes and dividend payments has already been presented in the literature (see, e.g., Poterba, 2004; Chetty and Saez, 2005; Hanlon and Hoopes, 2014). However, most studies use variation from the same US tax reform to identify the tax effect. Building on this literature, the analysis is extended from a single country study to a setting that includes a large number of countries and tax reforms, as well as multinational firm structures. The study is based on the *ORBIS* dataset which provides detailed firm-level balance sheet data of numerous firms in different countries, as well as information on the ownership relationships between the different firms. The results cast doubt on the notion that there might be an effect of the dividend tax rate on dividend payments. Several robustness checks are conducted that produce additional evidence in favor of an insignificant tax effect. To detect potential heterogeneous responses at different tax levels, semiparametric estimations are conducted subsequently. The results provide evidence that the tax effect remains insignificant for different sizes of the tax rate.

The third chapter investigates if top income earners themselves change their country of residence in response to tax increases. The effect of taxes on the location decision is rationalized through a stylized theoretical model. The empirical analysis is based on the *BoardEx* dataset which contains detailed information on firm managers, their income, and their firms. In a first step, descriptive statistics about the managers and their migration patterns are presented. In a next step, a simple event study is employed which suggests small but significant negative tax effects. Subsequently, the tax effect is estimated through different choice models using earned income taxes as well as different capital income taxes. The choice models, again, produce highly significant and negative effects of the tax rate. In a last step, these results are used to estimate the beneficiaries of a US tax increase in terms of an increase in the location choice probability. While culturally similar countries like the UK or nearby countries like Canada are expected to experience a marked increase in the net inflow of firm managers, remote and culturally different countries like France might not be affected at all. Consistent with the notion that a critical size in the tax difference is needed to trigger a relocation, the location choice probability of the other countries increases most notably if taxes in the US are increased to considerably high levels.

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Chapter 1

Top income taxes around the world[§]

Abstract

This paper provides a survey on top income taxes around the world and examines to what extent income taxes contribute to a more equal distribution of gross income. We first describe our newly collected tax dataset, covering about 160 countries, 11 tax measures, and 10 years. We then show that income taxes are negatively correlated with countries' Gini-coefficients as well as with GDP growth. Our key findings indicate that higher top income tax rates reduce the gross income shares of top income earners.

[§]This chapter is based on joint work with Georg Wamser.

1.1 Introduction

Policymakers as well as economists have raised concerns about an evermore unequal distribution of income (Piketty, 2014). Comparing the average Gini coefficients of 52 countries in 2006 (37.71) to the same countries in the year 2012 (36.34) suggests, however, that inequality has not become greater.[1] Similarly, for the same countries and years, the average top income tax rates have remained relatively stable at values of about 37.13% in 2006 and 35.63% in 2012. Since we would expect that tax policy can to some extent correct an unequal distribution of income by implementing high taxes on top earners, it is not too surprising to find a relatively strong negative cross-sectional correlation between the two measures (-0.32). It remains unclear whether we can conclude from such a comparison across countries that high taxes on top earners have an immediate effect on gross income and produce a more egalitarian distribution thereof.

The objective of this paper is to shed light on the following research question: Do taxes on top earners affect the gross income distribution? We are particularly interested in whether changes in top income tax rates reflect in the share of a specific percentile of the gross income distribution of a country (e.g, the 1% top earners relative to the rest of the population). We measure the latter by data provided by the World Wealth and Income Database (see Alvaredo, Atkinson, et al., 2018). While the effect of a higher tax on *after-tax income* mainly depends on the progressivity of the the tax system, a change in the tax obviously does not affect the *gross-income* distribution if gross income is *fixed*, ceteris paribus. Thus, the key question is how gross income responds to changes in income tax rates.

A change in income tax rates may result in more or less gross-income inequality. Assuming a progressive tax system and, for the sake of simplicity,

[1]Note the following issues. First, reliable data on Gini coefficients is only available for a limited set of countries. Second, the Gini coefficient may not be the correct measure to look at different forms of inequality as it does not distinguish between inequality with respect to earned or capital income, for example. Third, we only focus on a relatively short period of time.

that one part of the population is 'poor' and the other part is 'rich', we may broadly distinguish between the following cases. First, if gross income is fixed, the gross income distribution does not change, irrespective of the degree of progressivity of the tax system. Second, if both groups in the population (poor and rich) can fully shift the tax burden to keep net income constant, the gross income distribution becomes more unequal as the rich can shift a relatively larger amount of the additional tax burden (in a progressive tax system). Third, the latter effect increases in the degree of progressivity, i.e. higher progressivity leads to an even more unequal distribution of gross income. Fourth, the total effect when both poor and rich can shift some of the tax burden depends on (i) the relative shares to which this is possible, (ii) the progressivity of the tax system, and (iii) the extent of inequality in the gross income distribution before the change in the tax.

Given these cases, we would expect higher taxes on all income most likely to lead to more gross income inequality. In contrast, the findings of Piketty, Saez, and Stantcheva (2014) suggest a negative relationship between taxes and gross incomes of top income earners. They argue that high income earners are less willing to bargain aggressively for higher wages as a higher tax implies a lower net reward.

To address our research question, we first collect data on countries' tax systems (165 countries) to provide a survey on the following measures (among others): $TITR$ is the Top marginal Income Tax Rate; $TITRB$ is the income at which the $TITR$ starts to become effective, i.e. the Top Income Tax Rate Bound; $AITR$ is the Average Income Tax Rate, which applies at the $TITRB$, and accounts for all marginal tax rates below this income; DTR is the Dividend Tax Rate.

From unconditional correlations, we know that countries with relatively high $TITRs$ have more egalitarian income distributions (measured by the Gini coefficient), and that GDP growth rates are negatively correlated with $TITRs$. While these patterns are very clear in the cross-section of countries, our empirical approach focuses on changes in tax variables over time and how these affect different shares of income along the income distribution. A central result is that an increase in top income taxes significantly reduces the income shares of the highest percentiles of the income distribution. The tax effects become smaller the more we approach the highest percentiles. This finding is in line with evidence on tax avoidance and higher tax avoidance elasticities of high incomes.

This suggests that top income earners are not fully able to shift the burden of a higher tax to employers. For instance, as our dependent variable is the share of the 1% top earners in total gross income, this means that the relative share of the progressive tax that can be avoided by the top earners (relative to the rest of the population) becomes smaller. This means that even under tax avoidance and tax shifting, higher top income taxes have a redistributive effect on the gross income distribution.

The paper is organized as follows. Section 1.2 provides a review of the relevant literature. Section 1.3 surveys the data we have collected for the purpose of this paper. Some correlations between country-specific characteristics and the tax measures are presented in Section 1.4. The analysis, addressing the question of whether changes in taxes on top earners have measurable consequences on the income distribution, are presented in Section 1.5. Section 1.6 concludes.

1.2 Literature

A growing literature is concerned with the analysis of income inequality. Following the seminal work of Kuznets (1953) and Atkinson and Harrison (1978), many recent studies examining income inequality in the long-run draw on data from the World Wealth and Income Database (Alvaredo, Atkinson, et al., 2018).

Piketty and Saez (2003) demonstrate that there has been a decline in the US top income shares in the aftermath of World War II and a rebound in the 1970s leading to an even higher level of top income shares at the end of the century. According to the authors, these dynamics were largely driven by high growth rates in top wage incomes. The authors conclude that there is a new "working rich". Alvaredo, Chancel, et al. (2017) extend the data to study a larger set of countries. They show that several countries have experienced an increase in income inequality. Particularly pronounced is this effect in the US, where the top 1% income earners nearly doubled their share in total income, while the share of the bottom 50% of income earners collapsed from 20% to 12% between 1978 and 2015. Piketty, Saez, and Zucman (2018) suggest that capital income has become more important since the beginning of the 21st century and is now a driving factor of inequality in the US.

The effect of personal income taxes on income inequality has not received too much attention. Feldstein and Wrobel (1998) find that top income earners in the US are compensated by their employers for higher state taxes such that net incomes are not affected. The authors argue that this finding is plausible as regional labor markets are highly integrated. Using data from the OECD, Piketty, Saez, and Stantcheva (2014) find a significant negative relationship between the income share of the top 1% earners and income taxes. They argue that higher taxes at the top reduce inequality since top income earners bargain less aggressively for wage increases if expected net rewards are lower.

In a very recent publication, Egger et al. (2019) find that globalization-induced increases in the mobility of high income earners have reduced their tax burden at the expense of less mobile middle-income earners. For the purpose of this study, the authors compile their own dataset which focuses on earned income taxes.[2]

We contribute to this literature by collecting data on personal income taxes not only on earned but also on different types of capital income. We then assess the effect the different tax measures on alternative measures of inequality.

[2]There is a large literature on individual responses to changes in income tax rates, including Kleven, Landais, and Saez (2013), Kleven, Landais, Saez, and Schultz (2014), Akcigit et al. (2016), and Moretti and Wilson (2017). Consistently, all studies report significant negative effects of higher taxes on the location choice of high income earners.

1.3 Tax measures

For the purpose of this paper, we have collected tax data on 165 countries for the time period 2006 to 2015. Most of the tax information is taken from EY's *Worldwide Personal Tax and Immigration Guides* (see, for example, EY, 2016).[3] A detailed description of each variable can be found in the Appendix in Table 1.10. The dataset we have collected includes taxes on earned income, capital and self-employment income, as well as taxes on net wealth. If applicable, the tax measures include employee borne social security contributions. In the following, we introduce and discuss the most important ones of the tax measures.

1.3.1 Taxes on earned income

We first present data on top income tax rate ($TITRs$).[4] The $TITR$ is levied on earned income.[5] The yearly boxplots in Figure 1.1 show that there is quite some variation across countries. While the highest value of $TITR$ exceeds 70%, some countries do not tax earned income at all. The average value decreased from 35% in 2006 to 33.5% in 2015. However, the larger interquantile range suggests that the degree of heterogeneity across countries has increased. This becomes even more obvious when comparing the densities of the $TITR$ for the years 2006, 2010, and 2015. We see a shift of density mass from average values to the tails of the distribution (see Figure 1.2).

The $TITR$ is equal to zero in oil-rich countries like Qatar and the United Arab Emirates, or also in tax haven countries like the Cayman Islands. The group of countries with the highest $TITRs$ include high-tax Scandinavian countries like Sweden and Finland.

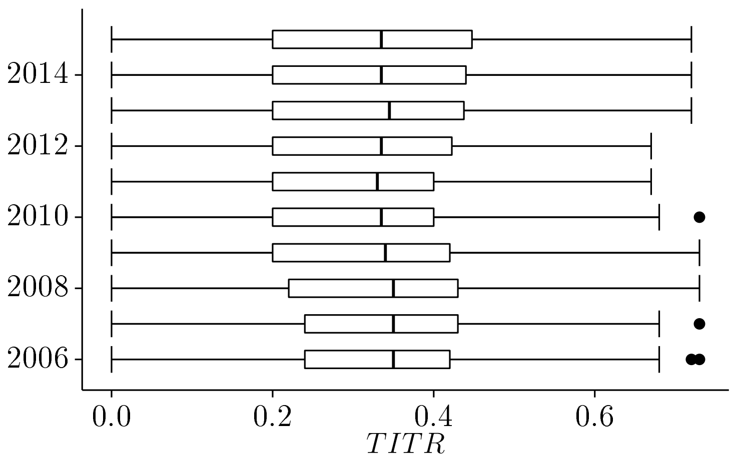
[3]We also consider tax reports by Deloitte and KPMG as well as local tax codes for cross-checks or to remove ambiguities were the EY reports remained unclear.

[4]Usually, the $TITR$ is also the highest marginal tax rate of the tax schedule. One exception is Gibraltar, where the marginal income tax rate starts to decrease at an income level of 105,000 GIP from 28% to only 5% for incomes exceeding 700,000 GIP in 2015.

[5]For the sake of clarity, note that earned income sometimes also is referred to as labor income in the literature.

Figure 1.3 illustrates the global distribution of countries' demeaned $TITRs$ in 2015, where darker color (lighter color) denotes that a country taxes above (below) the mean values across all countries. As expected, we find higher tax rates in more developed regions like Western Europe and North America, while the tax burden is lower in many Arab countries and Eastern European countries.

Figure 1.1: Boxplots of $TITR$



Notes: The vertical line indicates the median of the distribution of the $TITR$ for each year, the surrounding box portrays the interquartile range (IQR). The range of the whiskers is determined by the extreme values within the 1.5 × IQR, extreme values outside are represented by the dots.

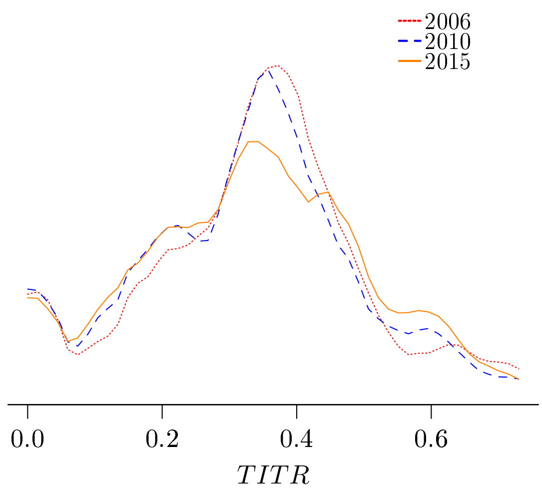
We define two additional measures to capture not only the marginal tax burden at the top. First, the income bound from where on the $TITR$ is levied, denoted by $TITRB$. Second, the average income tax rate, denoted by $AITR$, at that specific point. The $AITR$ is defined as

$$AITR = \frac{\sum_{b=1}^{B} \tau_b \cdot (Y_b - Y_{b-1})}{Y_B}, \tag{1.1}$$

where Y_b with $b \in (1, ..., B)$ is the upper limit of the b^{th} tax bracket[6] and

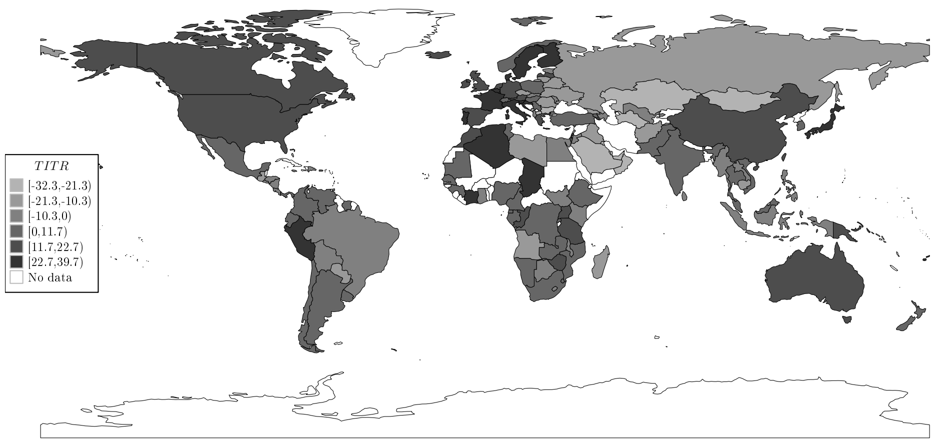
[6] We define the highest tax bracket B to be the tax bracket before the top marginal income tax rate steps in, i.e. $Y_B = TITRB$ is the last unit of income not to be taxed at $TITR$.

Figure 1.2: Distribution of $TITR$



Notes: Density of $TITR$ for the years 2006, 2010 and 2015. Nonparametric estimation (bandwidth selection: likelihood cross-validation, kernel: epanechnikov).

Figure 1.3: Demeaned $TITRs$ across countries



Notes: Map depicting the demeaned $TITR$ in 2015. Dark countries tax above average, light below.

$\tau(Y_b)$ the corresponding marginal tax rate.

Since tax rates below Y_B usually follow a progressive schedule, the relative tax liability τ of an individual i depends on the income level Y_i and, furthermore, we have $TITR > \tau(Y_i)$. However, according to our data, the average $TITRB$ is not more than USD 111,000. Hence, for a top income earner, we have that $TITR \approx \tau(Y_i)$:

$$\tau(Y_i) = \frac{\sum_{b=1}^{B} \tau(Y_b) \cdot (Y_b - Y_{b-1}) + TITR \cdot (Y_i - Y_B)}{\sum_{b=1}^{B} (Y_b - Y_{b-1}) + (Y_i - Y_B)} \approx TITR. \qquad (1.2)$$

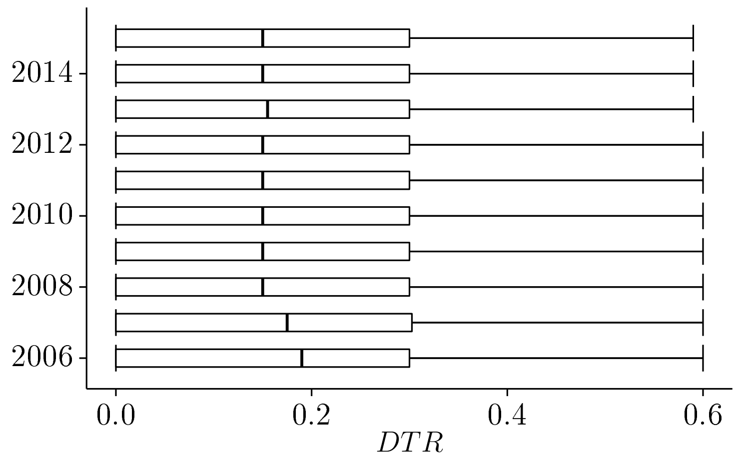
1.3.2 Taxes on dividend income

Among countries which levy non-zero tax rates, almost half of them use alternative taxes to generate tax revenue, such as taxes on capital incomes (e.g., dividend taxes). These taxes usually differ substantially in terms of rates but of course also in terms of tax base from the $TITR$. Let us, as for the $TITR$, first present the top marginal tax rate on dividend income, DTR.

In 2015, countries' dividend tax rates vary between a minimum of 0% and a maximum of 60%. The mean DTR across 165 countries in our data equals 18.17% in 2006, and 17.06% in 2015 (the grand mean over all years equals 17.11%). While the change over time in the mean is rather modest, the median DTR declines by 4 percentage points from 19% (2006) to 15% (2015). Figure 1.4 provides boxplots for the $DTRs$ for the 10 years of our sample, and Figure 1.5 the DTR-densities for the years 2006, 2010 and 2015. Both figures suggest that the number of countries with a zero tax rate has increased, while the number of countries with very high rates has decreased slightly. We cannot, however, detect systematic trends in the way countries tax dividend income.

Figure 1.6, finally, highlights the countries' $DTRs$ in darker or lighter color, depending on whether their $DTRs$ is above (darker) or below (lighter) the grand mean. While the distribution is comparable to the $TITR$, African countries tend to have relatively low $DTRs$.

Figure 1.4: Boxplots of DTR



Notes: The vertical line indicates the median of the distribution of the DTR for each year, the surrounding box portrays the interquartile range (IQR). The range of the whiskers is determined by the extreme values within the 1.5 × IQR, extreme values outside are represented by the dots.

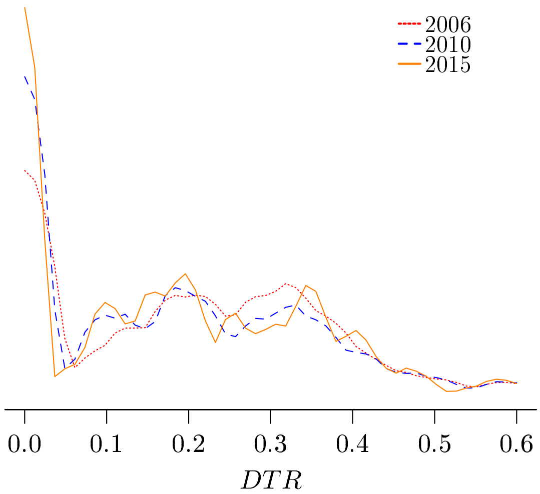
1.3.3 Summary of all tax measures

Our dataset includes a large number of additional tax measures, which we briefly discuss in the following. Table 1.1 provides summary statistics of all tax variables.

We find an average $AITR$ of 0.247. Thus, tax authorities levy on average a 7 percentage points lower tax burden on all income (average income) below the $TITRB$, compared to income above this threshold which is then taxed with a marginal tax rate that equals $TITR$. The tax rate on top income of the self-employed is denoted by $SEITR$. On average, $SEITR$ equals 29%, which is comparable to the $TITR$.[7] However, on average, this rate has been cut by governments over the last decade. The same is true for the capital

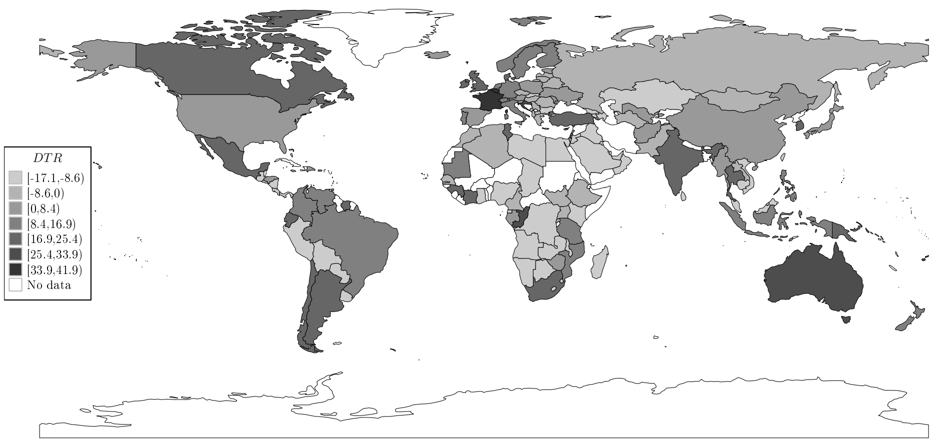
[7] This is what we would expect as there would otherwise be an incentive to systematically report income as one or the other type, depending on the tax differential between $TITR$ and $SEITR$.

Figure 1.5: Distribution of DTR



Notes: Density of DTR for the years 2006, 2010 and 2015. Nonparametric estimation (bandwidth selection: likelihood cross-validation, kernel: Epanechnikov).

Figure 1.6: (Demeaned) DTR across countries



Notes: Map depicting the demeaned DTR in 2015. Dark countries tax above average, light below.

gains tax rate, the interest tax rate, as well as the tax on royalties, which we denote by $CGTR$, ITR, and RTR, respectively. The mean values of these taxes are comparable to the mean DTR: 14.7% ($CGTR$), 18.6% (ITR), and 19.2% (RTR).

We finally observe only twelve countries with non-zero wealth taxes at least in one year. The average $TWTR$ equals 0.09% over all countries and 1.79% if we condition on countries where $TWTR$ is positive.

Table 1.1: Summary statistics tax data

Statistic		N	Mean	St. Dev.	Min	Max
$TITR$	Top Income Tax Rate	1,493	0.320	0.164	0.000	0.730
$TITRB$	Top Income Tax Rate Bound (USD 1000)	1,415	111.5	1,023	0.000	37,800
$AITR$	Average Income Tax Rate	1,493	0.247	0.128	0.000	0.590
$SEITR$	Self-Employed Income Tax Rate	1,493	0.290	0.150	0.000	0.660
DTR	Dividend Tax Rate	1,493	0.171	0.161	0.000	0.600
$CGTR$	Capital Gains Tax Rate	1,493	0.147	0.156	0.000	0.610
ITR	Interest Tax Rate	1,493	0.186	0.171	0.000	0.610
RTR	Royalties Tax Rate	1,493	0.192	0.176	0.000	0.610
$TWTR$	Top Wealth Tax Rate	1,493	0.001	0.005	0.000	0.060
$TWTRB$	Top Wealth Tax Rate Bound (USD 1000)	1,415	191	1,713	0.000	25,278
$AWTR$	Average Wealth Tax Rate	1,493	0.000	0.002	0.000	0.020

Notes: Our data includes information on 165 countries and 10 years (2006-2015). The total number of observations is smaller than 165*10=1650 since we did not find reliable sources for all countries in all years. Also, some states were founded (e.g. Kosovo) or dissolved (e.g. Netherlands Antilles) after 2006. The different variables are discussed in more detail in Table 1.10.

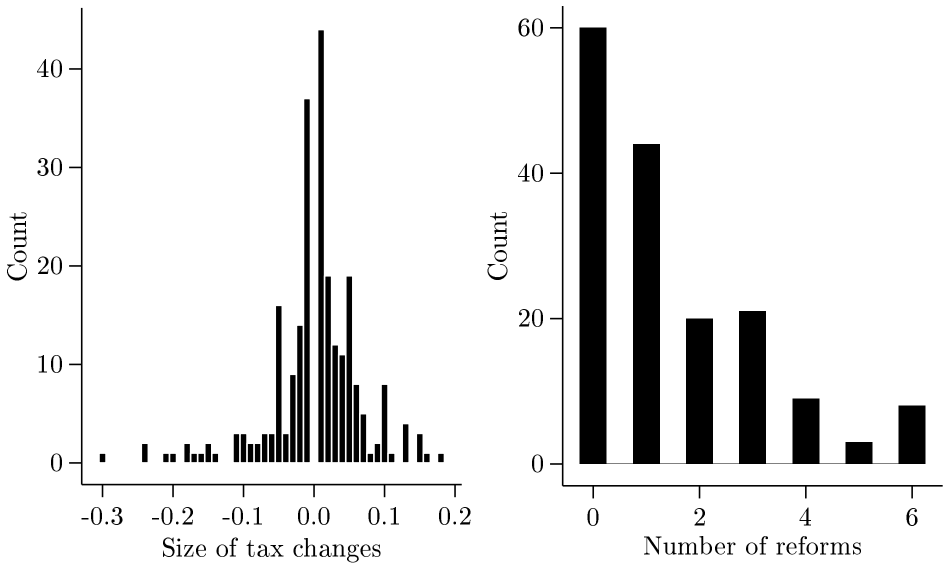
1.4 Correlations

The purpose of this section is to present some correlations between tax rates and country-specific characteristics. The first part discusses our main variable $TITR$, the second part focuses on the variable DTR.

1.4.1 *TITR*

As argued argued above, the average value of the $TITR$ has not changed substantially between 2006 and 2015. Let us now examine how level and tax changes of the $TITR$ are related to GDP growth and income inequality. We first plot the distribution of tax changes in Figure 1.7.

Figure 1.7: Distribution of changes in $TITR$

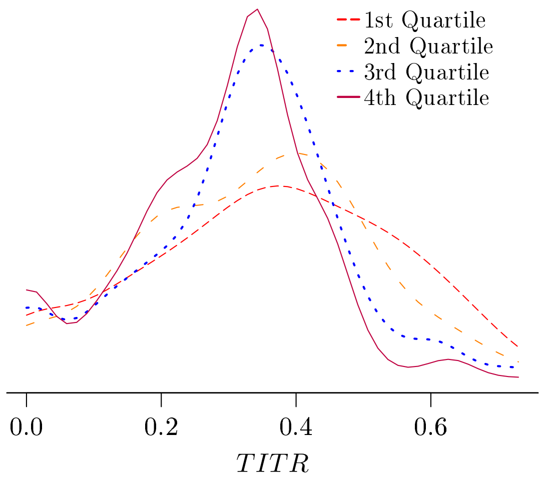


Notes: The left hand side provides a histogram on the different sizes of tax changes, we only include observations where we observe a change in the tax rate. The right hand side figure depicts the different counts of country groups which experience the same number of tax changes.

The left part of Figure 1.7 suggests that a large number of countries change tax rates over time. While many countries have changed their tax rates by about five percentage points, we also observe quite a few radical reforms where the change in the tax rate exceeds ten percentage points. The right-hand side of the figure sorts the countries by the number of tax changes. We observe tax changes in 105 countries. Among the countries that changed their tax rate, about half did so more than once. While there is an overall downward trend in the average $TITR$, more OECD countries increased (19) than decreased (7) their tax rates.

The former countries, i.e. those that increased their $TITRs$, experienced a lower average GDP growth rate in 2015 (2.387%), compared to the countries which decreased their tax rate (3.901%). Figure 1.8 depicts the density of $TITR$ for each quartile of GDP growth.[8]

Figure 1.8: Tax rate distribution and GDP growth

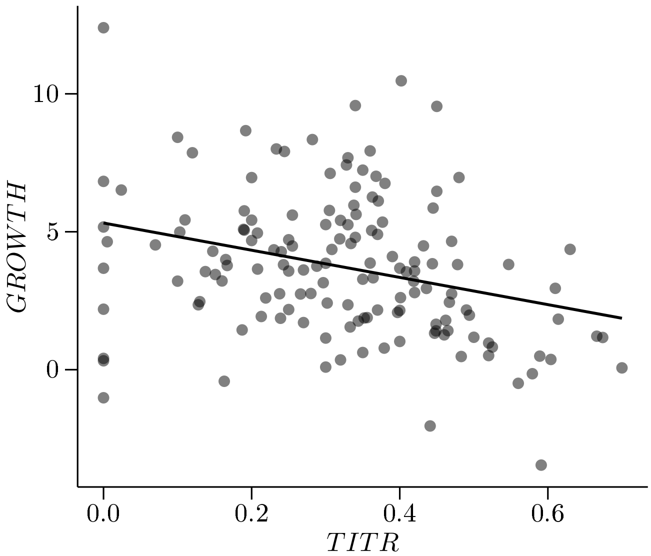


Notes: Density of $TITR$ for all GDP growth quartiles, all years. Nonparametric estimation (bandwidth selection: Silverman's Rule of Thumb, since likelihood cross-validation leads to under-smoothing, kernel: Gaussian).

While the number of countries with a zero tax rate are similar in the different quartiles, there are significantly more countries with high tax rates among countries with low GDP growth. Following Li et al. (2009), we per-

[8]We do not address the question of how taxes affect economic growth. This topic is discussed, for example, by Barro and Sala-I-Martin (1992), Alesina and Rodrik (1994), or Arin et al. (2015).

Figure 1.9: Tax rate distribution and GDP growth



Notes: This graph presents a scatterplot of the *TITR* and GDP growth. All observations represent country averages.

form a nonparametric test for equality of the distribution of the first and fourth quartile. Using 10,000 bootstrap replications, we reject equality at the 0.1% significance level. Figure 1.9 provides an alternative way to illustrate that there is a relatively clear negative relationship between growth and *TITRs*.[9]

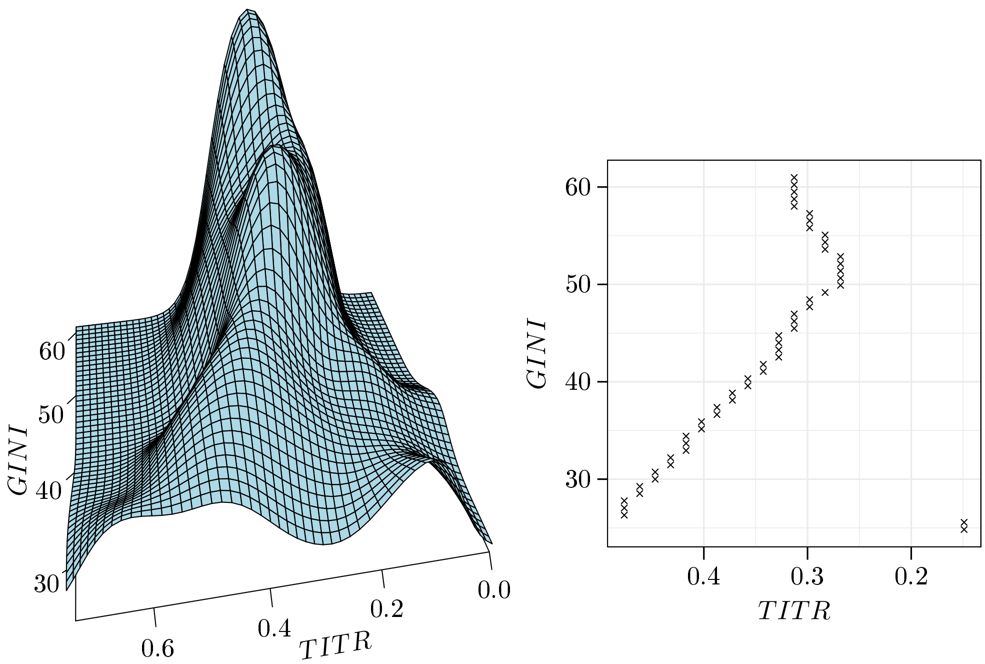
Countries that levy relatively high tax rates on top income earners may have a strong preference for redistribution. To see whether there is a relationship between income inequality and top tax rates, Figure 1.10 depicts the conditional density of the *TITR*, given different values of the Gini coefficient (henceforth, *GINI*).[10]

We find a strong negative relationship between *TITR* and *GINI*. On

[9]Of course, if developing or emerging economies implement lower taxes, the correlation may simply pick up the 'catching-up' process of these countries.

[10]A perfectly equal distribution of income implies a *GINI* of zero. If the value of inequality is at its maximum, i.e. all income accrues to a single person, *GINI* is equal to 1.

Figure 1.10: Conditional distribution of $TITR$ and $GINI$



Notes: The left hand side depicts the distribution of the $TITR$ conditional on $GINI$. The right hand side shows for each matrix dot of $GINI$ the respective $TITR$ value where the conditional density is maximized. We omit the largest outlier in the density estimation. Nonparametric estimation (bandwidth selection: likelihood cross-validation, kernel: Epanechnikov).

average, countries with a $GINI$ higher than 50 levy a tax rate equal to 31%; the $TITR$ is 39%, on average, for countries with a $GINI$ below 30.

1.4.2 *DTR*

As for the $TITR$, we also plot the distribution of the changes of the DTR. Figure 1.11 reveals that more countries left their DTR unchanged, as compared to the $TITR$. We observe more large tax increases than large tax decreases, while there are quite often smaller tax cuts. We also find that more OECD countries increased (12) than decreased (9) their $DTRs$.

The 2015 GDP growth rates of countries that increased their $DTRs$ are on average lower (1.781%) than the growth rates of those that decreased $DTRs$ (3.68%). Figure 1.12, in which we distinguish again between quartiles of GDP growth, depicts the DTR densities.[11]

Similar to the $TITR$, we find that countries with large growth rates are those where the DTR is typically low. Countries with poor growth rates tend to levy higher tax rates. However, based on the nonparametric test for equality of the distribution, we are not able to reject equality.[12]

Again similar to the $TITR$, we find a negative relationship between DTR and $GINI$, as presented in Figure 1.14. As we would expect, this relationship is weaker now, particularly since there is no significant number of countries with a high $GINI$ and a high DTR.

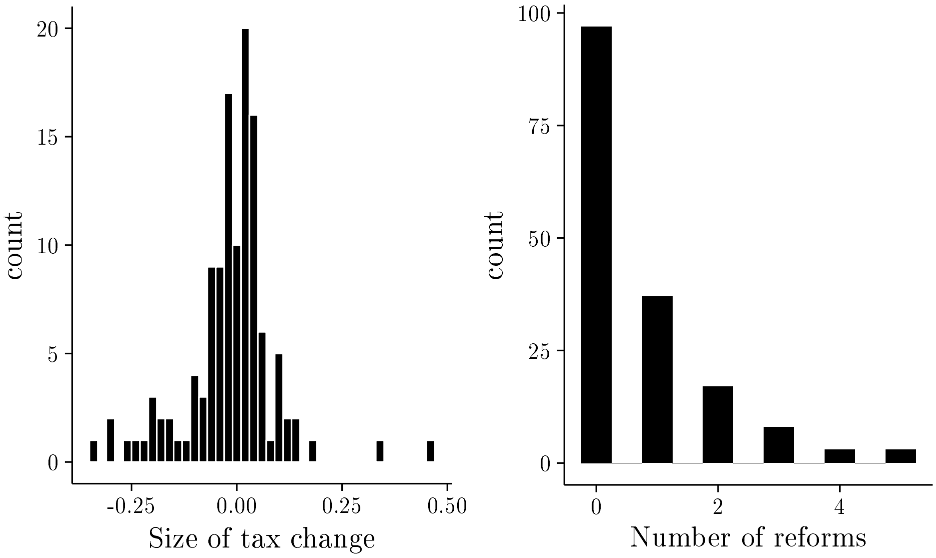
Both, the left and the right part of Figure 1.14 suggest broadly three types of countries:[13] countries that implement a relatively high DTR and have a low $GINI$; countries that implement a relatively low DTR and have a relatively high $GINI$; but there is also a significant number of countries where $GINI$ is relatively high and DTR is high as well.

[11] We provide Figure 1.13 as an alternative illustration.

[12] In contrast to the $TITR$, where the differences between the distributions are much more pronounced.

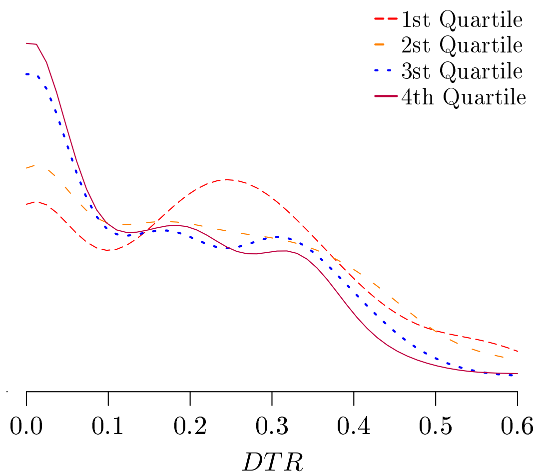
[13] Note that the right-hand side of Figure 1.14 again depicts the locus at which the estimates for the conditional density are maximized.

Figure 1.11: Distribution of changes in the *DTR*



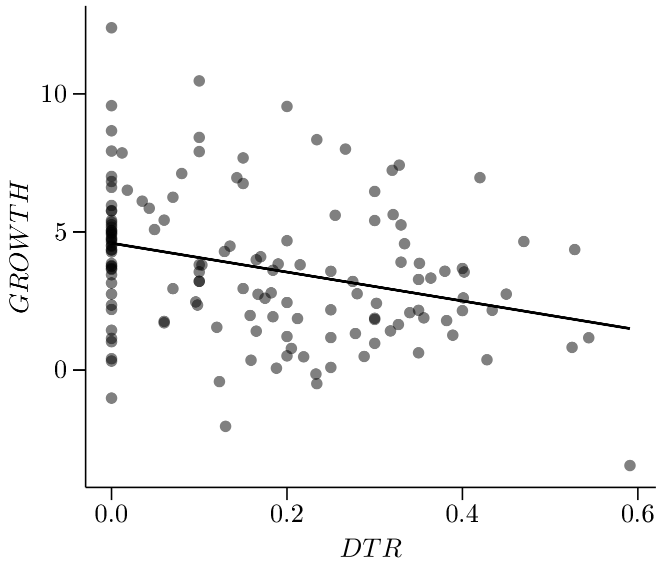
Notes: The left hand side provides a histogram on the different sizes of tax changes. We only include non-zero observations. The right hand side depicts the different counts of country groups which experience the same number of tax changes.

Figure 1.12: Tax rate distribution and GDP growth



Notes: Density of *DTR* for all GDP growth quartiles, all years. Nonparametric estimation (bandwidth selection: Silverman's Rule of Thumb since likelihood cross-validation leads to under-smoothing, kernel: Gaussian).

Figure 1.13: Tax rate distribution and GDP growth



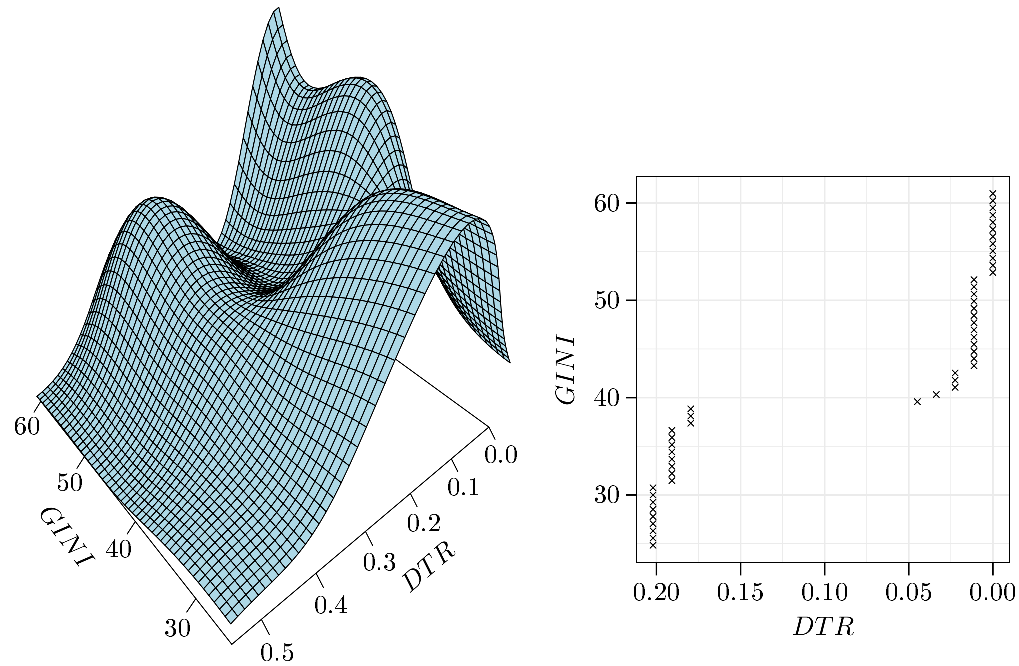
Notes: This graph presents a scatterplot of the *DTR* and GDP growth. All observations represent country averages.

There is of course reason to believe that countries' tax setting behavior is very different when comparing the *TITR* with the *DTR*. Although we find rather similar patterns, the two taxes naturally differ in terms of tax base, practical implementation, etc. In addition, whereas the *TITR* contributes quite substantially to tax revenue, most countries raise little revenue with the *DTR*.

1.5 On the redistributive effects of top income taxes

The purpose of this section is to assess the effects of top income taxes on the distribution of income. While higher tax rates reduce net-of-tax income, we analyze in the following the effects on the distribution of gross income. One concern of policymakers is that inequality in gross income may become even larger as high income earners are more able to shift the burden of higher taxes to their employers in order to compensate for the higher tax burden. In this context, the literature provides two different rationales for why income

Figure 1.14: Conditional distribution of DTR and $GINI$



Notes: The left hand side depicts the distribution of the DTR conditional on $GINI$. The right hand side shows for each matrix dot of $GINI$ the respective DTR value where the conditional density is maximized. We omit the largest outlier in the density estimation. Nonparametric estimation (bandwidth selection: Silverman's Rule of Thumb since likelihood cross-validation leads to under-smoothing, kernel: Gaussian).

taxes should influence the distribution of gross incomes.

Feldstein and Wrobel (1998) examine top income earners in the US and estimate whether changes in the US state income tax has an effect on top income. They find that top income earners are fully compensated for higher taxes: if income taxes increase, gross incomes of top earners increase proportionally. The reason behind this is that there is a credible threat of employees to move to states with lower tax rates if the employers do not compensate for the higher taxes. Similarly, Ruf and Schmider (2018) show in a cross-country setting that employers bear a large share of the tax burden levied on firm managers. As outlined in the introduction, Piketty, Saez, and Stantcheva (2014) identify a negative relationship between taxes and gross incomes of top income earners. In their view, the effort of high income earners negotiating their income is positively related to the expected net rewards. If income taxes increase, expected net rewards will decrease, which lowers the effort to bargain for higher wages. As a result, top wages will be lower compared to the situation when taxes are unchanged.

In the following, we use aggregate data on countries' gross-income distribution to examine whether changes in the tax rates described above affect inequality.

1.5.1 Empirical approach

Using data on Gini coefficients and on GDP growth from the World Bank's world development indicator dataset, as well as income shares of different percentiles of the income distribution taken from WID.world, we run different versions of the following regression

$$SI_{ct}^{p} = \beta_1 TAX_{ct} + \beta_2 GROWTH_{ct-1} + \Phi_t + \delta_c + \epsilon_{ct}. \tag{1.3}$$

The indices t and c denote time and country. In our preferred specification, we condition on $GROWTH_{ct-1}$, i.e. GDP growth, aggregate time effects

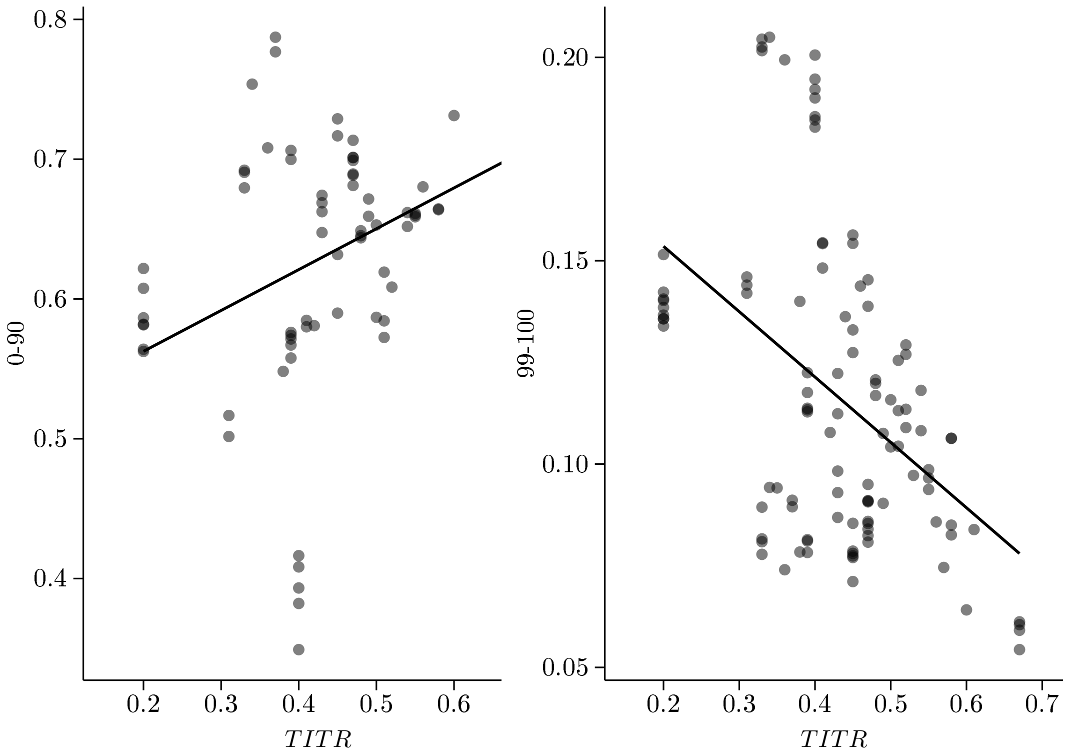
(Φ_t), country-specific effects (δ_c), and the $TITR_{ct}$. Beside this basic specification, we provide additional tests where $TITR_{ct}$ as well as all the other capital income tax measures are jointly included. The dependent variable, denoted as SI_{ct}^{p}, measures the share of income of the respective percentile of the income distribution, $p \in \{0-90; 0-99; 90-95; 95-99; 99-99.5; 99.5-99.9; 99.9-99.99; 90-100; 95-100, 99-100; 99.5-100; 99.9-100; 99.99-100\}$. Hence, if SI_{ct}^{99-100} is the dependent variable, we analyze the income share of the 1% highest income earners relative to the other 99% in a population.

We include $GROWTH_{ct-1}$ as we expect this variable to be related to inequality. Strong economic growth is usually related to the invention of new technologies.

Hence, high economic growth rates may mean that 'new' capital is accumulated at a higher rate. One consequence of this may be that relatively poor individuals find it easier to catch up by accumulating human capital and overproportionally benefit from new capital and opportunities. Another consequence would be that high income earners benefit most through previously accumulated capital and ownership claims. For our empirical analysis, we include the lag of GDP growth to account for potential simultaneity bias.

Figure 1.15 provides scatterplots for $TITR_{ct}$ and SI_{ct}^{0-90}, as well as $TITR_{ct}$ and SI_{ct}^{99-100}. We see a positive relationship for the former and a negative for the latter. The correlation coefficients are equal to 0.36 and -0.46. The largest income shares of the top 1% in our sample can be found in Colombia (20.49%), the lowest in Denmark (5.44%). Figure 1.16 describes the change of some of our inequality measures over time; Table 1.2 provides summary statistics for all variables we use.

Figure 1.15: Income shares and $TITR_{ct}$



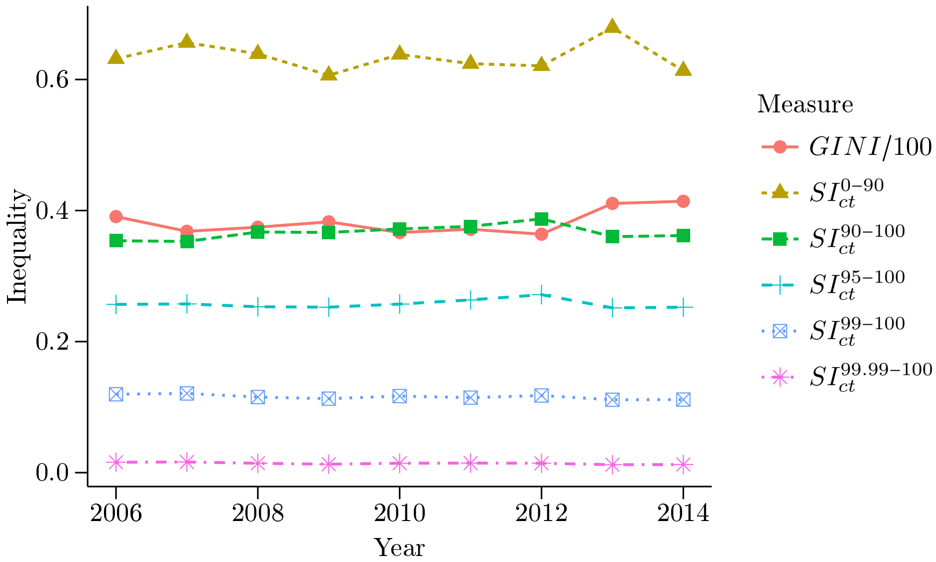
Notes: This graph provides a scatterplot of the $TITR_{ct}$ and two inequality measures: On the left hand side the income share of the lower 90% and on the right hand side of the top 1%.

Table 1.2: Summary statistics

Statistic	N	Mean	St. Dev.	Min	Max
$GROWTH_{ct-1}$	539	3.074	4.235	-14.814	15.316
$GINI_{ct}$	486	37.885	9.129	23.72	64.790
SI_{ct}^{0-90}	71	0.631	0.092	0.349	0.787
SI_{ct}^{0-99}	75	0.882	0.039	0.795	0.941
SI_{ct}^{90-95}	100	0.112	0.024	0.045	0.184
SI_{ct}^{95-99}	102	0.145	0.038	0.079	0.275
$SI_{ct}^{99-99.5}$	101	0.034	0.010	0.019	0.059
$SI_{ct}^{99.5-99.9}$	90	0.046	0.015	0.021	0.078
$SI_{ct}^{99.9-99.99}$	64	0.027	0.010	0.009	0.048
SI_{ct}^{90-100}	100	0.366	0.085	0.213	0.651
SI_{ct}^{95-100}	102	0.258	0.068	0.158	0.467
SI_{ct}^{99-100}	107	0.116	0.038	0.054	0.205
$SI_{ct}^{99.5-100}$	101	0.085	0.029	0.035	0.154
$SI_{ct}^{99.9-100}$	90	0.042	0.015	0.014	0.078
$SI_{ct}^{99.99-100}$	64	0.015	0.006	0.004	0.030
$TITR_{ct}$	539	0.357	0.144	0	0.73
DTR_{ct}	539	0.203	0.152	0	0.6
$CGTR_{ct}$	539	0.169	0.151	0	0.61
ITR_{ct}	539	0.218	0.161	0	0.61
RTR_{ct}	539	0.227	0.168	0	0.61

Notes: We do only include observations which are used for the estimations in this table. Since our tax dataset includes much more countries compared to the data on income inequality, the summary statistics of the tax measures in this table differ compared to the summary statistics in Table 1.1, where our discussion includes all tax measures.

Figure 1.16: Inequality measures over time



Notes: This graph plots country averages of some of our inequality measures over time. The y-axis gives the size ($GINI_{ct}$) and the shares (SI_{ct}^{0-90}-$SI_{ct}^{99.99-100}$) of these measures respectively.

1.5.2 Results

We present the results of our preferred model specification in Table 1.3.[14] Note that all specifications presented in this table condition on year as well as country fixed effects. When $GINI_{ct}$ is the dependent variable, we find a negative and significant effect of the $TITR_{ct}$ equal to -6.176. This suggests that the marginal effect of a 1-percentage point higher $TITR$ is tiny (approx. -0.06), given that the standard deviation of $GINI$ is equal to 9.13.

In the following, we discuss the estimates of the effects of $TITR_{ct}$ on the respective income shares. Specifications (*2.1*) and (*2.2*) present the results for the lower 90% and 99% percentiles of the income distribution (SI_{ct}^{0-90} and SI_{ct}^{0-99}). We find positive and highly significant effects of the $TITR_{ct}$ in these specifications. For SI_{ct}^{0-90}, the effect is substantially larger, which is

[14] Note that we also have tested a specification where we include a quadratic polynomial of $TITR_{ct}$. However, the squared term is insignificant. Furthermore, the AIC and BIC information criterion tests provide support in favor of excluding $TITR_{ct}$ to the square.

reasonable as SI_{ct}^{0-99} also captures relatively higher incomes. According to specification (*2.1*), a ten percentage point increase in $TITR_{ct}$ would lead to an increase in the income share of the lower 90% by 3.11 percentage points. This seems to be a substantial impact, given that we frequently observe large changes in countries' $TITRs$.

Specifications (*3.1*)–(*3.5*) examine the effects on five different measures of the income distribution (SI_{ct}^{90-95}–$SI_{ct}^{99.9-99.99}$). We always find a negative and highly significant impact of the $TITR_{ct}$. However, the effect on individuals above the 99^{th} percentile becomes considerably smaller. It may be surprising that the negative effect of $TITR_{ct}$ becomes weaker as we approach the top of the income distribution. One interpretation of this finding would be that the bargaining mechanism described above (see Piketty, Saez, and Stantcheva, 2014) becomes less important for the very top income earners. Another interpretation would be that the ability of this group to shift the tax burden is relatively high, which compensates for possible effects of a progressive tax system. Note that we cannot address the extent to which changes in the tax may lead to changes in the composition of income earners and total aggregate income. For example, very rich and mobile individuals may respond to changes in the tax at different margins: migration to other countries, real labor supply, different forms of tax avoidance and evasion, etc. All these effects reflect in the inequality measures. While we believe that our fixed effects approach captures basic differences across countries determining the relevant elasticities, the interpretation of larger and smaller estimates on $TITR_{ct}$, and the driving mechanisms behind that, remain highly speculative.

In specifications (*4.1*)–(*4.6*) we focus on the very top of the income distribution. We distinguish between six alternative cutoff values for 'top income': SI_{ct}^{90-100} to $SI_{ct}^{99.99-100}$. The results are very similar to the findings above. We also confirm that the negative and (statistically) highly significant effect becomes smaller when the income percentiles become smaller. For $SI_{ct}^{99.99-100}$, the effect even becomes insignificant.

As discussed above, Feldstein and Wrobel (1998) find for the US that

Table 1.3: Baseline regressions

	(1)	*(2.1)*	*(2.2)*	*(3.1)*	*(3.2)*
	$GINI$	SI_{ct}^{0-90}	SI_{ct}^{0-99}	SI_{ct}^{90-95}	SI_{ct}^{95-99}
$TITR_{ct}$	-6.176***	0.311***	0.115***	-0.061***	-0.110***
	(1.707)	(0.063)	(0.030)	(0.019)	(0.027)
$GROWTH_{ct-1}$	-0.010	-0.000	-0.001	-0.000	0.000
	(0.027)	(0.001)	(0.001)	(0.000)	(0.000)
$Constant$	41.109***	0.495***	0.833***	0.138***	0.191***
	(0.656)	(0.028)	(0.013)	(0.009)	(0.012)
Observations	486	71	75	100	102
R^2	0.218	0.383	0.491	0.279	0.276
	(3.3)	*(3.4)*	*(3.5)*	*(4.1)*	*(4.2)*
	$SI_{ct}^{99-99.5}$	$SI_{ct}^{99.5-99.9}$	$SI_{ct}^{99.9-99.99}$	SI_{ct}^{90-100}	SI_{ct}^{95-100}
$TITR_{ct}$	-0.022***	-0.052***	-0.035**	-0.292***	-0.234***
	(0.005)	(0.009)	(0.015)	(0.052)	(0.039)
$GROWTH_{ct-1}$	0.000	0.000	0.001**	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
$Constant$	0.043***	0.069***	0.042***	0.493***	0.359***
	(0.002)	(0.004)	(0.007)	(0.024)	(0.018)
Observations	101	90	64	100	102
R^2	0.268	0.469	0.510	0.344	0.379
	(4.3)	*(4.4)*	*(4.5)*	*(4.6)*	
	SI_{ct}^{99-100}	$SI_{ct}^{99.5-100}$	$SI_{ct}^{99.9-100}$	$SI_{ct}^{99.99-100}$	
$TITR_{ct}$	-0.125***	-0.105***	-0.065***	-0.014	
	(0.024)	(0.022)	(0.018)	(0.014)	
$GROWTH_{ct-1}$	0.000	0.000	0.000	0.001**	
	(0.000)	(0.000)	(0.000)	(0.000)	
	(0.003)	(0.003)	(0.002)	(0.002)	
$Constant$	0.172***	0.131***	0.071***	0.020***	
	(0.011)	(0.010)	(0.008)	(0.007)	
Observations	107	101	90	64	
R^2	0.465	0.466	0.487	0.535	

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ indicate significance at the 1%, 5% and 10% level, respectively. All specifications include year dummies as well as country fixed effects.

higher state taxes translate one to one into higher gross incomes of top income earners. The authors explain this finding by the threat of top income earners to migrate to a state with a more favorable tax legislation, unless employees are fully compensated for the tax increase.

1.5.3 Alternative tax measures

In a next step, we include the additional tax measures we have collected above. The impact of the $TITR_{ct}$ remains similar in size, although the precision of the estimates decreases somewhat. The other tax measures are insignificant in almost all specifications (Tables 1.4 – 1.8). The same is true for a specification where we include all tax measures (Table 1.9). This finding has important implications since it shows that taxes on capital incomes do not significantly contribute to a more even distribution of gross incomes. Instead, if governments aim at reducing gross income inequality by the means of income taxation, taxes on wage income is the more influential policy tool at hand. A very important result is that including $AITR_{ct}$ leaves $TITR_{ct}$ basically unchanged and there is no separate effect of our progressivity measure on the income shares of the different groups.

1.5.4 Robustness

We first run regressions where we only include European Union countries and Norway.[15] Table 1.11 presents the results (this and the following tables may be found in the appendix). This restriction obviously leads to a much smaller sample. However, most estimates remain significant. The results for the very top of the income distribution is insignificant, as before.

We further test a specification where we include GDP per capita and its square (Table 1.12). The estimated effect of the $TITR_{ct}$ changes only slightly, while the coefficients on GDP per capita are only significant in some

[15] As Norway is member of the European Economic Area (EEA) and is therefore obliged to accept the free movement of EU citizens.

Table 1.4: Regression income share on $TITR_{ct}$ and $AITR_{ct}$

	(1)	*(2.1)*	*(2.2)*	*(3.1)*	*(3.2)*
	$GINI$	SI_{ct}^{0-90}	SI_{ct}^{0-99}	SI_{ct}^{90-95}	SI_{ct}^{95-99}
$TITR_{ct}$	-6.662***	0.320***	0.118***	-0.065***	-0.112***
	(2.028)	(0.079)	(0.034)	(0.023)	(0.032)
$AITR_{ct}$	0.998	-0.016	-0.008	0.006	0.002
	(2.241)	(0.081)	(0.031)	(0.021)	(0.030)
$GROWTH_{ct-1}$	-0.009	-0.000	-0.001	-0.000	0.000
	(0.027)	(0.001)	(0.001)	(0.000)	(0.000)
$Constant$	41.001***	0.497***	0.834***	0.137***	0.190***
	(0.701)	(0.029)	(0.014)	(0.009)	(0.012)
Observations	486	71	75	100	102
R^2	0.218	0.383	0.491	0.279	0.276

	(3.3)	*(3.4)*	*(3.5)*	*(4.1)*	*(4.2)*
	$SI_{ct}^{99-99.5}$	$SI_{ct}^{99.5-99.9}$	$SI_{ct}^{99.9-99.99}$	SI_{ct}^{90-100}	SI_{ct}^{95-100}
$TITR_{ct}$	-0.028***	-0.055***	-0.038**	-0.306***	-0.243***
	(0.006)	(0.010)	(0.017)	(0.062)	(0.046)
$AITR_{ct}$	0.011**	0.007	0.004	0.025	0.016
	(0.005)	(0.008)	(0.010)	(0.058)	(0.043)
$GROWTH_{ct-1}$	0.000	0.000	0.001**	0.000	0.001
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
$Constant$	0.042***	0.068***	0.042***	0.491***	0.358***
	(0.002)	(0.004)	(0.008)	(0.024)	(0.018)
Observations	101	90	64	100	102
R^2	0.307	0.475	0.512	0.345	0.380

	(4.3)	*(4.4)*	*(4.5)*	*(4.6)*
	SI_{ct}^{99-100}	$SI_{ct}^{99.5-100}$	$SI_{ct}^{99.9-100}$	$SI_{ct}^{99.99-100}$
$TITR_{ct}$	-0.136***	-0.109***	-0.065***	-0.013
	(0.027)	(0.025)	(0.020)	(0.015)
$AITR_{ct}$	0.020	0.009	0.001	-0.001
	(0.025)	(0.023)	(0.016)	(0.009)
$GROWTH_{ct-1}$	0.001	0.000	0.000	0.001**
	(0.000)	(0.000)	(0.000)	(0.000)
$Constant$	0.171***	0.130***	0.071***	0.020***
	(0.011)	(0.010)	(0.008)	(0.007)
Observations	107	101	90	64
R^2	0.470	0.467	0.487	0.535

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ indicate significance at the 1%, 5% and 10% level, respectively. All specifications include year dummies as well as country fixed effects.

Table 1.5: Regression income share on $TITR_{ct}$ and DTR_{ct}

	(1)	(2.1)	(2.2)	(3.1)	(3.2)
	$GINI$	SI_{ct}^{0-90}	SI_{ct}^{0-99}	SI_{ct}^{90-95}	SI_{ct}^{95-99}
$TITR_{ct}$	-6.381***	0.385***	0.171***	-0.094**	-0.143***
	(1.819)	(0.123)	(0.058)	(0.036)	(0.051)
DTR_{ct}	0.610	-0.111	-0.077	0.046	0.046
	(1.853)	(0.157)	(0.068)	(0.043)	(0.061)
$GROWTH_{ct-1}$	-0.010	-0.000	-0.001*	-0.000	0.000
	(0.027)	(0.001)	(0.001)	(0.000)	(0.000)
$Constant$	41.057***	0.496***	0.833***	0.138***	0.191***
	(0.676)	(0.028)	(0.013)	(0.009)	(0.012)
Observations	486	71	75	100	102
R^2	0.218	0.389	0.504	0.289	0.282

	(3.3)	(3.4)	(3.5)	(4.1)	(4.2)
	$SI_{ct}^{99-99.5}$	$SI_{ct}^{99.5-99.9}$	$SI_{ct}^{99.9-99.99}$	SI_{ct}^{90-100}	SI_{ct}^{95-100}
$TITR_{ct}$	-0.008	-0.038**	-0.004	-0.371***	-0.267***
	(0.010)	(0.015)	(0.020)	(0.100)	(0.075)
DTR_{ct}	-0.019*	-0.020	-0.060**	0.111	0.046
	(0.012)	(0.018)	(0.027)	(0.119)	(0.089)
$GROWTH_{ct-1}$	0.000	0.000	0.001**	0.000	0.001
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
$Constant$	0.043***	0.069***	0.047***	0.495***	0.360***
	(0.002)	(0.004)	(0.007)	(0.024)	(0.018)
Observations	101	90	64	100	102
R^2	0.294	0.478	0.562	0.351	0.382

	(4.3)	(4.4)	(4.5)	(4.6)
	SI_{ct}^{99-100}	$SI_{ct}^{99.5-100}$	$SI_{ct}^{99.9-100}$	$SI_{ct}^{99.99-100}$
$TITR_{ct}$	-0.118**	-0.113***	-0.077**	-0.008
	(0.046)	(0.043)	(0.031)	(0.020)
DTR_{ct}	-0.010	0.011	0.018	-0.012
	(0.054)	(0.050)	(0.037)	(0.026)
$GROWTH_{ct-1}$	0.000	0.000	0.000	0.001**
	(0.000)	(0.000)	(0.000)	(0.000)
$Constant$	0.172***	0.131***	0.071***	0.021***
	(0.011)	(0.010)	(0.008)	(0.007)
Observations	107	101	90	64
R^2	0.466	0.467	0.489	0.537

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ indicate significance at the 1%, 5% and 10% level, respectively. All specifications include year dummies as well as country fixed effects.

Table 1.6: Regression income share on $TITR_{ct}$ and $CGTR_{ct}$

	(1)	(2.1)	(2.2)	(3.1)	(3.2)
	$GINI$	SI_{ct}^{0-90}	SI_{ct}^{0-99}	SI_{ct}^{90-95}	SI_{ct}^{95-99}
$TITR_{ct}$	-6.668***	0.334***	0.151***	-0.058**	-0.119***
	(1.870)	(0.082)	(0.043)	(0.025)	(0.035)
$CGTR_{ct}$	1.145	-0.022	-0.028	-0.003	0.008
	(1.766)	(0.048)	(0.024)	(0.015)	(0.021)
$GROWTH_{ct-1}$	-0.012	-0.000	-0.001	-0.000	0.000
	(0.027)	(0.001)	(0.001)	(0.000)	(0.000)
$Constant$	41.107***	0.490***	0.823***	0.137***	0.193***
	(0.657)	(0.031)	(0.016)	(0.010)	(0.013)
Observations	486	71	75	100	102
R^2	0.219	0.385	0.505	0.279	0.278
	(3.3)	(3.4)	(3.5)	(4.1)	(4.2)
	$SI_{ct}^{99-99.5}$	$SI_{ct}^{99.5-99.9}$	$SI_{ct}^{99.9-99.99}$	SI_{ct}^{90-100}	SI_{ct}^{95-100}
$TITR_{ct}$	-0.018***	-0.059***	-0.034*	-0.310***	-0.256***
	(0.007)	(0.012)	(0.020)	(0.068)	(0.051)
$CGTR_{ct}$	-0.004	0.006	-0.001	0.017	0.021
	(0.004)	(0.006)	(0.012)	(0.041)	(0.031)
$GROWTH_{ct-1}$	0.000	0.000	0.001**	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
$Constant$	0.042***	0.070***	0.042***	0.498***	0.365***
	(0.002)	(0.004)	(0.008)	(0.026)	(0.020)
Observations	101	90	64	100	102
R^2	0.277	0.475	0.510	0.345	0.383
	(4.3)	(4.4)	(4.5)	(4.6)	
	SI_{ct}^{99-100}	$SI_{ct}^{99.5-100}$	$SI_{ct}^{99.9-100}$	$SI_{ct}^{99.99-100}$	
$TITR_{ct}$	-0.138***	-0.121***	-0.074***	-0.019	
	(0.031)	(0.029)	(0.024)	(0.018)	
$CGTR_{ct}$	0.012	0.016	0.007	0.005	
	(0.019)	(0.017)	(0.013)	(0.011)	
$GROWTH_{ct-1}$	0.000	0.000	0.000	0.001**	
	(0.000)	(0.000)	(0.000)	(0.000)	
$Constant$	0.176***	0.135***	0.073***	0.021***	
	(0.012)	(0.011)	(0.009)	(0.007)	
Observations	107	101	90	64	
R^2	0.468	0.472	0.490	0.537	

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ indicate significance at the 1%, 5% and 10% level, respectively. All specifications include year dummies as well as country fixed effects.

Table 1.7: Regression income share on $TITR_{ct}$ and ITR_{ct}

	(1) $GINI$	*(2.1)* SI_{ct}^{0-90}	*(2.2)* SI_{ct}^{0-99}	*(3.1)* SI_{ct}^{90-95}	*(3.2)* SI_{ct}^{95-99}
$TITR_{ct}$	-4.954**	0.478***	0.020	-0.186***	-0.277***
	(1.939)	(0.169)	(0.086)	(0.048)	(0.068)
ITR_{ct}	-2.928	-0.203	0.108	0.149***	0.199***
	(2.212)	(0.190)	(0.092)	(0.053)	(0.075)
$GROWTH_{ct-1}$	-0.010	-0.000	-0.001*	-0.000	-0.000
	(0.026)	(0.001)	(0.001)	(0.000)	(0.000)
$Constant$	41.297***	0.489***	0.838***	0.143***	0.198***
	(0.671)	(0.029)	(0.014)	(0.008)	(0.012)
Observations	486	71	75	100	102
R^2	0.222	0.398	0.505	0.348	0.338

	(3.3) $SI_{ct}^{99-99.5}$	*(3.4)* $SI_{ct}^{99.5-99.9}$	*(3.5)* $SI_{ct}^{99.9-99.99}$	*(4.1)* SI_{ct}^{90-100}	*(4.2)* SI_{ct}^{95-100}
$TITR_{ct}$	0.000	-0.015	0.011	-0.501***	-0.311***
	(0.014)	(0.022)	(0.026)	(0.136)	(0.104)
ITR_{ct}	-0.026*	-0.045*	-0.065**	0.250	0.092
	(0.016)	(0.024)	(0.030)	(0.151)	(0.115)
$GROWTH_{ct-1}$	0.000	0.000	0.001***	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
$Constant$	0.042***	0.068***	0.044***	0.503***	0.363***
	(0.002)	(0.004)	(0.007)	(0.024)	(0.018)
Observations	101	90	64	100	102
R^2	0.295	0.495	0.561	0.367	0.385

	(4.3) SI_{ct}^{99-100}	*(4.4)* $SI_{ct}^{99.5-100}$	*(4.5)* $SI_{ct}^{99.9-100}$	*(4.6)* $SI_{ct}^{99.99-100}$	
$TITR_{ct}$	-0.028	-0.017	0.007	0.009	
	(0.062)	(0.061)	(0.044)	(0.025)	
ITR_{ct}	-0.115*	-0.102	-0.087*	-0.032	
	(0.069)	(0.067)	(0.049)	(0.028)	
$GROWTH_{ct-1}$	0.001	0.001	0.000*	0.001***	
	(0.000)	(0.000)	(0.000)	(0.000)	
$Constant$	0.168***	0.128***	0.070***	0.021***	
	(0.011)	(0.010)	(0.008)	(0.007)	
Observations	107	101	90	64	
R^2	0.484	0.483	0.511	0.549	

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ indicate significance at the 1%, 5% and 10% level, respectively. All specifications include year dummies as well as country fixed effects.

Table 1.8: Regression income share on $TITR_{ct}$ and RTR_{ct}

	(1) $GINI$	(2.1) SI_{ct}^{0-90}	(2.2) SI_{ct}^{0-99}	(3.1) SI_{ct}^{90-95}	(3.2) SI_{ct}^{95-99}
$TITR_{ct}$	-5.420***	0.268***	0.122***	-0.034	-0.072***
	(1.864)	(0.071)	(0.033)	(0.021)	(0.027)
RTR_{ct}	-1.878	0.049	-0.008	-0.030**	-0.039***
	(1.858)	(0.038)	(0.013)	(0.012)	(0.011)
$GROWTH_{ct-1}$	-0.011	-0.000	-0.001	-0.000	0.000
	(0.027)	(0.001)	(0.001)	(0.000)	(0.000)
$Constant$	41.277***	0.499***	0.832***	0.135***	0.187***
	(0.677)	(0.028)	(0.014)	(0.008)	(0.011)
Observations	486	71	75	100	102
R^2	0.220	0.405	0.494	0.336	0.376
	(3.3) $SI_{ct}^{99-99.5}$	(3.4) $SI_{ct}^{99.5-99.9}$	(3.5) $SI_{ct}^{99.9-99.99}$	(4.1) SI_{ct}^{90-100}	(4.2) SI_{ct}^{95-100}
$TITR_{ct}$	-0.027***	-0.050***	-0.035**	-0.252***	-0.200***
	(0.005)	(0.010)	(0.017)	(0.060)	(0.042)
RTR_{ct}	0.005**	-0.002	0.000	-0.044	-0.035**
	(0.002)	(0.004)	(0.004)	(0.034)	(0.017)
$GROWTH_{ct-1}$	0.000	0.000	0.001**	0.000	0.001
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
$Constant$	0.043***	0.068***	0.042***	0.490***	0.356***
	(0.002)	(0.004)	(0.008)	(0.024)	(0.017)
Observations	101	90	64	100	102
R^2	0.315	0.471	0.510	0.358	0.411
	(4.3) SI_{ct}^{99-100}	(4.4) $SI_{ct}^{99.5-100}$	(4.5) $SI_{ct}^{99.9-100}$	(4.6) $SI_{ct}^{99.99-100}$	
$TITR_{ct}$	-0.130***	-0.105***	-0.067***	-0.017	
	(0.026)	(0.024)	(0.020)	(0.015)	
RTR_{ct}	0.005	0.000	0.002	0.002	
	(0.011)	(0.010)	(0.007)	(0.004)	
$GROWTH_{ct-1}$	0.000	0.000	0.000	0.001**	
	(0.000)	(0.000)	(0.000)	(0.000)	
$Constant$	0.173***	0.131***	0.071***	0.021***	
	(0.011)	(0.010)	(0.008)	(0.007)	
Observations	107	101	90	64	
R^2	0.467	0.466	0.488	0.539	

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ indicate significance at the 1%, 5% and 10% level, respectively. All specifications include year dummies as well as country fixed effects.

Table 1.9: Regression income share on all tax variables

	(1) $GINI$	(2.1) SI_{ct}^{0-90}	(2.2) SI_{ct}^{0-99}	(3.1) SI_{ct}^{90-95}	(3.2) SI_{ct}^{95-99}
$TITR_{ct}$	-5.961**	0.566**	0.042	-0.203***	-0.298***
	(2.325)	(0.215)	(0.092)	(0.052)	(0.071)
$AITR_{ct}$	0.960	-0.071	-0.018	0.017	0.024
	(2.251)	(0.095)	(0.032)	(0.021)	(0.029)
DTR_{ct}	3.681	-0.032	-0.177*	-0.027	-0.053
	(2.422)	(0.204)	(0.089)	(0.051)	(0.071)
$CGTR_{ct}$	2.795	-0.012	-0.032	-0.017	-0.008
	(1.989)	(0.059)	(0.027)	(0.016)	(0.021)
ITR_{ct}	-5.974*	-0.281	0.294**	0.243***	0.314***
	(3.339)	(0.254)	(0.115)	(0.067)	(0.092)
RTR_{ct}	-1.559	0.057	-0.007	-0.038***	-0.044***
	(2.494)	(0.039)	(0.013)	(0.011)	(0.011)
$GROWTH_{ct-1}$	-0.009	-0.000	-0.001**	-0.000	0.000
	(0.027)	(0.001)	(0.001)	(0.000)	(0.000)
$Constant$	41.209***	0.494***	0.836***	0.138***	0.193***
	(0.731)	(0.033)	(0.016)	(0.009)	(0.012)
Observations	486	71	75	100	102
R^2	0.231	0.436	0.581	0.463	0.479

	(3.3) $SI_{ct}^{99-99.5}$	(3.4) $SI_{ct}^{99.5-99.9}$	(3.5) $SI_{ct}^{99.9-99.99}$	(4.1) SI_{ct}^{90-100}	(4.2) SI_{ct}^{95-100}
$TITR_{ct}$	-0.012	-0.024	-0.002	-0.569***	-0.353***
	(0.015)	(0.025)	(0.029)	(0.157)	(0.118)
$AITR_{ct}$	0.008	0.008	0.004	0.063	0.042
	(0.006)	(0.009)	(0.010)	(0.064)	(0.048)
DTR_{ct}	-0.013	-0.009	-0.057	-0.004	0.019
	(0.015)	(0.024)	(0.044)	(0.156)	(0.117)
$CGTR_{ct}$	0.001	0.015**	0.023	0.005	0.022
	(0.004)	(0.007)	(0.015)	(0.047)	(0.036)
ITR_{ct}	-0.014	-0.052	-0.047	0.347*	0.115
	(0.020)	(0.031)	(0.047)	(0.204)	(0.152)
RTR_{ct}	0.006**	-0.001	0.003	-0.058*	-0.039**
	(0.002)	(0.004)	(0.004)	(0.035)	(0.018)
$GROWTH_{ct-1}$	0.000	0.000	0.001*	0.000	0.001
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
$Constant$	0.043***	0.071***	0.054***	0.499***	0.363***
	(0.002)	(0.005)	(0.009)	(0.026)	(0.020)
Observations	101	90	64	100	102
R^2	0.382	0.529	0.595	0.400	0.429

	(4.3) SI_{ct}^{99-100}	(4.4) $SI_{ct}^{99.5-100}$	(4.5) $SI_{ct}^{99.9-100}$	(4.6) $SI_{ct}^{99.99-100}$
$TITR_{ct}$	-0.054	-0.030	0.009	0.005
	(0.071)	(0.068)	(0.049)	(0.028)
$AITR_{ct}$	0.022	0.012	-0.001	0.001
	(0.027)	(0.025)	(0.018)	(0.010)
DTR_{ct}	0.064	0.083	0.080	0.006
	(0.071)	(0.065)	(0.048)	(0.043)
$CGTR_{ct}$	0.031	0.028	0.014	0.015
	(0.021)	(0.019)	(0.015)	(0.015)
ITR_{ct}	-0.200**	-0.202**	-0.177***	-0.058
	(0.093)	(0.088)	(0.063)	(0.045)
RTR_{ct}	0.006	0.001	0.002	0.003
	(0.011)	(0.010)	(0.007)	(0.004)
$GROWTH_{ct-1}$	0.001	0.001	0.001*	0.001**
	(0.000)	(0.000)	(0.000)	(0.000)
$Constant$	0.173***	0.133***	0.071***	0.026***
	(0.012)	(0.011)	(0.009)	(0.009)
Observations	107	101	90	64
R^2	0.510	0.514	0.550	0.571

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ indicate significance at the 1%, 5% and 10% level, respectively. All specifications include year dummies as well as country fixed effects.

specifications. However, the effect is very small: if GDP per capita increases by 1000 USD, the share of the top percentile would increase by 0.4 percentage points only.

Other authors have used the logarithm of the retention rate instead of the level of the tax rate as regressor. The results of using this alternative specification of the tax variable are presented in Tables 1.13 - 1.20. The results are very similar to our baseline specification.

If we include contemporaneous $GROWTH_{ct}$ instead of the lag, the baseline coefficients become a little bit larger at the bottom and smaller (i.e. more negative) at the top. This seems to be consistent with potential endogeneity concerns, which is why we use the lagged growth variable in all the regressions above. The results are presented in Tables 1.21 - 1.22. We also provide specifications where we exclude $GROWTH_{ct-1}$ (Table 1.23).

Further robustness checks include specifications where we employ a simple pooled OLS estimation (Table 1.24) and where we use general government tax revenue[16] to instrument for the $TITR_{ct}$. This additional test may address possible endogeneity concerns. However, we use total tax revenue as an instrument for lack of more persuasive instruments (Table 1.25).

1.6 Conclusion

This study surveys tax rates (11 different measures) on top income earners for many countries (165) and years (10). In an additional step, we use our new dataset to estimate whether taxes have an impact on the before-tax income distribution.

We show that, while the median of the top income tax rate has remained fairly stable, cross-country variation has increased. This stands in contrast to taxes on dividend incomes where we find a slight downwards trend in the size of the tax rate. High income countries have increased their tax

[16]This data was taken from the IMF.

rates, whereas a downward trend across developing countries is observable. Unconditional tests suggest that top income taxes are negatively associated with GDP growth rates as well as with income inequality.

Using income inequality data from WID.world and the World Bank, we show that higher top income tax rates reduce income inequality. Our results, conditional on country-specific effects, yearly shocks, as well as GDP growth, imply that a 1 percentage point increase in the top income tax rate redistributes 0.3 percentage points of the income share of the top 10% income earners to the lower 90%. The effect of capital income taxes on inequality is found to be small and insignificant. Additional tests show that the redistributive effect decreases as we approach the highest percentiles of the income distribution.

While our estimates turn out to be highly significant and in line with the literature on taxes and inequality, the quantitative effect of taxes on gross income remains fairly small. A rough calculation based on our estimates suggests that an increase in the top income tax rate of ten percentage points would be necessary to decrease the income share of the top 1% by a little bit more than 1 percentage point. The redistributive effects of higher top income taxes on gross income is thus rather modest. Apart from this quantitative result and the fact that progressive taxes have a redistribute effect on the net income distribution, the result that top income taxes have a redistributive effect on the gross income distribution is rather surprising.

Our results suggest that available data (at the level of countries) can be used to study the effect of taxes on inequality. It is also clear that policymakers need to have a better understanding of how taxes affect the distribution of assets, which is an important determinant of inequality in the first place. Correcting an unequal distribution of assets can raise tax revenue and will be key for reducing income inequality in the long run.

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Appendix

Table 1.10: Tax measures

Variable		Description
$TITR$	Top Income Tax Rate	$TITR$ equals the marginal tax rate which is levied at the top of the tax schedule. We include social security contributions. As outlined in footnote 4, this is not necessarily equal to the highest marginal tax rate in the tax schedule.
$TITRB$	Top Income Tax Rate Bound	$TITRB$ indicates the income level from where on $TITR$ is levied.
$AITR$	Average Income Tax Rate	$AITR$ is a proxy for the progressivity of the tax schedule and measures the average tax liability for incomes equal to $TITRB$. We include social security contributions.
$SEITR$	Self-Employed Income Tax Rate	$SEITR$ provides the tax rate levied on income from self-employment.
DTR	Dividend Tax Rate	DTR indicates the top marginal tax rate on dividend income.
$CGTR$	Capital Gains Tax Rate	$CGTR$ equals the top marginal tax rate on income from capital gains.
ITR	Interest Tax Rate	ITR measures the top marginal tax rate on interest income.
RTR	Royalties Tax Rate	RTR provides the top marginal tax rate on income from royalties.
$TWTR$	Top Wealth Tax Rate	$TWTR$ is calculated analogous to $TITR$ with net wealth as the tax base.
$TWTRB$	Top Wealth Tax Rate Bound	$TWTRB$ is calculated analogous to $TITRB$ with net wealth as the tax base.
$AWTR$	Average Wealth Tax Rate	$AWTR$ is calculated analogous to $AITR$ with net wealth as the tax base.

Table 1.11: Baseline regressions: EU countries

	(1)	(2.1)	(2.2)	(3.1)	(3.2)
	$GINI$	SI_{ct}^{0-90}	SI_{ct}^{0-99}	SI_{ct}^{90-95}	SI_{ct}^{95-99}
$TITR_{ct}$	-3.984	0.227***	0.139**	-0.037**	-0.063***
	(4.334)	(0.073)	(0.058)	(0.017)	(0.019)
$GROWTH_{ct-1}$	-0.147	-0.000	-0.001	-0.000	0.000
	(0.135)	(0.002)	(0.002)	(0.000)	(0.001)
$Constant$	32.963***	0.544***	0.821***	0.122***	0.160***
	(2.327)	(0.037)	(0.029)	(0.009)	(0.010)
Observations	48	30	32	43	43
R^2	0.160	0.686	0.601	0.254	0.410
	(3.3)	(3.4)	(3.5)	(4.1)	(4.2)
	$SI_{ct}^{99-99.5}$	$SI_{ct}^{99.5-99.9}$	$SI_{ct}^{99.9-99.99}$	SI_{ct}^{90-100}	SI_{ct}^{95-100}
$TITR_{ct}$	-0.022***	-0.045***	-0.024	-0.229***	-0.192***
	(0.006)	(0.013)	(0.025)	(0.058)	(0.053)
$GROWTH_{ct-1}$	0.000	0.000	0.001	0.001	0.001
	(0.000)	(0.000)	(0.001)	(0.002)	(0.001)
$Constant$	0.040***	0.062***	0.033**	0.450***	0.328***
	(0.003)	(0.007)	(0.013)	(0.030)	(0.027)
Observations	39	39	31	43	43
R^2	0.677	0.677	0.571	0.605	0.629
	(4.3)	(4.4)	(4.5)	(4.6)	
	SI_{ct}^{99-100}	$SI_{ct}^{99.5-100}$	$SI_{ct}^{99.9-100}$	$SI_{ct}^{99.99-100}$	
$TITR_{ct}$	-0.129***	-0.113**	-0.068*	0.008	
	(0.046)	(0.045)	(0.033)	(0.025)	
$GROWTH_{ct-1}$	0.001	0.001	0.001	0.001	
	(0.001)	(0.001)	(0.001)	(0.000)	
$Constant$	0.169***	0.132***	0.071***	0.007	
	(0.024)	(0.023)	(0.017)	(0.013)	
Observations	43	39	39	31	
R^2	0.594	0.571	0.502	0.536	

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ indicate significance at the 1%, 5% and 10% level, respectively. All specifications include year dummies as well as country fixed effects. Countries included: Denmark, Finland, France, Italy, Norway, Spain and UK.

Table 1.12: Regression income share on $TITR_{ct}$ and GDP squared

	(1) $GINI$	*(2.1)* SI_{ct}^{0-90}	*(2.2)* SI_{ct}^{0-99}	*(3.1)* SI_{ct}^{90-95}	*(3.2)* SI_{ct}^{95-99}
$TITR_{ct}$	-7.464***	0.310***	0.100***	-0.062***	-0.118***
	(1.684)	(0.070)	(0.032)	(0.019)	(0.028)
GDP_{ct}	-0.000***	0.000	-0.000**	-0.000*	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
GDP_{ct}^2	0.000	-0.000	0.000**	0.000**	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Constant$	48.897***	0.473***	0.927***	0.181***	0.250***
	(1.891)	(0.120)	(0.052)	(0.033)	(0.047)
Observations	486	71	75	100	102
R^2	0.262	0.385	0.510	0.359	0.306

	(3.3) $SI_{ct}^{99-99.5}$	*(3.4)* $SI_{ct}^{99.5-99.9}$	*(3.5)* $SI_{ct}^{99.9-99.99}$	*(4.1)* SI_{ct}^{90-100}	*(4.2)* SI_{ct}^{95-100}
$TITR_{ct}$	-0.018***	-0.047***	-0.024	-0.289***	-0.228***
	(0.005)	(0.010)	(0.015)	(0.055)	(0.041)
GDP_{ct}	0.000**	0.000***	0.000**	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
GDP_{ct}^2	-0.000**	-0.000***	-0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Constant$	0.022**	0.035**	-0.007	0.510***	0.319***
	(0.009)	(0.014)	(0.019)	(0.094)	(0.070)
Observations	101	90	64	100	102
R^2	0.321	0.526	0.571	0.355	0.379

	(4.3) SI_{ct}^{99-100}	*(4.4)* $SI_{ct}^{99.5-100}$	*(4.5)* $SI_{ct}^{99.9-100}$	*(4.6)* $SI_{ct}^{99.99-100}$
$TITR_{ct}$	-0.110***	-0.092***	-0.060***	-0.008
	(0.024)	(0.022)	(0.019)	(0.015)
GDP_{ct}	0.000***	0.000***	0.000***	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
GDP_{ct}^2	-0.000***	-0.000***	-0.000***	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
$Constant$	0.069*	0.038	0.011	-0.014
	(0.039)	(0.037)	(0.028)	(0.019)
Observations	107	101	90	64
R^2	0.512	0.516	0.540	0.519

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ indicate significance at the 1%, 5% and 10% level, respectively. All specifications include year dummies as well as country fixed effects. GDP_{ct} denotes GDP per capita.

Table 1.13: Regression income share on $log(1-TITR_{ct})$

	(1)	(2.1)	(2.2)	(3.1)	(3.2)
	$GINI$	SI_{ct}^{0-90}	SI_{ct}^{0-99}	SI_{ct}^{90-95}	SI_{ct}^{95-99}
$log(1-TITR_{ct})$	3.995***	-0.149***	-0.058***	0.029***	0.052***
	(1.067)	(0.032)	(0.015)	(0.010)	(0.014)
$GROWTH_{ct-1}$	-0.012	-0.000	-0.001*	-0.000	0.000
	(0.026)	(0.001)	(0.001)	(0.000)	(0.000)
Constant	40.800***	0.543***	0.849***	0.128***	0.173***
	(0.562)	(0.020)	(0.009)	(0.006)	(0.009)
Observations	486	71	75	100	102
R^2	0.220	0.357	0.496	0.268	0.256
	(3.3)	(3.4)	(3.5)	(4.1)	(4.2)
	$SI_{ct}^{99-99.5}$	$SI_{ct}^{99.5-99.9}$	$SI_{ct}^{99.9-99.99}$	SI_{ct}^{90-100}	SI_{ct}^{95-100}
$log(1-TITR_{ct})$	0.011***	0.025***	0.018**	0.142***	0.115***
	(0.003)	(0.004)	(0.007)	(0.027)	(0.020)
$GROWTH_{ct-1}$	0.000	0.000	0.001**	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
Constant	0.040***	0.061***	0.037***	0.450***	0.325***
	(0.002)	(0.003)	(0.005)	(0.017)	(0.012)
Observations	101	90	64	100	102
R^2	0.265	0.454	0.525	0.325	0.362
	(4.3)	(4.4)	(4.5)	(4.6)	
	SI_{ct}^{99-100}	$SI_{ct}^{99.5-100}$	$SI_{ct}^{99.9-100}$	$SI_{ct}^{99.99-100}$	
$log(1-TITR_{ct})$	0.063***	0.054***	0.032***	0.008	
	(0.012)	(0.011)	(0.009)	(0.006)	
$GROWTH_{ct-1}$	0.001	0.000	0.000	0.001***	
	(0.000)	(0.000)	(0.000)	(0.000)	
Constant	0.155***	0.117***	0.062***	0.019***	
	(0.007)	(0.007)	(0.005)	(0.004)	
Observations	107	101	90	64	
R^2	0.463	0.469	0.490	0.541	

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ indicate significance at the 1%, 5% and 10% level, respectively. All specifications include year dummies as well as country fixed effects.

Table 1.14: Regression income share on $log(1-TITR_{ct})$ and $log(1-AITR_{ct})$

	(1)	(2.1)	(2.2)	(3.1)	(3.2)
	$GINI$	SI_{ct}^{0-90}	SI_{ct}^{0-99}	SI_{ct}^{90-95}	SI_{ct}^{95-99}
$log(1-TITR_{ct})$	4.275***	-0.151***	-0.058***	0.030***	0.052***
	(1.310)	(0.038)	(0.016)	(0.011)	(0.015)
$log(1-AITR_{ct})$	-0.579	0.005	0.001	-0.002	0.001
	(1.566)	(0.045)	(0.018)	(0.012)	(0.017)
$GROWTH_{ct-1}$	-0.011	-0.000	-0.001*	-0.000	0.000
	(0.027)	(0.001)	(0.001)	(0.000)	(0.000)
$Constant$	40.732***	0.543***	0.849***	0.128***	0.173***
	(0.592)	(0.022)	(0.010)	(0.006)	(0.009)
Observations	486	71	75	100	102
R^2	0.220	0.357	0.496	0.269	0.256
	(3.3)	(3.4)	(3.5)	(4.1)	(4.2)
	$SI_{ct}^{99-99.5}$	$SI_{ct}^{99.5-99.9}$	$SI_{ct}^{99.9-99.99}$	SI_{ct}^{90-100}	SI_{ct}^{95-100}
$log(1-TITR_{ct})$	0.013***	0.026***	0.019**	0.145***	0.116***
	(0.003)	(0.005)	(0.007)	(0.030)	(0.023)
$log(1-AITR_{ct})$	-0.005*	-0.003	-0.002	-0.006	-0.003
	(0.003)	(0.005)	(0.006)	(0.034)	(0.026)
$GROWTH_{ct-1}$	0.000	0.000	0.001**	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
$Constant$	0.039***	0.060***	0.037***	0.449***	0.324***
	(0.002)	(0.003)	(0.005)	(0.018)	(0.013)
Observations	101	90	64	100	102
R^2	0.293	0.457	0.527	0.325	0.362
	(4.3)	(4.4)	(4.5)	(4.6)	
	SI_{ct}^{99-100}	$SI_{ct}^{99.5-100}$	$SI_{ct}^{99.9-100}$	$SI_{ct}^{99.99-100}$	
$log(1-TITR_{ct})$	0.066***	0.054***	0.031***	0.008	
	(0.013)	(0.012)	(0.009)	(0.007)	
$log(1-AITR_{ct})$	-0.007	-0.001	0.001	0.000	
	(0.015)	(0.014)	(0.010)	(0.005)	
$GROWTH_{ct-1}$	0.001	0.000	0.000	0.001**	
	(0.000)	(0.000)	(0.000)	(0.000)	
$Constant$	0.154***	0.117***	0.062***	0.019***	
	(0.008)	(0.007)	(0.006)	(0.004)	
Observations	107	101	90	64	
R^2	0.465	0.469	0.491	0.541	

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ indicate significance at the 1%, 5% and 10% level, respectively. All specifications include year dummies as well as country fixed effects.

Table 1.15: Regression income share on $log(1-TITR_{ct})$ and $log(1-DTR_{ct})$

	(1) $GINI$	*(2.1)* SI_{ct}^{0-90}	*(2.2)* SI_{ct}^{0-99}	*(3.1)* SI_{ct}^{90-95}	*(3.2)* SI_{ct}^{95-99}
$log(1-TITR_{ct})$	4.164***	-0.162***	-0.089***	0.036**	0.055**
	(1.125)	(0.059)	(0.026)	(0.017)	(0.024)
$log(1-DTR_{ct})$	-0.668	0.023	0.050	-0.011	-0.005
	(1.398)	(0.084)	(0.034)	(0.023)	(0.033)
$GROWTH_{ct-1}$	-0.011	-0.000	-0.001*	-0.000	0.000
	(0.027)	(0.001)	(0.001)	(0.000)	(0.000)
$Constant$	40.716***	0.543***	0.851***	0.128***	0.173***
	(0.590)	(0.020)	(0.009)	(0.006)	(0.009)
Observations	486	71	75	100	102
R^2	0.220	0.358	0.517	0.271	0.256

	(3.3) $SI_{ct}^{99-99.5}$	*(3.4)* $SI_{ct}^{99.5-99.9}$	*(3.5)* $SI_{ct}^{99.9-99.99}$	*(4.1)* SI_{ct}^{90-100}	*(4.2)* SI_{ct}^{95-100}
$log(1-TITR_{ct})$	0.005	0.021***	0.010	0.165***	0.125***
	(0.005)	(0.007)	(0.009)	(0.048)	(0.036)
$log(1-DTR_{ct})$	0.009	0.005	0.023	-0.037	-0.016
	(0.006)	(0.010)	(0.016)	(0.064)	(0.048)
$GROWTH_{ct-1}$	0.000	0.000	0.001***	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
$Constant$	0.040***	0.061***	0.041***	0.450***	0.325***
	(0.002)	(0.003)	(0.005)	(0.017)	(0.013)
Observations	101	90	64	100	102
R^2	0.286	0.457	0.546	0.328	0.363

	(4.3) SI_{ct}^{99-100}	*(4.4)* $SI_{ct}^{99.5-100}$	*(4.5)* $SI_{ct}^{99.9-100}$	*(4.6)* $SI_{ct}^{99.99-100}$
$log(1-TITR_{ct})$	0.066***	0.065***	0.042***	0.009
	(0.022)	(0.020)	(0.014)	(0.009)
$log(1-DTR_{ct})$	-0.005	-0.018	-0.018	-0.003
	(0.029)	(0.026)	(0.020)	(0.015)
$GROWTH_{ct-1}$	0.001	0.001	0.000	0.001**
	(0.000)	(0.000)	(0.000)	(0.000)
$Constant$	0.155***	0.117***	0.061***	0.018***
	(0.008)	(0.007)	(0.005)	(0.005)
Observations	107	101	90	64
R^2	0.463	0.472	0.497	0.541

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ indicate significance at the 1%, 5% and 10% level, respectively. All specifications include year dummies as well as country fixed effects.

Table 1.16: Regression income share on $log(1-TITR_{ct})$ and $log(1-CGTR_{ct})$

	(1) $GINI$	*(2.1)* SI_{ct}^{0-90}	*(2.2)* SI_{ct}^{0-99}	*(3.1)* SI_{ct}^{90-95}	*(3.2)* SI_{ct}^{95-99}
$log(1-TITR_{ct})$	4.435***	-0.162***	-0.080***	0.028**	0.056***
	(1.182)	(0.043)	(0.021)	(0.013)	(0.018)
$log(1-CGTR_{ct})$	-1.229	0.013	0.019	0.001	-0.004
	(1.412)	(0.028)	(0.013)	(0.008)	(0.012)
$GROWTH_{ct-1}$	-0.015	-0.000	-0.001	-0.000	0.000
	(0.027)	(0.001)	(0.001)	(0.000)	(0.000)
Constant	40.781***	0.538***	0.841***	0.128***	0.174***
	(0.562)	(0.022)	(0.011)	(0.007)	(0.010)
Observations	486	71	75	100	102
R^2	0.221	0.360	0.517	0.269	0.257

	(3.3) $SI_{ct}^{99-99.5}$	*(3.4)* $SI_{ct}^{99.5-99.9}$	*(3.5)* $SI_{ct}^{99.9-99.99}$	*(4.1)* SI_{ct}^{90-100}	*(4.2)* SI_{ct}^{95-100}
$log(1-TITR_{ct})$	0.010***	0.030***	0.020**	0.156***	0.130***
	(0.004)	(0.006)	(0.009)	(0.036)	(0.027)
$log(1-CGTR_{ct})$	0.001	-0.005	-0.002	-0.013	-0.015
	(0.002)	(0.004)	(0.008)	(0.023)	(0.017)
$GROWTH_{ct-1}$	0.000	0.000	0.001**	0.000	0.001
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
Constant	0.039***	0.062***	0.038***	0.454***	0.330***
	(0.002)	(0.003)	(0.005)	(0.019)	(0.014)
Observations	101	90	64	100	102
R^2	0.268	0.467	0.526	0.328	0.368

	(4.3) SI_{ct}^{99-100}	*(4.4)* $SI_{ct}^{99.5-100}$	*(4.5)* $SI_{ct}^{99.9-100}$	*(4.6)* $SI_{ct}^{99.99-100}$
$log(1-TITR_{ct})$	0.074***	0.066***	0.038***	0.012
	(0.016)	(0.015)	(0.012)	(0.009)
$log(1-CGTR_{ct})$	-0.011	-0.013	-0.006	-0.004
	(0.011)	(0.010)	(0.007)	(0.007)
$GROWTH_{ct-1}$	0.001	0.000	0.000	0.001**
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.158***	0.121***	0.064***	0.020***
	(0.008)	(0.007)	(0.006)	(0.005)
Observations	107	101	90	64
R^2	0.470	0.481	0.495	0.545

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ indicate significance at the 1%, 5% and 10% level, respectively. All specifications include year dummies as well as country fixed effects.

Table 1.17: Regression income share on $log(1 - TITR_{ct})$ and $log(1 - ITR_{ct})$

	(1)	*(2.1)*	*(2.2)*	*(3.1)*	*(3.2)*
	$GINI$	SI_{ct}^{0-90}	SI_{ct}^{0-99}	SI_{ct}^{90-95}	SI_{ct}^{95-99}
$log(1 - TITR_{ct})$	3.370***	-0.223**	-0.036	0.078***	0.112***
	(1.239)	(0.087)	(0.043)	(0.024)	(0.034)
lrritr	1.701	0.096	-0.026	-0.062**	-0.077*
	(1.716)	(0.105)	(0.049)	(0.028)	(0.040)
$GROWTH_{ct-1}$	-0.011	-0.000	-0.001*	-0.000	-0.000
	(0.026)	(0.001)	(0.001)	(0.000)	(0.000)
Constant	40.946***	0.540***	0.850***	0.131***	0.176***
	(0.581)	(0.020)	(0.010)	(0.006)	(0.009)
Observations	486	71	75	100	102
R^2	0.222	0.368	0.499	0.313	0.290
	(3.3)	*(3.4)*	*(3.5)*	*(4.1)*	*(4.2)*
	$SI_{ct}^{99-99.5}$	$SI_{ct}^{99.5-99.9}$	$SI_{ct}^{99.9-99.99}$	SI_{ct}^{90-100}	SI_{ct}^{95-100}
$log(1 - TITR_{ct})$	0.001	0.013	0.001	0.225***	0.146***
	(0.007)	(0.011)	(0.013)	(0.068)	(0.051)
$log(1 - ITR_{ct})$	0.013	0.016	0.027	-0.105	-0.040
	(0.008)	(0.013)	(0.018)	(0.080)	(0.060)
$GROWTH_{ct-1}$	0.000	0.000	0.001***	0.000	0.001
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
Constant	0.040***	0.060***	0.039***	0.454***	0.326***
	(0.002)	(0.003)	(0.005)	(0.017)	(0.013)
Observations	101	90	64	100	102
R^2	0.288	0.466	0.548	0.341	0.365
	(4.3)	*(4.4)*	*(4.5)*	*(4.6)*	
	SI_{ct}^{99-100}	$SI_{ct}^{99.5-100}$	$SI_{ct}^{99.9-100}$	$SI_{ct}^{99.99-100}$	
$log(1 - TITR_{ct})$	0.030	0.031	0.010	0.001	
	(0.031)	(0.030)	(0.022)	(0.013)	
$log(1 - ITR_{ct})$	0.042	0.029	0.028	0.011	
	(0.036)	(0.035)	(0.026)	(0.017)	
$GROWTH_{ct-1}$	0.001	0.001	0.000*	0.001***	
	(0.000)	(0.000)	(0.000)	(0.000)	
Constant	0.154***	0.116***	0.061***	0.019***	
	(0.008)	(0.007)	(0.005)	(0.004)	
Observations	107	101	90	64	
R^2	0.473	0.474	0.500	0.545	

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ indicate significance at the 1%, 5% and 10% level, respectively. All specifications include year dummies as well as country fixed effects.

Table 1.18: Regression income share on $log(1-TITR_{ct})$ and $log(1-RTR_{ct})$

	(1) $GINI$	*(2.1)* SI_{ct}^{0-90}	*(2.2)* SI_{ct}^{0-99}	*(3.1)* SI_{ct}^{90-95}	*(3.2)* SI_{ct}^{95-99}
$log(1-TITR_{ct})$	3.624***	-0.120***	-0.063***	0.012	0.026*
	(1.179)	(0.040)	(0.017)	(0.012)	(0.015)
$log(1-RTR_{ct})$	1.033	-0.036	0.006	0.022**	0.030***
	(1.387)	(0.030)	(0.010)	(0.009)	(0.009)
$GROWTH_{ct-1}$	-0.013	-0.001	-0.001*	-0.000	0.000
	(0.027)	(0.001)	(0.001)	(0.000)	(0.000)
$Constant$	40.922***	0.545***	0.849***	0.126***	0.170***
	(0.586)	(0.020)	(0.009)	(0.006)	(0.008)
Observations	486	71	75	100	102
R^2	0.221	0.377	0.500	0.318	0.352

	(3.3) $SI_{ct}^{99-99.5}$	*(3.4)* $SI_{ct}^{99.5-99.9}$	*(3.5)* $SI_{ct}^{99.9-99.99}$	*(4.1)* SI_{ct}^{90-100}	*(4.2)* SI_{ct}^{95-100}
$log(1-TITR_{ct})$	0.015***	0.023***	0.018**	0.117***	0.091***
	(0.003)	(0.005)	(0.008)	(0.034)	(0.023)
$log(1-RTR_{ct})$	-0.004**	0.002	-0.000	0.031	0.027*
	(0.002)	(0.003)	(0.003)	(0.026)	(0.014)
$GROWTH_{ct-1}$	0.000	0.000	0.001**	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
$Constant$	0.040***	0.060***	0.037***	0.447***	0.322***
	(0.002)	(0.003)	(0.005)	(0.017)	(0.012)
Observations	101	90	64	100	102
R^2	0.308	0.458	0.525	0.337	0.393

	(4.3) SI_{ct}^{99-100}	*(4.4)* $SI_{ct}^{99.5-100}$	*(4.5)* $SI_{ct}^{99.9-100}$	*(4.6)* $SI_{ct}^{99.99-100}$
$log(1-TITR_{ct})$	0.066***	0.054***	0.033***	0.010
	(0.014)	(0.013)	(0.010)	(0.007)
$log(1-RTR_{ct})$	-0.003	-0.000	-0.001	-0.002
	(0.008)	(0.008)	(0.006)	(0.003)
$GROWTH_{ct-1}$	0.001	0.000	0.000	0.001**
	(0.000)	(0.000)	(0.000)	(0.000)
$Constant$	0.155***	0.117***	0.062***	0.019***
	(0.008)	(0.007)	(0.005)	(0.004)
Observations	107	101	90	64
R^2	0.464	0.469	0.491	0.545

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ indicate significance at the 1%, 5% and 10% level, respectively. All specifications include year dummies as well as country fixed effects. Countries included: Denmark, Finland, France, Italy, Norway, Spain and UK.

Table 1.19: Regression income share on log retention rate of all tax variables

	(1) $GINI$	(2.1) SI_{ct}^{0-90}	(2.2) SI_{ct}^{0-99}	(3.1) SI_{ct}^{90-95}	(3.2) SI_{ct}^{95-99}
$log(1-TITR_{ct})$	3.951**	-0.300**	-0.031	0.095***	0.132***
	(1.544)	(0.131)	(0.052)	(0.028)	(0.039)
$log(1-AITR_{ct})$	-0.573	0.055	0.005	-0.015	-0.018
	(1.583)	(0.062)	(0.021)	(0.013)	(0.018)
$log(1-DTR_{ct})$	-2.418	-0.030	0.086*	0.024	0.043
	(1.791)	(0.115)	(0.051)	(0.030)	(0.041)
$log(1-CGTR_{ct})$	-2.156	0.011	0.016	0.007	0.001
	(1.556)	(0.036)	(0.016)	(0.009)	(0.013)
$log(1-ITR_{ct})$	3.810	0.222	-0.128*	-0.136***	-0.166***
	(2.541)	(0.158)	(0.067)	(0.038)	(0.053)
$log(1-RTR_{ct})$	0.851	-0.044	0.005	0.030***	0.034***
	(1.849)	(0.031)	(0.010)	(0.009)	(0.009)
$GROWTH_{ct-1}$	-0.012	-0.000	-0.002**	-0.000	0.000
	(0.027)	(0.001)	(0.001)	(0.000)	(0.000)
$Constant$	40.819***	0.545***	0.852***	0.126***	0.173***
	(0.629)	(0.026)	(0.012)	(0.007)	(0.009)
Observations	486	71	75	100	102
R^2	0.230	0.412	0.569	0.432	0.438

	(3.3) $SI_{ct}^{99-99.5}$	(3.4) $SI_{ct}^{99.5-99.9}$	(3.5) $SI_{ct}^{99.9-99.99}$	(4.1) SI_{ct}^{90-100}	(4.2) SI_{ct}^{95-100}
$log(1-TITR_{ct})$	0.008	0.014	0.005	0.268***	0.165**
	(0.008)	(0.014)	(0.016)	(0.085)	(0.063)
$log(1-AITR_{ct})$	-0.004	-0.002	-0.001	-0.039	-0.021
	(0.004)	(0.006)	(0.007)	(0.040)	(0.030)
$log(1-DTR_{ct})$	0.008	0.008	0.027	0.031	0.009
	(0.008)	(0.014)	(0.025)	(0.090)	(0.067)
$log(1-CGTR_{ct})$	-0.002	-0.010**	-0.015	-0.010	-0.017
	(0.003)	(0.005)	(0.010)	(0.029)	(0.021)
$log(1-ITR_{ct})$	0.007	0.022	0.027	-0.198*	-0.072
	(0.011)	(0.018)	(0.027)	(0.116)	(0.085)
$log(1-RTR_{ct})$	-0.005**	0.001	-0.002	0.044	0.030**
	(0.002)	(0.003)	(0.003)	(0.028)	(0.014)
$GROWTH_{ct-1}$	0.000	0.000	0.001**	0.000	0.001
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
$Constant$	0.040***	0.064***	0.047***	0.451***	0.327***
	(0.002)	(0.004)	(0.007)	(0.020)	(0.015)
Observations	101	90	64	100	102
R^2	0.365	0.505	0.580	0.374	0.410

	(4.3) SI_{ct}^{99-100}	(4.4) $SI_{ct}^{99.5-100}$	(4.5) $SI_{ct}^{99.9-100}$	(4.6) $SI_{ct}^{99.99-100}$
$log(1-TITR_{ct})$	0.033	0.027	-0.001	0.001
	(0.038)	(0.037)	(0.027)	(0.015)
$log(1-AITR_{ct})$	-0.006	-0.002	0.005	0.000
	(0.017)	(0.016)	(0.012)	(0.006)
$log(1-DTR_{ct})$	-0.029	-0.039	-0.043	-0.006
	(0.040)	(0.037)	(0.028)	(0.024)
$log(1-CGTR_{ct})$	-0.019	-0.016	-0.006	-0.009
	(0.013)	(0.012)	(0.009)	(0.009)
$log(1-ITR_{ct})$	0.094*	0.087*	0.082**	0.030
	(0.052)	(0.050)	(0.036)	(0.025)
$log(1-RTR_{ct})$	-0.005	-0.001	-0.002	-0.002
	(0.009)	(0.008)	(0.006)	(0.003)
$GROWTH_{ct-1}$	0.001	0.001	0.001*	0.001**
	(0.000)	(0.000)	(0.000)	(0.000)
$Constant$	0.157***	0.120***	0.062***	0.022***
	(0.009)	(0.008)	(0.007)	(0.007)
Observations	107	101	90	64
R^2	0.500	0.506	0.538	0.568
Observations	107	101	90	64

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ indicate significance at the 1%, 5% and 10% level, respectively. All specifications include year dummies as well as country fixed effects.

Table 1.20: Regression income share on $log(1 - TITR_{ct})$: EU countries

	(1)	(2.1)	(2.2)	(3.1)	(3.2)
	$GINI$	SI_{ct}^{0-90}	SI_{ct}^{0-99}	SI_{ct}^{90-95}	SI_{ct}^{95-99}
$log(1 - TITR_{ct})$	1.810	-0.107***	-0.066**	0.017**	0.030***
	(1.957)	(0.033)	(0.027)	(0.008)	(0.008)
$GROWTH_{ct-1}$	-0.146	-0.001	-0.001	-0.000	0.000
	(0.135)	(0.002)	(0.002)	(0.000)	(0.001)
$Constant$	32.252***	0.582***	0.843***	0.116***	0.149***
	(1.572)	(0.025)	(0.020)	(0.006)	(0.006)
Observations	48	30	32	43	43
R^2	0.161	0.693	0.607	0.252	0.423

	(3.3)	(3.4)	(3.5)	(4.1)	(4.2)
	$SI_{ct}^{99-99.5}$	$SI_{ct}^{99.5-99.9}$	$SI_{ct}^{99.9-99.99}$	SI_{ct}^{90-100}	SI_{ct}^{95-100}
$log(1 - TITR_{ct})$	0.010***	0.021***	0.013	0.106***	0.089***
	(0.003)	(0.006)	(0.011)	(0.027)	(0.024)
$GROWTH_{ct-1}$	0.000	0.000	0.001	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.002)	(0.001)
$Constant$	0.036***	0.054***	0.030***	0.411***	0.295***
	(0.002)	(0.004)	(0.008)	(0.020)	(0.018)
Observations	39	39	31	43	43
R^2	0.672	0.674	0.587	0.607	0.632

	(4.3)	(4.4)	(4.5)	(4.6)
	SI_{ct}^{99-100}	$SI_{ct}^{99.5-100}$	$SI_{ct}^{99.9-100}$	$SI_{ct}^{99.99-100}$
$log(1 - TITR_{ct})$	0.059***	0.052**	0.032**	-0.001
	(0.021)	(0.021)	(0.015)	(0.011)
$GROWTH_{ct-1}$	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.000)
$Constant$	0.146***	0.113***	0.059***	0.011
	(0.016)	(0.015)	(0.011)	(0.008)
Observations	43	39	39	31
R^2	0.594	0.573	0.506	0.533

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ indicate significance at the 1%, 5% and 10% level, respectively. All specifications include year dummies as well as country fixed effects. Countries included: Denmark, Finland, France, Italy, Norway, Spain and UK.

Table 1.21: Regression income share on $TITR_{ct}$ and $GROWTH_{ct}$

	(1)	*(2.1)*	*(2.2)*	*(3.1)*	*(3.2)*
	GINI	SI_{ct}^{0-90}	SI_{ct}^{0-99}	SI_{ct}^{90-95}	SI_{ct}^{95-99}
$TITR_{ct}$	-6.088***	0.322***	0.125***	-0.066***	-0.116***
	(1.707)	(0.064)	(0.030)	(0.018)	(0.026)
$GROWTH_{ct}$	-0.029	0.001	-0.000	-0.001***	-0.001*
	(0.027)	(0.001)	(0.000)	(0.000)	(0.000)
$Constant$	41.199***	0.487***	0.825***	0.142***	0.196***
	(0.655)	(0.029)	(0.013)	(0.008)	(0.012)
Observations	486	71	75	100	102
R^2	0.220	0.386	0.463	0.366	0.307
	(3.3)	*(3.4)*	*(3.5)*	*(4.1)*	*(4.2)*
	$SI_{ct}^{99-99.5}$	$SI_{ct}^{99.5-99.9}$	$SI_{ct}^{99.9-99.99}$	SI_{ct}^{90-100}	SI_{ct}^{95-100}
$TITR_{ct}$	-0.024***	-0.054***	-0.038**	-0.306***	-0.244***
	(0.005)	(0.009)	(0.016)	(0.050)	(0.039)
$GROWTH_{ct}$	-0.000*	-0.000	0.000	-0.002**	-0.001
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
$Constant$	0.045***	0.071***	0.044***	0.507***	0.368***
	(0.002)	(0.004)	(0.008)	(0.023)	(0.017)
Observations	101	90	64	100	102
R^2	0.287	0.464	0.481	0.377	0.389
	(4.3)	*(4.4)*	*(4.5)*	*(4.6)*	
	SI_{ct}^{99-100}	$SI_{ct}^{99.5-100}$	$SI_{ct}^{99.9-100}$	99.99-100	
$TITR_{ct}$	-0.130***	-0.109***	-0.068***	-0.017	
	(0.024)	(0.022)	(0.018)	(0.015)	
$GROWTH_{ct}$	-0.000	0.000	0.000	0.000	
	(0.000)	(0.000)	(0.000)	(0.000)	
$Constant$	0.177***	0.134***	0.074***	0.022***	
	(0.011)	(0.010)	(0.008)	(0.007)	
Observations	107	101	90	64	
R^2	0.455	0.456	0.473	0.493	

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ indicate significance at the 1%, 5% and 10% level, respectively. All specifications include year dummies as well as country fixed effects.

Table 1.22: Regression income share on $log(1-TITR_{ct})$ and $GROWTH_{ct}$

	(1) GINI	*(2.1)* SI_{ct}^{0-90}	*(2.2)* SI_{ct}^{0-99}	*(3.1)* SI_{ct}^{90-95}	*(3.2)* SI_{ct}^{95-99}
$log(1-TITR_{ct})$	3.957***	-0.153***	-0.062***	0.031***	0.054***
	(1.066)	(0.033)	(0.015)	(0.009)	(0.013)
$GROWTH_{ct}$	-0.032	0.000	-0.000	-0.001***	-0.001*
	(0.027)	(0.001)	(0.000)	(0.000)	(0.000)
$Constant$	40.908***	0.536***	0.843***	0.132***	0.178***
	(0.562)	(0.021)	(0.009)	(0.006)	(0.008)
Observations	486	71	75	100	102
R^2	0.222	0.356	0.463	0.351	0.282
	(3.3) $SI_{ct}^{99-99.5}$	*(3.4)* $SI_{ct}^{99.5-99.9}$	*(3.5)* $SI_{ct}^{99.9-99.99}$	*(4.1)* SI_{ct}^{90-100}	*(4.2)* SI_{ct}^{95-100}
$log(1-TITR_{ct})$	0.012***	0.025***	0.018**	0.148***	0.119***
	(0.003)	(0.004)	(0.007)	(0.026)	(0.020)
$GROWTH_{ct}$	-0.000*	-0.000	0.000	-0.001*	-0.001
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
$Constant$	0.041***	0.062***	0.038***	0.461***	0.332***
	(0.002)	(0.003)	(0.005)	(0.016)	(0.012)
Observations	101	90	64	100	102
R^2	0.279	0.445	0.484	0.352	0.366
	(4.3) SI_{ct}^{99-100}	*(4.4)* $SI_{ct}^{99.5-100}$	*(4.5)* $SI_{ct}^{99.9-100}$	*(4.6)* $SI_{ct}^{99.99-100}$	
$log(1-TITR_{ct})$	0.065***	0.055***	0.033***	0.008	
	(0.012)	(0.011)	(0.009)	(0.007)	
$GROWTH_{ct}$	-0.000	0.000	0.000	0.000	
	(0.000)	(0.000)	(0.000)	(0.000)	
$Constant$	0.158***	0.120***	0.064***	0.020***	
	(0.007)	(0.007)	(0.005)	(0.005)	
Observations	107	101	90	64	
R^2	0.450	0.456	0.474	0.493	

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ indicate significance at the 1%, 5% and 10% level, respectively. All specifications include year dummies as well as country fixed effects.

Table 1.23: Regression income share, $GROWTH_{ct-1}$ omitted

	(1)	*(2.1)*	*(2.2)*	*(3.1)*	*(3.2)*
	GINI	SI_{ct}^{0-90}	SI_{ct}^{0-99}	SI_{ct}^{90-95}	SI_{ct}^{95-99}
$TITR_{ct}$	-6.179***	0.313***	0.125***	-0.060***	-0.111***
	(1.706)	(0.062)	(0.030)	(0.019)	(0.026)
$Constant$	41.055***	0.493***	0.825***	0.136***	0.191***
	(0.641)	(0.027)	(0.013)	(0.008)	(0.011)
Observations	486	71	75	100	102
R^2	0.218	0.382	0.463	0.275	0.276
	(3.3)	*(3.4)*	*(3.5)*	*(4.1)*	*(4.2)*
	$SI_{ct}^{99-99.5}$	$SI_{ct}^{99.5-99.9}$	$SI_{ct}^{99.9-99.99}$	SI_{ct}^{90-100}	SI_{ct}^{95-100}
$TITR_{ct}$	-0.023***	-0.053***	-0.043***	-0.295***	-0.239***
	(0.005)	(0.009)	(0.016)	(0.051)	(0.038)
$Constant$	0.044***	0.070***	0.048***	0.496***	0.363***
	(0.002)	(0.004)	(0.007)	(0.022)	(0.017)
Observations	101	90	64	100	102
R^2	0.256	0.458	0.451	0.342	0.375
	(4.3)	*(4.4)*	*(4.5)*	*(4.6)*	
	SI_{ct}^{99-100}	$SI_{ct}^{99.5-100}$	$SI_{ct}^{99.9-100}$	$SI_{ct}^{99.99-100}$	
$TITR_{ct}$	-0.130***	-0.109***	-0.068***	-0.021	
	(0.024)	(0.022)	(0.018)	(0.015)	
$Constant$	0.176***	0.135***	0.074***	0.026***	
	(0.010)	(0.009)	(0.008)	(0.007)	
Observations	107	101	90	64	
R^2	0.455	0.456	0.472	0.462	

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ indicate significance at the 1%, 5% and 10% level, respectively. All specifications include year dummies as well as country fixed effects.

Table 1.24: OLS regression income share on $TITR_{ct}$

	(1)	*(2.1)*	*(2.2)*	*(3.1)*	*(3.2)*
	GINI	SI_{ct}^{0-90}	SI_{ct}^{0-99}	SI_{ct}^{90-95}	SI_{ct}^{95-99}
$TITR_{ct}$	-9.253***	0.260*	0.110**	-0.017	-0.088*
	(2.794)	(0.135)	(0.054)	(0.030)	(0.045)
$GROWTH_{ct-1}$	0.614***	-0.002	-0.005*	0.000	0.002
	(0.111)	(0.006)	(0.003)	(0.001)	(0.002)
Constant	39.442***	0.520***	0.840***	0.117***	0.176***
	(1.730)	(0.082)	(0.033)	(0.018)	(0.027)
Observations	486	71	75	100	102
R^2	0.128	0.163	0.276	0.018	0.136
	(3.3)	*(3.4)*	*(3.5)*	*(4.1)*	*(4.2)*
	$SI_{ct}^{99-99.5}$	$SI_{ct}^{99.5-99.9}$	$SI_{ct}^{99.9-99.99}$	SI_{ct}^{90-100}	SI_{ct}^{95-100}
$TITR_{ct}$	-0.030**	-0.074***	-0.083***	-0.221**	-0.205**
	(0.011)	(0.018)	(0.018)	(0.103)	(0.080)
$GROWTH_{ct-1}$	0.001*	0.000	0.000	0.002	0.004
	(0.000)	(0.001)	(0.001)	(0.005)	(0.004)
Constant	0.044***	0.079***	0.067***	0.449***	0.340***
	(0.007)	(0.011)	(0.010)	(0.062)	(0.048)
Observations	101	90	64	100	102
R^2	0.268	0.347	0.536	0.123	0.176
	(4.3)	*(4.4)*	*(4.5)*	*(4.6)*	
	SI_{ct}^{99-100}	$SI_{ct}^{99.5-100}$	$SI_{ct}^{99.9-100}$	99.99-100	
$TITR_{ct}$	-0.133***	-0.080**	-0.066***	-0.043***	
	(0.042)	(0.035)	(0.019)	(0.009)	
$GROWTH_{ct-1}$	0.002	0.002	0.000	0.000	
	(0.002)	(0.002)	(0.001)	(0.000)	
Constant	0.172***	0.116***	0.073***	0.035***	
	(0.025)	(0.020)	(0.011)	(0.006)	
Observations	107	101	90	64	
R^2	0.246	0.230	0.276	0.586	
Observations	107	101	90	64	

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ indicate significance at the 1%, 5% and 10% level, respectively. All specifications include year dummies.

Table 1.25: Regression income share, instrumented tax

	(1)	*(2.1)*	*(2.2)*	*(3.1)*	*(3.2)*
	GINI	SI_{ct}^{0-90}	SI_{ct}^{0-99}	SI_{ct}^{90-95}	SI_{ct}^{95-99}
$\widehat{TITR}_{ct}$	-0.447***	0.004***	0.001***	-0.001***	-0.002***
	(0.032)	(0.001)	(0.000)	(0.000)	(0.000)
$GROWTH_{ct-1}$	0.197**	0.001	-0.004	-0.002	0.001
	(0.093)	(0.005)	(0.002)	(0.001)	(0.002)
$Constant$	53.269***	0.484***	0.837***	0.156***	0.209***
	(1.618)	(0.063)	(0.026)	(0.014)	(0.020)
Observations	507	71	75	100	102
R^2	0.349	0.252	0.315	0.162	0.272
	(3.3)	*(3.4)*	*(3.5)*	*(4.1)*	*(4.2)*
	$SI_{ct}^{99-99.5}$	$SI_{ct}^{99.5-99.9}$	$SI_{ct}^{99.9-99.99}$	SI_{ct}^{90-100}	SI_{ct}^{95-100}
$\widehat{TITR}_{ct}$	-0.000***	-0.001***	-0.000***	-0.004***	-0.003***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
$GROWTH_{ct-1}$	0.001*	0.001	0.002***	-0.000	0.002
	(0.000)	(0.001)	(0.001)	(0.004)	(0.003)
$Constant$	0.047***	0.066***	0.037***	0.511***	0.373***
	(0.005)	(0.008)	(0.006)	(0.047)	(0.036)
Observations	101	90	64	100	102
R^2	0.352	0.350	0.440	0.249	0.286
	(4.3)	*(4.4)*	*(4.5)*	*(4.6)*	
	SI_{ct}^{99-100}	$SI_{ct}^{99.5-100}$	$SI_{ct}^{99.9-100}$	99.99-100	
$\widehat{TITR}_{ct}$	-0.002***	-0.001***	-0.001***	-0.000***	
	(0.000)	(0.000)	(0.000)	(0.000)	
$GROWTH_{ct-1}$	0.002	0.002*	0.001	0.001***	
	(0.002)	(0.001)	(0.001)	(0.000)	
$Constant$	0.171***	0.120***	0.063***	0.021***	
	(0.019)	(0.016)	(0.008)	(0.003)	
R^2	0.301	0.283	0.287	0.535	

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ indicate significance at the 1%, 5% and 10% level, respectively. All specifications include year dummies as well as country fixed effects. $TITR_{ct}$ instrumented for by government tax revenue (Source: IMF).

Chapter 2

Do multinational firms respond to personal dividend income tax rates?

Abstract

This study examines the effect of investor-level income taxes on profit repatriations and dividend payout policies of multinational firms. The empirical estimations include two million firm-year observations in 130 countries. By augmenting the Lintner model of dividend payments, I employ parametric as well as semiparametric techniques to provide evidence that income taxes on dividends neither alter dividend payments to investors nor within-firm dividend payments. These results remain robust to a wide range of alternative specifications.

2.1 Introduction

Should governments tax investor-level dividend income or not? During the last decades, this topic has received increased attention in the public debate and the literature. Since wealthy people have the means to invest in shares and therefore generate disproportionally large dividend incomes, it is often considered as fair to impose high taxes on dividends. However, taxing dividend income might distort the allocation of capital. Investors might find it less worthwhile to invest their savings in shares, or they could simply move their capital abroad. Furthermore, firms might decide to lower dividend payments to reduce the tax burden of their shareholders.

If firms adjust their dividend payments in response to tax changes, firms might also update how much profits they repatriate from the firms they possess. If firms aim at decreasing dividend payments, they might find it optimal to repatriate a lower share of these profits. Hence, higher investor-level taxes on capital might reduce the inflow of capital from abroad. Gaining more insights on this topic will increase our understanding of the potential cost governments face if they increase dividend income taxes. The investigation of these tax effects is the purpose of this paper.

The effect of changes in the dividend tax rate (DTR) on dividend payments (DIV) has already been discussed in the literature; the results suggest that dividend payments increase in response to lower tax rates (e.g., Poterba, 2004; Chetty and Saez, 2005). However, most studies are based on the US dividend income tax cut in 2003. This paper attempts to extend this approach by basing the econometric analysis on a large panel dataset including several reforms in different countries.

The conceptual framework is based on the Lintner model (Lintner, 1956) which serves as the theoretical workhorse in the literature on dividend payments. The econometric analysis exploits balance sheet data from more than 1.3 million firms and a tax dataset which covers 165 countries. What makes this tax dataset unique is that it not only includes taxes on earned income for such a large number of countries, but also a wide range of other income taxes like the tax on dividend income. First, I replicate the Lintner model using different specifications. I find very similar results compared to previous studies. In a second step, for each firm, I include the tax rate of the country where the highest firm within the associated multinational firm (MNF) network resides. Henceforth, I will refer to this firm as the *GUO* (global ultimate owner). I do not only implement a standard parametric model for the econometric analysis, but I also allow for heterogeneous effects of the tax by means of a semiparametric approach. Furthermore, I present different robustness checks including alternative specifications and different subsamples.

The results indicate that investor-level dividend income tax rates do not play a significant role in the size of dividend payments, neither for dividend payments to investor-level shareholders nor for within MNF dividend payments. This suggests that the cost of increasing investor-level dividend income taxes are smaller than previous studies suggest.

This paper is structured as follows: I start with a review of the relevant literature in Section 2.2. The review is followed by a discussion of the conceptual framework and the empirical implementation in Sections 2.3 and 2.4. Section 2.5 provides a description of the data and some first evidence of the tax effect. The results are presented in Section 2.6, which is followed by a discussion of the robustness checks in Section 2.7. Section 2.8 concludes.

2.2 Related literature

Among the earliest and most influential studies in the literature on the dividend policy of firms is the seminal work by Lintner (1956) who discusses the determinants of dividend payouts on the basis of survey evidence. However, while Lintner was concerned with the determinants of dividend payout, it was far from clear why firms pay dividends at all. In fact, following the Modigliani-Miller theorem (Modigliani and Miller, 1958), in perfect capital markets, dividend payout policies of firms are not only irrelevant to the wealth of investors. Instead, retained earnings seem to be superior compared to dividend payments since capital gain taxes tend to be lower than dividend income taxes. Following Black (1976), this contradiction is often referred to as the Dividend Puzzle. This irrelevance finding was followed by a series of studies that aim at solving the Dividend Puzzle by providing rationals in favor of dividend payments. Shefrin and Statman (1984) argue that investors prefer a smooth and reliable dividend income stream over time compared to a large one-off payment at the moment when the stock is sold, due to unpredictable price fluctuations of the share. Similarly, Brennan (1971) assumes that dividend payments act as an insurance since firms may become insolvent before investors sell their share. A further rationale is provided by Ross (1977), Miller and Rock (1985), John and Williams (1985) and Ambarish et al. (1987), who ascribe dividend payments to the signaling of firms to inform investors of the conditions of the firm.

Many studies in this context rely on the Lintner model (Lintner, 1956) which serves as the workhorse in the literature on dividend payouts. In short, it states that dividend payments depend positively on the desired payout ratio and former dividend payments. Hence, firms do not just set dividend payments according to the desired payout ratio but also aim at a smooth dividend payment stream over time. Lintner (1956) estimates a target-payout ratio of 50% and a speed of adjustment coefficient of 30%, Babiak and Fama (1968) obtain similar results. Desai et al. (2002) estimate the payout ratio to be larger for subsidiaries in high-tax countries. As dividends are, in a statistical sense, left censored (they cannot fall below zero), they base their estimations on the Tobit model. Desai et al. (2007) use the Lintner model to investigate how taxation, costly external finance, and agency problems influence internal capital markets. Distinguishing between firms with and without a bond rating, Aivazian et al. (2006) find that the first exhibit a strong taste for dividend smoothing while the latter put more emphasis on a smooth dividend payment stream, i.e., adhering more to the payout ratio. Lehmann and Mody (2004) estimate the Lintner model in a within-MNF setting using the Arellano-Bond estimator.

Based on the Lintner model, Bellak and Leibrecht (2010) find a negative effect of taxes on dividend repatriations of German parent companies from foreign affiliates. Furthermore, the authors introduce a solution for the "initial conditions problem," i.e., while dividend payments depend on past dividend payments, typically, the first payment is unobserved. Accounting for this problem leads to a larger estimated speed of adjustment coefficient. Also, they provide a detailed literature review on the Lintner model; a meta-regression analysis can be found in Fernau and Hirsch (2019). These results are in line with a wide range of qualitative studies, see G. E. Powell (2009) for a summary.

Having discussed the literature on how and why firms pay dividends, I now turn to the literature on dividend taxation.

One strand of this literature is concerned with the effect of investor-level income taxes on firm behavior. Chetty and Saez (2005) estimate a substantial increase in dividend payments in response to the US personal dividend income tax cut in 2003 (Jobs and Growth Tax Relief Reconciliation Act), Hanlon and Hoopes (2014) find that firms anticipated the dividend tax increases in 2011 and 2013 by shifting tax payments to the year prior to the tax increase (i.e., 2010 and 2012). Poterba (2004) finds similar results. However, using a difference-in-differences approach based on C- and S-corporations,[1] Yagan (2015) finds no effect of the 2003 tax cut on real investments of the firm. Following the argumentation of the author, this supports the so-called "new-view" hypothesis of dividend taxation which states that marginal investments are financed with retained earnings instead of newly issued equity. Alstadsæter et al. (2017) find similar results in response to changes in the Swedish dividend tax concerning the level of investment. However, they report changes in the allocation of investment.

A further strand is concerned with dividend repatriation taxes of US MNFs. Grubert (1998) provides a comprehensive analysis on how US divi-

[1] In the US, firms are categorized in into C- and S-corporations. The only major difference is the fact that C-corporations are subject to dividend taxation while S-corporations are not.

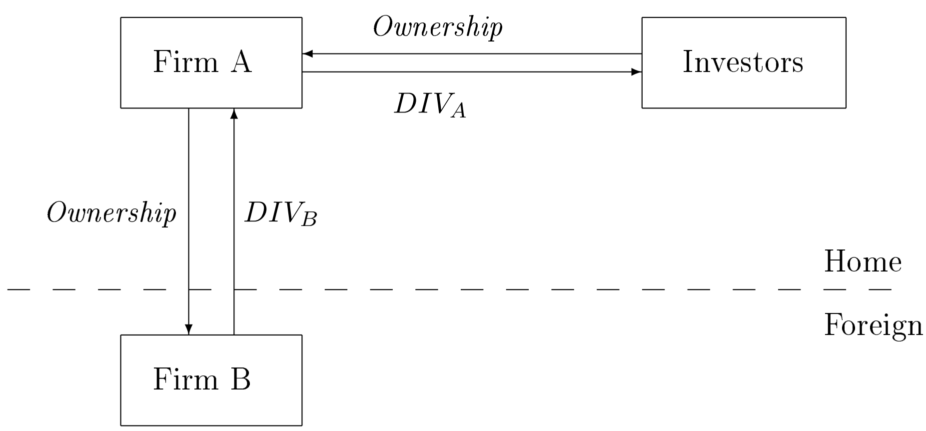
dend repatriation taxes affect royalty, dividend, interest and retained earnings of US multinationals' foreign affiliates. Altshuler and Grubert (2003) discuss optimal strategies for the repatriation of profits from low-tax countries to the US. Similarly, Desai et al. (2007) and Hanlon, Lester, et al. (2015) explore the effect of US repatriation taxes on intra-firm dividend payments.

As I will discuss later on, my preferred empirical specification uses the semiparametric fixed-effects panel estimator, as proposed by Baltagi and Li (2002). This estimator has already been implemented by some studies. Desbordes and Verardi (2012) estimate the effect of GDP per capita on inequality while Zhu et al. (2012) examine the impact of urbanization on CO_2 emissions. Using this semiparametric method, both find evidence against an inverted U-shaped relationship (Kuznets Curve) which is in contrast to the results using a fully parametrized specification. Baglan and Yoldas (2014) apply the Baltagi-Li estimator to data on inflation and economic growth and find a significantly lower threshold from where on inflation exerts a negative effect on growth, compared to the standard threshold model. Lessmann (2014) applies the Baltagi-Li estimator to a unique dataset to analyze the effect of economic development on spatial inequality and finds strong evidence in favor of an inverted-U relationship. Using Russian data, Guriev and Vakulenko (2015) provide evidence in favor of a non-monotonic effect of income on migration. While an increase in income reduces emigration from richer regions, it increases emigration from poorer regions. Tian and Yu (2015) estimate the effect of income growth on nutrition and find positive but diminishing marginal effects for higher incomes. Using data on rug manufacturers Atkin et al. (2017) show how an increase in exports leads to an improvement in the quality of traded goods, i.e., they find evidence that there might be learning-by-exporting. In a very recent study, Clemens et al. (2018) explore the effect of the exclusion of unskilled Mexican workers from the American labor market. Using the Baltagi-Li estimator, among others, they show that the exclusion did not change the labor market conditions significantly. These examples show that semiparametric estimates capture relationships in the data that might not be taken into account by standard parametric models.

2.3 Dividend repatriation and income taxes

2.3.1 Dividends and taxes

As discussed in the literature review above, different studies find supportive evidence that firms adjust dividend payments in response to investor-level dividend income taxes in their own country. However, to the best of my knowledge, these studies do not take into account that MNFs might, in addition, adjust their intra-firm dividend payments in response to investor-level income tax changes. For illustrative reasons, consider the following example:



Individual-level investors buy shares of a firm A and participate in the profits of A through dividend payments (DIV_A in the figure). So far, previous studies examine to which extent investor-level dividend income tax rates in country $HOME$ influence these dividend payments. However, in the context of MNFs, the profits of firm A do not only include the profits generated by firm A, but also the profits of B (the firm that is owned by A). Hence, if firm A indeed adjusts its dividend payments to its shareholders due to changes in investor-level income taxes, it might be reasonable for firm A to also adjust the repatriation of profits of the firms it owns (DIV_B in the figure). The goal of this paper is to examine if these dividend payments are responsive towards investor-level dividend taxes, i.e., if investor-level dividend income tax rates levied in country *Home* effect both dividend payments DIV_A and DIV_B.

A further question that this paper is concerned with is if the effect of the tax (if there is any at all) is constant or if the effect changes with the size of the tax rate. For example, one could imagine a five percentage point increase in the tax rate to have a lower effect if it results in an overall tax rate of 25% instead of an overall tax rate of 60%. The econometric analysis allows for these heterogeneous effects of the tax rate by means of the semiparametric Baltagi-Li estimator.

In the following, I first introduce the Lintner model of dividend payouts and, in a next step, extend the model where I include the dividend tax rate, as well as further control variables. Subsequently, I discuss the econometric techniques that are applied.

2.3.2 The standard Lintner model of dividend payouts

As discussed above, the Lintner model (Lintner, 1956) is commonly used in the literature to model dividend payments between firms and investors. This section provides a formal set-up of the Lintner model and discusses how investor-level dividend income taxes may alter dividend payments.

The basic Lintner model proposes that dividend payments DIV_{it} of firm i in time t are the result of an adaptive process driven by the trade-off between the aim to generate a smooth dividend payment stream over time and the desired long-run dividend payment $DIV_{it}^* = r\Pi_{it}$ with r being the desired long-run payout ratio and Π_{it} profits. Since the model considers changes in dividend payments over time, it is sometimes also referred to as the partial adjustment model of dividends.

Equation (2.1) serves as the starting point:

$$\begin{aligned} \Delta DIV_{it} &= \alpha + s(DIV_{it}^{*} - DIV_{it-1}) + u_{it} \\ &= \alpha + s(r\Pi_{it} - DIV_{it-1}) + u_{it} \end{aligned} \tag{2.1}$$

with constant α and error term u_{it}.

The Lintner model postulates that the change in the dividend payment from period $t-1$ to t is not equal to the difference of dividend payments in $t-1$ and the desired long-run dividend payment $DIV_{it}^{*} = r\Pi_{it}$, but equal to the fraction s thereof (i.e., the trade-off mentioned above).

The idea is that current dividend payments arise as a compromise between the hypothetical, optimal current level of dividend payment DIV_{it}^{*} and the dividend payment in the period before DIV_{it-1}. Lintner (1956) observed that firms tend to set a long run desired payout ratio r which determines the share of profits which is paid out to shareholders in the form of dividends. However, as changes in profits are not always sustainable, managers are reluctant to fully adjust dividend payments to changes in profits Π_{it} since managers are especially unwilling to decrease dividend payments as this would signal that the firm is in a bad state. Therefore, managers only increase dividend payments very carefully to avoid having to return to the initial level. Hence, managers prefer to change dividend payments only gradually if Π_{it} changes. This feature is captured by the smoothing parameter s which dampens the change in the dividend payment related to a change in Π_{it}. Note that a stronger taste for a smooth dividend payments stream leads to a *smaller* smoothing parameter, which might be counter-intuitive in the first moment. However, a larger s increases changes in the dividend payment in response to a deviation of current profits from past profits, while a lower s reduces changes in the dividend payments over time.

In summary, current dividend payments DIV_{it} are driven by the firm's profits in t through the pay-out ratio r and the smoothing parameter s which represents the speed of adjustment towards DIV_{it}^{*}. Dividends are thus not set independently in each period t but are serially correlated. Consequently, a higher r increases dividend payments in t while a higher s increases the impact of current profits on current dividend payments. Equation (2.2), which I obtain by rearranging (2.1), makes this point clearer. In the extreme case with $s = 1$, there is no influence of dividend payments in $t-1$ on t at all:

$$\begin{aligned} DIV_{it} - DIV_{it-1} &= \alpha + sr\Pi_{it} - sDIV_{it-1} + u_{it} \\ \Leftrightarrow DIV_{it} &= \alpha + sr\Pi_{it} + (1-s)DIV_{it-1} + u_{it} \\ &= \alpha + r\Pi_{it} + u_{it}. \end{aligned} \tag{2.2}$$

While this set-up might suggest, at first glance, that the adjustment of dividend payments is equally flexible for increases and decreases, Lintner (1956) expected that firm managers would be more reluctant to decrease than to increase dividend payments (as already discussed above). Hence, the Lintner equation includes a constant α which allows for positive dividend payouts even in cases where profits are negative.

The error term u_{it} is sometimes modeled as $u_{it} = \eta_i + \phi_t + \epsilon_{it}$ to allow for firm fixed effects η_i and aggregate time shocks ϕ_t (like in, e.g., Bellak and Leibrecht, 2010). η_i might, for example, reflect firm-specific distastes of reducing the dividend payments. I allow for this specification of the error term in the econometric analysis.

Following Lehmann and Mody (2004), an alternative approach to derive the Lintner model as represented in (2.2) is based on the minimization of the following loss function:

$$\Omega_{it} = \phi_1(DIV_{it} - \underbrace{r\Pi_{it}}_{=DIV^*_{it}})^2 + \phi_2(DIV_{it} - DIV_{it-1})^2. \tag{2.3}$$

The first term captures the goal to adjust the actual dividend payment to the desired long-run dividend payment while the second term incorporates the disutility of a volatile dividend payment stream. The parameters ϕ_1 and

ϕ_2 represent the weights firms place on these two objectives. Minimizing the loss function with respect to DIV_{it} yields

$$D_{it} = \frac{\phi_1}{\phi_1 + \phi_2} r\Pi_{it} + \frac{\phi_2}{\phi_1 + \phi_2} D_{it-1}. \tag{2.4}$$

Normalizing the sum of the weights ϕ_1 and ϕ_2 to 1 produces (2.2) (if we add the constant α to account for the reluctance of managers to reduce dividend payments as above, and the error term u_{it}).

Note that the Lintner model has not only been used to model dividend payments of firms to shareholders but also in the context of intra-firm dividend payments like it is the focus of this paper (see, e.g., Desai et al., 2002).

2.3.3 The Lintner model extended

According to the basic set-up of the Lintner model, current and previous profits are the only determinants of dividend payments of firms. This becomes obvious if (2.2) is solved recursively. However, there might be further firm and country characteristics like taxes that determine dividend payments. In the following, the model is augmented to allow for these additional factors.

There are different ways to augment the Lintner model. I follow Bellak and Leibrecht (2010) in extending the model utilizing the function $DIV^*_{it} = r\Pi^*_{it}$. Besides the optimal payout ($r\Pi_{it}$), I add investor-level income taxes (TAX_{kt})[2] and further country characteristics (X_{kt}) of the country k where the *GUO* is located, as well as characteristics of firm i (X_{it}) and country characteristics of country j (X_{jt}) which is the location of firm i:[3]

[2]Since the focus of the paper is on the dividend tax rate, I use the abbreviation of the dividend tax rate (DTR_{kt}) in most sections. However, since I also estimate specifications with the tax rate on capital gains ($CGTR_{kt}$), I use (TAX_{kt}) in the model as a more general abbreviation for taxes.

[3]I.e., the *GUO* and the affiliate may but do not necessarily have to be in the same country.

$$\begin{aligned}\Delta DIV_{it} &= \alpha + s(DIV_{it}^{*} - DIV_{it-1}) + u_{it} \\ &= \alpha + s(r\Pi_{it} + f(TAX_{kt}) + \theta_I X_{it} + \theta_J X_{jt} + \theta_K X_{kt} - DIV_{it-1}) + u_{it}.\end{aligned} \tag{2.5}$$

The intuition behind extending the model utilizing the function $DIV_{it}^{*} = r\Pi_{it}^{*}$ is that, as argued above, DIV_{it} is a blend of DIV_{it-1} and DIV_{it}^{*}. If changes to the business environment lead to a change in the dividend setting behavior, they will be driven by adjustments of DIV_{it}^{*} as DIV_{it-1} has already been set in $t-1$. Note that I do not restrict the effect of TAX_{kt} to have a certain functional form since this effect might depend on the initial level of the tax rate (as argued above). Rather, I am using nonparametric techniques to estimate the effect of the dividend income tax on dividend payouts. Defining $g(\cdot) \equiv sf(\cdot)$, Equation (2.5) can be rearranged to

$$DIV_{it} = \alpha + sr\Pi_{it} + (1-s)DIV_{it-1} + g(TAX_{kt}) + s\theta_I X_{it} + s\theta_J X_{jt} + s\theta_K X_{kt} + u_{it}. \tag{2.6}$$

Equations (2.2) and (2.6) serve as the basis for the econometric analysis. In the following, I will discuss how these equations are implemented empirically.

2.4 Empirical implementation

2.4.1 Basic Lintner

In a first step, I estimate the basic Lintner model to compare the results of the Lintner parameters[4] to the literature and hence to evaluate how the model performs in the context of data on MNFs. Furthermore, these results serve

[4]The Lintner parameters refer to the smoothing parameter and the long run desired payout ratio as defined in the model.

as a benchmark for the estimations where I include the tax rates. The basic Lintner model is based on Equation (2.2) and is estimated using standard OLS:

$$DIV_{it} = \alpha + \beta_1 \Pi_{it} + \beta_2 DIV_{it-1} + u_{it}. \tag{2.7}$$

The smoothing parameter s and the optimal payout ratio r are then given by

$$s = 1 - \beta_2 \text{ and } r = \frac{\beta_1}{s} = \frac{\beta_1}{1 - \beta_2}. \tag{2.8}$$

In some specifications, I allow for aggregate time shocks ϕ_t and firm fixed effects η_i in the error component, as discussed above: $u_{it} = \eta_i + \phi_t + \epsilon_{it}$.

2.4.2 The Baltagi-Li estimator

It is ex-ante unclear which functional form the dividend tax effect follows. Without imposing any parametric specification on this functional form, I estimate the following equation:

$$DIV_{it} = \alpha + \beta_1 \Pi_{it} + \beta_2 DIV_{it-1} + g(TAX_{kt}) + \beta_3 X_{it} + \beta_4 X_{jt} + \beta_5 X_{kt} + u_{it}, \tag{2.9}$$

which is based on Equation (2.6).

Again, I allow for aggregate time shocks ϕ_t and firm fixed effects η_i in the error component: $u_{it} = \eta_i + \phi_t + \epsilon_{it}$. The estimation of $g(TAX_{kt})$ is based on nonparametric methods to circumvent ex-ante restrictions on the functional form. The semiparametric Baltagi-Li estimator introduced by Baltagi and Li (2002) is well suited to be applied to this fixed effect semiparametric panel data model.

The firm fixed effects η_i are eliminated by first differences which yields

$$\Delta DIV_{it} = \beta_1(\Pi_{it} - \Pi_{it-1}) + \beta_2(DIV_{it-1} - DIV_{it-2}) + (g(TAX_{kt}) - g(TAX_{kt-1}))$$
$$+ \beta_3(X_{it} - X_{it-1}) + \beta_4(X_{jt} - X_{jt-1}) + \beta_5(X_{kt} - X_{kt-1})$$
$$+ (u_{it} - u_{it-1}). \tag{2.10}$$

The main idea is to approximate the function $g(z_t)$ with variable z_t by a series $p^k(z_t)$, and hence to approximate $G(z_t, z_{t-1}) = \{g(z_t) - g(z_{t-1})\}$ by $p^k(z_t, z_{t-1}) = \{p^k(z_t) - p^k(z_{t-1})\}$, where $p^k(z_t)$ is a sequence of k functions $[p_1(z_t), p_2(z_t)..., p_k(z_t)]$.

As proposed by Libois and Verardi (2013), this series is estimated through linear B-spline series. Intuitively, using regression splines amounts to splitting the data into bins where each bin is fitted individually by a polynomial function. Therefore, each bin can be fitted by a simpler polynomial instead of using a complex polynomial over the whole range which might explain the data poorly and could suffer from Runge's phenomenon.[5] To ensure that this procedure results in a smooth piecewise polynomial function, the different polynomials have to meet properly at each border of each bin (called knots). In formal terms, the function itself and the first $m - 1$ derivatives have to meet continuously at each knot.

For illustrative reasons, a spline series of degree m with k knots $c_1 < c_2 < ... < c_k$ can be represented using a power series:

$$S(z_t) = \sum_{j=0}^{m} \zeta_j z_t^j + \sum_{j=1}^{k} \lambda_j (z_t - c_j)_+^m \text{ with } (z_t - c_j)_+^m = \begin{cases} (z_t - c_j)^m & \text{if } z_t > c_j \\ 0 & \text{else.} \end{cases} \tag{2.11}$$

For example, if we set $m = 2$ and $k = 4$, evaluate the function at any value

[5]Runge's phenomenon describes the effect of potential low precision of an estimate which relies on a high-order polynomial. One reason is that for a high-order polynomial, the function may start to oscillate as the value of the derivatives increase.

z_t with $c_2 \leq z_t \leq c_3$ and reorder, this results in

$$S(z_t)\Big|_{c_2 \leq z_t \leq c_3} = (\zeta_0 + \lambda_1 c_1^2 + \lambda_2 c_2^2) + (\zeta_1 - 2\lambda_1 c_1 - 2\lambda_2 c_2) z_t + (\zeta_2 - \lambda_1 - \lambda_2) z_t^2. \tag{2.12}$$

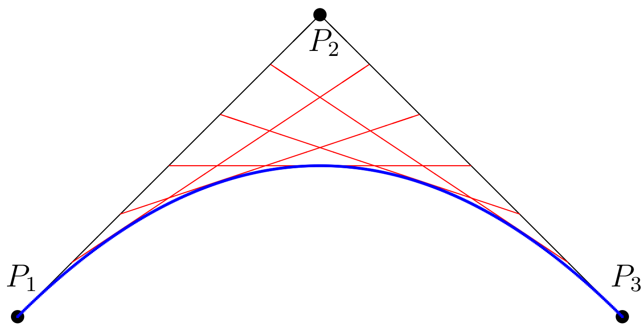
If we subsequently set $z_t = c_2$ and do the same for $S(z_t)\big|_{c_1 \leq z_t \leq c_2}$, we would have that

$$S(z_t)\Big|_{c_1 \leq z_t \leq c_2} = \zeta_0 + \lambda_1 c_1^2 + c_2(\zeta_1 - 2\lambda_1 c_1 + \zeta_2 c_2 + \lambda_1 c_2) = S(z_t)\Big|_{c_2 \leq z_t \leq c_3}, \tag{2.13}$$

which shows that the functions meet smoothly.

The same is true for the first derivative. Hence, the different polynomials meet continuously at the knots. Furthermore, note that three conditions are needed to identify a second order polynomial unambiguously. The first two conditions are given by the requirement that the first and second derivative have to join smoothly at c_1. These conditions are determined by the parameters resulting from the former bins (here: the bin below c_1 and the bin between c_1 and c_2): ζ_0, ζ_1, ζ_2, λ_1. Hence, there is precisely one free parameter left which may be determined by the data of the local bin: λ_2. Therefore, at each bin, the parameters arise as a compromise between the local data and the surrounding polynomials.

While spline series estimation based on power functions is a very intuitive concept, especially to motivate how the different parts meet continuously at the knots, it might suffer from computational issues. The polynomials might become almost collinear if bins are too small. Furthermore, small bins can lead to overflow errors in the numerical estimation procedure. This problem may be solved if B-spline bases are chosen instead of truncated polynomials. First, it is important to note that B-splines are more flexible since they can represent any spline series using linear combinations. In effect, B-splines can be thought of as a rescaling of the piecewise functions. B-splines are based on Bézier curves. Essentially, Bézier curves are built from a series of control points which are weighted by Bernstein polynomials. The following drawing shows how three control points P_1, P_2 and P_3 define a quadratic Bézier curve (The thick curve connecting P_1 and P_3):



Intuitively, these Bézier curves are then put together to construct the B-spline series. Technically, the Cox-de Boor recursion formula is used to combine the Bézier curves. For more details, the interested reader is referred to Boor (1972), M. J. D. Powell (1981) or Boor (2001).

Coming back to Equation (2.10), Baltagi and Li (2002) show that the parametric part is estimated under the standard $\sqrt{N}$ normality. While the speed of convergence is smaller for the nonparametric estimate, this will not be a problem in the context of this analysis due to the size of the dataset.

I obtain the coefficients from the parametric part after estimating the following equation:

$$\begin{aligned}\Delta DIV_{it} = {} & \beta_1(\Pi_{it} - \Pi_{it-1}) + \beta_2(DIV_{it-1} - DIV_{it-2}) + \omega(\{p^k(TAX_{kt}) - p^k(TAX_{kt-1})\}) \\ & + \beta_3(X_{it} - X_{it-1}) + \beta_4(X_{jt} - X_{jt-1}) + \beta_5(X_{kt} - X_{kt-1}) \\ & + (u_{it} - u_{it-1}).\end{aligned} \tag{2.14}$$

If I use the result of this estimation to calculate the intercept $\hat{\alpha}$ subsequently[6], I may estimate $g(TAX_{kt})$ according to the following equation:

$$\begin{aligned} \hat{r_{it}} &\equiv DIV_{it} - (\hat{\alpha} + \hat{\beta}_1 \Pi_{it} + \hat{\beta}_2 DIV_{it-1} + \hat{\beta}_3 X_{it} + \hat{\beta}_4 X_{jt} + \hat{\beta}_5 X_{kt}) \\ &= g(TAX_{kt}) + u_{it}. \end{aligned} \tag{2.15}$$

2.4.3 Instrumental variable strategy

If the estimators were implemented as introduced thus far, the results would be biased since I estimate a dynamic model with fixed effects (see, e.g., Wooldridge, 2010). Following Anderson and Hsiao (1982), I instrument DIV_{it-1} by DIV_{it-2}.

2.4.4 Further issues

As already discussed above, the basic Lintner model assumes only lagged dividend payments and current profits to determine dividend payments. Therefore, I first provide the results of the basic Lintner model with and without firm fixed effects and time fixed effects, as well as with and without the DTR_{kt}.[7] I then move on to present the results from the Baltagi-Li estimator. Following standard procedures, I use fourth-degree B-splines; optimal knots are chosen as described in Newson (2000). Equation (2.15) is then estimated by a kernel density using Epanechnikov kernels. I scale dividend payments (as in, e.g., La Porta et al., 2000; Fama and French, 2002), however, following the discussion in La Porta et al. (2000), I use turnover instead of assets. While assets are suitable if all firm observations are located in the same country, turnover is preferable if firms from different countries are considered. The main idea is that, compared to assets, turnover is less sensitive

[6] Using Equations (2.10) and (2.15), we see that ω secures the following equality: $\omega p^k(TAX_{kt}) = g(TAX_{kt})$. Therewith, I can construct the intercept: $\hat{\alpha} = DIV_{it} - \hat{\beta}_1 \Pi_{it} - \hat{\beta}_2 DIV_{it-1} - \hat{\omega} p^k(TAX_{kt}) - \hat{\beta}_3 X_{it} - \hat{\beta}_4 X_{jt}$.

[7] Recall that I abbreviate the dividend tax rate in time t in country k (i.e. the country of the GUO) by DTR_{kt}.

to differences in accounting standards and manipulative accounting practices across countries. Scaled variables are indicated by superscript S (e.g. DIV_{it}^{S}).

2.5 Data

2.5.1 Dividend income tax data

Most countries do not only levy taxes on earned income but also on capital income such as dividends. While some countries subsume all incomes together for tax purposes, about half of the countries have introduced separate taxes on capital income. Hence, it would not be appropriate to focus on earned income taxes. Therefore, I use the DTR_{kt} from the income tax dataset by Eklund and Wamser (2019) which provides a large range of different income taxes for 165 countries.

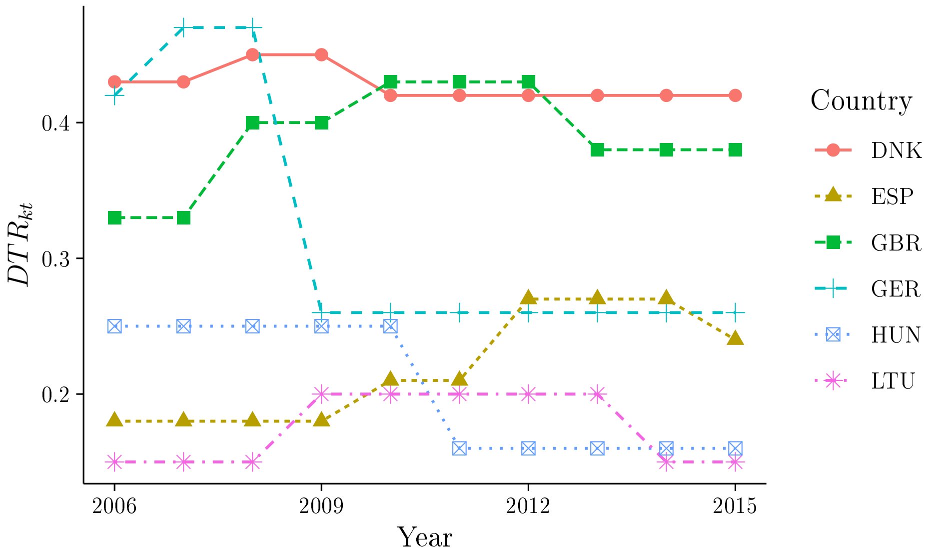
There are different ways of how countries collect dividend income taxes. In France, for example, taxpayers have to declare their dividend income to the tax authorities at the end of the year, which is in contrast to Germany that taxes capital income at source with a flat tax rate. Social security contributions are often levied at lower rates compared to the contributions on earned income.

The average DTR_{kt} equals 17.11% which is much smaller than the average tax rate on earned income (31.99%). Over the last decade, countries have decreased their $DTRs_{kt}$ by approximately 1 percentage point on average (18.17% in 2006, 17.06% in 2015). However, I observe strong within-country variation as shown in Figure 2.1. For a more in-depth analysis, see Eklund and Wamser (2019).

2.5.2 Dividend payout data

I base my empirical analysis on financial firm-level data which I take from the *ORBIS* dataset provided by Bureau van Dijk. This dataset is well-suited

Figure 2.1: Variation of DTR_{kt} by country



Notes: This figure provides the times series of the DTR_{kt} of a selection of countries: Denmark (DNK), Spain (ESP), the UK (GBR), Germany (GER), Hungary (HUN), and Lithuania (LTU).

for my analysis due to three different reasons: First, it provides detailed firm-level balance sheet data which allows me to calculate yearly dividend payments. Furthermore, it provides information on the ownership structure of the observed firms. Lastly, the raw dataset covers a vast number of different firms (about 280 million) in numerous countries.

I use information from the balance sheet data to calculate dividend payments since they are not directly observable. I follow the approach taken by Bellak and Leibrecht (2010) and Egger et al. (2015) where dividends follow from the difference between shareholder funds after current profits in $t-1$ and shareholder funds before current profits in t.[8] In principle, we can think of shareholder funds as the difference between assets and liabilities (minus minority interests), i.e., a sort of excess wealth which immediately could be

[8]More specifically, I calculate dividends according to the following formula: $DIV_{it} = SHFD_{it-1} + PL_{it-1} - SHFD_{it}$ where DIV_{it} denotes dividends, $SHFD_{it}$ available shareholder funds for distribution and PL_{it} current profits of firm i in period t. Negative values are set to zero as in Egger et al. (2015).

handed out the shareholders (ignoring liquidity constraints). Essentially, the approach taken is to compare this excess wealth between two subsequent periods. The difference gives the amount handed out to the shareholders.

One aspect of this paper is to estimate the effect of investor-level dividend income taxes on the repatriation behavior of firms within MNF networks. Hence, for each firm, I need to identify the MNF they belong to, as well as the country where the headquarter of the MNF resides. In *ORBIS*, this is possible through identifying the so-called *GUO*.[9] The *GUO* is defined as the highest level within an MNF, i.e., the last level of ownership which is not owned by a further firm.

For illustrative reasons, consider the structure of the Volkswagen group. The *GUO* of this group is the German firm Porsche SE which is primarily owned by the German families Porsche and Piëch. The principal subsidiary of Porsche SE is Volkswagen AG (based in Germany). This firm, in turn, holds Audi AG (based in Germany), which is the owner of Automobili Lamborghini Holding S.p.A. (based in Italy), which is the owner of the Ducati Motor Holding S.p.A (based in Italy). With *ORBIS*, I am able to identify the home country of the *GUO* of Ducati Motor Holding S.p.A. which is Germany. This enables me to explore the effect of a change in the German DTR_t on dividend payments of firms owned by German firms. In the example above, this means identifying changes in the repatriation of profits from Ducati Motor Holding S.p.A. to Automobili Lamborghini Holding S.p.A., from Automobili Lamborghini Holding S.p.A. to Audi AG, from Audi AG to Volkswagen AG and from Volkswagen AG to Porsche SE, as well as payouts of the Porsche SE to the Porsche and Piëch families.

Hence, I am going to use the investor-level dividend income tax rates in the country of the *GUO* (DTR_{kt}) as an explanatory variable for dividend payouts of the firms. See section 2.3.1 for more details.

[9] Recall that the abbreviation *GUO* refers to the global ultimate owner.

The analysis includes firms from the manufacturing sector[10] which report unconsolidated statements and plausible figures.[11] Firms which I observe in less than three consecutive years are dropped.[12] Furthermore, I only include firms for which it is possible to calculate dividend payments. As a result, I end up with 2,133,251 firm-year observations in 67 countries with *GUO*s in 130 countries between the years 2006 and 2014. Each firm appears on average 7.7 times in the dataset. I observe a *GUO* for 92.1% of the firms, 21.8% of these *GUO*s reside in a foreign country (foreign from the perspective of the firm that is owned by the *GUO*).

2.5.3 Summary statistics

Figure 2.2 plots the average DIV_{it}, and Figure 2.3 the DTR_{jt} in panel (a) and the average DTR_{kt}[13] in panel (b) for each country. The average dividend payment equals USD 3.34 million. I find the largest average DIV_{it} in South America and Asia where I also find high $DTRs_{jt}$. On average, the DIV_{it} in Europe is somewhat smaller while the $DTRs_{jt}$ is slightly larger. Interestingly, these conclusions do not change if we look at panel (b) where the differences between the DTR_{it} and the country average of the DTR_{kt} also are minimal.

While prima facie, one could expect this to be driven by a large number of firms having a *GUO* in the same country, the difference in the tax rates remains tiny if I only consider firms with foreign *GUO*s. The difference is

[10] Therewith, I exclude the following type of firms: Banks, financial companies, foundation and research institutes, insurance companies, funds, public authorities, and venture capital firms. These firms are excluded because of regulatory differences (as in, e.g., Duchin and Sosyura, 2013).

[11] I drop firms if the balance sheets report negative stocks of assets or negative values for cash or turnover. Note that I also conduct estimations where I trim or winsorize the data in the robustness checks (Section 2.7).

[12] Note that only observations from 2007 will end up in the estimations since I need one observation in $t-1$ to calculate DIV_{it}. Furthermore, the Lintner model includes one lag of DIV_{it}. Hence, I need at least three consecutive observations of a firm to include it successfully in the empirical estimations.

[13] Assume two firms are located in country A. Further assume, the DTR_t in the two countries of the firms' *GUO*s are equal to 0.2 and 0.3, respectively. Therewith, I assign $DTR_{kt} = 0.25$ to country *A*.

Figure 2.2: Average DIV_{it}

Notes: This figure provides the country average of the DIV_{it}. The tax rate is categorized into four quartiles.

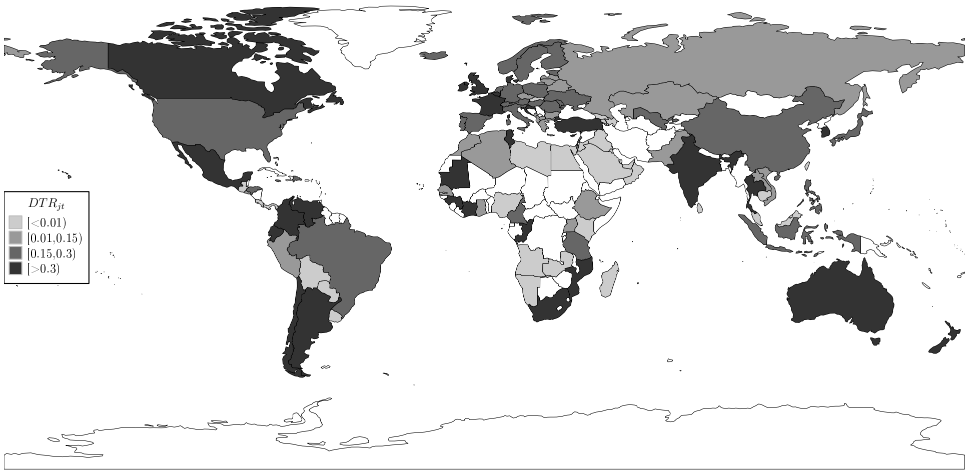
only slightly larger (0.2 vs. 1.2 percentage points). Similarly, I find almost the same average tax rates in the countries of the GUOs and in the countries of the firms they own (25.3% and 25.5%). If I look at how DTR_{jt}, DTR_{kt}, and DIV_{it} correlate, I find a value of 0.8 for the correlation of DTR_{jt} and DTR_{kt} while it is almost zero for DIV_{it} and the two tax rates. The same is true if I consider the correlation of the tax differential between the countries of the firm and the GUO (i.e., DTR_{jt} - DTR_{kt}), and DIV_{it}. Interestingly, there is also no significant correlation between DIV_{it} and the GDP of the countries.

Hence, these first findings do not suggest that changes in dividend payments are associated with changes in income taxes.

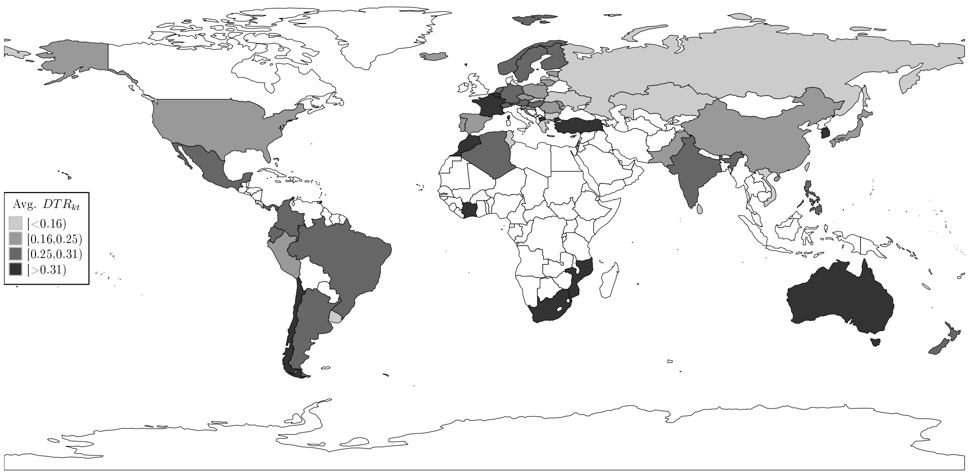
Among all firms, I observe zero dividend payments for 41.64% of the firms. I do not find evidence in favor of larger or smaller firms (in terms of assets, profits or turnover) paying zero dividends.

Figure 2.4 provides a scatterplot of the Lintner variables DIV_{it}, DIV_{it-1}, and PL_{it} (profits and losses), as well as a linear fit of the data. Many firms

Figure 2.3: DTR_{jt} and average DTR_{kt}



(a) DTR_{jt}

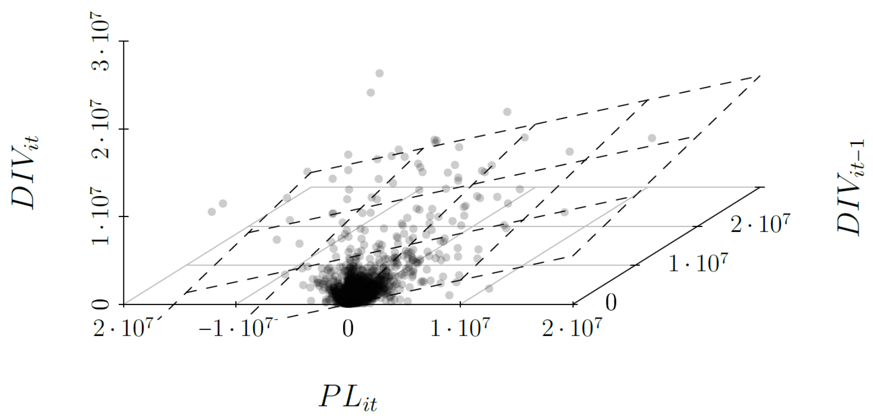


(b) Average DTR_{kt}

Notes: This figure provides the country averages of (a) the DTR_{jt} and (b) the DTR_{kt}. The tax rates are categorized into four quartiles. DTR_{jt} denotes the DTR in country j of firm i, DTR_{kt} the DTR in the country k of the GUO of firm i.

pay only relatively small dividends. However, I also observe firms with large payments. I find strong graphical evidence in favor of the Lintner model, higher values of PL_{it} or DIV_{it-1} are associated with higher DIV_{it}. Note that for some firms I observe large dividend payments and profits. The results in the econometric analysis are robust to winsorizing (e.g., at the 1^{st} and 99^{th} percentile) or to trimming the data, however.

Figure 2.4: Correlation Lintner variables



Notes: This figure provides a scatterplot of the Lintner variables (DIV_{it}, DIV_{it-1}, PL_{it}) and a linear fit.

2.5.4 Further control data

Some publications in the literature identify no need to include further control variables into the Lintner model (see, e.g., Fama, 1974). Nevertheless, in some specifications, I will include further country and firm-specific control variables to check for the robustness of the estimations and also to be consistent with other studies on this topic. Like Bellak and Leibrecht (2010) or Brown et al. (2007), I control for lagged firm debt ($DEBT_{it}$), GDP growth in the country of the firm (GDP^g_{jt}) and of the *GUO* (GDP^g_{kt}), as well as firm size (following, e.g., Benito and Young, 2003; Bond et al., 2007). While I use the debt indicator from the *ORBIS* dataset, I take GDP growth rates from the Worldbank's World Development Indicators. For the size of the firms, I use turnover ($TURN_{it}$) from *ORBIS* following the argument above (in an international context, this is the most comparable measure available).

Due to the high computational requirements of the Baltagi-Li estimator, I only use a smaller subsample where I keep firms with a total of assets worth at minimum USD 1 million.[14] I provide evidence that the estimates are not sensitive to this restriction of the sample.[15]

Summary statistics are provided in Table 2.1 for the full sample and in Table 2.2 for the sample which only includes firms with at least USD 1 million in assets.

Table 2.1: Summary statistics

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
DIV_{it}	3,339.727	84,086.601	0	26,331,272	2,133,251
PL_{it}	2,029.107	72,806.443	-15,138,905	23,924,918	2,133,251
DIV_{it}^{S}	2.955	424.655	0	367,105	2,133,251
PL_{it}^{S}	0.001	725.478	-772,246	591,289	2,133,251
$DEBT_{t}^{S}$	1.245	119.814	0	82,881.5	2,133,251
$TURN_{t}$	45,467.48	693,194.858	1	245,497,386	2,133,251
GDP_{jt}^{g}	0.529	3.401	-14.814	15.316	2,133,251
GDP_{kt}^{g}	0.499	3.306	-62.076	104.487	2,133,251
DTR_{kt}	0.253	0.135	0	0.6	2,133,251

Notes: This table presents descriptive statistics for the variables used in the econometric analysis and is based on the full sample. A detailed description of the variables is provided in section 2.5. Balance sheet data is denoted in USD 1,000.

[14]Note that I already use the bwHPC high performance computing cluster provided by Baden-Württemberg's ministry of science to carry out the estimations.

[15]To be more specific, I estimate the standard Lintner model by means of OLS using the restricted and the unrestricted sample. The results are virtually identical.

Table 2.2: Summary statistics (Assets≥ USD 1 million)

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
DIV_{it}	4,140.721	93,789.361	0	26,331,272	1,714,019
PL_{it}	2,519.341	81,216.115	-15138,905	23,924,918	1,714,019
DIV_{it}^{S}	3.587	471.842	0	367,105	1,714,019
PL_{it}^{S}	0.014	809.168	-772,246	591,289	1,714,019
$DEBT_{it}^{S}$	1.51	133.757	0	82,881.5	1,701,646
$TURN_{it}$	56,226.377	772,955.198	1	245,497,386	1,714,019
GDP_{jt}^{g}	0.515	3.285	-14.814	15.316	1,704,144
GDP_{kt}^{g}	0.479	3.183	-62.076	104.487	1,695,362
DTR_{kt}	0.266	0.136	0	0.6	1,714,019

Notes: This table presents descriptive statistics for the variables used in the econometric analysis and is based on the restricted sample including only firms with assets ≥ USD 1 million. A detailed description of the variables is provided in section 2.5. Balance sheet data is denoted in USD 1,000.

2.6 Results

In this chapter, I present the results of the econometric analysis. I start with the discussion of the results of the pure basic model. Then, I move on to the effect of the DTR_{kt} and further control variables on the dividend payments where I also use semiparametric techniques.

2.6.1 The Lintner model

Column (1) in Table 2.3 presents the results of the basic Lintner model based on Equation (2.7), using the full sample and unscaled variables. I find highly significant and positive coefficients for DIV_{it-1} and PL_{it}. Using Equation (2.8), I may calculate the smoothing parameter s and the desired payout ratio r, as defined in Equation (2.1). The results suggest that firms exhibit moderate preferences in favor of a smooth dividend payment stream (s = 0.7243)[16] which suggests that firms are somewhat reluctant to change

[16]Recall that larger smoothing parameters imply smaller preferences for dividend smoothing.

the dividend payment in response to a change in profits. Furthermore, I estimate the desired long-run payout ratio to be equal to 33.1%. Next, I report the results for firms with at least USD 1 million in assets and firm-specific variables scaled by turnover (as discussed in section 2.5.2). As can be seen in Column (2), excluding the small firms does not lead to significant changes in the results. If I use the scaled variables (3) and add aggregate year effects (4), I find somewhat larger smoothing parameters and smaller desired payout ratios. Adding firm fixed effects (5), however, generates results which are again more similar to the results in (1) and (2). I will refer to (5) as the preferred specification since the firm and aggregate year effects, as well as the scaling of the variables, have been used in the literature in a very similar way.

As already discussed above, Bellak and Leibrecht (2010) provide an overview of the estimated Lintner parameters in the literature. For dividend payments, the speed of adjustment coefficient ranges from 0.16 to 0.77; the desired payout ratio is estimated to be between 0.23 and 0.88. The estimates of (1) and (2) are within that range. I find somewhat larger smoothing parameters and smaller desired payout ratios in (3) and (4). In the preferred estimation (5), the smoothing parameter is just slightly larger.

However, the results discussed so far do not only suggest that the data fits the Lintner model very well, but I also find reasonable results for the intercept which is either significant and positive or insignificant (firms reduce dividends only reluctantly to avoid clashing with shareholders) but not negative, as predicted by the Lintner model. A significant negative coefficient would have called my approach into question since it would have suggested that firms only reluctantly *increase* dividends, which is very unlikely. Overall, I conclude that the results strongly support the econometric approach I have chosen and provide a sensible foundation to investigate the effect of the DTR_{kt} on dividend payments, which I discuss in the next part.

Table 2.3: Lintner model

Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Full sample					
DIV_{it-1}	0.276***				
	(0.001)				
PL_{it}	0.240***				
	(0.001)				
Assets>USD 1 million					
DIV_{it-1}		0.276***			
		(0.001)			
PL_{it}		0.240***			
		(0.000)			
DIV^S_{it-1}			0.089***	0.089***	0.219***
			(0.000)	(0.000)	(0.000)
PL^S_{it}			0.103***	0.103***	0.353***
			(0.000)	(0.000)	(0.000)
Constant	4,437.115***	2,463.934***	2.768***	1.029	1.279
	(120.444)	(65.409)	(0.258)	(1.029)	(1.101)
Obs.	2,133,251	1,714,019	1,696,560	1,696,560	1,345,052
Adj. R^2	0.168	0.168	0.061	0.061	0.164
Lintner parameters:					
s (Eq. (2.8))	0.724	0.724	0.911	0.911	0.781
r (Eq. (2.8))	0.331	0.331	0.114	0.114	0.452
Year FE	No	No	No	Yes	Yes
Firm FE	No	No	No	No	Yes

Notes: This table presents the results of the standard Lintner model as described in section 2.3.2. (1) is based on the full sample and original variables. (2) - (5) are based on a sample which includes firms with assets ≥ USD 1 million only. Variables, which are scaled by TURN, are used in (3) (as indicated by the superscript S). In (4) and (5) year and firm fixed effects are added successively. Standard errors in parenthesis. Where firm fixed effects are included, I follow Anderson and Hsiao (1982) in instrumenting DIV_{it-1} by DIV_{it-2}. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

2.6.2 Dividend payments and taxes

Table 2.4 presents the results of the specifications where I additionally include the DTR_{kt} and further control variables. I start by adding the DTR_{kt} to the preferred Lintner specification, with and without aggregate year fixed effects. Furthermore, I add the additional control variables as discussed in 2.5.4. The results are presented in columns (1) - (3). Adding the DTR_{kt} keeps the Lintner parameters completely unchanged, adding the additional controls gives only rise to slight adjustments. I find a significant negative effect of firm debt, all other additional variables, as well as the intercept, are insignificant.

However, the fact that the DTR_{kt} remains highly insignificant in all three specifications[17] is the most important finding. This result serves as a further piece of evidence that firms do not base their dividend payment decisions on investor-level income taxes.

As discussed above, it is ex-ante unclear if the parametric functional form I impose on the DTR_{kt} is valid. Therefore, I repeat the econometric analysis above where I estimate the effect of the DTR_{kt} nonparametrically using the Baltagi-Li estimator, as discussed in section 2.4 (I report the results in columns (4) - (6)). The first thing I note is that the smoothing parameter decreases a bit while the desired payout ratio is virtually unchanged. Therewith, both parameters are fully in line with previous results in the literature. Adding aggregated time shocks and additional control variables only changes these results fractionally. I present the nonparametric results of the estimate of the DTR_{kt} in Figure 2.5 panel (a). What we see is that, again, the effect of the DTR_{kt} is very small over the whole range. Furthermore, the effects are much smaller compared to the (insignificant) estimates in the parametric specification for each value of the DTR_{kt}. Nevertheless, I find positive effects for very small values which is puzzling.

While the similarity of these results with the parametric ones suggests

[17] Apart from being insignificant, the size of the estimated coefficient might be surprising, however, note that a tax rate of 20% is coded as 0.2 in the data and not as 20.

Table 2.4: Effect of DTR_{kt} on DIV_{it}

Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Assets>USD 1 million						
DIV^S_{it-1}	0.219***	0.219***	0.233***	0.305***	0.305***	0.304***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
PL^S_{it}	0.353***	0.353***	0.356***	0.327***	0.327***	0.327***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
DTR_{kt}	9.137	5.838	5.207	*Nonparametric results:*		
	(6.125)	(6.562)	(6.878)	*Figure 2.5*		
$DEBT^S_{it-1}$			-0.074***			-0.092***
			(0.002)			(0.002)
$TURN_{it}$			0.000			0.000
			(0.000)			(0.000)
GDP^g_{jt}			-0.054			0.008
			(0.155)			(0.185)
GDP^g_{kt}			0.062			-0.002
			(0.160)			(0.183)
Constant	-0.569	-0.279	0.023			
	(1.639)	(2.068)	(2.215)			
Obs.	1,345,052	1,345,052	1,318,900	998,293	998,293	979,731
Adj. R^2	0.168	0.164	0.168	0.395	0.395	0.397
Lintner parameters:						
s (Eq. (2.8))	0.781	0.781	0.767	0.696	0.696	0.696
r ((Eq. 2.8))	0.452	0.452	0.464	0.470	0.470	0.470
Year FE	No	Yes	Yes	No	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents the results of the tax augmented Lintner model as described in section 2.3.3. Several specifications use the semiparametric Baltagi-Li estimator following section 2.4.2. All specifications are based on a sample which includes firms with assets ≥ USD 1 million only. (1) provides the same specification as Table 2.3 where I include the variable DTR_{kt}. (2) adds year effects, (3) also includes firm and country-specific control variables. (4) - (6) repeat the analysis in (1) - (3). However, the DTR_{kt} is estimated nonparametrically using the Baltagi-Li estimator. Standard errors in parenthesis. Where firm fixed effects are included, I follow Anderson and Hsiao (1982) in instrumenting DIV_{it-1} by DIV_{it-2}.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

that the semiparametric findings of the tax rates also might be highly insignificant, I would need to estimate the standard deviations of the estimated parameters in order to come up with a more reliable statement. Since this is not even computationally feasible for the subsample with the firms with at least USD 1 million in assets, I repeat the estimation using firms with at least USD 5 million in assets. Subsequently, I plot the nonparametric estimate as well as the 95% confidence interval in Figure 2.5, panel (b). The results indicate the tax effect not to be significantly different from zero over the whole range. Hence, I still may conclude that the DTR_{kt} does not play a significant role in the decision of intra-firm dividend payments at any level of the tax rate.

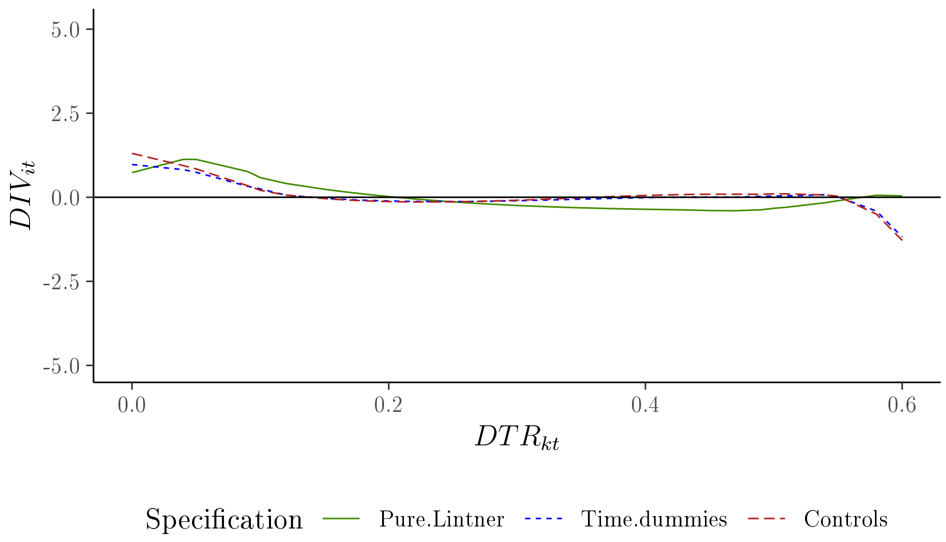
2.7 Robustness checks

This chapter covers the robustness checks I have conducted in order to examine the sensitivity of the results. Some first evidence has already been presented in section 2.6.1 where I show the results for the specifications with unscaled variables, and the full sample including small firms.

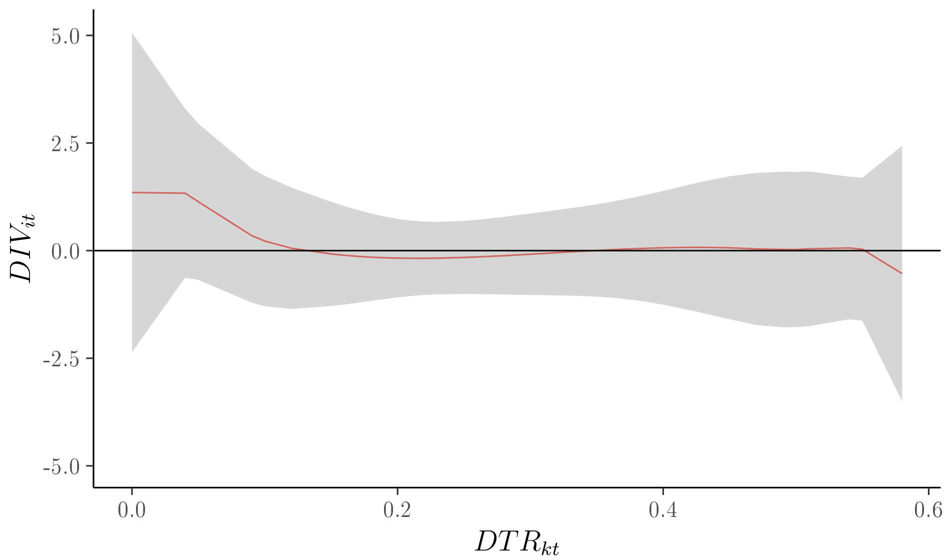
In a next step, I consider the approach taken by Bellak and Leibrecht (2010) who set dividend payments equal to zero where they observe zero profits or losses. The results can be found in column (1) in Table 2.5 (which also covers the other specifications I discuss in this section henceforth in columns (2) - (7)). I find similar results in terms of the Lintner parameters and the DTR_{kt}, the latter still being insignificant. In a further step, I additionally exclude firms where dividend payments exceed profits. The tax coefficient remains insignificant; the smoothing parameter s decreases somewhat.

For the next four specifications, I do not find any changes in the Lintner parameters compared to (1). In (3), I use the investor-level dividend tax rate in the country where the subsidiary resides (DTR_{jt}), in (4), I include the DTR_{kt} as well as the DTR_{jt}. All tax coefficients remain insignificant. Hence, I do not find any evidence that multinational firms base their dividend

Figure 2.5: Nonparametric results DTR_{kt}



(a) All specifications



(b) With 95% CI

Notes: This figure provides in (a) the nonparametric results of the DTR_{kt} from the estimations presented in Table 2.4, columns (4) - (6). In (b) I also present the 95% confidence interval. Due to computational restrictions, this estimation is based on a restricted sample including only firms with assets $\geq$ USD 5 million.

payments on investor-level tax rates in the country of the firms. In some countries, there are possibilities for investors to retain dividend earnings for reinvestment such that the capital income is finally taxed at the capital gain tax rate ($CGTR_{kt}$). Using the $CGTR_{kt}$[18], which I also take from Eklund and Wamser (2019), I still do not find a significant effect of the tax (as reported in column (5)), the same is true if I use the $CGTR_{jk}$ (6). Since the data includes firms with GUOs in the same country, as well as in a different country, I also test a specification where I include an interaction term of the DTR_{kt} with an indicator which is one if the subsidiary and the GUO are in different countries (column (7)). Also here, I do not find any significant effects of the dividend income tax rate. These findings underline that firms not only leave dividend payments unchanged but also repatriate profits from foreign firms they own in the same way as they did before taxes changed.

Furthermore, note that the results are robust to winsorizing (e.g., at the 1^{st} and 99^{th} percentile) or to trimming the data. The same is true if firms like financial companies that were omitted in the main estimations due to regulatory differences (see chapter 2.5.2 for more details) are included in the analysis. Similarly, the results are robust if only firms from the European Union are considered and if firms from the US are included additionally.

[18]I.e. the $CGTR_t$ in the country of the GUO.

Table 2.5: Robustness checks

Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
DIV^S_{it-1}	0.203***	0.264***	0.203***	0.203***	0.203***	0.203***	0.203***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
PL^S_{it}	0.346***	0.346***	0.346***	0.346***	0.346***	0.346***	0.346***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
DTR_{kt}	3.811	9.203		1.656			6.989
	(5.727)	(6.308)		(10.391)			(6.109)
DTR_{jt}			3.906	2.544			
			(5.643)	(10.238)			
$CGTR_{kt}$					-4.899		
					(3.463)		
$CGTR_{jt}$						0.742	
						(3.209)	
DTR_{kt} x $foreign$							-23.558
							(15.761)
$DEBT^S_{it-1}$	-0.024***	-0.028***	-0.024***	-0.024***	-0.024***	-0.024***	-0.024***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
$TURN_{it}$	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.0000)	(0.0000)
GDP^g_{jt}	-0.019	0.026	-0.009	-0.012	-0.033	-0.023	-0.001
	(0.1325)	(0.141)	(0.134)	(0.136)	(0.132)	(0.133)	(0.133)
GDP^g_{kt}	0.004	0.015	-0.006	-0.002	-0.012	-0.009	-0.004
	(0.1368)	(0.146)	(0.136)	(0.138)	(0.136)	(0.136)	(0.137)
$Constant$	0.241	-1.588	0.219	0.139	2.329*	1.102	0.753
	(1.7936)	(2.019)	(1.771)	(1.840)	(1.207)	(1.155)	(1.826)
Obs.	1,633,138	1,222,135	1,633,131	1,633,131	1,633,138	1,633,131	1,633,138
Adj. R^2	0.166	0.254	0.166	0.166	0.166	0.166	0.166
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents various robustness checks and is based on a sample which includes firms with assets ≥ USD 1 million only. In (1) I set $DIV_{it} = 0$ where $PL_{it} \leq 0$ as in Bellak and Leibrecht (2010), (2) additionally excludes firms where dividends exceed profits. (3) uses the DTR_{kt} in the country of the firm instead of the GUO while (4) uses both tax measures. (5) uses the $CGTR_{kt}$ instead of the DTR_{kt} in the country of the GUO. (6) controls for the $CGTR_{kt}$ in the country of the firm instead of the country of the GUO, (7) includes again the DTR_{kt}, interacted with a dummy which indicates if the GUO resides in a foreign country. Standard errors in parenthesis. I follow Anderson and Hsiao (1982) in instrumenting DIV_{it-1} by DIV_{it-2}. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

2.8 Conclusion

This study evaluates the effect of investor-level dividend income taxes on dividend payments of firms. While firms might change dividend payments to investors in response to a tax change, I do also take into account that this change in dividend payments might lead to adjustments of the repatriation of profits from other firms which the firm owns. I base my analysis on the Lintner model of dividend payouts. In a first step, I show that consistently with the literature dividend payments result as a combination between the desired payout ratio and dividend payments in the period before, since firms aim at providing with a smooth dividend payment stream. In a next step, I add different control variables and the dividend tax rate. While I deploy full parametric models, I also allow for heterogeneous effects of the tax using the semiparametric Baltagi-Li estimator. In a third step, I present the results of various robustness checks including alternative specifications and subsamples of the data.

All results consistently show that dividend income taxes on the level of investors do not have a significant impact on dividend payments of firms, neither on payments to investors nor on intra-MNF profit repatriations. This finding is robust if I use the tax rate of the subsidiary instead of the parent company. The same is true for the capital gains tax rate.

Furthermore, this study contributes to the literature by producing evidence that the Lintner model provides sensible results in a setting that includes large numbers of countries and firms that belong to MNF networks.

These findings have important implications for public policies. Most countries levy considerably smaller taxes on investor-level capital income compared to earned income. While there are various reasons for this difference, some countries do so because of fears that higher taxes might induce capital flights. The results of this study provide evidence that the cost of increasing the dividend income tax might be smaller than initially assumed.

However, this study also has some important limitations. While I observe the location of the mother company, I do not observe the country of residence of the most influential investors, i.e., I assume that they reside in the same country as the mother company within an MNF network. However, if these investors are taxed in different countries, firms might adjust their dividend payments according to some weighted average of the tax rate of the different countries. However, since studies (e.g., French and Poterba, 1991) have shown that there is an investment home bias (i.e., investors tend to invest disproportionally in the home market), the tax rate in the country of the firm could still serve as an instrument for the weighted average tax rate. Furthermore, the characteristics of investors could lead to a slight deviation from the standard tax rate in some countries. Hence, this research could be extended by including information on the influential shareholders themselves which would improve the precision of the approach taken.

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Chapter 3

Hello, goodbye: Do lower income taxes attract foreign firm managers?

Abstract

This paper examines to what extent personal taxes on earned and capital income influence the location choice of firm managers. The analysis is based on a large panel dataset including detailed information on income taxes and firm managers in 63 countries. Subsequently, an event study and different choice models are employed to estimate how an increase in the income tax rate translates into a change in the location choice of firm managers. The results suggest significant and negative tax effects. Based on these findings, the effect of an increase in US taxes on the location choice probability of other countries is calculated. While the choice probability of close by or similar countries like Canada and the UK increases, distinct and remote countries like France might not experience an effect at all.

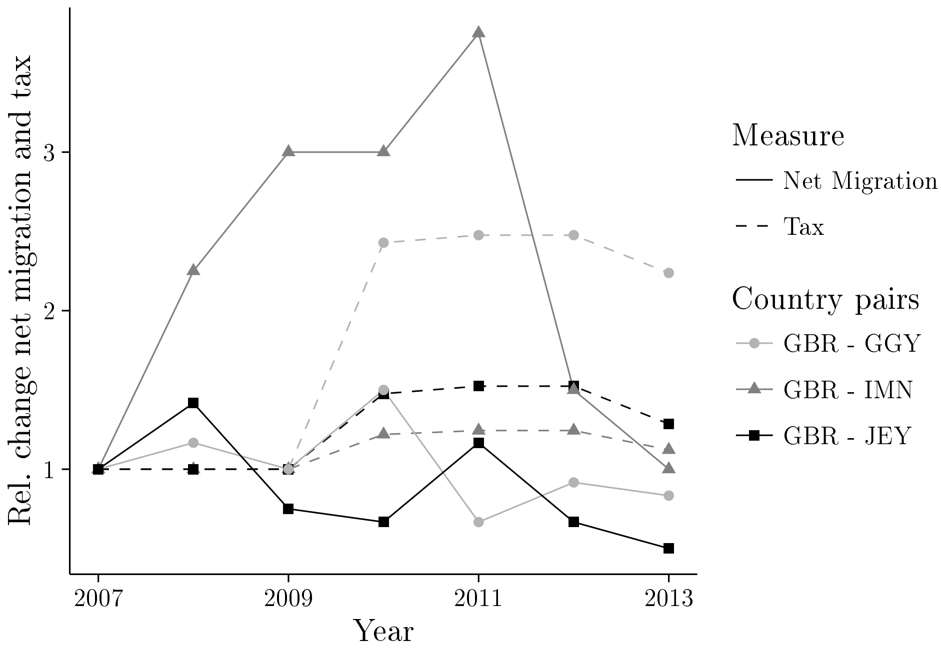
3.1 Introduction

The recent surge in income inequality (e.g., Piketty, 2015) has fueled new discussions about top income taxation. While higher income taxes could tackle income inequality, opponents suggest that especially top income earners might simply relocate to countries with lower tax rates. This would be a major concern since relatively few top income earners account for the bulk of tax revenue. For example, the top 1% income earners account for 22% of income tax revenue in Germany (Bundesministerium der Finanzen, 2017) and even 39% in the US (York, 2018). Indeed, there are substantial differences in the top income tax rates between neighboring countries, where reciprocal entry restrictions do not exist. For example, the top tax differentials between Sweden and Norway, Portugal and Spain, and France and Germany amount to about 15 percentage points in 2015. At the same time, migration costs for top income earners have fallen dramatically over the last decades (OECD, 2011). Lehmann et al. (2014) show that under such circumstances, the optimal tax rate exhibits negative marginal tax rates at the very top to account for the tax-induced emigration of top income earners. However, reducing the top income tax rate to counteract such emigration could reduce state revenue and undermine redistributive social policies (Mirrlees, 1982).

Despite these differences in personal income taxes, reports of mass emigration of top income earners from high to low-tax countries have mostly stayed away. Gérard Depardieu serves as one of the few prominent examples of wealthy individuals who changed their country of residence in response to a tax change. The actor moved from France to Russia in 2013 in response to significant tax increases (The Guardian, 2013). Still, it remains unclear to what extent tax differences induce migration of top income earners.

Figure 3.1 shows how the top income tax differential and cross-country migration rate of firm managers between the UK and its low-tax crown dependencies Guernsey, Isle of Man and Jersey evolved over time. What we see is that, as the tax rate increases in the UK relatively to Guernsey and Jersey, migration of firm managers increases in the following periods. For the Isle of Man, we see a sharp decline in the migration rate as the relative tax rate decreased slightly. However, the figure does also suggest that there is a wide range of additional factors influencing the migration flow of firm managers and it remains unclear how much we can attribute to tax changes.

Figure 3.1: Income taxes and net manager migration



Notes: This graph depicts the change of the difference of the top income tax rate and the difference in the net migration flow of firm managers for the country pairs UK (GBR) - Guernsey (GGY), UK (GBR) - Isle of Man (IMN) and UK (GBR) - Jersey (JEY). The tax rate differentials and the migration rate are normalized to one in 2007. An increase in the tax measure indicates a relative tax increase in the UK, compared to the other country.

While there is some earlier work on the topic (see, e.g., Kirchgässner and Pommerehne, 1996), the effect of income taxes on the location decision of top income earners has only gained increased attention in recent years. Kleven, Landais, and Saez (2013) use data on European football players and find the net-of-tax rate elasticity of the number of foreign players in football clubs to be close to one. Kleven, Landais, Saez, and Schultz (2014) exploit the preferential foreigners' tax scheme in Denmark.[1] They find very high migration elasticities of top income earners (between 1.5 and 2). Akcigit et al. (2016), as well as Moretti and Wilson (2017), use data on highly skilled individuals with, again, very similar results. While Akcigit et al. (2016) use international data on inventors, Moretti and Wilson (2017) look at the migration of star scientists within the US.

In contrast to these findings, Young et al. (2016) track how millionaires in the US respond to millionaire taxes over a period of 13 years and do only find small effects. They propose a so-called "transitory millionaire" hypothesis which states that top income earners are highly mobile and in search for lower tax places, and an "elite embeddedness" hypothesis which suggests that top income earners are strongly tied to places where they achieved exceptional success. Their finding of a very small tax effect suggests that the second hypothesis is more relevant than the first.

This paper contributes to this literature in several ways. First, I base the analysis on a rich dataset that contains detailed information on firm managers. Analyzing the behavior of firm managers in the context of top income earners is highly relevant. As this paper will show, the average income of firm managers is not only a multiple of the average income covering all workers. Firm managers do also generate significant amounts of capital income (e.g., dividends), which is a typical feature of top income earners (for an empirical analysis, see, e.g., Piketty and Zucman, 2014; Alvaredo et al., 2017).

The second contribution is based on the novel income tax data which I take from Eklund and Wamser (2019). This dataset includes tax rates for 165 different countries and covers, among others, taxes on earned income, interest, dividends, capital gains, and royalty income. While the size of the included countries is valuable by itself, the major advantage is based on the range of tax rates that are covered. Therewith, I am able to estimate the tax effect based on the entire range of income taxes, instead of only focusing on the earned income tax. This will increase the understanding of how top

[1] Under this scheme, top income earners are taxed at a preferential flat rate for up to three years.

income earners respond to changes in the tax legislation.

Finally, this paper provides extensive summary statistics about the migration pattern of firm managers and how these are associated with changes in the personal income tax. Due to the panel structure of the paper, these are not only based on cross-sectional correlations but also on dynamic changes in the tax rates over time. Furthermore, the effect of income taxes on a manager's country location choice is estimated using different discrete choice models. Also, in one choice model specification, I allow for heterogeneous tax responses across managers because it is ex-ante unclear if all managers share the same distaste for income taxes.

The empirical analysis reveals a statistically significant negative effect of income taxes on the location choice of managers. This finding is robust to the inclusion of taxes on capital income. While the negative effect of income taxes on the location choice is significant, other factors like nationality or distance between countries are found to be important as well. Furthermore, I show how a change in the US income tax affects managers' choice probabilities of alternative countries. Countries that are close or similar in geographical as well as cultural terms, like Canada or the UK, profit in terms of an increase in the location choice probability of firm managers, while more distant and distinct countries like France experience only minor effects.

The paper proceeds as follows: the next section describes the institutional backgrounds of income taxation and the effect of taxes on the location choice of top income earners. The data is presented in Section 3.3; Section 3.4 provides an event study. Section 3.5 discusses the econometric approach, which is followed by a presentation of the results in Section 3.6. Section 3.7 concludes.

3.2 The location decision of firm managers

The aim of this study is to provide further evidence on the effect of income taxes on the location decision of top income earners. This chapter outlines how income is taxed in most countries. Furthermore, it includes a stylized model on how taxes may influence firm managers' location decision.

Most countries tax income by means of a progressive tax schedule. While a certain amount of income is usually tax exempt, every additional unit of income is taxed at increasing marginal tax rates up to a certain upper bound. The largest marginal income tax rate, which I call top income tax rate ($TITR$), is levied on every unit of income above this threshold, which I denote by $TITRB$.

In most countries, this threshold is very low which is why I expect top income earners to focus primarily on the $TITR$. However, I also provide specifications in my empirical analysis where I include the tax burden on income below the $TITRB$ by measuring the average income tax rate ($AITR$) exactly at the $TITRB$.

Since taxes reduce disposable income, individuals might strategically choose their country of residence in order to lower their tax burden. This tax avoidance strategy seems to be especially present among top income earners (like firm managers), as they face a particularly high tax burden under a progressive tax regime. In this context, it is important to note that the mobility of top income earners has significantly increased over the last years (OECD, 2011). Hence, firm managers will find it easier to adjust their location decision in response to a tax change.

For illustrative reasons, consider the following stylized model on the location choice of firm managers. Assume a firm manager i with utility U_i resides in country $j = 1, ...J$.[2] I postulate that

$$U_{ij} = U_i(I_{ij}^N) \text{ with } \frac{\partial U_i}{\partial I_{ij}^N} > 0 \ \forall j. \tag{3.1}$$

Here, I_{ij}^N indicates net income of firm manager i in country j with $I_{ij}^N = I_{ij}^G - T_j(I_{ij}^G)$ and $\frac{\partial T_j}{\partial I_{ij}^G} > 0 \ \forall j$, where I_{ij}^G denotes gross earnings of i and $T_j(I_{ij}^G)$

[2] For notational simplicity, I omit the time index.

the tax schedule in country j. Hence, firm managers ultimately care about their net income which is determined by gross income and the income tax schedule (as argued above, $T_j(I_{ij}^G) \approx TITR_j \cdot I_{ij}^G$ for top income earners). Following Equation (3.1), an increase in the tax burden of manager i leads to a direct loss in utility:

$$\frac{\partial U_{ij}}{\partial T_j} = \frac{\partial U_{ij}}{\partial I_{ij}^N} \frac{\partial I_{ij}^N}{\partial T_j} = \frac{\partial U_{ij}}{\partial I_{ij}^N}(-1) < 0 \ \forall j. \tag{3.2}$$

If a change in the tax rate leads to a situation where at least one country $k = 1, ...J$ with $k \neq j$ exists such that $U_{ik} - U_{ij} > \delta_{ijk}$ with moving costs[3] δ_{ijk}, it will be optimal for firm manager i to leave the current country of residence j.[4]

It could be assumed that gross income I_{ij}^G is influenced by country-specific characteristics Ψ_j since these characteristics determine (among others) the economic success of firms: $I_{ij}^G = I_{ij}^G(\Psi_j)$. This assumption implies that firm managers do not necessarily leave the current home country if there exists a country with lower taxes since the characteristics of the home country might lead to extraordinary high income. Hence, countries might tax these excessive rents without provoking outflows of firm managers.

Note how I use gross income to introduce further country characteristics as determinants of firm managers' location choice. As country characteristics are assumed to be captured by gross income, managers ultimately only care about earnings in this simple setting. In the econometric analysis, however, I will include additional variables which control for country distances and the potential income of firm managers, among others. Since the income of managers is linked to the success of the firms they work for, I expect

[3]Moving costs may consist of monetary costs like airline tickets, or non-monetary costs like cultural and linguistic differences. Furthermore, the moving costs may consist of costs related to finding a new circle of friends or leaving cherished colleagues.

[4]Note that in this simple model, it is assumed that solely differences in potential country-specific income determine the difference $U_{ik} - U_{ij}$. However, in the econometric analysis I include a large range of further country-specific characteristics that might influence the location choice of managers.

managers to prefer countries that also are optimal from the perspective of firms. Therefore, I will use control variables mainly known from the literature on the location decision of firms. This reasoning is similar to the argument of Borjas (1989) who argues that workers migrate to countries where their return on human capital is maximized.[5]

In this context it is important to note that Ruf and Schmider (2018) investigate the tax incidence of top income earners, using the same manager dataset as I do. They find that if the marginal top income tax rate is increased by 10 percentage points, gross income increases by 11.57%. This finding suggests that the economic tax incidence on firm managers is small and that firms bear a larger share of the tax burden.

Following these results, we could model gross income as $I_{ij}^G = I_{ij}^G(T_j)$ with $\frac{\partial I_{ij}^G}{\partial T_j} > 0$. If this relationship between gross income and income taxes would indeed be present, this could act as a counterweight to the negative effect of taxes on net income I_{ij}^N, as modeled in Equation (3.2). The mechanical effect of an increase in income taxes T_j on net income I_{ij}^N[6] would partly be balanced by an increase in gross income I_{ij}^G. Under these circumstances, managers might be less responsive to tax changes.

To sum it up, it is ex-ante unclear if there is a tax effect on the location decision of firm managers. While taxes reduce firm managers' utility by mechanically reducing net income, a manager's gross income might increase in response to a tax increase because firms also bear parts of the tax burden. Since the positive effect of income taxes on gross income is larger for top income earners, as described in Ruf and Schmider (2018), the total tax effect will therefore presumably be smaller in absolute terms for managers with a larger income.

[5]Also, note that anecdotal evidence suggests that top income earners are very cosmopolitan, heading for metropolises like London and Paris or beach-clubs in Florida during weekends. This reduces the effect of the country choice of employment on leisure activities.

[6]Recall that $I_{ij}^N = I_{ij}^G - T_j(I_{ij}^G)$.

3.3 Data

The analysis of the effect of income taxes on the location choice of firm managers is based on the *BoardEx* dataset which includes information on listed companies in a large number of different countries. The data is supplied by the eponymous firm which provides business intelligence service on corporate governance and boardroom processes. I do not only observe detailed characteristics of firm managers in the data[7] but also on the firm itself, like revenue or market capitalization. Personal income tax measures are taken from Eklund and Wamser (2019). Furthermore, I use several country-specific control variables like GDP, population-weighted country distances, or indicators measuring the openness of a country, which I take from the World Bank, the Heritage Foundation and CEPII. A detailed description of the variables and their sources, as well as summary statistics, can be found in Tables 3.1 and 3.2.

After combining all datasets, I end up with 57,354 different managers which I observe on average in 4.8 years over the eight years period between 2006 and 2013 (i.e., 276,405 manager-year observations). Most managers are male (90.11%), and the average age is 54.84 years. The youngest manager is 19 (Luigi Berlusconi of Mediolanum SPA) and the oldest 103 (George E. Kane of Panera Bread Company) years old.[8] I observe firms in 63 different countries (see Figure 3.2), while the managers hold nationalities from 110 different countries.

[7]To be more specific, these firm managers are defined as board members and senior executives in the dataset.

[8]Note that in 2009, I observe a manager called Peter Redhead who is born 1995 and hence only 13 years old. However, according to further research, Peter Redhead is born 1965. Since the similarity of these both numbers makes a typo very likely, I do not include this observation.

Table 3.1: Description of variables used

Variable	**Description**	**Source**
$TITR_j$	Top income tax rate	Eklund and Wamser (2019)
DTR_j	Dividend income tax rate	Eklund and Wamser (2019)
$CGTR_j$	Capital gains tax rate	Eklund and Wamser (2019)
ITR_j	Interest income tax rate	Eklund and Wamser (2019)
RTR_j	Royalty income tax rate	Eklund and Wamser (2019)
$lGDP_j$	Log GDP	World Bank
$lGDPPC_j$	Log GDP per capita	World Bank
$GROWTH_j$	GDP growth	World Bank
$CONT_{jk}$	=1 if countries share common border	CEPII
$LANG_{jk}$	=1 if countries share common language	CEPII
$COLONY_{jk}$	=1 if countries share colonial history	CEPII
$lDIST_{jk}$	Log population weighted country distance	CEPII
$HOME_{ij}$	=1 if same country of residence as before	
$HOMENAT_{ij}$	=1 if country is manager's country of nationality	
$INCOME_i$	Income of firm manager	*BoardEx*
$AVGINC_j$	Average manager income per country	*BoardEx*

Continued on next page

Table 3.1 – *Continued from previous page*

$ASSETS_j$	Measure of the aggregated firm assets in a country	Bureau van Dijk (*ORBIS*)
$TAXWW_j$	Indicates if worldwide income is taxed	Eklund and Wamser (2019)
$CORRUPT_j$	Measure of corruption	Heritage Foundation
$PROPERTY_j$	Measures property rights	Heritage Foundation
$INVEST_j$	Measures freedom of investment flows	Heritage Foundation
$FINANCE_j$	Measures freedom of capital markets	Heritage Foundation

Notes: Table 3.1 provides a description and the sources of the variables used, where i refers to manager i and j refers to country j.

Figure 3.2: Observations across countries

Notes: This graph depicts the worldwide distribution of the manager-year observations in the dataset.

Table 3.2: Summary statistics

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
$TITR_j$	0.447	0.085	0	0.73	211,463
DTR_j	0.278	0.133	0	0.58	211,463
$CGTR_j$	0.298	0.13	0	0.61	211,463
ITR_j	0.393	0.103	0	0.59	211,463
RTR_j	0.397	0.11	0	0.59	211,463
$lGDP_j$	28.9	1.367	21.761	30.41	206,687
$lGDPPC_j$	10.652	0.228	7.681	11.705	206,687
$GROWTH_j$	0.715	0.669	-5.791	2.872	206,687
$CONT_{jk}$	0.003	0.059	0	1	164,530
$LANG_{jk}$	0.008	0.09	0	1	164,530
$COLONY_{jk}$	0.006	0.076	0	1	164,530
$lDIST_{jk}$	6.241	1.154	2.134	9.827	164,530
$HOME_{ij}$	0.763	0.425	0	1	211,463
$HOMENAT_{ij}$	0.569	0.495	0	1	211,463
$INCOME_i$	913.628	7,310.931	0	1,427,225.125	204,354
$AVGINC_j$	911.199	593.918	0	5,272.259	211,357
$ASSETS_j$	8.633bn	10.573bn	12,842.2	24.491bn	207,470
$TAXWW_j$	0.009	0.094	0	1	211,463
$CORRUPT_j$	76.534	9.586	16	97	206,455
$PROPERTY_j$	85.606	10.031	20	95	206,455
$INVEST_j$	79.459	11.448	20	95	206,455
$FINANCE_j$	77.214	11.701	30	90	206,455

Notes: Table 3.2 provides summary statistics of the variables used. Note that firm managers are the unit of observation. For country averages of the tax rates see Table 3.5. Billions are denoted by bn.

The income measure ($INCOME_i$[9]) consists of four different components as provided by *BoardEx*: direct compensations[10], share-based compensations[11], defined contribution pension plans (DCP), and other compensations.[12] Table 3.3 provides summary statistics of the share of the different components of total income. Considering all firm managers, direct compensations make up two-thirds of total income on average while share-based compensations amount to a little bit more than a fourth. However, if I only include firm managers with income above USD 1 million, the proportion of share-based compensations increases to 51.1%, while the proportion of direct compensations falls to 41.54%. Hence, especially at the top, a substantial share of firm managers' income is capital income. These numbers are striking and provide strong evidence for why it is essential not only to consider ordinary income taxes on earned income but also taxes on capital income if the location decision of top income earners is to be estimated.

Table 3.3: Average composition of total income

	Direct	Equity	DCP	Other	Obs.
All observations	67.496%	26.878%	0.852%	4.773%	210,838
$INCOME$>USD 1 million	41.54%	51.101%	2.676%	4.681%	26,968

Notes: Table 3.3 gives the average share of the different income components of total income. Total income consists of direct compensations (Direct), share-based compensations (Equity), defined contribution pension plans (DCP) and other compensations (Other). The first row includes the total sample, the second only managers with income above 1 million USD.

Managers working in the US earn by far the highest wages, as indicated in Table 3.4. If firm managers are sorted by income in the year 2013, the first eight observations are all US-American. Georg L. Chapman from Health Care Reit Inc., the manager with the highest income, earned a total of USD 592 million. By contrast, the income of the top non-US manager (Robert W.

[9] I express all monetary values in USD using exchange rates as of the first of June of the respective year.

[10] Cash based compensations like salary and bonus payments.

[11] Equity linked compensations like shares, options (estimated value using the Black-Scholes formula) and long-term incentive plans (LTIP). For the calculation, it is assumed that the manager receives the largest possible payment according to the LTIP.

[12] Other cash benefits like relocation costs and fringe benefits.

Dudley from BP Plc) is roughly a seventh of the income of George L. Chapman. As for the other managers at the top, total income consists practically only of share-based compensations.

The average income of the managers in the US equals USD 1.19 million while it is equal to USD 0.48 million for non-US managers. For the OECD, the number is USD 0.77 million and for the EU USD 0.51 million. Compared to the EU, the average income is only slightly larger in the UK (USD 0.52 million). While the average income is USD 0.72 million in 2006 for all managers, it increased to USD 1.09 million in 2013. I find the largest average income in the tobacco (USD 1.52 million), aerospace and defense (USD 1.24 million) and food production and processing (USD 1.24 million) industries. The lowest average income is earned by firm managers in investment companies (USD 0.07 million). While these numbers are impressive in itself, note that the average income in 2013 of all workers (thus, not only firm managers) amounted to USD 58,400 and USD 43,200 in the US and the UK, respectively (OECD, 2018). Hence, firm managers earn on average 20 times as much as the average worker in the US.

Summarizing, I may conclude that firm managers indeed are top income earners with large compensation packages. Furthermore, the composition of firm managers' income, which includes large shares of capital income, suggests that firm managers are not only affected by earned income but also by capital income taxes. These findings are robust to different industries and regions of the world.

Table 3.4: Highest-paid managers 2013

Company	Manager	Total Income (USD 1000)	Direct (USD 1000)	Equity (USD 1000)	DCP (USD 1000)	Other (USD 1000)	Country	Rank
		All managers						
Health Care Reit Inc	George L. Chapman	591,917	876	590,831	13	197	USA	1
Smucker(J.M.)Co	Richard Kim Smucker	443,964	938	442,936	0	90	USA	2
Salesforce.Com Inc	Marc R. Benioff	218,964	1,000	217,029	0	935	USA	3
Smucker(J.M.)Co	Vincent C. Byrd	192,761	633	192,106	0	22	USA	4
Oracle Corp	Lawrence Joseph Ellison	133,871	1	132,324	5	1,541	USA	5
Smucker(J.M.)Co	Timothy Paul Smucker	100,082	627	99,386	0	69	USA	6
Oracle Corp	Mark Vincent Hurd	95,374	950	94,402	5	17	USA	7
Oracle Corp	Safra Ada Catz	95,372	950	94,402	5	15	USA	8
BP Plc	Robert W. Dudley	86,701	3,807	82,809	0	84	GBR	9
Hewlett-Packard (Hp) Co	Margaret Cushing Whitman	67,230	0	66,955	0	275	USA	10
		Only non-US managers						
BP Plc	Robert (Bob) W. Dudley	86,701	3,807	82,809	0	84	GBR	1
Seagate Technology Plc	Stephen (Steve) J. Luczo	34,610	1,041	33,565	0	4	IRL	2
Aberdeen Asset Mgmt. Plc	Martin James Gilbert	28,755	2,516	26,236	0	3	GBR	3
Aberdeen Asset Mgmt. Plc	Hugh Young	28,748	2,290	26,236	0	221	GBR	4
Persimmon Plc	Jeffrey (Jeff) Fairburn	25,383	2,097	23,115	127	44	GBR	5
Roche Hldg Ag	Doctor Severin Schwan	23,686	4,264	18,840	581	0	CHE	6
Delphi Automotive Plc	Rodney O'Neal	21,964	1,616	20,319	17	12	GBR	7
Eaton Corp Plc	Alexander (Sandy) Cutler	21,625	1,135	20,365	9	116	IRL	8
Te Connectivity Ltd	Thomas (Tom) J. Lynch	21,421	1,041	20,144	12	225	CHE	9
Nxp Semiconductors N V	Richard (Rick) L. Clemmer	19,828	1,492	16,198	773	1,365	NLD	10

Notes: Table 3.4 lists the best paid managers I observe in the dataset for the year 2013. Total income consists of direct compensations (Direct), share based compensations (Equity), defined contribution pension plans (DCP) and other compensations (Other). The managers are ranked by income (Rank).

For the analysis of the number of cross-country moves, I only keep managers which I observe for more than one year. Furthermore, there are 10,822 managers which I observe multiple times in the same year since they hold positions in several firms. In these cases, I assume that the country of residence of the manager is the same as the country of the firm where the highest income is earned. Hence, I keep the observation with the highest income. This results in a total of 211,463 observations based on 46,887 managers. There are 3,169 transnational job changes in the dataset, based on 2,244 managers. Figure 3.3 depicts the number of immigrants and emigrants per country.

The UK and the US are the largest source (803 and 581 exits) and destination (778 and 472 entries) countries. I observe the largest bilateral migration flows from the US to the UK as well as from the UK to the US, from the US to Ireland and from the UK to Guernsey. Several countries which often are referred to as tax havens appear in the top ten of the largest migration flows (the UK to Ireland, Isle of Man, as well as to Jersey).

While I expect that relocations of managers are mainly based on intrinsic motivations (like higher net income) and hence lead to a change of the firms where they work, one could also think of cases where managers are relocated within firms by request of the employer. If I would find such intra-firm relocations to be common in the data, this could pose a threat to the empirical analysis as the location choice is not primarily based on preferences of the manager. Therefore, I merge the manager dataset with the *ORBIS* dataset which is provided by Bureau van Dijk. Using the *ORBIS* dataset allows me to identify the global ultimate owner of firms, i.e., the last level of ownership which is not owned by a further firm. For illustrative reasons, assume a manager works for the automotive manufacturer Rolls Royce which is owned by the BMW Group. Further assume that the BMW Group owns a second automotive manufacturer called Mini which in turn owns John Cooper Works, a racing car manufacturer. If now the BMW Group decides that the skills of the manager working for Rolls Royce are needed in the firm John Cooper Works and therefore relocates the manager to this firm, *ORBIS* provides the information needed to identify this movement as intra-firm (due to the

Figure 3.3: Manager migration by country

(a) Immigration

(b) Emigration

Notes: This graph depicts the number of total immigration (a) and emigration (b) of managers per country as observed in the dataset.

mutual global ultimate owner).

After merging the *BoardEx* and *ORBIS* datasets, 75% (123,806) of the manager observations are successfully associated with a firm in *ORBIS*. Within this group, I observe the global ultimate owner in 14% (17,535) of the cases. Among all cross-country movements within this subgroup, not a single one is intra-firm (i.e., both firms involved did not share the same global ultimate owner). Hence, I may conclude that intra-firm relocations at least do not play a significant role for firm managers. While I base this conclusion on a limited subsample, the striking result of zero intra-firm relocations in the subsample provides ample evidence that such relocations might rather be present below the management level.

The tax data includes the top marginal tax rates on income accruing from earned income ($TITR_j$), dividend income (DTR_j), capital gains ($CGTR_j$) and interest income (ITR_j).[13] These measures include uncapped social security contributions, where applicable.

On average, the countries in the dataset levy a $TITR_j$ of 36.53%, the tax rates on capital income (DTR_j, $CGTR_j$, ITR_j, and RTR_j) are considerably smaller (21.88%, 17.24%, 24.3%, and 24.42%, respectively). The average of all tax measures decreased between 2006 and 2013, as depicted in Table 3.5.

Over the sample period, I find not only large cross-country variations but also large within-country variations of the tax rates over the time dimension. Figure 3.4 depicts how the tax rate evolved over time for a sample of countries.

Comparing the tax rate of firm managers before and after a movement, I find that managers experience for all tax rates, except the DTR_j, on average a reduction of about 1 percentage points after the move, the DTR_j increased only slightly by 0.1 percentage points. While this change in the tax rate is rather modest, I find that the average tax differential is less ad-

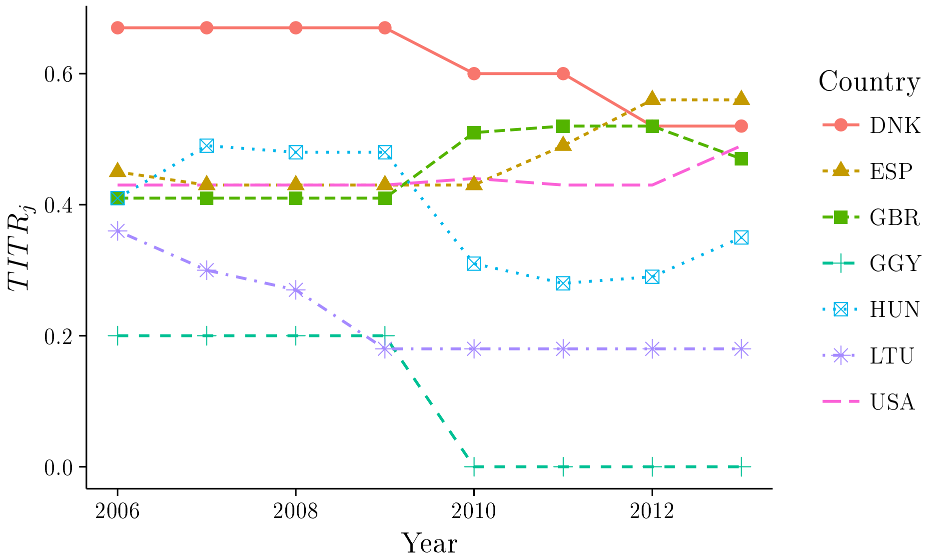
[13] Recall that I define all variables in Table 3.1. Here, the abbreviations refer to the top income tax rate ($TITR_j$), the dividend income tax rate (DTR_j), the capital gains tax rate ($CGTR_j$) and the interest income tax rate (ITR_j).

Table 3.5: Average income tax rates

Tax measure	*Average*	*Average 2006*	*Average 2013*
$TITR_j$	36.529%	37.442%	36.389%
DTR_j	21.875%	22.962%	21.750%
$CGTR_j$	17.237%	18.192%	16.833%
ITR_j	24.294%	25.692%	23.972%
RTR_j	24.424%	26.125%	22.167%

Notes: Table 3.5 provides summary statistics of the average income tax rates of the different countries.

Figure 3.4: Variation of $TITR_j$ by country



Notes: This graph depicts the change of the $TITR_j$ over time for Denmark (DNK), Spain(ESP), the UK (GBR), Guernsey (GGY), Hungary (HUN), Lithuania (LTU) and the US (USA).

vantageous in the years before the movement (except for the ITR_j). For example, the $TITR_j$ would on average have been 0.74 percentage points larger in the destination country if the manager would have moved five years before the movement while it was 1.21 percentage points lower in the actual year of movement. I observe a slightly larger number of movements into tax jurisdictions with higher rather than lower rates.

Besides the different tax rates, I control for a variety of additional factors that might determine the location choice of firm managers. Since moving is costly, managers might prefer to stay in the current host country. Similarly, managers might prefer their country of nationality over other countries even if these countries have lower tax rates. To account for these patterns, I include the variables $HOME_{ij}$ and $HOMENAT_{ij}$ which indicate if the former country of residence is equal to the country that might be chosen in the next period (i.e., no movement) and if the potential country of residence is the manager's country of nationality.

Furthermore, I include the log of GDP per capita, $lGDPPC_j$ to account for productivity. The log of GDP, $lGDP_j$, and GDP growth, $GROWTH_j$, account for the size and dynamics of country j. The institutional framework in country j is controlled for by $CORRUPT_j$ and $PROPERTY_j$, where a higher value indicates less corruption and stronger property rights.

To account for differences between the current country of residence j and the potential next country of residence, I include the following variables: $COLONY_j$ indicates if the countries share a colonial past to control for cultural similarity, $lDIST_j$ is the log population weighted distance. $CONTIG_j$ and $COMLANG_j$ indicate if the two countries share a common border or a common language, respectively.

Further country-specific controls are the average manager compensation ($AVGINC_j$)[14], aggregated firm assets ($ASSETS_j$)[15] and a variable which

[14] $AVGINC_j$ is calculated as the country-specific average manager income in the *BordeEx* dataset.

[15] $ASSETS_j$ is calculated as the aggregated firm assets.

indicates if worldwide income or only domestic income is taxed ($TAXWW_j$). The choice of control variables mainly follows the literature on the location choice of firms, as discussed in section 3.2.

Recall that I provide descriptions and the sources, as well as summary statistics of all variables in Tables 3.1 and 3.2.

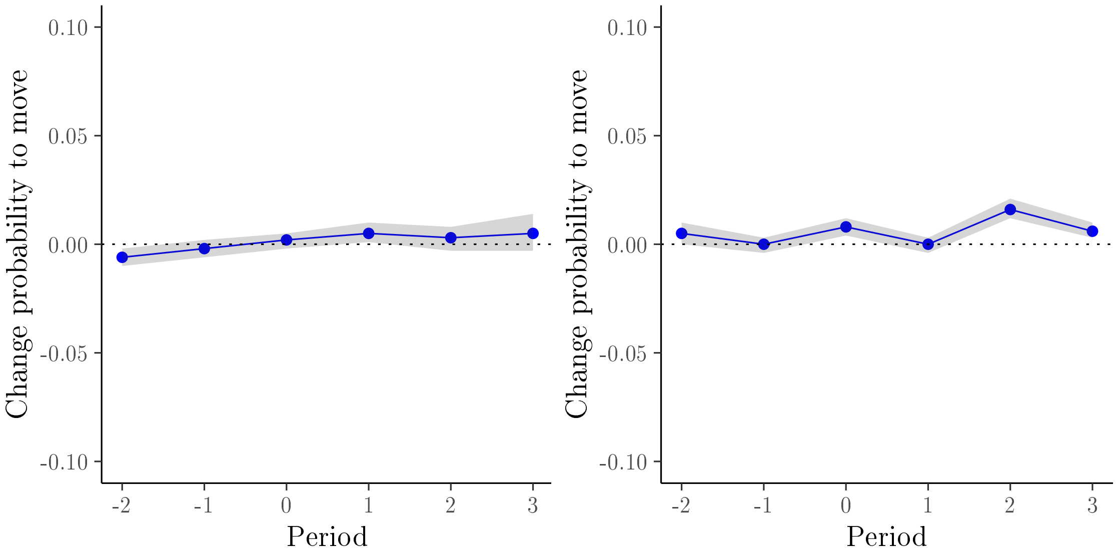
3.4 Event study

As a first piece of evidence, I present an event study to examine the timing of the effect of a tax change on the location decision of firm managers. I follow the methodology of Simon (2016) which also has been used recently by Fuest et al. (2018). The main idea is to use a vector $\sum_{m=-M}^{M} e_m$ of dichotomous indicators which indicate if a reform happened m periods before or after the current period. Furthermore, the same control variables as in the estimations of the discrete choice models (as discussed in Section 3.6) are included. I am mainly interested in the question if managers potentially anticipate tax changes and hence relocate before tax reforms take effect. For example, managers could in principle anticipate an increase in the tax rate due to proposals of the government to increase the tax rate some years later. Alternatively, managers might need some adjustment time such that we would mainly observe movements after tax reforms.

Figure 3.5 presents the results of the event study. The left-hand side panel depicts the results of a decrease in the $TITR_j$ on the probability to move. While I would expect a negative effect, I virtually do not find any significant effect at all, neither before nor after a reform. The same is true for the right-hand side panel where I would expect a positive effect in response to a tax increase. While I find some positive and statistically significant effects here, they are still vanishingly low. These effects are located in the period of the tax change and the second period after the tax change[16].

[16] Note that in the discrete choice models (discussed subsequently), I identify the effect that is located in the period of the tax change.

Figure 3.5: Event study



(a) Tax decrease (b) Tax increase

Notes: This graph depicts the results of the event study based on a linear probability model where I include dummies indicating a change in the $TITR_j$ in $t-2$, $t-1$, ... $t+3$ and the same country controls I use in the choice models. The gray area depicts the 95% confidence interval. The left-hand side shows the effect of a tax decrease in period 0 and the right-hand side of a tax increase in period 0 on the probability of managers to leave the country.

These results remain tiny and mostly insignificant if I require the tax change to exceed, among others, 1 or 5 percentage points to be counted as a reform, or if I adjust the number of time dummies e_m before and after the reform. If I consider the other tax rates (DTR_j, $CGTR_j$, ITR_j), the size of the estimated coefficients are of a negligible size or even statistically insignificant as well. These first results hint at a, at most, minor effect of tax changes on the location decision of managers.

While the event study provides first evidence on the effect of taxes on the location choice of firm managers, I will consider the effect in greater detail using discrete choice models. These methods are introduced an discussed in the following.

3.5 Discrete choice modeling

In order to model the discrete location choice of firm managers, I employ a model from the class of discrete choice models for the analysis. From this class of models, I choose the conditional logit model as the empirical workhorse. While the often used conditional logit model exhibits a high degree of numerical stability and is easy to implement, it heavily relies on the assumption of independence of irrelevant alternatives (IIA).[17] It is ex-ante uncertain if this assumption is fulfilled in this context. One way to test if the IIA assumption holds is to check if the taste for income taxes varies across individuals (Train, 2009). If the test suggests that the assumption of heterogeneity may be rejected, this will provide evidence in favor of the IIA. Since the mixed logit model allows for individual-specific parameters, I use the mixed logit model to test for the presence of heterogeneity.[18] As discussed later on, the results suggest no heterogeneity in the disutility of

[17] In short, it states that if a certain alternative is chosen among a set S of different alternatives, this alternative also has to be chosen in the set of alternatives A if A is a subset of S. In other words, if non-chosen alternatives are added or removed from the choice set, this may not change the choice decision of the individual (see, e.g., Ray, 1973; Wooldridge, 2010).

[18] E.g., Greene and Hensher (2003) provide a review of the mixed logit model.

taxes across managers. However, since the dataset is large, the computational requirements for the mixed logit model are immense. Therefore, I return to the much simpler conditional logit model to test further specifications since the mixed logit does not provide any further advantages over the conditional logit model in this context.

In the following, I discuss the general framework of choice modeling and introduce the conditional and the mixed logit model. This discussion is largely based on Train (2009). For convenience, I omit the time index t.

3.5.1 General framework

Assume manager i makes a choice y_i out of $j = 1, ..., J$ potential countries for a new country of residence, where each country $j = 1, ..., J$ generates (latent) utility U_{ij}. Following Equation (3.1) and the discussion in Section 3.2, I postulate that U_{ij} is influenced by observable country characteristics $\mathbf{X}_{ij}$ like income taxes, the distance between the current home country and the potential destination country to account for migration costs[19], and unobservables ϵ_{ij} in the following way:

$$U_{ij} = \beta_i' \mathbf{X}_{ij} + \epsilon_{ij}. \tag{3.3}$$

Per construction, ϵ_{ij} is unknown to the researcher, which is why it is considered as random with density function $f(\epsilon)$. I index β_i' by i to indicate that the parameters may vary across individuals i to reflect possible heterogeneity in the disutility of taxes.

Choice models assume utility-maximizing behavior as motivated by Thurstone (1927) and further developed by Marschak (1960). Utility may be denoted as $U_{ij} = V_{ij} + \epsilon_{ij}$ where U_{ij} denotes the true utility and $V_{ij} = V(\mathbf{X_{ij}})$ the part of utility that is observed. Again, assuming ϵ_{ij} as random since it

[19]Note that I use cultural as well as geographical distance measures in the estimations. Furthermore, I include a dummy which indicates the country where the manager currently resides.

is not observable[20], the probability of individual i to make a choice y_i for alternative j against any other alternative k is equal to:

$$
\begin{aligned}
P(y_i = j) &= P(U_{ij} > U_{ik} \;\; \forall k \neq j) = P(V_{ij} + \epsilon_{ij} > V_{ik} + \epsilon_{ik} \;\; \forall j \neq k) \\
&= P(\epsilon_{ik} - \epsilon_{ij} < V_{ij} - V_{ik} \;\; \forall j \neq k) \\
&= \int_{\epsilon} I\left[\epsilon_{ik} - \epsilon_{ij} < V_{ij} - V_{ik} \;\; \forall j \neq k\right] \; f(\epsilon_i) \; d\epsilon_i .
\end{aligned}
\tag{3.4}
$$

The function $h(\cdot)$ represents the behavioral process linking the choice y_i of individual i to $\mathbf{X}_{ij}$ and ϵ_{ij}: $y_i = h(\mathbf{X_{ij}}, \epsilon_{ij})$. Note that $h(\cdot)$ is deterministic since ϵ_{ij} incorporates all unknown factors influencing y_i. Then, using the indicator function $I(\cdot)$ being equal to one if the condition is true and treating ϵ_{ij} as random with density function $f(\epsilon_{ij})$ since it is unobserved, we may reformulate (3.4) as

$$
P(y_i = j|\mathbf{X_{ij}}) = P(I[h(\mathbf{X_{ij}}, \epsilon) = j] = 1) = \int I[h(\mathbf{X_{ij}}, \epsilon) = j] \; f(\epsilon) \; d\epsilon, \tag{3.5}
$$

where P is the probability of individual i to choose country $j = 1, ..., J$.

For the logit model, this expression can be represented as a closed form solution, which reduces the computational requirements significantly. However, for the mixed logit model, a *convenient error partitioning* is applied (Train, 1995). The idea is to split ϵ_i in two parts, ϵ_{i1} and ϵ_{i2}, such that a closed form expression of the integral exists for one part (denoted $g(\epsilon_1)$ in Equation (3.6)) with numerical methods only being necessary for the second part. This approach leads to more accuracy and reduces the need for computational power:

[20]Note that ϵ_{ij} is not determined ex ante. In fact, ϵ_{ij} could be seen as the residuum between the true utility U_{ij} and the utility V_{ij}, which is specified by the researcher. Hence, ϵ_{ij} itself is first determined when V_{ij} is specified.

$$P(y_i = j|\mathbf{X_{ij}}) = \int_{\epsilon_{i1}} \underbrace{\left[\int_{\epsilon_{i2}} I[h(\mathbf{X_{ij}}, \epsilon_{i1}, \epsilon_{i2}) = j] \; f(\epsilon_{i2}|\epsilon_{i1}) \; d\epsilon_{i2} \right]}_{g(\epsilon_{i1})} \; f(\epsilon_{i1}) \; d\epsilon_{i1}. \tag{3.6}$$

To be more specific, one part is assumed to be iid extreme value for all alternatives j. This assumption is not a constraint. Rather, it can be shown that any discrete choice model could be approximated by mixed logit. The mixed logit model is thus a fully general model. See Train (2009) for more details.

The choice decision of any individual will only depend on the ranking of the utility level of the different alternatives in this general choice framework. It would not influence the results of the estimation if a constant is added to all utility levels or if they are multiplied by a constant factor. Hence, identification will only be possible if one of the alternative-specific constants is set to a fixed number (usually zero). All other constants may therefore only be interpreted relatively to the fixed constant. To solve the identification issue concerning the scale of utility, the variance of the error term is normalized.[21]

3.5.2 The mixed logit model

In contrast to the standard logit model, the mixed logit model assumes individual-specific parameters. If we would observe $\boldsymbol{\beta_i}$, the (conditional) choice probability L_{ij} for country $j = 1, ..., J$ could be calculated using $U_{ij} = \boldsymbol{\beta}_i' \mathbf{X}_{ij} + \epsilon_{ij}$ with ϵ_{ij} following an iid extreme value distribution and the standard logit model where I condition on $\boldsymbol{\beta_i}$:

$$L_{ij}(\boldsymbol{\beta_i}) = \frac{e^{\boldsymbol{\beta}_i' \mathbf{X}_{ij}}}{\sum_j e^{\boldsymbol{\beta}_i' \mathbf{X}_{ij}}}. \tag{3.7}$$

However, the parameters $\boldsymbol{\beta_i}$ are unobserved in the mixed logit model.

[21] See Train (2009) for more details.

Hence, I express the probabilities using the *mixing* distribution $f(\boldsymbol{\beta_i})$[22] where I integrate over $\boldsymbol{\beta_i}$:

$$P_{ij} = \int (L_{ij}(\boldsymbol{\beta_i}))\ f(\boldsymbol{\beta_i})\ d\boldsymbol{\beta_i} = \int \left(\frac{e^{\boldsymbol{\beta}_i' \mathbf{X}_{ij}}}{\sum_j e^{\boldsymbol{\beta}_i' \mathbf{X}_{ij}}} \right) f(\boldsymbol{\beta_i})\ d\boldsymbol{\beta_i}. \tag{3.8}$$

Since I only observe the distribution of the parameters, this model is also known as the random coefficients model. Because I ex ante do not want to rule out negative or positive effects of the covariates, I assume $f(\boldsymbol{\beta_i})$ to follow a normal distribution with mean $\boldsymbol{a}$ and variance-covariance matrix $\boldsymbol{\Omega}$. $\boldsymbol{a}$ and $\boldsymbol{\Omega}$ are the parameters to be estimated later on.

As already indicated above, the mixed logit model may also be used for panel data, as it is the case in this paper. Considering the sequence of alternatives $\mathbf{j} = j_1, j_2, ..., j_T$ for T periods, it is straightforward to show that the probability of an individual i to choose a specific sequence of alternatives over time is just the product of all choice probabilities of each period. Hence, L_{ij} becomes:

$$\mathbf{L}_{ij} = \prod_{t=1}^{T} \left[\frac{e^{\boldsymbol{\beta}_i' \mathbf{X}_{ij_t t}}}{\sum_j e^{\boldsymbol{\beta}_i' \mathbf{X}_{ijt}}} \right]. \tag{3.9}$$

3.5.3 Implementation

The mixed logit model is solved with maximum simulated likelihood. A detailed description of this method is provided by Hayashi (2000), among others. The integrals in Equation (3.6) are solved by numerical simulations. Bhat (2001) has shown that so-called Halton sequences, which are distributed normally (not randomly, however), lead to better estimations in terms of speed of convergence, time consumption, accuracy and the number of draws needed, compared to Monte Carlo simulations. Therefore, Halton sequences

[22] A density function $f(\cdot)$ that weights other functions is called a mixing distribution.

were used for the estimation procedure here.

3.6 Results

This section presents the results of the choice models in the first part. This is followed by back-of-the-envelope calculations and the results of the robustness checks.

3.6.1 Results discrete choice models

The results of the mixed logit estimation are depicted in Table 3.6. As discussed above, I allow for individual-specific parameters of the $TITR_j$. The mean and standard deviation of the estimated normal distribution of the parameter of the $TITR_j$ are reported at the bottom of the table. As expected, I find a negative and highly significant effect of the $TITR_j$ on the probability of firm managers to locate in a specific country. However, looking at the estimated standard deviation, we see that it is very small relative to the mean value and, furthermore, it is highly insignificant.[23] This result suggests that the distribution of the tax parameter is almost degenerate and that all managers rather share a very similar distaste for taxes. As argued above, this provides evidence in favor of the IIA. Therefore, I resort to the much simpler conditional logit model in the next specifications where I compare the effect of the different income taxes since there is no additional advantage of the mixed logit model over the conditional logit model in this context.

I report the results of the conditional logit model estimations with the different tax rates in Table 3.7. All income taxes exhibit negative effects on the location probability of firm managers. This effect is highly significant for the $TITR_j$, $CGTR_j$, and RTR_j but insignificant for the DTR_j and ITR_j. The result of the $TITR_j$ implies an elasticity of about 0.1 for an average country with a $TITR$ of 30%. Hence, if countries increase taxes on earned

[23]Note that, due to technical reasons, the standard deviation is reported to be negative. However, the sign should be assumed to be positive when interpreting this parameter.

Table 3.6: Results mixed logit

$lGDP_j$	0.573***	$HOMENAT_{ij}$	1.657***
	(0.017)		(0.030)
$lGDPPC_j$	0.247***	$HOME_{ij}$	5.177***
	(0.063)		(0.069)
$GROWTH_j$	-0.030	$TAXWW_j$	-1.052***
	(0.020)		(0.144)
$HOMENAT_{ij}$	1.657***	$CORRUPT_j$	-0.005*
	(0.048)		(0.003)
$AVGINC_{jk}$	-0.000***	$PROPERTY_j$	0.014***
	(0.000)		(0.004)
$CONT_{jk}$	-0.372***	$INVEST_j$	0.010***
	(0.079)		(0.002)
$LANG_{jk}$	0.806***	$FINANCE_j$	0.015***
	(0.065)		(0.002)
$COLONY_{jk}$	0.733***		
	(0.063)		
	Mean		*Standard deviation*
$TITR_j$	-1.015***		-0.005
	(0.237)		(0.335)
Obs.	3,974,608		

Notes: Table 3.6 gives the results of the mixed logit specification where I estimate the probability to choose a country with different controls and the tax variable $TITR_j$. I allow for individual-specific heterogeneity of the tax parameter. The estimation is based on the Newton-Raphson optimization procedure, and 500 Halton draws. Standard errors in parenthesis.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3.7: Results conditional logit

	(1) $TITR_j$	**(2)** DTR_j	**(3)** $CGTR_j$	**(4)** ITR_j	**(5)** RTR_j
TAX	-0.613***	-0.067	-0.414***	-0.085	-0.947***
	(0.238)	(0.175)	(0.148)	(0.196)	(0.153)
$lGDP_j$	0.421***	0.414***	0.433***	0.418***	0.480***
	(0.0191)	(0.019)	(0.020)	(0.021)	(0.022)
$lGDPPC_j$	0.680***	0.692***	0.681***	0.694***	0.756***
	(0.067)	(0.068)	(0.068)	(0.068)	(0.068)
$GROWTH_j$	-0.042**	-0.034*	-0.038*	-0.033*	-0.024
	(0.020)	(0.020)	(0.0120)	(0.020)	(0.020)
$AVGINC_j$	0.000*	0.000**	0.000**	0.000**	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$HOME_{ij}$	5.484***	5.495***	5.503***	5.497***	5.473***
	(0.073)	(0.073)	(0.072)	(0.072)	(0.073)
$HOMENAT_{ij}$	1.598***	1.591***	1.596***	1.592***	1.608***
	(0.048)	(0.048)	(0.048)	(0.048)	(0.048)
$CONT_{jk}$	-0.124	-0.116	-0.110	-0.114	-0.132*
	(0.080)	(0.080)	(0.080)	(0.079)	(0.079)
$LANG_{jk}$	0.771***	0.770***	0.764***	0.770***	0.786***
	(0.064)	(0.064)	(0.064)	(0.064)	(0.064)
$COLONY_{jk}$	0.625***	0.620***	0.621***	0.620***	0.619***
	(0.062)	(0.062)	(0.062)	(0.062)	(0.0620)
$lDIST_{jk}$	-0.554***	-0.547***	-0.544***	-0.546***	-0.557***
	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)
$ASSET_j$	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$TAXWW_j$	-0.956***	-0.825***	-0.881***	-0.830***	-1.076***
	(0.138)	(0.135)	(0.128)	(0.137)	(0.133)
$CORRUPT_j$	-0.016***	-0.017***	-0.018***	-0.017***	-0.016***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
$PROPERTY_j$	0.022***	0.023***	0.024***	0.023***	0.024***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
$INVEST_j$	-0.003	-0.005**	-0.005**	-0.005**	-0.005***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
$FINANCE_j$	0.009***	0.009***	0.009***	0.009***	0.009***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Obs.	3,917,434	3,917,434	3,917,434	3,917,434	3,917,434
Pseudo R^2	0.9672	0.9672	0.9672	0.9672	0.9673

Notes: Table 3.7 gives the results of the conditional logit specification where I estimate the probability to choose a country with different controls and the tax variables $TITR_j$, DTR_j, $CGTR_j$, ITR_j, RTR_j. Standard errors in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Note that the number of observations is significantly larger than the number of managers as each alternative in the choice set in the data constitutes an observation.

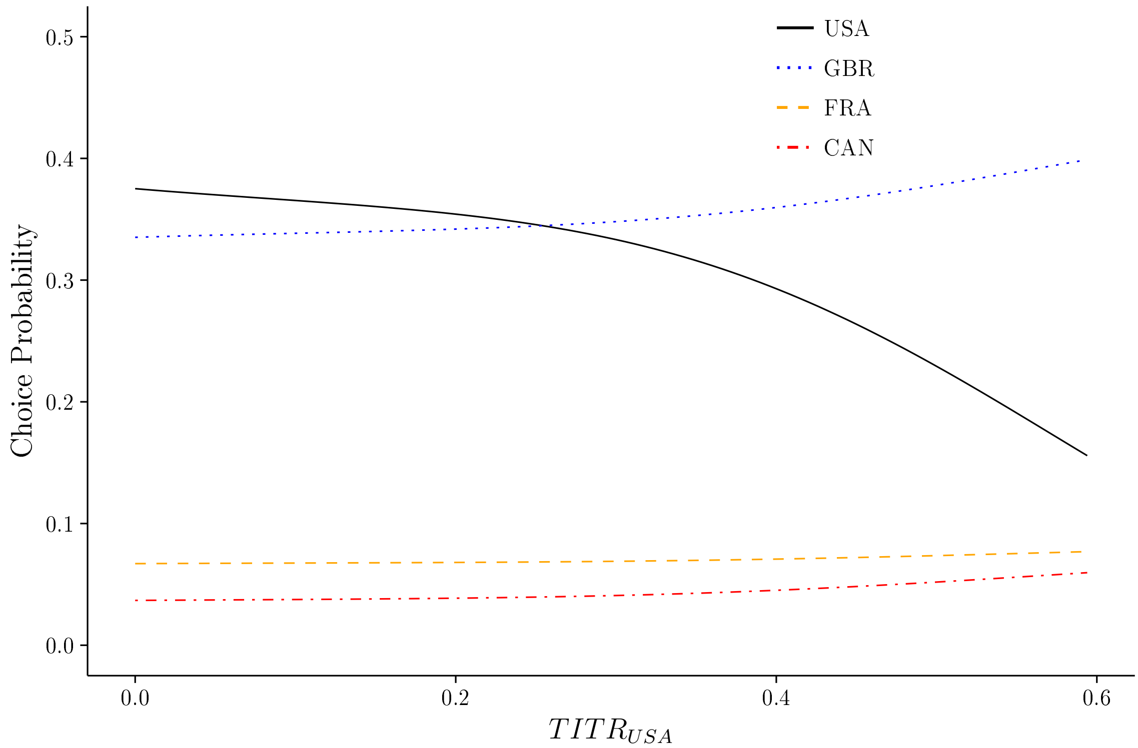
and royalty income, as well as on capital gains, the probability of managers to locate there decreases. As it may be expected, larger $lGDP_j$ and $lGDPPC_j$ increase the location probability, while the effect of $GROWTH_j$ is small and barely significant (it is negative, though). The estimates of $HOME_{ij}$ are significantly positive which suggests that managers prefer to stay in the country where they already lived in the period before, i.e., that managers are not perfectly mobile and experience relocation costs. Similarly, the results of $HOMENAT_{ij}$ show that managers prefer their country of nationality over other countries, ceteris paribus. The effect of the $AVGINV_j$ is very small and barely significant. There is no significant effect on the location probability if a country shares a common border with the country where the manager resides hitherto. In contrast, similar languages or a common colonial history have positive and significant effects on the probability of managers to immigrate. Sensibly, a larger distance between countries reduces significantly the probability to relocate.

3.6.2 Back-of-the-envelop calculations

So far, I have investigated how higher taxes influence the probability of firm managers to locate in a country. The results suggest that the effect is significantly negative. However, since the combined choice probabilities of all countries have to add up to 100%, a tax-induced change in the choice probability of one country immediately affects the choice probability of the other countries. The purpose of this section is to examine how a tax change in one country changes the choice probabilities of the other countries.

Using the estimated results above, I calculate the probability that a firm manager locates in the US for different tax rates between 0% and 60%. The results are shown in Figure 3.6. If the $TITR_j$ is increased from 0% to 60%, the probability for firm managers to locate in the US more then halves. However, this effect is not linear. Rather, there is only a very small effect at lower tax rates while the effect becomes steeper for tax rates above 35%. Starting at 35%, an increase in the tax rate by 20 percentage points reduces the location choice probability by about 16 percentage points[24]. This pattern suggests that managers value non-tax characteristics of the US which are only offset if taxes are very high.

Figure 3.6: US tax rates and managers' location choice



Notes: The graph depicts the choice probability of a firm manager to either choose the US (USA), the UK (GBR), France (FRA) or Canada (CAN) for different levels of US income tax rates.

Furthermore, I do not only calculate the changes in the location probability of the US for the different US tax rates, but also for Canada, France, and the UK (leaving the tax rates unchanged in these countries). The simulation shows that the UK is the largest beneficiary of a larger US tax, even larger than Canada (in absolute terms, the increase is similar in relative terms). For France, there are virtually no changes. From this follows that a tax change in one country affects the other countries very differentially. Consistent with our results above we see that cultural similarity is important, which is the

[24]Recall that these numbers are based on rough back-of-the-envelope calculations only.

case for the economies of the UK and the US. Furthermore, geographic distance is also important as the case of Canada shows. France, which is not very close to the US in geographical and cultural terms, is barely affected.

3.6.3 Robustness checks

This section provides some robustness checks; the results are presented in Table 3.8. In a first step, I restrict the analysis to firm managers that are employed at large firms in terms of market capitalization (market capitalization larger than USD 100 million, column (1)) or revenue (revenue larger than USD 50 million, column (2)). While the effect of the $TITR_j$ remains negative, it is now insignificant. As discussed above, firms are expected to bear a large part of the economic tax burden. Since larger firms might be in a more intense competition for firm managers because they demand higher skill levels and compete to a higher degree for managers in an international context, these firms might be willing to bear a larger share of the tax burden. Hence, I expect managers in these firms to care even less for income taxes, which is in line with what the results suggest.

In column (3), I include the $TITR_j$ and the DTR_j simultaneously. Here, only the $TITR_j$ is significant which suggests that the tax rate on earned income is more important compared to the tax on dividend income. Because I have shown above that managers earn a substantive share of their total income with equity-based compensation, this might be puzzling. However, if managers retain their dividend payments for reinvestment, under certain conditions, their income may subsequently be taxes with the $CGTR_j$. Since this tax usually is lower than the DTR_j, firm managers might be more sensitive to the $CGTR_j$. Column (4) explores this by including both taxes (i.e., the $CGTR_j$ and the DTR_j). Consistently, the coefficient of the $CGTR_j$ is much more negative (and highly significant) compared to the DTR_j. Note that in a specification where the $TITR_j$ and the $CGTR_j$ are included jointly, both tax rates are significantly negative.

As discussed in Section 3.2, I do not expect the tax rate which applies to

Table 3.8: Results robustness checks

	(1)	(2)	(3)	(4)	(5)
$TITR_j$	-0.333	-0.240	-0.707***		
	(0.265)	(0.269)	(0.264)		
DTR_j			0.160	-0.090	
			(0.195)	(0.175)	
$CGTR_j$				-0.418***	
				(0.148)	
$AITR_j$					0.295
					(0.261)
$lGDP_j$	0.428***	0.419***	0.424***	0.433***	0.407***
	(0.022)	(0.023)	(0.020)	(0.020)	(0.020)
$lGDPPC_j$	0.848***	0.940***	0.688***	0.675***	0.691***
	(0.079)	(0.081)	(0.068)	(0.069)	(0.068)
$GROWTH_j$	-0.056**	-0.049**	-0.040*	-0.041**	-0.030
	(0.022)	(0.023)	(0.021)	(0.020)	(0.020)
$AVGINC_j$	0.001***	0.001***	0.001*	0.001**	0.001**
	(0.0000)	(0.000)	(0.000)	(0.000)	(0.000)
$HOME_{ij}$	5.104***	5.210***	5.487***	5.499***	5.499***
	(0.086)	(0.088)	(0.073)	(0.073)	(0.072)
$HOMENAT_{ij}$	1.663***	1.663***	1.600***	1.596***	1.588***
	(0.053)	(0.054)	(0.048)	(0.048)	(0.048)
$CONT_{jk}$	-0.354***	-0.310sym***	-0.118	-0.114	-0.113
	(0.092)	(0.094)	(0.080)	(0.080)	(0.079)
$LANG_{jk}$	0.851***	0.853***	0.770***	0.765***	0.768***
	(0.073)	(0.074)	(0.064)	(0.064)	(0.064)
$COLONY_{jk}$	0.541***	0.577***	0.626***	0.621***	0.618***
	(0.072)	(0.073)	(0.062)	(0.062)	(0.062)
$lDIST_{jk}$	-0.671***	-0.624***	-0.553***	-0.545***	-0.544***
	(0.038)	(0.038)	(0.031)	(0.031)	(0.031)
$ASSET_j$	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$TAXWW_j$	-1.119***	-1.316***	-0.935***	-0.907***	-0.758***
	(0.182)	(0.187)	(0.140)	(0.138)	(0.133)
$CORRUPT_j$	-0.015***	-0.013***	-0.015***	-0.018***	-0.017***
	(0.004)	(0.004	(0.003)	(0.003)	(0.003)
$PROPERTY_j$	0.019***	0.017***	0.021***	0.025***	0.022***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
$INVEST_j$	-0.008***	-0.007***	-0.003	-0.005**	-0.005**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
$FINANCE_j$	0.008***	0.004	0.009***	0.009***	0.010***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
Obs.	2,803,341	2,741,338	3,917,434	3,917,434	3,917,434
Pseudo R^2	0.9653	0.9654	0.9672	0.9672	0.9672

Notes: Table 3.8 provides the results of the different robustness checks. (1) only includes firms with a market capitalization larger than USD 100 million, (2) only firms with revenues of at least USD 50 million. (3) - (5) include alternative specifications with respect to the tax rates: $TITR_j$ and DTR_j, DTR_j and $CGTR_j$ as well as the $AITR_j$. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

incomes below the $TITRB_j$ to play a significant role for top income earners (i.e., no effect of the progressivity of the tax schedule). I test this presumption by including the average income tax rate below the $TITRB_j$ ($AITR_j$).[25] Column (5) provides the results. They suggest that the $AITR_j$ does not play a significant role in the location decision of firm managers. As the $TITR_j$ in most cases already steps in for incomes at intermediate levels, it is not surprising to find insignificant results for the $AITR_j$ when we look at top income earners, as it reflects characteristics of the lower part of the tax schedule.

3.7 Conclusion

This study analyzes how income taxes influence the location decision of top income earners and may be summarized as follows: First, the analysis is based on panel data that includes firm managers and different income tax rates for a wide range of different countries. The data shows that firm managers easily belong to the group of top income earners, not only due to their large earned incomes, but also because they generate large amounts of capital incomes.

Second, based on summary statistics and different estimation methods, I find that there is indeed a negative effect of taxes on the probability of firm managers to choose a specific country. I do not only observe vibrant migration flows between high and low-tax countries, but I do also find negative and significant tax effects using different discrete choice models. This effect is not only negative for earned income taxes but also for different capital income taxes. Furthermore, the results suggest that all firm managers share the same degree of distaste for higher income taxes.

Third, I show through back-of-the-envelope calculations that an increase in the US income tax would benefit culturally similar or nearby countries significantly in terms of an increased location choice probability of firm man-

[25] As already discussed, I calculate the tax rate which applies exactly at the point where the top income tax rate ($TITR_j$) steps in, i.e., I calculate the tax rate at the point $TITRB_j$.

agers.

Three important implications follow directly from these results. Proposals to raise top income taxes to reduce income inequality are often dismissed on the grounds that this would lead to an increase in the emigration rate of top income earners. As they contribute a large share of total tax revenue, higher taxes could in effect lead to a decrease in transfers available for lower income earners. While the results of this study support the hypothesis of a negative effect of higher taxes on the location choice probability, they also suggest that this effect is relatively small, though (at least for intermediate tax changes where the elasticity equals about 0.1). Therewith, this study sheds more light on the potential cost a government has to bear if it decides to counteract income inequality by an increase in income taxes.

Moreover, the results show that capital income taxes indeed determine the location choice of firm managers significantly. While the debate has so far mainly been centered around taxes on earned income, this study underlines that all income taxes should be looked at if top income earners are considered.

Finally, the findings suggest that countries compete for top income earners since firm managers are sensitive to changes in the tax rates. Indeed, several countries have already implemented advantageous tax legislation which aims at attracting foreign high-skilled workers. These include tax allowances or relatively low flat taxes. As income taxes constitute the most important source of tax revenue, countries could prevent this tax competition induced reduction in top income taxes by starting to agree upon minimum standards concerning income taxation. While there have been many efforts to implement minimum standards in the context of corporate taxation (e.g., the BEPS initiative of the OECD), this has been mostly neglected in the case of income taxes until today.

However, there are several limitations of this study which could be improved by future research. Obviously, the group of top income earners does not only consist of firm managers. Assembling data on other groups would undoubtedly increase our understanding of the behavior of top income earners altogether.

Also, information on the location of the wealth of top income earners would be advantageous. If the residence of the top income earner and the country where the top income earner's wealth is located are in different countries, this could be easily exploited to reduce income taxes by means of countries like Malta where corresponding loopholes exist in the tax legislation. As this could pose a threat to the identification strategy of this paper, gaining more insights on this issue would constitute a large benefit.

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Appendix: Notes income tax data

General remarks

This chapter summarizes the most important country-specific assumptions that underlie the income tax dataset which is discussed in Chapter 1 and used throughout this dissertation. In most cases, these assumptions were made since some countries apply separate tax legislation for different groups of taxpayers. While this description is non-exhaustive, it summarizes the most important assumptions and adjustments that were made while collecting the income tax data.

Examples in these notes are based on numbers from 2015 if not indicated differently. Note also that these notes do not include all countries covered in the dataset but only countries where additional remarks are necessary.

The *EY Worldwide Personal Tax and Immigration Guides* were used as the main source for the tax data (e.g., EY, 2016). For some countries, further sources were used in addition. In these cases, this is indicated below.

In a small number of countries, social security contributions were charged at a fixed amount. To make this contribution fit into the dataset, it was transformed into a relative contribution of 10% by introducing an artificial upper limit for social security payments. Hence, an income below this artificial threshold does not mean that social security contributions are lower. However, since the dataset is focused on top income earners and the artificial upper limits are very small relative to the country-specific average incomes, this approach should not lead to a bias of the estimates.

Afghanistan

In Afghanistan, there are several possibilities to tax business income. We included the so-called business income tax rate.

Belarus

To determine the upper bound of social security contributions in terms of the local currency, tables provided by the National Bank of Belarus were used for the calculations (National Bank of the Republic of Belarus, 2016).

Belgium

Note that if capital gains accrue from speculative behavior, the tax rate might be larger. In line with the procedure for other countries, we included the highest municipality tax of 9%.

Bermuda

The payroll tax is entirely levied on the employer. However, the employer may shift some of the tax burdens to the employee (up to 5.5%).

Botswana

If capital gains are realized within Botswana, one should take into account that a general capital transfer tax applies in addition to the regular taxes included in the dataset. Since this transfer tax has only been used in very few cases, this additional tax rate was not included in the dataset.

British Virgin Island

Employers may shift up to 8% of payroll taxes to their employees.

Cameroon

Cameroon levies a 10% council surtax on the rates of the general taxation, which is accounted for in the data.

Canada

Income taxation in Canada varies widely from state to state. This feature is incorporated into the dataset by calculating the average marginal top income tax of the different states. This rate was then added to the tax rate that is levied on the federal level.

Only half of the capital gains are taxed, the tax rate is equal to the tax rate of the individual income tax bracket. For this dataset, the capital gains tax is calculated as 50% of the top income tax rate.

China

The upper threshold of earned income which is subject to social security contributions is calculated as three times the average income of the city where the individual lives. As the city-specific limits differ to a very large extent, the upper limit of the earned income tax rate was used here for the sake of convenience.

Congo D.R.

The Democratic Republic of Congo levies a progressive earned income tax with a top tax rate equal to 40%. However, the tax law also stipulates that the maximum tax liability may not exceed 30%. Since the average tax rate equals 30% exactly at the point where the top marginal tax rate steps in, the 40% top rate is in effect irrelevant. Therefore, the dataset indicates that the average tax rate below the threshold of the top tax rate equals the top tax rate.

Côte d'Ivoire

Employment and business income is subject to a proportional tax and general tax. These tax rates were calculated as follows: $\textit{proportional tax rate} * 0,8 + (1 - 0,2 * 0,8) * \textit{general tax rate}$, which takes into account that only 80% of income is subject to proportional tax and that only net income is subject to the general tax.

Croatia

Municipalities in Croatia may impose surtaxes on the income tax. The highest surtax is imposed in Zagreb (18% in 2015). In line with the procedure for most of the other countries with similar municipal surtaxes, we used this tax rate.

Curaçao

Additionally to the EY reports, information was taken from Steevensz and Beckers (2015).

Czech Republic

The earned income tax rate for the years 2012 to 2015 includes a solidarity surcharge equal to 7% for individuals earning 48 times the Czech average annual income of the country.

Cyprus

The defense tax on interest and dividend income was taken into account when computing the tax rates.

Denmark

In Denmark, municipalities may levy surcharges on earned income taxes which is why the actual total tax rate in a certain municipality may differ from the rate indicated in the dataset. The labor market tax, which was introduced in the year 2012, is included in the tax rate.

For low income earners, the dividend tax rate may differ. However, since we are looking at top income earners, the top dividend tax rate was chosen.

Dominican Republic

Additionally to the EY reports, information was taken from Deloitte (2016a).

Ecuador

Additionally to the EY reports, information was taken from Deloitte (2016b).

El Salvador

Although the nominal top marginal tax rate is higher, the tax law also stipulates for the years 2006 to 2011 that the effective tax rate may not exceed 25% of taxable income. Therefore, the dataset indicates that the top marginal tax rate equals 25%.

Equatorial Guinea

Since taxes on capital incomes are not enforced, they are assumed to be 0% in the dataset.

Estonia

It is assumed that interest income is received from credit institutions that are resident within the EU. In this case, the tax rate on interest income is equal to 0%. This is also the tax rate which is included in the dataset.

Finland

Finnish municipalities are authorized to levy a tax surcharge. In line with the procedure in other countries, the highest local tax rate was used.

France

In France, social security contributions are calculated in a very complicated manner and depend heavily on tax payer's characteristics. Therefore, the numbers in the dataset should only be used with caution.

Georgia

Additionally to the EY reports, information was taken from Deloitte (2016c).

Gibraltar

Gibraltar imposes income taxes via different tax systems for which individuals may apply. Besides the standard tax scheme for employed residents, there are other tax schemes which aim at attracting top income earners from abroad.

Broadly speaking, foreign top earners may qualify for very low tax rates if a large share of their income is generated abroad, if they do not need any funding by the government, or if the income generated abroad is very high. There are different special tax schemes for top income earners. For this dataset, the GIB tax system, which is also applied to ordinary residents, was used.

Greece

The upper limit for the social security contribution in Greece is considerably lower if the first contribution was paid before 1993. For the dataset, we assumed that this is the case.

Guatemala

There exist different taxation schemes in Guatemala for business income and income from self-employment. The Regime on Profits from Business achievements was chosen since it allows for a broader range of deductions.

Furthermore, we included the optional tax regime on capital gains in the dataset.

Hong Kong

A flat income tax of 15% is included in the dataset for the earned income tax rate even though a progressive tax schedule exists as well. However, the tax authorities apply the tax rule which results in the lower tax liability. Since the flat tax is equal to 15% and the top tax rate for the progressive tax schedule amounts to 17%, top income earners will opt for the flat tax rate.

Hungary

The capital gains tax was calculated assuming "income from regulated capital market transactions".

Iceland

Municipalities in Iceland may levy a surtax. In line with the procedure for other countries, the surtax of the municipality with the highest surtax was applied.

India

Although there are mandatory social security contributions in India for some years, they are indicated as being equal to 0% in the dataset since they are voluntary for top income earners.

Iraq

In Iraq, the levy on capital gains varies widely and depends on the circumstances of the achieved gains. For this dataset, the capital gains tax accruing from trading activities was applied.

Furthermore, it should be noted that social security contributions are different in the oil and gas industry. However, this does not influence the portion of the contribution levied on employees, only the portion of the employers.

Most of the tax information provided in the context of Iraq does not apply for the autonomous region of Iraqi Kurdistan. Therefore, this dataset should not be used for this area.

Ireland

In Ireland, different tax schemes may be considered. Here, the most common system was applied. Broadly speaking, the other tax systems are mainly in place to attract foreign skilled workers and provide with temporary tax reliefs only.

Isle of Man

Here, the tax cap system was applied to the dataset. In 2007, a cap on total tax payments was introduced. This is why capital income tax rates are indicated to be 0% and the corresponding dummy variable, which indicates whether taxation is limited to domestic income, is one. While the tax rate is technically not 0%, we assume that the individual earns sufficient income such that he neglects the small part of the income that is below the cap and thus taxed.

Italy

Since it is not included in the dataset, it should be noted here that there is an additional 10% tax levy on income from variable remuneration in the financial sector.

Also, there are different surtaxes between the different municipalities. In line with the procedure in other countries, the highest rate was included in the dataset.

This dataset does not include the IRAP tax, which is a regional tax on productive activities and concerns primarily the taxation of business income.

Jamaica

The contributions to the National Housing Trust and the Education tax are included in the earned income tax. In 2015, these contributions amounted to 4,25%.

Latvia

For the years 2006 to 2009, it was assumed that dividend and interest income was received from countries within the EEA/EU area.

Lebanon

The top marginal business income tax rate is included, although the tax schedule is progressive for low business income.

Libya

Since 2011, the political situation is very volatile in Libya, as different regional governments are fighting for nationwide leadership. Therefore, it is not always clear which individuals abide by the rule of which government. Hence, the information regarding Libya in this dataset should be used with caution.

The jihad-tax was included in the tax calculations.

Liechtenstein

Wealth tax is taxed by including 4% of an individual's wealth to the taxable income, representing notional income. Hence, the net wealth tax was calculated as 4% of the income tax rates.

Income tax rates were calculated under the assumption of a municipality surtax of 200%.

Additionally to the EY reports, information was taken from Baker Tilly International (2015), PriceWaterhouseCoopers (2016a), World.Tax (2016a) and Deloitte (2016d).

Lithuania

Regarding the taxation of business income, we assume that the individual elects to be taxed on gross income.

Luxembourg

The capital gains tax rate applicable to gains realized from assets that were held at least for six months was included. Capital gains from assets that are owned for a shorter time would be included in the amount that is taxed according to the earned income tax rates.

Macao

A one-time tax relief was provided in Macao in 2015, which has been accounted for in the dataset.

Additionally to the EY reports, information was taken from PriceWaterhouseCoopers (2016b).

Madagascar

Additionally to the EY reports, information was taken from Musviba (2015).

Malaysia

Additionally to the EY reports, information was taken from Angloinfo (2016), The Commissioner of Law Revision (2006) and PriceWaterhouseCoopers (2016c).

Malta

Additionally to the EY reports, information was taken from Deloitte (2014).

Morocco

Additionally to the EY reports, information was taken from PKF (2013) and Trading Economics (2016).

Netherlands

It should be pointed out that there was a one-time capital income rebate of 3 percentage points in 2014 if capital income was low. However, the rebate is not included since this dataset focuses on individuals with high income.

Netherlands Antilles

Each island within the group was able to choose specific surtaxes. In line with the procedure in other countries, the surtax for Curaçao is included since it levies the highest surcharge.

Additionally to the EY reports, information was taken from PKF (2010).

Nigeria

In Nigeria, foreign capital income is free from taxation if it is repatriated via authorized banks. This is the case which was considered here. In any other case, a tax of 10% is levied on this income.

Furthermore, the mandatory contributions to the National Housing Fund (levied in 2013 the first time) were included in the income tax rate.

Norway

Additionally to the EY reports, information was taken from KPMG (2015a).

Pakistan

In 2015, a super tax was imposed on high earners which is accounted for in this dataset.

Muslim inhabitants of Pakistan have to pay a special wealth tax on certain goods. Since this only applies to Muslim inhabitants and is limited to a very restricted range of goods, it was excluded from the dataset.

Panama

The education tax that is imposed in Panama is included in the tax rates in the dataset.

Paraguay

Additionally to the EY reports, information was taken from PriceWaterhouseCoopers (2016d).

Peru

We assume that the individual elects to contribute to the government-sponsored Pension fund ONP instead of contributing to the private pension fund.

Poland

Additionally to the EY reports, information was taken from EURES Polska (2011).

Russia

The tax rate on interest earnings is zero as indicated by the dataset, but only if returns are not too high. The upper limit for the return is defined as the refinancing rate of the central bank plus 5 percentage points if the deposits are in ruble or plus 9 percentage points if they are denoted in another currency.

Seychelles

Additionally to the EY reports, information was taken from World.Tax (2016b).

Slovak Republic

Additionally to the EY reports, information was taken from KPMG (2016a), PriceWaterhouseCoopers (2016e) and OECD (2013). Also, data was used from OECD (2016a), a discussion of the data may be found in OECD (2016b).

South Africa

In 2015, South Africa taxed capital gains at the usual income tax rates. Since only 33% of the profit is regarded as the tax base, the top income tax rate was multiplied by 0.33 before it was included in the dataset.

Spain

The tax rates in some autonomous regions may differ from the ones included in the dataset.

Additionally to the EY reports, information was taken from EY (2014).

Swaziland

Additionally to the EY reports, information was taken from KPMG (2014).

Sweden

In Sweden, municipalities and regions may impose additional surtaxes. In line with the procedure in other countries, the highest tax rates were chosen and added to the income tax rate.

Additionally to the EY reports, information was taken from The Swedish Trade and Invest Council (2016).

Switzerland

In Switzerland, tax rates vary between regions and also between municipalities. Therefore, the tax rates for earned income and wealth taxation was used that applied to individuals living in Zurich. This is also one of the places in Switzerland where income is taxed at the highest level.

Tanzania

The tax rates for mainland Tanzania were used for the dataset. However, it should be noted that the progression of the income tax rates differs for the island of Zanzibar (the total tax levy increases slightly).

We assume that the individual works in the private sector in 2008 while determining social security contributions.

Additionally to the EY reports, information was taken from KPMG (2012).

Thailand

Thai tax authorities are empowered by law to adjust the income tax rate for individuals possessing a high net wealth by a rate that is considered fair by the local authorities themselves. However, in practice, this instrument is rarely used. Therefore, it is not accounted for in the dataset.

Due to the massive flooding in 2012, the social security contributions in Thailand were reduced to 3% in the first six months of that year and raised to 4% in the subsequent months. For the calculation, the average of 3.5% was used.

Trinidad and Tobago

Additionally to the EY reports, information was taken from Government of the Republik of Trinidad and Tobago (2016) and PriceWaterhouseCoopers (2016f).

Tunisia

Additionally to the EY reports, information was taken from KPMG (2016b).

Turkmenistan

The city maintenance tax (TMT 2 per month) was included in the calculations of the income tax rate.

Additionally to the EY reports, information was taken from Deloitte (2016e).

United States of America

In the US, there are different taxation schemes for dividends. Here, the tax rates for dividends accruing from shares held at least for 60 days in a 120 day period (beginning 120 days before the ex-dividend date) were considered.

No net wealth tax was included. However, it should be noted that some states and municipalities impose such a taxation scheme.

In the US, there are different local surtaxes on the federal tax rate. For this dataset, the average of the various state surtaxes and a 1% municipality surtax were applied. This approach is not in line with the procedure for other countries in this dataset, as we usually applied the highest surtax. However, we use this procedure for the US since the surtax varies strongly.

Uruguay

Note that foreign income like capital gains are taxable from 2011 onwards.

Additionally to the EY reports, information was taken from KPMG (2015b).

Uzbekistan

Additionally to the EY reports, information was taken from Deloitte (2016f).

Zimbabwe

The capital gains tax included in the dataset (2.5%) accounts for the inflation allowance.

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