Avoidance, Evasion, and Non-Filing – Three Essays on Behavioral Responses to Taxation

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Preface

In times of severe economic crises, firms and individuals rely on governments for help. Throughout the last fifteen years, the world has seen two crises of such scope. Following the financial crisis of 2007/2008, governments bailed out troubled banks to mitigate the spread of adverse effects to the real economy. Likewise, in 2020, governments were fast to set up relief programs for troubled firms and individuals following the SARS-CoV-2 virus containment measures. This governmental assistance, mostly provided through direct monetary transfers, is being funded by tax revenue. Either there are funds readily available or governments issue bonds to implicitly borrow against future tax revenue.

Even absent such dire circumstances, taxes play an important role in today's economies. Since the year 2000, the average tax-to-GDP ratio in OECD countries has remained fairly stable while ranging between 32% and 34% (OECD 2020). Also in non-OECD countries, taxes play a substantial role. As of 2015, the average tax-to-GDP ratio across a sample of 16 African countries was 19.1%, while 25 Latin American and Caribbean countries experienced an average ratio of 23.1% (Modica et al. 2018).

When governments or policymakers decide to levy a tax, they mainly do so for three reasons. First, tax revenues finance governmental expenditures. Besides mitigating adverse crisis effects, the tax revenue collected enables governments to perform their core duties such as maintaining and enhancing infrastructure or providing public education. Second, taxes on income and wealth are the main tools to redistribute from rich to poor taxpayers. In recent years, the debate about marginal and average tax rates, especially for the top 1%, has renewed the interest in taxation as a tool to reduce inequality (e.g. Saez and Zucman 2019b). Third, taxes are levied to correct for market failure induced by externalities. Carbon emission taxes, as discussed in "Green New Deal" policy proposals in the United States and Europe, are prime examples for such interventions.

While some taxes, like those on carbon dioxide emissions, are designed in a way that taxpayers' behavioral responses to them are desired, this is not universally true. Nonetheless, taxes change taxpayers' incentives and, thus, affect their economic choices.

For example, when the infamous window tax was introduced by King William III in 17^{th} century England, tenants, who faced the legal burden of the tax, simply avoided tax payments by bricking up windows (Oates and Schwab 2015). Even today, English houses are still sprinkled with bricked up windows, highlighting the long-lasting excess burden that this particular tax, and responses to it, have had.

While avoiding taxes is considered the legal way of reducing the tax liability, taxpayers might also respond to taxation by outright evasion. For example, to escape tax payments on income and wealth, various citizens from developed countries (Alstadsæter et al. 2019) and developing countries (Londoño-Velez and Ávila-Mahecha 2020) alike hide parts of their resources in offshore financial centers without reporting it to the respective tax authorities.

Similarly, taxpayers might also decide not to file a tax return, thereby averting the interaction with the formal tax system. While this is a concern in many developing countries (see e.g. Figure 1 in Brockmeyer et al. 2019), recent evidence suggests that this is also a sizeable issue in developed countries. For example, estimates suggest that about 48% of taxpayers required to file a city tax return in Detroit did not do so (Meiselman 2018).

These three behavioral responses to taxation – avoidance, evasion, and non-filing – are at the core of this dissertation. Chapter 1 adds to the theoretical literature on multinational firms' tax avoidance and the measures taken by high-tax countries to limit profit shifting. Specifically, this chapter discusses the implications of introducing countermeasures by tax havens that limit the effectiveness of anti profit shifting policies. Chapter 2 contributes to the large literature on policy interventions to limit tax evasion. By empirically evaluating the recent tool of enforcement focus lists, insights on the usability and the optimal design thereof can be drawn. Chapter 3 examines an optional filing system that offers taxpayers a legal way to abstain from filing an income tax return. In this chapter, the consequences of this system for the distribution of non-filers and for effective taxation are presented. Additionally, two reforms of the optional filing system are discussed that highlight potential gains for equity or efficiency. All three chapters are based on individual essays and can therefore be read independently. Chapter 1 is theoretical work, while chapters 2 and 3 use micro

data on German taxpayers. In the following, I provide a brief overview of the relevant literature that each chapter adds to before giving the most important results.

Chapter 1 adds to the ongoing discussion about multinational firms' tax avoidance and the countermeasures used by high-tax countries to limit profit shifting. In contrast to purely domestic firms, multinationals benefit from being located in multiple jurisdictions. For instance, highly profitable intellectual property can be located in a country with lower tax rates or prices for intra-firm trades can be adjusted such that less profit arises in high-tax countries. Recent research suggests that tax havens play a particularly large role in multinationals' potential to avoid tax payments in high tax countries (Tørsløv et al. 2018).

Both researchers and policymakers have been aware of tax havens' role for at least two decades. In 1998, the OECD published a report on *Harmful Tax Competition* (OECD 1998), which propelled the use of a number instruments, such as tax information exchange agreements and blacklists, which are intended to limit the tax haven business model. However, these tools seem to be rather ineffective. For example, when the European Union's list of non-cooperative tax jurisdictions was first published in 2017, a number of countries that were expected to end up on this list were put on a less salient "greylist".[1]

Previous research has focused mostly on the determinants under which the instruments are likely to be effective (see e.g. Bacchetta and Espinosa 1995, 2000, for work on tax information exchange agreements) or on the effects of general policies (e.g. Picard and Pieretti 2011; Pieretti and Pulina 2017). However, these articles largely ignore the possibility that tax havens could use countermeasures against onshore countries' policies to limit profit shifting. This is surprising, given the fact that other work has shown that tax havens are small but well-governed countries (Dharmapala and Hines 2009).

Chapter 1 starts from this observation. It incorporates responses by well-governed tax havens in a theoretical two-country model. In this model, a high-tax country competes with a tax haven for mobile profits. While the high-tax country can exert pressure on its domestic profit shifting multinationals, the tax haven can lobby against this and thereby reduce the effective pressure experienced by the multinational firms. The results show that pressure exerted by onshore countries and offshore lobbying are strategic substitutes. Thus, if high-tax countries would increase their efforts to close

[1] See https://www.bbc.com/news/business-42237315 (last accessed: 2021-02-23) for an exemplary news report about the initial publication of the EU's list.

down tax havens, there would be less lobbying against profit shifting rules. However, there is an extensive margin incentive for tax havens to use these countermeasures. Furthermore, contrary to intuition, when initially high costs for shifting profits decrease, less firms shift profits. This is because of the countries' optimal tax responses. For the high-tax country, this cost reduction can be thought of as an increase in the elasticity of the tax base. Thus, tax rates on profits are reduced. For initially high levels of shifting costs, this indirect effect of a reduced tax rate outweighs the direct effect of less expensive profit shifting. Then, more firms stay onshore. Expanding this model to incorporate a second tax haven demonstrates that the individual tax havens reduce their lobbying effort, i.e. there is free-riding, but aggregate lobbying increases.

Chapter 2 discusses a second way to respond to taxation – tax evasion. The most important form of tax evasion is under-reporting of income. According to recent estimates, 80% of the United States' tax gap is due to under-reported income (Internal Revenue Service 2019). While tax evasion can be individually rational, especially in environments with low detection probabilities, it leads to sizeable revenue losses for governments.

Given the large empirical literature that evolved in recent years, there is a consensus on the most effective interventions to reduce tax evasion. The larger the degree of third-party reporting, the larger the detection probability of evasion and, consequently, the higher tax compliance (e.g. Kleven et al. 2011). Also, sending taxpayers letters with audit threats (e.g. Slemrod et al. 2001) and the audits themselves (e.g. Advani et al. 2019) significantly reduce tax evasion. Yet, third-party reporting might not be available for all income sources and audits, or the threat thereof, are often prohibitively expensive when expanded to all taxpayers.

In chapter 2, I empirically assess the effectiveness of enforcement focus lists, a new low-cost, population-wide tool to potentially reduce tax evasion and to complement the effective but expensive measures mentioned before. The lists, published by local revenue agencies, contain income categories, or particular line items, that are focal points in the tax filing process. To examine whether this intervention reduces tax evasion, I use the variation induced by the introduction of these lists in a German state combined with a difference-in-differences estimation strategy. Assuming that enforcement focus lists shift the perceived detection probability, changes in reported income in the treatment group can be interpreted as traces of tax evasion. I show that, empirically, the introduction of the enforcement focus lists had a limited direct effect and only increased reported income in three out of seven income categories.

Furthermore, total taxable income only increases significantly for those taxpayers facing higher scrutiny with respect to capital income. One noteworthy exception is the easily verifiable commuting cost deduction line item, which is explicitly mentioned in the (first) enforcement focus list. Treated taxpayers immediately reduce their reported deduction with a significant and stable effect for the remainder of the study period.

Chapter 3 examines the consequences that optional filing rules, i.e. tax systems with a legal form of non-filing, have for effective taxation. Related to the introductory example, more than thirty countries worldwide feature some form of optional tax filing, explicitly exempting their wage earning individual taxpayers from the duty to file an income tax return (see Table C.1). In the presence of third-party reporting and automatic withholding, there is little worry for tax authorities to forgo tax revenue from non-filers. For individual taxpayers, the benefits of such a system are unclear. When expected refunds are small and filing costs are large, such systems can be an improvement relative to a general tax filing duty. On the other hand, taxpayers might not be aware of their expected refunds and forgo sizeable amounts of money.

Surprisingly, previous work in the realm of individual tax filing has mostly focused on non-filers in the US. Researchers have characterized non-filers (e.g. Erard and Ho 2001; Fullerton and Rao 2019), analyzed interventions that increase tax filing (e.g. Guyton et al. 2017), and examined the lasting benefits that go along with tax filing (e.g. Ramnath and Tong 2017). Recently, Benzarti (2020) highlights that when deciding about whether or not to itemize deductions, i.e. at the intensive margin of tax filing, taxpayers exhibit rational behavior. However, none of these contributions explicitly consider the effects for effective taxation when taxpayers have the legal right not to file an income tax return. In this chapter, which is based on unpublished work conducted in collaboration with Luisa Wallossek, a doctoral student at the University of Munich, we aim to address this gap.

To do so, we exploit the optional filing system for wage earners in Germany using cross-sectional micro data. We show that low income wage earners are overrepresented among the set of non-filers, despite being hurt relatively hardest. Below the basic allowance threshold, where the non-filing share is as high as 90%, non-filers with over-remittances face an effective average tax rate of 5%, despite a statutory rate of zero. In 2014, all over-remittances add up to a total of at least 949 million €, or 118 € per capita. Comparing these numbers to monetary filing cost estimates suggests that other frictions are relatively more important. Consequently, we argue that policymakers should automatically refund over-remitted taxes, or reduce informational frictions

regarding filing as a second-best, if their aim is to realign statutory and effective taxation. If, however, the effective taxation currently observed is the policymakers' aim, we show that there would be a more efficient way to achieve the same effective tax burden. In our hypothetical system, the same distribution of average tax rates could be achieved by a different system of marginal tax rates. This would result in fewer distortions and, under some assumptions, even create labor supply incentives.

Chapter 1

Lobbying and the International Fight Against Tax Havens

This chapter is based on a single-authored publication. See Hauck (2019) for the full reference of the published version.

1.1 Introduction

In the past few years, revelations such as the Panama Papers and the Offshore Leaks reinvigorated the discussion about the persistent existence of tax havens. Simultaneously, several studies highlighted the economic importance of tax havens. Tørsløv et al. (2018) estimate the global tax revenue loss that is due to profit shifting to tax havens at roughly € 200 billion. Furthermore, Alstadsæter et al. (2019) emphasize the role that tax havens have in fueling wealth inequality in rich countries.

Efforts to fight tax havens can be traced back to as early as 1998, when the Organisation for Economic Co-operation and Development (OECD) published its report on *Harmful Tax Competition* (OECD 1998). As a consequence, many actions, such as the widespread introduction of tax information exchange agreements (TIEA), withholding taxes on interest payments (e.g. the EU Tax Savings Directive), or the Action Plan on Base Erosion and Profit Shifting (OECD 2013a,b) followed suit. Most recently, the European Union (EU) published the "EU list of non-cooperative tax jurisdictions" in December 2017. The publication of this list exemplifies the seemingly low effectiveness of the measures mentioned above. Several countries, which were expected to be on the EU's blacklist, did not end up there.

For example, the British Virgin Islands (BVIs) were not part of this blacklist and were only added to a less salient accompanying greylist several months later. This is despite ample evidence that the BVIs have been among the most important centers for tax avoidance. Most prominently, more than half of the offshore entities incorporated by Mossack Fonseca, the firm whose records were at the center of the Panama Papers, were in the BVI.[1]

The reason for this seemingly ineffective behavior can be found in offshore lobbying, conducted either by politically or historically linked EU member states or by the respective tax havens themselves. For example, several British Overseas Territories hired public relation companies or approached politically relevant representatives to make their case both in London and Brussels. More specifically, the Cayman Islands hired a member of the United Kingdom's House of Lords as their UK representative.[2]

A second example is given by the United Kingdom's efforts to shield Bermuda, one of

[1] See `https://www.icij.org/investigations/panama-papers/explore-panama-papers-key-figures/` (last accessed: 2021-02-17) for more information.

[2] See `https://www.thebureauinvestigates.com/stories/2012-04-19/tax-havens-boost-their-lobbying-efforts` (last accessed: 2021-02-17).

Google's main profit hubs, from being put on the same blacklist.[3] Sven Giegold, the financial and economic policy spokesperson of the Green Parties in the European Parliament, summarized this as follows:

"*In the shadow of the opaque Code of Conduct Group, Member States successfully lobbied to get their own dependencies and overseas territories off the hook.*"[4]

In this paper, I aim to explain the existence and the effects of offshore lobbying by employing a theoretical two country model with a three-stage game. The main argument is that offshore lobbying, which has thus far not been considered in the literature, is a reason for the empirical results and the anecdotal evidence presented.[5] At the core of this model are two simultaneous choices by the tax revenue-maximizing governments which are in stage one and two of the game: The onshore and the offshore country decide about their level of pressure and lobbying respectively, before setting tax rates; then, firms with heterogeneous shifting costs decide whether to engage in profit shifting or not.

The main results of the model are as follows. There exists an extensive margin incentive for tax havens to engage in international lobbying when the onshore country is unable to fully eliminate profit shifting. Generally, the usage of one country's policy tool decreases the effectiveness of the other country's policy. Hence, onshore pressure and offshore lobbying are found to be strategic substitutes.

Furthermore, when starting at high costs of profit shifting, a reduction in these costs leads to a smaller number of profit-shifting firms. In this case, there are two countervailing effects at work. First, there is the mechanical direct cost reduction for firms. Second, the reduction in profit-shifting costs induces the onshore country to reduce its tax rate. Consequently, the tax rate differential between the onshore and the offshore country shrinks. This second effect is larger in size when profit-shifting costs are initially high and therefore more firms remain onshore.

[3] See `https://www.theguardian.com/technology/2016/jan/30/google-tory-battle-protect-30bn-tax-haven-bermuda` (last accessed: 2021-02-17) for more information.

[4] See `https://sven-giegold.de/tax-havens-eu-finance-ministers-agree-on-whitewashed-blacklist/` (last accessed: 2021-02-17).

[5] I deviate from lobbying in a common-agency model as established by Grossmann and Helpman (1994). In this paper, I abstract from a microfoundation of lobbying and from potential lobbying by multinational firms. However, as tax havens' sole source of revenue is to provide shelter for profits, I assume these countries have a genuine interest to protect their business model and ultimately do so by engaging in international lobbying. In this paper, I consider this lobbying in a reduced form.

When generalizing the model to allow for a second tax haven, the resulting equilibrium pressure level for the onshore country is higher, as the marginal benefit of applying pressure rises. Concerning the tax havens, the overall level of lobbying is higher, whereas each country's lobbying level falls. This is the case as one tax haven benefits indirectly from the lobbying efforts of the other country, as lobbying reduces the effectiveness of pressure. Hence, both offshore countries will set less than their original lobbying from the single tax haven case.

My analysis relates to two areas of research.[6] The first one concerns the various measures used against profit shifting. Bacchetta and Espinosa (1995, 2000) are two seminal contributions with respect to TIEAs that examine the conditions under which TIEAs are more likely to form. Elsayyad (2012) examines the determinants for TIEAs in a generalized Nash bargaining model with cost free onshore pressure. More recently, Dharmapala (2016) analyzes the effects of the unilateral Foreign Account Tax Compliance Act by the United States.[7] Onshore pressure policies, that is, blacklisting and "naming and shaming", are additional tools in the fight against tax havens and have also been discussed by other authors. Picard and Pieretti (2011) look at pressure conditions under which offshore financial centers voluntarily comply to monitor their investment. A more general point is made by Elsayyad and Konrad (2012). They argue why a *big-bang-approach* is more efficient than the sequential approach of closing down tax havens when facing internationally mobile profits. Konrad and Stolper (2016) stress the importance of individual beliefs in the fight against tax havens. Pieretti and Pulina (2017) have introduced pressure policies as an additional instrument in the fight against tax havens. They argue that real economic activity by onshore multinationals can be sufficiently important for their home government, such that the efficient level of pressure lies below the level that would eliminate profit shifting.

The present model builds on the approach by Pieretti and Pulina (2017) regarding its use of onshore pressure but it differs in two important dimensions. First, Pieretti and Pulina (2017) allow for real economic activity in the tax haven. This is not the case in this model. Here, a tax haven's only business model is to shield profits from taxation for a lump-sum payment. Second, adding the lobbying policy allows the offshore

[6]There is also a literature on international taxation and interest groups (see e.g. Chu et al. 2015; Janeba and Schjelderup 2009; Lai 2010, 2019). In contrast to this study, these authors have looked at domestic interest groups rather than offshore lobbying.

[7]Empirical contributions in this respect are from Ligthart and Voget (2009) and Bilicka and Fuest (2014). The latter examines the determinants of TIEAs between countries, the former looks at the determinants of information exchange requests from Dutch tax offices.

country to directly counteract the onshore government's pressure policy. In Pieretti and Pulina (2017), there is no direct countervailing measure to onshore pressure.

A further related area of research concerns the welfare effects of tax havens.[8] In contrast to the contributions such as Tørsløv et al. (2018), Alstadsæter et al. (2019), and Slemrod and Wilson (2009), which highlight the negative effects of tax havens, there are valid arguments against fighting tax havens. Hong and Smart (2010) find that tax havens create a welfare-enhancing possibility for international tax planing. Wilson (2005) argues more generally why competition for mobile capital can be welfare improving. Rose and Spiegel (2007) find that offshore financial centers can have procompetitive effects on onshore monopolists, and Picard and Pieretti (2011) find positive effects for institutional competition.

The remainder of this paper is organized as follows. Section 1.2 introduces the model, its results, and the comparative statics. Section 1.3 adds a second tax haven to the model. Section 1.4 examines two additional extensions before Section 1.5 concludes.

1.2 Model

The model contains two countries H and F, denoting the onshore and the offshore country, respectively.[9] Furthermore, there is a continuum of firms, all residing in H. The firms differ in their propensity to conduct profit-shifting activity, which is captured by the shifting cost parameter x_i for firm i. This characteristic is uniformly distributed over the $[0, 1]$ interval with density $dF(x)$.

A firm that wants to offshore profits faces transaction costs, for example, due to internal restructuring, amounting to kx_i, where $k > 0$ represents an inverse measure of international financial integration. The higher k, the more frictions are present in the financial market.

If a given firm decides to offshore profits, these profits only face a fixed fee $f_t \geq 0$ offshore. This is set by the tax haven's government and represents filing costs and the like. In contrast, in the onshore country, there is a proportional tax rate $t \in [0, 1]$ for profits. There is no coordination between the two countries about their tax rates.

Furthermore, the domestic country decides about a level of pressure $\alpha > 0$ that is

[8] Arguments that go beyond the tax competition literature are summarized by Schjelderup (2016).

[9] Note that in this study I will use "offshore country" and "tax haven" interchangeably.

applied to all firms that engage in profit-shifting activities. Examples for this pressure are a "naming and shaming"[10] approach or an increase in costs for shifting profits offshore due to a TIEA between the onshore and the offshore country.

Pressure α causes quadratic costs in the amount of $\frac{\alpha^2}{2}g$, where g represents an inverse efficiency parameter of pressure. The first time an onshore country publicly denounces a tax haven, and thereby the firms that are active there, is effective. However, the more denouncements an onshore country publishes, the costlier it gets to achieve the same effectiveness. This is the case as economic agents update their expectations.[11] This makes a further increase of pressure more costly.

On the contrary, the offshore country decides about how much to lobby. In this context, lobbying is mainly motivated by the anecdotal evidence presented in the introduction and the disconnect between several measures used in the fight against tax havens and their apparent ineffectiveness. One way to think about lobbying activities can be the hiring of public relations agencies or lobbyists. Alternatively, lobbying can be thought of as using historical or political ties to have other countries make a tax haven's case.

I model lobbying as reducing the effective pressure to $\alpha\gamma$, with $0 < \gamma \leq 1$. Hence, the extent of lobbying can be expressed by $(1 - \gamma)$. The associated costs for lobbying are given by $\frac{(1-\gamma)^2}{2}\rho$, where ρ is an inverse measure for the efficiency of lobbying. These convex costs for lobbying can be motivated by the increasing difficulty to conduct successful lobbying. Although the costs for (temporarily) avoiding the status of a blacklisted country might indeed be limited, lobbying against broader and more general measures, as for example laid out in the Base Erosion and Profit Shifting (BEPS) Action plan, are over-proportionally costlier.[12]

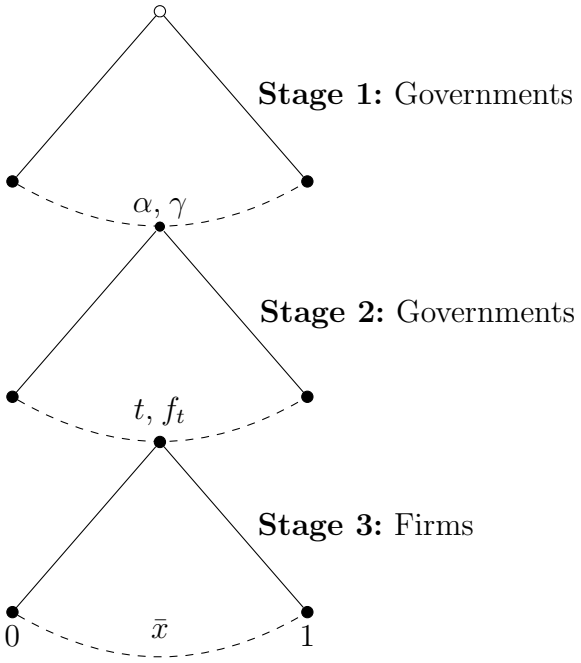
The timing of the model can be seen in Figure 1.1. In the first stage, governments choose pressure and lobbying, before deciding about tax rates in the second stage. Firms decide in the last stage. This structure is intended to reflect the long-term dimension of the decision to become a tax haven. International policies are more time-intensive and are therefore more long-term in nature. Hence, the sequence of deciding about national policies at a later stage seems sensible. Furthermore, assuming simultaneity for the first two stages is a natural assumption. It remains questionable whether

[10] See, for example, Hanlon and Slemrod (2009) for a study implicating that stock prices decrease if a firm's aggressive tax behavior is covered in a major news outlet.

[11] Following the argumentation by Hanlon and Slemrod (2009), once a firm's tax haven usage is public knowledge future denouncements should have no effect on the firm's stock price.

[12] I thank an anonymous referee for pointing out a possible second interpretation. When onshore countries renew their lists, it becomes increasingly difficult for tax havens to stay off such a list.

Figure 1.1: Setup of the Game



economically relevant onshore countries move first and offshore countries react by lobbying (or setting taxes) afterward or if well-organized tax havens anticipate the offshore pressuring (tax rate).[13]

1.2.1 Third Stage: Firms' Decisions

In the last stage of the game, firms take the policy parameters as given and only decide whether or not to shift profits abroad. It is assumed that the gross income of any firm is given by $\Pi = s\pi_x + h\pi_x$, where s represents the immobile share of profits and h the mobile share of profits. Hence, it holds that $s + h = 1$.

For the purpose of tax planing, the multinational firm compares the different payoffs. When shifting profits abroad the net profit is $V_x^F = \pi_x - f_t - kx_i - \alpha\gamma$. The effective level of pressure diminishes the firm's profit directly. The profit in the domestic country is the profit net of the proportional tax: $V_x^H = (1-t)\pi_x$. Without loss of generality, I assume that $\pi_x = 1$.

Hence, equalizing the two net-profit functions V_x^F and V_x^H yields the marginal profit-shifting firm $\overline{x}$, with

[13] See Stöwhase (2013) for a related case with Stackelberg competition.

$$\overline{x} = \frac{t - f_t - \alpha\gamma}{k} \, . \tag{1.1}$$

As seen above, the number of profit-shifting firms is positively linked with the tax rate differential $t - f_t$. The higher it is, the more firms engage in profit shifting. For higher levels of effective pressure $\alpha\gamma$ and for more frictions in the financial market k, fewer firms shift their profits abroad.

It is noteworthy that reactions to changes in the tax rate differential and the effective pressure are scaled by the financial market frictions k. The higher is k, the lower is the reaction to a change in these parameters. Hence, the higher is k, the lower is each firm's elasticity with respect to changes in the tax rates and the effective pressure.

1.2.2 Second Stage: Tax Rates

In the second stage, both countries decide upon the respective tax rates t and f_t. Given that firms try to minimize their tax burden by shifting profits, which is associated with tax revenue losses for the onshore country, I assume a Leviathan objective function for the onshore government. Although this is a simplification, it implies that for the subset of corporate profits shifted to other countries, the onshore country only cares about repatriating these tax revenues.[14] As there are no firms residing in the tax haven, I also assume a tax revenue-maximizing strategy for the offshore country, as this is the most important way to generate funds for this government.

For the onshore country, this yields

$$\max_t \; W_H = \underbrace{t\Big[s + h\int_{\overline{x}}^{1} dF(x)\Big]}_{\text{Tax revenue}} \quad - \quad \underbrace{\frac{\alpha^2}{2}g}_{\text{Pressure costs}} \quad . \tag{1.2}$$

The tax revenue in equation (1.2) is dependent on the immobile share of profits s and the mobile shares h that remain in the country. This is then multiplied by the onshore country's proportional tax rate t. Pressure is costly and has to be deducted from the tax revenue.

Applying the uniform distribution property for x, plugging in the equilibrium value $\overline{x}$ and taking the first-order derivative results in the best-response tax rate t^{br} as follows:

[14] For an extension taking into account domestic net firm profits, see Section 1.4.1

$$\frac{\partial W_H}{\partial t} = 1 - h\Big[\frac{t - f_t - \alpha\gamma}{k} - \frac{t}{k}\Big] \stackrel{!}{=} 0 \tag{1.3a}$$

$$\Leftrightarrow t^{br} = \frac{1}{2}\big(\frac{k}{h} + f_t + \alpha\gamma\big) \ . \tag{1.3b}$$

The onshore country's best-response function is positively dependent on the level of financial frictions k. As lower levels of integration make profit shifting less attractive, the onshore country moves closer to full taxation of profits. This is, however, scaled by the mobile share of capital, h. For high levels of h, that is, a high share of mobile profits, the effect of frictions on the best-response tax rate is smaller compared with lower levels of h. Hence, the onshore country cares about the size of mobile profits. As both the offshore country's fee f_t and the effective pressure level $\alpha\gamma$ diminish the incentives to shift profits offshore, the onshore country's best-response tax rate increases.

For the offshore country, the objective function is similar. The net tax revenue function is given by

$$\max_{f_t} \ W_F = \underbrace{f_t \int_0^{\overline{x}} dF(x)}_{\text{Tax revenue}} \quad - \quad \underbrace{\frac{(1-\gamma)^2}{2}\rho}_{\text{Lobbying costs}} \ . \tag{1.4}$$

The first part represents the income from the lump-sum tax for onshore profit-shifting activity. The second term represents the convex lobbying costs that arise. Again, applying the uniform distribution property for x and plugging in $\overline{x}$ gives the best-response lump-sum tax rate:

$$\frac{\partial W_F}{\partial f_t} = \Big[\frac{t - f_t - \alpha\gamma}{k} - \frac{f_t}{k}\Big] \stackrel{!}{=} 0 \tag{1.5a}$$

$$\Leftrightarrow f_t^{br} = \frac{1}{2}\big(t - \alpha\gamma\big) \ . \tag{1.5b}$$

As is seen by equations (1.5b) and (1.3b), the tax rates are strategic complements. When plugging one into another, the equilibrium values for both tax rates, t^* and f_t^*, can be computed. They are given by

$$t^* = \frac{1}{3}\big(2\frac{k}{h} + \alpha\gamma\big) \quad ; \quad f_t^* = \frac{\frac{k}{h} - \alpha\gamma}{3} \ . \tag{1.6}$$

The comparative statics for these results are quite intuitive. The offshore country's tax rate decreases with increasing effective pressure $\alpha\gamma$ to offset the negative effect that an increase of pressure has on the number of profit-shifting firms. The opposite holds for the onshore country. More effective pressure leads to higher levels of t. If the marginal firm now stays onshore, due to higher $\alpha\gamma$, there is some leeway to increase tax revenue by increasing the tax rate.

The level of shiftable profits h negatively influences both tax rates. An increasing amount of shiftable profits exerts downward pressure on onshore tax rates. This is seen by inspection of equation (1.3b). When a large part of the possible tax base is mobile, having a higher tax rate leads to more profits being shifted. Hence, the onshore country reduces its tax rate.

Interestingly, for higher levels of financial frictions, both tax rates rise. This is due to two effects. First, an increase in k increases every firm's cost of shifting profits offshore. Hence, the previously marginal firm now stays onshore. This leads to a pure positive income effect on onshore tax revenue without a change in the tax rate. However, as pointed out previously, an increase in k reduces the elasticity of firms with respect to the policy parameters. Therefore, the onshore country finds it optimal to increase the tax rate t further.

For the offshore country, the effect is the opposite. An increase in k reduces the number of firms and leads to a mechanical decrease in tax revenues. However, as the onshore country increases its tax rate, the offshore country can raise its fee as well, while remaining attractive for onshore profit-shifting firms.

Finally, $\overline{x}$ can be simplified for further use by plugging in the values obtained in (1.6) and is given by the following:

$$\overline{x} = \frac{1}{3h} - \frac{\alpha\gamma}{3k} \,. \tag{1.7}$$

The nonnegativity constraint for the lump-sum fee in equation (1.6) and the requirement for a nonnegative number of profit-shifting firms in equation (1.7) give the upper limit of pressure at $\alpha^{up} = \frac{k}{h}$, for the maximum case of $\gamma = 1$.

1.2.3 First Stage: Pressure and Lobbying

Turning now to the first stage of the game,[15] by incorporating previous results the onshore country's tax revenue function can be rewritten as

$$\max_{\alpha} \; W_H = t^* \Big[s + h \int_{\overline{x}}^{1} dF(x) \Big] - \frac{\alpha^2}{2} g = t^* [s + 1(h - \overline{x})] - \frac{\alpha^2}{2} g \; . \tag{1.8}$$

Taking the first-order derivative and solving for the equilibrium level of pressure thus yield

$$\alpha^* = \frac{\frac{4}{9}\gamma}{g - \frac{2\gamma^2 h}{9k}} \; . \tag{1.9}$$

For the offshore country, the tax revenue function can be rewritten as

$$\max_{\gamma} \; W_F = f_t \int_{0}^{\overline{x}} df(x) - \frac{(1-\gamma)^2}{2} \rho = f_t \, \overline{x} - \frac{(1-\gamma)^2}{2} \rho \; . \tag{1.10}$$

Taking the first-order derivative and solving for the optimal level of lobbying yield

$$\gamma^* = \frac{9kh\rho - 2\alpha k}{9kh\rho - 2\alpha^2 h} = 1 - \frac{2\alpha k - 2\alpha^2 h}{9kh\rho - 2\alpha^2 h} \; . \tag{1.11}$$

For (1.9) and (1.11) to be the best-response equilibrium levels of pressure and lobbying, two sufficient conditions have to be fulfilled: The costs of exerting pressure have to be sufficiently large, that is, $g > \frac{2h}{9k}$. Similarly, the costs of offshore lobbying have to be sufficiently large as well, $\rho > \frac{2k}{9h^2}$. Appendix A.1 examines this in more depth. This result is summarized in Proposition 1.1:

Proposition 1.1 *There exists a Nash equilibrium for both policy parameters, with the respective best-response functions given by* (1.8) *for onshore pressure and by* (1.11) *for offshore lobbying, if the following two sufficient (but not necessary) conditions are fulfilled:*

(i) $g > \frac{2h}{9k}$*, that is, using the pressure policy is sufficiently costly and*

(ii) $\rho > \frac{2k}{9h^2}$*, that is, offshore lobbying is sufficiently costly.*

This equilibrium constitutes an interior equilibrium with $0 < \alpha^* < \alpha^{up} = \frac{k}{h}$ *and* $0 < \gamma^* < 1$*, if pressure costs are sufficiently high such that*

[15] For the more detailed analysis, please consult Appendix A.1.

(iii) $g > \frac{2h}{3k}$.

For cases in which (i) and (ii) are fulfilled, but not (iii) ($\frac{2h}{9k} < g \leq \frac{2h}{3k}$)*, a corner solution with* $\gamma^* = 1$ *and* $\alpha = \alpha^{up} = \frac{k}{h}$ *results.*

Proof. Appendix A.1 shows that if both sufficient conditions are fulfilled, there exists an equilibrium. It further derives the condition for g to constitute an interior equilibrium. ■

The assumption for high pressure costs is sensible, when following the arguments by Schjelderup (2016). Tax havens provide secrecy services and therefore increase the costs for onshore governments to tax onshore multinationals' profits. It is a quite regular phenomenon that multinationals adapt their profit-shifting tactics once a previous loophole has been found and closed by the onshore government.

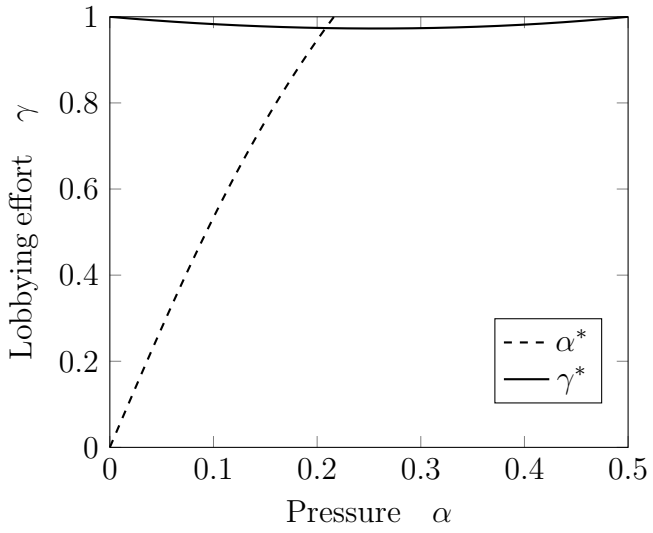
The sufficient condition for offshore lobbying costs could be rationalized by the inherent complexity of finding a public relations firm or a spokesperson that is willing to make a tax haven's case. A second explanation could be a related complexity with which historically or politically connected countries would be approached to speak on behalf of a tax haven.

Intuitively, both sufficiency conditions can be linked to the ratio of shiftable profits h to financial market frictions k. For condition *(i)*, if the share of shiftable profits h (or the financial market frictions k) becomes to large (small), then pressure needs to be sufficiently costly to ensure an equilibrium. To arrive at an interior solution, the costs of applying pressure have to be three times as large as for the sufficiency condition of the existence of an equilibrium.

For offshore lobbying, the relationship is the opposite. The higher the share of shiftable profits h, the lower the costs for lobbying can be while still achieving an (interior) equilibrium.

Figure 1.2 depicts a numerical example for the best-response functions of pressure (1.9) and lobbying (1.11). It is clearly visible that either in the case of no pressure at all ($\alpha = 0$) or in the case of upper boundary pressure (here $\alpha^{up} = \frac{1/4}{1/2} = \frac{1}{2}$), there is no lobbying, that is, $\gamma = 1$. Also, high levels of lobbying, that is, low levels of γ, are associated with low levels of onshore pressure.

Figure 1.2: First Stage Equilibrium



Parameters: financial frictions $k = \frac{1}{4}$, share of shiftable profits $h = \frac{1}{2}$, pressure efficiency parameter $g = 2.5$, lobbying efficiency parameter $\rho = 2.5$. Own illustration.

1.2.4 Comparative Statics

As regards comparative statics, the change in financial integration (k) as well as an efficiency change in the offshore cost-effectiveness (ρ) and the onshore costs (g) are examined. As the previous results are not given explicitly, the implicit function theorem is applied.

The matrix of second order (cross-) derivatives is given by $|D|$:

$$|D| = \begin{vmatrix} \frac{\partial^2 W_H}{\partial \alpha^2} & \frac{\partial^2 W_H}{\partial \alpha \partial \gamma} \\ \frac{\partial^2 W_F}{\partial \gamma \partial \alpha} & \frac{\partial W_F^2}{\partial \gamma^2} \end{vmatrix} = \begin{vmatrix} \frac{2\gamma^2 h}{9k} - g & \frac{4}{9} + \frac{4\alpha\gamma h}{9k} \\ -\frac{2}{9h} + \frac{4\alpha\gamma}{9k} & \frac{2\alpha^2}{9k} - \rho \end{vmatrix} . \tag{1.12}$$

Throughout, I assume that direct effects outweigh indirect effects and thus $|D| > 0$.[16]

Onshore Cost Efficiency g As regards the onshore pressure costs, comparative static results are in line with regular expectations. As seen in equation (1.13), an increase in the cost of the pressure policy tool is associated with a decrease in the usage of this policy instrument.

[16] See Appendix A.2 for more comments.

$$\frac{\partial \alpha^*}{\partial g} = \frac{\begin{vmatrix} -\frac{\partial^2 W_H}{\partial \alpha \partial g} & \frac{\partial^2 W_H}{\partial \alpha \partial \gamma} \\ -\frac{\partial^2 W_F}{\partial \gamma \partial g} & \frac{\partial^2 W_F}{\partial \gamma^2} \end{vmatrix}}{|D|} = \frac{\begin{vmatrix} \alpha & \frac{4}{9} + \frac{4\alpha\gamma h}{9k} \\ 0 & \frac{2\alpha^2}{9k} - \rho \end{vmatrix}}{|D|} < 0 \, . \tag{1.13}$$

For the offshore country, the result is the opposite. An increase in the cost of onshore pressure leads to an increase in lobbying, that is, a decrease in γ:

$$\frac{\partial \gamma^*}{\partial g} = \frac{\begin{vmatrix} \frac{2\gamma^2 h}{9k} - g & \alpha \\ -\frac{2}{9h} + \frac{4\alpha\gamma}{9k} & 0 \end{vmatrix}}{|D|} < 0 \, . \tag{1.14}$$

Offshore Cost Efficiency ρ The effect for an increase in the costs for offshore lobbying is unambiguous for both α and γ.

$$\frac{\partial \gamma^*}{\partial \rho} = \frac{\begin{vmatrix} \frac{2\gamma^2 h}{9k} - g & 0 \\ -\frac{2}{9h} + \frac{4\alpha\gamma}{9k} & -(1-\gamma) \end{vmatrix}}{|D|} > 0 \, . \tag{1.15}$$

Remembering that the first cell in the top left corner is negative, it holds that the main diagonal is positive. Hence, the overall effect is positive; that is, there is less lobbying. Thus, if the policy instrument becomes more expensive, the government is reluctant to use it. For the equilibrium level of pressure, this results in

$$\frac{\partial \alpha^*}{\partial \rho} = \frac{\begin{vmatrix} 0 & \frac{4}{9} + \frac{4\alpha\gamma h}{9k} \\ -(1-\gamma) & \frac{2\alpha^2}{9k} - \rho \end{vmatrix}}{|D|} > 0 \, . \tag{1.16}$$

An increase in the level of offshore lobbying costs increases the level of onshore pressure. The onshore country anticipates the lower level of lobbying and therefore finds it optimal to apply more pressure to keep more firms within its boundary.

To sum those two parts up, it is easy to see that the level of pressure and the level of lobbying are strategic substitutes. If the cost for one policy parameter increases, the respective measures are used less intensively. In turn, the other country's measure is used more intensively. Along the arguments from Bulow et al. (1985), a decrease of the other country's policy tool (due to higher costs) leads to an increase in the marginal benefit for the country not affected by the cost increase. Hence, the latter finds it beneficial to increase the use of its policy tool until the first-order condition

holds again. In different words, an increase in one country's cost of the policy tool is directly affecting its own marginal benefit and indirectly affecting the other country's marginal benefit.

Financial Integration k The most interesting comparative statics result is found by looking at a change in frictions in the international financial market, hence a change in k.[17] For the onshore country this yields

$$\frac{\partial \alpha^*}{\partial k} = \frac{\begin{vmatrix} \frac{2\alpha\gamma^2 h}{(9k)^2} & \frac{4}{9} + \frac{4\alpha\gamma h}{9k} \\ \frac{2\alpha^2\gamma}{(9k)^2} & \frac{2\alpha^2}{9k} - \rho \end{vmatrix}}{|D|} < 0 \, . \tag{1.17}$$

Note that the equilibrium tax rate t^* as given by equation (1.6) is an increasing function in k. Therefore, if k increases, so does the onshore tax rate, which in turn increases each firm's incentive for shifting profits. This increase in t^* for all firms outweighs the cost increase in firm specific costs kx_i that has made the marginal firm abstaining from profit shifting. Hence the onshore country cuts back on pressure.

$$\frac{\partial \gamma^*}{\partial k} = \frac{\begin{vmatrix} \frac{2\gamma^2 h}{9k} - g & \frac{2\alpha\gamma^2 h}{(9k)^2} \\ -\frac{2}{9} + \frac{4\alpha\gamma h}{9k} & \frac{2\alpha^2\gamma}{(9k)^2} \end{vmatrix}}{|D|} < 0 \, . \tag{1.18}$$

For the offshore country, the effect is the opposite. An increase in financial frictions makes the offshore country relatively attractive, as the tax rate differential $t - f_t$ increases. Hence, there are more incentives for onshore firms to shift profits. Nonetheless, the offshore country also increases its tax rate $\frac{\partial f_t^*}{\partial k} > 0$, as seen in equation (1.6). This increase in tax revenue releases further funds for increasing lobbying and thus makes the offshore country even more attractive.

Obviously, the effects are reversed for reductions in k. This means that with a higher degree of globalization, the onshore country intensifies its pressure ($\frac{\partial \alpha^*}{\partial -k} > 0$) and the offshore country lobbies less ($\frac{\partial \gamma^*}{\partial -k} > 0$). This is particularly interesting, when one looks at the number of firms that are engaged in profit shifting and how this changes with higher levels of globalization.

[17] Note that I consider an increase in financial frictions (increase in k), the opposite is true for a decrease in financial frictions, a decrease in k. The latter is what people usually refer to as economic integration.

Number of Profit-Shifting Firms The effect of financial integration on the equilibrium level of profit-shifting firms, that is, the total derivative of $\overline{x}$ with respect to $-k$, is the following:

$$\frac{d\overline{x}}{d-k} = \frac{d\left(\frac{1}{3h} + \frac{\alpha\gamma}{-3k}\right)}{d-k} \tag{1.19a}$$

$$= \frac{\alpha\gamma - k\left(\alpha\frac{\partial\gamma}{\partial-k} + \gamma\frac{\partial\alpha}{\partial-k}\right)}{3k^2} \lessgtr 0 \; . \tag{1.19b}$$

As seen above, the resulting effect is crucially dependent on the existing level of financial market frictions k. Remember that there are two effects at work, when k decreases. First, the elasticity of firms with respect to the tax rate increases, and thus the onshore country sets a lower tax rate. Second, there is a mechanical cost reduction effect on the firm level, as kx_i falls. Although the first leads the firms to stay onshore, the second one does the opposite. Hence, there exists a cutoff point $\hat{k}$ below which a reduction in financial frictions leads to more profit shifting. This cutoff is given by

$$\hat{k} = \frac{\alpha\gamma}{\alpha\frac{\partial\gamma}{\partial-k} + \gamma\frac{\partial\alpha}{\partial-k}} \; . \tag{1.20}$$

Therefore, international integration need not necessarily be bad for the onshore country. When the indirect effect associated with international integration, namely a lower tax rate, is sufficiently larger than the direct cost reduction for firms, then there is a possibility for a lower number of profit-shifting firms. On the contrary, when the effect of a reduction in k on the firm level (via the heterogeneous costs) outweighs the effect of the change in economic environment, there will be more profit shifting. This is true for a reduction of low values of k. This is summarized in Proposition 2:

Proposition 1.2 *If the level of international frictions is sufficiently large, that is, $k > \hat{k}$, a marginal reduction in frictions decreases the number of profit-shifting firms. On the contrary, if $k < \hat{k}$, more financial integration results in a higher number of profit-shifting firms.*

Proof. See equations (1.19) and (1.20) for the formal results. ■

1.3 Multiple Tax Havens

1.3.1 Third Stage

In this section, I consider the case with two tax havens. The main question now is whether the sum of the individual country's lobbying levels is larger than the lobbying effort in the initial setup. Furthermore, the second insight is to examine whether the onshore country's pressure level rises or decreases, relative to the case with one tax haven.

To this end, I employ a generalized version of the previous model. Now, firm profits are divided up between three countries. There is a fraction s that is immobile and two shares h_1 and h_2 that are bilaterally mobile to the respective tax havens F_l and F_m, $m, l = (1, 2)$.[18] It holds that $1 = s + h_1 + h_2$.

The second modification is the cost structure of the firms, now denoted by $\zeta_i = \binom{x_i^1}{x_i^2}$, indicating the firm-specific costs of shifting parts of their profits to either of the two tax havens.[19] For the sake of simplicity, I assume that financial frictions are the same worldwide. Furthermore, I assume that the pressure exerted cannot be varied on the country level. Although this is a restricting assumption, there are valid reasons why countries cannot discriminate between tax havens.[20] The potential profits of each firm are then given as follows:

$$\Pi\binom{x_i^1}{x_i^2} = \begin{cases} (1-t)(s+h_1+h_1) & \text{if } x_i^1 \in (\overline{x^1};1] \ \ \& \ \ x_i^2 \in (\overline{x^2};1], \\ (1-t)(s+h_2) + (1-f_{t1}-\alpha\gamma_1 - kx_i^1)h_1 & \text{if } x_i^1 \in (0;\overline{x^1}] \ \ \& \ \ x_i^2 \in (\overline{x^2};1], \\ (1-t)(s+h_1) + (1-f_{t2}-\alpha\gamma_2 - kx_i^2)h_2 & \text{if } x_i^1 \in (\overline{x^1};1] \ \ \& \ \ x_i^2 \in (0;\overline{x^2}], \\ (1-t)(s) + (1-f_{t1}-\alpha\gamma_1 - kx_i^1)h_1 & \\ \qquad +(1-f_{t2}-\alpha\gamma_2 - kx_i^2)h_2 & \text{if } x_i^1 \in (0;\overline{x^1}] \ \ \& \ \ x_i^2 \in (0;\overline{x^2}] \ , \end{cases} \tag{1.21}$$

where the cutoffs are given by

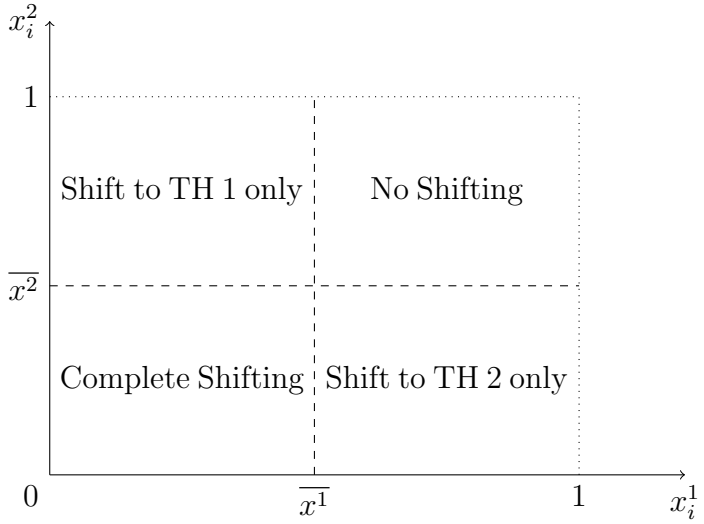
$$\overline{x^1} = \frac{t - f_{t1} - \alpha\gamma_1}{k} \ , \ \overline{x^2} = \frac{t - f_{t2} - \alpha\gamma_2}{k} \ . \tag{1.22}$$

[18] For this part I abstract from fully mobile profits. Section 1.4.2 examines an extension with two different cases of tax competition.

[19] I do not assume any form of correlation between the two cost parameters within a firm.

[20] When looking at countries on blacklists, such as the OECD's, there is no way to discriminate between countries that are within one category.

Figure 1.3: Distribution of Firms into the Different Profit Shifting Schemes



Notes: Distribution of firms into the different profit shifting schemes. Four outcomes are possible: Either no shifting, complete shifting, or shifting to only one of the two tax havens (TH).

The intuition for the different profits in equation (1.21) is fairly obvious. As the profit-shifting decision into one country is distinct from the shifting decision into the second country, firms will face a choice set of four actions.

When the firm is neither efficient in shifting profits into haven one nor into haven two, all profits will remain in the onshore country (first line). The second line describes the case in which the firm finds it optimal to shift profits to F_1 but not to F_2. The third line represents the opposite case. In the last case, firms shift all mobile profits to the respective haven. Thus, only the immobile share of profits remains onshore. This is summarized graphically in Figure 1.3.

1.3.2 Second and First Stage

The tax revenue functions as previously given by equation (1.2) and (1.4) are extended to

$$\max_t \; W_H = t[s] + t\Big[h_1 \int_{\overline{x^1}}^{1} dF(x_i^1) + h_2 \int_{\overline{x^2}}^{1} dF(x_i^2)\Big] \; . \tag{1.23}$$

There are now two different mobile parts of the onshore multinational's profit that have weights h_1 and h_2. For the individual tax haven l, the tax revenue function looks very similar to the one seen in the previous part:

$$\max_{f_{tl}} W_{F_l} = f_{tl} \int_0^{\overline{x^l}} dF(x_i^l) - \frac{(1-\gamma_l)^2}{2}\rho_l \ . \tag{1.24}$$

Solving for the first-order conditions and inserting the equilibrium values into one another yields the optimal onshore tax rate $\tilde{t^*}$ and the optimal offshore lump-sum fee $\tilde{f_{tl}^*}$. These are given by:

$$\tilde{t^*} = \frac{1}{3(h_1+h_2)}\Big[2k + \alpha\gamma_1 h_1 + \alpha\gamma_2 h_2\Big] \ , \tag{1.25}$$

$$\tilde{f_{tl}^*} = \frac{1}{6(h_l+h_m)}\Big[2k - 2\alpha\gamma_l h_l + \alpha h_m\big[\gamma_m - 3\gamma_l\big]\Big] \ . \tag{1.26}$$

The equilibrium onshore tax rate $\tilde{t^*}$ is still positively associated with higher levels of effective pressure. It is easy to see that the individual offshore lump-sum fee for country l now also depends on the actions by country m. When assuming symmetric countries in terms of their lobbying, that is, $\gamma_m = \gamma_l$, then the negative spillover on the fee by country l prevails, as the interior bracket turns negative. However, when countries are quite different and residing lobbying levels vary such that $3\gamma_l > \gamma_m$, then there is an overall positive effect from the other country.[21] Put differently, the high lobbying effort by country l allows tax haven m to increase its lump-sum fee.

The resulting number of profit-shifting firms is given by

$$\overline{x^l} = \frac{1}{3(h_l+h_m)} - \frac{1}{2(h_l+h_m)}\Big[\frac{2\alpha\gamma_l h_l + \alpha h_m\big[3\gamma_l - \gamma_m\big]}{3k}\Big] \ . \tag{1.27}$$

For the equilibrium number of profit-shifting firms, there is again a spillover effect of the other country's lobbying. For the benchmark case of symmetric tax havens, that is, $\gamma_l = \gamma_m$, the interior bracket remains positive. Hence, the positive effect of the own lobbying prevails. However, when the difference in lobbying levels is rather pronounced, $\gamma_m > 3\gamma_l$, the interior bracket becomes negative.

Note that this bracket is reversed to the interior bracket seen in equation (1.25). This is quite intuitive. Assuming that $\gamma_m > 3\gamma_l$, that is, country l experiences a large spillover effect for the lump-sum fee and thus finds it optimal to raise this fee. In

[21] For example, it might be the case that there is one tax haven which has significantly low costs of lobbying and therefore lobbies quite intensively. The offshore country with high costs benefits from this by being able to set a higher lump-sum fee.

turn, this reduces the number of firms that shift profits to this country, as higher fees make profit shifting to this shore less attractive. This last point is observed in equation (1.27). Furthermore, note that equation (1.27) nests the single tax haven number of profit-shifting firms as given by equation (1.7), assuming equal lobbying levels ($\gamma_l = \gamma_m$) and $h = h_l + h_m$.

When turning to the first stage of the game, I assume symmetric offshore countries for the sake of simplicity. Symmetry hereby refers to both countries enjoying the same share of attainable profits, $h_m = h_l$, and the same cost-effectiveness of lobbying, $\rho_l = \rho_m$. This in turn implies that both countries will set the same level of lobbying. Hence, examining one tax haven is sufficient. Following the tax revenue-maximization approaches given in equations (1.23) and (1.24), this yields the following level of offshore lobbying, $\tilde{\gamma^*}$, that is efficient for each tax haven:

$$\tilde{\gamma^*} = \frac{9k\rho h - 1.25k\alpha}{9k\rho h - 2.5\alpha^2 h} \ . \tag{1.28}$$

Furthermore, the equilibrium pressure level of the onshore country for the case of multiple tax havens, $\tilde{\alpha^*}$, is given by

$$\tilde{\alpha^*} = \frac{\frac{4}{9}\gamma}{g - \frac{3\gamma^2 h}{9k}} \ . \tag{1.29}$$

1.3.3 Comparison to the Single Tax Haven Case

As the equilibrium values of pressure and lobbying in the presence of multiple tax havens are given, a comparison whether these levels are larger or smaller in size is insightful.

Equilibrium Pressure Level For the equilibrium pressure level, the comparison is as follows:

$$\tilde{\alpha^*} = \frac{\frac{4}{9}\gamma}{g - \frac{3\gamma^2 h}{9k}} > \alpha^* = \frac{\frac{4}{9}\gamma}{g - \frac{2\gamma^2 h}{9k}} \ . \tag{1.30}$$

As is seen in equation (1.30), for a given level of lobbying, the level of pressure applied in the two tax haven case is higher than in the case with only one tax haven. Mathematically, this is seen by the smaller denominator for $\tilde{\alpha^*}$ relative to α^*.

As onshore pressure and offshore lobbying are strategic substitutes, there is an incentive for the onshore government to set a higher level of pressure when facing multiple tax havens. This is the case because an increase in onshore lobbying now reduces the marginal benefit of lobbying for more than one tax haven. Therefore, a higher level of pressure relative to the case with only one tax havens remains.

Equilibrium Lobbying Level Equally interesting is how the equilibrium value of lobbying will be for a given tax haven compared with the initial case of one tax haven:

$$\tilde{\gamma^*} = \frac{9k\rho h - 1.25\alpha k}{9k\rho h - 2.5\alpha^2 h} > \frac{9k\rho h - 2\alpha k}{9k\rho h - 2\alpha^2 h} = \gamma^* \ . \tag{1.31}$$

For a given level of pressure α, there is less lobbying per country, that is, $\tilde{\gamma^*}$ is larger, in the case with multiple tax havens than in the case with one tax haven. However, it can be shown that the aggregate level of lobbying still weakly increases ($2(1-\tilde{\gamma^*}) \geq (1-\gamma^*)$).

This result is due to a positive externality. For the case of one tax haven, γ^* is optimal. However, when a second tax haven enters the game, there is a positive externality with respect to the other tax haven's lobbying. Remembering that onshore pressure and offshore lobbying are strategic substitutes, the lobbying effect of one tax haven (partially) crowds out the lobbying effort of the second tax haven. Thus, both tax havens lobby less than what was previously efficient, that is, $\tilde{\gamma^*} > \gamma^*$. However, this effect is of second order relative to the mechanical doubling of lobbying efforts.

This last result is summarized in Proposition 1.3:

Proposition 1.3 *For a given level of onshore pressure and with two symmetric offshore countries, there is less lobbying per country than relative to the case with only one tax haven. However, aggregate lobbying increases.*

Proof. See (1.31) for the respective comparison. ■

1.4 Extensions

In the following, I incorporate two extensions into the model. In the first one, the onshore government considers onshore profits in its function. In the second extension, two possibilities for the incorporation of tax competition are analyzed. These extensions build upon one another and subsequently increase the level of tax competition.

The incorporation of domestic profits only changes the results quantitatively, whereas the introduction of tax competition between the two tax havens significantly alters the result when there are fully mobile profits.

1.4.1 Positive Welfare Weight on Domestic Profits

In Section 1.2, the objective function of the onshore government, given specifically by equation (1.2), only takes tax revenue from firms into account. In the expanded model, the onshore government's objective function also reflects a valuation for net domestic firm profits, as the firms are ultimately owned by onshore individuals.[22] For this analysis, the onshore net of tax profit of the firms enter the objective function with a weight $0 \leq \lambda < 1$, wheras the implicit weight for tax revenue is one.

Note that if the government cares (more than) equally about net firm profits, that is, $\lambda \geq 1$, relative to tax revenue, it would be optimal to refrain from taxation.[23] The modified objective function $\hat{W_H}$ is given by

$$\max_t \hat{W_H} = \underbrace{t\Big[s + h\int_{\bar{x}}^{1} dF(x)\Big]}_{\text{Tax revenue}} + \underbrace{\lambda\Big[(1-t)s + (1-t)h\int_{\bar{x}}^{1} dF(x)\Big]}_{\text{Social valuation of onshore profits}} - \underbrace{\frac{\alpha^2}{2}g}_{\text{Pressure costs}} \quad . \tag{1.32}$$

As each firm's individual decision to shift profits abroad has not changed, the number of profit-shifting firms remains at $\bar{x}$ as represented in (1.1). With no change in the objective function of the offshore country, the equilibrium values for the tax rates change to $\hat{t}$, $\hat{f}_t$:

[22] Although the government could potentially also care about firm profits offshore, I abstract from incorporating these profits into the onshore government's welfare consideration.

[23] Intuitively, if the country cares equally about tax revenue and net of tax profits, it is optimal to forgo taxation, thereby eliminating the incentives to shift profits offshore. Consequently, there is no need to apply pressure and therefore $\hat{\alpha} = 0$. This is also seen by (1.33) and (1.34).

$$\hat{t} = \frac{1}{3}\Big(2\frac{k}{h}(1-\lambda) + \alpha\gamma\Big) \quad ; \quad \hat{f}_t = \frac{\frac{k}{h}(1-\lambda) - \alpha\gamma}{3} \,. \tag{1.33}$$

Ceteris paribus, the equilibrium onshore tax rate is lower than in the case without the social valuation of profits. The higher the social valuation, that is, the higher λ, the lower the tax rate. Consequently, the offshore country lowers its lump-sum fee to remain competitive. For the first stage and hence the equilibrium level of pressure and lobbying, the results are as follows:

$$\hat{\alpha} = \frac{\frac{\gamma}{3k}(1-\lambda)}{g - \frac{2\gamma^2 h}{9k}} \quad ; \quad \hat{\gamma} = \frac{9kh\rho - \alpha k(2-\lambda)}{9kh\rho - 2\alpha^2 h} \,. \tag{1.34}$$

For the inclusion of profits into the onshore country's objective function, lower levels of equilibrium pressure result. Given the relatively low tax rates, more firms stay onshore and the benefit from pressuring the remaining profit-shifting firms is not as high. Hence, the level of equilibrium pressure will fall. In response, the offshore country lobbies more as its benefit of doing so is higher.

Proposition 1.4 *If the onshore government includes domestic firm profits in the objective function, that is, $\lambda \in (0,1)$, both the resulting tax rate $\hat{t}$ and the level of pressure $\hat{\alpha}$ are lower than in the case in which the government does not incorporate domestic firm profits ($\lambda = 0$).*

Proof. This is proven by direct comparison of equation (1.33) with equation (1.6) for tax rates and equation (1.34) with (1.9) and (1.11) for pressure and lobbying, respectively. ■

1.4.2 Tax Competition with Multiple Tax Havens

So far Section 1.3 only considers bilateral mobility of profits and abstracts from international mobility. To examine the effect of international tax competition in this framework, two extensions that build upon each other are considered.

Mobile Profits with Bilateral Loyalty The first extension considers the case in which there is no immobile share of profits anymore, that is, $s + h_1 + h_2 = 1$ with $s = 0$. This means that there are only two bilaterally mobile shares $h_1 > 0$ and $h_2 > 0$ that are mobile between the onshore country and the respective tax haven.

Although the individual firm's decision whether or not to shift profits offshore has not changed, there are some changes on the country level. In the second stage, there is an unambiguous fall in the onshore tax rate that is now given by

$$\hat{t^*} = \frac{1}{3}\Big[2k + \alpha\gamma_1 h_1 + \alpha\gamma_2 h_2\Big] < \tilde{t^*} = \frac{1}{3(h_1+h_2)}\Big[2k + \alpha\gamma_1 h_1 + \alpha\gamma_2 h_2\Big] \ . \tag{1.35}$$

Intuitively, as there is no immobile share of profits anymore, the onshore country reduces the tax rate to retain some mobile profits that were previously immobile. The lump-sum fee for the offshore country, here for tax haven 1, is given by

$$\hat{f_{t1}} = \frac{1}{6}\Big[2k - 2\alpha\gamma_1 - h_2\alpha[\gamma_1 - \gamma_2]\Big] \ . \tag{1.36}$$

It is not possible to make a definite statement whether the derived offshore fee $\hat{f_{tl}}$ is larger or smaller than in the case with immobile profits, as the relative increase in h_1 and h_2 influences this fee. However, for the case of symmetric countries as discussed in Section 1.3, $\hat{f_{tl}} < f_{tl}$ holds unambiguously.

Regarding the last stage of the game, it is again assumed that the offshore countries are symmetric in important respects, such as lobbying cost-effectiveness and attainable share of profits, that is, $h_1 = h_2 = 0.5$, in line with Section 1.3.

The resulting levels of onshore pressure and offshore lobbying are then given by

$$\hat{\alpha^*} = \frac{\frac{4\gamma}{9}}{g - \frac{\gamma^2}{6k}} \quad ; \quad \hat{\gamma^*} = \frac{9k\rho - 2.5k\alpha}{9k\rho - 2.5\alpha^2} \ . \tag{1.37}$$

Relative to the case presented in Section 1.3, the level of onshore pressure is lower, that is, $\hat{\alpha^*} < \tilde{\alpha^*}$. In contrary, the level of offshore lobbying increases, $\hat{\gamma^*} < \tilde{\gamma^*}$. This is quite intuitive, as the position of the onshore country has worsened relative to the initial case. There is no share of profit that remains onshore any more. Hence, the domestic government has to react to the stronger level of international tax competition and reduce its tax rate. This also leaves less funds for using the pressure tool. Given that onshore pressure and offshore lobbying are strategic substitutes, the tax havens use their tool more intensively.

Mobile Profits without Loyal Profits One can further increase the level of tax competition by making the previously loyal profits completely mobile, that is, $h = 1$. This means that profits can remain in the onshore country or be moved to either of the two tax havens. Following the previous part, there are no immobile profits anymore, $s = 0$.

Because there is no certain base for any of the offshore countries anymore, there is a Bertrand-style competition for the internationally mobile profits. Given that the marginal costs for the service offered is zero, there will be a corner solution in which both countries set a lump-sum fee of zero.[24]

Given an unchanged equilibrium for the number of profit-shifting firms $\bar{x}$, there is a new equilibrium in the second stage given by

$$\hat{t} = \frac{1}{2}\Big(k + \alpha\gamma\Big) \quad ; \quad \hat{f}_{tl} = 0 \; . \tag{1.38}$$

As the fee for the offshore country is zero, there is no benefit of inducing firms to shift profits offshore. Hence, it is efficient for the offshore country to abstain from using lobbying. Concerning the onshore country, there is a positive level of pressure to further induce firms to remain onshore. The equilibrium parameters are given by

$$\hat{\alpha} = \frac{\frac{3}{4}}{g - \frac{1}{k}} \quad ; \quad \hat{\gamma} = 1 \; . \tag{1.39}$$

To sum up, in the first case, when allowing for bilateral tax competition between onshore country and each tax haven, there is downward pressure on the tax rate. Furthermore, onshore pressure falls. As a a consequence, the offshore countries increase their lobbying efforts. When further allowing for tax competition between the tax havens, there is the corner solution of a zero fee. Because there are no funds available, there is also no lobbying. In this case, the onshore country uses both a positive tax rate and pressure to ensure that more firms remain onshore.

[24] As a tie breaking rule, one country gets all mobile profits. Analogous results hold for an equal split rule.

1.5 Conclusion

In this paper, I have emphasized the role of international lobbying in the fight against tax havens. To this end, I used a three-stage, two country model in which the onshore country and offshore country decide about pressure and lobbying before setting their respective tax rates. Lastly, onshore multinational firms decide whether to shift profits or not.

In this context, international lobbying is found to decrease the onshore country's benefit to apply pressure and is thus an important tool used by offshore countries to attenuate the negative effects associated with pressure. Only in rare cases, when onshore governments are over-proportionally efficient and able to eliminate profit shifting, there is no lobbying. If this is not the case, there is at least some lobbying.

This result helps to explain the puzzle that, despite the various measures used in the fight against tax havens, there remains scope for international profit shifting by multinational firms. This is the case, as the effective level of pressure endured by firms is significantly below the level intended by the onshore governments.

Furthermore, I show that early stages of international integration might potentially reduce profit shifting. Up to a threshold, general tax incentives change at a relatively high pace compared with cost reductions in firm-level profit-shifting costs. Assuming that this threshold has already been passed, further improving capital mobility within Europe will fuel profit shifting. In this respect, accessions to the EU may give rise to suitable setups to empirically examine a reduction in international frictions and to confirm the theoretical predictions.

When generalizing the model to allow for a second tax haven, there is evidence that an adding-up effect of lobbying takes place. Despite some intercountry spillovers among tax havens, the overall lobbying that onshore countries face is higher than in the case with only one tax haven. For an increasing number of tax havens, the onshore country also increases its pressure level, as the marginal benefit of pressure is higher than in the case with one haven only.

Starting from these new results, there is ample scope for future research. One example could be an examination of a generalized model with offshore countries that are heterogeneous in costs. This is left for future research.

Chapter 2

Enforcement Focus Lists and Tax Evasion

The idea for this chapter came up in discussions with Franz Reiter. The chapter is based on single-authored work.

2.1 Introduction

Personal income tax evasion is a concern to governmental revenue agencies all over the world. According to the most recent estimates, 56% (or 245 billion US-$) of the United States' annual overall tax gap is due to under-reporting in the individual income tax (Internal Revenue Service 2019). Similarly, 40% of the United Kingdom's tax gap comes from missing payments related to the income tax, national insurance contributions, and capital gains taxes (HMRC 2018).

As a consequence, various policies to limit personal income tax evasion have emerged in recent years. Most prominently, the growing access to third-party-reported data made it less costly for tax revenue agencies to cross check reported income. For example, wage earning taxpayers might have their salary directly reported to the tax administration by their employer. As the detection probability for under-reporting wage income is close to one, taxpayers' expected costs of evading taxes are high. However, third-party reporting is not available for all income sources.

In randomized control trials, researchers have shown that increasing the salience of the potential punishment for tax evasion by sending letters, e-mails, or home visits increases tax compliance.[1] Similarly, announcing and conducting thorough audits is an additional tool to increase compliance for all income sources (Kleven et al. 2011). However, unlike the expansion of third-party reporting, rolling out personal visits or thorough audits for the entire taxpayer population is prohibitively expensive.[2]

Thus, alternative low-cost interventions which increase tax compliance on a population-wide scale are worthwhile to examine. One candidate policy is currently conducted in Germany. Since 2011, the German state of North Rhine-Westphalia (NRW) announces an annual enforcement focus list. At the beginning of each year, the Ministry of Finance publishes income sources, and sometimes line items, which are a focus in the enforcement process for personal income taxes.[3] These focal items are announced in one list and vary at the level of the local tax offices which are responsible for the personal income tax enforcement of taxpayers living in their respective

[1] See Slemrod (2019) for a recent overview of the literature on tax compliance and enforcement with a focus on empirical studies. Alm (2012) provides an earlier overview regarding the literature on tax evasion.

[2] See Kuchumova (2017) for a theoretical analysis of the optimal information reporting and auditing mix.

[3] Similar nationwide programs are conducted in the Netherlands (see e.g. Kastoryano 2015) and in Sweden.

district. Initially, the list was only rolled out in a part of the state, before being expanded to a complete state-wide coverage in early 2014. The list can be found on and downloaded from the Ministry's website and has been discussed in various national and local news outlets.[4] For taxpayers who previously under-reported income, the enforcement focus list increases the detection probability for this behavior. Thus, relative to a control group, affected taxpayers increase their reported income. This, in turn, provides indirect evidence for tax evasion.

In this paper, I examine whether the introduction of the population-wide enforcement focus list in North Rhine-Westphalia in early 2011 did in fact increase tax compliance. To do so, I use the Taxpayer-Panel data set, a 5%-stratified random sample of all German taxpayers provided by the Research Data Center of the Federal Statistical Office and Statistical Offices of the Federal States. As the data set contains information about the residence of taxpayers, I am able to assign taxpayers in NRW to their respective tax office and, thus, their respective treatment for the first list published in early 2011, i.e. for the tax year 2010.

In my main estimation approach, I rely on taxpayers who were living in the policy area in the tax year 2010 and employ a generalized difference-in-differences estimation strategy. If a taxpayer's tax office has a certain income category as a focus point, this taxpayer is part of the treatment group. Taxpayers whose tax offices do not have this income category on the enforcement focus list serve as the control group. To ensure that my results are not biased by potential spillover evasion in other items, three robustness checks are conducted. These robustness checks respectively consider NRW's later treated group, neighboring taxpayers in other states, and all German taxpayers outside of NRW as the control group.

Overall, I find that the introduction of the enforcement focus list has limited effects on tax compliance. Only three out of seven income categories (capital income, rental income, and other income) experience significant positive direct effects, i.e. increases in reported income, when included in the enforcement focus list. Out of these three income categories, only capital income also experiences a significant increase in overall taxable income.

Yet, when specific line items are mentioned in the enforcement focus list, taxpayers do react strongly. To demonstrate this, I provide evidence for the line item "commuting

[4] One example for the list in 2019: `https://www.focus.de/finanzen/steuern/steuertipps/prueffelder-ruecken-jedes-jahr-in-den-fokus-vorsicht-bei-der-steuererklaerung-wo-das-finanzamt-jetzt-genauer-hinschaut_id_10773972.html` (last accessed: 2021-01-30).

cost deduction" (labor income) which has been on the first enforcement focus list as a single item. Taxpayers adjust these deductions immediately and persistently, leading to lower deductions in the labor income category. Thus, instead of broadly mentioning income categories, picking distinctive line items seems to be a more efficient approach.

This work relates to a large literature on tax evasion. The seminal work by Allingham and Sandmo (1972), based on Becker (1968), gives a first theoretical foundation for tax evasion. Allingham and Sandmo show that tax evasion can be a rational choice and it depends on three parameters: The tax rate, the penalty on undeclared income, and the detection or audit probability. Yitzhaki (1974) further shows that the important trade-offs also persist if the penalty is levied on evaded taxes rather than evaded income. Sandmo (2005) summarizes this theoretical literature on tax evasion.

As tax rates and imposed penalties are hardly ever randomized, most empirical research on tax evasion has focused on the detection probability. One general result of the literature is that sources of income that are characterized by a high detection probability, such as third-party reported wage income, experience low levels of tax evasion.[5] In contrast, self-reported components of the tax return are more likely to be used to evade tax payments. Kleven et al. (2011) show this using Danish data, whereas Engström and Hagen (2017) and Engström and Holmlund (2009) confirm the result for Swedish data. When expanding third-party reporting, taxpayers increase reported income but also reported costs (Carrillo et al. 2017; Naritomi 2019).

Starting with Blumenthal et al. (2001) and Slemrod et al. (2001), a large literature using randomized control trials in the tax evasion context emerged. Mostly using modified letters, researchers examine the effectiveness of different contents or modes of communication. For example, Bott et al. (2020) sent various letters to Norwegians that potentially under-reported foreign income. While the salience of the detection probability leads taxpayers to start reporting foreign income, the moral appeal treatment mainly increases the amount reported. Generally, moral appeals and social information seem to have limited effects (Fellner et al. 2013). Other recent work has examined notification strategies for late-payers in the United Kingdom (Hallsworth et al. 2017) or notification strategies with respect to local property taxes (Chirico et al. 2016). Recently, researchers have also looked at other forms of increasing tax compliance with different modes of communication such as phone calls or personal visits (e.g. Ortega and Scartascini 2017). The authors find that the more personal an in-

[5]Even in the absence of any detection probability, taxpayers are intrinsically motivated to pay taxes, as shown by Dwenger et al. (2016).

teraction with a taxpayer is, the larger the increase in tax compliance. Generally, there are long-term increases in taxable income and tax revenue from one-time interventions as recently highlighted by Advani et al. (2019), DeBacker et al. (2018), and Gemmell and Ratto (2012). I contribute to this literature by empirically assessing a low-cost, population-wide tax enforcement policy. My findings suggest that general enforcement announcements are less effective in increasing tax compliance than precise enforcement announcements, i.e. on the line item level. Thus, tax administration officials should carefully consider how to design such enforcement focus lists.

The remainder of this paper is organized as follows. Section 2.2 gives some institutional background on tax enforcement in Germany and explains the enforcement focus list policy in more detail. Section 2.3 introduces the data set, before the empirical strategy is explained in Section 2.4. Section 2.5 presents the results, provides a discussion, and two robustness checks. Section 2.6 concludes.

2.2 Institutional Background and Policy Details

2.2.1 Institutional Background

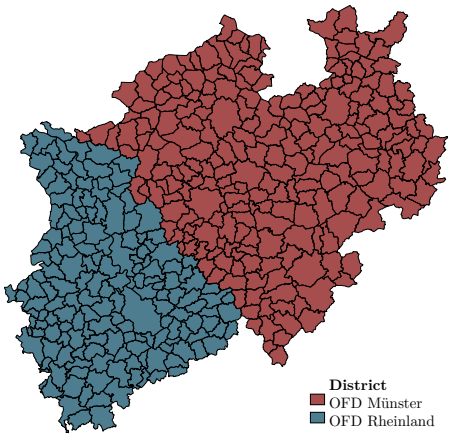
To evaluate the policy of publishing enforcement focus lists, it is key to understand the institutional background concerning personal income taxation in Germany.

The German personal income tax system only consists of one federal tax code. Unlike many other countries, German taxpayers do not pay additional state taxes. Rather, the revenue from the personal income tax is split between the different layers of government. The federal government and the state government each obtain 42.5% of the personal income tax revenue while the municipality of residence receives the remaining 15%. Changes to the tax code are passed by the federal legislature (*Bundestag*) and have to be approved by a majority of the states (*Bundesrat*).

Generally, the German income tax code distinguishes seven different categories of income: (i) Agricultural and forestry Income (AFI), (ii) business income (BIN), (iii) self-employed income (SEI), (iv) labor income (LIN), (v) capital income (CIN), (vi) rental income (RIN), and (vii) other income (OIN). Taxpayers whose single income source is employment income can decide whether or not to file an income tax return.[6]

[6]See Hauck and Wallossek (2021) for a comprehensive introduction to the German optional tax filing system for employees.

Figure 2.1: OFD Districts in North Rhine-Westphalia (Municipality Level)



Data: GeoBasis-DE/BKG (2018). Based on VG250, own illustration.
Notes: This map shows to which of the two intermediate layers of tax administration (*Oberfinanzdirektion*) in North Rhine-Westphalia a municipality belongs in 2010. *OFD Münster* in red, *OFD Rheinland* in blue.

For those earning income in one of the other categories, filing is mandatory and has to be done by May the following year.[7] If taxpayers consult a tax adviser, the deadline is prolonged until February the following year, i.e. February 2012 for the 2010 tax return.

Unlike legislation, the enforcement of personal income taxes in Germany is conducted by the states. Based on their residence, taxpayers file an income tax return with their local tax office. In 2016, there were 535 tax offices in Germany (Bundesministerium der Finanzen 2018a), which are all under the supervision of the respective state's Ministry of Finance. As Germany has 401 counties (NUTS-3 level), the average tax office district is smaller than the average German county. Given the above mentioned revenue sharing quotas, the state and the municipality receive a combined 57.5% of the income tax revenue, thereby providing strong incentives to enforce the personal income tax.

As of 2017, eight of the sixteen German states had an additional intermediate layer within the tax administration – so-called *Oberfinanzdirektionen* (OFD) (Bundesministerium der Finanzen 2018a). Most relevant for this paper, until June 2013, North Rhine-Westphalia had two disjoint intermediate tax authorities, *OFD Münster* and *OFD Rheinland*. In June 2013, both merged to form a single intermediate layer in the tax administration – *OFD North Rhine-Westphalia*. Figure 2.1 shows the assignment of municipalities to both OFDs in the state in 2010.

[7]For tax returns concerning the tax years 2018 and later, the filing deadline was prolonged by two months. This is however outside of this paper's time frame.

2.2.2 Enforcement Focus List Policy

As of January 2011, *OFD Münster*, one of NRW's intermediate tax authorities, started publishing an enforcement focus list containing one or multiple income sources for each tax office, sometimes even naming particular line items. Each year, a single list is published which includes the name of the tax office, the tax office number, and which income categories, or line items, are focal points. Figure B.1 in the appendix shows the first page for the first list which was published in early 2011, i.e. for the tax year 2010. For example, taxpayers residing in the tax office district *Altena* (tax office number 302), were facing, among other things, more scrutiny with respect to their rental income for the tax year 2010. It is possible that tax offices have more than one income category as an enforcement focus point in a given year.

Since 2011, NRW's tax authority publishes this list at the beginning of each year, usually by the end of January. The latest version is published on the state's Ministry of Finance's website and both local and national news outlets regularly report about these lists, suggesting that taxpayers are aware of the policy.[8]

For the tax year 2013, following the merger of OFD Münster and OFD Rheinland, all tax-offices in North Rhine-Westphalia are on the enforcement focus list and thus all taxpayers in NRW are treated. For the purpose of this paper, I focus on the variation in tax evasion detection probabilities induced by the introduction of the enforcement focus list in 2011 (tax year 2010) in the OFD Münster region. This has multiple benefits. As further discussed in subsection 2.4.3, using the introduction alleviates concerns currently discussed in the empirical literature on biased estimates in difference-in-differences settings with variation in treatment timing (e.g. Goodman-Bacon 2020). Second, previous research has highlighted that one-time interventions can have long-term effects (e.g. Advani et al. 2019). Focusing on the introduction of the enforcement focus list allows me to capture these long-term effects. Third, arguably the largest shock induced by an enforcement policy should be in the first year, rather than in later years when taxpayers are accustomed to it.

Given the previous literature, especially Allingham and Sandmo (1972), an increase in the perceived detection probability, as induced by the enforcement focus list, changes the tax evasion incentives for taxpayers. For the relevant income source, the detection

[8]See for example `https://www.handelsblatt.com/finanzen/steuern-recht/steuern/serie-ratgeber-steuererklaerung-spickzettel-fuer-steuerzahler-wo-das-finanzamt-2019-genauer-hinschaut/22597714.html?ticket=ST-5561966-CDh5fBR45pWZvuJpcbZU-ap5` (last accessed: 2021-02-12) for the list in early 2019.

probability increases and thus marginal costs of evading taxes rise. Hence, I expect taxpayers to report a larger share for this income category. For overall taxable income, the comparative statics are less straightforward and depend on assumptions. For example, substitution evasion in other income sources can take place, as theoretically highlighted by Klepper and Nagin (1989). Cummings et al. (2006) show in a laboratory experiment that this can even lead to overcompensation and ultimately less taxable income.

Early empirical work, constructing line item audit probabilities by using post-audit adjustments from the IRS, contradicts the laboratory overcompensation result (Martinez-Vazquez and Rider 2005).[9] Thus, the overall response of taxable income to an increase in the detection probability for some income source remains empirically unclear.

2.3 Data Set and Sample Selection

To causally analyze whether the first publication of the enforcement focus list had an effect on reported income, I use a 5% stratified random sample of German taxpayers for the tax years between 2005 and 2016, based on the German Taxpayer-Panel (TPP). The TPP is an administrative panel data set, provided by the Research Data Center of the Federal Statistical Office and Statistical Office of the Federal States. It is drawn from the universe of German taxpayers who file an income tax return in at least five years between 2001 and 2016, whereby the taxable unit is either a single taxpayer or married couples if they decide to file jointly.[10] If not indicated otherwise, all results in this paper are estimated using the statistical weights provided by the statistical offices.

The data set includes a number of variables. Most interesting for this analysis, the data set contains the levels of revenue net of expenses (or standard deductions) for the seven different income categories as stated in the taxpayer's final tax assessment. Furthermore, it contains a limited number of line items, for example commuting cost deductions for labor income, and overall taxable income.

To assign treatment and control group status to taxpayers, residence data is necessary. The data set includes a unique eight-digit identifier (*Amtlicher Gemeindeschlüssel*) for

[9] Similar questions have been addressed in the context of firm taxation (Carrillo et al. 2017) and import duties (Yang 2008).

[10] See Kriete-Dodds and Vorgrimler (2007) for a description explaining the sampling procedure of the German TPP.

taxpayers' municipalities of residence between the tax years 2012 and 2016. For years prior to 2012, only information on a taxpayer's state of residence is given. Thus, I impute the taxpayers' residence municipalities for prior years. Intuitively, if a taxpayer's state of residence in 2011 corresponds to the state of residence in the 2012 municipality information, I extrapolate the 2012 municipality information back to 2011. This iterative procedure is done for as long as the 2012 state of residence is equal to the respective tax year's state of residence. Whenever taxpayers moved between states before 2012, I don't have sufficient information on their residence and the previous years for this taxpayer are discarded.[11]

Administrative data on tax office districts, provided by the Federal Statistical Office, is available from 2009 to 2016. By using the unique eight-digit identifier, I match taxpayers to their respective tax office district. For taxpayers living in cities with more than one tax office, the matching is imperfect and I attribute one common tax office to all taxpayers living in this city.[12] To match taxpayers to tax office districts prior to 2009, I fix the oldest official tax office district data available (2009) and ascribe it to the previous years used in this study (2005-2008).

Imputing residence and tax office district data does not influence the results strongly. First, German citizens are moving less often than citizens of other countries. According to recent estimates, only about 3% of the population move beyond county borders in Germany every year (Rosenbaum-Feldbrügge and Stawarz 2020). Second, as concerns the tax office district imputation, the number of tax office districts, and their composition, has remained fairly stable over time.

Since the tax year 2012, the Taxpayer-Panel started sampling legal non-filers, which are mainly single employees with wage income only. As these taxpayers are not affected by the publication of the enforcement focus list, these observations are excluded. Furthermore, taxpayers with loss-carryforwards and loss-carrybackwards are excluded, as they were also not sampled prior to 2012.

Lastly, I restrict the sample to taxpayers who have a standard filing status, excluding widows and widowers in the year of their spouse's death and the subsequent year as they face a special tax scheme.

[11] The main results are stable to a (not-reported) robustness check where all between-state moving taxpayers are excluded.

[12] For example, in NRW the city district determines the tax office. Unfortunately, residence data is not available at such a detailed level. This leads to 475 unique tax office districts in Germany in 2009.

2.4 Empirical Strategy

2.4.1 Generalized Difference-in-Differences

In order to assess the average treatment effect of introducing enforcement focus lists on reported income, I use a generalized difference-in-differences estimation strategy. For the main specification, only taxpayers residing in the OFD Münster area in 2010 are considered. This has two benefits. First, as discussed before, tax enforcement is organized on the state level or the intermediate tax administration level. Thus, if the treatment and control group are from the same enforcement environment, the general enforcement regime is the same and other (orthogonal) changes to the enforcement regime at this level affect both groups equally. Second, local control groups are more likely to be similar in unobserved characteristics, too. When these characteristics potentially change over time, and cannot be controlled for, similar groups mitigate concerns of biased results. In a robustness check, see subsection 2.5.4, I also use three additional control groups.

Whether a taxpayer is in the treatment or the control group for a certain income category depends on the residence when filing. Based on the list list from early 2011, Figure B.2 in the appendix presents the treatment assignments for all income categories at the municipality level for the tax year 2010 visually. The intuition for the treatment and control group assignment is as follows.

For example, rental income is listed as an enforcement focus in Dortmund in 2010. Consider a taxpayer earning rental income in Dortmund in 2010. If this taxpayer previously evaded taxes on rental income, an announcement on the enforcement focus list shifts the perceived detection probability. Thus, the marginal costs of evading taxes increase and the level of reported rental income should increase, as predicted by Allingham and Sandmo (1972). Hence, these taxpayers constitute the treatment group for rental income. Taxpayers in the tax office district Wiedenbrück, for example, did not see rental income on the enforcement focus list. Thus, their incentives to under-report rental income do not change directly and they serve as the control group.

Based on this treatment assignment, I employ a generalized difference-in-differences estimation strategy. This allows me to estimate a common trend for the treatment and the control group, while controlling for other covariates that might influence the outcome (Jacobson et al. 1993). This yields the following baseline estimation equation:

$$Y_{ilt} = \alpha_0 + \sum_{t=2005, t\neq 2009}^{t=2016} \alpha_t Year_t + \sum_{t=2005, t\neq 2009}^{t=2016} \beta_t Year_t \cdot D_{il,2010} + \gamma_i + \delta_o + \boldsymbol{X}_{ilt} + \epsilon_{ilt} \ , \tag{2.1}$$

where Y_{ilt} is the reported level of revenue net of expenses for income category l by taxpayer i in tax year t. $D_{il,2010}$ is the binary treatment indicator whether taxpayer i was subject to the treatment for income (line item) l in 2010 and $Year_t$ is a year dummy for year t, common for the treatment and the control group. Furthermore, individual fixed effects (γ_i) and tax office fixed effects (δ_o) are considered.[13]

Intuitively, $\hat{\alpha}_t$ estimates the common time trend that the treatment and control group share. The $\hat{\beta}_t$ estimates represent the deviation of the treatment group, relative to the control group. In the absence of pre-trends between the treatment and the control group, $\hat{\beta}_{2005}$ - $\hat{\beta}_{2009}$ should not be statistically different from zero. For the years after 2010, $\hat{\beta}_{2010}$ - $\hat{\beta}_{2016}$ identify the causal effect of income category l being part of the first enforcement focus list in 2010 on reported income in the years 2010 to 2016, respectively. For example, $\hat{\beta}_{2012}$ estimates the change in reported income in the tax year 2012, causally induced by the enforcement focus list in 2010, conditional on the control variables. To avoid multi-collinearity in α_t and β_t, the estimates are normalized to the base year 2009, one year prior to the introduction of the policy.

Lastly, $\boldsymbol{X}_{ilt}$ is a vector controlling for treatments in other income categories $k \neq l$ in 2010 and for treatments in all income categories in the years thereafter. In line with the current literature, standard errors are clustered at the level of treatment assignment, i.e. the tax office level (Abadie et al. 2017).

In principle, there are other estimation strategies possible to assess the causal effect of enforcement focus lists. However, using the introduction of the enforcement focus list, rather than, for example, pooling all announcements after 2010 into a single treatment dummy, has multiple advantages. First, there is a very recent methodological literature on biased estimates in difference-in-differences analyses with twoway fixed effects and differential treatment timing (Goodman-Bacon 2020). For a pooled treatment dummy to represent an unbiased estimate, one key requirement is that treatment effects remain

[13] As the treatment assignment is fixed over the entire period, there is no benefit in including the treatment group dummy on its own. It would be perfectly collinear with the individual fixed effects.

constant over time. In this particular setting, reactions to the first list would have to be equal to reactions in all later years, which is likely a problematic assumption.

Second, in line with previous research on enforcement initiatives, one time interventions can have long-term effects. For example, Advani et al. (2019) show for audits in the United Kingdom that reported income, and therefore also tax revenue, is significantly higher for at least five years after an audit. The difference-in-differences specification here allows me to estimate such effects, while controlling for the content of the lists concerning the tax years 2011 and later. Lastly, the shock induced by the initial introduction of the enforcement focus list is probably larger relative to any later year, as taxpayers are not yet accustomed to this tool.

2.4.2 SUTVA and Substitution Evasion

One criterion that ought to be met for an unbiased estimate of the causal effect is the stable unit treatment value assumption (SUTVA). Put differently, the general policy rollout in the OFD Münster area must not have spillovers to the control group, otherwise this criterion is violated. One potential violation can be constructed as follows: Taxpayers in Wiedenbrück, who serve as the control group in the rental income example before, are treated for labor income. If these taxpayers have a fixed amount of under-reported income that they aim for, or if they assume that the enforcement budget is fixed and all other income categories are therefore screened less intensively, substitution evasion might take place. It might thus be that the enforcement announcement for labor income increases reported labor income but induces taxpayers to report less in other income categories, such as rental income. Then, the $\hat{\beta}_t$ estimates for rental income would be upwards biased. If, however, local spillovers lead to more reported income, also in the control group, as suggested by Rincke and Traxler (2011), then my estimates would be downwards biased.

To alleviate concerns about this problem, I conduct further robustness checks. In these robustness checks, I use three different control groups whose reporting incentives are not affected by the introduction of the enforcement focus list. These groups are (i) taxpayers in the untreated part of NRW, (ii) taxpayers in neighboring districts outside of NRW, and (iii) all German taxpayers living outside of NRW. The results for these exercises are reported in the Appendix, subsection B.1, and are similar to the baseline estimates. This suggests that substitution evasion is not a first order concern.

2.4.3 Further Threats to Identification

Besides the aforementioned stable unit treatment value assumption, additional criteria have to be met for equation (2.1) to identify an unbiased causal estimate of the average treatment effect. First, in the absence of the intervention, both the treatment and the control group should have exhibited the same trend. While this common trend assumption is ultimately untestable, I argue that this is not a concern here. The pre-intervention treatment group differences are not jointly statistically significant from zero for the majority of the income categories, as reported later in the Results, i.e. Table 2.3 and Figure 2.2.

Second, other margins of response, specifically a selection out of treatment, must not be relevant. While this is theoretically possible, it seems fairly unlikely that taxpayers' moving decisions are causally influenced by these lists. This is especially true when considering the fact that Germans are relatively immobile and only about 3% of the German population move to other counties every year (Rosenbaum-Feldbrügge and Stawarz 2020).

Furthermore, when using difference-in-differences settings, potential anticipation effects have to be taken into account. As the first list has been published in January 2011, i.e. after the end of the tax year 2010, there is no potential for real adjustments ex-post and only reporting responses can take place.

A more general caveat however is that the treatment assignment could be the result of negative selection and might bias the results. For example, if the tax authority in NRW suspects that taxpayers in Dortmund are under-reporting rental income, taxpayers in Dortmund might exactly be treated in this area. Unfortunately, the tax authorities did not communicate the intent of the enforcement focus list.

However, if the tax authority was strategically targeting tax office districts where they suspect evasion for an income source, this should be visible in the data. Tax offices with lower averages in an income category should have a higher probability of ending up on the 2010 enforcement focus list. Using a linear probability model, I am able to provide suggestive evidence that treatment assignment was most likely not based on this simple heuristic.

Table 2.1 summarizes these results, comparing treated tax offices in the OFD Münster area with all German tax offices and with all tax offices within the state. Each coefficient represents the point estimate for the respective linear probability estimation, where the outcome variable is the treatment status in 2010 and the explanatory variable

Table 2.1: Treatment Assignment Prediction

Panel A: All German Tax Offices							
	AFI	BIN	SEI	LIN	CIN	RIN	OIN
Mean 2009	0.038*	0.017*	-0.012	0.000	0.002	0.049*	0.012
	(0.020)	(0.009)	(0.009)	(0.000)	(0.008)	(0.029)	(0.021)
Mean 2008	0.027*	0.001	-0.013*	0.000	0.000	0.040	0.008
	(0.015)	(0.005)	(0.007)	(0.000)	(0.001)	(0.026)	(0.020)
Observations	462	462	462	462	462	462	462
Panel B: Only Tax Offices in NRW							
	AFI	BIN	SEI	LIN	CIN	RIN	OIN
Mean 2009	0.340**	0.025	-0.071**	-0.007	0.015	-0.120	-0.129
	(0.135)	(0.033)	(0.032)	(0.007)	(0.079)	(0.170)	(0.116)
Mean 2008	0.277**	0.016	-0.077**	-0.006	-0.011	-0.259	-0.152
	(0.113)	(0.025)	(0.036)	(0.007)	(0.011)	(0.169)	(0.122)
Observations	87	87	87	87	87	87	87

Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Taxpayer-Panel, 2001-2016, own calculations.
Notes: Dependent variable: Treatment assignment in one of the seven categories: AFI: Agricultural and Forestry Income; BIN: Business Income; LIN: Labor Income; RIN: Rental Income; CIN: Capital Income; OIN: Other Income. The difference in the number of tax offices reported (462) to the number of unique tax offices in Germany (475) is due to incorrect residence information in Mecklenburg-Western Pomerania as noted in the official data description. Each coefficient represents the point estimate for a heteroskedasticity robust linear probability model, whereby the outcome variable is the treatment status in 2010. *Reading example:* For a tax office in North Rhine-Westphalia, an increase in the mean agricultural and forestry income in 2009 by 1,000 € increases the likelihood that this tax office is on the focus list by 34%. See Figure B.3 for a graphical representation of tax office level means in NRW in 2009. ***p<0.01, **p<0.05, p*<0.1.

the respective income category's mean in 2009 or 2008, respectively. Only for self-employed income, a higher mean of reported income in 2009 is associated with a lower likelihood to be treated in 2010, i.e. a negative selection. Surprisingly, there is a positive selection for agricultural and forestry income, suggesting a specialization for this income category. Tax offices which had tax returns with higher than average income in this category were treated.

For the remaining five income categories, there is no significant selection on pre-intervention means. Figure B.2 in the appendix visually illustrates for each income category the means of treated and control group tax offices in NRW. Furthermore, a robustness check using entropy-balancing to match on pre-2010 income category means yields similar results than the baseline results, see subsection 2.5.4. This suggests that there was no treatment assignment on observables. Finally, Table 2.2 provides basic descriptive statistics for all taxpayers in the OFD Münster area in 2009.

Table 2.2: Descriptive Statistics (Tax Year 2009)

	OFD Münster			
	Mean	Median	SD	Observations (weighted)
Taxable Income	40,045.15	29,969	178,587	67,806 (1,644,623)
Agricultural Income	408.97	0	17,399	67,808 (1,644,696)
Business Income	5,551.13	0	174,673	67,777 (1,644,487)
Self-Employed Income	2,836.64	0	27,080	67,793 (1,644,227)
Labor Income	35,643.61	30,920	39,029	67,791 (1,644,216)
Capital Income	395.10	0	7,833	67,537 (1,642,037)
Rental Income	653.91	0	11,570	67,789 (1,644,478)
Other Income	1,415.46	0	7,806	67,484 (1,643,490)
Age	46.82	46	14.02	67,810 (1,644,698)

Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Taxpayer-Panel, 2001-2016, own calculations.
Notes: Basic descriptive statistics for various income sources and the age distribution in the treated OFD Münster district in North Rhine-Westphalia, based on weighted data. *SD = Standard Deviation.* There is a difference between the sum of all income categories and taxable income, as taxable income includes deductible special expenses, while the first does not. Observations are given in absolute numbers and in weighted numbers. See Table B.1 for the same descriptive statistics for OFD Rheinland and the remaining German states.

2.5 Results

2.5.1 Direct Effects

Table 2.3 presents the direct effects of the enforcement focus list announcements. Each column represents a distinct regression with the corresponding level of income as the dependent variable. Column (1) for example, represents the effect that enforcement focus announcements for agricultural and forestry income have on the level of reported income in this category. The coefficients reported here are the generalized difference-in-differences year dummies for the treatment group in 2010 and later years, i.e. $\hat{\beta}_{2010}$ - $\hat{\beta}_{2016}$. As can be seen, the initial publication of the enforcement focus list did not have a clear and systematic effect on reported income.

For capital income and other income, there are, respectively, two and three years after 2010 with borderline significant point estimates, suggesting some prior tax evasion. One reason for the time lag in the response could be that taxpayers adjust their reported income gradually rather than instantaneously. However, the regression concerning capital income has to be taken with a grain of salt. Starting in the tax year 2009, automatic capital income tax withholding at source exempt the majority of German

Table 2.3: Difference-in-Differences Regressions - Direct Effect (Income Category)

	Dependent Variable : **Income in the Respective Income Category**						
	AFI	BIN	SEI	LIN	RIN	CIN	OIN
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$D_{il,2010} \cdot 2010$	63.55	-1,084.38	74.12	-391.00	90.99	-75.07*	41.26
	(99.32)	(704.33)	(139.62)	(346.92)	(59.08)	(34.11)	(31.79)
$D_{il,2010} \cdot 2011$	165.32	-758.57	-43.42	-	62.25	-	102.36**
	(116.62)	(550.67)	(178.92)	-	(66.63)	-	(43.33)
$D_{il,2010} \cdot 2012$	198.40	-348.01	-89.17	135.30	54.11	10.01	51.58
	(138.08)	(721.26)	(192.76)	(219.67)	(88.20)	(54.40)	(48.13)
$D_{il,2010} \cdot 2013$	481.66	-156.43	-138.22	-682.08	146.98*	131.59*	96.25*
	(310.14)	(1,248.62)	(200.52)	(514.27)	(86.75)	(70.97)	(55.90)
$D_{il,2010} \cdot 2014$	-20.33	-633.15	33.37	-538.10	112.48	176.50	256.52**
	(198.51)	(1,207.88)	(226.34)	(413-23)	(90.01)	(120.76)	(143.42)
$D_{il,2010} \cdot 2015$	-309.44	-1.286.08	18.64	33.90	341.13***	227.25**	106.90
	(300.68)	(1,647.13)	(257.52)	(372.69)	(97.90)	(94.78)	(80.67)
$D_{il,2010} \cdot 2016$	-2.72	88.19	120.61	-167.87	249.52**	147.66	78.00
	(192.02)	(1,428.99)	(322.92)	(410.94)	(126.04)	(127.64)	(103.46)
Individual FE	✓	✓	✓	✓	✓	✓	✓
Tax Office FE	✓	✓	✓	✓	✓	✓	✓
Other Treatments	✓	✓	✓	✓	✓	✓	✓
F-value (Pre-2010)	0.26	1.93	0.62	1.25	2.93	4.11	1.04
p-value (Pre-2010)	0.91	0.11	0.65	0.29	0.02	0.00	0.39
Non-zero restriction	✓	✓	✓	✓	✓	✓	✓
Observations (absolute)	256,373	513,589	413,628	744,996	540,453	573,977	405,237

Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Taxpayer-Panel, 2001-2016, own calculations.
Notes: Dependent variables: AFI: Agricultural and Forestry Income; BIN: Business Income; LIN: Labor Income; RIN: Rental Income; CIN: Capital Income; OIN: Other Income. Each column represents a separate regression. Only observations with at least one year of non-zero values for the respective income category between 2005 and 2009 are considered. All treatment effects are in absolute € values. All regressions include individual fixed effects and tax office fixed effects. All regressions use taxpayers in the OFD Münster area only. Treatments in the same year and in later years are controlled for with dummies. F-value and p-value for the test that the pre-2010 treatment group dummies $\hat{\beta}_{2005}$- $\hat{\beta}_{2008}$ are jointly different from zero. Standard errors are clustered at the tax office level and given in parentheses. The enforcement focus announcements for labor and capital income are perfectly collinear in 2010 and 2011. Given that I extrapolate residence information back from 2012 to 2010, all taxpayers that were treated in these categories in 2010 were also treated in 2011. Thus, these point estimates cannot be calculated. ***p<0.01, **p<0.05, *p<0.1.

taxpayers from the duty to report their capital income. Thus, responses in this income category might be driven by a different adjustment speed following the 2009 reform, as well. Additionally, the relevant tax office districts treated for capital income have been at the center of Germany's fight against capital tax evasion within the same time period.[14] Unfortunately, as the introduction of the enforcement focus list has the same level of variation (the tax office-year level), controlling for these developments

[14]In early 2010, the Ministry of Finance in North Rhine-Westphalia purchased a CD-Rom with data on German account holders at the Swiss bank Credit Suisse. See `https://www.reuters.com/article/uk-germany-switzerland-tax-evasion/german-state-buys-swiss-data-to-track-tax-frauds-ft-idUKBRE86D04820120714` last accessed: 2021-01-12).

is not possible. The strongest effects in terms of magnitude can be observed for the rental income category, starting in 2013. Taxpayers who saw rental income on the first enforcement focus list in 2010 on average increased their reported income in this category by 341.13 € in 2013, relative to the control group.

All generalized difference-in-differences estimates, $\hat{\beta}_t$, can be seen in Figure 2.2. With the exception of the rental income category, there does not seem to be an apparent pre-trend in the data, suggesting that also in the absence of the intervention, both treatment and control group would have evolved similarly. The F-values and corresponding p-values for the hypothesis that all pre-2010 dummies are unequal to zero can be found in Table 2.3. For rental income, and for capital income, this test suggests that the pre-2010 dummies are not jointly equal to zero. To alleviate concerns regarding potential pre-trends, and thus violations to the common trend assumption, subsection 2.5.4 discusses a robustness check using the entropy balancing re-weighting method to account for initial (trend) differences. The results of this exercise, which are visually summarized in Figure B.7, are similar in magnitude to the baseline results.

2.5.2 Total Effect on Taxable Income

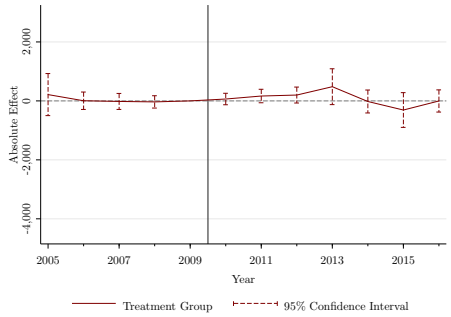
While the effectiveness of the enforcement focus announcement seems limited for individual income categories, taxable income ultimately matters for tax payments. Here, taxable income is the sum of all income categories less a limited number of clearly defined special expenses. Thus, whenever there is a positive direct effect, i.e. reported income in the category increases, the question arises whether this also transmits to higher taxable income and thus ultimately higher tax payments.

Table 2.4 reports the point estimates for this analysis. It shows the causal effects of enforcement focus announcements on ultimate taxable income. In contrast to the previous table, here the dependent variable is always taxable income and each column represents a different income category that is treated. For example, column (1) represents the effect of enforcement focus announcements in the agricultural and forestry income category on total taxable income. Figure 2.3 illustrates the results graphically.

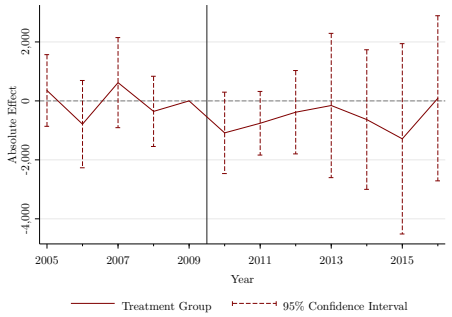
Overall, there is no significant effect for agricultural and forestry income, business income, and self-employment income. Surprisingly, listing labor income in 2010 has a strong one-time negative effect in 2013, while taxpayers treated for other income in 2010 gradually report lower taxable income than the control group. For taxpayers experiencing a higher scrutiny with respect to their rental income, the point estimates

Figure 2.2: Treatment Effects - Direct Effect (Income Categories)

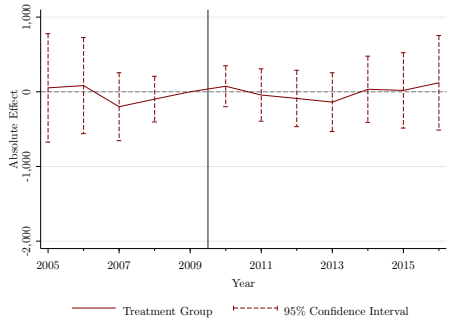
A: Agricultural and Forestry Income



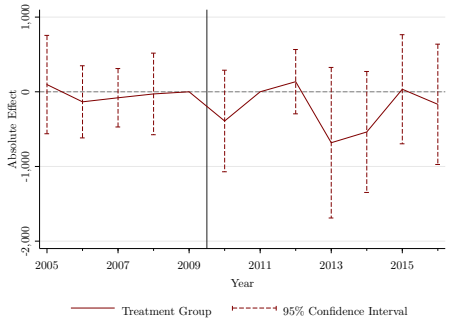
B: Business Income



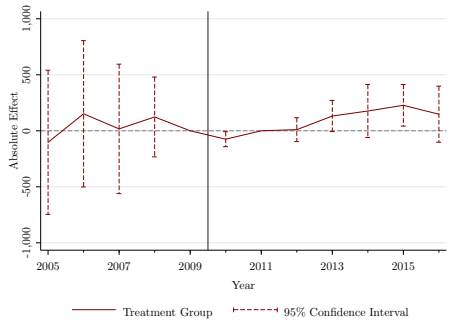
C: Self-Employed Income



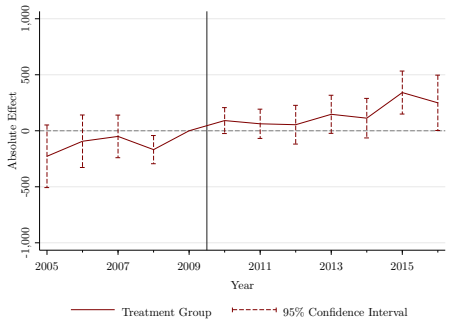
D: Labor Income



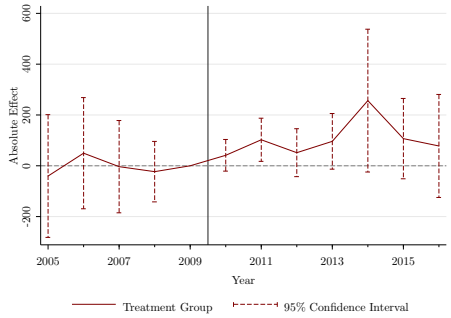
E: Capital Income



F: Rental Income



G: Other Income



Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Taxpayer-Panel, 2001-2016, own calculations.

Notes: Each graph shows the point estimate and the 95%-confidence interval for $\hat{\beta}_{2005}$ to $\hat{\beta}_{2016}$: The difference in the respective income category between the treatment and control group. Furthermore, the estimates shown here include individual, year, and tax office fixed effects and control for treatments in all years of the policy. Standard errors are clustered at the tax office level. Until 2009, prior to the first enforcement policy, point estimates should be zero, indicating no significant differences between the two groups. Significant differences to zero in 2010 and later indicate immediate and long-term effects of the 2010 enforcement focus list policy. See Table 2.3 for the $\hat{\beta}_{2010}$ - $\hat{\beta}_{2016}$ point estimates.

Table 2.4: Difference-in-Differences Regressions - Total Effect (Taxable Income)

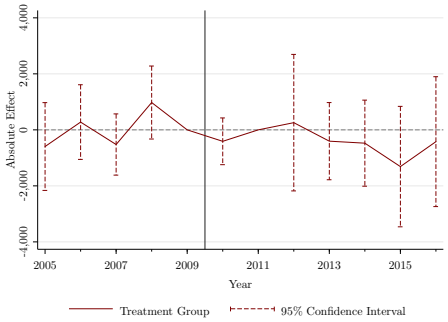
	Dependent Variable : **Taxable Income**						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$D_{il,2010} \cdot 2010$	-409.12	-1418.19*	-125.31	-588.30	189.29	780.29	-466.90
	(425.80)	(834.77)	(532.49)	(542.18)	(572.19)	(871.10)	(527.88)
$D_{il,2010} \cdot 2011$	-	-494.604	-447.41	-	910.97	-	-1698.26***
	-	(932.07)	(529.08)	-	(939.06)	-	(556.74)
$D_{il,2010} \cdot 2012$	256.69	-312.26	274.15	183.63	902.00	1269.46*	-1483.43**
	(1243.46)	(1313.36)	(743.91)	(222.12)	(681.67)	(747.28)	(611.31)
$D_{il,2010} \cdot 2013$	-403.71	-921.56	385.99	-1863.06***	1261.70	964.53	1913.72**
	(703.03)	(1053.32)	(880.73)	(704.16)	(779.65)	(646.08)	(840.41)
$D_{il,2010} \cdot 2014$	-475.45	-1125.88	5.98	696.05	1171.07	3823.83***	-2151.74***
	(784.06)	(1504.64)	(866.81)	(626.60)	(756.20)	(663.50)	(829.21)
$D_{il,2010} \cdot 2015$	-1311.73	-1125.88	65.99	-492.70	627.09	3054.98***	2476.76**
	(1097.07)	(1504.64)	(925.32)	(496.74)	(880.15)	(1064.97)	(1003.75)
$D_{il,2010} \cdot 2016$	-421.27	-308.46	457.92	-484.73	1860.60*	181.29	- 2350.38**
	(1183.08)	(1651.47)	(925.32)	(642.86)	(1082.06)	(331.68)	(1174.21)
Treated Category	AFI	BIN	SEI	LIN	RIN	CIN	OIN
Individual FE	✓	✓	✓	✓	✓	✓	✓
Tax Office FE	✓	✓	✓	✓	✓	✓	✓
Other Treatments	✓	✓	✓	✓	✓	✓	✓
F-value (Pre-2010)	1.74	2.05	1.06	2.42	0.13	14.02	1.38
p-value (Pre-2010)	0.14	0.09	0.37	0.05	0.97	1.58	0.24
Non-zero restriction	✓	✓	✓	✓	✓	✓	✓
Observations (absolute)	256,372	513,802	413,718	745,079	540,555	593,148	409,037

Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Taxpayer-Panel, 2001-2016, own calculations.
Notes: Dependent variable: Taxable Income. Each column represents a separate regression in which one of the income categories is on the enforcement focus list: AFI: Agricultural and Forestry Income; BIN: Business Income; LIN: Labor Income; RIN: Rental Income; CIN: Capital Income; OIN: Other Income. Only observations with at least one year of non-zero values for the respective income category between 2005 and 2009 are considered. All treatment effects are in absolute € values. All regressions include individual fixed effects and tax office fixed effects. All regressions use taxpayers in the OFD Münster area only. Treatments in the same year and in later years are controlled for with dummies. F-value and p-value for the test that the pre-2010 treatment group dummies $\hat{\beta}_{2005}$ - $\hat{\beta}_{2008}$ are jointly different from zero. As this is violated for capital income in the years 2006 - 2008, the corresponding p-value is larger than one. Standard errors are clustered at the tax office level and given in parentheses. The enforcement focus announcements for labor and capital income are perfectly collinear in 2010 and 2011. Given that I extrapolate residence information back from 2012 to 2010, all taxpayers that were treated in these categories in 2010 were also treated in 2011. Thus, these point estimates cannot be calculated. Furthermore, the point estimate for agricultural and forestry income in 2011 cannot be estimated. ***p<0.01, **p<0.05, *p<0.1.

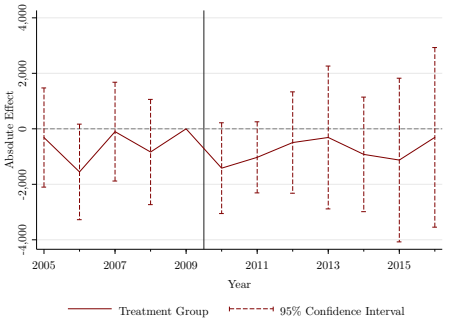
concerning taxable income are above zero and suggest a positive increase. However, the point estimates are not statistically significant from zero at conventional levels. For capital income, point estimates after 2010 are positive and significant, but larger in size than the direct effects. These large effects, the pre-trend concerns, and the potential selection issues as mentioned before lead to a cautious interpretation of these point estimates. For the other six income categories, the point estimates obtained for the direct effects (Table 2.3) are well within the 95% confidence intervals of the effect on taxable income.

Figure 2.3: Treatment Effects - Total Effect (Taxable Income)

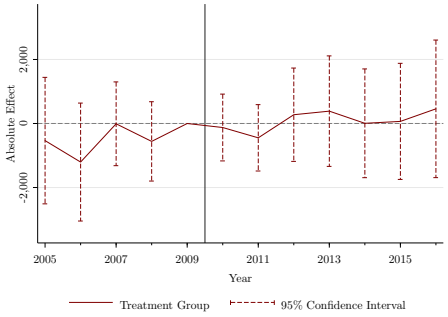
A: Agricultural and Forestry Income



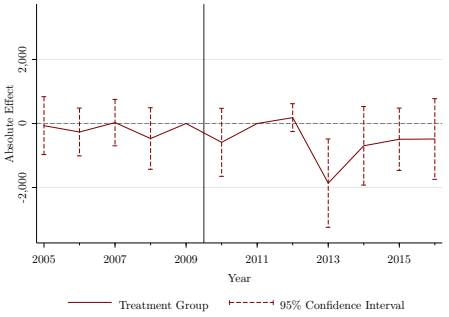
B: Business Income



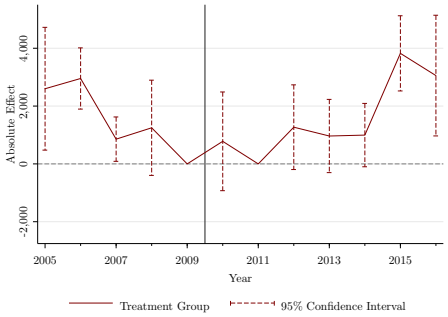
C: Self-Employed Income



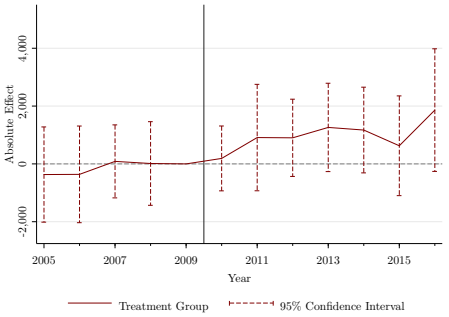
D: Labor Income



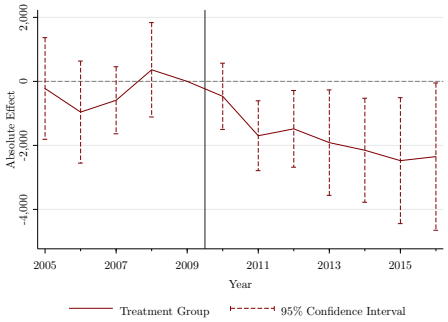
E: Capital Income



F: Rental Income



G: Other Income

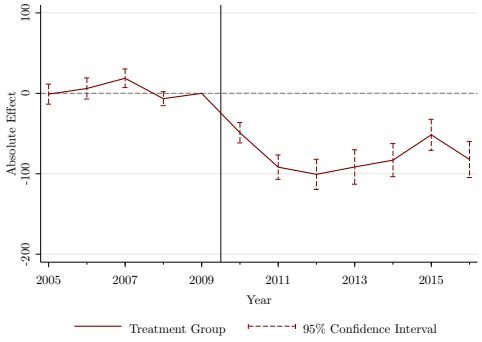


Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Taxpayer-Panel, 2001-2016, own calculations.

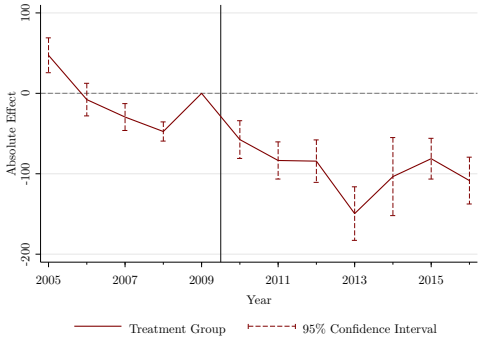
Notes: Each graph shows the point estimate and the 95%-confidence interval for $\hat{\beta}_{2005}$ to $\hat{\beta}_{2016}$: The difference in overall taxable income between the treatment and control group for treatments in an income category. Furthermore, the estimates shown here include individual, year, and tax office fixed effects and control for treatments in all years of the policy. Standard errors are clustered at the tax office level. Until 2009, prior to the first enforcement policy, point estimates should be zero, indicating no significant differences between the two groups. Significant differences to zero in 2010 and later respectively indicate immediate and long-term effects of the 2010 enforcement focus list policy. See Table 2.4 for the $\hat{\beta}_{2010}$ - $\hat{\beta}_{2016}$ point estimates.

Figure 2.4: Treatment Effects - Commuting Cost Deduction

A: Commuting Cost Deduction



B: Sum of all Deductions for Labor Income



Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Taxpayer-Panel, 2001-2016, own calculations.
Notes: Both figures show the $\hat{\beta}_{2005}$ - $\hat{\beta}_{2016}$ of being treated in labor income related commuting costs in 2010. Figure 2.4a shows deductible commuting expenses on the y-axis. Figure 2.4b shows the sum of all labor income related deductions on the y-axis. Thus, levels below zero indicate (a) lower commuting deductions or (b) lower sum of all deductions for labor income relative to the control group.

To summarize, these results suggest that enforcement focus list announcements are rather limited in their effectiveness to significantly reduce tax evasion. One noteworthy exception is rental income, where focus announcements lead to long-term increases the income reported in this category and could increase taxpayers' overall taxable income.

2.5.3 Effects on Line Items

So far, the analysis has concentrated on enforcement focus announcements on the income category level. One apparent drawback of these broad announcements is that they might not be distinctive enough to induce changes in taxpayers' detection probabilities. However, there are also a number of line items which are mentioned on the focus lists and available in the data set.

One of these particular line items concerns the commuting cost deductions that German taxpayers can use. For every workday at the office, taxpayers can report the single distance between their residence and the office. The commuting cost deduction was explicitly mentioned on the 2010 enforcement focus list.

Taxpayers who were treated for this deduction did react significantly to the policy. On average, treated taxpayers report 50 € less in deductible commuting costs in 2010 relative to the control group. Relative to the national average of taxpayers reporting commuting costs in 2010, this represents a decrease of about 3% ($\frac{48.98}{1{,}585.15}$). As seen in

Figure 2.4a, this reduction is persistent over time and increases in the following years to point estimates of about -100 €. A general effect is also visible, albeit less clearly, when looking at the sum of all deductions for labor income in Figure 2.4b. Thus, very distinctive enforcement announcements of line items can have a significant, immediate, and long lasting effect.

It should be noted that this is a line item with a high level of verifiability at low costs. For taxpayers commuting with their car, the commuting cost deduction is simply the product of days worked and the one-way distance between residence and workplace. For taxpayers using public transportation, tickets could be requested to verify expenses. Interestingly, over-stating commuting cost deductions does not seem to be unique to the German context, as researchers in Austria have highlighted (Paetzold and Winner 2016).

2.5.4 Robustness Checks

The results in the previous part are based on an analysis with taxpayers residing in the OFD Münster area. For these results to be unbiased, the stable unit treatment value assumption has to hold, i.e. no substitution evasion.

Different Control Groups. To alleviate concerns about violations of the SUTV assumption, three additional control groups are considered for which this violation is unlikely. These control groups have in common that they are not subject to the initial enforcement focus list announcement for the tax year 2010 and thus see no change in their tax evasion detection probability. First, I consider taxpayers residing in the disjoint part of North Rhine-Westphalia (OFD Rheinland), as highlighted in blue in Figure 2.1. While not being subject to the enforcement focus lists, taxpayers in this control group are still within the same state. Thus, whenever there are state-wide time-varying changes that can effect the evasion decision, this affects both the treatment and the control group.[15] As shown in Figure B.4, when using this control group, the point estimates for the direct effects are zero for all income categories. One explanation for this result could be that NRW taxpayers in the untreated part still consider the rollout in the OFD Münster area as a general increase in their evasion detection probability and thus increase reported income.

As a second alternative control group, I consider taxpayers residing in neighboring

[15] As the enforcement focus list was rolled out in the OFD Rheinland area starting with the 2013 tax returns as well, this control group is only available until including 2012.

states' districts that share a border with the OFD Münster area. As these taxpayers are subject to a different state's tax enforcement regime (Lower Saxony, Hesse, or Rhineland-Palatinate), the policy in North Rhine-Westphalia does not contain any information regarding tax enforcement. Nonetheless, these taxpayers might be similar in (time-varying) unobserved characteristics to those living just across the border. Therefore, these taxpayers constitute a reasonable additional control group for taxpayers residing in the OFD Münster area. The results for this robustness check are in line with the baseline specification. Only capital income, rental income, and other income experience positive direct effects following the introducing of the enforcement focus list.

Third, I consider all taxpayers living outside North Rhine-Westphalia as a control group. Relative to this control group, the treated taxpayers only significantly increase their capital income as a result of the initial publication of the enforcement focus list. All other income sources remain unaffected.

To summarize, when using alternative control groups the results are similar or slightly weaker than those of the baseline specification, underlining that the initial announcement of enforcement focus lists was rather limited in its effectiveness. Likewise, this demonstrates that substitution evasion is likely not a first order concern in this setting.

Entropy Balancing. For the direct effect on rental income and capital income, both the graphical inspection of Figure 2.2 and the p-values in Table 2.3 suggest a violation of the common trend assumption.

To alleviate concerns with respect to the common trend assumption, I provide a robustness check using the entropy balancing reweighting method as proposed by Hainmueller (2012). Here, I match the treatment and control group on the pre-policy level means such that pre-intervention differences are mechanically eliminated. However, one assumption I have to make is that the likelihood of evasion is equal after reweighting. The results of this exercise can be seen in Figure B.7 in the appendix. The results are in line with the baseline direct results and suggest that announcing rental income as a focus point did increase the level of reported income. Likewise, taxpayers treated on capital income and other income report more in their respective category, following the initial publication of the enforcement focus list.

2.5.5 Discussion

As seen in the previous parts, publishing enforcement focus lists has little direct effects on reported income and limited effects on total taxable income. Only for three income sources, capital income, rental income, and other income, the introduction of the enforcement focus list leads to an increase in reported income, i.e. positive direct effects, for a few years. This limited response is at odds with the theoretical predictions by Allingham and Sandmo (1972) concerning increases in detection probability. Previous work, e.g. Kleven et al. (2011), highlights that changes to the detection probability lead to changes in reported income, with relatively larger effects for income categories with a low degree of third-party reporting.

One potential explanation for this pattern could be the that tax compliance is already very high in Germany. Then, a change in the detection probability would lead only to small changes in reported income - potentially not distinguishable from zero - as the vast majority of income is already reported. This is however rather unlikely, given the existing level of tax evasion detected as published in official statements. For example, in 2017 about 62,000 criminal proceedings related to tax evasion where processed (see Bundesministerium der Finanzen 2018b).

For taxpayers to react to the enforcement focus list, they have to know about the policy to begin with. Unfortunately, data on the awareness of this policy is not available. However, given that it has been discussed in local and national newspaper outlets (see footnote 8), it is likely that informed taxpayers are aware of the list. Furthermore, conditional on being aware of the policy, the list has to shift a taxpayer's subjective detection probability in order to react by reporting more income in this category.

Similarly, it might be that the very general income source announcements only lead to within-income category shifts. For example, if the list only mentions the general category of business income, taxpayers might potentially report higher revenue but then adjust costs accordingly, as previous research in the firm context suggests (Carrillo et al. 2017). Unfortunately, besides the previously highlighted line items for labor income, there is no data on individual line items. Thus, quantifying within income category shifting is unfortunately not possible.

As discussed here, the null-result for the majority of income categories can be rationalized by a number of reasons. However, the fact that taxpayers adjust the commuting cost line item when it is mentioned on the list suggests that taxpayers are aware of the policy and that there is indeed a reaction to the policy. Therefore, the enforcement fo-

cus list can potentially be a useful tool to diminish tax evasion if the items mentioned are chosen carefully, i.e. distinctive enough, and rather easy to verify.

2.6 Conclusion

This paper evaluates the causal effects of introducing enforcement focus list announcements in the context of the German taxation process. These lists represent a simple and low-cost tool to potentially increase tax compliance that has not been thoroughly evaluated thus far. Due to the enforcement focus list, taxpayers who previously underreported income now face an increase in their evasion detection probability and should therefore increase their income reported, relative to unaffected taxpayers.

By exploiting the initial rollout of the enforcement focus list and using a generalized difference-in-differences estimation strategy, I show that the effects of this policy are limited. Only three out of seven income categories, capital income, rental income, and other income experience statistically significant direct effects, i.e. increases in the level of reported income, relative to the control group. Overall taxable income only increases significantly for one treated income category (capital income). However, for the distinctive and easily verifiable line item of labor income related commuting costs, taxpayers immediately report less deductions as a response to the enforcement focus list. These effects further increase in size in 2011 and remain stable for the years thereafter.

Overall, this suggests that taxpayers do react to the enforcement focus list. If the threat is specific enough, taxpayers adjust their deductions accordingly. Thus, more research is necessary on determinants of the reaction strength. Then, enforcement focus lists could be a viable, low-cost tool to limit tax evasion.

Chapter 3

Optional (Non-)Filing and Effective Taxation

This chapter is based on co-authored work with Luisa Wallossek. See Hauck and Wallossek (2021) for the full reference.

3.1 Introduction

Progressive income taxes are a common feature of tax systems around the world. They balance the desire for revenue and redistribution on the one hand and the inevitable distortion of taxpayers' labor supply decisions on the other hand (Mirrlees 1971; Saez 2001). While most research on optimal taxation concerns statutory tax rates, effective and statutory taxation often diverge. Potential reasons can be tax evasion or, as highlighted in this paper, features of the tax system.

Twenty-five countries worldwide use complete optional tax filing systems, exempting their taxpayers from filing an income tax return if they only earn wage income.[1] An additional five countries, such as Luxembourg and Japan, do not require their taxpayers to file if their wage income falls below a certain threshold. Even in the United States, taxpayers can be exempt from the duty to file if their income falls below a certain threshold.[2]

Despite the significant number of countries employing optional filing systems, little is known about their effects for effective taxation. Intuitively, optional tax filing systems induce yet another trade-off in the taxation process. If withholding works well, taxpayers do not need to file. However, if over-withholding is likely, taxpayers might want to incur the costs of filing an income tax return to obtain a refund, or abstain from filing altogether. Thus, effective taxation is likely affected by optional filing settings, even more so when the share of non-filing taxpayers is high.

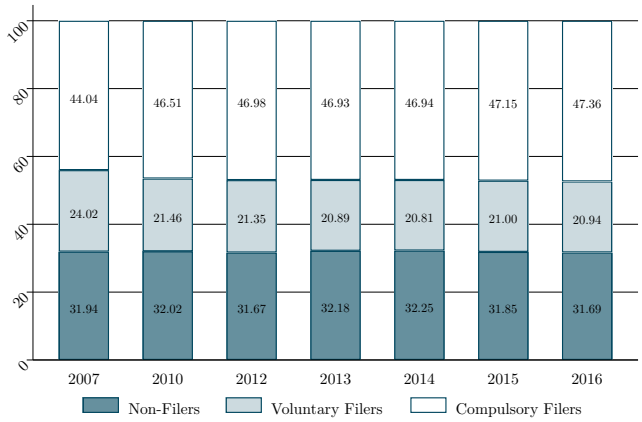
In this paper, we provide empirical evidence that optional tax filing systems have strong effects on effective taxation. To do so, we focus on taxpayers in Germany, as the German income tax system is a textbook example for optional tax filing. Similar to many other countries, it features only very limited tax filing duties, exempting most employees from the obligation to file an income tax return. As seen in Figure 3.1, every year about one third of the German taxpayer population does not file an income tax return, while only 21% do so voluntarily. In other words, while 53% of all taxpayers can decide whether to file (*optional filers*), a minority of about 47% is legally required to file an income tax return (*compulsory filers*).

For our work, we use the most recent cross-sectional administrative data set on tax-

[1] See Table C.1 for more information on countries with optional tax filing systems.

[2] Different thresholds apply depending on individual characteristics such as marital status or age. The Internal Revenue Service (IRS) provides an interactive tax assistant that determines filing requirements (`https://www.irs.gov/help/ita/do-i-need-to-file-a-tax-return`, last accessed: 2020-12-01).

Figure 3.1: Distribution of Filing Status in Germany



Data: Lohn- und Einkommensteuerstatistik, 2007-2016; provided by the German Federal Statistical Office upon request.
Notes: The data set is the same as the one used in the empirical analysis in this paper. Prior to 2012, this statistic was published every three years. Since 2012, the statistic is published annually. Data prior to 2007 is not directly comparable, as employers were only required to electronically submit income tax returns by 2006. Therefore, not all non-filers are captured prior to 2007. Differences to 100% are due to rounding.

payers in Germany for the year 2014. As a key feature, this data set includes relevant information on non-filers, originating from the taxpayers' automatic income tax withholding statement provided by their employers at the end of the year. This statement contains basic demographic information, gross wages, and income taxes remitted throughout the year. Based on this information, we can compute the statutory tax liabilities as defined in the tax schedule and compare it to effective tax remittances observed in the data.

We provide multiple important insights. The share of non-filers relative to all optional filers falls over income. While the non-filing share is as high as 90% in the lowest income bins, the share drops to about 30% for taxpayers in the highest percentiles. This is despite the fact that, relatively, non-filing hurts most at the lower end of the income distribution. Over-remitting non-filers with income within the basic allowance pay an effective average tax rate (ATR) of about 5%, despite a statutory rate of zero. In 2014, these over-remittances sum up to at least 949 million €. On average, over-remitting non-filers paid 360 € more than intended, while the average for all non-filers is 116 €.

By using cross-sectional data from 2010, we show that these patterns are persistent over time. Furthermore, repeated cross-sectional analysis suggests that the filing patterns are rather persistent than a once-in-a-lifetime phenomenon. Using non-filers' average over-remittances and conventional tax filing time estimates, we argue that

either information frictions about potential refunds or non-monetary filing costs, e.g. aversion to forms, have to be sizeable to explain the observed patterns.

These descriptive results lead to a number of implications. If policymakers are concerned about the equity effects of optional filing systems, the implications of our study are straightforward. Non-filers' over-remitted taxes should be automatically refunded at the end of the year. For the unlikely case that these governmental funds are indispensable, we provide a reform proposal for the top (two) marginal tax rates (MTRs) to refinance the refunds.

However, if preferences are such that the effective taxation observed under the optional filing system is desired, we highlight that there are institutional arrangements that can achieve the same effective outcome more efficiently. Currently, non-filing taxpayers face higher average tax rates and, by the nature of the progressive tax system, also higher marginal tax rates. However, following the intuition of the tax perturbation approach, while these higher marginal tax rates distort the labor supply decision of individual non-filers, there is no tax revenue gain from taxpayers with higher income.

Thus, in a first hypothetical tax system, we compute the tax revenue effects associated with the abolition of the basic allowance. Instead, all taxpayers would then pay a marginal tax rate of 1.87%, the current effective marginal tax rate, for the previous basic allowance of 8,354 €. While taxpayers in the basic allowance range are, on average, not worse off, this tax change raises about 4.03 billion € in additional tax revenue from taxpayers with income exceeding 8,354 €. Hence, in this first approach, taxpayers beyond the basic allowance pay more taxes than before.

In the second hypothetical tax system, we add another building block. Now, also taxpayers beyond the basic allowance, on average, should not pay more income taxes than in the current situation. Since higher income taxpayers already pay taxes starting from the first euro of taxable income, marginal taxes beyond the basic allowance can be reduced. As the net-of-tax return for labor increases, taxpayers exert additional effort and increase their taxable income. Overall, this reform, purely based on behavioral effects while maintaining the status-quo effective taxation, could lead to an increase in taxable income ranging from 670 million € to 1.4 billion € and associated tax revenue increases between 157 million € and 327 million €.

Our work relates to three broad strands of the literature. First, there is an evolving literature on tax filing. Especially for the United States, previous research has characterized non-filing taxpayers, either in the cross-sectional dimension (Erard and Ho 2001) or over time (Fullerton and Rao 2019; Heim et al. 2014). Additionally,

prior work examines the determinants (Guyton et al. 2017) and the long-term consequences of tax filing (Ramnath and Tong 2017). Most closely related, Benzarti (2020) highlights on an aggregate level that filing taxpayers behave rationally when deciding about whether or not to itemize deductions. We contribute to this literature by showing on the individual level that taxpayers forgo sizeable refunds by not filing a tax return at all. Here, our results also relate to the broad literature on social stigma and low take-up of social welfare programs (Currie 2006). In the context of personal income taxation, social stigmata should most likely not be present, yet taxpayers forgo sizeable refunds.[3] Furthermore, our results show that optional tax filing systems are associated with distortions that lead to sup-optimal outcomes in both the equity and the efficiency dimension of personal income taxation.

Second, we add to the literature on effective taxation over the income and wealth distribution. So far, this literature has mostly examined taxpayers at the upper end of the income distribution. Prominently, Saez and Zucman (2019a,b) recently contributed to the debate about the effective taxation of the very wealthy in the US. In a similar vein, Advani and Summers (2020) document low effective average tax rates for UK's top income taxpayers. Roller and Schmidheiny (2016) show that high-income taxpayers migrate to low-tax regions in order to reduce their effective tax burden. Our work highlights that optional tax filing systems are a feature of the tax system that over-proportionally increases the effective tax burden at the lower end of the income distribution.[4]

Lastly, we add to the broader literature on how taxpayers perceive and react to taxes. Abeler and Jäger (2015) highlight that taxpayers do not always make optimal decisions when facing complex tax systems. Similarly, Aghion et al. (2017) show that taxpayers seem to be trading-off complexity with forgoing tax savings. More generally, individuals seem to use simplifying heuristics when interacting with taxes (Rees-Jones and Taubinsky 2020), and are therefore likely to misperceive (marginal) tax rates (e.g. Feldman et al. 2016). Our results suggest that taxpayers might also not be aware of basic institutional features of a tax system, namely withholding throughout the year and thus potential benefits from tax filing. We discuss policy implications that can reduce compliance costs and thus alleviate these concerns.

[3]It should be noted that unlike the EITC in the United States, social welfare programs in Germany are not administered via the tax code.

[4]Relatedly, in a recent report, the Treasury Inspector General for Tax Administration (2020) describes that high-income non-filers in the United States are able to reduce their tax liability.

The remainder of this paper is organized as follows. Section 3.2 explains the institutional background for tax filing in Germany, before Section 3.3 introduces the data set. Section 3.4 gives descriptive information about non-filers, provides estimates for over-remitted taxes, and highlights that the effective tax progressivity is attenuated due to non-filing. In section 3.5, we discuss our results before analyzing the resulting policy implications, from an equity and an efficiency perspective, in section 3.6. Lastly, section 3.7 concludes.

3.2 Institutional Background

To evaluate the effects of optional filing systems, it is important to understand the institutional background for personal income taxation in Germany, as outlined below. A more extensive overview is relegated to Subsection B.3 in the Online Appendix.

Tax Schedule. The German tax system features a progressive income tax schedule. In 2014, annual taxable income up to a threshold of 8,354 € is tax free. Above this basic allowance, marginal tax rates are linearly increasing from initially 14% up to 42% for a taxable income of 52,881 €. Taxable income above this cutoff is taxed at a flat marginal tax rate of 42%, before the top MTR of 45% applies for all taxable income exceeding 250,730 €. For joint filing spouses, their tax liability equals twice the amount of taxes that correspond to their mean taxable income. Figure C.1 graphically shows marginal and average taxes for single and joint filing taxpayers in 2014.

Tax Deductions and Tax Credits. Taxpayers can reduce their taxable income through various deductions.[5] In a given year, all taxpayers are entitled to a standard deduction for special expenses (36 €) with wage earners being entitled to an additional standard deduction for work-related expenses (1,000 € in 2014). As these standard deductions are rather small and various expenses are deductible, many taxpayers surpass the standard level when itemizing. For a significant share of wage earners, simply itemizing commuting costs is sufficient to exceed the standard deduction.[6]

[5]See Doerrenberg et al. (2017) for a detailed introduction regarding deduction possibilities in Germany.

[6]Data from the Federal Institute for Research on Building, Urban Affairs and Spatial Development (`https://www.bbsr.bund.de/BBSR/DE/Home/Topthemen/2017-pendeln.html`; last accessed: 2020-02-13) shows an average commute of 16.8 km in 2015. Only itemizing the average commuting of about 15 km is sufficient to surpass the standard deduction in 2014.

Furthermore, taxpayers can deduct social security contributions. This includes parts of the public health insurance costs and parts of their contributions towards the public pension insurance. Additional special allowances, e.g. for single parents or elderly employees, also exist. While there are tax credits that reduce the tax liability directly, they are rather limited in scope. However, these expenses include common household related services, e.g. for cleaning or facility management.

Optional and Compulsory Filing. Taxpayers can be divided into two main groups: *Compulsory filers*, who have to file an income tax return, and *optional filers*, who are free to choose whether to file. When optional filers decide to file an income tax return, we call them *voluntary filers*, whereas *non-filers* abstain from filing an income tax return.

Whether a taxpayer is an optional or a compulsory filer is determined by three broad circumstances. First, when appropriate taxes are withheld throughout the year, which is true for labor income and most of capital income, there is no legal need to file an income tax return. However, if taxpayers have other income sources for which taxes are not or only partially withheld, such as business income, tax filing is legally required. Second, taxpayers receiving social benefits to replace income, for example unemployment benefits, which exceed an annual threshold (410 €) are required to file. Third, for wage earners, alterations to the automatic withholding scheme trigger a filing duty. Most prominently, joint filing spouses can allocate both basic allowances to one spouse. In order to assure correct taxation, these couples have to file an income tax return if both earn wages. However, newlyweds have to opt-in for this allocation of allowances, otherwise the withholding schedule effectively remains as if both were single.

Thus, optional filers are either single taxpayers or married taxpayers for whom taxes are withheld as if they were singles. Overall, as seen in Figure 3.1, optional filers account for roughly 53% of the taxpayer population in 2014, with 32% of all taxpayers (or 60% of all optional filers) not filing.

Exact Automatic Withholding. Employers automatically withhold income taxes for their employees. On a monthly basis, employers extrapolate the annual gross income (usually by multiplying the monthly gross income with twelve) and obtain the corresponding extrapolated taxable income. When doing so, they take into account one twelfth of the basic allowance, one twelfth of the two standard deductions, and

the corresponding deductible social security contributions. Then, employers withhold income taxes according to the ATR applying to the extrapolated taxable income.

Thus, there are two main ways through which over-withholding can occur. First, due to inflated annual income extrapolations, the applicable ATR can be too high. This includes taxpayers who are employed for less than twelve months as well as those who are employed for the entire year but with fluctuating income. As the income tax schedule is progressive, once a taxpayer receives a pay raise, withheld taxes are too high on an annual level. Consider a taxpayer experiencing a pay raise in July. From then onward, the applicable ATR will be as if this taxpayer earns the post-raise income for the complete year. Thus, at the end of the year, withheld taxes are too high.

As this problem has been considered by lawmakers, employers have to adjust the final income tax withholding in a given year to correct these fluctuations. However, while employers with ten or more employees are required to conduct this adjustment, it is optional for firms with less than ten employees to adjust the final withholding.[7]

Second, less than full consideration of the standard deductions leads to over-withholding. When withholding income taxes, employers consider standard deductions for income related expenses and social security contributions for the corresponding paycheck period (i.e. usually monthly). If the total employment period is less than a year, only a fraction of the standard deduction is considered. However, the German income tax code allows employees to fully deduct both standard deductions (36 € and 1,000 € in 2014) as soon as they worked for at least one day in the respective year. Likewise, only a fraction of the basic allowance (8,354 €) is considered.

Taxpayers who are employed less than twelve months therefore face both adverse effects. As their employment spell with their employer is less than the full year, no annual adjustment can take place. Furthermore, while being entitled to the full standard deductions and the full basic allowance, their employer only considers a fraction of both.

Automatic withholding is thus *exact* in the sense that, each month, employers apply the correct schedule for the extrapolated yearly income. However, there is over-withholding whenever the true annual income does not equal this extrapolation, lead-

[7] In 2010, 81% of German enterprises had 9 or less individuals employed, representing 19% of all employees (`https://www-genesis.destatis.de/genesis/online?sequenz=tabellen&language=en&selectionname=48121-0001`; last accessed: 2020-04-12). This suggests a limited number of mandatory end-of-year adjustments. Unfortunately, according to the Federal Ministry of Finance, there is no official data on the number or share of conducted end-of-year adjustments.

ing to tax over-remittances for non-filers. Then, even taxpayers with an annual taxable income below the basic allowance may pay a significant amount of taxes. We quantify the amount of tax over-remittances that occur from over-withholding in subsection 3.4.2.

Tax Filing. Generally, there are three ways to file an income tax return in Germany. First, taxpayers can file taxes all by themselves. This can be done either digitally, with a free online solution provided by the tax authority, or in paper. The forms can be found in local administration buildings or downloaded from official websites. Self-filing is fairly common in Germany, as a 2013 online survey finds that about 50% of taxpayers file either on their own or with the help of friends or family.[8]

Second, there are various electronic filing solutions. Specialized websites or applications provide fairly user-friendly interfaces and usually guide through the filing process at low fixed fees. These filing solutions regularly provide hints for deductible expenses. As mentioned before, there is also a cost-free governmental e-filing solution, which is however rather less intuitive.

Third, taxpayers can hire a tax adviser. While this facilitates filing significantly, this is the costliest solution in monetary terms. Furthermore, there are non-profit organizations in Germany, similar to the Volunteer Income Tax Assistance Program in the US, which provide low-cost tax advising and filing services for wage earners (*Lohnsteuerhilfevereine*). The applicable fee depends on the annual income but is usually significantly smaller than for certified tax advisers.

When taxpayers file an income tax return, they are required to provide a general cover form with basic demographic and social information (including date of birth and current residence) as well as their unique lifetime taxpayer-ID number. Furthermore, special expenses, such as the above mentioned household related services, have to be filed in here as well. Similar to various other countries, each income category has a different form that taxpayers have to fill out. Thus, the number of additional forms depends on the number of income sources.

While filing options, refund potentials, and individual costs might be driving the decision to file an income tax return, the purpose of this paper is to document the aggregate effects of optional filing. However, some potential mechanisms and suggestive expla-

[8]This was part of a survey by the market research firm *YouGov* (`https://yougov.de/news/2013/05/28/knapp-die-halfte-der-deutschen-hatte-unterstutzung/`; last accessed: 2020-05-17).

nations for the observed filing behavior are discussed in section 3.5.

Minimal Tax Filing. If taxpayers simply want to obtain over-withheld taxes, the filing requirements are limited. Figure B.8 in the Online Appendix shows the corresponding two-page form for what we call a *minimal filing* scenario (correcting for over-withholding only, not itemizing further deductions). For minimal filing, voluntary filers simply have to fill out these two pages by filling in personal information and copy-pasting six values from their wage tax certificate (*Lohnsteuerbescheinigung*) as shown in Figure B.7 in the Online Appendix. All wage income taxpayers are entitled by law to receive this nationwide standardized wage tax certificate from their employers. The overall nomenclature in the tax filing form and in the wage tax certificate is very similar, some lines in the filing form even explicitly refer to lines on the wage tax certificate.

The minimal filing scenario ensures that all standard deductions and the full basic allowance are taken into account and that the annual adjustment of taxes takes place. While this minimal filing scenario has rather small real compliance costs in terms of collecting information and filling out forms, it ensures that over-withholding throughout the year is corrected for. Hence, this serves as our benchmark for correct taxation in subsection 3.4.2, where we compute forgone refunds for non-filing taxpayers.[9]

After filing the income tax return, it usually takes up to three months until taxpayers receive their final tax assessment (*Steuerbescheid*) and their potential refund. This represents the end of the personal income taxation process for this tax year.

3.3 Data Set

The aim of this paper is to examine the effects of optional tax (non-)filing on the effective taxation and to understand its distributional consequences. To do so, we use the 10% stratified random sample of taxpayers in Germany for the latest year available (2014), provided by the Research Data Center (RDC) of the Federal Statistical Office and Statistical Offices of the Federal States. This data set contains 4,017,600 observations,

[9]While we abstract from the possibility that taxpayers might also have sufficient deductible expenses to benefit from itemizing for the main analysis, Subsection B.4 in the Online Appendix provides a counterfactual with assumptions about deductible expenses for non-filers.

including 400,000 non-filers.[10] In our data set, an observation, i.e. a *taxpayer* or a *taxable unit*, refers either to married couples filing jointly or to taxpayers filing individually.

Information for filing taxpayers originate from their tax returns and final tax assessments. Consequently, the data set includes a large variety of information for voluntary and compulsory filers. This includes all kinds of income measures, such as wage income and other income sources, standard or itemized deductions, and the corresponding tax payments - withheld taxes, final tax liabilities, and potential refunds or additional tax payments. Furthermore, the data set includes information on taxpayers' states of residence, as well as basic demographic characteristics such as gender, age, number of children, and marital status.

For non-filers, the statistical offices collect information from the employer-provided end-of-year wage tax certificate, as described in the previous section. Thus, the information provided in the data set is limited to the information provided by the employer. This includes basic socio-demographic characteristics, such as gender, age, the taxpayer's state of residence, and the number of children that are known to the employer for tax purposes. Most importantly, we know the gross income the taxpayer earned throughout the year and withheld taxes. Based on this rather basic information, we can both analyze non-filing behavior over the wage income distribution (subsection 3.4.1) and calculate the amount of over-remitted taxes for large parts of the population of non-filers as described in subsection 3.4.2.

To be included as a filing taxpayer in this data set, the tax assessment has to be concluded within 2 years and 9 months after the tax year, i.e. September 30, 2016 for the tax year 2014. More generally, this data set does not contain tax assessment information for (i) taxpayers who are still waiting for their final tax assessment, (ii) taxpayers who objected their tax assessment and still wait for the final decision, and (iii) voluntary filers who plan to file a tax return later. Compulsory filers regularly have to file a tax return within five months following the tax year, whereas optional filers have up to four years to file. While this is a potential confounder to our results, there is no administrative data available to estimate this. However, off-the-record

[10] Basic descriptive statistics for the full sample can be found in Table C.2. To show consistency later on, we run the same analyses on the 10% stratified random sample for 2010 (see also section 3.5).

conversations with practitioners suggest that this number is rather low.[11]

Throughout our main analyses, our focus is on optional filers. Thus, in section 3.4, we exclude all compulsory filers to construct a sub-sample of all optional filers. This excludes, for example, taxpayers who altered the withholding schedule throughout the year or taxpayers with income sources that trigger a filing duty, e.g. rental income.

Lastly, to be able to determine the amount of over-remitted taxes in subsection 3.4.2, we restrict our sample to optional filers for whom we can impute taxable income. This excludes civil servants and optional filers with wage income of more than 48,600 € (about the 90$^{\text{th}}$ percentile within the wage income distribution of optional filers) due to social security contribution rules.

3.4 Results

This section is divided into three parts. First, we document the prevalence of non-filing and provide basic descriptive statistics for non-filers. Second, we compute tax over-remittances for non-filers that occur from automatic withholding. In the third part, we analyze the result of optional tax (non-)filing for differences between statutory and effective tax schedules. Various extensions to these results, including robustness checks and evidence for persistence, are discussed in the subsequent section, section 3.5.

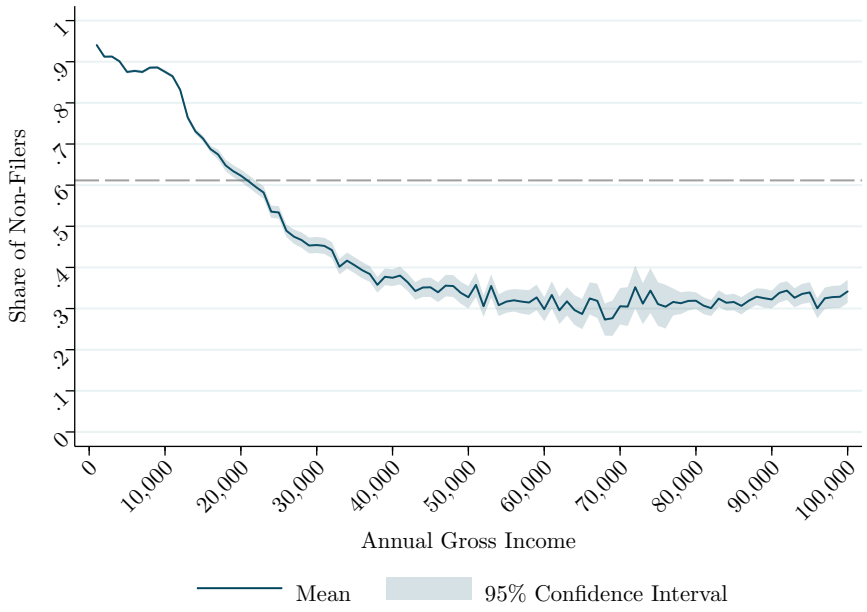
3.4.1 Prevalence of Non-Filing

As previously shown, a substantial share of Germany's taxpayers does not file a tax return, so-called *non-filers*. In this section, we investigate the prevalence of non-filing in more detail. Based on the administrative data described in section 3.3, we shed some light on how (non-)filing differs along the income distribution. In addition, we provide some basic characteristics for optional filers in general as well as both subgroups, non-filers and voluntary filers.

Since we aim to investigate the effects of optional (non-)filing systems, we first restrict our sample to all optional filers. These are mainly non-married employees with wage income only. Additionally, our sample also includes married spouses who do not choose to reallocate allowances between them throughout the year.

[11] After fifteen months following the tax year, i.e. starting in April 2012, tax refunds start to accrue 4.5% p.a. in interest. However, this level of interest payment has recently been struck down in Germany's Federal Tax Court for refunds accruing in the calendar year 2015 and later.

Figure 3.2: Prevalence of Non-Filing over Gross Income



Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Lohn- und Einkommensteuerstatistik, 2014, own calculations.
Notes: Share of non-filers among optional filers over annual wage gross income. Dashed grey line: Average share of non-filers (61.15%) across all gross income levels. Statistics refer to taxable units which may be either an individual or married spouses in case of joint filing. For jointly filing spouses, we consider the average gross income. See Figure C.2 for non-filing shares over income percentiles.

In the Appendix, Table C.3 provides basic descriptive statistics for all optional filers as well as for the two subgroups of voluntary filers and non-filers. In total, there are 683,718 optional filers in the sample, representing about 14.9 million German taxpayers. Non-filers account for 61.15% of the weighted sample.[12]

Most relevant for our analysis, non-filers have significantly lower income than voluntary filers. The average annual gross wage income for non-filers is 18,047 €, or only 52% of the average for voluntary filers. Figure 3.2 visualizes the share of non-filers among all optional filers over the income distribution, showing a substantial heterogeneity in filing behavior across income. Overall, there is a negative correlation between gross income and tax non-filing. While close to 90% of the optional filers with an annual gross income of less than 10,000 € do not file a tax return, this share sharply declines for higher income levels. Yet, Figure 3.2 also shows that non-filing is not unique to low income earners. The share of non-filers stabilizes at around 30% for taxpayers with

[12]Deviations from the entire population of taxpayers, as shown in Figure 3.1, come from the fact that we focus on singles and single-like married taxpayers.

an annual gross income of at least 50,000 €. Figure C.2 in the appendix shows this relationship as a function of income percentiles.

In addition to income, there is some heterogeneity in filing behavior across other demographic characteristics (see again Table C.3). Compared to voluntary filers, non-filers are younger (34 vs. 37), they are more likely to live in Eastern German states (23% vs. 19%), they are less likely to have kids (15% vs. 21%), and less often married (7% vs. 13%). Overall, the share of married individuals is rather low among optional filers, since the majority of married spouses are taxed jointly throughout the year which triggers compulsory filing. In the Appendix, Figure C.4 and Figure C.3 decompose the non-filing shares for different marital and family statuses and over age and gender, respectively. The observed patterns can be squared with multiple theories which we discuss in section 3.5.

3.4.2 Tax Over-Remittance through Non-Filing

In subsection 3.4.1, we document that large parts of the taxpayer population are non-filers and that non-filing occurs mainly, though not exclusively, at the lower end of the income distribution. However, non-filing is not harmful if withholding works well and there are no tax over-remittances. In this section, we compute non-filers' tax over-remittances occurring from automatic (over-)withholding and their choice not to file an income tax return. To do so, we define a tax over-remittance as the difference between the effective tax remittance of individual i (T_i^{eff}) via employer-withholding and statutory tax payments that apply to her taxable income y_i according to the tax schedule ($T^{schedule}(y_i)$).

As discussed in section 3.2, taxes withheld are greater or equal than taxes according to schedule, $T_i^{eff} \geq T^{schedule}(y_i)$, under automatic employer withholding - a feature common to most progressive income tax systems. Taxpayers with constant income over the entire year have a difference of zero, i.e. $T_i^{eff} = T^{schedule}(y_i)$, while there are over-remittances in all other cases, $T_i^{eff} - T^{schedule}(y_i) > 0$.

To obtain $T^{schedule}(y_i)$, we proceed as follows: Starting from the annual gross wage income, we construct the taxable income y_i by subtracting the standard deductions and special allowances for single parents or elderly employees, if applicable. Based on demographics, we then determine social insurance contributions which are partly tax deductible and subtract the corresponding deductions. This leads us to y_i, the annual individual taxable income (without taking into account any additional or itemized

Table 3.1: Descriptive Statistics - Final Sample

		Optional Filers	Voluntary Filers	Non-Filers
Income	mean^{+}	19,137.60	27,192.55	15,243.17
	p25	6,513.00	18,930.00	4,185.00
	p50	17,820.00	28,444.00	11,614.00
	p75	30,407.00	36,338.00	24,300.00
	p90	38,713.00	42,388.00	34,735.00
	p99	47,186.00	47,903.00	46,218.00
Age	mean^{+}	33.72	35.22	33.00
	p50	30	32	29
Married	share^{+}	4.61	0.63	6.53
East	share^{+}	21.99	17.98	23.92
Children	share^{+}	15.20	16.50	14.57
N	absolute	429,069	220,818	208,251
	weighted	12,016,340	3,916,260	8,100,080

Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Lohn- und Einkommensteuerstatistik, 2014, own calculations.
Notes: Individual taxpayers with gross income up to 48,600 € only. No civil servants. Statistics are based on weighted data if not indicated differently. *Income*: Annual gross wage income in €. *Married*: Share of married taxpayers. This includes only individually filing spouses. *East*: Share of taxpayers that live in Eastern states of Germany. *Children*: Share of taxpayers with at least one child that is relevant for the tax authority. $^{+}$ indicates mean/share difference between voluntary filers and non-filers significant at the 0.1% - level (two-sided t-test).

deductions). Following the statutory tax schedule, we then compute $T^{schedule}(y_i)$ which is equivalent to the tax payment in the event of minimal tax filing.

This simulation corrects for over-withholding through employers by smoothing fluctuating incomes, i.e. it performs the annual adjustment of wage tax and considers both the full standard deductions and the full basic allowance. Put differently, we simulate the effects from minimal filing, as described in section 3.2. Under correct withholding, for constant income over twelve months, y_i equals the employer's extrapolation of the annual taxable income and $T^{schedule}(y_i) = T_i^{eff}$. As this measure of tax over-remittance does not take into account any additional itemized deductions, it can be interpreted as the lower bound for benefits from filing. In Subsection B.4 of the Online Appendix, we provide a range for potential gains when considering potential additional deductions.

To determine the amount of over-remitted taxes, we have to restrict the sample to taxpayers for whom the taxable income is imputable. Since we infer social insurance contributions based on annual gross income, we have to exclude taxpayers for whom

this cannot be done. This excludes taxpayers with an annual gross income above 48,600 € in 2014 as well as civil servants. Both groups are free to choose whether or not to enroll in the public health insurance and there is no information on the enrollment status for non-filers. Additionally, we exclude joint filing married spouses and restrict the sample to the working age population ($16 \leq \text{age} \leq 64$).

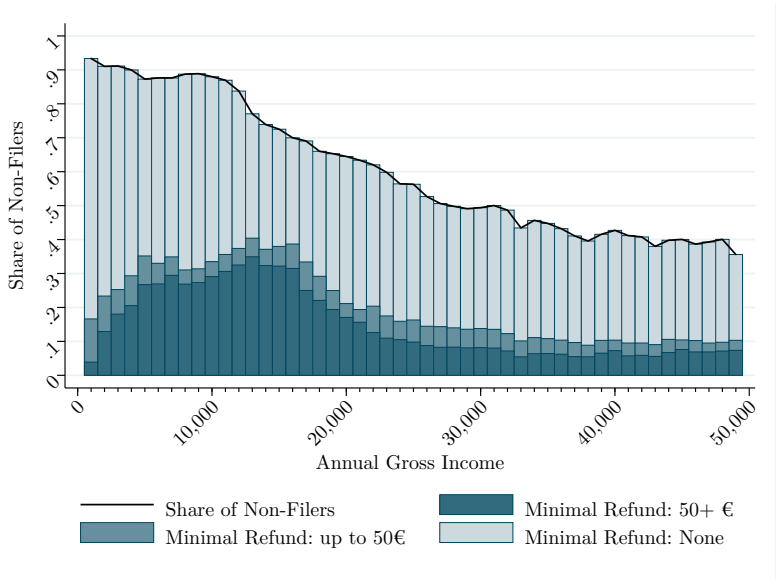
The sample restrictions are explained in more detail in the appendix, subsection C.4. The descriptive statistics for this final sample, which we will use for the remainder of this section, are shown in Table 3.1.

In a first step, we decompose the share of non-filers by their tax over-remittances to better understand the monetary impacts of non-filing. The black line in Figure 3.3 indicates the share of non-filers among all optional filers over the income distribution. The stacked bars indicate the amount of over-remittance among the non-filers. For each income bin, Figure 3.3 shows the share of taxpayers who over-remit 50 € or more, as well as the share of those who over-remit little or nothing. Put differently, the figure highlights how tax over-remittance through non-filing is distributed over the income distribution.

At first glance, it is apparent that automatic tax withholding works quite well for the majority of non-filers. In each income bin, the share of non-filing taxpayers with precise withholding (no over-remittance) is the largest. However, equally striking, a significant number of non-filers substantially over-remit taxes through automatic withholding and can expect refunds exceeding 50 € from minimal filing. The share of these taxpayers is particularly large at the lower end of the gross income distribution. This includes taxpayers who, following the statutory tax schedule, should not pay any income taxes, i.e. individuals with an annual taxable income $y_i \leq 8{,}354$ €, $T^{schedule}(y_i) = 0$. Depending on the taxpayer's situation, a taxable income of 8,354 € roughly corresponds to a gross income of about 10,000 € when applying standard deductions. Put differently, taxpayers in the first nine income bins should not pay any taxes following the tax schedule. Further along the income distribution, the share of taxpayers who do not file although they can expect a positive refund decreases, in absolute and in relative terms. Thus, automatic withholding works increasingly well along the income distribution.

Figure 3.4a shows the average (lower-bound) over-remittance for non-filing taxpayers within each income bin. As documented in Figure 3.3, non-filers over-remit taxes at all income levels. In absolute terms, the average over-remittance for all non-filers (solid red line) is increasing with income until it reaches its maximum of about 270 € for

Figure 3.3: Non-Filing Share by Refund Potential



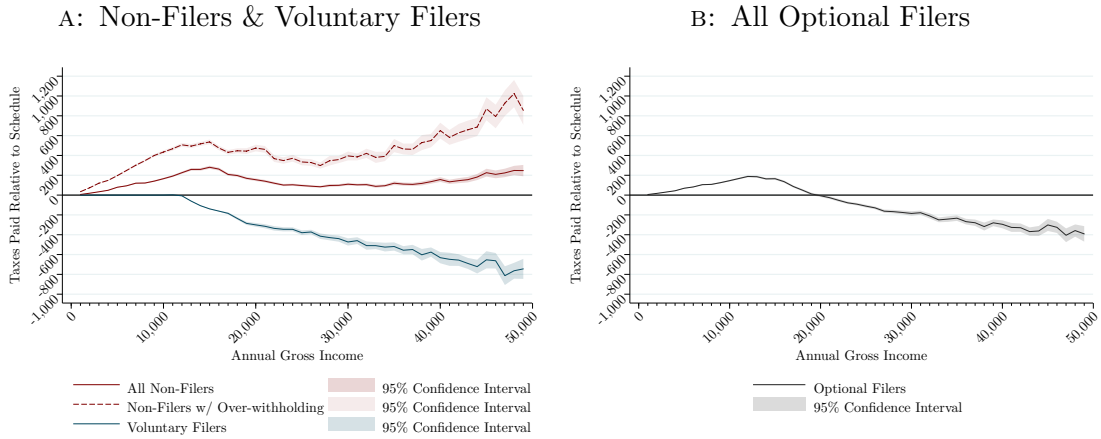
Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Lohn- und Einkommensteuerstatistik, 2014, own calculations.
Notes: Decomposition of the non-filing share (black line) over income by refund potential of the non-filers. Individuals are grouped in 1,000-€-bins. *Minimal refund*: Lower bound for taxes over-remitted through non-filing. *None*: No refund from minimal filing because taxes are withheld correctly. This is allowing for a range of 0 +/- 5 €. *Up to 50 € (50+ €)*: Minimal refund of up to (more than 50 €). *Reading example:* 64% of optional filers with an annual gross income of 20,000 € are non-filers. In this income bin, 17% of all optional filers have a minimal refund potential of at least 50 €.

the gross income bin around 16,000 €. For higher income non-filers, the average over-remittance is decreasing. There are two intuitive explanations for this pattern. First, the increase in the average over-remittance for low income earners is likely driven by a mechanical effect. Assuming that the extrapolated annual taxable income correlates with the annual gross income, absolute over-remittance is increasing with gross income because employers apply a higher average tax rate for a higher (extrapolated) taxable income. Second, automatic withholding produces particularly high over-withholding when the overall employment period within a given tax year is very short. In these cases, the annual income is presumably low.

Conditional on over-remittance, the pattern is similar but the amount of over-remitted taxes is significantly higher. Over-remitting non-filers with an annual gross income of 16,000 € effectively pay, on average, 570 € more than they should according to the statutory tax schedule.

Aggregated numbers for over-remitted taxes are shown in Table 3.2. On average, non-filers over-remit 118 € which is equivalent to 0.7% of their average annual gross income. Conditional on over-withholding, non-filers over-remit 360 € on average. In

Figure 3.4: Effective Tax Payments of Optional Filers



Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Lohn- und Einkommensteuerstatistik, 2014, own calculations.
Notes: Individuals are grouped in 1,000-€-bins. See Figure B.6 in the Online Appendix for the same figure with 100-€-bins. Voluntary filers only. Figure 3.4a shows over-remitted taxes (positive) for non-filers and refunds (negative) for voluntary filers, both relative to the statutory tax schedule by gross income. Figure 3.4b is the observation-weighted combination of both graphs from Figure 3.4a.

aggregate, this leads to an overall sum of over-remitted taxes of at least 949 million €. Columns 2 and 4 of Table 3.2 show that much of the over-remitted taxes occur at the very bottom of the income distribution. Overall, individuals with an annual gross wage income below the basic allowance threshold over-remit 317 million € or 33.5% of the total over-remittance even though the statutory tax payment for taxpayers with taxable income $y_i \leq 8{,}354$ € is $T^{schedule}(y_i) = 0$.[13]

It is important to recall that we only show the minimum amount of tax over-remittance here. We exclude civil servants as well as employees with an annual wage income greater than 48,600 € from our analysis. Since non-filing behavior is also present in these groups, this is likely to further increase the overall amount of over-remitted taxes through limited filing requirements. Furthermore, our estimates for tax over-remittance include standard deductions only. When taxpayers can make use of itemized deductions, refunds are higher. Additionally, we abstract from advantages for joint filing married spouses here. For married non-filing individuals, we calculate their filing counterfactual assuming individual filing. However, married spouses can typi-

[13]For our main analysis, we exclude taxpayers for whom too little taxes ($\Delta \leq$ -5 €) were withheld relative to the tax schedule. We hypothesize that this may be driven by either changes in tax relevant characteristics throughout the year which are not captured in yearly data or by mistakes in withholding or reporting. When including these taxpayers, our results remain fairly robust: The sum of over-remittance in 2014 is 805 million € instead of 949 million €.

Table 3.2: Taxes Over-Remitted through Non-Filing - Lower Bound Estimates

		(A) All Non-Filers		(B) With Over-Remittance	
		All	y < threshold	All	y < threshold
Over-Remittance	total	949,512,506	317,948,477	951,685,618	317,774,299
	mean	118.66	79.41	360.04	247.40
	p25	-0.40	0.00	42.00	45.00
	p50	0.00	0.00	182.90	137.00
	p75	40.09	38.00	518.60	348.00
	p90	425.28	277.00	959.56	639.00
	p95	760.16	498.00	1,265.00	846.00
N	absolute	205,678	103,761	68,138	33,350
	weighted	8,001,646	4,004,070	2,643,277	1,284,469

Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Lohn- und Einkommensteuerstatistik, 2014, own calculations.
Notes: Over-Remittance is defined as the difference between the the automatically withheld income taxes and the income tax that applies according to the tax schedule. Over-remittances are listed in €. (*A*): All non-filers in the sample. (*B*): Only those non-filers with over-remittance, defined as a deviation of more than 5 € from the statutory tax schedule. *y < threshold*: Individuals with an annual gross wage income below the basic tax allowance threshold.

cally reduce their tax liabilities by filing jointly. As we lack information on married non-filers' spouses, we cannot compute this here.

3.4.3 Effective Tax Schedule

To better understand the redistributional consequences of the optional (non-)filing system, we evaluate effective tax payments. In a first step, we combine the effective tax payments of non-filers (including over-remittances) and the effective tax payments of voluntary filers (including refunds from deductions beyond the standard deductions) to highlight adverse effects of optional tax (non-)filing. In a second step, we define the effective tax schedule for non-filers and highlight the deviation from the statutory tax schedule.

Figure 3.4 displays taxes remitted by non-filers and optional filers relative to the minimal filing scenario. Hence, the zero intercept represents $T^{schedule}(y_i)$, the case of minimal filing. As discussed before, due to over-withholding, non-filers pay more than foreseen by the schedule and are found above the zero intercept. Voluntary filers, who might be able to report further itemized deductions and ultimately reduce their tax

liability, relative to the minimal filing scenario, are below the zero.

In Figure 3.4a, non-filers and voluntary filers are analyzed separately. While non-filers over-remit taxes at all income levels, the opposite is true for voluntary filers. They always reach at least the minimal filing situation or can reduce their tax liabilities by itemizing deductions. Naturally, voluntary filers with income below the basic allowance, i.e. around 10,000 € in gross income, pay no income tax. As there is no way to reduce the tax payments below zero here, voluntary filers remain on the zero line. Above the allowance threshold, tax refunds are almost linearly increasing with income. The maximum refund is reached for individuals with an annual gross wage income of 47,000 € and is as high as 813 € for this group. Put differently, in addition to correcting for over-remitted taxes through automatic withholding, voluntary filers in this income bin report deductions which lead to an additional average refund of 813 €.

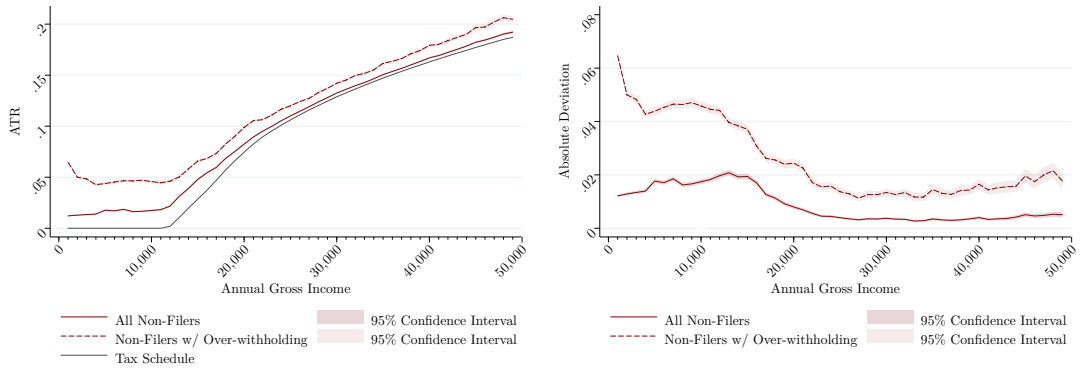
In the appendix, Table C.4 shows that voluntary filers achieve these refunds primarily through two channels, by itemizing special expenses (declared by 64% of voluntary filers) and income related expenses (declared by 58%). In monetary terms, income related expenses are the most relevant with an average value of 1,716 € above the standard deduction of 1,000 €. Especially low income voluntary filers are good at reducing their tax liability, as the share of filing taxpayers receiving a full benefit is large.[14] Intuitively, for these employees, obtaining higher refund shares is much easier as their withheld taxes are relatively low in absolute terms. Significant shares of lower income earners manage to get a full tax refund. For higher incomes, the refund share stabilizes at around 10%, indicating that absolute refunds are strongly correlated with gross income.

Figure 3.4b is a combination of both solid lines from Figure 3.4a, each weighted by the corresponding number of observations in each income bin. Combining over-withholding by non-filers and refunds by voluntary filers leads to the overall effective tax payments for the population of optional filers. There is a clear relationship between the effective tax payment and annual gross income. On average, very low income earners lose due to non-filing, while medium and higher income earners are more likely to be voluntary filers. Voluntary filers benefit from two channels: Potential over-withholding is corrected when filing and, additionally, itemized deductions lead to further tax reductions. In aggregate, optional filers with an annual gross income of up to 19,000 € over-remit taxes relative to the schedule. Higher income optional fil-

[14] Schächtele (2019) shows that filing taxpayers bunch with their taxable income at the basic allowance threshold in the German system. However, he abstains from examining non-filers.

Figure 3.5: Effective Tax Schedule for Non-Filers

A: Effective ATR for Non-Filers B: Deviation Effective ATR from Schedule



Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Lohn- und Einkommensteuerstatistik, 2014, own calculations.
Notes: Individuals are grouped in 1,000-€-bins. See Figure B.5 in the Online Appendix for the same figure with 100-€-bins. ATR based on taxes remitted over the year through automatic withholding by the employer. *Tax schedule*: Statutory ATR that corresponds to the respective gross income in the income tax schedule. Figure 3.5b shows the absolute difference between the red lines and the black line in Figure 3.5a. This is equivalent to the lower bound for gains from filing/minimal filing.

ers, on average, claim more than the standard deductions and thus pay less than under minimal filing.

Figure 3.5 displays the effective tax schedule in terms of the average tax rate for non-filers and mirrors the results of Figure 3.4 in relative terms. As in Figure 3.4, the black line in panel A and the horizontal intercept at zero in panel B correspond to $T^{schedule}(y_i)$. It is clearly visible in Figure 3.5a that taxpayers below the basic allowance have positive effective average tax rates, despite facing a statutory ATR of zero and thus not being liable to pay any income tax. Overall, non-filers whose statutory ATR is zero face an effective ATR of about 2%. This already includes non-filers for whom automatic withholding works well. Conditional on over-remittance, the effective ATR is close to 4.5% for these taxpayers.

It is important to stress that non-filers in this income range would receive a full tax refund for all taxes remitted throughout the tax year when filing a minimal tax return (see section 3.2 for minimal filing). Furthermore, Figure 3.5b highlights again that, when moving along the income distribution, the absolute deviation of the effective ATR from the tax schedule is decreasing and automatic withholding works increasingly well for higher income levels. The absolute difference between effective and statutory ATRs as depicted in Figure 3.5b can also be interpreted as the monetary costs of non-filing relative to the annual gross income. Non-filers in the lowest income bins thus forgo

nearly 2% of their annual gross income due to non-filing. These relative monetary costs of non-filing are much lower for higher incomes. For non-filers with an annual gross income of 30,000 € or more, their average over-remittance amounts to less than 0.5% of their gross income.

There are two factors driving the high effective ATRs at very low income levels. First, as shown in Figure 3.2, low income earners are very likely to be non-filers. Second, automatic withholding has its strongest shortcomings at the lower end of the income distribution, as over-withholding is particularly likely for very low income earners. Interestingly, a similar pattern can be found in the US, where over-withholding is very common among all taxpayers but especially likely for low income earners (Jones 2012).

So far, we have shown that non-filing is very common, with the highest non-filing shares at the lower end of the income distribution. Overall, non-filers substantially over-remit income taxes, especially low income non-filers. Thus, the optional (non-)filing system leads to an effective taxation that does not match the statutory taxation as defined by the tax schedule. Since mainly low income earners face higher effective ATRs compared with statutory tax rates, effective redistribution is weakened. Consequently, optional (non-)filing also affects the income inequality of after-tax income. We document the effect of optional (non-)filing on income inequality in Table C.5, by comparing the Gini-coefficient and percentile ratios for pre-tax income as well as for after-tax income pre and post filing.

If legislators want the effective taxation to match the statutory tax schedule, this could be attained by refunding taxpayers in case of tax over-remittance. However, this comes at the cost of reducing the governmental budget. Implications and potential budget neutral reforms are discussed below in subsection 3.6.1.

It is also possible that behavioral responses to the optional (non-)filing system have been taken into account by legislators and that the effective taxation matches the intended effective tax schedule. In this case, legislators may not want to refund over-remittances. However, we can show that the optional (non-)filing system cannot be the optimal tax system for obtaining the observed effective taxation. In subsection 3.6.2, we examine such an alternative approach. This reform would preserve the current effective taxation (T_i^{eff}) over the income distribution but allows for lower MTRs in certain income ranges and thus potential efficiency gains.

3.5 Discussion

In this part, we do multiple things. First, we provide two robustness checks to validate our results from the previous section. Second, we provide suggestive evidence on the persistence of non-filing before, third, discussing potential drivers of non-filing. Fourth, we provide an analysis of tax filing incentives.

3.5.1 Robustness Checks

While Figure 3.1 provides evidence that non-filing is constant over time on an aggregate level, we provide micro-level evidence that the observed patterns in the previous sections are stable over time. We do so by running the same analyses on the 10% stratified random sample for 2010. All results are qualitatively similar, yet smaller in size.

The average over-remittance for non-filers is 102 € in 2010, compared to 118 € in 2014. This is equivalent to a 15% increase from 2010 to 2014, which is proportional to the overall economic development over the same time period.[15] We estimate that non-filers in 2010 over-remitted at least 603 million € through automatic tax withholding, about 346 million € less than in 2014. While the deviation is relatively small in per capita terms, the number of non-filers in our sub-sample is significantly smaller in 2010, leading to a larger aggregate deviation. Descriptive statistics concerning filing shares and refund potentials are similar to those found in 2014. All figures and tables for this robustness check can be found in Subsection B.1 of the Online Appendix.

When examining non-filing shares at the lower end of the income distribution, see Figure 3.2, we included all taxpayers, irrespective of whether they had any tax payments withheld throughout the year or not. However, for taxpayers who had no taxes withheld, there is no immediate monetary benefit of filing an income tax return. Excluding this group decreases the non-filing share below the basic allowance threshold by roughly ten percentage points. Nonetheless, the non-filing share in these income ranges remains at about 80 percent (see Figure C.5).

[15] Following data from the Federal Statistical Office (`https://www-genesis.destatis.de/genesis/online?sequenz=tabellen&language=en&selectionname=81000-0003`; last accessed: 2021-01-17), the German gross national income increased from 2,616 billion € in 2010 to 2,986 billion € in 2014 which constitutes a 14% rise.

3.5.2 Persistence of Non-Filing

While tax non-filing and over-remittances are consistent over time on the aggregate level, it is equally interesting whether these patterns persist on the individual level, too. It might be that over-remittances occur only in distinct circumstances that happen very rarely or maybe only once.[16] The prime example is a young employee entering the labor market mid-year. Since vocational training cycles and academic education programs regularly end throughout the year, these employees typically work less than twelve months in their first job post graduation. Thus, employers will typically over-withhold taxes for those entering the labor market, as these taxpayers do not qualify for the annual adjustment. In addition, one may assume that knowledge about the institutional details of the tax filing system is relatively small for young employees who pay income taxes for the first time in their life. These taxpayers would thus be overly prone to non-filing.

In order to assess whether non-filing is a once-in-a-lifetime phenomenon or persistent over time, individual level panel data is necessary. Unfortunately, the corresponding administrative data set, the German Taxpayer-Panel, only recently started sampling non-filers. Therefore, conclusive inferences on the persistence of non-filing cannot be drawn yet. However, we can exploit the repeated cross-sections to shed some light on the question whether over-remittance is a one-time phenomenon or a persistent pattern.

Figure 3.6 illustrates that the share of non-filers relative to optional filers is indeed highest among taxpayers in their early twenties. This pattern also holds when examining the share of non-filers relative to all taxpayers (see Figure 3.6b). Figure 3.6 furthermore shows how this same cohort has evolved four years later. While young taxpayers under the age of thirty in 2010 see a reduction in non-filing shares, i.e. an increase in tax filing, older cohorts do not seem to change their behavior.

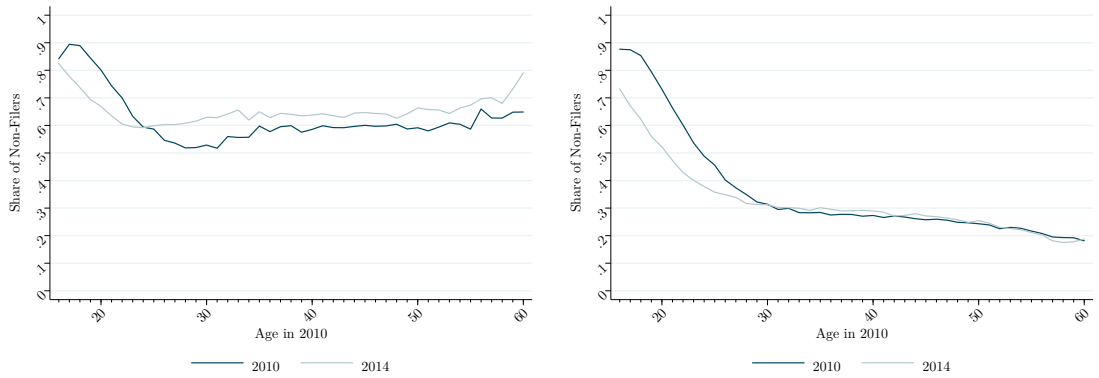
The combination of Figure 3.6a and Figure 3.6b also illustrates that the older taxpayers are, the more likely it is for them to be compulsory filers. While the share of non-filers relative to all optional filers remains fairly constant starting at age 30, the share of non-filers relative to all taxpayers declines with age.

In additional work, presented in the appendix (Figure C.6), we illustrate that over-remittance is common over the entire age distribution. While there are slightly more

[16] See Fullerton and Rao (2019) for a related analysis of taxpayers who do not owe federal income taxes.

Figure 3.6: Non-Filing Share Over Age in 2010

A: Non-Filers as a share of Optional Filers B: Non-Filers as a share of All Taxpayers



Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Lohn- und Einkommensteuerstatistik, 2010 and 2014, own calculations.
Notes: Repeated cross sections. Individuals are grouped by their age in 2010. Figure 3.6a shows the share of non-filers among the optional filers in the final sample. After age 30, non-filing relative to all optional filers is a persistent phenomenon. Figure 3.6b shows the share of non-filers relative to all taxpayers (with mean age for married taxpayers). Within a cohort, tax filing increases up until age 30. As older taxpayers become more and more likely to be compulsory filers, due to e.g. marriage and additional income sources, the share of non-filers relative to all taxpayers decreases beyond the age of thirty.

tax over-remittances for taxpayers in their early twenties, there is no strong variation for older age groups. In 2014, more than 10 percent of optional filers within each age cohort are non-filers with over-remittances of more than 50 €. For teen aged taxpayers, substantial over-remittances are least prevalent which can be explained by their low income levels. Employees in this age span are often apprentices whose income, even on an annual level, is within the basic allowance.[17]

Based on this repeated cross-sectional analysis, we conclude that over-remittance is likely not a one-time phenomenon that occurs for labor market entrants only, but a rather persistent behavior over time. The optional (non-)filing system thus systematically leads to over-remittance for taxpayers at various stages of their lives.

3.5.3 Potential Drivers for Non-Filing

As non-filing is persistent over time, it remains important to understand potential drivers for this. Given the limited socio-economic data available for non-filers, we can

[17]Following data from the Federal Institute for Vocational Education and Training, the average monthly income of apprentices in 2014 is 802 € in West German States and 737 € in East German States (`https://www.bibb.de/de/12209.php`; last accessed: 2020-11-25). These values refer to apprenticeships covered by social agreements. The overall average is likely to be lower.

Table 3.3: Compliance Costs

	Compliance Time	Implied Net Hourly Wage
(A) Statistisches Bundesamt (2012)		
Basic forms	1.69	213.04
All forms	4.52	79.65
(B) Blaufus et al. (2014)		
Lower bound y_{low}	3.90	92.32
Upper bound y_{med}	9.76	36.89
(C) Benzarti (2020)		
Form 1040	9.40	38.30

Notes: On average, non-filing can be rational if the implied net hourly wage, i.e. the average lower bound refund (360.04 €) divided by the respective time estimates above, is higher than the average net wage. Time is measured in hours, wages are measured in €. *(A)*: Based on interviews, the German Federal Statistical Office directly measures the average compliance time for tax filing in Germany in 2009 to be 4.52 hours for a typical employee. The estimate includes time spent for filing (3.83 hours) as well as for preparation and follow-up work (0.69 hours). Out of the 3.83 hours, 1 hour results from three basic forms that require information similar to the minimal filing form which leads to a total of 1.69 hours. *(B)*: Blaufus et al. (2014) find that compliance time increases with income. They estimate the compliance time to be at least 3.9 hours for non self-employed taxpayers whose taxable income y is $\leq$ 22,000 € and at most 9.76 hours for taxpayers with $y \in$ (22,001 €, 42,000 €). *(C)*: Benzarti (2020) in Table 1, Panel b, column (1), he mentions that filing hours for a standard 1040 as surveyed by the IRS amount to 9.40 hours. We assume this to be the closest substitute for our minimal filing counterfactual.

only draw cautious conclusions. Generally, if expected refunds are smaller than filing costs, non-filing can still be rational. These costs to file consist of monetary and non-monetary costs. The former can be thought of as the time required to collect necessary forms and to fill them out. In contrast, non-monetary costs are diverse in nature and include, for example, aversion to fill out tax forms. When using conventional monetary filing cost estimates from the literature and related studies, we find that they are, on average, rather unlikely to exceed refunds.

Conditional on tax over-remittance, the average forgone refund in our sample is 360 € for non-filers (see Table 3.2). For non-filing to be individually rational, compliance costs thus have to be higher than 360 €. For each of these time estimates, we calculate the implied net hourly wage that is required to result in non-filing as the rational decision, given the average forgone refund of 360 €. The results are shown in Table 3.3. For the compliance time, we use estimates from three different sources (Benzarti 2020; Blaufus et al. 2014; Statistisches Bundesamt 2012).

The estimated compliance times in Table 3.3 originate from different filing situations (see table notes for more details) and thus vary largely in size. As a consequence, the implied net hourly wages differ equally. We consider the filing time estimate of 1.69 hours from the German Federal Statistical Office (Statistisches Bundesamt 2012) to

be closest to our minimal filing situation. To fill out three forms that lead to the same result as in the minimal filing situation, an employee needs on average 1.69 hours. Yet, this does not necessarily imply that 1.69 hours is a good approximation for the average non-filer's compliance time. If we assume positive selection into filing based on tax literacy, non-filers are likely to need more time for the same filing requirements than filers.

Importantly however, for the entire range of compliance times, the implied net hourly wages are significantly larger than the average hourly gross wages of about 21 € in 2014.[18] Even the smallest implied net hourly wage is nearly twice as large as the average gross hourly wage. Therefore, we conclude that non-filing, on average, cannot be explained by monetary filing costs alone. Therefore, non-monetary costs and information frictions are likely to be significant.

Here, our results also shed some light on the puzzling pattern that especially low income earners often exhibit incomplete take-up rates for the EITC or other social welfare benefits (see e.g. Currie 2006). In these situations, individuals forgo large sums of money, often larger than in our study. However applying for the EITC or social welfare benefits often comes with a certain degree of social stigma. These stigmata are often seen as a driver for low take-up albeit more widespread eligibility. We argue that for the case of non-filing no such stigmata exists. However, even in the absence of social stigma, take-up of refunds is low, suggesting that other frictions, inherent to tax filing and welfare take-up, seem to be important too (see also Finkelstein and Notowidigdo 2019; Linos et al. 2020).

One likely explanation are informational frictions. A representative survey in 2014, conducted at the request of a non-profit organization assisting with filing, revealed that on average respondents could only answer 5.2 out of 9 basic questions about the tax system correctly. Interestingly, 29% of the respondents think that deductions are only applicable up until the value of the standard deduction.[19] Hence, it seems very likely that non-filers are also not aware of their individual potential refund. In line with previous evidence related to benefit take-up, e.g. Chetty et al. (2013) and Bosch et al. (2019), we conclude that informational frictions are likely to play an important role in the filing decision as well.

[18]The Federal Statistical Office provides quarterly data for gross earnings. In 2014, those ranged from 20.54 € to 20.99 € (`https://www-genesis.destatis.de/genesis/online?sequenz=tabellen&language=en&selectionname=62321-0001`; last accessed: 2020-11-25).

[19]See `https://www.vlh.de/presse/pressemitteilungen/umfrage-so-viel-wissen-die-deutschen-ueber-steuern.html` (last accessed: 2021-02-24) for more information.

As concerns gender, Figure C.3 in the appendix highlights that the difference in filing rates between gender are limited. At older ages, female taxpayers seem to be more likely to voluntarily file an income tax return. However, generally, gender does not seem to be driving tax filing.

3.5.4 Tax Filing Incentives

As previously outlined, both filing costs and informational frictions concerning the filing process and refund potentials influence the tax filing decision. As tax filing rates correlate with some socio-demographic characteristics, this suggests that tax filing incentives do also play a role in the tax filing decision.

In the appendix, Figure C.4 illustrates non-filing shares over income split up along two dimensions: Marriage and children. Generally, both single and married taxpayers with children are more likely to be tax filers. Single taxpayers without children have the highest non-filing share for close to all income levels. We suggest that a potential explanation for this difference can be found in different filing incentives: While opportunity costs are likely to be higher for single taxpayers with children, they still exhibit a larger share of filers, conditional on income. Similarly, both single and married parents have higher deduction potential (e.g. childcare expenditures) and might be more liquidity constrained. Therefore, these taxpayers might view tax filing as an opportunity to obtain a refund.

More generally, as seen in Figure 3.2, tax filing is more likely the higher a taxpayer's income is. This might be driven by differences in institutional knowledge about the filing system and deduction possibilities. Additionally, their incentive to file an income tax return is also higher, as marginal tax rates increase with income.

When voluntary filing an income tax return, a the majority of taxpayers is able to declare deductions beyond the standard values of 1,000 € and 36 € for work-related expenses and special expenses, respectively. We provide specific numbers on this in the appendix (Table C.4). While only a limited number of taxpayers declare extraordinary burden, e.g. due to severe illnesses, about 21% of all voluntary filing taxpayers in 2014, are able to report expenses qualifying as tax credits. This number is however relatively low, given that household related services, e.g. for cleaning or facility management, and home improvement costs for craftsmen are included in this category. Thus, both homeowners and renters are likely to benefit from this regulation.

3.6 Policy Implications

We have shown that, due to tax over-withholding and limited tax filing obligations, statutory and effective income taxation do not coincide. Especially low income taxpayers are hurt as they are more likely to be non-filers and to over-remit taxes.

Our results have tangible implications for policymakers and the design of the tax system. A general take-away concerns behavioral responses which have to be taken into account when designing (tax) policies. Effective outcomes are not only shaped by legal institutions but also by individual decisions. In related tax settings, Roller and Schmidheiny (2016) show that high income taxpayers reduce their effective tax burden by moving to low-tax regions. Furthermore, Saez and Zucman (2019b) show that, in the US, very wealthy individuals are able to substantially decrease their effective tax rates on wealth. Importantly, our findings stress that there also exist policy settings that affect taxpayers at the lower end of the income distribution.

For the specific setting that we study, policy implications depend on the intended degree of income redistribution. Two alternatives are possible. In the first alternative, the statutory tax schedule mirrors the intended degree of redistribution. Put differently, the assumption is that policymakers strive for the effective taxation to reflect what is written down as the statutory tax schedule. In particular, this implies that the basic allowance threshold for low income taxpayers is considered. This seems rather likely for two reasons. First, a basic allowance is included in the statutory tax code. Second, the German Federal Constitutional Court ruled in 1992 that a minimum amount of income may not be taxed.[20] In this alternative, the status quo is concerning in terms of equity because there is less income redistribution than desired. Here, the intuitive policy recommendation is to refund over-remitted taxes to non-filers. We discuss this scenario and potential practical challenges in subsection 3.6.1.

A second possible alternative is that policymakers take taxpayers' non-filing behavior into account when designing the tax system. In this case, the effective taxation may mirror the intended degree of redistribution. In other words, non-filing and tax over-remittances, mostly by low income taxpayers, are taken into account when desigining the tax schedule. In subsection 3.6.2 we analyze the current effective taxation from this perspective. Providing two hypothetical tax systems, we show that the current system

[20]The decision is based on the premise that income should only be taxed when surpassing the amount that is required to meet existential needs. The full ruling can be found here: `http://www.bverfg.de/e/ls19920925_2bvl000591.html` (last accessed: 2021-02-06).

exhibits sizeable efficiency deficits. The same effective taxation can be achieved while simultaneously increasing tax revenue.

First, we implement the current de-facto taxation below the basic allowance into the statutory tax system, rather than obtaining it through over-remittances of low income non-filers. This leads to a mechanical increase in tax revenue from higher income taxpayers without imposing additional distortions in terms of higher MTRs. Building on the intuition from the first hypothetical tax system, we then provide a more sophisticated approach for demonstrating that optional (non-)filing cannot be considered an efficient tool for reaching the effective income taxation. In this second approach, we show that even without mechanically increasing tax revenue, implementing the observed effective taxation as statutory tax schedule would increase tax revenue because of behavioral responses. Put differently, we show that the same effective redistribution over income can be obtained in a more efficient way, i.e. with less distortions in terms of effective MTRs.

3.6.1 Implications for Equity

Due to non-filing, the effective tax progressivity observed is lower than the statutory tax progressivity. Thus, if we assume that the statutory tax schedule reflects societal preferences for redistribution, this attenuation of redistribution is sub-optimal from an equity perspective. The coherent policy implication in this case is to automatically refund any over-remittance to non-filing taxpayers. This ultimately realigns statutory and effective taxation.

Intuitively, one can think of automatic refunds for non-filers as equity gains without efficiency losses. On average, non-filing taxpayers currently face higher average and marginal taxes than intended by the schedule. A tax refund would reduce their effective average tax rate and the applicable marginal tax rate, increasing their net-of-tax rate and thus generating welfare gains for low income taxpayers. In terms of labor supply incentives, this would, if anything, lead to efficiency gains as formerly over-remitting non-filers would now face lower effective MTRs.

Clearly, automatically refunding over-remittances to non-filers reduces the governmental budget relative to the current situation. However, while substantial in absolute terms, the relative importance of tax revenue collected through over-remittances is limited. The sum of all over-remittances (950 million €) accounts for about 0.15% of

Germany's overall tax revenue in 2014 (644 billion €).[21] For the case that automatic refunds, nevertheless, jeopardize the governmental budget, we provide two back-of-the-envelope calculations for budget neutral reforms. We approximate the required increase in the (two) top marginal tax rates that would levy sufficient funds to finance automatic refunds for non-filers. Abstracting from income effects, we show that for conventional elasticity of taxable income estimates, today's top marginal tax rate of 45% would have to be increased by about 2.9 to 4.9 percentage points. This change raises the required tax revenue of 950 million € only from taxpayers in the highest income tax bracket. When considering the top two MTRs (45% and 42%), both would have to be increased by 0.8 to 1.1 percentage points to around 46% and 43%, respectively. We provide more details for the approach and results of this computation in Subsection B.5 of the Online Appendix.

If automatic refunds are not feasible due to administrative or legal reasons, tax authorities could provide pre-populated forms for taxpayers exclusively earning wage income. Automatically sending out pre-populated forms is a policy that is already in place in other countries, for example in Norway.[22]

These pre-filled forms can address two potential drivers for non-filing. First, they might provide information about over-remittances that may not be salient to non-filers in the current system. Second, they reduce the (expected) compliance costs of filing. Providing pre-populated forms is considered a rather cost-effective way to reduce compliance costs of tax filing (Benzarti 2021). For the US, Benzarti (2021) estimates that 70% of Schedule A could be pre-populated which would lead to a 70% reduction in compliance costs (from $ 24 to $ 7 billion).

Both automatic refunds and pre-populated forms would increase the degree of effective income redistribution. In addition, both measures would also be beneficial for a large set of currently filing taxpayers. Automatic refunds would benefit voluntary filers who only file to obtain their over-withheld taxes. Filing an income tax return would no longer be necessary for those taxpayers. For automatically provided pre-populated forms, all taxpayers with wage income can benefit, assuming that this would reduce

[21] Data from the Federal Statistical Office (`https://www-genesis.destatis.de/genesis/online?sequenz=tabellen&language=en&selectionname=71211-0001`; last accessed: 2020-11-26).

[22] Information on pre-populated tax forms in Norway is provided by the Norwegian Tax Administration (`https://www.skatteetaten.no/en/person/taxes/`, last accessed: 2020-11-30). Right now, pre-populated forms in Germany are available upon request for taxpayers that are already registered for online filing (`https://ec.europa.eu/cefdigital/wiki/display/CEFDIGITAL/2019/07/31/German+pre-filled+tax+return`, last accessed: 2020-11-30).

the compliance costs for filing. In 2014 for example, this would have benefited about 23 million taxable units, single filing individuals and joint filing spouses, that received some wage income.

3.6.2 Implications for Efficiency

So far, we have focused on the redistributive effects of optional tax (non-)filing in terms of effective ATRs or total tax remittances. However, higher average tax rates inextricably imply higher effective marginal tax rates. Tax over-remittances occur due to incorrect extrapolations of the annual taxable income $\tilde{y}_i$ as described in section 3.2. Given the progressive nature of the tax system, a taxpayer's effective ATR is, at best, equal to the statutory ATR, i.e. $ATR^{schedule}(\tilde{y}_i) \geq ATR^{schedule}(y_i)$. Consequently, the same intuition applies to the effective MTR defined as $\tau_i^{eff} = \tau^{schedule}(\tilde{y}_i) \geq \tau^{schedule}(y_i)$. Thus, over-remitting non-filers also face higher effective MTRs than intended by the tax schedule, as illustrated in the appendix (Figure C.7).[23]

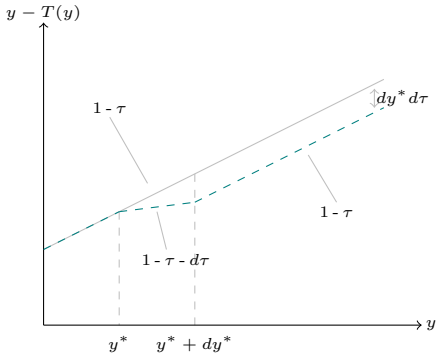
While higher marginal tax rates increase tax revenue for a given level of income, they also entail efficiency costs. If the elasticity of taxable income with respect to the (effective) marginal tax rate is positive, an increase in the marginal tax rate decreases the incentives to work. Consequently, the taxpayer's labor supply decision and income are affected. This conflict between raising more tax revenue to support lower income taxpayers and the efficiency costs of distorting labor supply decisions is known as the equity-efficiency trade-off and has been at the core of the decade-long research regarding optimal income taxation (e.g. Mirrlees 1971; Saez 2001). Thus, even if the status quo effective taxation represents the societal preferences for redistribution, i.e. there are no equity concerns related to the optional (non-)filing system, the system may not be optimal in terms of efficiency. Building on the intuition of the tax-perturbation approach introduced by Saez (2001), we analyze the efficiency properties of effective income taxation under optional tax (non-)filing.

Intuition Tax Perturbation. Consider an increase in the MTR τ by $d\tau > 0$ for the taxable income range $y \in [y^*, y^* + dy^*]$ as described by Saez (2001). Two groups of taxpayers are affected by this perturbation. First, taxpayers with $y \in [y^*, y^* + dy^*]$ face

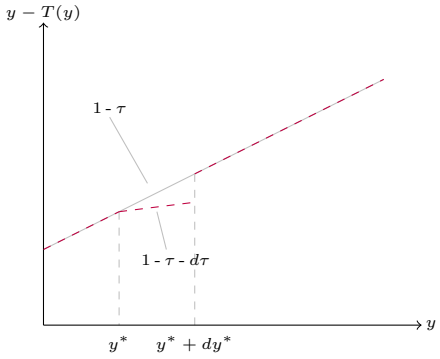
[23] This is true as long as the MTR at the extrapolated income ($\tilde{y}_i$) is larger than the MTR at the statutory income (y_i), $\tau^{schedule}(\tilde{y}_i) > \tau^{schedule}(y_i)$. As the German tax system features linearly increasing marginal tax rates in the first three brackets (see Figure C.1), this applies to the majority of taxpayers in our main analysis.

Figure 3.7: Tax Perturbations

A: Change in Statutory MTR



B: Change in Effective MTR



Notes: Simplified visualization of the effect of increasing the marginal tax rate τ for the income range $[y^*; y^* + dy^*]$ by $d\tau > 0$. Panel (a) refers to an increase in the statutory MTR as defined in the tax schedule and follows closely Saez (2001). Panel (b) refers to an increase in the effective MTR, leaving the tax schedule unchanged. y: taxable income; $T(y)$: taxes paid on taxable income; $y - (Ty)$: net-of-tax income. Slopes are indicated in the graphs.

higher tax liabilities as their MTR increases. Second, for taxpayers with $y > y^* + dy^*$, tax liabilities increase by the change in the MTR, $d\tau$, times the width of the affected range, dy^*, while their MTR does not change. This is illustrated in Figure 3.7a, following closely Saez (2001).

Assuming a positive elasticity of taxable income with respect to the marginal net-of-tax rate, i.e. $\varepsilon_{y,1-\tau} = \frac{(1-\tau)}{y} \frac{\partial y}{\partial(1-\tau)} > 0$, taxpayers in the directly affected range, $y \in [y^*, y^* + dy^*]$, face an increase in tax remittances for a given income and, at the same time, a decrease in their labor supply incentives. For taxpayers with income above the directly affected income range, $y > y^* + dy^*$, tax payments increase. When abstracting from income effects, there are no distortionary labor supply effects.[24] However, there is a negative welfare effect for this group as they have less income available than before the MTR increase.

Importantly, a change in the MTR for $y \in [y^*, y^* + dy^*]$ affects taxpayers with higher income, $y > y^* + dy^*$, only if the change concerns the statutory MTR. Increasing the effective MTR in a given income range without changing the statutory MTR has no effect on higher income taxpayers. We illustrate this in Figure 3.7b. Thus, increasing the effective MTR for certain income groups imposes distortionary effects on these groups without raising additional tax revenue from anyone else.

[24] Following Saez et al. (2012), abstracting from income effects can be considered reasonable given that there is no compelling evidence for income effects.

The same intuition applies to the optional tax (non-)filing setting. In any given income range, the average effective MTR for over-remitting non-filers is higher than the statutory MTR. However, all other taxpayers are not affected, since their statutory MTRs remain unchanged. Based on this intuition, we argue that optional (non-)filing is an inefficient way to achieve the effective taxation currently observed.

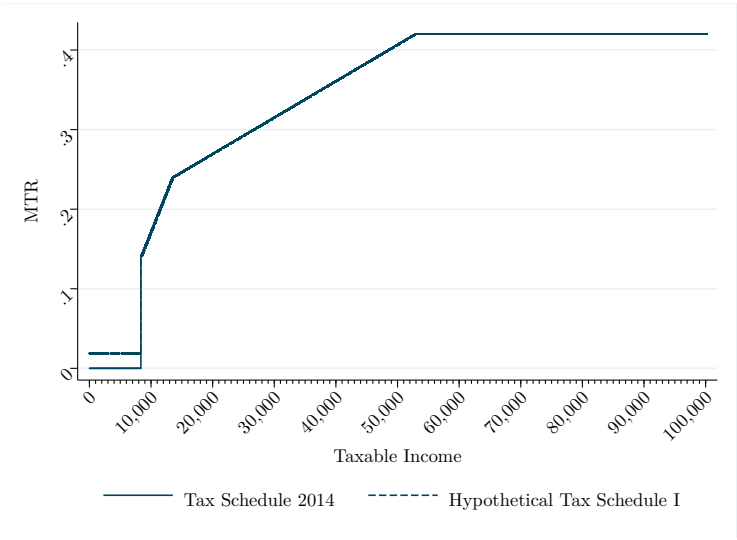
To show this, we design two hypothetical tax systems in which the current effective tax liabilities are obtained through tax schedules rather than through non-filing behavior. First, we compute tax revenue gains that would arise when abolishing the basic allowance and replacing the current statutory MTR of zero with the current effective MTR of about 1.87%. Building on this first tax system, we propose a second measure of inefficiency. We show that implementing the effective taxation across all income levels as statutory schedule allows to reduce marginal tax rates for the taxpayers beyond the basic allowance. In this second hypothetical tax system, while maintaining the same effective taxation, the behavioral responses to reductions in the marginal tax rates lead to increases in tax revenue. These increase can then be interpreted as an inefficiency measure for the current system. Given, among other things, the legal constraints outlined previously, we do not understand these policies as implementable but rather as a theoretical thought experiment and as a benchmark for quantifying the inefficiencies of the current system.

For both alternatives, the estimated effects on tax revenue stem from stylized back-of-the-envelope calculations with some assumptions. Relative to the main analysis in section 3.4, we broaden the scope and use the full data set for this analysis. For those non-filers that were previously excluded, as we could not compute their precise taxable income, we now rely on the slightly imprecise taxable income reported by the tax authority.

Hypothetical Tax System I: Abolition of the Basic Allowance. As non-filing and over-remittances are especially common among low income earners, we observe an effective ATR of around 1.87% for all taxpayers with income up to the basic allowance threshold of $y_0 = 8{,}354\,€$. The tax liabilities of (filing) taxpayers with $y > y_0$ are not affected, such that they pay no taxes for their first $8{,}354\,€$.

In this first approach, we set up a hypothetical tax system to provide a back-of-the-envelope calculation for the mechanical increase in tax revenue that would follow the abolition of the basic allowance for both non-filers and filers. The idea is as follows: We design a tax schedule that matches the existing statutory tax schedule but includes

Figure 3.8: Hypothetical Tax System I: Abolition of the Basic Allowance in the Statutory Tax Schedule



Notes: Tax Year 2014. Figure 3.8 shows the hypothetical marginal tax rate schedule that the abolition of the basic allowance would entail. Then, the previous MTR $\tau_0 = 0$ for income below the basic allowance $y \leq y_0 = 8{,}354\,€$ would be replaced by the effective flat tax $\tau_0^{hyp} = 0.0187$.

a flat tax $\tau_0^{hyp} > 0$ for the income below the basic allowance threshold. This flat tax τ_0^{hyp} is defined such that it matches the average effective tax liability of taxpayers with income below the basic allowance in the current system of optional (non-)filing, i.e. $\tau_0^{hyp} = 0.0187$. The resulting tax schedule is depicted in Figure 3.8. The pivotal feature of this hypothetical tax system is that all taxpayers effectively pay a flat tax for income below the previous basic allowance threshold, 8,354 €. A stylized version of the associated effects is characterized by switching from Figure 3.7b to Figure 3.7a.

The results are an approximation and require a few assumptions. First, we assume that all taxpayers with income above the basic allowance did not pay taxes on this basic allowance. However, for some non-filers this may not be true, even if they earn (slightly) more than the basic allowance. Second, for this analysis we use all taxpayers in the data set, including compulsory filers. While this allows us to quantify the aggregate effect on tax revenue, information on taxable income is not fully accurate for non-filers. Furthermore, for taxpayers with income below $y_0 = 8{,}354\,€$, we abstract from the fact that although the average effective taxation is kept constant, this is not necessarily true for individual tax liabilities. We also abstract from potential behavioral responses that follow a change in the effective ATR and consequently also in the effective MTR. Taxpayers with income above the previous basic allowance threshold

do not exhibit behavioral responses, if we abstain from income effects, as their MTR remains unchanged.

Taxpayers with income y <8,354 € will, on average, not be worse off, since the tax schedule is defined such that the average effective taxation is kept constant for the whole income range $0 \leq y \leq$8,354 €. Taxpayers with income above the previous basic allowance, $y > y_0$, face an additional tax liability of $0.0187 \times 8{,}354\,€ = 156.49\,€$. Aggregating over the universe of taxpayers above the previous basic allowance, this flat tax leads to a total increase in tax revenue of 4.02 billion € relative to the existing tax schedule.

Put differently, if the effective ATR of 0.0187 for taxable income up to 8,354 € was not obtained via non-filing and tax over-remittances of very low income earners but through implementation in the tax schedule, tax revenue could be increased by around 4 billion €. Clearly, an abolition of the basic allowance for taxpayers would likely come with negative welfare effects since a large share of taxpayers would pay more taxes than in the current system. Furthermore, it would likely be unconstitutional given that the German Federal Constitutional Court decided that a minimum amount of income is not to be taxed, as described before. While not implementable in practice, calculating tax revenue gains in this hypothetical tax system shows that implementing positive taxation for income up to y_0 through non-filing is likely not efficient.

Hypothetical Tax System II: Effective Taxation as Tax Schedule. In the first hypothetical tax system, we have shown that implementing the observed effective tax rates below the basic allowance threshold into the statutory tax system would mechanically increase overall tax revenue. Now, we take a slightly more sophisticated approach to assess the efficiency of the effective income taxation under optional (non-) filing. In this second hypothetical tax system, the observed effective taxation for all income levels (rather than for income below the basic allowance only) is reached through a new tax schedule instead of non-filing behavior. Again, the intuition follows the tax perturbation approach and is closely related to the intuition of the first hypothetical tax reform. In contrast to the first reform, we now abstract from mechanical increases in tax revenue from higher income earners. Thus, only behavioral responses, i.e. adjustments to labor supply, lead to increases in tax revenue.

We define this new tax schedule such that for each income level, the tax liability equals the average effective tax payment that we observe under the current system. As in the first approach, we implement a statutory MTR of 1.87% instead of 0% for

income up to $y_0 = 8{,}354$ €. However, now, this has also implications for the tax schedule for $y > y_0$. Since taxpayers with income above the basic allowance now already pay taxes on their first 8,354 € of income, marginal tax rates further up in the income distribution can be reduced while keeping the effective average tax rates constant. Assuming positive elasticities of taxable income with respect to the MTR, this leads to increases in taxable income and consequently increases in tax revenue. Put differently, as the same effective taxation can be obtained with less distortions, while simultaneously increasing tax revenue through behavioral effects, optional (non-)filing cannot be considered efficient. Thus, the additional tax revenue that can be generated in this new systems serves as our measure for inefficiency.

This approach builds on some assumptions. First, we only consider taxpayers' average tax payments at a given income level. This implies that, while the effective tax liabilities $T^{eff}(y)$ are kept constant, some individuals with income y will pay more and others will pay less. Second, we only consider behavioral responses at the intensive margin, assuming that taxpayers can adjust their income without frictions. Thus, no individual will enter (leave) the labor market because of lower (higher) effective MTRs but only increase (decrease) their taxable income. Third, interactions with the social security and transfer system are disregarded. Lastly, an implied assumption is that the financial authorities are able to automatically refund over-remitted taxes to non-filers and that they would do so to align effective taxation with the statutory tax schedule.

To quantify the increase in tax revenue that follows from implementing this hypothetical tax system, the following steps are required. First, we define $T^{eff}(y)$, a smoothed function of observed tax liabilities. Second, we derive the effective MTR in the new hypothetical system $\tau^{eff}_{new}(y_i)$ as the derivative of $T^{eff}(y)$. Third, for each individual, we can then compare the new effective MTR to the old effective MTR yielding an individual-specific change in the MTR, $d\tau^{eff}_i = \tau^{eff}_{new}(y_i) - \tau^{eff}_i$. Fourth, we calculate individual behavioral responses in taxable income dy_i and the corresponding changes in tax liabilities dT^{eff}_i. The overall effects are then obtained by aggregating dT^{eff}_i over the taxpayer population.

As non-filing introduces sizeable volatility in effective taxation, we smooth the effective tax liabilities to obtain $T^{eff}(y)$. Otherwise, there would be extreme fluctuations in the corresponding marginal tax rates. Effective tax liabilities are smoothed separately for each tax bracket to account for the kinks between tax brackets. Two approaches for smoothing $T^{eff}(y)$ are considered, a linear approach using an ordinary-least-squares (OLS) regression and a spline interpolation to allow for a more flexible functional form.

Table 3.4: Potential Efficiency Gains from Reform - Full Sample

	dy_i	$\sum dy_i$	dT_i^{eff}	$\sum dT_i^{eff}$
	(A) Same Elasticity for Filers and Non-Filers			
	($\varepsilon^F_{y,1-\tau} = \varepsilon^{NF}_{y,1-\tau} = 0.2$)			
Linear	41.23	1,416,984,425	7.62	261,936,774
Non-linear	39.67	1,363,195,406	9.52	327,319,967
	(B) Different Elasticities for Filers and Non-Filers			
	($\varepsilon^F_{y,1-\tau} = 0.2$, $\varepsilon^{NF}_{y,1-\tau} = 0.0$)			
Linear	20.24	695,455,088	4.59	157,834,870
Non-linear	19.43	667,592,843	6.66	228,880,727

Notes: The table shows the effect of the proposed hypothetical tax reform in terms of changes in taxable income and tax revenue (both in €) for the full data set, including all taxpayers. Panel (A) shows results for an elasticity of taxable income $\varepsilon_{y,1-\tau} = 0.2$ for all taxpayers, both filers (F) and non-filers (NF). Panel (B) shows results for $\varepsilon^F_{y,1-\tau} = 0.2$ for filers and $\varepsilon^F_{y,1-\tau} = 0.0$ for non-filers. Results for$\varepsilon_{y,1-\tau} = 0.3$ are shown in Table C.7. *Linear*: Effective individual tax liabilities $T_i^{eff}(y_i)$) are smoothed by fitting a quadratic function (OLS) for each tax bracket b to derive $T^{eff}_{new,b}(y_b) = \beta_0 + \beta_1 y_b + \beta_2 {y_b}^2$. $\beta_0 = 0$ for the first bracket, to make sure that $T^{eff}_{new,1}(y_1) \geq 0$. The resulting $\tau^{eff}_{new}(y)$ is a linear function of y within each tax bracket. This design follows the current design of the German Income Tax Schedule (see Figure C.1). *Non-linear*: Effective individual tax liabilities are smoothed by interpolating a restricted cubic spline function (5 knots) within each tax bracket. This allows for more flexibility within a given tax bracket and leads to a non-linear function $\tau^{eff}_{new}(y)$. Compared to a higher order polynomial fit, spline interpolations exhibit less oscillation, making it more suitable for defining $T^{eff}(y)$. dy_i: Average change in individual taxable income in €. $\sum dy_i$: Aggregate change in taxable income in €. dT_i^{eff}: Average individual change in tax remittance in €. $\sum dT_i^{eff}$: Aggregate change in tax revenue in €.

In this hypothetical tax system, the effective MTR decreases for two different reasons. First, after implementing the average effective taxation for the previous basic allowance, the effective MTR for taxpayers with income above 8,354 € has to decrease. Figure C.8 in the appendix offers a graphical representation, which highlights that deviations are largest for taxpayers in the second and third income tax bracket. Second, and potentially less intuitive, the effective MTR also decreases for the first tax bracket with $y \leq y_0$. To understand this pattern, one has to recall that the lowest positive MTR in the German tax schedule is 14%. Consequently, as soon as the effective ATR is larger than zero, this implies an effective MTR of at least 14%. If the effective taxation is obtained through the tax schedule rather than through non-filing, the effective MTR will be close to the observed effective ATR in the lowest tax bracket, leading to a sizeable decrease in the average effective MTR.

Panel A of Table 3.4 shows the average and the aggregate responses to these changes in marginal tax rates for taxable income and tax revenue when assuming an elasticity of taxable income $\varepsilon_{y,1-\tau} = 0.2$. Although the two approaches to construct the new

marginal tax rates, linear OLS and spline smoothing, lead two different functional forms for the tax schedule, the results are within the same magnitude. Individual responses are rather small with an average increase in the annual taxable income of 39 € to 41 €. Consequently, average changes in effective tax liabilities are also rather small, between 7 € and 9 € for both approaches. Aggregating over the universe of all taxpayers leads to a total increase in tax revenue of 261 million € to 327 million €. This effect is sizeable given that it stems only from behavioral responses. The estimated increases in tax revenue can be interpreted as efficiency gains from the hypothetical tax system absent changes in real effective taxation. Likewise, it can be interpreted as an approximation for the efficiency losses in the current optional filing system.

Estimates for the elasticity of taxable income typically do not differentiate between filing and non-filing taxpayers. However, it is possible that the two groups differ systematically in their responsiveness to changes in their effective MTRs. In order to react to a higher effective MTR, taxpayers have to be aware of the increase in the first place. If, for instances, over-remitting non-filers abstain from filing their taxes because they are inattentive and not aware of their over-remittances, they may also be inattentive towards changes in their effective MTR. In Panel B of Table 3.4, we account for this possibility and introduce heterogeneity in the elasticity of taxable income based on the filing status. While the elasticity for filers remains unchanged ($\varepsilon^{F}_{y,1-\tau} = 0.2$), we assume $\varepsilon^{NF}_{y,1-\tau} = 0$ for all non-filers. Under this assumption, the hypothetical tax system would lead to an increase in tax revenue ranging from 157 million € to 228 million €. Given that these values are computed under the strong assumption that non-filers do not react to changes in their effective MTRs at all, this is still a sizeable effect.

Summarizing the results outlined above, we conclude that the current effective income taxation induced by the optional tax (non-)filing system cannot be considered optimal. If the statutory tax schedule reflects societal preferences for redistribution, then the effective tax burden of low income non-filers leaves room for significant equity improvements. If, however, the effective tax liabilities observed reflect societal preferences for redistribution, we show that there are more efficient ways to achieve the same outcome.

3.7 Conclusion

In this paper, we examine the effects of optional tax (non-)filing for effective taxation. We show that non-filing is particularly prevalent at the lower end of the income distribution. Taxpayers in these income ranges are hurt most by optional filing rules. Below the basic allowance threshold, over-remitting non-filers face an average tax rate of about 5% relative to a statutory rate of zero. Furthermore, on average, over-remitting non-filers paid 360 € more than intended by the schedule in 2014, adding up to a total of at least 949 million €.

We show that the results are persistent over time. Additionally, we provide suggestive evidence that conventional filing costs estimates cannot explain these patterns. Rather, informational frictions about potential refunds or non-monetary filing costs have to be sizeable to explain these patterns.

Therefore, if policymakers want to realign statutory and effective taxation, automatic refunds or, at least, pre-populated returns should be used. However, if the current effective taxation is considered equitable, we provide a hypothetical tax reform that demonstrates that the same outcome can be obtained while simultaneously providing larger labor supply incentives. This could ultimately increase tax revenue while preserving the same effective taxation as today.

Conclusion

Three behavioral responses to taxation have been at the core of this dissertation. Chapters 1 and 2 focus on avoidance and evasion, while the third chapter relates to non-filing of personal income tax returns.

Both the theoretical essay in chapter 1 and the empirical analysis in chapter 2 highlight that policies which aim to limit the avoidance and evasion potential must be distinctive to be effective. The first chapter argues that tax havens will use countermeasures, modeled as lobbying, to reduce high-tax countries' pressure directed at profit shifting multinational firms. As a result, the effective pressure endured by multinational firms is smaller than intended by high-tax countries and the firms keep shifting profits offshore. Only in extreme cases, when the exerted pressure is prohibitively high, tax havens forgo the possibility to use countermeasures. Similarly, as seen in chapter 2, announcing broad income categories as the enforcement focus has very limited effects for personal income tax reporting. Ultimately, for the policy analyzed in chapter 2, broad audit announcements only lead to more overall taxable income in one out of seven income categories. However, when enforcement announcements are distinctive, i.e. on the line item level, taxpayers react significantly and permanently.

Complementary to the active responses to taxation, chapter 3 highlights that inactivity, in the form of non-filing, is equally relevant. Optional tax filing systems take this into account and explicitly exempt wage earners from the mandatory duty to file an income tax return. As presented in chapter 3, this has strong effects for effective tax rates, as low income taxpayers are more likely to be non-filers and to over-remit taxes. Consequently, automatic refunds could realign effective and statutory taxation. However, if the current distribution of effective tax rates reflects social preferences for redistribution, chapter 3 also shows that there are more efficient ways to achieve the status quo effective taxation.

To conclude, this thesis has shed more light on three behavioral responses to taxation – avoidance, evasion, and non-filing. These responses are highly relevant for tax policy design, as they lead to a divergence of statutory and effective taxation. While taxpayers who avoid or evade taxes do so to ultimately reduce their effective tax burden, taxpayers who do not file an income tax return are likely to end up remitting more than intended by the tax schedule. Thus, when policymakers want to assess the effects of a particular tax policy, understanding the behavioral responses, to which this thesis has contributed, is crucial.

Appendices

A Appendix to Chapter 1

A.1 Proof of Proposition 1

To demonstrate that the best-response functions given by (1.8) for onshore pressure and by (1.11) for offshore lobbying constitute an interior Nash equilibrium, three conditions have to be fulfilled for both policy tools:

1) The objective functions W_H and W_F are continuous in the respective policy tool.

2) Each objective function ought to have (strictly) concave curvature to ensure an optimum, that is, the second-order derivative has to be (strictly) negative.

3) The best-response functions (1.8) for α^* and (1.11) for γ^* have to lie within their respective boundaries, that is, $0 < \alpha^* < \alpha^{up} = \frac{k}{h}$ and $0 < \gamma^* < 1$.

While 1) and 2) ensure the existence of an equilibrium, 3) ensures that this equilibrium is an interior equilibrium.

Onshore Country For the onshore country, the objective function can be rewritten as

$$\max_{\alpha} W_H = t^* \Big[s + h \int_{\overline{x}}^{1} dF(x) \Big] - \frac{\alpha^2}{2} g = t^* [s + 1(h - \overline{x})] - \frac{\alpha^2}{2} g \,, \tag{A.1}$$

$$= \frac{1}{3} \Big[2\frac{k}{h} + \alpha\gamma \Big] \Big[1 - h \big[\frac{1}{3h} - \frac{\alpha\gamma}{3k} \big] \Big] - \frac{\alpha^2}{2} g \,. \tag{A.2}$$

Taking the first-order condition and solving for α^* yields

$$\frac{\partial W_H}{\partial \alpha} = \frac{4}{9}\gamma + 2\frac{\alpha\gamma^2 h}{9k} - \alpha g \stackrel{!}{=} 0 \,, \tag{A.3}$$

$$\Leftrightarrow \alpha^* = \frac{\frac{4}{9}\gamma}{g - \frac{2\gamma^2 h}{9k}} \,. \tag{A.4}$$

1) As is clearly visible from (A.2), the objective function W_H is continuous in α.

2) To ensure the (strictly) concave curvature, it has to hold that (A.5) is (strictly) negative for all parameter values:

$$\frac{\partial^2 W_H}{\partial \alpha^2} = \frac{2\gamma^2 h}{9k} - g < 0 \quad \forall \; g > \frac{2\gamma^2 h}{9k} \,. \tag{A.5}$$

This is the case when g is sufficiently large, that is,

$$g > \frac{2\gamma^2 h}{9k} \quad . \tag{A.6}$$

To have the maximum level for the sufficient condition, one can insert the maximum value for γ, $\gamma = 1$. Hence, the sufficient condition can be simplified to $g = \frac{2h}{9k}$.

3) Because 2) ensures the concave curvature of the objective function, for α^* to be an interior best-response function, it has to hold that $\frac{\partial W_H}{\partial \alpha}|_{\alpha=0} > 0$ and $\frac{\partial W_H}{\partial \alpha}|_{\alpha=\alpha^{up}=\frac{k}{h}} < 0$. Put differently, there has to be a positive slope for the policy tool at the lower boundary and there has to be a negative slope at the upper boundary.

$$\frac{\partial W_H}{\partial \alpha}|_{\alpha=0} = \frac{4}{9}\gamma > 0 \ \ \forall \ \ \gamma \ \ \in \ \ (0,1) \ \ , \tag{A.7}$$

$$\frac{\partial W_H}{\partial \alpha}|_{\alpha=\alpha^{up}=\frac{k}{h}} = \frac{4}{9}\gamma + \frac{2(\frac{k}{h})\gamma^2 h}{9k} - \frac{h}{k}g < 0 \ \ \forall g > \frac{2h}{9k}\big[\gamma[2+\gamma]\big] = \frac{2\gamma^2 h + 4\gamma h}{9k} \ . \tag{A.8}$$

Hence, there is a positive slope at the lower boundary for values of $\gamma \in (0,1)$, that is, for all interior values of γ. Given that the additional condition for g is fulfilled, the slope at the upper boundary is negative. Again, taking the maximum value for offshore lobbying, that is, $\gamma = 1$, the condition simplifies to $g = \frac{2h}{3k}$. This implies, together with the concave curvature, that (1.8) is an interior Nash equilibrium. If the sufficient condition is fulfilled, but not the additional condition, that is, $\frac{2h}{9k} < g \leq \frac{2h}{3k}$, the boundary solution of $\alpha^* = \alpha^{up} = \frac{k}{h}$ remains.

Offshore Country For the offshore country, the objective function can be rewritten to

$$\max_{\gamma} \ W_F = f_t \int_0^{\overline{x}} df(x) - \frac{(1-\gamma)^2}{2}\rho = f_t\, \overline{x} - \frac{(1-\gamma)^2}{2}\rho \ , \tag{A.9}$$

$$\Leftrightarrow \frac{1}{3}\Big[\frac{k}{h} - \alpha\gamma\Big]\Big[\frac{1}{3h} - \frac{\alpha\gamma}{3k}\Big] - \frac{(1-\gamma)^2}{2}\rho \ . \tag{A.10}$$

Again, taking the first-order derivative and solving for the optimal level of lobbying yields

$$\frac{\partial W_F}{\partial \gamma} = 2\gamma\frac{\alpha^2}{9k} + (1-\gamma)\rho - \frac{2}{9h}\alpha \stackrel{!}{=} 0 \ , \tag{A.11}$$

$$\Leftrightarrow \gamma^* = \frac{9kh\rho - 2\alpha k}{9kh\rho - 2\alpha^2 h} = 1 - \frac{2\alpha k - 2\alpha^2 h}{9kh\rho - 2\alpha^2 h} \ . \tag{A.12}$$

1) As is visible in (A.10), the offshore country's objective function is continuous in γ.

2) Again, to ensure the strict concavity of the objective function W_F, the second derivative with respect to γ has to be smaller than zero:

$$\frac{\partial^2 W_F}{\partial \gamma^2} = \frac{2\alpha^2}{9k} - \rho < 0 \ \forall \ \rho > \frac{2\alpha^2}{9k} \ . \tag{A.13}$$

Hence, $\rho > \frac{2\alpha^2}{9k}$ ensures the strict concavity of the offshore country's maximization problem. When inserting the maximum value of pressure ($\alpha^{up} = \frac{k}{h}$), this condition simplifies to $\frac{2k}{9h^2}$.

3) To avoid a potential corner solution, it has to hold that $\frac{\partial W_F}{\partial \gamma}|_{\gamma=0} > 0$ and $\frac{\partial W_F}{\partial \gamma}|_{\gamma=1} < 0$.

$$\frac{\partial W_F}{\partial \gamma}|_{\gamma=0} \qquad = \rho - \frac{2\alpha}{9h} > 0 \qquad\qquad \forall\ \rho > \frac{2\alpha}{9h} \ , \tag{A.14}$$

$$\frac{\partial W_F}{\partial \gamma}|_{\gamma=1} \qquad = 2\frac{\alpha^2}{9k} - 2\frac{\alpha}{9h} = 2\alpha\Big[\frac{\alpha}{9k} - \frac{1}{9h}\Big] < 0 \qquad \forall\ \alpha < \frac{k}{h} \ . \tag{A.15}$$

This second line is the condition for an interior solution of onshore pressure. Hence, as long as the level of pressure is below the upper boundary, there is an incentive for the onshore country to lobby, that is, γ is at least marginally smaller than 1. For the case of upper limit pressure, $\gamma = 1$, that is, there is no offshore lobbying.

As concerns the derivative at the lower boundary, $\frac{\partial W_F}{\partial \gamma}|_{\gamma=0}$, it can be shown that the sufficient condition nests the condition that ensures an interior equilibrium: For this it has to be hold that $\frac{2\alpha}{9h} \leq \frac{2\alpha^2}{9k} \ \forall\, \alpha \in [0,\ \frac{k}{h}]$:

$$\frac{2\alpha}{9h} \leq \frac{2\alpha^2}{9k} \,, \tag{A.16}$$

$$2\alpha k \leq 2\alpha^2 h \,, \tag{A.17}$$

$$\frac{k}{h} \leq \alpha \,. \tag{A.18}$$

The last line is the condition for the upper limit of pressure. Hence, the sufficient condition for the maximum nests the condition to avoid the corner solution. This concludes the proof for Proposition 1. □

A.2 Comparative Statics

As the equilibrium values of γ^* and α^* are only implicitly given, the implicit function theorem is necessary to evaluate the comparative statics for the given equilibrium values. Hence, the matrix of second-order (cross-) derivatives is given by $|D|$, where

$$|D| = \begin{vmatrix} \frac{\partial^2 W_H}{\partial \alpha^2} & \frac{\partial^2 W_H}{\partial \alpha \partial \gamma} \\ \frac{\partial^2 W_F}{\partial \gamma \partial \alpha} & \frac{\partial^2 W_F}{\partial \gamma^2} \end{vmatrix} = \begin{vmatrix} \frac{2\gamma^2 h}{9k} - g & \frac{4}{9} + \frac{4\alpha\gamma h}{9k} \\ -\frac{2}{9h} + \frac{4\alpha\gamma}{9k} & \frac{2\alpha^2}{9k} - \rho \end{vmatrix} . \tag{A.19}$$

To arrive at conditions for this determinant to be either positive or negative, taking a closer look yields

$$|D| = \underbrace{\left(\frac{2\gamma^2 h}{9k} - g\right)}_{-} \underbrace{\left(\frac{2\alpha^2}{9k} - \rho\right)}_{-} - \underbrace{\left(-\frac{2}{9h} + \frac{4\alpha\gamma}{9k}\right)}_{\text{ambiguous}} \underbrace{\left(\frac{4}{9} + \frac{4\alpha\gamma h}{9k}\right)}_{+} \gtreqless 0 . \tag{A.20}$$

The first part of the determinant is negative, as this imposed by the sufficient condition $g > \frac{2\gamma^2 h}{9k}$. The second part has to be negative. Assuming that one starts at the equilibrium value of γ, an increase in γ leads to a negative first-order condition, as lowering γ further yields more benefits. The third term is positive if it holds that $\frac{\alpha\gamma}{k} < \frac{1}{2h}$, that is, if the effective pressure component on the firm relative to financial market frictions is smaller in size than $\frac{1}{2h}$. The last term is unambiguously positive.

Assuming that direct effects are larger in size than indirect ones, $|D| > 0$ is used for further computations.

B Appendix to Chapter 2

B.1 Additional Figures

Figure B.1: Enforcement Focus List Tax Year 2010 (First Page)

Stand 06.01.2011

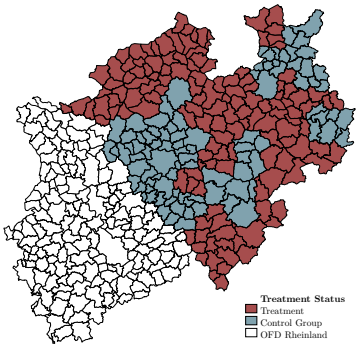
FA-Nr.	FA	Bezeichnung Prüffeld
301	Ahaus	**Gewinneinkünfte § 13 EStG**
		Liebhaberei
		Nutzungsumfang/Nutzungsänderungen/Veräußerungen von LuF Flächen
		Gewinneinkünfte §§ 15/18 EStG
		Branchenspezifische Untersuchung
		Gewinneinkünfte § 15a EStG
		Gewinneinkünfte § 16 EStG
		Gesellschafterwechsel bei vorhandenem Sonderbetriebsvermögen
		Überschusseinkünfte § 21 EStG
		Erstmalige Vermietung
		Gewerbesteuer
		§ 10a GewStG: Gewerbeverlust
		Gemeinnützigkeit
		Umsatzsteuerjahreserklärungen mit Erstattungsüberhängen
		Wegfall der steuerbegünstigten Zwecke
		Wirtschaftlicher Geschäftsbetrieb
302	Altena	**Gewinneinkünfte § 17 EStG**
		Anteilsveräußerung
		Überschusseinkünfte § 21 EStG
		Vermietung und Verpachtung
		Gemeinnützigkeit
		Steuerabzug § 50a EStG
303	Arnsberg	**Gewinneinkünfte §§ 15/18 EStG**
		Arbeitszimmer
		Schuldzinsenabzug § 4 Abs. 4a EStG
		Gewinneinkünfte § 15a EStG
		Überschusseinkünfte § 19 EStG
		Arbeitszimmer
		Außergewöhnliche Belastungen
		Unterstützung naher Angehöriger

1

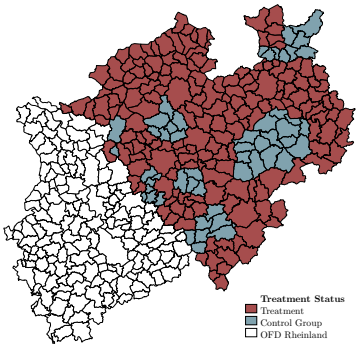
Notes: First page of the first enforcement focus list as announced in January 2011 (Tax Year 2010). The full PDF can be found online (e.g. `http://files.vogel.de/iww/iww/quellenmaterial/dokumente/110399`; last accessed: 2021-02-17). All lists (2010-2016) are also available from the author.

Figure B.2: Treatment Assignment (2010)

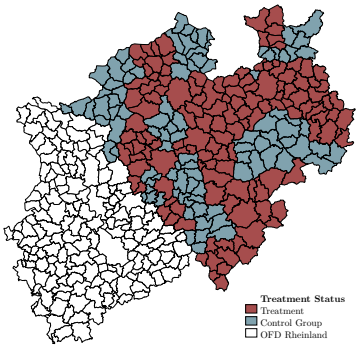
A: Agricultural and Forestry Income



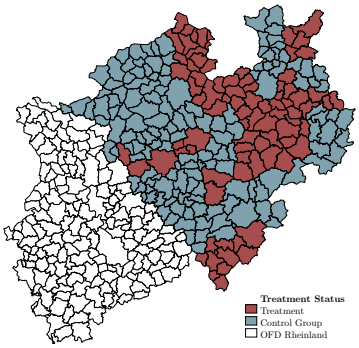
B: Business Income



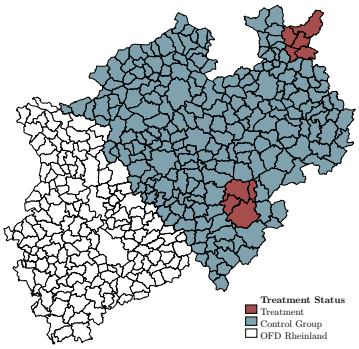
C: Self-Employed Income



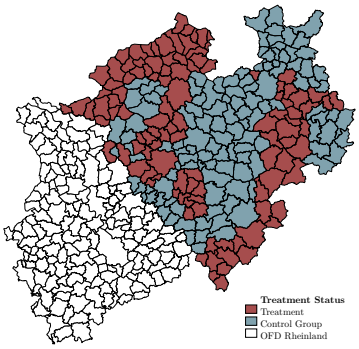
D: Labor Income



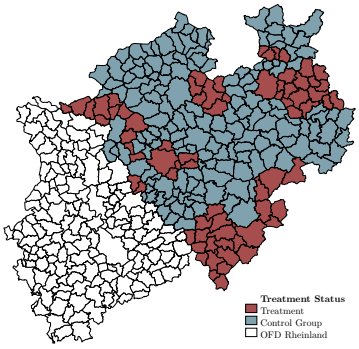
E: Capital Income



F: Rental Income



G: Other Income

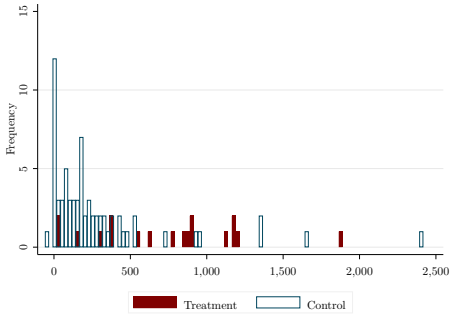


Data: GeoBasis-DE/BKG (2018). Based on VG250, own illustration.

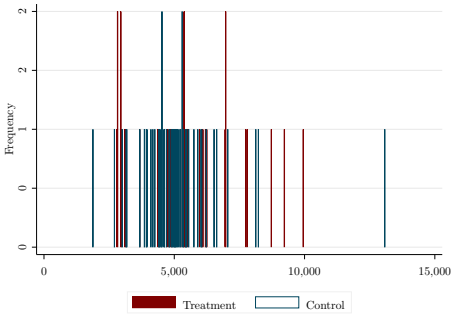
Notes: Each map highlights the treatment assignment of a particular income category on the municipality level in North Rhine-Westphalia for the tax year 2010. Treated municipalities are highlighted in red. Municipalities which are in the OFD Münster area but not treated, i.e. the control group, are highlighted in blue. Municipalities belonging to the OFD Rheinland area are represented in white.

Figure B.3: Distribution of Income Category Means by Treatment Status (2009)

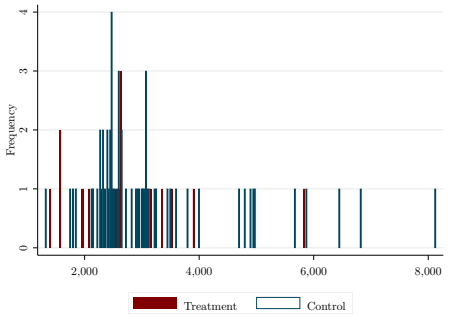
A: Agricultural and Forestry Income



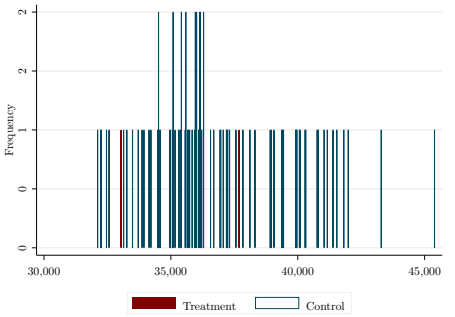
B: Business Income



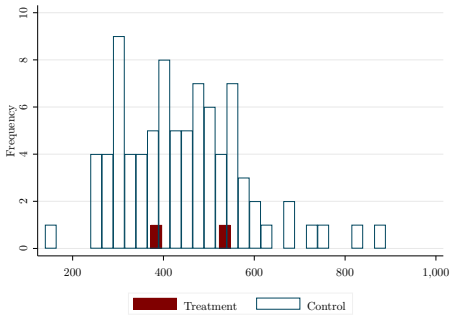
C: Self-Employed Income



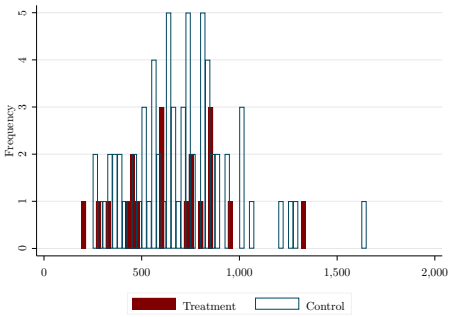
D: Labor Income



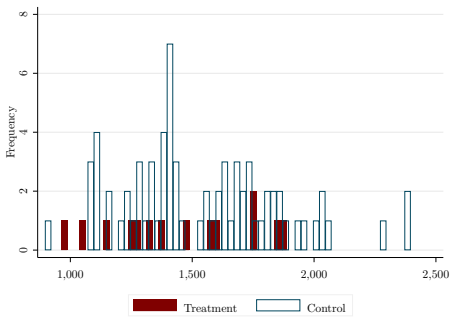
E: Capital Income



F: Rental Income



G: Other Income

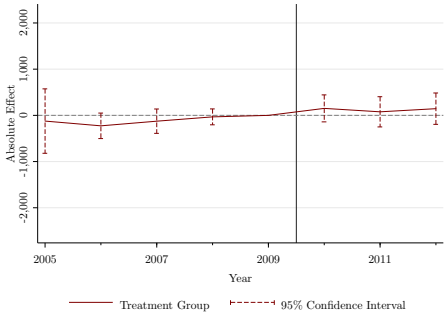


Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Taxpayer-Panel, 2001-2016, own calculations.

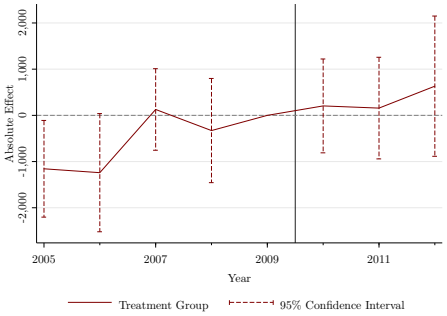
Notes: Each histogram represents the distribution of an income category's mean value across all tax offices in North Rhine-Westphalia in the tax year 2009. Observations are binned into 25-€-bins. In each income category, an observation in red indicates that this tax office was treated in this income category in 2010, whereas an observation in the blue indicates that this tax office was not treated in this income category in 2010.

Figure B.4: Treatment Effects - OFD Rheinland Control Group

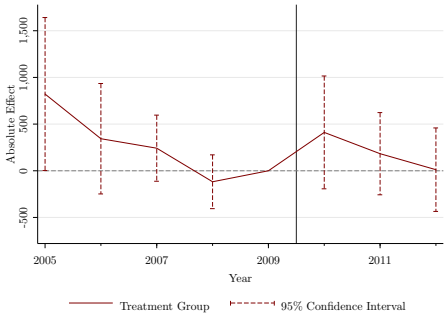
A: Agricultural and Forestry Income



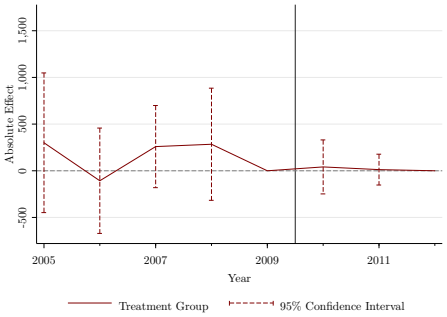
B: Business Income



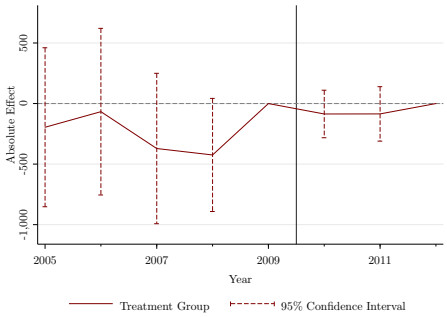
C: Self-Employed Income



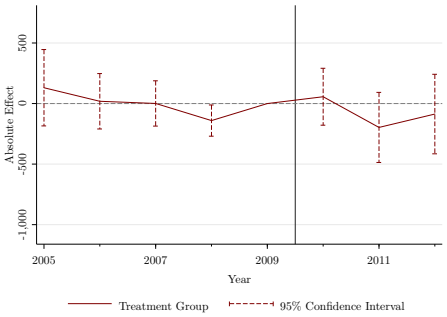
D: Labor Income



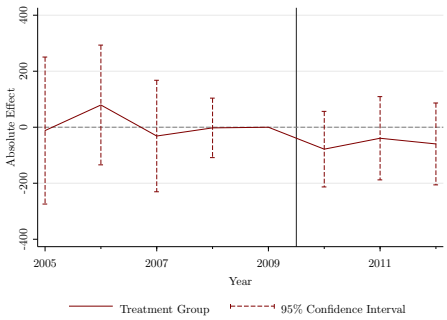
E: Capital Income



F: Rental Income



G: Other Income

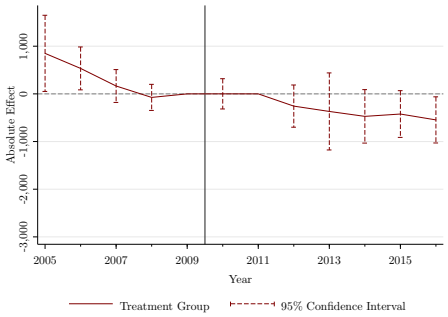


Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Taxpayer-Panel, 2001-2016, own calculations.

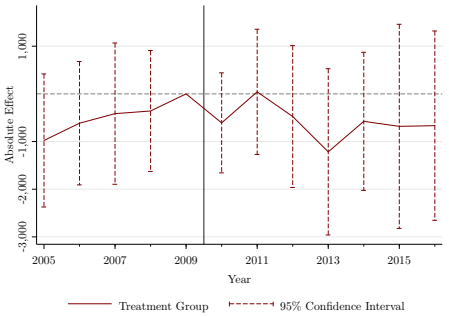
Notes: Each graph shows the point estimate and the 95%-confidence interval for $\hat{\beta}_{2005}$ to $\hat{\beta}_{2012}$: The difference in the respective income category between the treatment and control group. Here, the control group consists of taxpayers living in the second OFD district in North Rhine-Westphalia. As taxpayers residing there were treated starting in 2013, this control group is only available until 2012. The estimates shown here include individual, year, and tax office fixed effects and control for treatments in all years of the policy. Standard errors are clustered at the tax office level. Until 2009, prior to the first enforcement policy, point estimates should be zero, indicating no significant differences between the two groups. Significant differences to zero in 2010 and later respectively indicate immediate and long-term effects of the 2010 enforcement focus list policy.

Figure B.5: Treatment Effects - Neighboring Taxpayers Control Group

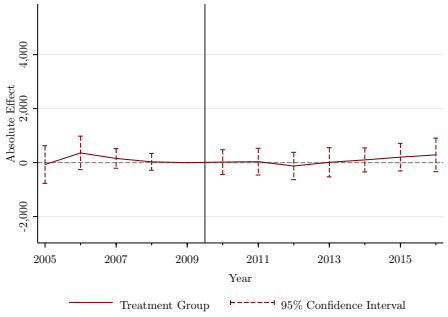
A: Agricultural and Forestry Income



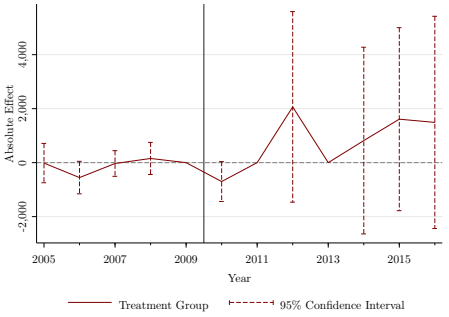
B: Business Income



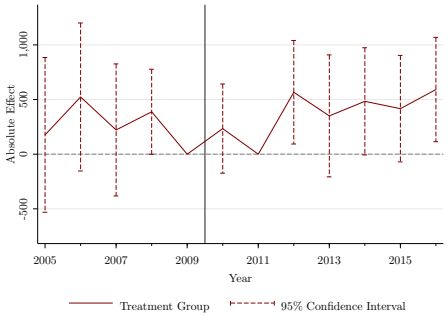
C: Self-Employed Income



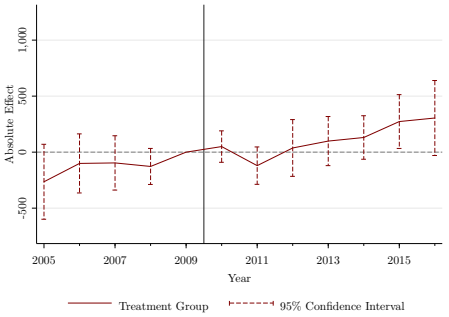
D: Labor Income



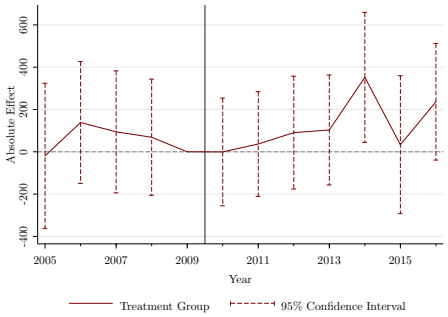
E: Capital Income



F: Rental Income



G: Other Income

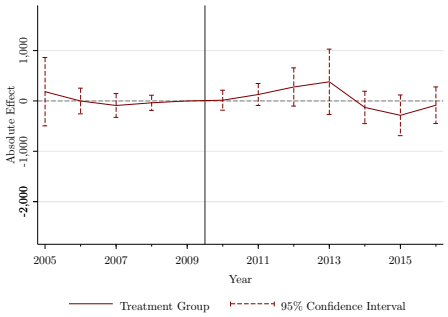


Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Taxpayer-Panel, 2001-2016, own calculations.

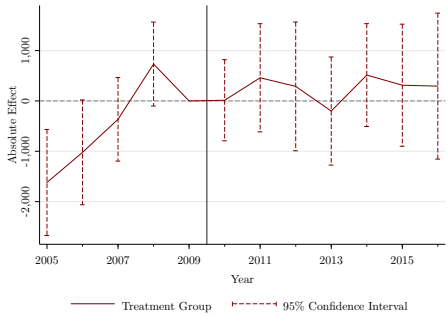
Notes: Each graph shows the point estimate and the 95%-confidence interval for $\hat{\beta}_{2005}$ to $\hat{\beta}_{2016}$: The difference in the respective income category between the treatment and control group. Here, the control group consists of taxpayers living in neighboring districts to NRW. The estimates shown here include individual, year, and tax office fixed effects and control for treatments in all years of the policy. Standard errors are clustered at the tax office level. Until 2009, prior to the first enforcement policy, point estimates should be zero, indicating no significant differences between the two groups. Significant differences to zero in 2010 and later respectively indicate immediate and long-term effects of the 2010 enforcement focus list policy.

Figure B.6: Treatment Effects - All Non-NRW Taxpayers Control Group

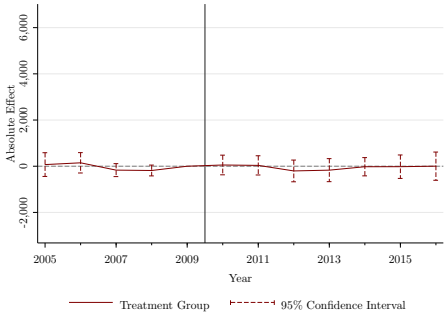
A: Agricultural and Forestry Income



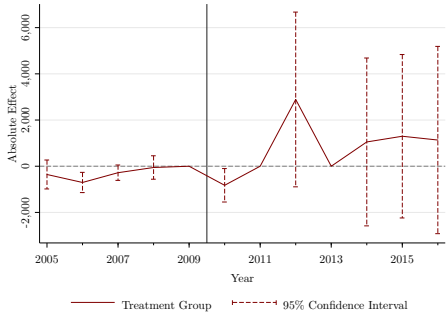
B: Business Income



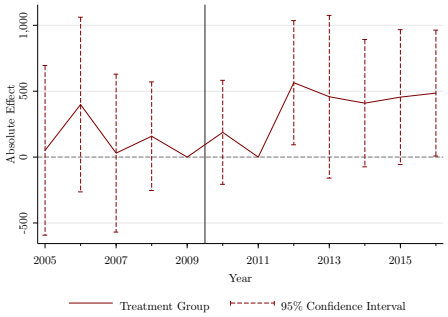
C: Self-Employed Income



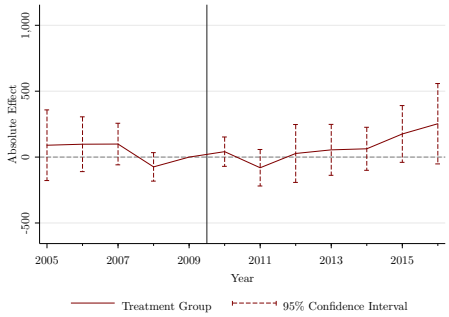
D: Labor Income



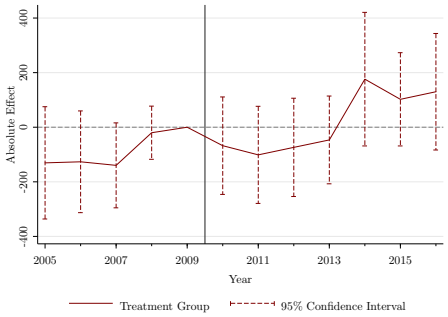
E: Capital Income



F: Rental Income



G: Other Income

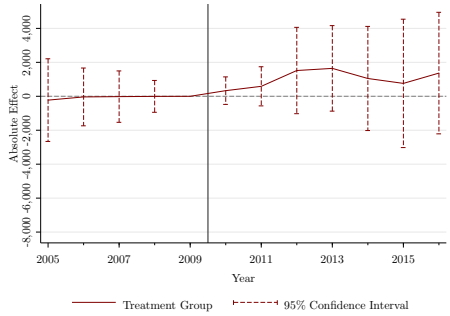


Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Taxpayer-Panel, 2001-2016, own calculations.

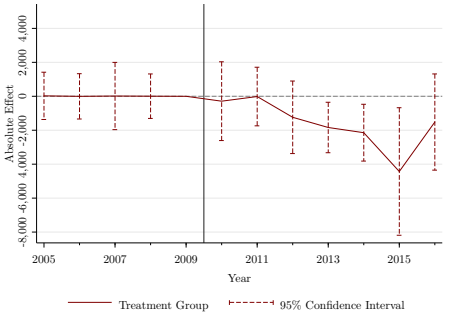
Notes: Each graph shows the point estimate and the 95%-confidence interval for $\hat{\beta}_{2005}$ to $\hat{\beta}_{2016}$: The difference in the respective income category between the treatment and control group. Here, the control group consists of all taxpayers residing outside of North Rhine-Westphalia. The estimates shown here include individual, year, and tax office fixed effects and control for treatments in all years of the policy. Standard errors are clustered at the tax office level. Until 2009, prior to the first enforcement policy, point estimates should be zero, indicating no significant differences between the two groups. Significant differences to zero in 2010 and later respectively indicate immediate and long-term effects of the 2010 enforcement focus list policy.

Figure B.7: Treatment Effects - Entropy Balancing

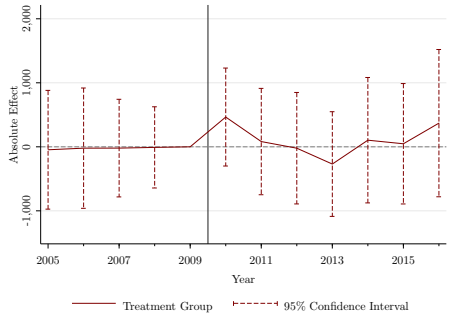
A: Agricultural and Forestry Income



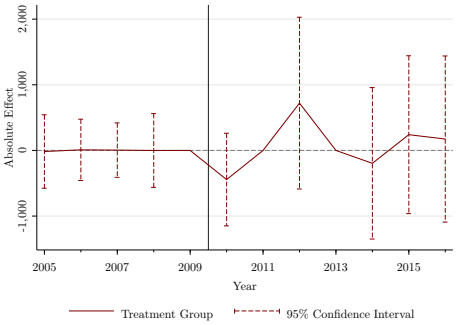
B: Business Income



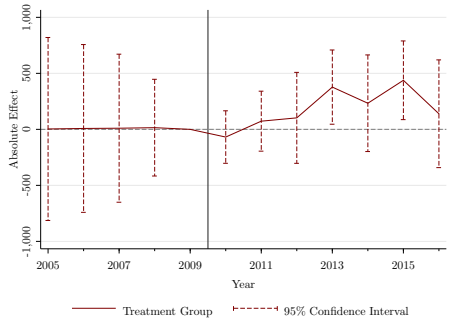
C: Self-Employed Income



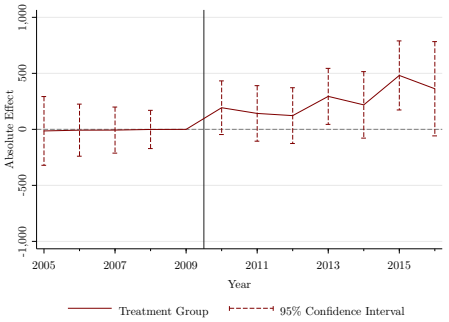
D: Labor Income



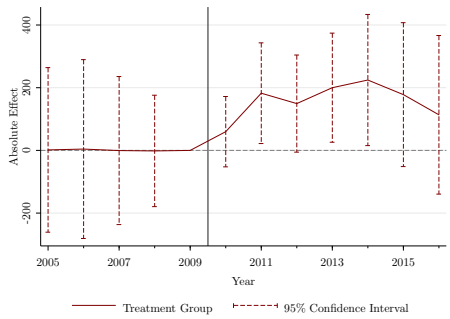
E: Capital Income



F: Rental Income



G: Other Income



Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Taxpayer-Panel, 2001-2016, own calculations.

Notes: Each graph shows the point estimate and the 95%-confidence interval for $\hat{\beta}_{2005}$ to $\hat{\beta}_{2016}$: The difference in the respective income category between the treatment and control group. Here, the treatment and the control group are re-weighted with the entropy-balancing procedure (Hainmueller 2012), using all pre-2010 levels of the respective income category. Only taxpayers residing in the OFD Münster area in 2010 are considered. The estimates shown include individual, year, and tax office fixed effects and control for treatments in all years of the policy. Standard errors are clustered at the tax office level. Until 2009, prior to the first enforcement policy, point estimates should be zero, indicating no significant differences between the two groups. Significant differences to zero in 2010 and later respectively indicate immediate and long-term effects of the 2010 enforcement focus list policy.

B.2 Additional Tables

Table B.1: Descriptive Statistics (Tax Year 2009) - OFD Rheinland and Other German States

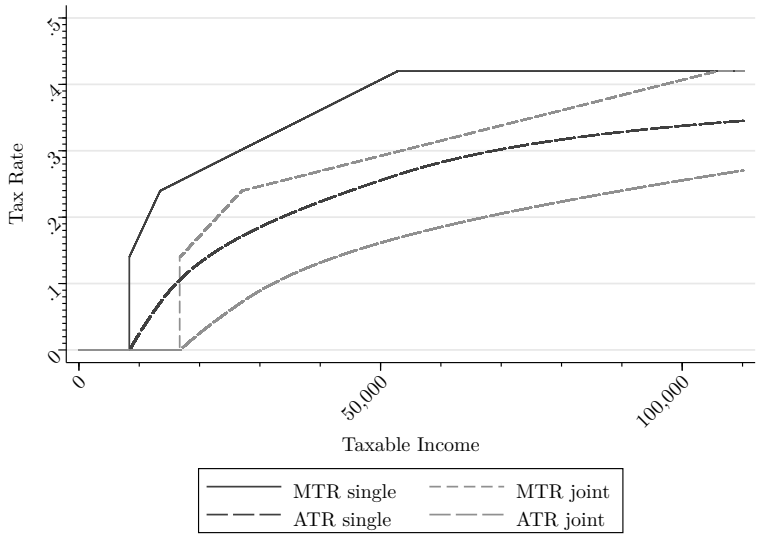
	Other German States				OFD Rheinland			
	Mean	Median	SD	Observations (weighted)	Mean	Median	SD	Observations(weighted)
Taxable Income	36,718.33	26,973	298,370	941,854 (16,490,442)	38,927.77	28,194	110,728	127,561 (2,717,343)
Agricultural Income	372.33	0	7,222	941,960(16,491,236)	167.83	0	6,573	127,567 (2,717,309)
Business Income	4,300.14	0	305,163	941,548 (16,487,699)	4,211.08	0	98,973	127,468 (2,716,557)
Self-Employed Income	3,101.53	0	28,057	941,910 (16,490,545)	3,287	0	31,941	127,517 (2,716,340)
Labor Income	33,009.73	27,081	44,945	941,280 (16,483,393)	34,791	28,151	48,669	127,496 (2,716,423)
Capital Income	450.03	0	10,933	884,357 (15,866,197)	502.97	0	10,077	127,194 (2,713,207)
Rental Income	507.10	0	12,010	941,742 (16,487,918)	749.95	0	15,374	127,511 (2,716,297)
Other Income	1,511.51	0	10,784	938,258 (16,476,198)	1,876.04	0	5,632	126,840 (2,714,904)
Age	46.53	46	14.53	941,956 (16,491,310)	48.03	47	15.49	127,569 (2,717,342)

Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Taxpayer-Panel, 2001-2016, own calculations.
Notes: Basic descriptive statistics for various income sources and the age distribution in the OFD Rheinland district and all remaining German States, all based on weighted data. *SD = Standard Deviation.* There is a difference between the sum of all income categories and taxable income, as the latter includes deductible special expenses, while the first does not. Observations are given in absolute numbers and in weighted numbers. See Table 2.2 for the same table for all treated taxpayers.

C Appendix to Chapter 3

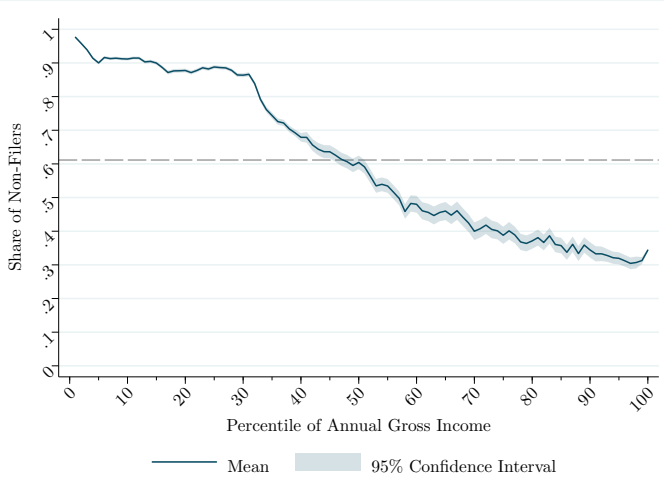
C.1 Additional Figures

Figure C.1: Average and Marginal Tax Rates for Single and Joint Filers in Germany



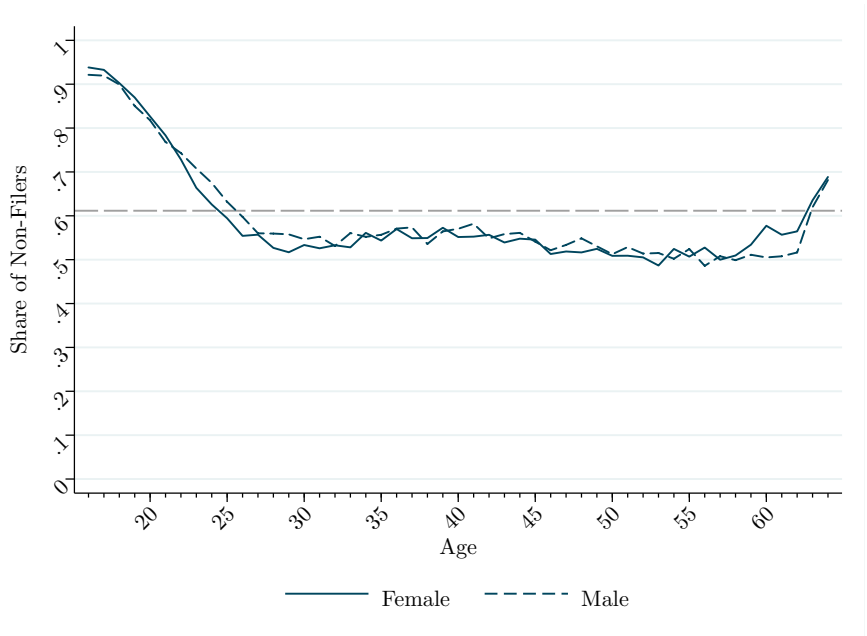
Notes: Statutory average (ATR) and marginal tax rates (MTR) in Germany in the tax year 2014 as a function of taxable income. Tax rates are calculated based on the tax schedule for single taxpayers and joint taxpayers respectively. The x-axis is cut at 110,000 € for illustrative purposes.

Figure C.2: Prevalence of Non-Filing over the Income Distribution



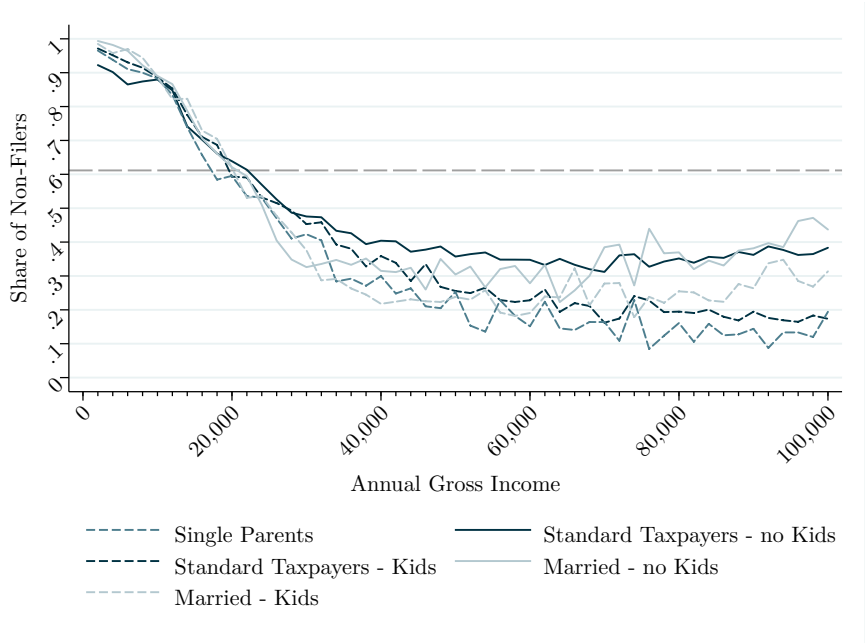
Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Lohn- und Einkommensteuerstatistik, 2014, own calculations.
Notes: Share of non-filers among optional filers along the income distribution. Dashed grey line: Average share of non-filers (61.15%) across all income percentiles. Statistics refer to taxable units which may be either an individual or married spouses in case of joint filing. Percentiles are based on the annual gross wage income of optional filers. For jointly filing spouses, we consider the average gross income. Figure 3.2 shows the non-filing share over gross income.

Figure C.3: Differences in Filing Behavior across Gender and Age



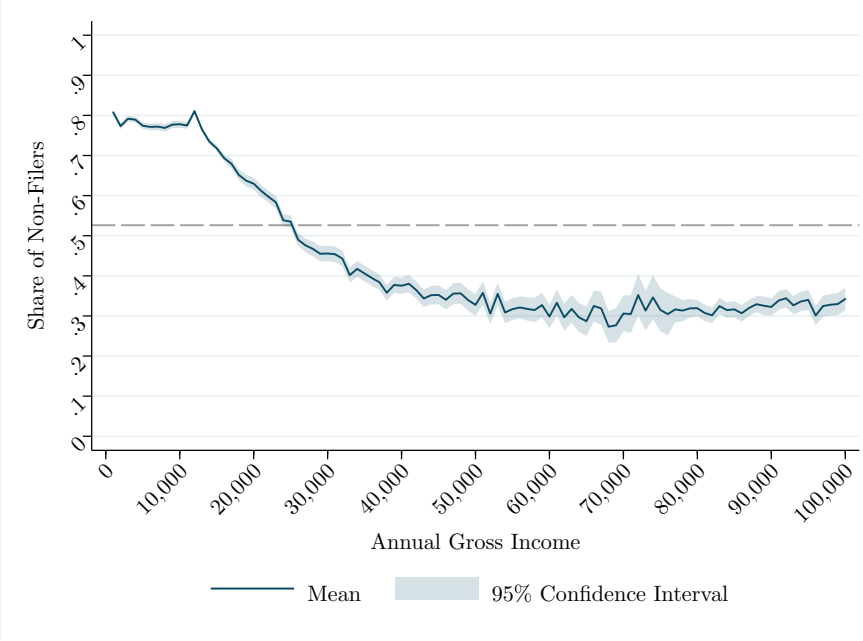
Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Lohn- und Einkommensteuerstatistik, 2014, own calculations.
Notes: Share of non-filers among optional filers for women and men over age. The sample is restricted to individuals with age $\in [16; 64]$. Dashed grey line: Average share of non-filers (61.15%) across all age and gender.

Figure C.4: Differences in Filing between Married and Non-Married Taxpayers with and without Children



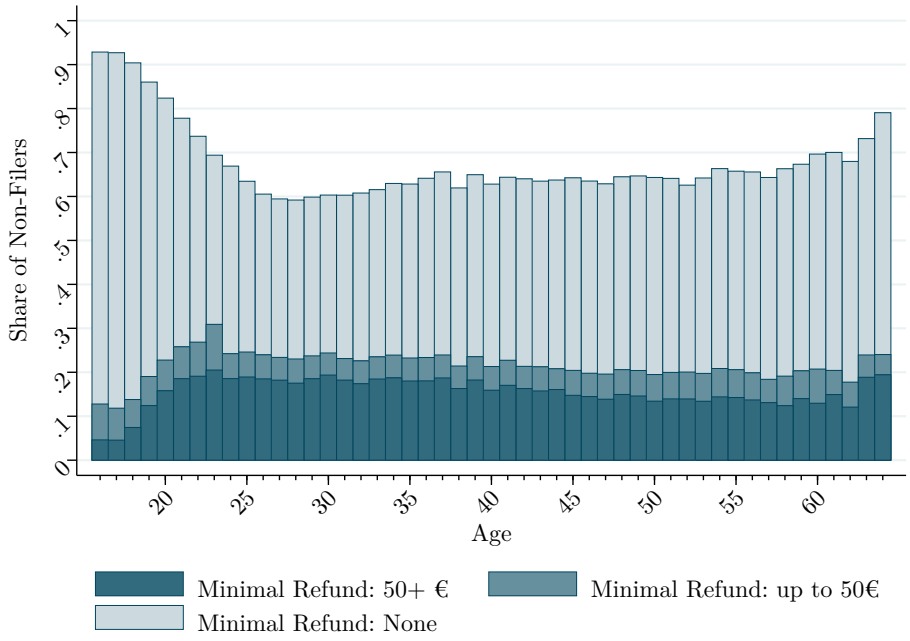
Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Lohn- und Einkommensteuerstatistik, 2014, own calculations.
Notes: Individuals are grouped in 2,000-€-bins. Share of non-filers over income for five groups: (i) Standard single taxpayers, (ii) married taxpayers, (iii) single parents, (iv) single taxpayers with children but no single parents, (v) married taxpayers with children. Dashed grey line: Average share of non-filers (61.15%) across all groups and gross income levels.

Figure C.5: Prevalence of Non-Filing over Gross Income - Only Taxpayers with Positive Tax Remittance



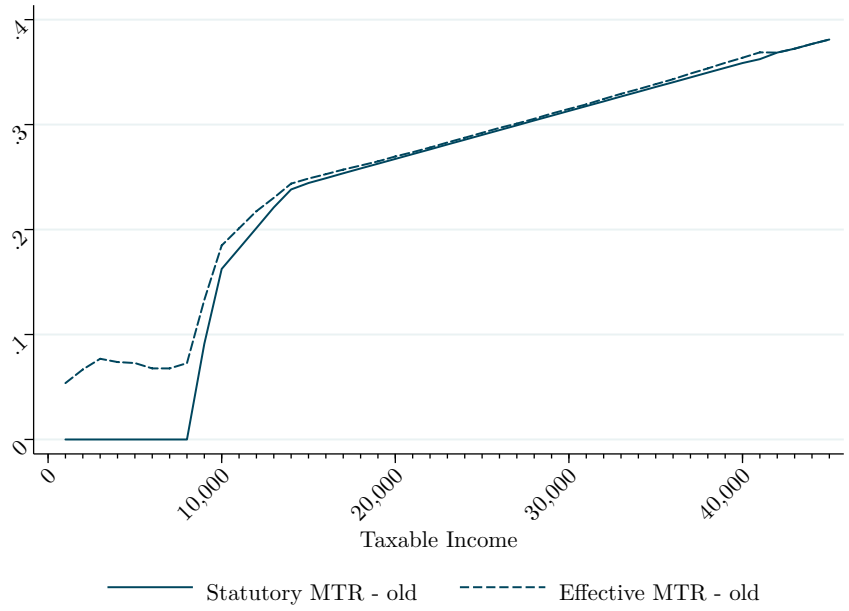
Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Lohn- und Einkommensteuerstatistik, 2014, own calculations.
Notes: Sample restricted to taxpayers with a positive tax remittance. Thus excluding taxpayers below the basic allowance threshold for whom no taxes were withheld. Individuals are grouped in 1,000-€-bins. Share of non-filers among optional filers. Dashed grey line: Average share of non-filers (52.62%) across all gross income levels. Statistics refer to taxable units which may be either an individual or married spouses in case of joint filing. For jointly filing spouses, we consider the average gross income.

Figure C.6: Non-Filing Share by Refund Potential over Age



Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Lohn- und Einkommensteuerstatistik, 2014, own calculations.
Notes: Decomposition of the non-filing share over age by refund potential for non-filers. *Minimal Refund*: Lower bound for taxes over-remitted through non-filing. *None*: No refund from minimal filing because taxes are withheld correctly. This is allowing for a range of 0 +/- 5 €. *Up to 50€ (50+ €)*: Minimal refund of up to (more than 50 €). *Reading example:* 64% of optional filers aged 50 are non-filers. In this age cohort, 13% of all optional filers have a refund potential of at least 50 €.

Figure C.7: Statutory and Effective MTR under Optional (Non-)Filing

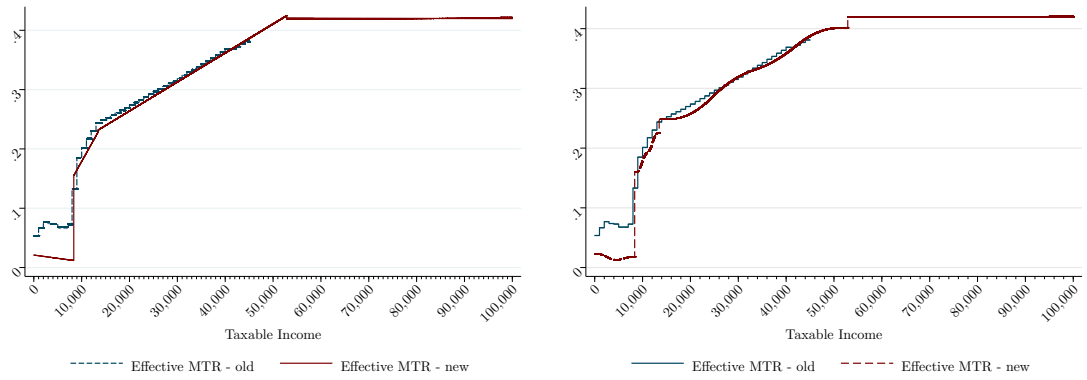


Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Lohn- und Einkommensteuerstatistik, 2014, own calculations.
Notes: Final sample with optional filers as defined in subsection 3.4.2. Individuals are grouped in 1,000-€-bins. Comparison between the effective MTR that correspond to the extrapolated annual taxable income and the statutory MTR as defined in the tax schedule. Over-remitting non-filers face an effective MTR of at least 0.14, which is the smallest possible positive MTR (see Figure C.1 for the tax schedule). Consequently, effective MTRs below the basic allowance threshold are higher than effective ATRs for that income range as shown in Figure 3.5a.

Figure C.8: Effective Marginal Tax Rates Pre and Post Reform

A: Full Sample - Linear

B: Full Sample - Flexible



Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Lohn- und Einkommensteuerstatistik, 2014, own calculations.

Notes: All taxpayers included. X-axis is cut at 100,000 €. *Linear*: Effective individual tax liabilities $T_i^{eff}(y_i))$ are smoothed by fitting a quadratic function (OLS) for each tax bracket b to derive $T_{new,b}^{eff}(y_b) = \beta_0 + \beta_1 y_b + \beta_2 {y_b}^2$. $\beta_0 = 0$ for the first bracket, to make sure that $T_{new,1}^{eff}(y_1) \geq 0$. The resulting $\tau_{new}^{eff}(y)$ is a linear function of y within each tax bracket. This design follows the current design of the German Income Tax Schedule (see Figure C.1). *Non-linear*: Effective individual tax liabilities are smoothed by interpolating a restricted cubic spline function (5 knots) within each tax bracket. This allows for more flexibility within a given tax bracket and leads to a non-linear function $\tau_{new}^{eff}(y)$. Compared to a higher order polynomial fit, spline interpolations exhibit less oscillation, making it more suitable for defining $T^{eff}(y)$.

C.2 Additional Tables

Table C.1: Countries with Income Tax Non-Filing Options

Country	Non-Filing Option	Limitation	Country	Non-Filing Option	Limitation
Argentina	✓	-	Japan	(✓)	y < 20 mio. JPY
Austria	✓	-	Korea, Rep.	✓	-
Belarus	✓	-	Lithuania	✓	-
Bulgaria	✓	-	Luxembourg	(✓)	y < 100,000 EUR
Chile	✓	-	Macedonia	✓	-
China	(✓)	y < 120,000 CNY	Madagascar	✓	-
Costa Rica	✓	-	Moldova	✓	-
Croatia	✓	-	New Zealand	✓	-
Czech Republic	✓	-	Nicaragua	✓	-
Dominican Republic	✓	-	Peru	✓	-
Ecuador	✓	-	Philippines	✓	
El Salvador	(✓)	y < 60,000 USD	Ukraine	✓	-
Estonia	✓	-	Romania	✓	-
Guatemala	✓	-	Russia	✓	-
Iran	✓	-	Slovak Republic	✓	-
Israel	(✓)	y < 643,000 NIS	Turkey	(✓)	y < 30,000 TRL

Notes: Filing requirements are taken from International Bureau of Fiscal Documentation (2016), section 1.10 of each country chapter. *Non-Filing Option:* In a country, is a wage earning single taxpayer with a single employer exempt from tax filing. *Limitation:* Whenever (✓) is indicated, this columns gives more information about the relevant limitation for non-filing. For example, in Japan, wage earning taxpayers with income exceeding 20 mio. have to file an income tax return. Wage earners with less income do not have to file.

Table C.2: Descriptive Statistics - Full Sample

Income	mean	22,564.31
	p25	4,152.00
	p50	18,484.00
	p75	33,365.00
	p90	48,494.00
	p99	99,023.00
Age	mean	45.75
	p50	45
Married	share	45.35
East	share	18.25
Children	share	27.72
N	absolute	4,017,600
	weighted	40,175,995

Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Lohn- und Einkommensteuerstatistik, 2014, own calculations.
Notes: Statistics refer to taxable units which may be either an individual or married spouses in case of joint filing. Statistics are based on weighted data if not indicated differently. *Income*: Annual gross wage income in €. For jointly filing spouses, the average gross income is taken into account. *Married*: Share of married taxpayers. *East*: Share of taxpayers that live in Eastern states of Germany. *Children*: Share of taxpayers with at least one child that is relevant for the tax authority.

Table C.3: Descriptive Statistics - Optional Filers

		Optional Filers	Voluntary Filers	Non-Filers
Income	mean^{+}	24,447.75	34,524.08	18,046.71
	p25	8,231.00	22,624.00	4,479.00
	p50	21,951.00	32,559.00	13,023.00
	p75	35,465.00	43,225.00	27,200.00
	p90	48,539.00	56,855.00	40,063.00
	p99	86,952.50	97,373.00	75,206.00
Age	mean^{+}	34.92	37.12	33.62
	p50	32.00	34.00	30.00
Married	mean^{+}	9.28	12.79	7.05
East	mean^{+}	21.54	18.99	23.17
Children	mean^{+}	16.88	20.62	14.51
N	absolute	683,718	425,579	258,139
	weighted	14,863,136	5,773,958	9,089,178

Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Lohn- und Einkommensteuerstatistik, 2014, own calculations.
Notes: Statistics refer to taxable units which may be either an individual or married spouses in case of joint filing. Statistics are based on weighted data if not indicated differently. *Income*: Annual gross wage income in €. For jointly filing spouses, the average gross income is taken into account. *Married*: Share of married taxpayers. *East*: Share of taxpayers that live in Eastern states of Germany. *Children*: Share of taxpayers with at least one child that is relevant for the tax authority. $^{+}$ indicates mean/share difference between voluntary filers and non-filers significant at the 0.1% - level (two-sided t-test).

Table C.4: Declared Deductions

		Income Related Expenses	Special Expenses	Extraordinary Burden	Tax Reductions
Declared Value	mean	1,715.78	402.48	235.51	95.65
	p25	536.00	127.00	36.00	22.00
	p50	1,181.00	303.00	67.00	45.00
	p75	2,328.00	489.00	306.00	85.00
	p90	3,804.00	683.00	569.00	186.00
Share of voluntary filers		58.48	64.43	4.70	21.05
N	absolute	99,207	105,185	9,996	21,027
	weighted	2,290,281	2,523,092	183,994	824,275

Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Lohn- und Einkommensteuerstatistik, 2014, own calculations.
Notes: Declared deductions in €. *Share of Voluntary Filers*: who itemize deductions in the corresponding category. *Income Related Expenses*: Deductions claims that go beyond the basic deduction of 1,000 €. *Special Expenses*: Deductions claims that go beyond the basic deduction of 36 €. *Tax Reductions*: Reduce the tax liability while all other deductions reduce the taxable income.

Table C.5: Different Inequality Measures for Different Income Concepts

	Gini	Percentile Ratios		
		p90/p10	p90/p50	p50/p10
Pre-Tax Gross Income	0.4079	18.0384	2.1793	8.2772
After-Tax Income Pre Filing	0.3832	15.4307	1.9632	7.8599
After-Tax Income Post Filing	0.3897	15.6391	2.0403	7.6650

Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Lohn- und Einkommensteuerstatistik, 2014, own calculations.
Notes: We report two different measures for inequality for three different income concepts for the final sample used in section 3.4. *Gini*: Indicates the Gini-coefficient. *Percentile Ratios*: Indicates the ratio between two income percentiles. For instance, *p90/p10=18.0384* indicates that the 90^{th} income percentile is 18 times larger than the 10^{th} income percentile. *Gross Income*: Gross wage income before taxes. *After-Tax Income Pre Filing*: Gross income minus taxes withheld through the employer, before potential tax filing. *After-Tax Income Post Filing*: This is the final after tax income that optional filers realize. For voluntary filers, this is their taxable income after filing. For non-filers, this is their gross income minus taxes withheld.

Table C.6: Taxes Over-Remitted through Non-Filing - Lower Bound Estimates (2010)

		(A) All Non-Filers		(B) With over-remittance	
		All	y < threshold	All	y < threshold
Over-Remittance	total	603,046,641	240,758,764	604,502,377	240,584,508
	mean	102.26	81.12	318.89	238.33
	p25	0.37	0.00	41.90	48.00
	p50	0.00	0.00	164.00	139.00
	p75	34.34	52.00	441.54	331.00
N	absolute	168,805	83,296	55,399	29,741
	weighted	5,897,323	2,967,949	1,895,650	1,009,474

Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Lohn- und Einkommensteuerstatistik, 2010, own calculations.
Notes: Over-Remittance is defined as the difference between the the automatically withheld income taxes and the income tax that applies according to the tax schedule. Over-remittances are listed in €. (*A*): All non-filers in the sample. (*B*): Only those non-filers with over-remittances, defined as a deviation of more than 5 € from the statutory tax schedule. $y <$ *threshold*: Individuals with an annual gross wage income below the basic tax allowance threshold.

Table C.7: Efficiency Gains Hypothetical Tax System II - $\varepsilon_{y,1-\tau} = 0.3$

	dy_i	$\sum dy_i$	dT_i^{eff}	$\sum dT_i^{eff}$
		(A) $\varepsilon^F_{y,1-\tau} = 0.3, \varepsilon^{NF}_{y,1-\tau} = 0.3$		
Linear	61.85	2,125,476,638	11.48	394,538,427
Non-linear	59.50	2,044,793,109	13.38	459,655,161
		(B) $\varepsilon^F_{y,1-\tau} = 0.3$, $\varepsilon^{NF}_{y,1-\tau} = 0.0$		
Linear	30.36	1,043,182,632	6.94	238,385,571
Non-linear	29.14	1,001,389,265	9.08	311,996,301

Data: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Lohn- und Einkommensteuerstatistik, 2014, own calculations.

Notes: The table shows the effect of the proposed hypothetical tax reform in terms of changes in taxable income and tax revenue (both in €) for the full data set, including all taxpayers. Panel (A) shows results for an elasticity of taxable income $\varepsilon_{y,1-\tau} = 0.2$ for all taxpayers, both filers (F) and non-filers (NF). Panel (B) shows results for $\varepsilon^F_{y,1-\tau} = 0.2$ for filers and $\varepsilon^F_{y,1-\tau} = 0.0$ for non-filers. Results for$\varepsilon_{y,1-\tau} = 0.2$ are shown in Table 3.4. *Linear*: Effective individual tax liabilities $T_i^{eff}(y_i)$) are smoothed by fitting a quadratic function (OLS) for each tax bracket b to derive $T^{eff}_{new,b}(y_b) = \beta_0 + \beta_1 y_b + \beta_2 {y_b}^2$. $\beta_0 = 0$ for the first bracket, to make sure that $T^{eff}_{new,1}(y_1) \geq 0$. The resulting $\tau^{eff}_{new}(y)$ is a linear function of y within each tax bracket. This design follows the current design of the German Income Tax Schedule (see Figure C.1). *Non-linear*: Effective individual tax liabilities are smoothed by interpolating a restricted cubic spline function (5 knots) within each tax bracket. This allows for more flexibility within a given tax bracket and leads to a non-linear function $\tau^{eff}_{new}(y)$. Compared to a higher order polynomial fit, spline interpolations exhibit less oscillation, making it more suitable for defining $T^{eff}(y)$. dy_i: Average change in individual taxable income in €. $\sum dy_i$: Aggregate change in taxable income in €. dT_i^{eff}: Average individual change in tax remittance in €. $\sum dT_i^{eff}$: Aggregate change in tax revenue in €.

C.3 Sample Restrictions - Optional Filers

Besides filing and non-filing single taxpayers, we also include married taxpayers if they fulfill one of the following three criterion. First, spouses who did not choose to reallocate allowances between them over the year, but still file jointly, are considered. Hence, for tax withholding purposes, each spouse is treated like a single taxpayer. For these couples, we consider their average refund and their average income to be able to compare them to single taxpayers. Second, married individuals that filed their taxes individually, and third, married individuals who are non-filers are considered.

C.4 Sample Restrictions - Over-Remittance Sample

In general, contributions to the health insurance, to the nursing care insurance, and to the pension insurance are tax deductible up to a threshold for both private and public insurances. However, while contributions to the public social insurances are a function of gross income and can thus be computed with the data set at hand, this is not the case for private insurances. Unfortunately, the data set does neither include information on the contribution fees remitted for private insurances nor on the enrollment status (public or private) if not declared in the tax return. Hence, we cannot calculate the contribution payments for non-filers enrolled in private insurances and thus cannot derive their taxable income. The same is true for filers who do not claim their contributions in their tax returns. Therefore, we restrict the sample to those for whom it is certain that they are enrolled in the public insurance.

It is important to note that, for employees with an annual income up to 48,600 € in 2014, enrollment in all public social insurances is compulsory. By restricting the sample to this group, we thus exclude all observations with an annual gross wage income above 48,600 €, which is close to the 90^{th} percentile of gross wages. Additionally, we exclude civil servants who do not contribute to the public pension insurance and who are free to choose whether to enroll in a private health insurance even at lower income levels. Additionally, for voluntary filers, we focus on individually filing taxpayers here, including married individuals that do not file jointly with their spouses. We do so as for joint filing spouses not all relevant variables are available at the individual level.

We further restrict the sample to individuals for whom the calculated statutory tax liability is less than the withheld taxes, allowing for a 5- €-inaccuracy. This means that we exclude non-filers for whom the minimal refund potential is significantly negative. There are several reasons for why we observe optional filers who pay too little taxes

through automatic withholding. First, it might be that employers may make mistakes when calculating and withholding the wage taxes for their employees. Second, there may be cases in which the tax schedule we apply to a taxpayer's income is imprecise because one or several of her individual characteristics changed within the tax year. Since the data set only contains yearly information, no such changes are observable. Additionally, some of these unobservable changes trigger an obligation to file. A third potential explanation is that some information in the data is incorrect.

Since for none of the above cases, we can correct for the shortcomings, we exclude these cases. We replicate all findings with a sample without any restrictions regarding the refund potential. Since we include negative refunds, this consequently reduces the lower bound for over-remitted taxes. However, the effects are comparable in size. In section 3.5, we show that including this group does not change our results significantly. It is noteworthy that voluntary filers do not have to pay more taxes than withheld by their employers. If, after voluntary filing, the taxes due are higher than the taxes withheld, taxpayers can withdraw from filing.

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