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Local Tax Havens*

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Abstract

This paper analyzes how (local) tax havens function. Using the German municipal business tax setting as a laboratory, I investigate the characteristics and emergence of local tax havens. I demonstrate that local tax havens are situated in close proximity to large agglomeration areas, while firms' profit-to-wage ratios in these jurisdictions are exceptionally high. I document that the amount of local profit shifting is substantial. The empirical results indicate that local profit shifting is of a similar magnitude to recent findings regarding international profit shifting by German multinationals. I deploy synthetic difference-in-differences methods, combined with administrative data sources and standard profit shifting equations, to estimate the amount of profit shifting to local tax havens. Between 2013 and 2019, around 52 billion Euros of corporate profits were shifted to local tax havens. The results are driven by a small number of large firms that offer business and financial services. The direct fiscal cost to non-tax haven municipalities amounts to roughly 7.9 billion Euros, while tax haven municipalities gain around 4.3 billion Euros in tax revenues. I conduct a case study on the emergence of Germany's largest local tax havens. I estimate that between 2012 and 2019, around 20.5 billion was transferred to its jurisdiction. The increase in local tax revenues is used to reduce public debt burdens and finance a high level of public expenditures.

Keywords: Public Finance, Fiscal Federalism, Corporate Taxation, Tax Havens, Profit Shifting

JEL Classification: H25, H26, H32, H71

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1 Introduction

Tax avoidance by multinational corporations (MNCs) is a central concern of contemporary tax policy and a heated topic of the public debate. Recent empirical evidence suggests that 36% of MNCs' global profits are shifted to international tax havens (Tørsløv et al., 2023). Profit shifting reduces the fiscal capacity of national governments, while undermining the tax sovereignty and trust in the integrity of the tax system (OECD, 2013). A large body of academic literature examines corporate profit shifting to international tax havens (see Beer et al., 2020, for a survey). In many countries, firms are liable to sub-national tax on corporate income. By way of example, municipalities' local business tax (LBT) accounts for roughly 50% of corporations' income tax burden in Germany.[1] Like international tax havens, local governments have an incentive to set very low tax rates to attract not only real economic substance but also shifted profits. I label these jurisdictions as *local tax havens*. Sub-national tax havens become especially important in light of global initiatives aimed at curbing international profit shifting. Despite the prevalence and rising importance of local tax havens, we know very little about their characteristics, the amount of profit shifting to them, or the corresponding fiscal cost.

This paper closes this gap by studying municipal profit shifting and the function of tax havens in the context of the German LBT. The German setting is ideal, as it provides a high-stakes environment while maintaining a constant institutional framework across jurisdictions. The analysis proceeds along three research questions: (1) *What characterizes local tax havens?* Local tax havens are relatively small municipalities in close proximity to large agglomeration areas. The measured profitability of firms in these jurisdictions is exceptionally high. Local governments utilize high tax revenues to fund high public expenditure levels, while maintaining low debt burdens. (2) *What amount of corporate profits do firms shift to local tax havens?* Between 2013 and 2019, around 52 billion Euros of corporate profits were shifted to local tax havens. The amount of local profit shifting is of a similar magnitude to international profit shifting (see Fuest et al., 2022). (3) *What are the fiscal implications of local profit shifting?* The direct fiscal cost to non-tax haven municipalities amounts to roughly 7.9 billion Euros, while tax haven municipalities gain around 4.3 billion Euros in tax revenues. The aggregate analysis is complemented by a case

[1] In nine of the thirty-eight OECD member states, firms are subject to a sub-national corporate income tax (CIT). Sub-national CITs are usually levied at the state or municipal level. In 2019, the sub-national CIT made up on average just under 30% of the overall CIT. The share ranged from 5% in Portugal to around 68% in Switzerland (OECD, 2025). Note that these shares are computed based on the statutory tax rates, not taking into account potential differences in the tax base definitions between the sub-national and the federal level.

study on the emergence of Germany's largest local tax havens. The case study corroborates the aggregate results, while allowing for a more detailed analysis of the underlying mechanisms. For the empirical analysis, I combine administrative data on firms' tax returns, social security records, and municipal information on public finances and demographics. Limited data coverage and poor data quality, together with differences in the institutional frameworks of countries, exacerbate the study of profit shifting behavior and tax havens in the cross-country context. The institutional setting and data deployed in this study enable me to precisely document the characteristics and emergence of tax havens, investigate firms' profit shifting behavior, and the corresponding fiscal costs.

First, examine the characteristics of local tax havens. I document that a small set of low-tax jurisdictions, that specialize in profit–shifting–intensive sectors such as licensing services, holding companies, and real estate management, capture a disproportionately large share of national corporate profits. I classify these municipalities as local tax havens. Tax haven municipalities are located in close proximity to major metropolitan areas. The profitability, measured as the sum of corporate profits divided by the sum of wages, in tax haven jurisdictions, is among the highest nationwide. Administrative information on municipal public finances is used to explore the fiscal characteristics of tax haven municipalities. I demonstrate that the substantial amount of corporate profits taxed in these jurisdictions results in high tax revenues. Local governments use these revenues to finance high levels of public expenditure while maintaining comparatively low debt burdens.

Second, I quantify the magnitude of local profit shifting. For this, I draw on administrative data from firms' corporate tax returns, sales, employment, and wage bills, as well as municipal characteristics. I estimate profit shifting equations on the sector-municipality-year level to predict excess profits while controlling for real economic activity. Between 2013 and 2019, firms shifted around 52 billion Euros to local tax havens (92% of local tax havens' LBT base). The results are driven by a few large firms offering business and financial services. The estimation results are robust to different methods of classifying local tax havens. The static estimation results are supplemented by an event study approach that deploys the synthetic differences-in-differences (SDID) estimator developed by Arkhangelsky et al. (2021). The event-study approach evaluates the effect of large tax cuts on local profit shifting. The estimates align closely with the cross-sectional estimations.

Third, I estimate the direct fiscal cost of local profit shifting. I draw on data from the trade register to document firms' movement patterns and from the Orbis database to capture their ownership structures, which I then use to construct counterfactual tax rates for each local tax haven. The counterfactual tax rate provides information on the tax rate that would have been applied to shifted profits in the absence of local tax havens. Using firms' movement patterns or ownership structure to compute the counterfactual, between 2013 and 2019, the fiscal loss to non-tax haven municipalities amounts to roughly 7.8 and 7.9 billion Euros, respectively. Shifted profits increase local tax haven revenues by around 4.3 billion Euros. Alternative assumptions for computing the counterfactual tax rate and potential limitations are discussed.

In addition to the aggregate results, I conduct a case study on the emergence of Germany's largest local tax haven. The case study is used to illustrate the effect of becoming a local tax haven on the municipality and its residents, as well as to provide a detailed analysis of the mechanisms of profit shifting. The city of *Monheim am Rhein* (from here on *Monheim*) is a relatively small municipality in the center of one of Germany's most vibrant economic areas. In 2012, after the youngest mayor in Germany took office in the city, the local government drastically reduced the LBT rate to the lowest level in the state. I demonstrate that corporate profits taxed in *Monheim* increased rapidly following the LBT rate cut. The surge in corporate profits cannot be explained by increased real economic activity in the municipality. I deploy the dynamic SDID estimator to quantify the amount of profit shifting to the municipality. Between 2012 and 2019, shifted profits to *Monheim* amount to around 20.5 billion Euros (91% of *Monheim*'s LBT base). Large German MNCs moved their intellectual property management subsidiaries to the municipality right after the tax cut. Most of the increase in the municipality's LBT base can be explained by the profit shifting of a small number of very large firms. Looking at the municipality's public finances, the increase in the LBT base more than offset the reduction in its tax rate. The positive effect on municipal revenues and expenditures steadily increased after the reform, reaching around ten thousand Euros per capita in 2019. I do not find a statistically significant effect on the municipality's population numbers, migration patterns, residents' income, or the number of unemployed. Finally, I document a positive but noisy effect on local house prices, indicating that part of the increase in local public services may have been capitalized in house prices.

Investigating tax havens and profit shifting in the local setting has several advantages compared to the international context. First, differences in jurisdictions' legal architecture exacerbate the identification of international tax havens (Ogle, 2017; Laffitte, 2024). The code of law does not differ across municipalities in Germany. Maintaining a consistent legal architecture across jurisdictions facilitates the clean identification of tax havens in the sub-national setting. Second, due to limited data availability, studies in the international context typically focus on the effect of profit shifting on the corporate tax revenues of tax haven and non-haven jurisdictions (e.g. Fuest et al., 2022; Tørsløv et al., 2023). These studies abstract from the corresponding adjustments in governments' public expenditures and residents' economic outcomes. The extensive information on municipal public finances, demographics, and the housing market allows for a detailed analysis of the characteristics of tax havens and the behavior of local governments. Using the emergence of Germany's largest local tax haven, I can quantify not only the revenue gain of a tax haven jurisdiction but also public expenditure adjustments and the effect on residents' economic outcomes and the housing market. Third, studies that aim to quantify international profit shifting often rely on data sources that provide comprehensive firm-level information only for large MNCs (e.g. Garcia-Bernardo et al., 2021; Delis et al., 2025). The administrative data sources used in this paper enable me to study the entire population of firms liable to the LBT in Germany. Thus, I can explore profit shifting activities not only of a small number of very large MNCs but also for small to medium-sized firms.

The incentives that govern firms' decision to use international and local tax havens are identical: reducing the corporate tax burden by shifting profits from high-tax to low-tax jurisdictions. Many of the study's findings, such as the high importance of large, dominant firms in profit shifting (Wier & Erasmus, 2023; Clifford et al., 2025) and the significant role of spatial closeness to large markets as a primary determinant of local tax havens (Laffitte, 2024), are not domain-specific but also directly apply to the international context. The comprehensive data, combined with the constant institutional framework, provide an ideal setting to learn more about the specific features and mechanisms that explain the functioning of tax havens, as well as corporate profit shifting to their jurisdictions.

A central objective of global initiatives designed to prevent corporate tax avoidance, such as the OECD's Base Erosion and Profit Shifting (BEPS) initiative, is to ensure that tax liability aligns with actual economic activity and value creation. These measures target artificial profit shifting practices by large multinational corporations, ensuring that profits are taxed in the jurisdictions where substantive economic functions, such as production, innovation, and decision-making, occur. However, local tax havens represent an overlooked blind spot in these initiatives. While global regulatory frameworks address cross-border tax avoidance of MNCs, sub-national jurisdictions within certain countries can also offer preferential tax treatments that attract economic corporate profits on paper but lack meaningful real economic substance. Sub-national tax havens may become especially attractive for firms' tax planning strategies, given that global initiatives such as the recently introduced global minimum tax are likely to reduce profit shifting to international tax havens (Hugger et al., 2024; Boukal et al., 2024).

The findings of this paper indicate that profit shifting to local tax havens is of a substantial magnitude. The highly concentrated surge in tax revenues in a small number of tax haven jurisdictions leads to a spatial misallocation of local public goods provision. Local tax havens erode the fairness and integrity of the tax system, highlighting the potential costs of fiscal federalism. Current apportionment formula rules, which govern the allocation of the tax burden of large firms across local jurisdictions, can be easily circumvented. This enables firms to shift taxable profits to low-tax municipalities without relocating actual economic activity. Thus, in addition to global initiatives, national governments must introduce fiscal policies that address profit shifting to domestic low-tax jurisdictions. The high policy relevance of sub-national tax havens is underscored by the recent coalition agreement of the current German government, which identifies sham relocations to local tax havens as a pressing fiscal issue (see CDU/CSU & SPD, 2025). I propose an amendment to the current apportionment formula rules that takes into account the ownership structures of very large companies. This supplement is likely to reduce local profit shifting severely.

This paper connects to various strands of literature. First, I contribute to research on corporate profit shifting to tax havens (e.g. Hines & Rice, 1994; Clausing, 2016; Dowd et al., 2017; Fuest et al., 2022; Tørsløv et al., 2023).[2] So far, academic research has focused mostly on the profit shifting of MNCs to international tax havens. I contribute to this literature by providing the first evidence that firms not only shift profits to international tax havens but also to sub-national, local tax havens. Profit shifting to local tax havens is especially relevant in institutional settings, where strict Controlled Foreign Corporation (CFC) rules and exit taxation impede the use of international tax havens. Drawing on country-by-country reporting (CbCR), Fuest et al. (2022) find that between 2015 and 2016, large German MNCs shift around 5.4 billion Euros annually to international tax havens. Clifford et al. (2025) utilize administrative microdata and estimate that German MNCs shift 19 billion Euros to international tax havens in 2022. I

[2] An extensive meta-analysis of the existing academic literature on corporate profit shifting is provided by Heckemeyer & Overesch (2017) as well as Beer et al. (2020).

estimate that between 2013 and 2019, approximately 7.4 billion Euros of corporate profits are annually shifted to local tax havens in Germany. Thus, local profit shifting is sizeable, even when compared with the profit shifting of German MNCs to international tax havens.

Studies in the international context find that estimates of profit shifting differ systematically depending on the underlying data sources. Estimations based on aggregated macro-data yield higher estimates than those based on firm-level micro-data (Beer et al., 2020). Using the universe of South African corporate tax returns, Wier & Erasmus (2023) show that this gap between micro and macro estimates can be explained by profit shifting being concentrated among a relatively small number of large firms. Similarly, Clifford et al. (2025) finds that the profit shifting aggressiveness of German MNCs increases with their size. The current study estimates profit shifting to local tax havens at the macro-level (sector). Nevertheless, quantile regressions on the micro level are used to explore firm-level heterogeneity. The results reveal that profit shifting is concentrated among large firms that comprise the majority of local tax havens' LBT base.

Finally, empirical studies that draw on firm-level data to quantify international profit shifting often only cover very large companies (e.g., CbCR) or are plagued by poor data quality (e.g., Orbis). The administrative data used in this paper allows me to investigate the entire population of firms liable to the LBT in Germany. I show that although large MNCs make up most of the shifted profits, there also exist many smaller-sized firms that strategically relocate their corporate earnings to local tax havens.

Second, this paper contributes to academic research that explores the characteristics and development of corporate tax havens (e.g. Dharmapala & Hines, 2009; Laffitte, 2024; Dharmapala, 2024). Dharmapala & Hines (2009) provides descriptive evidence, showing that international tax havens are relatively small, affluent countries that are spatially close to large markets and have high-quality governance institutions.[3] Laffitte (2024) utilizes a novel database on changes in tax havens' legal architectures to explore the determinants and consequences of international tax havens. The study finds that demand shocks can explain the emergence of international tax havens, while supply-side competition shocks lead tax havens to update their legal architecture further. The author shows that the demand for tax haven services has a strong geographical component, which can explain why tax havens are often located in close proximity to large markets.

[3] Note that Dharmapala & Hines (2009) measure spatial distance as the air distance between a country's capital city and one of the following three cities: New York, Rotterdam, or Tokyo.

This study documents that many findings from the local context carry over to international tax havens, while the data sources used allow for a more detailed analysis of governments' behavior and local residents' outcomes. Geographical closeness to large markets is an important determinant in explaining the spatial distribution of local tax havens. My findings reveal that low-tax municipalities located near agglomeration areas attract a substantial amount of corporate profits. Large firms own service subsidiaries in said municipalities, allowing them to shift part of their corporate profits to the low-tax jurisdiction. I document that the profitability of firms located in local tax havens is of a similar magnitude to that of foreign subsidiaries in European tax havens (see Tørsløv et al., 2023). The tax bases of tax haven jurisdictions are highly concentrated, making the municipal revenues dependent on a small number of large firms. Finally, the empirical results show that becoming a local tax haven has a positive impact on municipalities' public finances. Local tax havens typically have low public debt levels, while their tax revenues and expenditures are extraordinarily high. I provide suggestive evidence that a part of the increase in local public goods may have been capitalized in the local housing market.

The case study on the emergence of Germany's most prominent tax haven provides novel evidence of the interaction between the supply (local governments) and the demand side (firms) in the market of tax havens. The results illustrate that only very large firms initially reacted to the studied tax cut. Internal reports from city council meetings suggest that these large firms have been in contact with the local government, providing them with detailed information about the future tax cut. Incomplete information (Becker & Davies, 2017) and the direct influence of large corporations on local governments (Bischoff & Krabel, 2017; Riedel & Simmler, 2021) are introduced as two reasons that may explain the high importance of spatial closeness to large agglomerations for local tax havens.

Third, this paper connects to the emerging literature on sub-national tax havens. Agrawal (2024) provides an overview of the scarce literature on sub-national tax havens, coining them as "hidden havens". Empirical papers focus primarily on local tax havens in personal (Martínez, 2022) or corporate income (Mintz & Smart, 2004; Neugebauer et al., 2020; Boning et al., 2024; Buettner & Poehnlein, 2024), or wealth taxation (Agrawal & Foremny, 2019; Agrawal et al., 2024). Mintz & Smart (2004) show that the taxable income elasticity of large single-province subsidiaries is larger than for other large non-subsidiary firms in Canada. Their findings suggest that corporate groups may shift income to subsidiaries located in low-tax provinces. Most importantly, this project is related to two studies investigating the introduction of a minimum LBT rate in 2004 in Germany. Boning et al. (2024) and Buettner & Poehnlein (2024) both estimate the reform's effect on local tax competition.[4] The two studies label municipalities with a tax rate below the introduced floor rate as business tax havens. Both studies find that most municipalities in the neighborhood of local tax havens did not adjust their local tax rates. Buettner & Poehnlein (2024) highlight that only high-tax municipalities adjust slightly by reducing their LBT rate.

This paper contributes to the literature by focusing on profit shifting to local business tax havens and the corresponding fiscal costs. The results suggest that having a very low tax rate is a necessary but not a sufficient condition for attracting shifted corporate profits. Spatial proximity to large markets is a crucial factor that distinguishes local tax havens from the broader set of low-tax municipalities.[5] Drawing on the population of corporate tax returns in Germany, I develop a definition of local tax havens based on a jurisdiction's local tax rate and its dependence on profit shifting-intensive sectors. The outlined definition is contrasted with the one used by Boning et al. (2024) and Buettner & Poehnlein (2024), illustrating how the classification used in this paper is more suitable for defining local tax havens in the context of profit shifting.

The remainder of the paper is structured as follows. Section 2 introduces the institutional background. Section 3 develops a classification of local tax havens, before presenting a case study on the emergence of Germany's largest local tax haven. The data sources are presented in Section 4. Section 5 gives an overview of the empirical strategy, before Section 6 presents the empirical results. Section 7 discusses the results and Section 8 concludes.

[4]Besides estimating the effect of the minimum tax reform on tax competition, Boning et al. (2024) set out to predict profit shifting to local tax havens. They do not draw on firm-level profit information but impute firms' profits based on sales and input costs. They show descriptively that imputed profits per worker are exceptionally high in the tax havens with the lowest LBT rate. The paper does not estimate the amount of shifted profits or the associated fiscal costs.

[5]This observation is substantiated by Neugebauer et al. (2020) findings, which look at the corporate structure of twenty-eight of Germany's largest firms. They show that many of these firms have business service subsidiaries located in low-tax municipalities near large agglomerations. Additionally, they outline how these low-tax subsidiaries can be used to lower the corporate tax burden. Their paper does not provide any estimates of local profit shifting.

2 Institutional Background

In this section, I outline the institutional background of the LBT setting in Germany. I explain how firms can shift corporate profits to local business tax havens and the importance of strict CFC rules and exit-taxation in preventing international profit shifting of German firms.

2.1 The Local Business Tax in Germany

Germany consists of sixteen federal states (*Bundesländer*), which in 2022 were made of 400 districts (*Landkreise/kreisfreie Städte*) that can be subdivided into just below eleven thousand municipalities (*Gemeinden*). Upper-level governments delegate some of their responsibilities to their subordinated municipalities.[6] As an example, municipalities in Germany are tasked with providing the local infrastructure, public transport, and kindergartens. Municipalities get reimbursed by intergovernmental transfers, a share of the personal income tax, and value-added taxes on goods and services. Municipalities raise their revenues via local taxes and other forms of levies.[7] The LBT is the most important tax revenue source for local governments and not deductible from the federal corporate tax (*Körperschaftssteuer + Solidaritätszuschlag*).

The municipal council of a German municipality sets the LBT multiplier. The statutory LBT rate is computed as the product of the LBT multiplier (*Hebesatz*) and the basic federal rate (*Steuermesszahl*). The product of the sum of firms' profits and the basic federal rate is called LBT base amount (*Gewerbesteuergrundbetrag*).[8] The LBT rate is applied to the profits of firms operating within a municipality's borders. In the following, I refer to profits after additions such as interest payments and deductions when discussing firms' profits. Freelance professionals (*Freiberufler*), e.g., architects, medical doctors, and lawyers, as well as the agricultural and forestry sectors, are not subject to the LBT. Since 2004, the LBT multiplier has to be at least 200%, while the basic federal rate has been 3.5% since 2008, leading to a minimum LBT rate of

[6] The boundaries of German municipalities can be subject to change over time. I harmonized the municipal borders of all the data sources I use to the 31st of December 2022. The harmonization is explained in more detail in Section A1.

[7] The "other forms of levies" include but are not limited to dog license fees and charges for garbage collection and street cleaning. In the later analysis, I will refer to the sum of those levies as "fees and contributions" as they are already classified as one category in the Statistical Office's data set and constitute a relatively small share of overall revenues.

[8] The LBT base amount divided by the basic federal rate is a good approximation for the sum of firms' profits within a municipality. The approximation differs from the actual sum of profits as the LBT base amounts can contain out-of-period payments, e.g., reimbursements of tax payments. One advantage of the LBT base amount is that it is available as an annual administrative statistic (*Realsteuervergleich*) for an extended period. Information on actual firm profits has been available annually since 2010.

7%.[9] Thus, the LBT burden of a firm in 2019 can be computed as:

$$\text{LBT burden} = \text{LBT multiplier} \cdot 0.035 \cdot \text{profits} \quad \text{where} \quad \text{LBT multiplier} > 2 \tag{1}$$

Profits of firms that operate establishments in multiple municipalities are subject to a formula apportionment (FA). Specifically, the overall firm profits are allocated to the different municipalities based on the sum of wages the firm pays in each jurisdiction. Buettner et al. (2011) provide suggestive evidence that even under an FA regime, firms may strategically exclude specific affiliates from their consolidation, effectively lowering their overall tax burden by shifting profits to low-tax jurisdictions. Neugebauer et al. (2020) outline different ways a corporation can adjust its structure so that the FA does not apply.

In 2019, the LBT multiplier ranged from 200% to 600%, corresponding to an LBT rate between 7% and 21% (see Figure B1). There are some clear regional patterns. LBT rates are relatively high in the West of Germany, while the economically strong South and the North East contain many municipalities with low LBT rates. Large cities generally set relatively high LBT rates.

2.2 Profit Shifting to Local Tax Havens

Profit shifting to local tax havens is, in essence, very similar to profit shifting to international tax havens in that both shift firms' profits from a high tax to a low tax jurisdiction with only a small or no reallocation of real economic substance. For both types of profit shifting, the line between legal tax avoidance and illegal tax evasion is often thin. Many activities intended to shift profits operate in a complex, legal gray area. I cannot determine the share of estimated shifted profits that accrues to each type of profit shifting. In the following, I will first give a short overview of legal ways of shifting firms' profits to a local tax haven in Germany before turning to illegal ways of evading the LBT via profit shifting.

[9] Before the minimum tax multiplier was introduced in 2004, municipalities could choose a local LBT multiplier as low as zero percent. Recent empirical papers investigate the tax competition effects of this reform on affected regions (Buettner & Poehnlein, 2024; Boning et al., 2024). A business tax reform in 2008 changed two central things for the LBT. First, before 2008, the basic federal rate depended on a firm's legal form and revenues. By way of example, the basic federal rate for partnerships (*Personengesellschaften*) and sole proprietors (*Einzelunternehmer*) ranges from 1% to 5% depending on the firm's revenue. In contrast, a flat rate of 5% was applied for all corporations (*Kapitalgesellschaften*). The 2008 reform abolished this dependence and introduced a flat rate of 3.5% for all firms. Second, before 2008, LBT payments were deductible from the LBT base so that an LBT multiplier of 400% would result in an effective LBT rate of $\frac{4 \cdot 0.05}{1+4 \cdot 0.05} \approx 18.519\%$ for local corporations.

Neugebauer et al. (2020) provides an exhaustive overview of different ways how affiliates in local tax havens can be utilized to lower the overall tax burden of a company.[10] They show that there are three important channels through which firms can shift their profits to a local tax haven without affecting the allocation of firms' real economic activity. First, a parent company can move intangible assets such as patents or trademarks to an affiliate located in a local tax haven. This affiliate then receives royalties from other group-affiliated subsidiaries in Germany and abroad. Second, a parent company may make a cash contribution to establish a holding subsidiary in a local tax haven. The parent company transfers shares as a non-cash contribution to the holding subsidiary. Profits derived from the dividend payments are retained in the holding affiliate, which can provide loans to other group affiliates, using debt shifting to lower profits in a high-tax municipality while increasing them in said haven. Third, a parent company can create a real estate affiliate in a local tax haven. The real estate affiliate then leases real estate to other group affiliates, receiving rent in return. Again, this procedure lowers the profits of the other group affiliates while artificially increasing them in the haven affiliate. The authors highlight that similar to the foregoing examples, other business service affiliates, e.g., technical facility management, IT support, and leasing administration, can be moved to a local tax haven to reduce the overall tax burden.[11] It is important to note that all the foregoing procedures require that formula apportionment of the LBT is not applied. Therefore, no profit and loss transfer agreement is signed between the tax haven affiliate and the parent company. The profit of the tax haven affiliate is not consolidated with that of the parent company and remains within the tax haven affiliate.[12]

The foundation of the methods mentioned above is that the affiliate or holding company located in the tax haven is indeed liable to LBT in the haven in which it is located. Under German tax law, this requires not only that the firm's business address is located in the municipality but also that the decisions of the firm's management (*maßgebliche Wille der Geschäftsführung*) are

[10] The article by Neugebauer et al. (2020) is only available in German. I provide an overview of the main findings and their examples of applications in Section A5. Besides corporations, (affluent) individuals can also benefit by locating a wealth-managing holding company in a low-tax municipality. The exact working of this arrangement is shortly described in Section A6.

[11] Neugebauer et al. (2020) explain that the mentioned business services differ from licensing, financing, and real estate management in the sense that they are oftentimes more labor-intensive, i.e., they require real relocations of productive assets and workers. The three examples mentioned above can be realized by simply adjusting the corporate structure without affecting the firms' allocation of real economic activity. Nevertheless, I argue that the increase of home office take up and virtual offices over the last few years may make it relatively easy to outsource some business services to a local tax haven while moving only a very limited amount of workers there.

[12] The subsidiary can transfer the (after-tax) profit back to the parent company as part of a dividend distribution. In this case, 5% of the dividend payment is taxed with a capital gains tax of 26.375% (*Kapitalertragsteuer + Solidaritätszuschlag*).

formed where the firm is registered. By way of example, just having a shell company registered in a local tax haven is not sufficient to benefit from its low LBT rate. Using such a shell company to lower the LBT burden while the firm's real location, i.e., the place where the management decisions are formed, is somewhere else, is sanctioned as tax evasion. The enforcement of the law is difficult as the resources of the local tax authority (*Finanzämter*) are limited, and it is difficult to observe the actual location where the firm's management decisions are made. This is especially true for the service sector. By way of example, firms that provide services such as facility management, asset management, or IT support, and firms that mainly operate online, e.g., online marketing, may have the incentive to relocate their business on paper to a local tax haven while leaving their real allocation of economic activity unchanged. Anecdotal evidence suggests that local tax authorities may explicitly reassess a firm's location if the residence of its general manager is far from the actual business address. Thus, firms that want to shift profits to a local tax haven illegally have an incentive to choose a low-tax municipality close to the residence of the firm's owner or the parent company, as this reduces the likelihood of getting detected by the local tax authorities.[13]

There have been numerous cases of LBT evasion in recent years. I will briefly outline a widely publicized example in Germany to illustrate how local tax havens are used for tax evasion in reality. During the Covid-19 pandemic, there was a shortage of respirator masks and protective equipment in Germany. In the spring of 2020, Munich-based entrepreneur Ms. T. established contact between the German health ministries and the Swiss company Emix Trading. With a business partner, Ms. T. received 10% of Emix Trading's net sales as commission, resulting in a tax-relevant profit of over 48 million euros. Said profits were passed through a company named Little Penguin GmbH, which was founded by the two of them. In order to avoid the high LBT rate in Munich (17.15%), the two businessmen relocated Little Pinguin GmbH to the neighboring municipality of *Grünwald* (8.4%), one of Germany's largest local tax havens. Ms. T. rented a small office room in *Grünwald* as part of this movement. The fifteen square meter office room was rented simultaneously to more than twenty other companies. Some landlords in local tax havens make a business out of renting out small office rooms to several companies simultaneously, often aggressively advertising their services online. Companies rent these office spaces to acquire a business address in the tax haven. The prosecution proved in court that the relocation of Little

[13] The same rationale applies to firms operating in a gray area. In the absence of deception, a firm may prefer a tax haven in its proximity as it lowers the possible travel time. Moreover, a firm may have established social and business ties to the region, so a low-tax municipality in the same region is preferred over one further away.

Penguin GmbH to *Grünwald* only took place on paper. The actual management was still in Munich, where all relevant business decisions were made. The court ruled that over 8.2 million Euros in LBT had been evaded at the expense of the City of Munich.

Why a company should shift its profits to a local tax haven may seem puzzling. In a local tax haven, corporate profits are taxed at least 22.825% (federal CIT + LBT), while several international tax havens offer statutory tax rates of zero. The following section will clarify why local tax havens are widely used to lower corporate tax burdens, even in a world with international tax havens.

2.3 Restrictions on International Profit Shifting

I will outline three important reasons why corporations decide to use local tax havens instead of international tax havens to lower their local tax burden: (1) *Controlled Foreign Corporation (CFC) rules*, (2) *exit-taxation* and (3) *costs of profit shifting*.

First, CFC rules are anti-tax avoidance measures designed to prevent companies from shifting profits to subsidiaries located in low-tax jurisdictions. Recent research by Clifford (2019) indicates that CFCs rules effectively reduce profit shifting to low-tax jurisdictions. In Germany, CFC rules are part of the Foreign Tax Act (*Außensteuergesetz*) introduced in 1972. The German CFC rules state, given that specific conditions are satisfied, the passive income of CFCs is included in the shareholder's income and taxed under German law.[14] CFC's passive income is subject to the federal corporate tax and the LBT if said shareholder is a firm.

Assume that a German company faces a corporate income tax rate of around 30%. The company moves its patents to an international tax haven without actual R&D operations in this region. Under the Foreign Tax Act, the royalty payments received by the patent-managing subsidiary are classified as passive income and will be attributed to the parent company. Thus, the CFC's passive income will be taxed at 30%. Alternatively, the parent company could move its patents to a local tax haven. Assuming the local tax haven has the lowest possible LBT, the subsidiary is subject to a corporate tax rate of just below 23%. CFC rules do not apply to subsidiaries within Germany. In conclusion, German CFC rules impede the use of international tax havens for corporate tax avoidance. Conditional that CFC rules apply, local tax havens enable firms to lower their corporate tax burden by utilizing (sub-national) LBT differentials

[14]The specific requirements for German CFC rules to apply as well as the definition of passive income are stated in Section A2. Beyond that, Förster & Schmidtmann (2004) give an extensive overview of the historical background and legal consequences of CFC legislation in Germany.

even when international tax havens cannot be used.

Second, exit-taxation is a charge a country imposes when assets are moved out of its jurisdiction, so that the unrealized capital gain accrued while under that country's jurisdiction is taxed before it escapes. In practice, the move is treated like a deemed sale at fair market value (FMV), and the gain (FMV minus tax book value) is taxed immediately by applying the CIT and LBT. Thus, exit-taxation reduces the potential tax benefit a firm may receive by moving intangible assets to a country that taxes its future profits at a lower rate. This is especially relevant for assets with substantial unrealized capital gains, e.g., patents and trademarks, whose FMV far exceeds the recorded book value.

Finally, the cost of establishing a profit shifting subsidiary may be higher in an international tax haven than in a local tax haven. High legal and restructuring fixed costs may prevent firms from utilizing international tax havens. This constraint should be especially important for small and medium-sized firms operating solely in the domestic market. Subsidiaries in a local tax haven operate under German law, so additional legal costs are relatively low.

3 Local Tax Havens in Germany

In this section, I develop a classification of local business tax havens. The fiscal, demographic, and spatial characteristics of local tax havens are explored. Finally, I present the case study of *Monheim am Rhein*, a municipality that became Germany's most important tax haven after a large LBT cut in 2012.

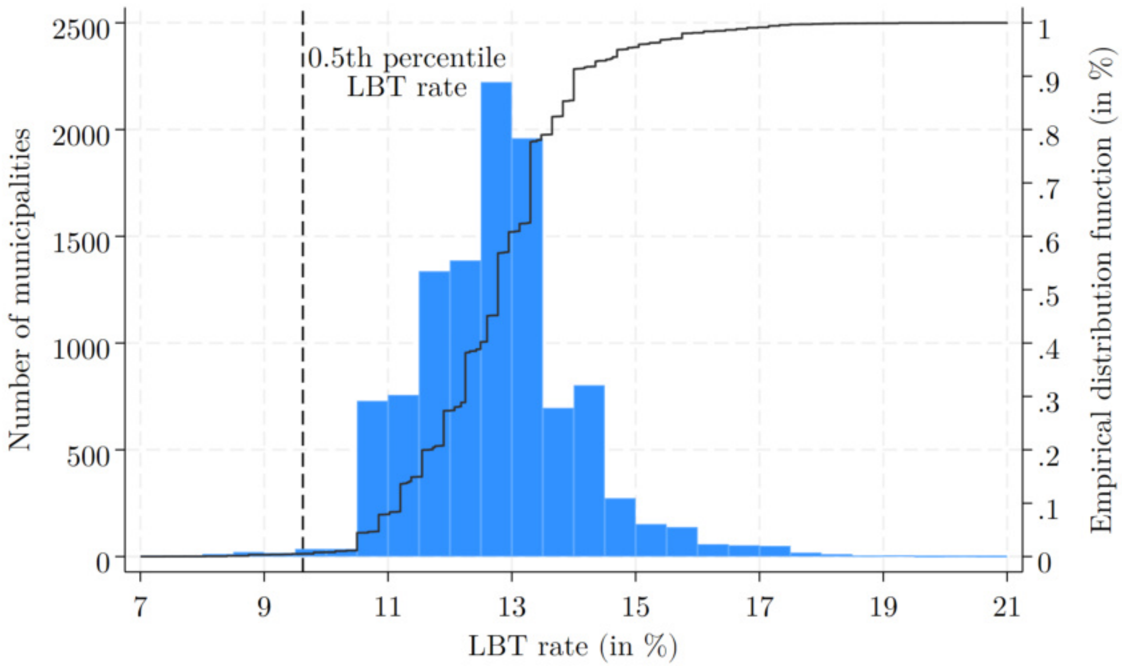
3.1 Classifying Local Tax Havens

Classifying tax havens is a notoriously arbitrary task. Researchers investigating tax havens in an international context draw on a wide range of classifications (see Palan et al., 2009). Although these lists may differ in the classification of some border cases, the most important international tax havens can be found in all of them. Most economists agree that the presence of very low tax rates on income or wealth is a key characteristic for distinguishing tax havens from other jurisdictions (e.g. Hines & Rice, 1994; Slemrod & Wilson, 2009).[15]

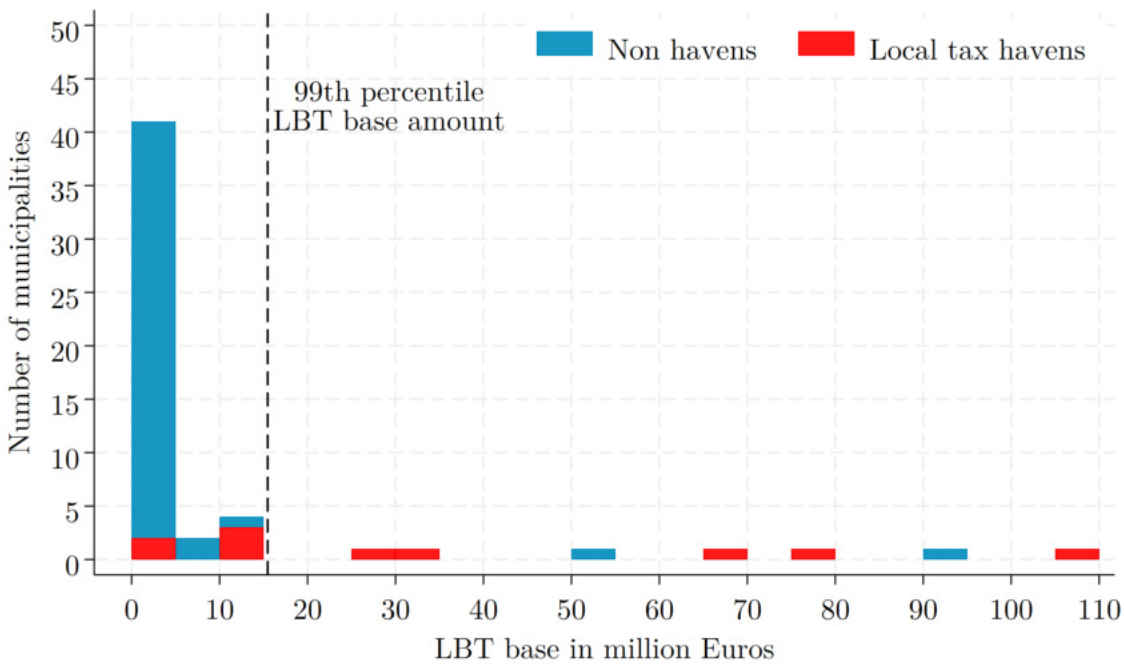
[15] Recent papers that investigate tax havens in a local setting follow this general notion. Martínez (2022) conducts a case study, evaluating the effect of a large income tax cut in one Swiss canton on the mobility response of affected top-income earners. Boning et al. (2024) investigate a nationwide LBT reform in 2004, which introduced a mandatory minimum LBT multiplier in Germany. The authors classify municipalities directly affected by the reform, i.e., had a business tax multiplier below the newly introduced floor, as a business tax haven. Using this classification, twenty-five municipalities are labeled as local tax havens.

Figure 1: Low-tax municipalities (2019)

(a) Distribution of LBT rates



(b) Distribution of LBT base amounts



Note: The left panel illustrates the distribution of LBT rates in 2019. The blue bars depict the histogram of the distribution, while the solid black line depicts the empirical cumulative distribution function. The dashed line depicts the 0.5*th* percentile. The right panel depicts the distribution of LBT base amounts in low-tax municipalities in 2019. The red area indicates the distribution of LBT base amounts in local tax havens, which is a subset of the set of low-tax municipalities. The dashed line indicates the 99*th* percentile of LBT base amounts.

In the following, I will develop a classification for local business tax havens in Germany for the period 2013 to 2019. Local tax havens are identified as (1) *low-tax municipalities* with a (2) *high dependence on shifting sectors*. Dharmapala & Hines (2009, p. 1058) define international tax havens as "locations with very low tax rates and other tax attributes designed to appeal to foreign investors." One advantage of classifying tax havens in the sub-national context is that most relevant "other tax attributes" such as institutions or the legal framework are the same across all German municipalities. Holding institutions constant, I argue that the LBT rate should be the most important determinant in classifying a local tax haven.

Low-tax municipality: Define a low-tax municipality as a municipality whose LBT multiplier is less than or equal to the $0.5th$ percentile of the LBT multiplier distribution in a given year.[16] Figure 1a depicts the distribution of LBT rates in 2019. The dashed line indicates the $0.5th$ percentile, which corresponds to an LBT rate of 9.625%. In 2019, 57 out of 10772 municipalities are classified as low-tax municipalities.

High dependence on shifting sectors: Section 2.2 documented that licensing services, holding companies, and real estate management are important channels that are used for shifting profits to low-tax municipalities. I use administrative microdata on corporate tax returns to identify each municipality's dependence on these sectors, as measured by the share of the LBT base that can be attributed to firms operating in the three mentioned sectors. A municipality is classified as having a high dependence on shifting sectors if the share of shifting sectors is equal to the $95th$ percentile or higher in a given year.[17]

Local tax havens: A municipality i is classified as a local tax haven in year t if it is a (1) low tax-municipality, with a (2) high dependence on shifting sectors, and has (3) at least three consecutive years of satisfying (1) and (2) during the period of observation. Condition (3) is imposed to avoid the definition of a local tax haven being robust to the large volatility observed for tax bases of small municipalities. Section A3 discusses various alternatives to define a local tax haven and illustrates how the changes in the chosen threshold values of (1) and (2) affect the

[16]The threshold of the $0.5th$ percentile was chosen, as, for the latest available data, it corresponds roughly to the new minimum LBT rate multiplier proposed by the federal government (CDU/CSU & SPD, 2025). Different threshold values are deployed as a robustness check in Section A3. I do not impose a fixed multiplier cutoff for every year, as LBT rates have been steadily increasing over the last decades, which would result in a steady decrease in the number of low-tax municipalities over time.

[17]Due to data confidentiality reasons, I cannot present the share of shifting sectors for individual municipalities. Additionally, the binary variable, which indicates if a municipality's share is equal to or above the $95th$ percentile of the nationwide distribution, can only be presented for municipalities that have at least three firms operating in shifting sectors as well as non-shifting sectors. This constraint affects only tiny municipalities. A list of the shifting sectors' share for every municipality can be provided at the Research Data Centres of the Statistical Offices of the Federation and the Federal States.

later estimation results.

Figure 1b depicts the distribution of LBT base amounts for all low-tax municipalities in 2019. The dashed line indicates the 99*th* percentile of all municipalities' LBT base in the same year. Most low-tax municipalities do not attract a substantial amount of corporate profits. Focusing on the seven municipalities on the right-hand side of the dashed line, we notice that five of them, depicted in red, have not only a low-tax rate but also a high dependence on shifting sectors. Among other jurisdictions, this subset includes Germany's largest local tax havens, such as *Monheim*, *Grünwald*, and *Schönefeld*, which are the central focus of the public debate on the issue of profit shifting to municipal tax havens in Germany. The other two low-tax municipalities with noticeably high tax bases are *Walldorf* and *Gräfelfing*, which host the German headquarters of two large multinational corporations (see Section 3.2).

My classification deviates from the one used by Boning et al. (2024) for three main reasons: First, I argue that using the 2004 reform for identifying tax havens does not identify any relevant local tax havens in the later years. German business tax multipliers are significantly lower in the Eastern states of Germany than in the western states. As a consequence, following Boning et al. (2024), 23 out of 25 local tax havens would be located in the Eastern states, while the two remaining havens are part of Schleswig-Holstein (Germany's most northern state). Large business tax havens of the Western states would be ignored. In fact, none of the local tax havens in 2019 would be labeled as a local tax haven using the 2004 reform for classification.[18]

Second, more generally, using solely the LBT rate for the classification of local tax havens will lead to many false positives. By way of example, using the deployed low-tax municipality condition would identify 57 local tax havens in 2019 (Figure 1b). Most of those municipalities neither attract a large tax base nor host companies that could be suspected of engaging in profit shifting. Even among the subset of low-tax municipalities with conspicuous large tax bases, we observe some municipalities whose tax base can be easily explained by other reasons than profit shifting, e.g., by the presence of a headquarters of one of Germany's largest corporations. Being a low-tax municipality is a necessary but not a sufficient condition for becoming a local tax haven. Consequently, it is crucial to apply a second condition, i.e., the municipal tax base's dependence on shifting sectors, for identifying local tax havens from the set of low-tax municipalities.

[18]Note that the misclassification is affecting not only municipalities that are acting as tax havens in the later years, i.e., after 2004, but also those which were already established as local havens in 2004. In 2004, only one municipality (i.e., *Norderfriedrichskoog*) was a relevant tax haven, which can be identified by using the introduction of the minimum LBT rate. All other municipalities labeled as local tax havens do not attract substantial corporate profits.

Finally, coding all municipalities directly affected by the 2004 minimum LBT reform as local tax havens implies that being a tax haven is an absorbing state. In reality, local tax havens do not have to be stable. We can observe that a non-haven municipality can become a local tax haven due to some aggressive tax cuts. On the other hand, a municipality can lose its status as a local haven due to tax increases. An example of the last-mentioned case is *Norderfriedrichskoog*, a small municipality in the North of Germany. *Norderfriedrichskoog* set an LBT rate of zero percent before the 2004 reform before it had to increase its LBT multiplier to 200% after the reform. As a reaction, companies have relocated or dissolved their subsidiaries in the municipality. The LBT base amount in the municipality decreased rapidly, falling from just below 30 million Euro in 2006 to less than 3 million Euro in 2010 (Figure B2). The corresponding pressure on the fiscal budget led the municipality to increase the LBT multiplier to 310% in 2011. The municipality can no longer be described as a tax haven. An example in the other direction is *Monheim am Rhein*, a municipality that became a local tax haven following aggressive tax cuts starting in 2012 (see Section 3.3). Treating a local tax haven status as an absorbing state is inappropriate. Instead, the haven status must be frequently reassessed to capture its dynamic nature.

3.2 Characteristics of Local Tax Havens

Spatial location: Figure 2 illustrates the spatial location of low-tax municipalities (blue), local tax havens (red), and Germany's largest eight cities (orange) in 2019. The circles drawn around the local tax havens are proportional to a municipality's LBT base amounts. All sizeable tax havens are located in the close neighborhood of one of Germany's largest cities. Spatial closeness to large agglomerations is a key determinant in explaining the location of local tax havens. This pattern is in line with recent work by Laffitte (2024), who finds that spatial closeness to large, high-tax countries is an important determinant when explaining the emergence of international tax havens.

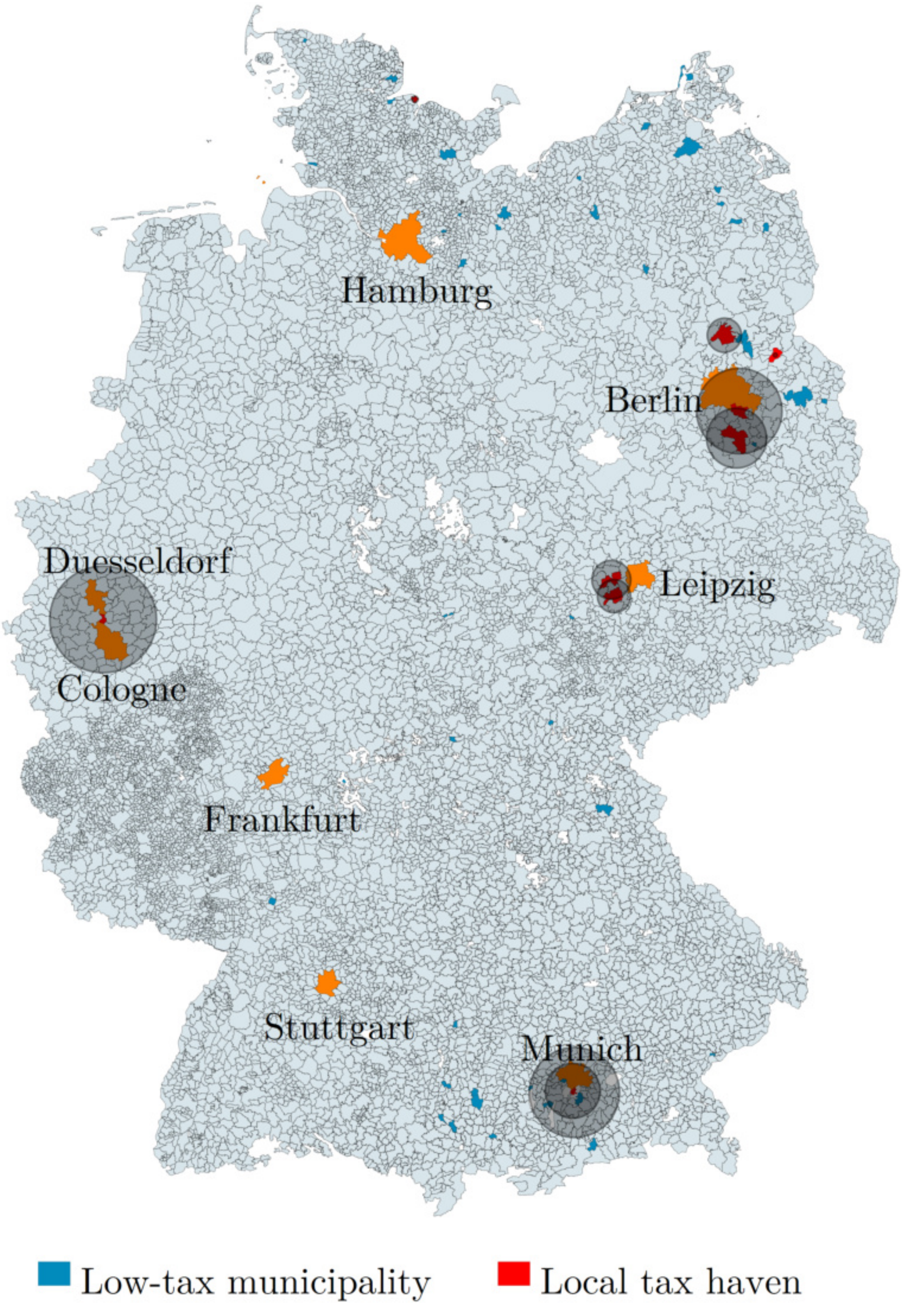
In the following, I am going to present two arguments that can rationalize the observed spatial pattern of local tax havens. First, Section A7 outlines a simple tax competition model based on Kanbur & Keen (1993). In this model, firms can shift a part of their taxable income between jurisdictions. Relocating profits is costly, while the costs are assumed to be increasing in the distance between the home jurisdiction and the jurisdiction to which the profits are shifted. Municipalities maximize their tax revenue by choosing the optimal tax rate, taking firms' behavior into account. In the two-municipality case, in equilibrium, the smaller municipality will choose the lower tax rate as it faces the higher tax base sensitivity. Equilibrium tax rates are increasing in the distance between the two municipalities. Allowing for a positive fixed cost of profit shifting introduces a threshold on the extensive margin of the profit shifting decision, which can explain why predominantly large companies engage in profit shifting.[19] Finally, policymakers may only have incomplete information about firm's cost of profit shifting and the corresponding tax base elasticity (Becker & Davies, 2017). Learning about firms' cost parameters may be easier for local governments in close proximity, thus explaining why the optimal tax rate in a nearby municipality may be lower than the one of a same-sized municipality in a far distance.

Second, local dominant firms may have a direct impact on a municipality's LBT rate by engaging in lobbying behavior, influencing the tax setting of local policymakers (Bischoff & Krabel, 2017; Riedel & Simmler, 2021). It is plausible that a firm's influence on policymakers increases with its share in the LBT base. In line with this argument, Figure B4a documents a negative relation between the LBT rate and its tax base concentration for the period 2013 to 2019. This relation remains even after controlling for the overall size of the LBT base and is especially strong in the right tail of the concentration distribution (Figure B4b). A large firm may have a strong impact on the tax rate if it is located in a relatively small municipality, while a same-sized firm located in a large city has only a very limited impact on the LBT rate. Firms can shift a part of their taxable income to other jurisdictions (see Section 2.2). A large company, which may not be able to influence the tax rate in its local, large city, may decide to relocate a part of its profits to a nearby, smaller jurisdiction, where it may be able to influence the LBT rate. This can explain why we often observe profit shifting subsidiaries of multinationals in local tax havens, which are located in the close neighborhood of the large city that hosts the headquarters of these multinationals (see Section 3.3).

Excess profitability: Figure 1 presents the ratio of pre-tax profits taxed in a municipality and the wage sum of establishments located in this municipality on the vertical axis and the LBT rate on the horizontal axis. The figure only displays municipalities where the LBT base is at the 99*th* percentile or higher in 2019. By definition, local tax havens are among the municipalities with the lowest LBT rates. In addition, the profit-to-wage ratio is among the highest in local tax havens, reaching from just above 130% in *Pullach im Isartal* to around 565% in *Grünwald*. The

[19] Another explanation is that some important channels of profit shifting, e.g., the relocation of patents or trademarks, are only available to larger firms, as small-sized companies oftentimes do not own any patents or trademarks.

Figure 2: Spatial distribution of local tax havens (2019)



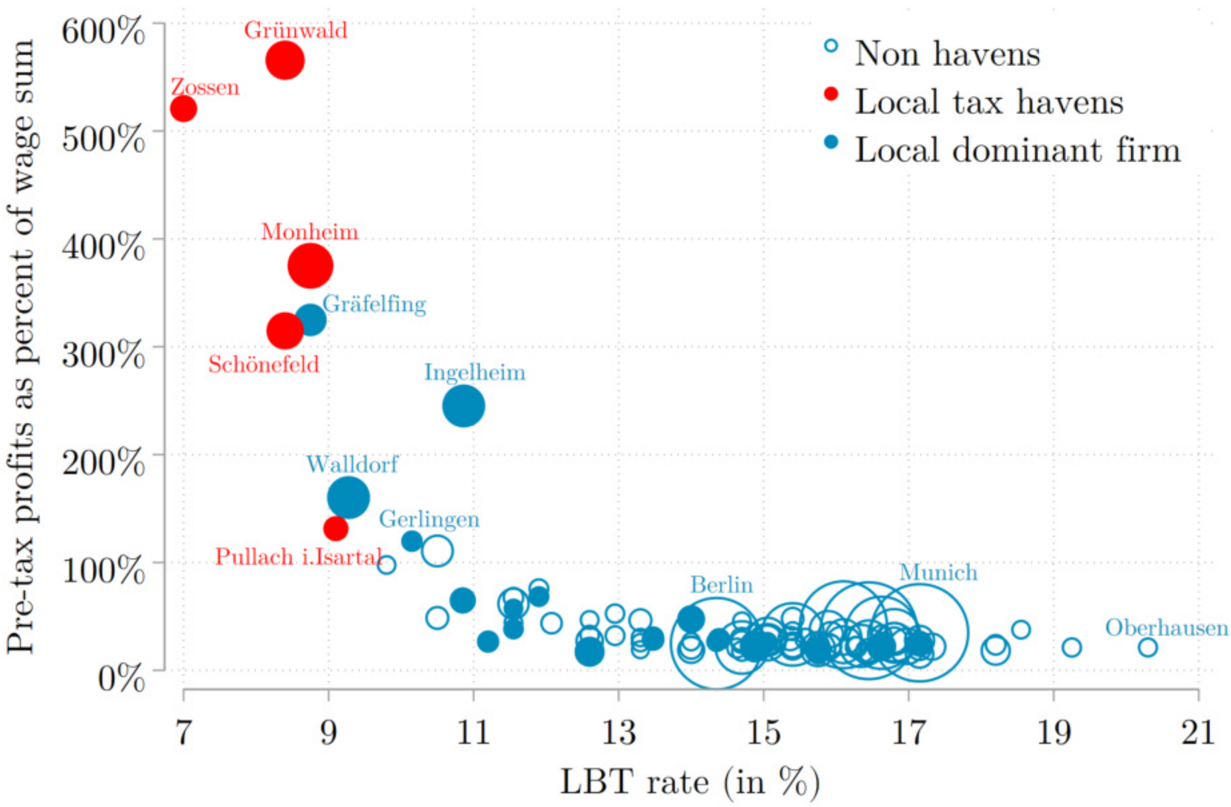
Note: The figure illustrates the spatial distribution of low-tax municipalities (blue) and local tax havens (red) in 2019. The eight largest cities are marked in orange. The circles around the local tax havens are proportional to the municipality's LBT base amount. The blank areas within Germany are non-municipal territories (*gemeindefreie Gebiete*) or municipalities with missing population counts or missing information on local business tax rates.

observed ratios of pretax profits to wage sum in local tax havens are in magnitude similar to the ratios of pretax profits to compensation of employees that Tørsløv et al. (2023) find in foreign firms located in large European tax havens like Switzerland (319%), Luxembourg (461%), or Ireland (800%) in 2015. This remarkable excess profitability is an indicator that not all of the observed profits, taxed in local tax havens, are based on real economic activity but may originate from profit shifting to these low-tax jurisdiction.

The figure reveals that a relatively small number of non-haven municipalities have similar profit-to-wage sum ratios and LBT rates to local tax havens. All these municipalities have one thing in common: one of Germany's largest companies has its headquarters in their jurisdiction. By way of example, *Walldorf* hosts the headquarters of Germany's largest software company *SAP SE*, *Gerlingen* the headquarters of the German multinational engineering company *Robert Bosch GmbH*, and *Ingelheim* the headquarters of one of the largest pharmaceutical companies *C.H. Boehringer Sohn AG & Co. KG*. Finally, the German headquarters of the international tobacco company *Philip Morris GmbH* are located in *Gräfelfing*. One can argue that the headquarters of these highly productive multinationals explain the observed profit-to-wage ratios as well as the large amount of profits taxed in these jurisdictions. The low LBT rates in these municipalities may be explained by the influence locally dominant firms may have on local governments (see Bischoff & Krabel, 2017; Riedel & Simmler, 2021).

Descriptive statistics: Table 1 depicts fiscal and demographic characteristics of non-havens and tax havens between 2013 and 2019 in our estimation sample. Overall, our estimation sample comprises nine unique local tax havens and 6,504 non-haven municipalities. The average LBT rate is substantially higher in non-haven municipalities (12.74%), compared to tax havens (8.12%). The average LBT base amount in a haven municipality is approximately thirty-nine million Euros, more than sixteen times higher than in a non-haven municipality. While shifting sectors contribute less than nine percent of the LBT base in non-havens, they account for more than 68% of corporate profits taxed in local tax havens. Using firm-level tax returns reveals that the LBT base in local tax havens is very concentrated. The average Herfindahl-Hirschman-Index (HHI) in local tax havens is around 0.232, while it is only 0.059 in non-haven municipalities. On average, a handful of firms make up most of the LBT base in local tax havens. Accounting for real economic activity by comparing the ratio of pretax profits to wages between the two groups reveals that said ratio is substantially higher in haven (611%) than in non-haven (39%) municipalities.

Figure 3: Profit-to-wage ratio vs. LBT rate (2019)



Note: The figure depicts municipalities that have a LBT base amount that is at the 99*th* percentile or higher. The vertical axis of the figure illustrates the quotient of pre-tax profits taxed in a municipality to the overall wage sum of establishments located in this municipality. The horizontal axis displays the LBT rate as a percentage. The red and blue circles indicate local tax havens and non-havens, respectively. The solid blue circles depict municipalities whose tax base depends strongly on a large, local firm. A large, local firm is defined as a firm that makes up more than fifty percent of the pre-tax profits taxed within a municipality and which has additional annual pre-tax profits higher than one hundred million Euros. Due to data confidentiality reasons, large local firms are defined based on financial statement information from the Orbis database. The size of the circles is proportional to the LBT base amounts in the municipality. Selected municipalities are marked with their name. All data is for the year 2019.

Local public finances are substantially better in local tax havens than in non-havens. Revenues and expenditures per capita are around four times as high as in non-haven municipalities. Differences in LBT revenue can explain all of the differences in public revenues. LBT revenues comprise more than eighty percent of local tax havens' revenues, while they only constitute around twenty percent in non-haven municipalities. Local public debt per capita is substantially lower in tax havens than in non-havens. Local tax havens are more likely to be located in the East of Germany, while the population in local tax havens is lower than in non-haven municipalities. Finally, local tax havens are especially small compared to their neighboring municipalities, which are, on average, around three times larger than the haven. Table C1 presents a list of all local tax havens for the period of estimation.

Table 1: Non-havens and Tax havens (2013-2019)

	Non-havens		Tax havens	
	Mean	SD	Mean	SD
LBT rate and base				
LBT rate (in %)	12.74	1.42	8.12	0.84
LBT base amount (in million Euro)	2.34	15.03	38.76	37.27
Share shifting sectors (in %)	8.78	11.39	68.15	20.24
Ratio sum pretax profits to wage sum (in %)	39.47	41.56	611.20	694.98
HHI LBT base	0.059	0.084	0.232	0.198
Fiscal variables (in per capita)				
Revenues	2173.77	1308.77	8555.47	5352.91
LBT revenue	454.78	1027.79	7094.52	5972.45
Expenditures	2129.78	1430.27	8200.72	5131.82
Investment	351.81	366.97	1012.59	962.47
Debt	852.09	1020.91	524.07	656.58
Demographic variables				
East Germany	0.19	0.39	0.69	0.47
Area (in km^2)	50.48	50.32	81.20	59.97
Population (in '000s)	14.70	70.06	13.18	9.30
Neighboring municipalities				
Population buffer (in '000s)	1370.46	1118.63	3272.14	1569.82
Average population (in '000s)	12.59	15.19	40.87	28.90
LBT base amount (in million Euro)	243.63	251.93	568.71	343.00
Year-municipality-observations	36442		51	
Unique Municipalities	6504		9	

Note: The table depicts the summary statistics of the municipalities contained in the estimation sample. The mean and standard deviation of each variable is stated separately for the group of non-haven municipalities and the local tax havens. The estimation sample covers the years between 2013 and 2019 and contains municipality-year observations that provide information on all relevant variables (see Equation 5). The group of neighboring municipalities includes all municipalities within a thirty-kilometer radius around the jurisdiction.

3.3 The Emergence of a Local Tax Haven

Monheim am Rhein is one of 396 municipalities belonging to the most populous state of Germany, North Rhine-Westphalia. The municipality is located in between *Düsseldorf*, *Cologne*, and *Leverkusen* (see Figure B5). The first two cities are Germany's fourth and seventh largest cities. *Leverkusen* is mainly known because the headquarter of the *Bayer AG* is located there. Before 2012, *Monheim* can be described as "average" when compared with the other municipalities of the state. Its LBT rate is around fifteen percent, a bit higher than the state's average, while the LBT base amount is just below the state's average (Table 2). The municipal population, revenues, and expenditures are similar to those of the average municipality, while the debt per capita is around one thousand Euros higher than the average.

In the fall of 2009, *Monheim* elected a 27-year-old mayor — the youngest in the state — who strongly advocated for drastically reducing the LBT rate. In 2012, the municipal council of *Monheim* cut the LBT rate from 15.225% to 10.5%, making it the lowest LBT rate in the whole state (see Figure 4). The reduction in the LBT rate was followed by smaller tax cuts in the subsequent years so that the LBT rate reached 8.75% in 2018. The low LBT rate in *Monheim* is not only substantial when compared with the state average (15.799%), but especially large when compared with the neighboring cities of *Cologne* (16.625%), *Düsseldorf* (15.4%) and *Leverkusen* (16.625%, all in 2019). After the LBT cut, the municipality's LBT base increased rapidly, while real economic activity in the city increased more modest.[20] The municipality became Germany's most important local tax haven. In Section 5.2, I estimate how much of this increase in corporate profits can be attributed to profit shifting.

Looking closer at the firms founded in or moved to *Monheim* after the LBT cut reveals interesting patterns. By way of example, the *Bayer AG* moved many of its patents and trademarks to *Monheim* in 2012, where they have been managed by the *Bayer Intellectual Property GmbH* since then. Affiliates of the *Bayer AG* paid 2.1 billion Euros in royalty payments to *Bayer Intellectual Property GmbH* in 2019 alone. Two other of Germany's largest firms, *BASF SE* and *Henkel AG & Co. KGaA*, also moved their intellectual property managing subsidiaries (*BASF IP Licensing GmbH* and *Henkel IP Management and IC Services GmbH*) to the municipality. Drawing on information from the German Patent and Trademark Office (DPMA), it can be shown

[20] Figure B6 illustrates the development of the LBT base amount, employment, wage sum, and income in *Monheim* between 1998 and 2019. For better comparability, the time series are normalized relative to their 1998 values (i.e. 1998 = 100%).

Table 2: Monheim am Rhein and state averages (1998-2019)

	1998-2011		2012-2019	
	Monheim	State	Monheim	State
LBT rate and base				
LBT rate (in %)	15.23	14.66	9.60	15.47
LBT base amount (in million Euro)	5.19	5.62	98.53	6.52
Ratio pretax profits to wage sum (in %)	30.12	32.60	399.70	35.29
Fiscal variables (in per capita)				
Revenues	2323.42	2087.99	9939.24	2526.30
LBT revenue	499.27	416.44	6570.96	558.37
Expenditures	2349.54	2120.13	9440.11	2495.72
Payments intergovt. transfers	559.53	593.39	4589.89	752.03
Investment	234.14	222.85	637.01	198.38
Purchase financial assets	29.41	28.09	1544.65	48.67
Debt	2345.78	1341.02	400.56	1707.20
Demographic variables				
Area (in km^2)	23.11	86.07	23.05	86.14
Population (in '000s)	43.42	45.43	40.57	44.92
Year-municipality-observations	14	5544	8	3168
Unique Municipalities	1	396	1	396

Note: The table depicts the average value of chosen variables separately for the municipality *Monheim am Rhein* and the other municipalities located in the state of *North Rhine-Westphalia*. *Monheim am Rhein* is included in the state average. The average value is computed separately for the 1998 to 2011 (prior LBT cut) and the 2012 to 2019 (post LBT cut) period. Note that the payments to intergovernmental transfers, investment, and the purchase of financial assets are selected subcategories of the overall expenditures.

that in the years following the tax cut, hundreds of patents and trademarks were transferred to the municipality Figure B7. Around 78% of these intangible assets were relocated from the neighboring city *Leverkusen*. Inspecting the local commercial register reveals that firms operating in wealth and real estate management, e.g., holding companies, have become increasingly numerous after the tax cut. In 2011, less than ten percent of the firms located in *Monheim* are operating in this area; in 2019, more than forty-one percent are. Section 2.2 outlines that holding companies and real estate management, in particular, are popular ways to shift profits to local tax havens to benefit from the low LBT rate.[21]

The increase in *Monheim*'s LBT base is mirrored by a surge in its LBT revenues, indicating that *Monheim*'s LBT rate was on the right side of the Laffer Curve before the tax cut. In 2019, *Monheim* is by far the fiscally most affluent municipality in the state, with municipal revenues and expenditures (per capita) around double the size of the second-highest municipality. The public debt level has decreased rapidly after the tax reform, while public investment has increased steadily. Public transportation, as well as childcare, have become free in *Monheim*. In this sense, *Monheim* may be described as a local "fiscal paradise" (Hines & Rice, 1994, p. 149) that became a "service paradise" (Agrawal, 2024, p. 8) due to the high LBT base, which moved within its boundaries after the tax cut. The stark increase in local public services is also mirrored in the incumbents' voting results, while receiving around 30% of the votes for his first term, the mayor received just below 95% of the votes in his second election in 2014 (**?**). Although public services increased substantially, population and migration statistics do not indicate that the jurisdiction attracted many new residents compared to the state's other municipalities (see Figure B8). Similarly, the income of the municipality's residents and the number of unemployed do not show any clear deviation from the state's time trend (see Figure B9). These findings indicate that residents are affected by the emergence of a local tax haven mainly through the effect on municipal public spending.

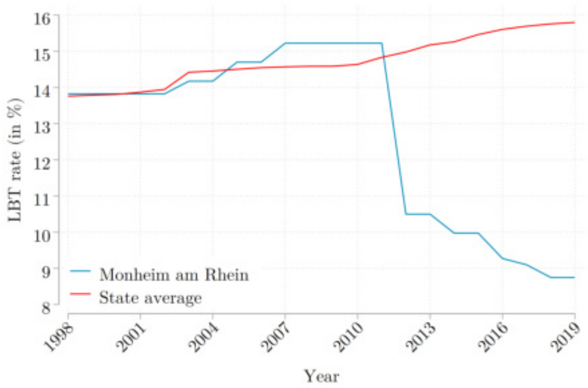
4 Data

I draw on various public and proprietary administrative data sources as part of the project. In the following, I will present the various data sources before explaining the restrictions applied to

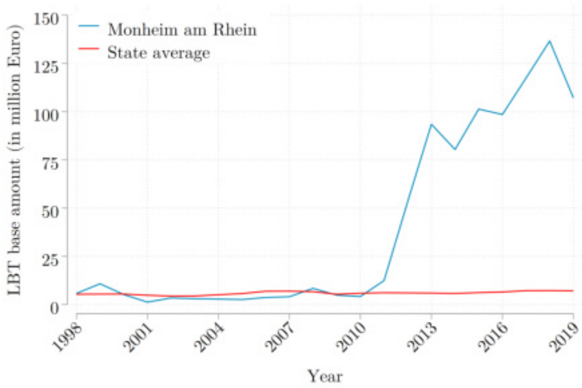
[21] Figure B10 shows exemplary pictures of business addresses where some holding and real estate management companies are registered. Many of these firms may be classified as letterbox firms, similar to shell companies in the international context.

Figure 4: Monheim am Rhein

(a) Local business tax rate



(b) Local business tax base amount



Note: The left panel illustrates the development of the local business tax (LBT) rate in Monheim as well as the state average between 1998 and 2019. For simplification, the LBT rate is computed by multiplying the LBT multiplier by 3.5 for the whole period of observation. The right panel illustrates the development of the LBT base amounts (in million Euros).

the estimation dataset I use for the subsequent empirical estimations.

Local Business Tax Statistic (*Gewerbesteuerstatistik*): This administrative data source contains the population of firms subject to the German LBT for which an LBT assessment amount was determined for the respective reporting year. The local Business Tax Statistic provides information on the firm's location, legal form, sector, and pretax profits. The pretax profits are non-negative. Profits of firms with establishments in several municipalities are allocated to the individual municipalities based on the total wages paid in the respective municipality. The data is available every three years between 1995 and 2007 and annually starting from 2010. The individual observation years can be linked to a panel using a firm's tax number.[22]

Business-Tax-Panel (BTP): The BTP combines administrative information on firms' income and sales tax payments in Germany from many tax statistics (Kristiansen, 2023). Most notably, the BTP provides information on a firm's annual sales of goods and services, equity, location, and sector. In the BTP, the tax numbers from various tax statistics and the commercial register entry are used to merge the different statistics. Using the tax identifier, the BTP can be directly linked to the LBT Statistic. The dataset is available annually between 2013 and 2019.

Establishment History Panel (BHP) (*Betriebs-Historik-Panel*): The BHP contains all establishments with at least one employee liable to social security. The dataset provides establishment-level information on location, sector, and the number of employees liable to social

[22] A firm located in Germany will be assigned to a new tax number if it changes the municipality. Consequently, the Local Business Tax Statistic does not provide information if a new firm was actually founded in the municipality or if it moved there from another municipality. Similarly, the data cannot distinguish between the closure of a firm and a firm moving to another municipality.

security and marginal part-time employees. Additionally, the data set contains information on average daily wages paid within an establishment. I use the BHP data to compute the annual sum of wages paid at the *sector* $\times$ *municipality* $\times$ *year* level. The data is provided by the Institute for Employment Research (IAB) and available annually from 1975 up until today.

Local Public Finance Data: This data set contains information on municipalities' revenues, expenditures, debt, and local tax rates. Revenues can be split into subcategories, most importantly the LBT revenues. The data distinguishes between different kinds of municipal expenditures, e.g., personnel expenses and investment. The dataset also provides information on the municipal LBT base amount, which can be used to compute a proxy variable for the sum of firms' profits taxed in a specific municipality in a given year (see Section 2.1). I divide all revenue and expenditure variables by the municipality's population count to ease comparison between municipalities of different sizes. The data set is provided by the Statistical Offices of Germany (*Statistische Landesämter*) and is available annually from 1998 to 2019.

Commercial Register (*Handelsregister*): The commercial register is a public directory where businesses are officially recorded. The register is managed by the local district courts (*Amtsgericht*). All corporations (*Kapitalgesellschaften*) must register in the local commercial register. Partnerships (*Personengesellschaften*) are subject to registration depending on the type and scope of their commercial business operations. The commercial register provides legal and financial information about local firms and promotes transparency in business dealings. The register contains information on a firm's name, business address, legal form, and objective. Importantly, changes in the business address can be used to track firm movements across municipal borders. The owner states the firm's objective as a free text, often consisting of several sentences or paragraphs. Thus, the obtained information is considerably more detailed when compared to other data sources, which contain only information on a firm's sector of operation. I use the commercial register for the period 2010 to 2019.[23]

Orbis: The Orbis data aggregate information on global companies sourced from official filings, government registers, regulatory disclosures, and media reports. They encompass a wide range of data, including financial statements, ownership structures, and performance metrics for both public and private enterprises. Most importantly, I will use the information on corporate ownership structure to identify the parent companies of tax haven subsidiaries. The financial

[23]The commercial register has been completely digital since January 1, 2007, while its information can be accessed free of charge since August 1, 2022. I use a version of the commercial register which has been scraped and preprocessed by the Open Knowledge Foundation Deutschland e.V.

services provider *Moody's Corporation* provides the data.

Other Data: I supplement the outlined data sources by adding annual information on municipalities' population, income (*Lohn- und Einkommensteuerstatistik*), migration across municipal borders (*Wanderungsstatistik*), as well as the gross domestic product on the district level. The Statistical Offices of Germany provide all the information. The German Federal Employment Agency (*Bundesagentur für Arbeit*) provides information on the annual number of unemployed on the municipality level. The German Patent and Trademark Office (DPMA) provides information about patent and trademark holders as well as the holders' business location. Finally, information regarding the local housing market is taken from Ahlfeldt et al. (2023).

Under current German data laws, it is not possible to link the firms included in the LBT Statistics with the firms included in the BHP.[24] I aggregate variables drawn from the LBT Statistic and BHP on the *sector* × *municipality* × *year* before computing my later estimations. Due to data availability, I restrict the data set for the main profit shifting estimation to the years 2013 to 2019.

5 Empirical Strategy

I deploy two different empirical strategies to quantify the amount of firms' profits shifted to local tax havens. First, I conduct a case study, exploiting a large tax reform in the city of *Monheim am Rhein*. The tax reform allows me to utilize the dynamic emergence of a local tax haven to quantify the degree of profit shifting taking place. Second, I estimate standard profit shifting equations on the *sector* × *municipality* × *year*. These estimations are conducted for all municipalities in the period 2013 to 2019.

5.1 Synthetic Difference-in-Differences

Monheim emerged as one of Germany's most important local tax havens following a large cut in the LBT rate in 2012. I deploy a synthetic difference-in-differences (SDID) estimator proposed by Arkhangelsky et al. (2021) to estimate the dynamic effect of becoming a tax haven on shifted profits.[25] The SDID estimator estimates the average treatment effect of the treated by solving

[24] To be more specific, the German Federal Statistics Law (*Bundesstatistikgesetz*) §13a Nr.4, does not allow the linkage of other data sources to the administrative tax microdata if the linked data source is not freely accessible. The microdata of the social security system, e.g., the BHP, is only accessible to researchers. Therefore, it cannot be linked to the tax microdata.

[25] The computational implementation of the SDID estimator in Stata is based on the *sdid* command provided by Clarke et al. (2023). The event study extension *sdid_event* is outlined and implemented in Stata by Ciccia

the following optimization problem:

$$\left(\hat{\tau}^{sdid}, \hat{\mu}, \hat{\alpha}, \hat{\gamma}\right) = \arg\min_{\tau,\mu,\alpha,\gamma} \left\{ \sum_{m=1}^{M} \sum_{t=1}^{T} \left(\Pi_{mt} - \mu - \alpha_m - \gamma_t - W_{mt}\tau\right)^2 \hat{\omega}_m^{sdid} \hat{\lambda}_t^{sdid} \right\} \tag{2}$$

where Π_{mt} denotes the ratio of LBT base amount to the overall wage sum in municipality $m \in \{1, ..., M\}$ in year $t \in \{1, ..., T\}$, i.e. $\Pi_{mt} = \frac{\text{sum of pretax profits}_{mt}}{\text{wage sum}_{mt}}$. $W_{mt} \in \{0, 1\}$ denotes the binary treatment indicator. In our specific case, W_{mt} equals zero for all municipalities in all years except for *Monheim*. W_{mt} equals zero for *Monheim* before the 2012 LBT reform and one afterward.[26] Similar to standard synthetic control (SC) estimators (Abadie et al., 2010), the SDID estimator uses unit weights ω_m^{sdid} to match pre-treatment outcomes of the dependent variable Π_{mt} between the untreated municipalities and the treated. Arkhangelsky et al. (2021) allow for an intercept term when computing the SDID unit weights. Thus, the SDID estimator allows for more flexibility by matching pre-treatment outcomes of the treated and untreated units in trends, compared to Abadie et al. (2010) SC estimator, which matches the two groups in levels. Besides unit weights, the SDID estimator utilizes time weights λ_t^{sdid} to balance pre- and post-treatment periods for the untreated municipalities. α_m and γ_t capture municipality and year fixed effects, respectively. In the following, we assume that the first M_{co} (control) units are never treated, while the last $M_{tr} = M - M_{co}$ (treated) units are treated from time T_{pre} onward.

Following Ciccia (2024), the SDID estimator can be disaggregated to estimate the dynamic treatment effect s periods after the tax reform as:

$$\hat{\tau}_s^{sdid} = \frac{1}{M_{tr}} \sum_{m=M_{co}+1}^{M} \Pi_{ms} - \sum_{m=1}^{M_{co}} \hat{\omega}_m^{sdid} \Pi_{ms} - \sum_{t=1}^{T_{pre}} \left(\frac{1}{M_{tr}} \sum_{m=M_{co}+1}^{M} \hat{\lambda}_t^{sdid} \Pi_{mt} - \sum_{m=1}^{M_{co}} \hat{\omega}_m^{sdid} \hat{\lambda}_t^{sdid} \Pi_{mt} \right) \tag{3}$$

In our specific application we only have one treated unit (*Monheim*), so that the estimator can be stated as:

$$\hat{\tau}_s^{sdid} = \Pi_{Ms} - \sum_{m=1}^{M-1} \hat{\omega}_m^{sdid} \Pi_{ms} - \sum_{t=1}^{T_{pre}} \left(\hat{\lambda}_t^{sdid} \Pi_{Mt} - \sum_{m=1}^{M_{co}-1} \hat{\omega}_m^{sdid} \hat{\lambda}_t^{sdid} \Pi_{mt} \right) \tag{4}$$

The foregoing estimator predicts the causal effect of becoming a tax haven on the profits-to-wages ratio in *Monheim*. The amount of shifted profits to *Monheim* in post period s can be

(2024). I follow the notation of Arkhangelsky et al. (2021) while outlining the SDID estimator.

[26] Note that the SDID imposes two general conditions on the population of treated and untreated units: First, the estimator requires that being treated is an absorbing state, i.e. there are no treated units which switch back to being untreated. Second, always treated units cannot be incorporated in the SDID estimator. The second condition is the same for all synthetic control methods, which explicitly impose at least one pre-treatment period for each treated unit.

retrieved by computing the counterfactual profits as $(\Pi_{Ms} - \hat{\tau}_s^{sdid}) \cdot \text{wage sum}_{Ms}$ and subtracting it from the observed profits Π_{Ms}. I argue that the development of the profits-to-wages ratio in the constructed synthetic control is a good reference point to assess what share of the observed profits in *Monheim* are based on profit shifting.[27]

5.2 Profit Shifting Estimation

In this section, I present the empirical equation used to estimate profit shifting to local tax havens. The goal is to quantify excess profits in local tax havens — specifically, profits that cannot be explained by real economic activity. The following log-linear equation is estimated at the sector-municipality-year level:

$$log(\pi_{smt}) = \beta_0 + \beta_1 Haven_{mt} + \gamma Sector_{smt} + \lambda Muni_{mt} + \mu_{st} + \rho_{f(m)} + \epsilon_{smt} \quad (5)$$

where π_{smt} denotes the logarithm of pretax profits in sector s in municipality m in year t. $Haven_{mt}$ is a binary variable equal to one if municipality m is classified as a local tax haven in year t, and zero otherwise. $Sector_{smt}$ is a vector of sector-municipality-year variables, including the sum of wages and value of sales for sector s in municipality m in year t. Vector $Muni_{mt}$ is a vector of time-variant, municipality-specific variables such as population numbers or the district's annual gross domestic product. μ_{st} captures *sector* × *year* fixed effects. Thus, we compare similar sectors within the same year and control for any common sector-level shock, e.g. nationwide demand shocks for the goods or services of a specific sector. Finally, $\rho_{f(m)}$ and ϵ_{smt} denote state-fixed effects and the error term, respectively. β_1 is our coefficient of interest and allows us to quantify excess profits in tax havens.

One can think of several reasons why $\hat{\beta}_1$ may be a biased and inconsistent estimate of β_1. First, if the most productive firms decide to locate in local tax havens, our estimate of β_1 would be upward biased. The outlined estimation equation includes *sector* × *year* fixed effects, capturing the possible selection bias arising from firms in particularly profitable sectors located in tax havens. I also control the annual wage sum and sales at the *sector* × *municipality* × *year* level. Thus, the concern mentioned above would require holding annual labor cost and sales at the sector level constant; firms located in a local tax haven are more productive than firms in the

[27] This procedure is similar in spirit to Tørsløv et al. (2023), who estimate the amount of profits shifted by comparing the profits-to-employee compensation ratios of foreign firms and local firms, both located in international tax havens. They argue that local firms are a good reference point to evaluate the shifted profits of multinational affiliates in tax havens.

same sector in another municipality.

Second, the relationship between firms' profits and being located in a tax haven may be affected by reverse causality. It is possible that firms with high profits were already located in a municipality, even before it became a local tax haven. The large LBT base may enable a municipality to cut its LBT rate so that it is classified as a tax haven in the dataset. I provide evidence that in the case study of *Monheim*, the large tax cut took precedence over the rapid rise in firms' profits. I show that the increase in firms' profits is completely driven by new firms, which were not present in the municipality before the tax cut.

Third, a general concern arises from possible misclassification of local tax havens $Haven_{mt}$. Misclassification of the independent variable $Haven_{mt}$ leads to a non-classical measurement error of the binary regressor. Assuming homogeneous treatment effects and independence between the unobserved measurement error and the estimation equation's error term, Aigner (1973) and Bollinger (1996) show that the estimate $\hat{\beta}_1$ is biased towards zero (attenuation bias). Thus, the estimated coefficient should be interpreted as a lower bound under these assumptions. Section A4 gives a detailed explanation about the likelihood of misclassifying non-haven municipalities as local tax havens (false positives) and local tax havens as non-haven municipalities (false negatives). The corresponding effect on the estimated coefficient and profit shifting estimations are discussed.

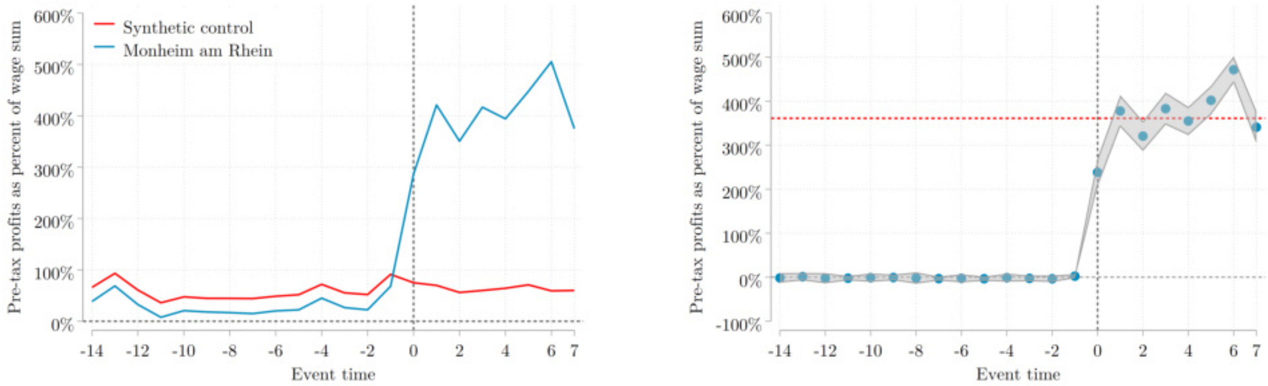
6 Results

6.1 Synthetic Difference-in-Differences

Figure 5 illustrates the dynamic SDID estimates for the effect of *Monheim*'s LBT tax cut in 2012 on the ratio of pretax profits to wage sum. The left panel depicts the dependent variable for the treated and its synthetic twin. The synthetic control captures the development of the dependent variable well before the tax cut, before the two time series diverge strongly starting in the year of the tax cut. The right panel plots the difference between *Monheim* and the synthetic control group. The difference is normalized to one year before the tax cut. The gray area plots the 95% confidence interval using 1000 placebo simulations. The synthetic DiD estimate (red dashed line) shows that the profit-to-wage ratio in the treated municipality increases by around 361 percentage points compared to the control. The dynamic effects reveal that the effect is present even in the first year of the tax cut, indicating that firms were well informed about the policy change in *Monheim*. The shifted profits can be computed as the difference between actual

Figure 5: Ratio pretax profits and wage sum

(a) Monheim and its synthetic control (b) SDID estimation



Note: The left panel illustrates the development of the ratio of pretax profits to wage sum in *Monheim* and its synthetic control. The right panel illustrates the dynamic SDID estimates deploying the ratio of pretax profits to wage sum as the dependent variable. The red dashed line depicts the static SDID estimate. Event time zero corresponds to year 2012. The gray lines depict the 95% confidence intervals based on 1000 placebo simulations.

and counterfactual profits. For each period, counterfactual profits are calculated as the product of the wage sum and the difference between the estimated, dynamic treatment effect and the actual profits-to-wage ratio observed for the treated unit. Based on the estimates, around 20.5 billion Euros of corporate profits were shifted to *Monheim* between 2012 and 2019, making up roughly 90% of the observed municipal profits.[28]

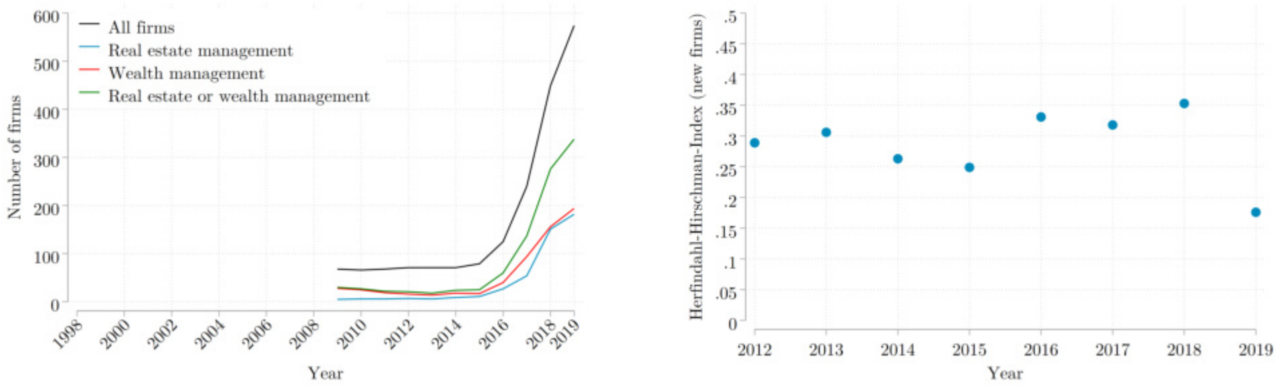
The left panel of Figure 6 depicts the number of firms listed in the commercial register of *Monheim* between 2009 and 2019. One can see that the number of firms stays relatively constant between 2009 and 2015 before steeply increasing starting at 2016. We observed the increase in the municipality's LBT base already in 2012, which is the year of the tax cut. Hence, the municipal LBT base increase is driven by only a small number of firms. Classifying the firms by their business objectives reveals that the rise in the number of firms after 2015 is to a large share explained by an increase in firms that operate in the area of real estate or wealth management. Section 2.2 explained how subsidiaries offering these two types of business services can be used to shift profits to low-tax municipalities.

The right panel illustrates the Hirschman-Herfindahl-Index (HHI) for the profits of firms that moved to or were founded in the municipality after the LBT tax cut. The HHI fluctuates around 0.3, indicating that the shifted profits are highly concentrated among a small number of

[28]Estimating Equation 5 while only including *Monheim* from the set of local tax havens yields similar results. This approach relies on cross-sectional variation, while controlling for real economic activity at the sector-municipality-year level. The estimation results of Table C1 indicate that between 2013 and 2019 shifted profits account for just above 91% of the corporate profits taxed in the municipality.

Figure 6: Concentration of shifted profits

(a) Number of firms by objective (b) HHI index pretax profits of new firms



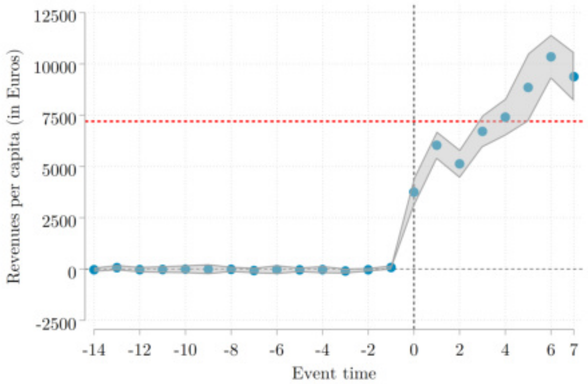
Note: The left panel illustrates the development of number of firms contained in the commercial register and located in *Monheim* between 2009 and 2019. The overall number of firms (black line) is also split by their business objective, distinguishing between real estate (blue line) and wealth management (red line). The right panel illustrates the Herfindahl-Hirschman-Index of new firms' profits between 2012 and 2019. A firm is labeled as a new firm if it is located in *Monheim* in at least one year of the 2012 – 2019 period but was not located within *Monheim* in 2011.

firms, which began shifting profits to *Monheim* as early as 2012. An internal transcript of the city council meeting reveals that city officials contacted several firms in late 2011, informing them about a planned tax cut in 2012 (Stadt Monheim am Rhein, 2012). It is likely that said officials were talking especially to large firms in the nearby agglomeration area. This could explain the observed patterns of profit shifting.

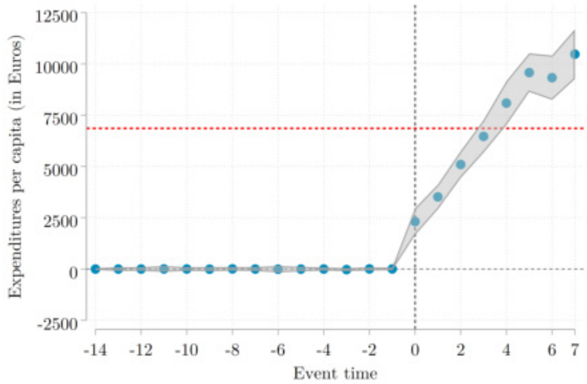
The large amount of corporate profits shifted to *Monheim* positively affects the municipalities' public finances. The upper left panel of Figure 7 illustrates the positive effect of the tax cut on municipal revenues. The stark increase in revenues indicates that the municipality was on the right-hand side of the Laffer Curve before its tax cut. Note that the average of public revenues in the municipality was just above 2300 Euros per capita in the pre-treatment (1998-2011) period (Table 2), so that a revenue increase of roughly 10000 Euros per capita in the later years amounts to an increase of more than 400%. The upper right panel depicts the effect of municipal expenditures, which closely follow the development of public revenues. The left panel in the second row documents that around half of the increase in public expenditures is due to higher payments into intergovernmental transfer schemes, thus reducing the net fiscal benefit of becoming a local tax haven. The rise in public spending has led to an increase in local public investment and public services. For example, childcare in the municipality has been free since 2014 and public transport has been free since spring 2020. This increase in public services is reflected by an increase in the public budget's current expenses on personnel and material (Figure B12). The

Figure 7: Public finances

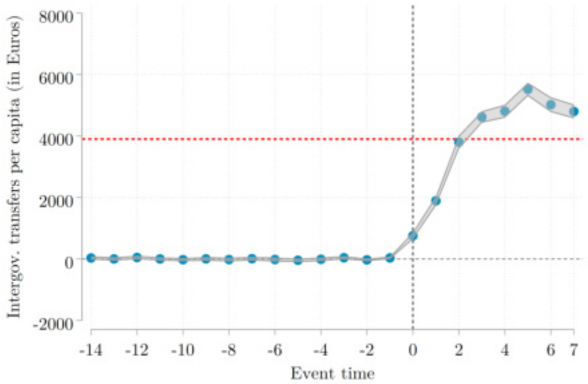
(a) Revenues



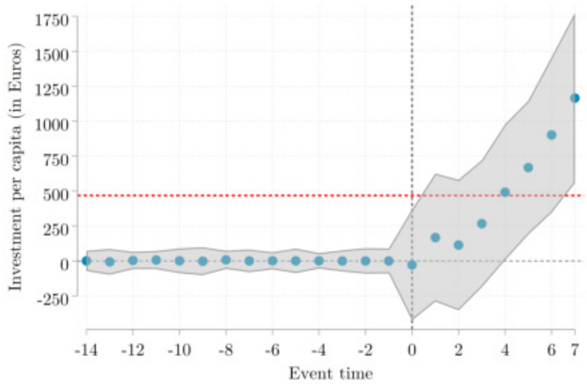
(b) Expenditures



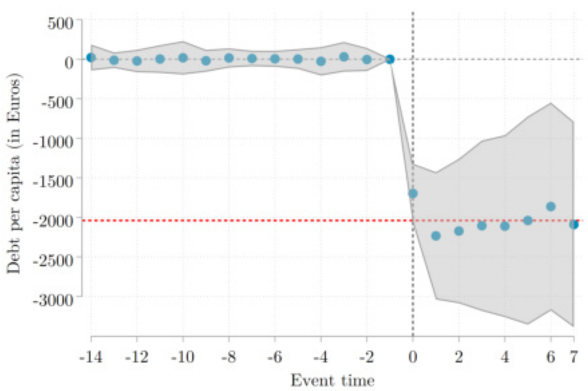
(c) Payment to intergovernmental transfer



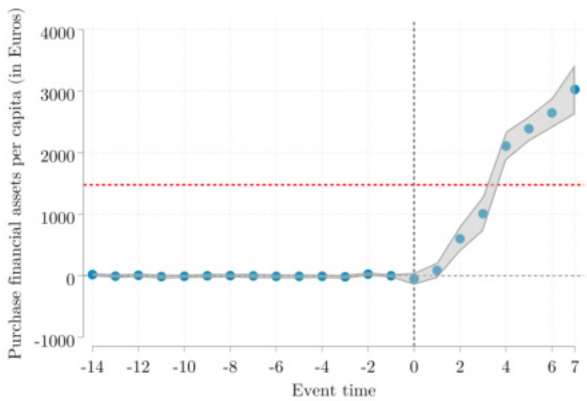
(d) Investment



(e) Debt



(f) Purchase of financial assets



Note: The figure illustrates the dynamic SDID estimates deploying municipal revenues, expenditures, payments to intergovernmental transfer schemes, investment, debt, and purchase of financial assets as the dependent variables. The red dashed line depicts the static SDID estimate. All variables are depicted in Euros per capita. Event time zero corresponds to the year 2012. The gray lines depict the 95% confidence intervals based on 1000 placebo simulations. The raw time series for Monheim and the constructed synthetic control are illustrated in Figure B11.

lower left panel shows how the LBT cut affects the public debt level. The municipality used the increase in tax revenues to drastically reduce its debt level, becoming debt-free one year after the tax cut. Additionally, the local government has spent an increasing amount on the purchase of financial assets, thereby building up reserves for financing future spending. The estimation results do not find that the increase in local public services and investment leads to a rise in the population or net migration of the municipality (Figure B13). On the other hand, we find a positive effect on house prices in the municipality and no statistically significant effect on rent prices (Figure B14). The results regarding the housing market should be treated with caution, as the estimates made are quite noisy since the housing data are only available for a short pre period.[29]

The presented results are robust to (1) backdating the treatment year and (2) restricting the set of donor units (Figure B16). First, I artificially moved the treatment year six years before the actual treatment year. The results show that the synthetic control closely tracks the treated unit development of the profit-to-wage sum ratio before diverging in period six, i.e., the year when the actual treatment occurred. Second, I drop all municipalities within a thirty-kilometer radius around the treated unit as those municipalities are likely to host many corporations that start shifting their profits to *Monheim* after the LBT cut. The presented results do not change when applying the two robustness checks.

Finally, the local government of Monheim cut its property tax (*Grundsteuer B*) simultaneously with the LBT rate. Suppose a firm's profit shifting decision is positively affected by the cut in the property tax rate. In that case, our outlined estimator may overestimate the effect of becoming a local business tax haven on shifted profits (see Baker et al., 2025). The foregoing argument is unlikely in the context of local taxation in Germany. The overall property tax revenue in Monheim decreased between 2011 and 2012 by less than one million Euros, about one hundred Euros per building in the municipality (Figure B17). These potential property tax savings are negligible compared to the hundreds of millions saved due to the LBT rate cut.

6.2 Aggregate Profit Shifting Estimation

Table 3 shows the estimation results of Equation 5. The first column shows that when including only state×year and sector×year fixed effects, sectors in local tax havens have around

[29]Turning to possible tax competition effects, the results in Figure B15 indicate that seven years after the tax cut the LBT rate in municipalities close to *Monheim* is around two percent lower than in a suitable control group.

Table 3: Profit shifting to local tax havens (2013-2019)

	(1)	(2)	(3)
Tax haven	2.859	2.688	2.514
	(0.462)	(0.417)	(0.321)
State × Year FE	Yes	Yes	Yes
Sector × Year FE	Yes	Yes	Yes
Sector × Municipality × Year variables	No	Yes	Yes
Municipality × Year variables	No	No	Yes
Sectors	10	10	10
Municipalities	6509	6509	6509
Observations	338465	338465	338465

Note: The table depicts the estimation results of Equation 5. The dependent variable is the log of the sum of pretax profits at the sector×municipality×year level. The tax haven variable is a binary indicator, taking on the value one if, in a given year, the municipality is classified as a local tax haven and zero otherwise. The sector×municipality×year covariates include the wage sum, the value of sales, and equity. The municipality×year covariates contain the municipality's population and the gross domestic product on the district level. All of the foregoing covariates are included as a second-order polynomial. Standard errors are clustered at the municipality level and stated in parentheses.

2.859 log points higher profits than those in non-havens.The effect declines when we add sector×municipality×year (column 2) and municipality×year (column 3) covariates. The first-mentioned variables control for the economic size of a sector in a municipality in a given year by including the wage sum, the value of sales, and equity. The municipality×year contains the municipality's population and the gross domestic product on the district level. All sector×municipality×year and municipality×year are included as a second-order polynomial. After controlling for the outlined economic and demographic characteristics, profits in local tax havens are around 2.514 log points ($\approx$ 1135%) higher than in non-haven municipalities. Based on that, I calculate the counterfactual, that is the amount of corporate profits we would expect to observe in local tax havens in the absence of profit shifting, by dividing the observed profits taxed in local havens by $e^{\hat{\beta}_1}$.[30] Shifted profits are computed as the difference between observed profits and the counterfactual. Between 2013 and 2019, around 52 billion of profits got shifted to local tax havens, constituting roughly 92% of all taxable profits in local tax havens.

In the following, the static, cross-sectional estimates are supplemented by a dynamic event study approach. Seven of the nine local tax havens identified in our estimation sample experienced

[30] This procedure is similar to Fuest et al. (2022) who utilize the linear approximation $1 + \hat{\beta}_1$ instead of $e^{\hat{\beta}_1}$ to calculate the counterfactual. I do not use the linear approximation as the estimated coefficient $\hat{\beta}_1$ is relatively large. Thus, the linear approximation would lead to an underestimation of the actual amount of profit shifting.

a sizable LBT cut during our period of observation.[31] Define a large LBT cut as a reduction of the LBT multiplier by at least 30 basis points.[32] We focus on tax changes between 2003 and 2019, so there are at least five periods before the tax cut occurs. Figure 8 depicts the dynamic SDID around the first large LBT cut observed for each of the seven local tax havens. The dependent variable is the ratio of pretax profits to wage sum. The donor pool includes all municipalities that did not have a large LBT cut over this time period. Periods with an absolute distance of at least five years to event time zero are binned together.

Figure 8a illustrates the development of the ratio of pretax profits to wage sum for the local tax havens and the constructed synthetic control. Both groups share a similar time trend in the pre period. After the tax cut, we document a strong increase in the profitability in local tax havens. The blue markers in Figure 8b depicts the dynamic SDID estimates. The profit-to-wage ratio increases in the four post periods, before leveling around 690% in the long run. Based on these estimates, I deploy the same procedure as in the case study, to predict the shifted profits as the difference between observed profits and the counterfactual profits, that would be expected to be observed if the treated units would follow to same profitability development as the synthetic control. The annual amount of shifted profits amounts to more than 0.8 billion Euros per year in the long run. The overall amount of shifted profits can be computed by multiplying the point estimates by the number of treated. Thus, around 5.9 billion Euros are shifted annually to the seven included tax havens. In comparison, the cross sectional profit shifting estimates (Table 3) indicate that between 2013 to 2019 around 7.4 billion (52/7) Euros are annually shifted to all local tax havens.[33]

There are two reasons why the static approach is used as our main estimate of profit shifting and the corresponding fiscal cost. First, not all local tax havens experienced a tax cut in our period of observation. Thus, the dynamic approach may miss some relevant tax havens. Second, note that the average profit-to-wage ratio of the treated units before the tax cut is around 100%,

[31] Our period of observation ranges from 1998 to 2019. As many firm-level variables are only available for the 2013 to 2019 period, we restricted our main estimation sample for the cross-sectional analysis to this period. Most of the relevant tax cuts occurred before 2013, thus we deploy the same SDID approach as in the case study (Section 6.1) to quantify the dynamic effect of large tax cuts on profit shifting. This method only relies on information regarding a jurisdiction's LBT rate, LBT base, and wage sum, which is available for the entire observation period. The dynamic effect of a large tax cut on local tax havens' public finances is presented in Figure B18.

[32] Note that this approach aligns closely with Giroud & Rauh (2019), who focus on tax changes of at least 100 basis points. A reduction of the LBT multiplier by at least 30 basis points corresponds to a decrease in a corporation's LBT rate of at least 105 basis points, depending on the exact year of observation (see Section 2).

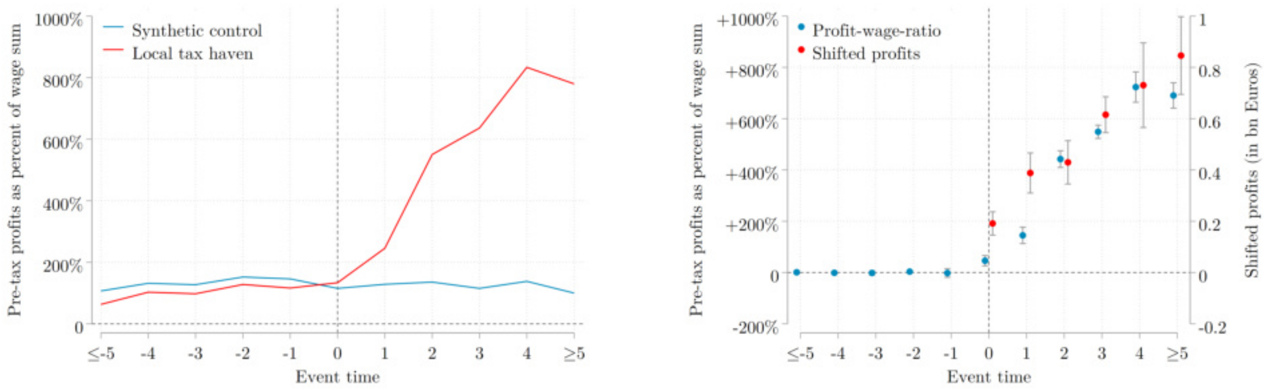
[33] Multiplying the dynamic long run effect by nine, i.e. extrapolating for the two local tax havens, that do not experience a large LBT cut in the period of observation, would predict that around 7.6 billion Euros of profits are shifted annually to local tax havens. This estimate aligns closely with the presented cross-sectional evidence.

which is substantially higher than for our estimation sample (see Table 1). These relatively high levels of profitability in some of the local tax havens in the pre period may indicate that some form of profit shifting was already happening before the tax cut. In the process of quantifying shifted profits, the dynamic approach assumes that in absence of treatment, the treated units profitability would follow the same time trend as the synthetic control. If part of the pre period tax base already contains shifted profits, the dynamic approach would underestimate the overall amount of shifting profits as it can only identify shifted profits moved to the jurisdiction after the observed tax cut.

Figure 8: Event study estimates (2003-2019)

(a) Treated and synthetic control

(b) SDID estimation



Note: The left panel illustrates the development of the ratio of pretax profits to wage sum in local tax havens and the synthetic control. The local tax havens had their first large LBT cut at event time zero. A large LBT cut is defined as a year-by-year reduction thirty basis points. The right panel illustrates the dynamic SDID estimates in red, deploying the ratio of pretax profits to wage sum as the dependent variable. The red markers indicate the predicted amount of shifted profits in the post-period based on the SDID estimates. The gray lines depict the 95% confidence intervals based on 1000 placebo simulations.

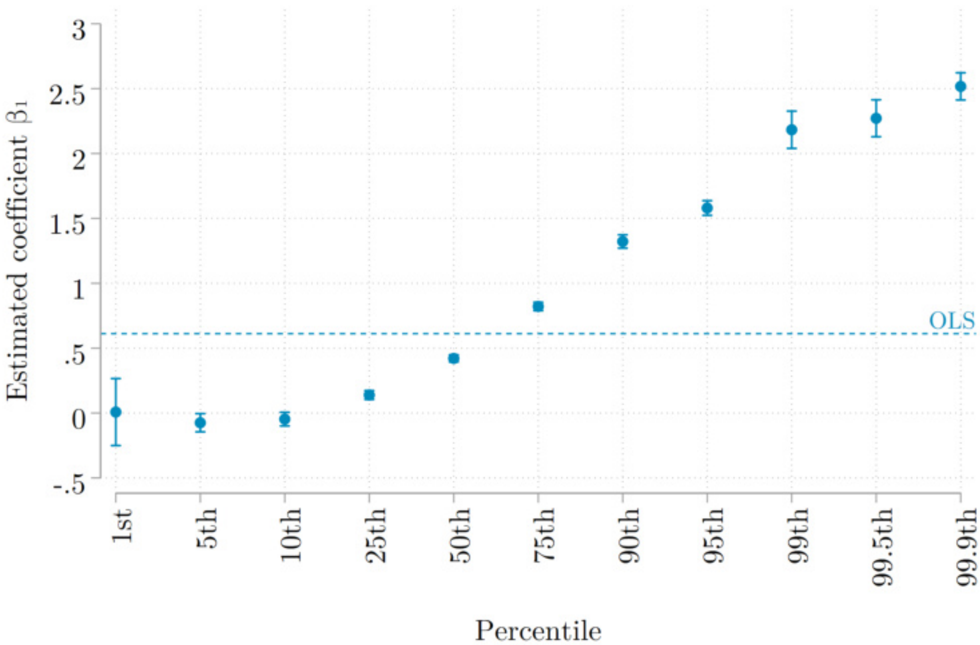
6.3 Heterogeneity

In this section, I will explore some of the heterogeneity underlying the presented aggregate results. Around 78% of the estimated amount of corporate profit shifting can be explained by profit shifting to the largest three local tax havens. Splitting by sectors, one can show that around 86% of shifted profits are due to firms operating in business and scientific services, information, finance- and insurance or real estate management. Finally, the estimated effect is mainly driven by relatively large firms shifting substantial amounts of corporate profits to local tax havens.[34]

[34]Section A9 presents an extension of the dynamic SDID approach to the overall sample of tax havens, utilizing large LBT cuts to estimate the effect of becoming a local tax haven on corporate profit shifting. Possible limitations of this approach are discussed.

Table C3 depicts the estimation results when including only the three largest local tax havens as tax havens. This subset of local tax havens contains around 74% of the overall LBT base taxed in local tax havens. The results indicate that around 78% of local profit shifting can be attributed to the three largest local tax havens. Splitting the estimation sample by sectors reveals that around 86% percent of local profit shifting can be attributed to firms operating in the areas of business and scientific services, information, finance, and insurance or real estate management.[35] This finding is in line with Neugebauer et al. (2020), who explain that subsidiaries offering the mentioned services can be used to shift corporate profits to low-tax jurisdictions.

Figure 9: Firm-level quantile regressions



Note: The figure depicts the results of Equation 5 estimated as a quantile regression on the firm-level. The dependent variable is the log of the firm's pretax profits at the firm×year level. The tax haven variable is a binary indicator, taking on the value one if, in a given year, the municipality is classified as a local tax haven and zero otherwise. The sector×municipality×year covariates include the wage sum. The municipality×year covariates contain the municipality's population and the gross domestic product on the district level. All of the foregoing covariates are included as a second-order polynomial.

Figure 9 illustrates the results of quantile regressions estimating Equation 5 at the firm level.[36] Focusing on the lower tail of the profit distribution, we can see that at the tenth percentile, the amount of corporate profits does not substantially differ between firms located in a local tax haven and those situated in non-haven municipalities. The two groups start to diverge at the first quartile. At the median, profits are around 0.339 log-points (≈ 40%) higher in tax haven

[35]The exact estimation results by a sector-by-sector split cannot be presented due to data confidentiality reasons.
[36]Due to data restrictions, the specifications on the firm level do not contain information on the values of sales and equity as this information is not available for all firms. A version of the figure containing only the subset of firms with information on all covariates is available upon request.

municipalities before steeply increasing at the upper tail of the distribution. Comparing the 90^{th}, 99^{th} and 99.9^{th} percentiles of the distribution of profits between firms located in tax havens and non-havens, we observe that firms located in tax havens have around 1.322 ($\approx 275\%$), 2.183 ($\approx 787\%$) and 2.517 ($\approx 1139\%$) log-points higher profits, respectively.

Similar to Wier & Erasmus (2023) and Clifford et al. (2025), the results show that profit shifting is especially prevalent among large firms, i.e., firms located at the right tail of the profit distribution. Fixed costs of profit shifting and shifting opportunities are two reasons that can explain the observed pattern. Large firms can absorb fixed profit shifting costs more easily. In addition, small firms usually do not own intellectual property like patents or trademarks, so certain opportunities for profit shifting only arise for firms with a minimal size. Estimating the log-linear profit shifting equation at the firm level would severely underestimate the overall amount of shifted profits. The OLS estimate at the firm level is around 0.486, well below the sector-level estimate. Section A10 outlines how the concave transformation of the dependent variable in the log-linear estimation model, combined with the stark concentration of profit shifting among a relatively small number of firms, can explain the divergence of micro and macro-level estimates.

6.4 Robustness

In this section, I examine the robustness of the outlined regression results with respect to various definitions of local tax havens, sample selection, specification of the functional form of the estimation equation, and placebo tests that randomly assign tax haven status to non-haven jurisdictions.

First, local tax haven status is based on a definition chosen by the researcher. Section A3 discusses different alternative definitions of a local tax haven and contrasts them with the in Section 3.1 outlined definition (main definition). A key advantage of the main definition is that it contains all of the large, well-established local tax havens, while the number of "other local tax havens" is small. I argue that municipalities in the set of "other local tax havens" may contain false positives. Consequently, we would expect the possible attenuation bias to be relatively low when applying the more conservative, main definition (see Section A4). The main definition of a local tax haven requires that a municipality must be a low-tax municipality with a high dependence on shifting sectors for at least three consecutive years, thereby qualifying it as a local tax haven. Reducing this threshold to two years (Table C5) or abolishing it completely

(Table C6) does not substantially change the estimated effects.

Second, our estimation sample contains all German municipalities without missing values for the variables in the estimation equation. Due to confidentiality reasons, the *Institute for Employment Research* (IAB) does not provide labor market information on municipalities with less than three firms at each *sector* × *municipality* × *year* cell. Very small municipalities are dropped from the estimation sample due to this restriction.[37] In 2019, these municipalities contain just below 7% of Germany's population and less than 4% of its LBT base. The estimated coefficient of interest gets a bit larger when the whole population of German municipalities is included (Table C4). This result can be based either on the changing sample composition or on the exclusion of the wage sum from the set of control variables, i.e. the specification without the wage sum probably is less good at controlling for real economic activity.

Third, the main estimation equation Equation 5 includes the LBT rate only implicitly due to its inclusion in the tax haven definition, but not implicitly as a further covariate. Table C7 shows that the estimation results do not change when including the LBT rate as a covariate that captures the general, linear relationship between the LBT base and its rate. In addition to the linear specification, I estimate a nonlinear specification of the profit equation by including a quadratic term for the LBT rate. This specification enables me to capture potential nonlinearity in the tax elasticity of corporate profits (see Dowd et al., 2017). The estimated coefficient becomes larger when including the second polynomial of the LBT rate (Table C8).

Finally, similar to Laffitte & Toubal (2022), I conduct a placebo test, by assigning tax haven status randomly to non-haven municipalities in the 2013 to 2019 estimation period. For each placebo run, I impose that the overall number of tax havens per year is identical to the number in the true estimation sample. Figure B19 illustrates the distribution of $\hat{\beta}_1$ based on $10,000$ place samples. The placebo distribution is approximately normally distributed, centered around zero with a median of 0.000. Around 95% of estimates can be placed between -0.401 and 0.372. This finding suggests that the absence of a notable effect in the placebo samples is due to the specific characteristics of the tax havens identified in our true estimation sample.

[37] Note that none of the local tax havens is affected by this restriction as all local tax havens host a relatively large number of firms within their jurisdiction. Thus, only small non-haven municipalities have dropped due to lacking municipal labor market information.

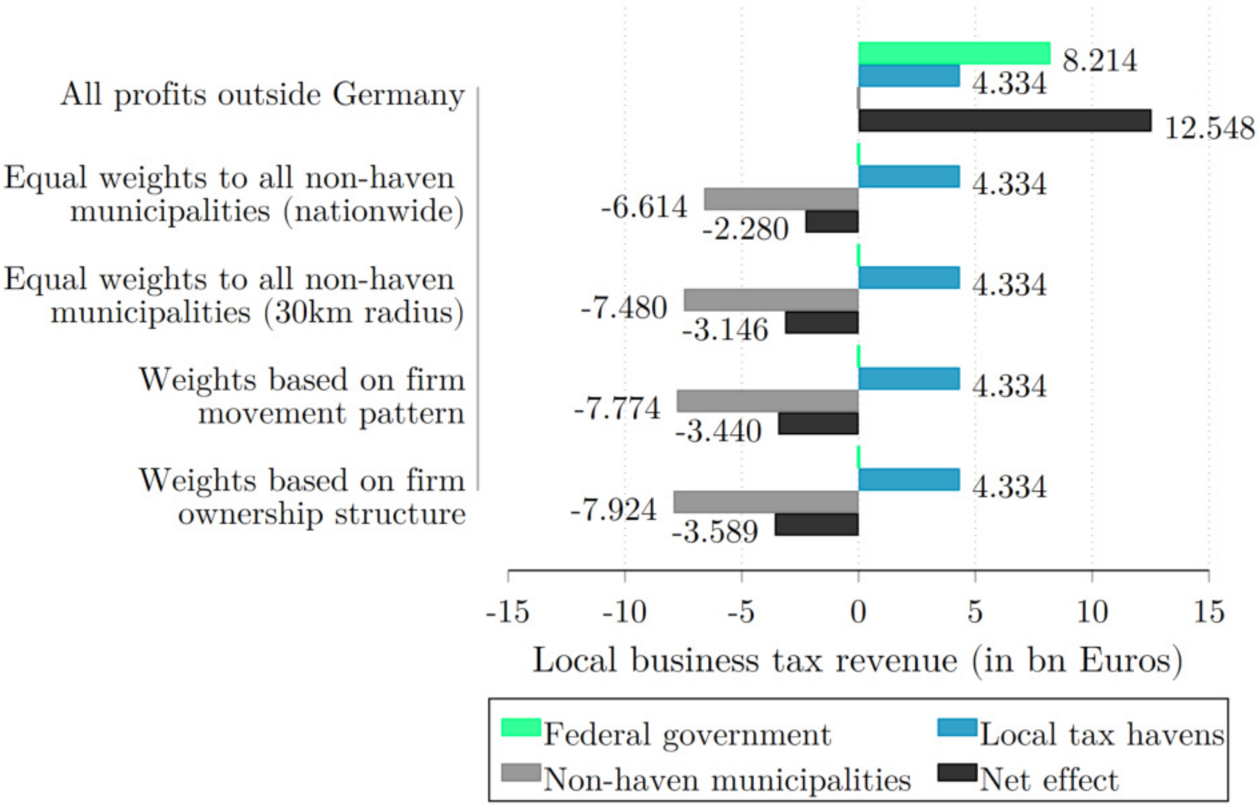
6.5 Fiscal Cost

In this section, I estimate the direct fiscal cost of profit shifting based on the foregoing estimation results. This exercise aims to assess where profits in local tax havens would have been taxed if they had not been relocated to these havens. Based on this, we can estimate the amount that non-havens lose due to local profit shifting and the aggregate net loss, i.e., the gain of tax havens minus the loss of non-havens. Note that the net loss coincides with the sum of tax savings of profit shifting firms before accruing any shifting costs. It is straightforward to estimate the direct fiscal gain of local tax havens by multiplying the amount of shifted profits by a weighted average LBT rate of the local tax havens, where the weights are determined by a local tax haven's LBT base. Between 2013 and 2019, local tax havens' LBT revenue increased by around 4.334 billion Euros due to profit shifting.

Figure 10 presents five different scenarios on how to estimate the counterfactual of where profits would have been taxed if they were not shifted to local tax havens. The first row assumes that in the absence of local tax havens, all shifted profits would have been taxed outside of Germany, e.g., in international tax havens. In this scenario, the federal government would gain 8.214 billion Euros as CIT revenue due to the attracted profits. The overall revenue gain would amount to 12.548 billion Euros. The first scenario does seem implausible for two main reasons. First, exit taxation, CFC rules, and higher shifting costs impede the use of cross-country profit shifting. Second, the case study on Germany's largest local tax haven revealed that the vast majority of the transferred intangible assets were located in other municipalities within Germany before being relocated to *Monheim* (Figure B7). If shifted profits are, in fact, moved from outside of Germany to local tax havens, one would assume that the intangible assets located there would also originate from abroad. The presented evidence suggests otherwise.

The second row presents a scenario where, in the absence of local tax havens, the shifted profits would have been equally distributed among all non-haven municipalities in Germany. Thus, the counterfactual LBT rate is the average LBT rate of non-haven municipalities in a given year. Based on that, non-haven municipalities lose around −6.614 billion due to local profit shifting, while the aggregate loss amounts to −2.280 billion. The third row presents a scenario where, in the absence of local tax havens, the shifted profits would have been equally distributed among all non-haven municipalities within a thirty-kilometer radius of a tax haven. Using this specification, the LBT loss of non-havens (net loss) amounts to −7.480 (−3.146) billion.

Figure 10: Fiscal cost of local profit shifting (2013-2019)



Note: The table depicts the estimated fiscal cost of local profit shifting. The rows on the left depict five different scenarios on where shifted profits would have been taxed if they were not moved to a local tax haven, and how to compute the counterfactual LBT rate, i.e., the rate with which the shifted profits would have been taxed if they had not been moved to a local business tax haven. (1) *All profits outside Germany*: Assumes that all profits taxed in local tax havens would otherwise be taxed outside of Germany. (2) *Equal weights to all non-haven municipalities (nationwide)*: Computes the counterfactual LBT rate as the average of all non-haven municipalities in a given year. (3) *Equal weights to all non-haven municipalities (30 km)*: Computes the counterfactual LBT rate as the average of all municipalities within a 30km radius of a local tax haven. (4) *Weights based on firm movement pattern*: Computes the counterfactual LBT rate as the weighted average of municipalities in which firms were located before they moved to a local tax haven. The weights are based on the number of firms that moved from a specific municipality to a tax haven. Firms' movement patterns are observed in the commercial register. (5) *Weights based on firm ownership structure*: Computes the counterfactual LBT as the weighted average of municipalities in which the ultimate parent companies of firms that are registered in a local tax haven are located. The weights are based on the number of tax haven parent companies in a specific municipality. Firms' ownership structure is observed in the Orbis database for the years 2017 to 2019.

The administrative corporate tax return data does neither provide information on firms' movement across municipalities nor about the ownership relations of a firm located in a local tax haven. Row four draws on information provided by the commercial register. Although we cannot directly link a specific firm from the commercial register to the administrative tax data, the movement patterns detected in the commercial register provide us with some general insight into where firms in tax havens have been located before relocating to a haven. In this specification, the counterfactual LBT rate is computed as a weighted average of the LBT rates of municipalities that hosted firms that moved to a local tax haven. The weight is based on the number of firms that move from a specific municipality. For example, the LBT rate of the city of Munich receives a higher weight if many firms relocate from Munich to one of the nearby tax havens. Non-haven municipalities lose around −7.774 billion, while the net loss is estimated at around −3.440 billion.

Finally, the fifth row assumes that in the absence of local tax havens, shifted profits would have been taxed at the location of a corporation's headquarters. I use the Orbis database to link firms located in a local tax haven with their direct or ultimate parent if at least one of the two is located in a German municipality. The counterfactual LBT rate is then computed as the weighted LBT rate of the municipalities where the parent companies are located. The weights are based on the number of parent companies in a specific municipality. The LBT loss of non-havens is predicted to be −7.924 billion, and the corresponding net loss is −3.589 billion.

7 Discussion

In this section, I compare the estimated amount and fiscal cost of local profit shifting to estimates from the international profit shifting literature. Second, I propose a supplement to the current formula apportionment rules, which will effectively address the profit shifting of the most aggressive firms. This addition would expand specific regulations from CFC rules to the sub-national context. Third, I explore several reasons why we do not observe more local tax havens. Finally, I discuss several limitations of this paper and outline directions for future research on the topic of local tax havens.

Magnitude of profit shifting: The foregoing results show that between 2013 and 2019, around 52 billion of profits got shifted to local tax havens in Germany, constituting roughly 92% of all taxable profits in local tax havens and around 1.8% of nationwide profits. Fuest et al. (2022) use Country-by-Country Reporting (CbCR) and find that in the years 2016 and 2017, large German MNCs shift annually around 5.4 billion Euros in profits out of Germany. These internationally shifted profits lead to an annual CIT loss of around 0.8 billion and an LBT loss of an additional 0.8 billion. Drawing on administrative microdata, Clifford et al. (2025) estimate that German MNCs shift around 19 billion Euros to international tax havens in 2022. The corresponding direct fiscal loss would amount to a reduction of CIT and LBT revenue of around 2.9 billion Euros each. Our estimates indicate that annually, around 7 to 8 billion in corporate profits are shifted to local tax havens in Germany. Local shifting does not lead to a CIT revenue loss, as the CIT is applied at the federal level. Local profit shifting leads to an annual net loss of LBT revenues of around 0.5 billion. This number masks a large redistribution of LBT revenues among non-havens and local tax havens. Non-haven municipalities lose more than 1.1 billion annually in tax revenue due to local profit shifting.[38] The high concentration of profit shifting due to a small number of companies implies that the costs for the non-haven municipalities are also concentrated, namely in a few cities that host the headquarters of the large profit shifting firms. The results show that local profit shifting and the corresponding fiscal cost are sizeable, even when compared with international profit shifting. Section A3 outlines that the chosen main definition of a local tax haven is relatively conservative. By way of example, classifying *Monheim* as a local tax haven already starting in 2012 increases the amount of shifted profits between 2013 and 2019 by a further 7.2 billion.

Policy implications: Many policymakers are concerned about profit shifting because it entails that the place of taxation no longer corresponds to the place of actual economic activity and value creation (e.g. CDU/CSU & SPD, 2025). Municipalities where the actual economic activity occurs lose hundreds of millions in local tax revenues, likely resulting in lower levels of public goods and services in these jurisdictions compared to a scenario without local tax havens. The results of this study document that local tax havens are relatively small municipalities that use high tax revenues from shifted profits to finance high levels of public expenditures. This high concentration of (profit-shifted financed) public spending potentially aggravates the misallocation of local public goods due to profit shifting. The increase in expenditure in tax haven municipalities only benefits a relatively small number of people, while spending cuts in non-haven jurisdictions are spread across a much larger number of residents.

One advantage of addressing tax havens at the sub-national instead of the international level

[38] For comparison: Germany's smallest three states (*Saarland*, *Bremen*, and *Mecklenburg-Vorpommern*) have a combined annual LBT revenue of around 1.5 billion over the same time span. Together, the three states have a population of around 3.3 million.

is that the federal government, as the higher-level authority, can issue rules that limit local profit shifting. In order to limit profit shifting by large companies, I propose an addition to the current apportionment formula rules, which is, in spirit, closely related to the current CFC rules.

The empirical results of this paper show that the majority of shifted profits can be attributed to a relatively small number of large firms. We have seen firms that want to shift their corporate profits to a local tax haven avoid triggering the apportionment formula rules. The addition to the apportionment formula rule would only apply to large firms that are subject to the LBT in Germany (*size condition*). Said firms must provide information on pretax profits, number of employees, and the location of all their subsidiaries operating in Germany in which they hold at least a fifty percent ownership (*ownership condition*).[39] Finally, the addition only targets passive income (*passive income condition*). To keep the complexity as low as possible, one could deploy a similar definition of passive income as in the current CFC rules. Passive income would have to encompass all income sources currently used for profit shifting, such as income from real estate management, holding companies, or licensing.[40] If all of the foregoing requirements are satisfied, the low-taxed passive income of the subsidiary is included in the taxable income of the German resident shareholders. LBT that was already paid on the subsidiary's passive income may be deducted by the shareholder from her corporate tax bill. This addition to the current apportionment formula rule would effectively target the large firms that are most aggressive in local profit shifting.

The federal government is currently proposing to increase the minimum LBT rate from 7% to 9.8% to reduce profit shifting to local tax havens (see CDU/CSU & SPD, 2025). Kochems (2025) discusses the possible impact this reform would have on local tax havens. It seems unlikely that firms will stop shifting profits to local tax havens, as after the reform, these municipalities would still provide the lowest possible LBT rate in the country. Addressing the problem directly, by adjusting the current apportionment formulas, seems like a more promising way of impeding local profit shifting.

Number of local tax havens: The empirical results of this paper suggest that becoming a local tax haven has a positive effect on a municipality's local public finances. Thus, a natural

[39]Alternatively, one could restrict this set to only those subsidiaries that are not consolidated with the parent company, that is subsidiaries which can potentially be used to circumvent the current apportionment formula rules.

[40]Similar to the application of CFC rules, income based on real economic activity is not classified as passive income, e.g., patent income that can be traced back to actual RD activity in the municipality would not be as classified passive income.

question arises: Why do not more municipalities become a local tax haven?

The analysis in Section A9 examines the effects of large tax cuts on LBT bases and on observed profit-to-wage ratios. The results show that only a small subset of municipalities, with very low post-cut tax rates and located in close proximity to large agglomerations, successfully attract large tax bases and exhibit high profit-to-wage ratios. Several factors jointly explain why only a limited number of local tax havens emerge.

First, there may exist a first-mover advantage. Given the fixed costs of establishing a tax haven subsidiary, firms may remain in an existing haven even if another municipality offers a slightly lower LBT rate. Established havens often maintain close relationships with local governments, providing firms with greater certainty regarding future tax policy. Their reputations are also well known nationwide, particularly among tax advisors who recommend them for tax optimization. Finally, companies offering tax haven services have already established themselves in existing tax havens. These companies assist other companies in legally relocating their headquarters to the local low-tax jurisdictions.

Second, revenues received through fiscal-equalization schemes and municipal payments to intergovernmental transfer schemes reduce the incentive to become a tax haven jurisdiction. Equalization schemes redistribute fiscal resources to narrow the gap between jurisdictions' fiscal needs and fiscal capacities. Buettner (2006) shows that these schemes provide German municipalities with an incentive to set LBT rates significantly higher than they would under a system without those transfers. German municipalities are obliged to pay into intergovernmental transfer schemes. The amount of the payments depends on a municipality's fiscal capacity. Importantly, fiscal capacity is not computed based on actual tax revenues but on a municipality's tax base. Thus, keeping the tax base constant, a municipality's payments to intergovernmental transfer schemes as a share of its overall tax revenues decrease with the local tax rate, reducing the fiscal benefit of becoming a tax haven jurisdiction.[41]

[41] A municipality's three most important payments to intergovernmental transfer schemes are payments to district transfers (*Kreisumlage*), LBT transfers (*Gewerbesteuerumlage*), and financial equalization transfers (*Finanzausgleichsumlage*). The district transfer is paid by municipalities within a district to the district council to finance the public services provided by the district. The exact payments depend on the district transfer multiplier, set by the district council each year. Thus, there can be substantial differences between similar municipalities located in different districts. The LBT transfer is a fixed share of municipalities' LBT base amounts, which municipalities pay to the federal and state governments. Importantly, municipalities in the new (Eastern) states of Germany have to pay a substantially lower share (20.5%) than those in the old states (49.5%). The share liable to the federal government is the same for all municipalities (14.5%). Finally, the financial equalization transfers target affluent municipalities, where the fiscal capacity vastly exceeds their fiscal needs. The financial equalization transfers are paid to finance part of the fiscal-equalization schemes. The exact calculation of payments varies greatly between the individual federal states. For example, there are states where payments are a fixed share, while in others they are structured progressively in a municipality's fiscal capacity.

Third, the demand for tax havens may be limited. It seems reasonable to argue that most large corporations that could reduce their tax liabilities by using local tax havens already do so. Consequently, a municipality that lowers its tax rate to the same level as the current haven jurisdictions may not be able to attract a substantial tax base. To summarize the three preceding arguments: It is a significant fiscal risk for a non-haven jurisdiction to lower its tax rate in the hope of attracting shifted profits. A local government must be certain, for example, through prior agreements with companies, as in the case of the municipality of Monheim, that a large reduction in its LBT rate will actually attract a tax base. Otherwise, there is a high risk of over-indebtedness and, if necessary, intervention by the municipal financial supervisory authority.

Limitations: This paper has several limitations. First, Laffitte (2024) argues that demand shocks, together with proximity to large markets, are key determinants in explaining why countries become international tax havens. There is a close exchange of information between local policymakers and firms. The researcher cannot directly observe these interactions. Consequently, I am unable to empirically explore the role that potential demand shocks from large firms play in explaining the emergence of local tax havens in their vicinity. Future work could systematically investigate the written notes of the municipal council meetings to gain a better understanding of how relevant the role of local dominant firms is in the tax setting process.

Second, the administrative data sources do not allow me to link the local tax haven subsidiaries with their parent company. Thus, I cannot control for time-invariant factors within the corporate group that may influence the degree of corporate profit shifting. Similarly, I cannot delve deeper into the importance of specific channels of profit shifting. As an alternative data source, Orbis can provide information on a corporation's ownership structure as well as financial information at the subsidiary level. Unfortunately, the overall coverage of this data source is often unsatisfactory, so that the shifted profits of many important taxpayers located in local tax havens would be unaccounted for.

Finally, my fiscal cost estimation takes into account only the direct fiscal impact of profit shifting; that is, it ignores possible spillover effects due to (1) local tax competition, (2) fiscal equalization schemes, as well as the impact on (3) corporations' overall economic output. Local tax competition may exacerbate the aggregate loss due to non-haven municipalities' reduction of the LBT rate (see Figure B15). Fiscal equalization schemes, on the other hand, may dampen the effect as a part of the tax revenues accruing in local tax havens are redistributed to non-haven municipalities. The case study on the emergence of Germany's largest tax haven showed that higher payments to intergovernmental transfer schemes accounted for around half of the increase in municipal expenditures. I am currently collecting data on municipal fiscal equalization schemes for all municipalities to further explore this channel. Due to data limitations, the current study cannot analyze the impact local tax haven usage may have on a corporation's overall employment, investment, or R&D activity.[42] By way of example, recent empirical evidence suggests that a reduced tax burden may induce a firm to increase its investment or R&D activity (see Link et al., 2024; Lichter et al., 2025). This increase in overall economic activity may lead to a higher tax base, dampening the negative effect of local profit shifting. A promising extension could be to use the corporation's ownership data in combination with the emergence of a local tax haven, to examine the effect tax haven usage may have on the outlined outcomes.

8 Conclusion

In this paper, I investigate the fiscal impact of corporate profit shifting to local business tax havens in Germany. I identify local business tax havens as low-tax municipalities with a high dependence on profit shifting sectors. The paper's findings show that local tax havens are situated in close proximity to large agglomerations, and the profit-to-wage ratios in these jurisdictions are exceptionally high. Local governments use the high tax revenues to finance high levels of public expenditures while maintaining low public debt levels.

I deploy synthetic difference-in-differences methods, combined with administrative data sources and standard profit shifting equations, to estimate the amount of profit shifting to local tax havens. The empirical analysis of this paper indicates that between 2013 and 2019, around 52 billion Euros are shifted to local tax havens. Shifted profits account for around 92% of corporate profits taxed in local tax havens. The results are driven by a small number of large firms that offer business and financial services. The estimation results are robust to various definitions of local tax havens. Finally, I utilize large tax cuts to identify their dynamic effect on local profit shifting. The estimates based on the event study approach align closely with the findings of the cross-sectional estimations.

[42] There is a small but emerging literature that addresses these real economic effects of tax haven usage in the international context. These studies deviate from the often implicitly imposed assumption that the shifting of taxable income between jurisdictions is a zero-sum activity (see Alstadster et al., 2024, for a survey). Recent studies that investigate the employment effect of tax haven usage come to mixed results (Lopez Forero, 2021; Souillard, 2022; Davies & Scheuerer, 2023). Empirical work that explores the impact of anti-avoidance rules suggests that a decrease in profit shifting is associated with a reduction of firms' investment (Buettner et al., 2018; De Mooij & Liu, 2020; Bilicka et al., 2022).

I estimate the direct fiscal cost of local tax havens based on the foregoing results. I utilize information on firms' movement across municipal boundaries and their corporate ownership structures to construct counterfactual tax rates that would be applied to shifted profits in the absence of local tax havens. Between 2013 and 2019 local tax havens gained around 4.3 billion Euros based on local profit shifting, while the LBT loss to non-haven municipalities amounts to roughly 7.9 billion Euros. The substantial relocation of public tax revenue is likely to be associated with a misallocation of local public goods and services.

The aggregate results are supplemented with a case study of the emergence of the largest local tax haven. The municipality became a local tax haven following a large LBT cut in 2012. The results indicate that between 2012 and 2019, around 20.5 billion Euros of corporate profits were shifted to the municipality. I show that the increase in the LBT base occurred immediately after the LBT cut in 2012, while the number of firms located in the municipality only increased in 2016. This implies that the majority of the surge in the LBT base can be attributed to the relocation of corporate profits by a handful of firms. The increase in the LBT base results in a significant rise in public revenues, expenditures, investment, and purchases of financial assets, while the public debt level decreases. Higher payments to intergovernmental transfer schemes account for around half of the increase in public expenditures, reducing the net fiscal benefit of becoming a tax haven.

I explore the policy implications of the presented results. I propose a supplement to the existing apportionment rule, which is very similar to the laws on the taxation of CFCs. This addition would target only large companies with subsidiaries that generate passive income. Given the stark concentration of local profit shifting, only targeting large companies would be sufficient to impede most of the observed local shifting. Finally, I discuss possible limitations of the current study as well as directions for future research.

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A Additional Material

A1 Dealing With Municipal Boundary Changes

A central challenge when constructing the data set are boundary changes of municipalities over the period of observation, i.e., between 1998 and 2019. The vast majority of these changes occurred to the municipalities in former East Germany right after the reunification in 1990. As an example, Germany consisted out of 16,127 municipalities in 1990, while there are only 11,056 municipalities in 2017, i.e. an overall decrease of 5,071 municipalities which corresponds to a decline of around thirty percent (Eichhorn, 2018). 4,961 of these 5,071 merged municipalities are located in former East Germany. Due to data restrictions, my main empirical estimations are based on the 2013 to 2019 period. Note that there are only few municipal mergers in said period (see Eichhorn, 2018), and none of the mergers affect a local tax haven.

Previous papers that worked with German municipal data have dealt with municipal mergers in two ways: Fuest et al. (2018) drop all municipalities that underwent a municipality merger in their sample period from the baseline sample. Focusing on the years 1993 to 2010, they use a sample of 10,001 non-merged German municipalities for their main analysis. Langenmayr & Simmler (2021) treat changes in municipalities' borders during their sample period as if they had already occurred at the beginning of the sample period. Assume municipality A and B merge in the year 2000 to the new municipality C. The authors compute municipality C's variables, e.g. the local business tax rate, for the pre-merger years as a population weighted average of the tax rates of municipality A and B.[43]

I follow Langenmayr & Simmler (2021)'s approach applied to the municipal boundaries of December 31st, 2022. The choice of the municipal boundary year is based on data availability of the LBT statistic (*Gewerbesteuerstatistik)*. Additionally, I drop all municipalities that split at some point in time contained in my period of observation. Assume that the period of observation is 1998 to 2019 and that municipality D splits into municipality E and F in 2010. The firm-level data does not provide me with information on whether a given firm was located in the area of a later established municipality, which is E or F. Thus, applying the outlined harmonization procedure is impossible. Affected municipalities are dropped from the datasets. This amounts to dropping less than ten municipalities, which split at some point in time over the period of observation.

[43] Note that Fuest et al. (2018) use the same approach in their online appendix, where they compute changes in local tax rates for the whole sample, i.e. all German municipalities.

A2 Controlled Foreign Corporation (CFC) Rules

Controlled Foreign Corporation (CFC) rules are anti-tax avoidance measures designed to prevent companies from shifting profits to subsidiaries located in low-tax jurisdictions. In Germany, CFC rules are part of the *Außensteuergesetz* (Foreign Tax Act) introduced in 1972 and are based on the US subpart F legislation enacted in 1964 (**?**). The German CFC rules are subject to change over time. In the following explanations, I focus mostly on the rules for the 2013 to 2019 period while giving additional information on relevant changes in previous or subsequent years. For German CFC rules to apply, three requirements have to be met:

1. **Ownerhship**: The ownership requirement is satisfied if more than 50% of ordinary shares or voting rights in the foreign corporation are directly or indirectly held by individuals or companies which reside in Germany.

2. **Passive income**: The CFC rules only apply to the so-called 'passive income' of foreign subsidiaries. The tax code differentiates between active and passive income. Passive income is negatively defined, i.e., every income not explicitly listed as an active income is labeled a passive income. By way of example, income from agriculture, forestry, manufacturing and construction are defined as active incomes. The exact list of income sources deemed active income is revised slightly over time. Income derived from patents and trademarks are explicitly excluded from being part of active income, except when said intellectual property rights are based on research conducted by the subsidiary itself.

3. **Low taxation**: The CFC rules apply only to low-taxed passive income of foreign subsidiaries. The "low-taxed" threshold is 30% before 2001, 25% between 2001 and 2023 and 15% starting from 2024. The last reform of the threshold brings the German CFC rules in line with the global minimum tax on corporate income.

If all of the foregoing requirements are satisfied, the low-taxed passive income of CFC is included in the taxable income of the German resident shareholders. Foreign income taxes that were already paid on the CFC's passive income may be deducted by the shareholder from her German income or corporate tax bill.

A3 Defining Local Tax Havens

In this paper, I define local tax havens as (1) low-tax municipalities that have (2) a high dependence on profit shifting sectors. In the following, I outline different ways to operationalize the first criterion, while also exploring how the set of local tax havens changes in response to small perturbations of the chosen thresholds.

Low-tax municipalities: I define low-tax municipalities as municipalities whose LBT multiplier is equal to or lower than the $0.5th$ percentile of the LBT multiplier distribution in a given year (main definition). Thus, this definition compares LBT multipliers across Germany. An alternative approach would be to calculate the difference between a municipality's LBT multiplier and the average LBT multiplier in its surrounding areas. A low-tax municipality can then be defined as a municipality whose difference in LBT multiplier to the surrounding average of LBT multipliers is equal to or lower than the $0.5th$ percentile in a given year (alternative specification). Defining the included surrounding area to the whole of Germany equalizes both definitions.

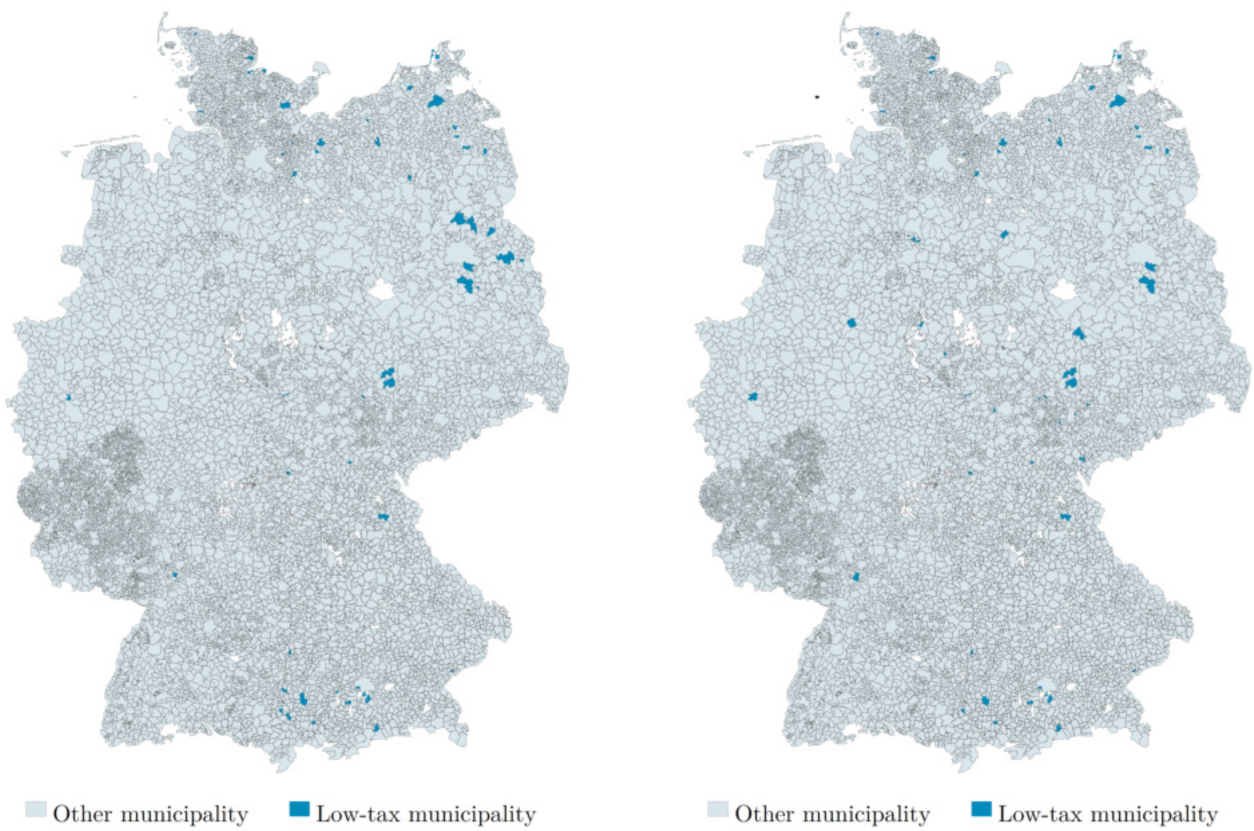
Figure A1 illustrates the differences in these two classifications for 2019. The left panel depicts the main definition used in this paper. It assumes that having among the lowest LBT rates across all municipalities is important for firms' profit shifting decisions. The right panel depicts the alternative definition. The alternative definition assumes that the tax differential between a municipality and its surroundings determines firms' decision to shift profits. One drawback of the alternative definition is that it classifies some municipalities in high-tax regions as low-tax municipalities even though they have relatively high tax rates when compared to other municipalities classified as low-tax municipalities. This is also reflected in the mean and standard deviation of the LBT rate, which are substantially higher in the low-tax municipalities using the alternative definition (262% and 29%) compared to when applying the main definition (252% and 16%). One extreme example is the city of *Verl*, which has an LBT multiplier of 340% in 2019. Applying the alternative definition, the municipality is labeled as a low-tax municipality. The nationwide average LBT multiplier in 2019 is around 364%, while 2239 municipalities offer a LBT rate which is lower than 340%. Hence, it is unlikely that any firm will decide to shift its corporate profits to *Verl*, when many municipalities offer substantially lower tax rates.

Another key disadvantage of the alternative definition is that it fails to classify some relevant local tax havens as low-tax municipalities, e.g., *Pullach im Isartal* and *Liebenwalde* in 2019. Both municipalities are located in regions with relatively low LBT rates overall, so that by deploying

Figure A1: Spatial distribution of low-tax municipalities (2019)
- different *low-tax* definition -

(a) Main definition

(b) Alternative definition



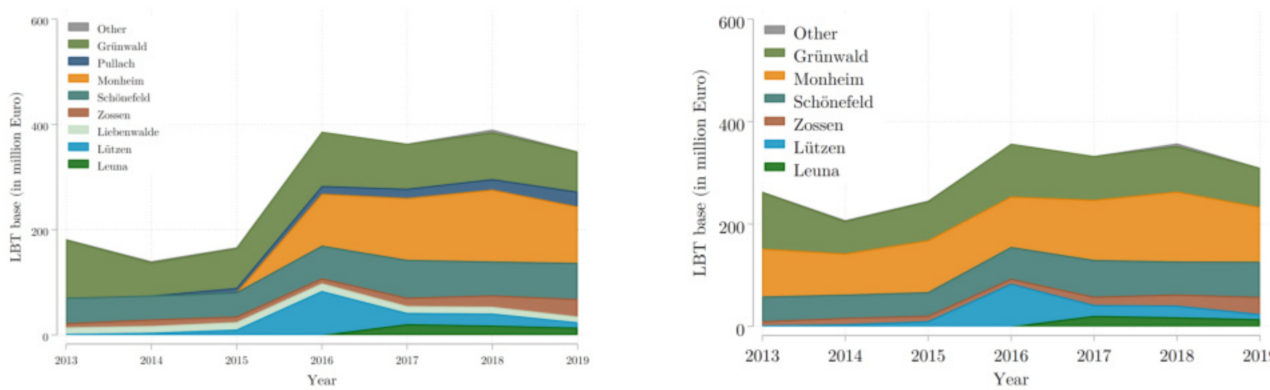
Note: The left panel illustrates the spatial distribution of low-tax municipalities (blue) and local tax havens (red) in 2019 using the main definition. Using the alternative definition, the right panel illustrates the spatial distribution of low-tax municipalities (blue) in 2019. The alternative definition computes the difference between a municipality's local business tax multiplier and the average multiplier of its thirty-kilometer surroundings. The blank areas within Germany are non-municipal territories (*gemeindefreie Gebiete*) or municipalities with missing population counts or missing information on local business tax rates.

the alternative approach, the two jurisdictions would not be classified as local tax havens. One remedy would be to increase the percentile cutoff, e.g., to the $1st$ instead of the $0.5th$ percentile. This would increase the overall set of low-tax municipalities. The developed main definition encompasses all relevant local tax havens, selected from a sparse set of low-tax jurisdictions. Finally, deploying the alternative approach forces the researcher to decide on the size of the buffer zone around the municipality, which is used to compute the tax rate differential between a jurisdiction and its surrounding. This introduces an additional threshold, which is potentially arbitrarily chosen by the researcher.

One crucial difference between the two definitions is the classification of *Monheim am Rhein* as a local tax haven. *Monheim* is Germany's largest local tax haven in 2019. The local government made a large LBT cut in 2012, followed by additional minor cuts in the subsequent years (2014, 2016, 2017, 2018). Although the empirical results of the case study presented in Section 6.1 show that profit shifting to *Monheim* started right in 2012, the chosen main definition labels the municipality as a local tax haven only after its 2016 LBT cut. The alternative definition defines *Monheim* as a local tax haven starting in 2012. Focusing on the period of our main estimation sample (2013-2019), solely because of the differences in *Monheim*'s classification, the main definition therefore underestimates the overall amount of profit shifting by 7.2 billion. Thus, the main definition provides a conservative estimate of the amount of overall profit shifting.

Figure A2: Importance of individual tax havens (2013-2019)
- different *low-tax* definition -

(a) Main definition (b) Alternative definition



Note: The figure illustrates the sum of the LBT tax base in local tax havens between 2013 and 2019. The left panel uses the main definition to classify local tax havens. The right panel uses the alternative low-tax definition to classify local tax havens. The alternative definition computes the difference between a municipality's local business tax multiplier and the average multiplier of its thirty-kilometer surroundings.

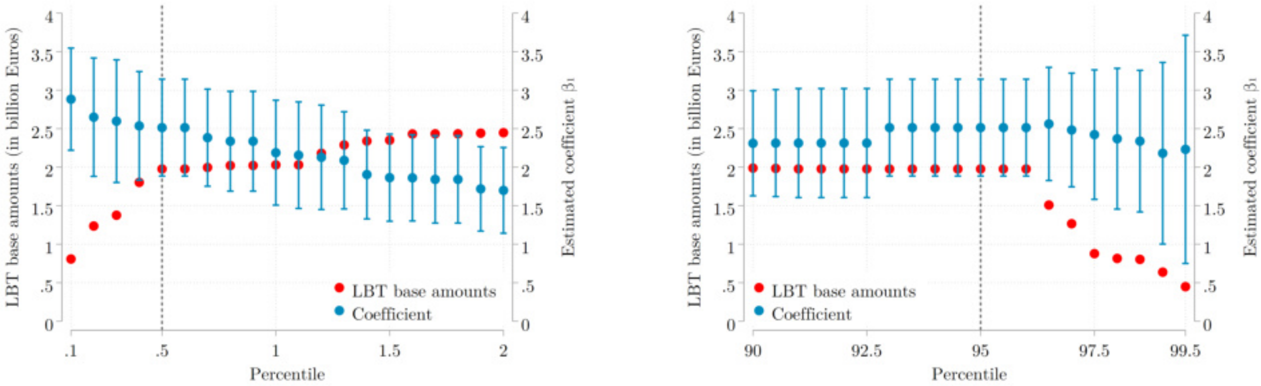
Finally, choosing the $0.5th$ percentile as the threshold for defining low-tax municipalities, due to the discussed increase in the minimum LBT rate (see ?), is relatively arbitrary. One wants to choose a cutoff that is sufficiently low but not too low. In this context, 'sufficiently low' refers to an LBT rate that is low enough to attract shifted corporate profits. Nevertheless, we do not only want to include the few municipalities with the lowest LBT rate, as factors such as the cost of profit shifting, spatial location, planning security, or personal ties to a specific region may make a municipality with a slightly higher LBT rate more attractive than a municipality with a lower LBT rate. By way of example, *Monheim* has a LBT rate of 8.75% while *Zossen* has a LBT rate of 7%. Nevertheless, *Monheim* attracts substantially more corporate profits to its jurisdiction, presumably due to its spatial location and business-friendly mayor, who may provide firms with better planning security compared to other local governments.

The left panel of Figure A3 depicts the sum of LBT base amounts in local tax havens and the estimated coefficient $\hat{\beta}_1$ of Equation 5 for different LBT rate cutoffs used in the main definition. The LBT base attributed to local tax havens increases monotonically as the LBT rate threshold becomes looser, with an increasing number of municipalities being labeled as local tax havens. The increase in the LBT base is relatively modest starting from the 0.5*th* percentile. Moving from the 0.5*th* to the 2*nd* percentile increases the LBT base by roughly 24%. This indicates that in this range of the threshold distribution, increasing the LBT threshold rate mostly adds relatively small-sized municipalities to the set of local tax havens. The increase in the LBT base is more pronounced at the left end of the threshold distribution. Moving from the 0.1*st* to the 0.5*th* percentile increases the LBT base amount by around 145%. This is because choosing a very low threshold excludes many relevant local tax havens, e.g., *Grünwald* or *Monheim*. The perturbation exercise suggests that the baseline threshold is a sensible choice, as it encompasses all relevant local tax havens while remaining relatively conservative in defining a low LBT rate.

High dependence on profit shifting sectors: Besides having a low LBT rate, I argue that local tax havens are municipalities with a high dependency on profit shifting sectors. These sectors are real estate management, licensing, and holding companies. In the baseline definition, I use the 95*th* percentile of the share of shifting sectors as the threshold value for defining a high dependency on these sectors. The right panel of Figure A3 depicts the sum of LBT base amounts in local tax havens and the estimated coefficient $\hat{\beta}_1$ of Equation 5 for different shifting sector share cutoffs used in the main definition. The LBT base attributed to local tax havens decreases monotonically as the shifting sector share threshold becomes more restrictive, with a corresponding decrease in the number of municipalities labeled as local tax havens. Note that the LBT base amount attributed to local tax havens remains nearly unchanged between the

Figure A3: Perturbations around main definition (2013-2019)

(a) LBT multiplier threshold (b) Shifting sector share threshold



Note: The figure illustrates the sum of the LBT tax base in local tax havens and the estimated coefficient $\hat{\beta}_1$ of Equation 5 for different perturbations around the main definition of local tax havens. The period of observation is 2013 to 2019. The left panel depicts small perturbations of the LBT multiplier cutoff ranging from the 0.1st to the 2nd percentile. The shifting share cutoff is held constant at the 95th percentile. The right panel depicts small perturbations of the shifting share cutoff ranging from the 90th to the 99.5th percentile. The LBT multiplier cutoff is held constant at the 0.5th percentile. The vertical dashed lines indicate the baseline threshold in both panels.

90th and 96.5th percentiles. The decrease in the LBT base is more pronounced at the right end of the threshold distribution. Moving from the 96.5th to the 99.5 percentile decreases the LBT base amount by around 77%. This is because choosing a very high threshold excludes many relevant local tax havens, e.g., *Grünwald* or *Monheim*. Again, the presented perturbation exercise suggests that the baseline threshold is a sensible choice, as it encompasses all relevant local tax havens while remaining relatively conservative in defining a high municipal dependency on shifting sectors.

A4 Misclassification and profit shifting Estimates

There are two possible types of misclassification: (1) misclassifying a non-haven municipality as a local tax haven (false positive) and (2) misclassifying a local tax haven as a non-haven municipality (false negative). Let p be the probability of a false positive, that is, the share of non-haven municipalities falsely classified as local tax havens; and q be the probability of a false negative, the share of local tax haven municipalities falsely classified as non-havens. The overall effect of misclassification of tax haven status on the later-on estimated amount of local profit shifting depends on two channels: (1) its effect on the LBT base and (2) its effect on the estimated coefficient of profit shifting. I follow Fuest et al. (2022) in estimating the amount of shifted profits as the observed sum of corporate profits in local tax havens minus the predicted sum of corporate profits in said jurisdictions. The counterfactual is estimated by dividing the observed sum of corporate profits in local tax havens by $e^{\hat{\beta}}$, where $\hat{\beta}$ is the estimated coefficient of profit shifting based on a sector-municipality-year level profit shifting equation.

Effect on LBT base: The effect on the LBT base can go in two directions. False positives (negatives) lead to an increase (decrease) in the LBT base of local tax havens, increasing (decreasing) the latter estimate of shifted profits. Figure A2 documents that the deployed main definition of a local tax haven captures all relevant local tax havens, while the set of other included municipalities is small. Applying the main definition, the city of *Monheim* is classified as a local tax haven only starting in 2016. The case study conducted in Section 6.1 shows that the municipality became a local tax haven as early as 2012, that is, the year of the large LBT cut when firms began shifting their corporate profits to its jurisdiction. *Monheim*'s LBT base between 2013 and 2015 amounts to 275 million Euros (false negative). Consequently, the main definition will likely give us a lower bound on the true LBT base in local tax havens.

Effect on profit shifting coefficient: For simplicity, assume that local tax havens $Haven_m = 1$ and non-haven municipalities $Haven_m = 0$ do not differ in any characteristics except for the LBT base. The difference in the average LBT base between the two groups will be interpreted as profit shifting. Imposing the standard log-linear functional form, the profit shifting equation is given by

$$log(\pi_m) = \alpha + \beta Haven_m + e_m \tag{6}$$

where π_m depicts the sum of corporate profits in municipality m and $E\left[\epsilon_m \mid Haven_m\right] = 0$.

Suppose we do not observe the real tax haven status but only the potentially misclassified indicator $\widetilde{Haven}_m = Haven_m + \nu_m$, where the measurement error ν_m is assumed to be independent of the residual error e_m. Misclassification of the independent variable $Haven_m$ leads to a non-classical measurement error of the binary regressor. Aigner (1973) finds that the ordinary least squares estimate of β is biased towards zero (attenuation bias). Regressing the dependent variable on the mismeasured, binary tax haven indicator $\widetilde{Haven}_m$ gives us a lower bound of the true parameter, that is $|\tilde{\beta}| \leq |\beta|$. Bollinger (1996) shows that under the assumption that $p + q < 1$ and the normalization that $\beta > 0$ one can calculate an upper bound $\bar{\beta}$ such that $\tilde{\beta} \leq \beta \leq \bar{\beta}$. Prior information on the probability of false positives or false negatives can be used to tighten the foregoing bounds. Much of the literature has focused on applications in dealing with measurement errors in the context of survey data, where measurement errors are usually based on false information provided by respondents (Bound et al., 2001).

Contrary to measurement errors of survey data, we can directly influence the number of false positives and false negatives by the chosen classification of local tax havens. In the following, I will outline possible concerns regarding false positives and negatives based on the deployed definition of local tax havens before providing a simple simulation highlighting the robustness of the estimator with regard to different levels of misclassification (p and q).

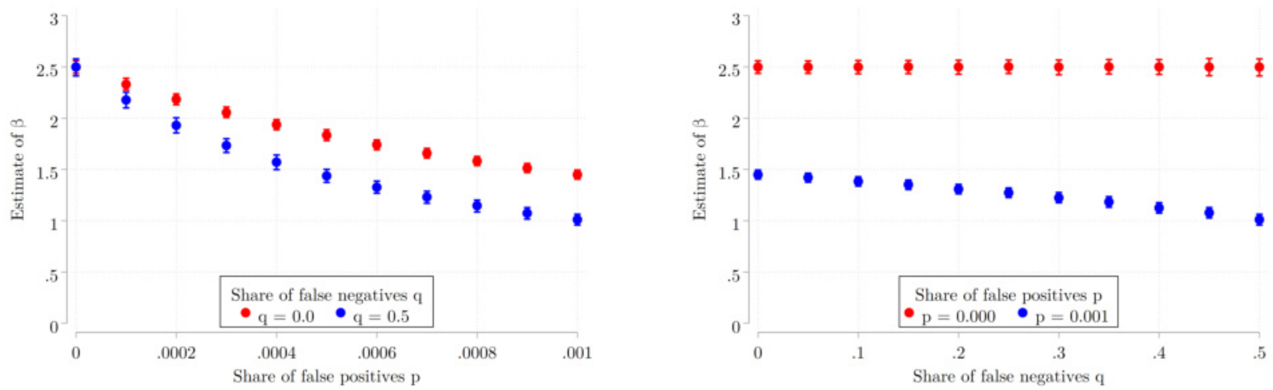
Before we propose any ranges of p and q, we want to get an idea of the number of actual local tax havens and non-havens in our estimation sample ($2013 - 2019$). Section A3 outlines that the largest part of LBT base attributed to local tax havens can be traced back to eight municipalities (47 year-municipality observations). Based on the presented evidence, I argue that these municipalities are correctly classified as local tax havens. We classify 9 municipalities (51 observations) as local tax havens based on our main definition. Based on that, we would assume that all other 6500 municipalities are non-havens (36442 observations).

False positives: Assuming that the largest eight local tax havens (see Section A3) are correctly classified implies that one local tax haven contained in "other local tax havens" can be a false positive. In our estimation sample, one municipality in "other local tax havens" makes up 4 observations. If this one municipality is indeed a false positive, the share of false positives amounts to $p = \frac{4}{36442} \approx 0.011\%$. The misclassification of non-havens as local tax havens leads to a downward bias of the estimated coefficient. Note that the diluting effect of misclassifying non-havens as local tax havens increases with the number of false negatives. This downward bias can be observed in the perturbation exercises presented in Figure A3. Making the definition of a local tax haven less strict, i.e., loosening the LBT rate and shifting sector share threshold values, is likely to result in the inclusion of more false positives in the set of local tax havens. The misclassification of false positives can explain the observed decline in the estimated coefficient $\hat{\beta}_1$ as the deployed threshold values become less strict.

False negatives: I have documented that the municipality of *Monheim* between 2012 and 2015 (4 observations), is likely to be a local tax haven, and is not captured by the main definition. Thus, our best guess for the share of false negatives amounts to $q = \frac{4}{51} \approx 7.843\%$. Assume that the share of shifted profits as a share of municipal LBT base is the same across all local tax havens (*homogeneous treatment effects*). False negatives lead to underestimating the true parameter, as we classify local tax havens as non-havens. In the absence of false positives ($p = 0$), the effect of false negatives is small, as only a relatively small share of municipalities are local tax havens. Thus, moving a few local tax haven municipalities to the set of non-havens has a negligible effect on the average profits in the control group. The effect of false negatives on the estimated coefficient may be larger in the presence of false positives ($p > 0$) (see above).

Figure A4: Simulation test of different degrees of misclassification
- homogeneous treatment effects -

(a) Varying share of false positives p (b) Varying share of false negatives q



Note: The figure depicts a simulation test, estimating a regression based on 50000 observations. The true share of local tax havens is assumed to be $\frac{9}{6509}$ and the true share of non-havens $\frac{6500}{6509}$. In the figure, we vary the share of false positives p and the share of false negatives q. Note that p is the share of all local tax havens that are misclassified as non-havens, while q is the share of all non-havens that are misclassified as local tax havens. For each combination of p and q we draw 1000 samples and depict the distribution of the ordinary least squares estimator $\hat{\beta}$. The true parameter β is assumed to be 2.5. The error term ϵ_m is assumed to be normally distributed with a mean of 0 and a standard deviation of 0.25. In the left panel, the share of false negatives q is fixed at 0 (red) or 0.5 (blue), while the share of false positives p ranges from 0 to 0.001. In the right panel, the share of false positives p is fixed at 0 (red) or 0.001 (blue), while the share of false positives q ranges from 0 to 0.5. The markers depict the average of the estimated 1000 $\hat{\beta}$ coefficients, while the bars capture the region that captures 95% of the estimates.

Simulations: The impact of possible misclassifications on the estimated ordinary least squares estimate is illustrated in a simple simulation study. In this exercise, we assume that the true parameter β equals 2.5, the mean of log-profits in non-havens α equals 0, and the idiosyncratic error term ϵ_m is normally distributed with mean 0 and standard deviation 0.25. The sample size is 50000 municipalities, while $\frac{9}{6509}$ percent are local tax havens and the remaining $\frac{6500}{6509}$ percent are non-havens. Figure A4 depicts the results of the simulation exercise, varying the misclassification parameters p and q. Note that p is the share of all local tax havens that are misclassified as non-havens, while q is the share of all non-havens that are misclassified as local tax havens. For each combination of p and q we draw 1000 samples and depict the distribution of the ordinary least squares estimator $\hat{\beta}$.

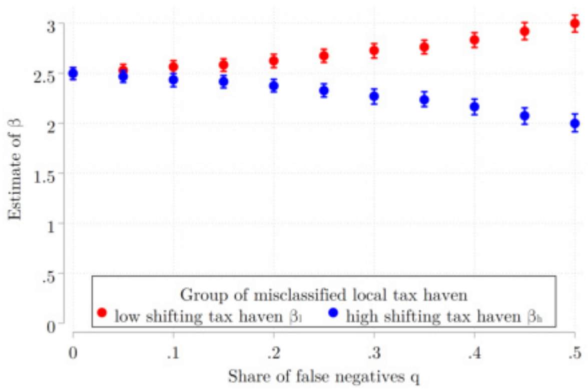
In the left panel, we fix the share of false negatives q before varying the share of false positives p. The underestimation of $\hat{\beta}$ becomes more severe as the share of false positives p increases. As already suggested above, we see that the two types of misclassification reinforce each other. The difference between the true parameter $\beta = 2.5$ and the estimate $\hat{\beta}$ increases as we move from the scenario with no false negatives $q = 0$ to the scenario where half of the local tax havens are misclassified $q = 0.5$. In the right panel, we fix the share of false positives p before varying the share of false negatives q. In the absence of false positives $p = 0$, an increase in the share of false negatives q does not lead to a downward bias of the estimated parameter. The reason behind that is the small size of the treated group relative to the control group; that is, moving a treated unit to the control group has only a negligible effect on the control group's mean.

So far, we have always assumed homogeneous treatment effects, i.e., the parameter β is constant across all local tax havens. Suppose we allow for β to differ between local tax havens; that is $\exists m \quad \text{such that} \quad \beta_m \neq \beta$ where β_m is the individual treatment effect of tax haven m and $m \in (1, ..., M)$ is the set of all local tax havens. In this setting, misclassifying a local tax haven as a non-haven can lead to an over- or underestimation of the true parameter, depending on which local tax havens are wrongly classified. Suppose $p = 0$ and that the set of misclassified local tax havens is given by the first Q municipalities of the set $(1, ..., M)$. Let $\beta_{avg} = \frac{1}{M}\sum_{m=1}^{M}\beta_m$, then if $\beta_{avg(Q)} = \frac{1}{Q}\sum_{m=1}^{Q} < \beta_{avg}$, the wrong classification of the Q local tax havens leads to an overestimation of the true parameter β; while $\beta_{avg(Q)} = \frac{1}{Q}\sum_{m=1}^{Q} > \beta_{avg}$ the wrong classification of the Q local tax havens leads to an underestimation of the true parameter β. Note that we do not have a prior on the possible degree of heterogeneity of β_m.

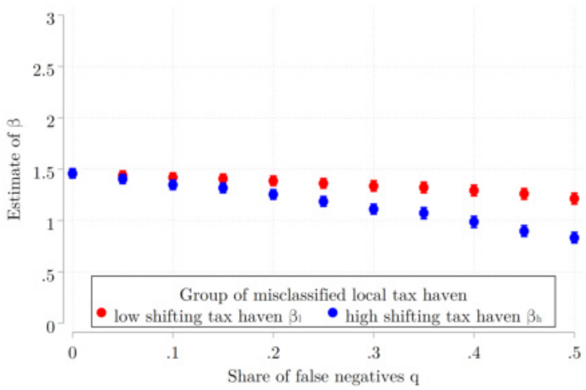
Figure A5 depicts simulations for a setting in which there are two types of local tax havens, that is low-shifting $\beta_l = 2$ and high-shifting $\beta_h = 3$ havens. Both groups make up half of the overall number of local tax havens. The figure illustrates the two most extreme cases, where

Figure A5: Simulation test of different degrees of misclassification
- heterogeneous treatment effects -

(a) Varying share of false negatives q ($p = 0.000$)



(b) Varying share of false negatives q ($p = 0.001$)



Note: The figure depicts a simulation test, estimating a regression based on 50000 observations. The true share of local tax havens is assumed to be $\frac{9}{6509}$ and the true share of non-havens $\frac{6500}{6509}$. In the figure, we vary the share of false positives p and the share of false negatives q. Note that p is the share of all local tax havens that are misclassified as non-havens, while q is the share of all non-havens that are misclassified as local tax havens. For each combination of p and q we draw 1000 samples and depict the distribution of the ordinary least squares estimator $\hat{\beta}$. The true parameter β is assumed to be 2.5. There are two types of local tax havens, low shifting $\beta_l = 2$ and high shifting $\beta_h = 3$ havens. Each type makes up half of the overall number of local tax havens. The error term ϵ_m is assumed to be normally distributed with a mean of 0 and a standard deviation of 0.25. In the left panel, the share of false positives p is fixed at 0, while the share of false positives p ranges from 0 to 0.001. The red color depicts a scenario where misclassification only affects low-shifting local tax havens. The blue color depicts a scenario where misclassification only affects high-shifting local tax havens. In the right panel, the share of false positives p is fixed at 0.001. The markers depict the average of the estimated 1000 $\hat{\beta}$ coefficients, while the bars capture the region that captures 95% of the estimates.

misclassifying affects either (1) only low-shifting havens (red) or (2) only high-shifting havens (blue). In the absence of false positives ($p = 0$), the first scenario results in an overestimation of the true parameter, while the second scenario yields an underestimation.

A5 How to Shift Profits Locally

Neugebauer et al. (2020) provide an exhaustive overview of how corporations can restructure to take advantage of differences between local business tax rates to legally reduce their overall tax burden. Their article is only available in German. I will summarize their main findings below.[44] The general idea is to restructure a corporation so that its taxable profits are shifted from a high tax municipality to a local tax haven. The depicted group structures have been especially designed so that the apportionment of the local business tax (LBT) does not apply.

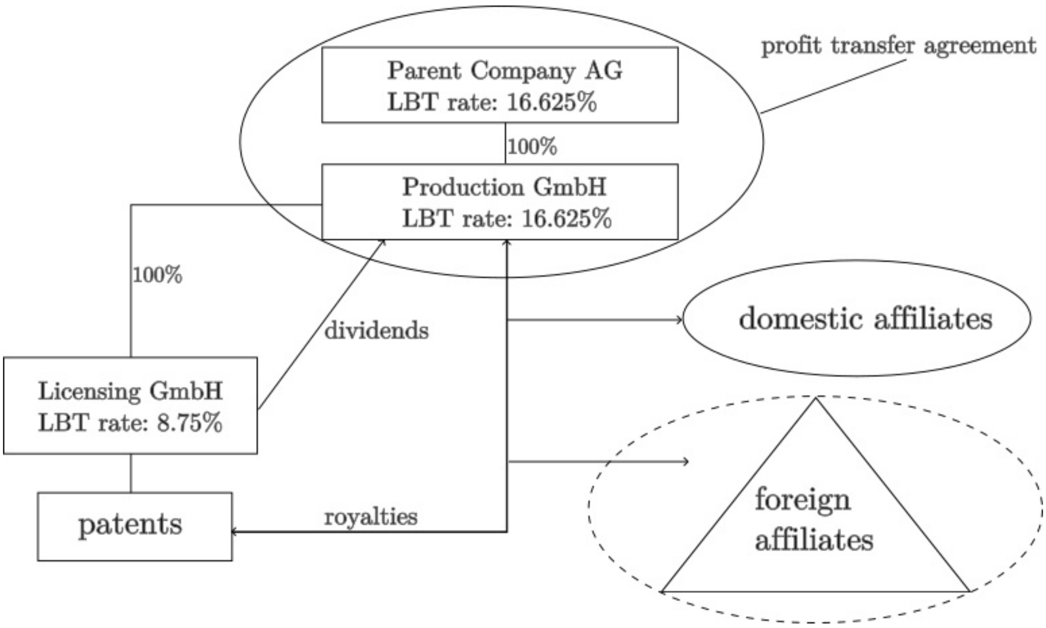


Figure A6: Licensing (source: Neugebauer et al., 2020, Figure 1)

Licensing: The parent company (Parent Company AG) remains the legal owner of a license and merely grants an intermediate subsidiary corporation (Production GmbH) a right of use free of charge. The subsidiary, in turn, concludes a sublicense agreement with a subsequent company (Licensing GmbH) located in a local tax haven, which receives royalties from group-affiliated subsidiaries in Germany and abroad. Typically, the Licensing GmbH has no employees other than the managing directors. The advantage of the local tax haven can only be utilized if the apportionment of the LBT is not applied. Therefore, no profit and loss transfer agreement is concluded between the Licensing GmbH and the Group AG, but only between the Group AG

[44] In the illustrated examples I will focus on licensing, financing and real estate management as three means of shifting corporate profits between municipalities in Germany. Neugebauer et al. (2020) highlight, that other business services, e.g. technical facility management, IT support, leasing administration, call centers, business leases, management contracts as well as secretarial and typing services, can be centrally moved to a tax haven to reduce the corporate tax burden. Nevertheless, the mentioned business services differ from licensing, financing and real estate management in the sense that they are (oftentimes) more labor-intensive, i.e. they require real realocations of productive assets and workers, while the aforementioned three examples can be realized by simply adjusting the corporate structure and moving one individual into the tax haven.

and the Production GmbH. If the profit of Licensing GmbH is distributed to its shareholder (Production GmbH) there is an additional tax burden on 5% of the dividend distribution, which can be avoided by reinvestment at the level of the licensing company.

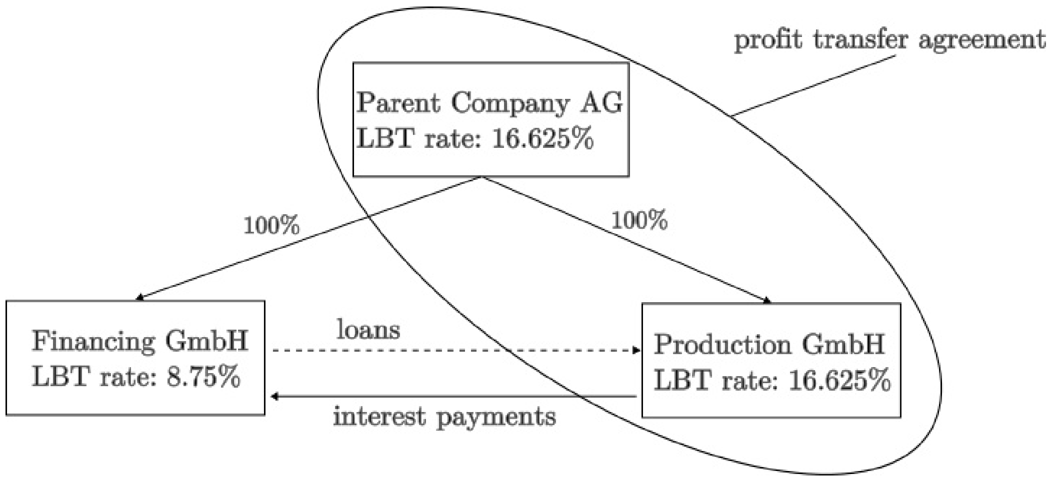


Figure A7: Financing (source: Neugebauer et al., 2020, Figure 2)

Debt shifting: The financing subsidiary (Financing GmbH) is founded in a local tax haven by means of a cash contribution by the parent company (Parent COmpany AG). In order to secure further financing, the parent company transfers shares (90%) in a high-profit sister corporation producing in a high LBT municipality by means of a contribution in kind. Financing GmbH retains its profits in full and passes them on to affiliated companies (Production GmbH) in the form of loans. As a result, this approach leads to a shift of LBT base to the local tax haven in the amount of the standard interest rate for the loan granted to Debtor GmbH without triggering an addition of taxable income for the latter. Both the notional consumption of expenses and the interest actually paid are recognized by the parent company as part of the calculation of income subject to LBT due to the profit and loss transfer agreement, resulting in a corresponding deduction in the high LBT municipality. Again, the advantage of the local tax haven can only be utilized if the apportionment of the LBT is not applied. Therefore, no profit and loss transfer agreement is concluded between the Financing GmbH and the Parent Company AG, but only between the Parent Company AG and the Production GmbH.

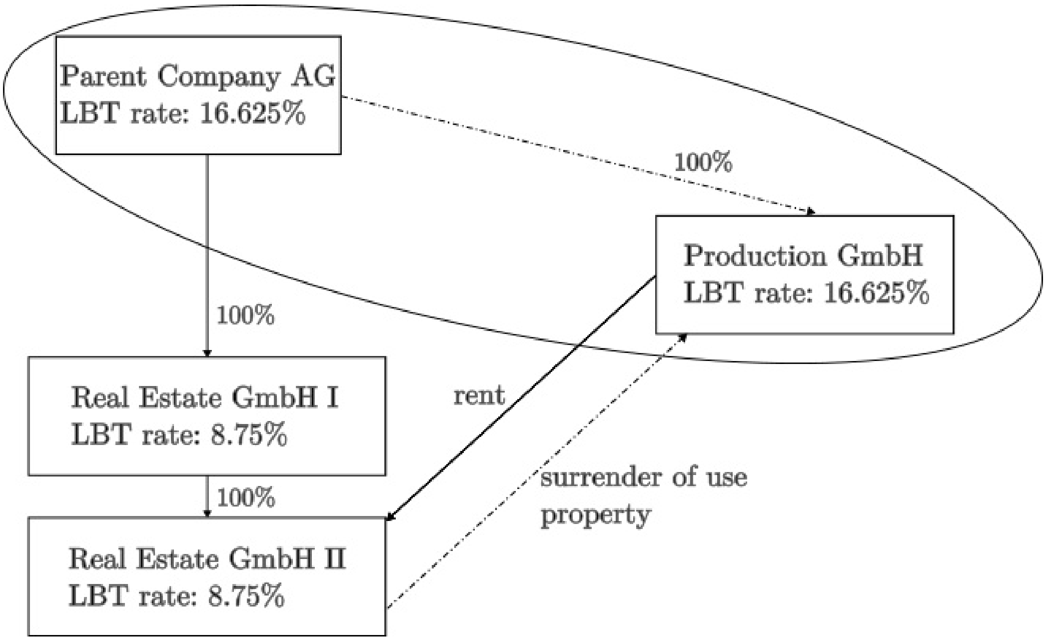


Figure A8: Real estate management (source: Neugebauer et al., 2020, Figure 4)

Real estate management: The parent company (Parent Company AG) creates two real estate management subsidiaries (Real Estate GmbH I and Real Estate GmbH II) in a local tax haven. Real Estate GmbH I manages and utilizes undeveloped land and buildings with structural facilities; Real Estate GmbH II, on the other hand, only manages and utilizes developed land without technical equipment and machinery.[45] Real Estate GmbH II leases real estate to production subsidiaries (Production GmbH) which are located in a high LBT municipality. This procedure generates profits in the local tax haven, while decreasing taxable profits in the high LBT municipality. Again, the advantage of the local tax haven can only be utilized if the apportionment of the LBT is not applied. Therefore, no profit and loss transfer agreement is concluded between the Real Estate GmbH II and the Parent Company AG, but only between the Group AG and the Production GmbH.

[45]The split into two distinct real estate management subsidiaries is necessary due to the German tax code, i.e. to fully utilize all available deductions while avoiding a capitalist business split-up. While Real Estate GmbH I can only claim the flat-rate deduction in accordance with Section 9 no. 1 sentence 1 GewStG, Real Estate GmbH II has the option of applying for the extended deduction in accordance with Section 9 no. 1 sentence 2 GewStG, meaning that no LBT is payable on its profits.

A6 Local Tax Havens and Private Wealth Management

Local tax havens cannot only be utilized to lower companies' corporate tax liability but also by (affluent) individuals to reduce their overall tax burden. Assume that person A's private wealth consists of shares in different companies and that these companies distribute their profits to their shareholder. Under German law, person A has to pay a 26.375% dividend tax (*Kapitalertragssteuer + Solidaritätszuschlag*) on the distributed dividends. If person A holds the company shares not directly but in a holding company, only five percent of the distributed profits are liable to taxation. These five percent will be taxed by 15.825% of the federal corporate tax plus the LBT. In this second scenario, the 26.375% dividend tax is only paid when the person transfers the accumulated wealth from the holding company to her private wealth. Thus, using a holding company is especially lucrative for individuals who plan to reinvest the distributed profits, managing their private wealth via the holding company. As the holding company is liable to LBT, said individuals have an incentive to locate their holding company in a local tax haven to lower the tax burden.

A7 Conceptual Framework

We have seen that local tax havens in Germany are (1) relatively small municipalities located (2) close to large cities or agglomeration areas. The spatial distribution of tax havens can be rationalized by a simple model of tax competition building on previous work by Kanbur & Keen (1993), Hines & Rice (1994) and Gumpert et al. (2016). Specifically, I model local jurisdictions that compete for firms' shifted profits, abstracting from tax competition for real economic substance.

Firm problem: Consider a local tax setting comprised of N municipalities, $i \in \{1, ..., N\}$. For simplicity, we assume that each municipality hosts one local firm that cannot move its economic activity to another jurisdiction. The local firm can also be interpreted as a proxy for the local market size. Following Hines & Rice (1994), the pretax profits of the firm located in municipality i are denoted as $\rho_i > 0$ and are subject to the local business tax $\tau_i \in [0, 1]$. Firms can shift a nonnegative amount $\psi_{ij} \geq 0$ of their profits to another local jurisdiction j where $j \in \{1, ..., N\}$ and $j \neq i$ where the shifted profits will be taxed with $\tau_j \in [0, 1]$.

The cost of relocating ψ_{ij} Euros of profits from the host municipality i to a municipality j is described by $C_{ij}(\psi_{ij}) = \frac{a}{2}\left(\frac{\psi_{ij}^2}{\rho_i}\right) d_{ij} + c_{ij}$, such that $\frac{\partial C_{ij}(\psi_{ij})}{\partial \psi_{ij}} = \frac{a d_{ij}}{\rho_i}\psi_{ij}$ and $\frac{\partial^2 C_{ij}(\psi_{ij})}{\partial \psi_{ij}^2} = \frac{a d_{ij}}{\rho_i}$. The first and second terms of the cost function $C_{ij}(\psi_{ij})$ depict the variable and fixed costs of profit shifting, respectively. The slope parameter $a \in [0, 1]$ captures how the cost of profit shifting increases with the amount shifted. $\left(\frac{\psi_{ij}^2}{\rho_i}\right)$ depicts the convexity of the cost function with regard to the shifted amount ψ_{ij}. Shifting profits to another jurisdiction becomes increasingly more expensive as the shifted amount increases relative to the actual pretax profits ρ_i. I assume that the variable costs directly depend on the distance $d_{ij} \in [0, 1]$ between host municipality i and municipality j. Two arguments why the cost of profit shifting may positively depend on d_{ij} are the following. First, a firm that wants to establish a shell company to evade part of the local business tax may have the incentive to locate said affiliate close to the parent company. An affiliate located spatially close to the parent company may be less likely to be detected by the local tax authorities. Thus, the probability of being detected may be modeled as an increasing function in the distance between the parent company and its affiliate. Second, even in the local context, transaction costs may be higher depending on the spatial distance between two municipalities. Maintaining an affiliate in a municipality in the neighborhood of the firm's host municipality is cheaper than maintaining one in a far distance. By way of example, firm managers may have to visit the subsidiary from time to time to make the case that the decisions of the firm's management are indeed formed where the subsidiary is located.

Similar to Gumpert et al. (2016), I assume that c_{ij} captures the fixed costs of shifting profits, e.g., firm i's cost of establishing an affiliate in another municipality j. The model allows the fixed costs of company i to differ in municipality j and municipality j'. Firm i may have some business or social ties to a specific municipality j, which results in lower fixed costs $c_{ij} < c_{ij'}$. [46] Additionally, some companies in local tax havens publicly advertise their services in helping firms open up an establishment in their jurisdiction. If municipality j is a local tax haven, this may explain a low value of c_{ij} for all $i \neq j$.[47] The fixed cost parameter c_{ij} can also depend on the spatial distance d_{ij}.

Firm i will shift profits to the municipality that offers the highest net benefit of profit shifting. The net benefit b_{ij} of firm i shifting profits to municipality j is described by:

$$b_{ij} = (\tau_i - \tau_j)\psi_{ij} - C_{ij}(\psi_{ij}) = (\tau_i - \tau_j)\psi_{ij} - \frac{a}{2}\left(\frac{\psi_{ij}^2}{\rho_i}\right) d_{ij} - c_{ij} \tag{7}$$

The first term depicts the tax savings due to shifting profits from i to j, while the second and third term capture the variable and fixed costs, respectively. Suppose that firm i shifts its profits to jurisdiction j. The optimal amount of shifted profits $\psi_{ij}^*(\tau)$ minimizes the firm's overall tax burden:

$$\min_{\{\rho_i \geq \psi_{ij} \geq 0\}} \left[\tau_i\left(\rho_i - \psi_{ij}\right) + \tau_j\psi_{ij} + \frac{a}{2}\left(\frac{\psi_{ij}^2}{\rho_i}\right) d_{ij} + c_{ij}\right] \tag{8}$$

Solving the foregoing equation gives us the optimal amount of shifted profits $\psi_{ij}^*(\tau)$ as

$$\psi_{ij}^*(\tau) = \max\left(0, \frac{(\tau_i - \tau_j)\rho_i}{ad_{ij}}\right) \tag{9}$$

where $\psi_{ij}^*(\tau) = 0$ if $\tau_i - \tau_j \leq \sqrt{\frac{2ad_{ij}c_{ij}}{\rho_i}}$, that is the firm does not shift any profits to municipalities j if the net benefit of profit shifting is negative. All things equal, the optimal amount of shifted

[46] For instance, if firm i already operates a non–profit shifting subsidiary in municipality j, then establishing a profit shifting subsidiary, will likely incur low fixed costs c_{ij}. This argument is supported by the fact that *Bayer AG* and *BASF SE* already had subsidiaries in *Monheim* before they decided to relocate their intellectual property managing subsidiaries to the municipality. These kind of business ties between firm i and jurisdiction j are captured in c_{ij}. Note that the current model for simplicity does not explicitly incorporate non-profit shifting subsidiaries.

[47] Nevertheless, it can be argued that these service companies themselves only move to said jurisdiction *after* the local tax rate is established. In this simple, static model, we assume that firms make profit shifting decisions after observing local tax rates and other shifting relevant variables, such as c_{ij}. Thus, it is not obvious why c_{ij} should already capture a tax haven's local business service infrastructure.

profits $\psi^*_{ij}(\tau)$ is increasing in firms' size (i.e. pretax profits) ρ_i and the tax differential $\tau_i - \tau_j$. The firm shifts less profits if the cost of shifting a is large or the municipality j is far from the home municipality i.

Plugging Equation 9 back into Equation 10 allows us to determine municipality j^* to which jurisdiction firm i will shift profits. Suppose that any profit shifting takes place, that is $\exists j \quad s.t. \quad \psi^*_{ij}(\tau) > 0$, then j^* is defined by the following expression:

$$\forall j \in (1, ..., N) \quad s.t. \quad \tau_i \leq \tau_j \wedge j \neq j^* : \quad b_{ij^*} = \frac{1}{2}\frac{(\tau_i - \tau_{j^*})^2 \rho_i}{a d_{ij^*}} - c_{ij^*} > \frac{1}{2}\frac{(\tau_i - \tau_j)^2 \rho_i}{a d_{ij}} - c_{ij} = b_{ij} \tag{10}$$

Note that the intensive margin of $\psi^*_{ij}(\tau)$ depends only on the tax rate differential between i and j, while the extensive margin decision depends on the vector of all municipalities' tax rates τ. In the absence of fixed costs c_{ij}, j^* is simply defined as the municipality j with the highest ratio of squared tax differential $(\tau_i - \tau_j)^2$ to distance d_{ij}.

Municipality problem: Municipality i receives revenues $R_i(\tau)$ by levying τ_i on the tax base B_i. B_i consists of the not-shifted profits of the local company i and the shifted profits from firms hosted in other municipalities $\sum_{j\neq i} \tau_i \psi^*_{ji}$. Denoting the profits of firm i taxed in municipality i as π_i, we can express municipality i's tax revenues as:

$$R_i(\tau) = \tau_i B_i(\tau) = \tau_i(\tau)\left(\pi_i + \sum_{j\neq i} \psi^*_{ji}(\tau)\right) = \tau_i\left(\rho_i(\tau) - \sum_{j\neq i} \psi^*_{ij}(\tau) + \sum_{j\neq i} \psi^*_{ji}(\tau)\right) \tag{11}$$

The local jurisdiction maximizes its tax revenue $R_i(\tau)$ by choosing the optimal tax rate τ^*_i, taking into account the firm's optimal reaction as well as the tax rates set by other municipalities.

$$\max_{\{1\geq\tau_i\geq 0\}} \left[\tau_i\left(\rho_i - \sum_{j\neq i} \psi^*_{ij}(\tau) + \sum_{j\neq i} \psi^*_{ji}(\tau)\right)\right] \tag{12}$$

Solving the general model ($N > 3$) is beyond the scope of this paper. Nevertheless, a simple illustration of the local tax base sensitivity that local governments face when choosing the optimal tax rate τ_i can give a first intuition of the driving forces in the outlined model. Suppose there are N jurisdictions, which may differ in their size ρ_i and spatial distance to each other d_{ij}. Assume that there are no fixed costs of profit shifting and that at the status quo, all jurisdictions choose the same tax rate, $\forall i : \tau_i = \bar{\tau}$. Under the equal tax rate regime, no firm will shift its profits, so that the local tax base equals the local firm's profits, $\forall i : B_i(\tau) = \rho_i$. Keeping all other tax rates

τ_{-i} constant, a unilateral deviation from τ_i to $\tau_i - \mu$ increases municipality i's tax base to:

$$B_i(\tau) - B_i(\tau_i - \mu, \tau_{-i}) = \sum_{j \neq i} \psi^*_{ji}(\tau_i - \mu, \tau_{-i}) = \sum_{j \neq i} \mu \frac{\rho_j}{ad_{ij}} = \sum_{j \neq i} \frac{\mu}{\partial^2 C_{ij}(\psi_{ij})/\partial \psi^2_{ij}} \tag{13}$$

Thus, the tax base sensitivity to a unilateral deviation directly depends on the shape of firms' cost functions $\frac{1}{\partial^2 C_{ij}(\psi_{ij})/\partial \psi^2_{ij}}$. The tax base attracted from the jurisdiction j increases in the size of pretax profits ρ_j and decreases in the shifting cost parameter a and distance d_{ij}. Consequently, municipalities close to large agglomerations can gain more than similar municipalities in remote areas.[48]

Two municipalities case ($N = 2$): Suppose that there are only two municipalities, A and B. Assume that $c_{AB} = c_{BA} = 0$.[49] The municipalities simultaneously choose their optimal tax rate, taking the firms' profit shifting behavior into account. Firms choose the optimal amount of shifted profits after the municipalities have set the tax rates. The revenue function of municipality A is described as:

$$R_A(\tau_A, \tau_B) = \begin{cases} \tau_A \left(\rho_A - \dfrac{(\tau_B - \tau_A)\,\rho_A}{a\, d_{AB}} \right) & \text{if } \tau_A \geq \tau_B, \\[2ex] \tau_A \left(\rho_A + \dfrac{(\tau_B - \tau_A)\,\rho_B}{a\, d_{AB}} \right) & \text{if } \tau_A \leq \tau_B. \end{cases} \tag{14}$$

Define the ratio of the size parameters as $\theta_{AB} = \frac{\rho_A}{\rho_B}$. The best response correspondence if $\theta_{AB} \leq 1$ is defined by (see Section D):

$$\tau_A(\tau_B) = \begin{cases} \frac{1}{2}\left(ad_{AB} + \tau_B\right) & \text{if } \tau_B \leq ad_{AB}\sqrt{\theta_{AB}}, \\[2ex] \frac{1}{2}\left(ad_{AB}\theta_{AB} + \tau_B\right) & \text{if } \tau_B \geq ad_{AB}\sqrt{\theta_{AB}}. \end{cases} \tag{15}$$

[48] In recent work, Agrawal et al. (2025) study tax competition games where the shape of cost functions $C_{ij}(\psi_{ij})$ may differ between firms. The authors show that in the non-duopolity case ($N > 2$), the standard result that larger jurisdictions choose higher tax rates does not necessarily hold true. The outlined cost function can be interpreted as one specific implementation belonging to the more general set of functions studied by Agrawal et al. (2025). It shows how distance-dependent shifting costs can be a reason for firms' heterogeneous cost functions.

[49] The first assumption is made so that we can ensure that any profit shifting will place. This assumption is similar to assuming infinite reservation prices in the commodity tax setting described in Kanbur & Keen (1993). Firm i's optimal amount of shifted profits can be expressed as $\psi^*_{ij} = \max\left(0, \frac{(\tau_i - \tau_j)\rho_i}{ad_{ij}}\right)$ where $\psi^*_{ij} = 0$ if $\tau_i < \tau_j$. As long as the tax rates are not identical, the firm located in the high-tax municipality will shift part of its profits to the low-tax municipality. Alternatively, one could assume that c_{AB} or c_{BA} are sufficiently small.

while the best response correspondence if $\theta_{AB} \geq 1$ is defined by:

$$\tau_A(\tau_B) = \begin{cases} \frac{1}{2}\left(ad_{AB} + \tau_B\right) & \text{if } \tau_B \leq ad_{AB}, \\ \\ \tau_B, & \text{if } ad_{AB} \leq \tau_B \leq ad_{AB}\theta_{AB} \\ \\ \frac{1}{2}\left(ad_{AB}\theta_{AB} + \tau_B\right) & \text{if } \tau_B \geq ad_{AB}\theta_{AB}. \end{cases} \tag{16}$$

The best response correspondences depict an asymmetry depending on a country's relative size. If municipality A is smaller than B ($\theta_{AB} < 1$), its best response $\tau_A(\tau_B)$ is characterized by a discontinuous shift at $\tau_B = ad_{AB}\sqrt{\theta_{AB}}$. For tax rates $\tau_{AB} < ad_{AB}\sqrt{\theta_{AB}}$ municipality A's best response is to choose a tax rate strictly higher than τ_B, while an increase in τ_B leads to an increase of the optimal tax rate $\tau_A(\tau_B)$ by $\frac{1}{2}\tau_B$. At $\tau_B = ad_{AB}\sqrt{\theta_{AB}}$, municipality A can increase its revenue by a discontinuous cut in its tax rate, choosing a tax rate below the one set by the other municipality. The reduction in the tax rate is optimal as the tax revenue derived from taxing shifted profits ($\tau_A\psi^*_{BA}$) from the larger country outweighs the decrease in revenue derived from its local tax base ($\tau_A\rho_A$). If municipality A is larger than B ($\theta_{AB} > 1$), its best response $\tau_A(\tau_B)$ is a continuous function, strictly increasing in τ_B. This asymmetry is already highlighted by Kanbur & Keen (1993), who investigate the role of country size in a two-country tax competition model. The outlined best response correspondences are equivalent to those derived by Kanbur & Keen (1993) in a commodity tax setting when assuming infinite reservation prices. Without loss of generality, we assume that municipality A is the smaller municipality ($\theta_{AB} < 1$) in the following discourse.

Proposition 1. *Assuming $c_{AB} = c_{BA} = 0$, there exists a unique Nash Equilibrium. The equilibrium tax rates are:*

$$\tau_A(\tau_B) = ad_{AB}\left(\frac{1}{3} + \frac{2}{3}\theta_{AB}\right) \tag{17}$$

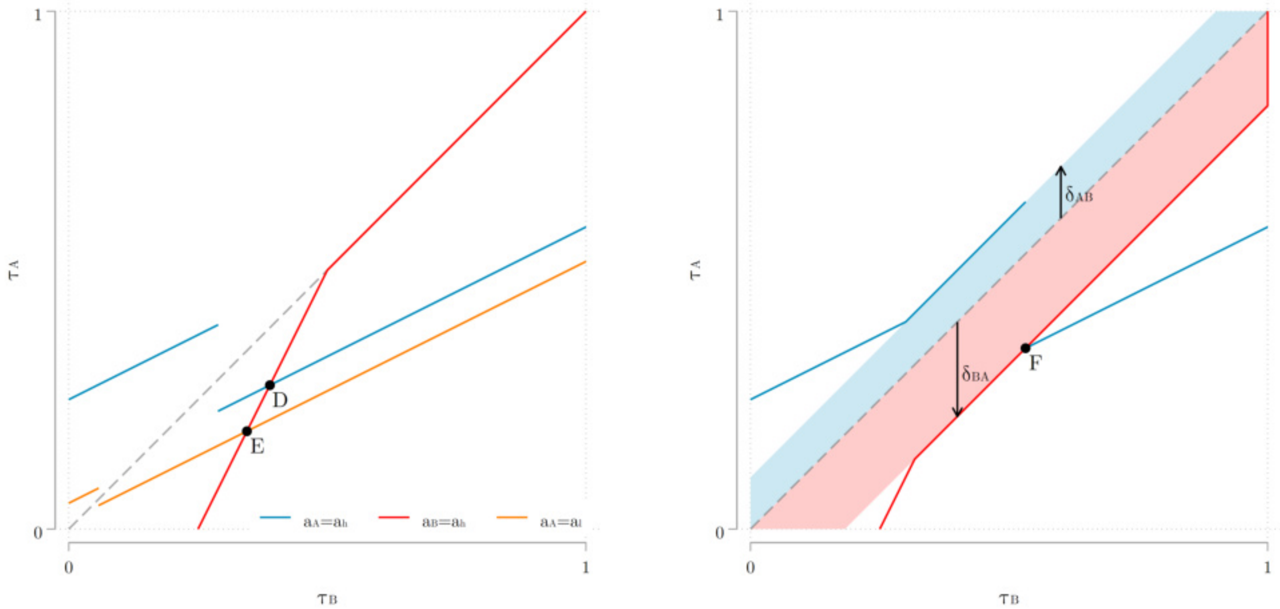
$$\tau_B(\tau_A) = ad_{AB}\left(\frac{2}{3} + \frac{1}{3}\theta_{AB}\right) \tag{18}$$

Proof: see Section D

I want to highlight three things. First, the municipality with the smaller local firm sets a lower tax rate, that is, $\tau_A < \tau_B$ if and only if $\theta_{AB} < 1$ and vice versa. This can be explained via two channels. On the one hand, the municipality with the smaller local firm faces lower costs when setting a low tax rate, as the losses due to lower tax revenues from the local firm are relatively small. On the other hand, the municipality can benefit more from setting a lower rate, as the profit shifting firm in the neighboring municipality is relatively large. Second, the equilibrium tax rates are increasing in cost parameter a and distance d_{AB}. In the absence of fixed costs, firms' cost function is given by $\frac{a}{2}\frac{\psi_{ij}^2}{\rho_i}d_{ij}$. If the costs of profit shifting increase due to an increase in cost parameter a or the spatial distance d_{AB} the optimal amount of shifted profits decreases. Third, if both municipalities are of equal size, the tax rate collapses to the product of cost parameter a and distance d_{AB}.

Figure A9: Equilibrium tax rates with asymmetric information and positive fixed cost

(a) Asymmetric information (b) Positive fixed cost



Note: The figure illustrates the best response correspondences for municipality A and B in settings with asymmetric information or positive fixed costs. The left panel depicts the best response correspondences for different beliefs about cost parameter a. The blue (red) line indicates municipality A's (B's) best response correspondence if $a_A = a_h$ ($a_B = a_h$). The orange line indicates municipality A's best response correspondence if $a_A = a_l$. The intersection of the two best response correspondences depicts the equilibrium. The chosen parameters are $a_l = 0.1$, $a_h = 0.5$, $d_{AB} = 1$, $\rho_A = 1$ and $\rho_B = 3$. The right panel depicts the best response correspondences in a setting with positive fixed cost ($c_{AB} > 0$ and $c_{BA} > 0$). The blue and red area indicates the set of strictly dominated tax rates due to the introduction of positive fixed costs (see Lemma D3). The chosen parameters are $a = 0.5$, $d_{AB} = 1$, $\rho_A = 1$, $\rho_B = 3$, $c_{AB} = 0.01$ and $c_{BA} = 0.1$.

Asymmetric information: Next, we explore the effect of asymmetric information about firms' cost functions on municipalities' optimal tax setting. Suppose municipalities cannot observe firms' cost function; that is, municipality A and B do not know the true value of the cost parameter a. Assume that the local governments hold identical initial beliefs (a_h), which are higher than the true value ($a_h > a = a_l$). Denote a_A and a_B, as the beliefs of municipality A and B about parameter a, respectively. Initial beliefs below the actual value of a are in line with local governments, who generally underestimate firms' abilities to shift profits to another jurisdiction. Local governments may learn about the true parameter a by informal interactions with firm officials.[50] Assume that municipality A learns about the true cost parameter ($a_A = a_l$) while municipality B holds the belief $a_B = a_h$. The following proposition summarizes the effect of a change in municipality A's beliefs on the equilibrium tax rates:

Proposition 2. *Denote* $\{\tau_A^{NE}(\tau_B, a_A, a_B), \tau_B^{NE}(\tau_A, a_A, a_B)\}$ *as the Nash equilibrium corresponding to beliefs* a_A *and* a_B*. If* $\theta \leq 1$, $\forall a_A = a_l < a_h$ *holds that:*

$$\text{(a)} \quad \tau_A^{NE}(\tau_B, a_l, a_h) < \tau_A^{NE}(\tau_B, a_h, a_h) \quad \text{and} \quad \tau_B^{NE}(\tau_A, a_l, a_h) \leq \tau_B^{NE}(\tau_A, a_h, a_h) \tag{19}$$

$$\text{(b)} \quad \frac{\partial}{\partial a_l}\left(\tau_B^{NE}(\tau_A, a_l, a_h) - \tau_A^{NE}(\tau_B, a_l, a_h)\right) < 0 \tag{20}$$

Proof: see Section D

The first part of Proposition 2 states that a unilateral decrease of municipality A's belief over cost parameter a leads to a decrease in the equilibrium tax rates. The reduction in a_A brings A to choose a lower tax rate τ_A for any given τ_B as the cost of profit shifting is lower than initially expected. Keeping the beliefs of municipality B constant, this change in a_A leads to a downward shift of municipality A's best response correspondence. The equilibrium tax rates are lower in the new equilibrium.

The left panel of Figure A9 depicts the best response correspondence of A and B for different beliefs. The blue and red lines indicate municipality A's and B's best response correspondence given their initial beliefs $a_A = a_B = a_h > a_l$. Point D depicts the equilibrium realized for initial beliefs. The orange line illustrates municipality A's best response correspondence for the correct belief $a_A = a_l$. Reducing A's belief about profit shifting cost parameter to the true value a_l leads to a downward shift in municipality A's best response correspondence. The new equilibrium is at point E, with both tax rates below the prior equilibrium D.

The second part of the foregoing proposition states that reducing municipality A's belief over the cost parameter a increases the tax differential in equilibrium. Figure A9 illustrates this finding by the distance between the equilibrium points D and E and the dashed diagonal line. In equilibrium D both municipalities overestimate the true value of cost parameter a, leading to equilibrium tax rates D. A's adjustment to the correct belief $a_A = a_l$ widens the distance between the equilibrium point E and the diagonal line. The observed increase in the difference

[50] Note that this static model abstracts from possible (dynamic) learning based on the observed amount of shifted profits. In the outlined setup, municipalities with wrong beliefs base their decision on a wrong revenue function; hence, there exists a difference between the expected and actual tax revenues the municipalities receive for a given tax differential. In reality, local officials may learn over time about a firm's cost parameters by observing its profit shifting behavior for different tax differentials.

in equilibrium tax rates is explained by a stark decline in A's tax rate and a relatively modest reduction in B's. This finding is especially relevant as local tax havens are often characterized by an overall low tax rate as well as a low tax rate compared to the neighboring city.

Positive fixed costs: Now assume that positive fixed costs exist, that is $c_{AB} > 0$ and $c_{BA} > 0$.[51] Fixed costs influence firms' decisions at the extensive margin, introducing a discontinuity in their profit shifting decision. In the presence of fixed cost of profit shifting, the tax differential $\tau_i - \tau_j$ has to be sufficiently large so that firm i decides to shift its profits to municipality j. Define the threshold of the tax differential $\tau_i - \tau_j$ as $\delta_{ij} = \sqrt{\frac{2ad_{ij}c_{ij}}{\rho_i}}$. Note that $\forall i, j : \delta_{ij} \geq 0$ and $\frac{\partial \delta_{ij}}{\partial \rho_i} < 0$. The extensive margin threshold value decreases in firm size, which is in line with large firms being able to absorb fixed costs more easily when compared with smaller corporations. Differences in fixed costs can be one reason why even same-sized municipalities set different optimal tax rates, as they differ in their ability to attract shifted profits. The existence of the Nash equilibrium (see Proposition 1) without fixed costs can only be guaranteed if (1) fixed costs are sufficiently small compared to the jurisdictions' size differences (Assumption 1) and (2) fix costs do not differ too much between the two municipalities (Assumption 2).

The right panel of Figure A9 depicts municipality A and B's best response correspondences in a setting with positive fixed costs. Positive fixed costs shrink the set of municipalities' possible best responses. It can be shown that $\tau_A(\tau_B) \in (\tau_B - \delta_{BA}, \tau_B + \delta_{AB})$ cannot be a best response of municipality A and $\tau_B(\tau_A) \in (\tau_A - \delta_{AB}, \tau_A + \delta_{BA})$ cannot be a best response of municipality B (see Lemma D3). The equilibrium is depicted at point F. The equilibrium tax rates are higher than in the setting without fixed costs (point D in the left panel). In fact, it can be shown that equilibrium tax rates are always weakly larger in a setting with positive fixed costs than in one without (see Lemma D5).

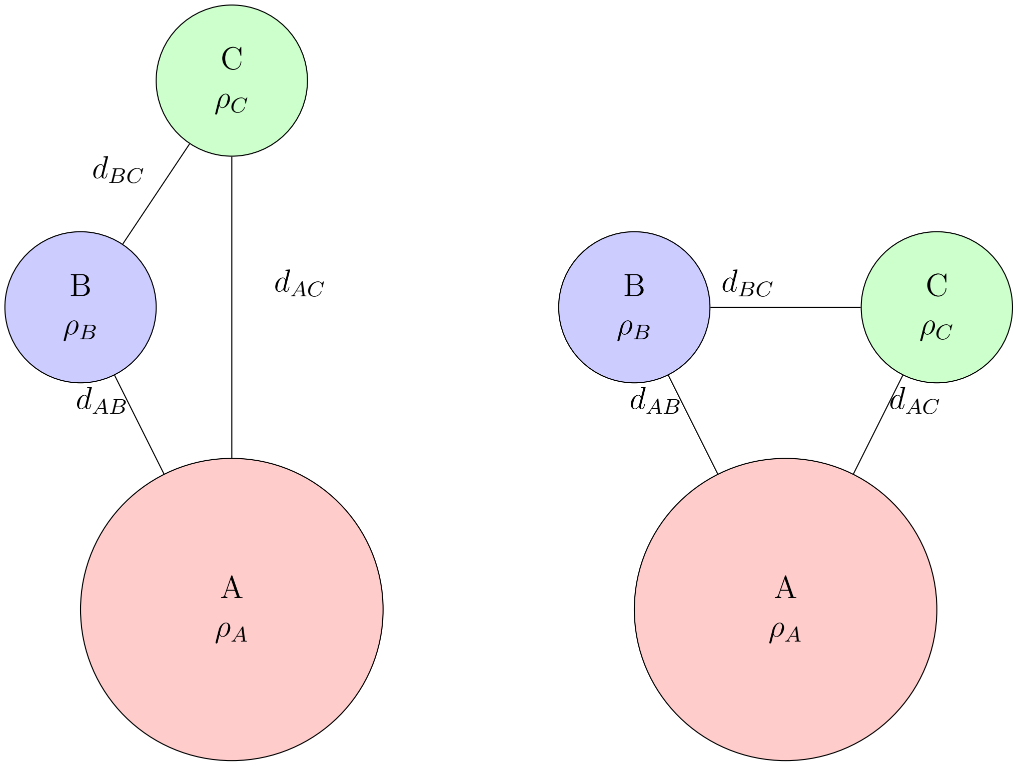
Assumption 1. $(1 - \theta_{AB}) \geq \frac{2(\delta_{AB}+\delta_{BA})}{ad_{AB}}$

Assumption 2. $\delta_{BA} \leq min(\sqrt{ad_{AB}\theta_{AB}\delta_{AB}}, 2\delta_{AB})$

Proposition 3. *For a given set of parameters $\{a, d_{AB}, \rho_A, \rho_B\}$, denote $\{\tau_A^{FC}, \tau_B^{FC}\}$ as the Nash equilibrium with positive fixed costs ($c_{AB} > 0$ and $c_{BA} > 0$) and $\{\tau_A^{NE}, \tau_B^{NE}\}$ as the Nash equilibrium with fixed costs equal zero. If Assumption 1 and Assumption 2 hold then $\{\tau_A^{FC}, \tau_B^{FC}\} = \{\tau_A^{NE}, \tau_B^{NE}\}$.*

Proof: see Section D

[51] In the following, we assume that local governments' beliefs about cost parameters a, c_{AB} and c_{BA} are correct.



(a) Setup 1 (b) Setup 2

Figure A10: Local tax competition ($N = 3$)

Three municipalities case ($N = 3$): Figure A10 illustrates two simple settings containing three municipalities, A, B and C. Throughout this exercise, we assume that the local profits in municipality A are larger than those of municipalities B and C, which are of equal size, i.e., $\rho_A > \rho_B = \rho_C = \rho$. Without loss of generality, let $\rho_A = 1$ so that ρ depicts the size of profits in B and C relative to A. Besides that, municipalities may differ in the distances $d_{ij} \quad i \in \{A, B, C\}, j \neq i$ between each other and the fixed cost c_{ij} of establishing an affiliate in a specific municipality.

The left panel depicts a setting in which the distance between municipality A and B is equal to the distance between B and C, which in turn is smaller than the distance between A and C. For simplicity, assume that the fixed cost parameter $c_{ij} = 0 \quad \forall i, j$. In the unique Nash equilibrium of the outlined tax competition game, municipality B chooses the lowest tax rate. The municipality attracts shifted profits of both of its neighboring municipalities. This finding can be explained by B's relatively small size and its closeness to the large profits of municipality A. The benefit of choosing a low tax rate is larger for B than it is for C, as profits ρ_A can be more easily, that is, cheaper, relocated from A to B than from A to C.

The right panel illustrates a setup where the distances between all municipalities are identical. Assuming that fixed costs are the same in B and C, $c_{AB} = c_{CB} = c_{BC} = c_{AC} = c$, municipality

B and C will choose the same local tax rate ($\tau_B = \tau_C$). As highlighted before, asymmetric information about firms' cost parameters or differences in fixed costs may be two reasons that can explain differences in τ_B and τ_C. First, municipalities may differ in the fixed cost c_{ij} associated with establishing an affiliate within their boundaries. One can show that, holding $c_{CB} = c_{BC}$ constant, if $c_{AB} < c_{AC}$, then $\tau_B < \tau_C$. Second, allowing for asymmetric information, local governments may not know the actual parameters of firms' profit shifting cost function. By way of example, local governments' beliefs $\tilde{a}$ about firms' cost parameter a may be higher than the actual cost a. Based on the outlined beliefs $\tilde{a} > a$ equilibrium tax rates $\tilde{\tau}_i \quad \forall i$ will be higher than in the equilibrium with perfect information. Personal interactions between local governments and firms in their close neighborhood may cause some local governments to update their belief about firms' cost parameters. Suppose that firm A interacts with the local governments of municipality B, leading policymakers in B to adjust their belief about a to the true value. All things equal, it can be shown that this change in local government B's belief leads the municipality to choose a lower local tax rate than municipality C.

A8 Commercial Register Data (*Handelsregister*)

The German Commercial Register (*Handelsregister*) is a public register that plays a central role in ensuring legal transparency and certainty in commercial transactions in Germany. It contains information about companies and business partnerships legally required to register their operations. Most importantly, the register provides information about a business's legal status, registered office, representative, subscribed capital, and business purpose.

Structure and scope: Any business operating as a commercial business (*Handelsgewerbe*) must register in the commercial register. This applies to companies with a corporate form and sole proprietors if their business activities reach a certain scale and complexity.[52] The commercial register is structured into two main parts: part A (*Abteilung A*) and part B (*Abteilung B*). Part A primarily records partnerships and other entities where the business is run by natural persons, such as the *Offene Handelsgesellschaft (OHG)*, *Kommanditgesellschaft (KG)*, and the hybrid form *GmbH & Co. KG*, where liability issues and management structures are distinctly different from those in corporations. In contrast, part B is dedicated to incorporated companies with a legal personality and limited liability, such as the *Gesellschaft mit beschränkter Haftung (GmbH)*, *Aktiengesellschaft (AG)*, *Unternehmergesellschaft (UG)*, and other similar legal forms. Not every business in Germany is required to register. For instance, freelancers and professionals (e.g., lawyers, doctors, tax consultants) who operate in liberal professions (*freie Berufe*) usually fall outside the mandatory scope of the commercial register. Registration and subsequent changes in the commercial register are subject to a fee. Notary fees are also incurred for the registration certification or the notarization of the articles of association for corporations.

Data access: The commercial register has been kept entirely electronically since 2007. Access to the commercial register is provided either at the respective local court or online via the joint register portal of the federal states. The obligation to pay a fee for accessing specific contents of the register was abolished on August 1, 2022. I draw on the commercial register database provided by the *OffeneRegister* and *OpenCorporate* initiatives (OffeneRegister & OpenCorporate, 2024). The dataset is based on web scrapping of the commercial register announcements (*Handelsregisterbekanntmachungen*) and, to a lesser extent, on search results listings of the

[52] Small businesses (*Kleingewerbe*) do not have to register in the commercial register but can register voluntarily. Note that small businesses are not obliged to keep accounts under commercial law and can, therefore, usually calculate their profit using a cash method of accounting (*Einnahmenüberschussrechnung*). Note that although small businesses are often not registered in the commercial register, they can be contained in the Local Business Tax Statistic and the Establishment History Panel.

commercial register. The commercial register announcements inform about registration, deletion, or amendments of entries in the register. I use the commercial register predominantly to get information on companies' movement patterns, that is to explore where companies were located before they moved to a local tax haven. This information is well covered in the commercial register announcements. For the purposes of this project, I am using the years 2010 to 2019, as data coverage appears to be poorer in the earlier years.

Classifying firms: I classify the firms by their stated business objective. The commercial register gives information on a firm's business objective as a free text field. I classify firms as *wealth management* or *real estate management*. A firm is classified as a wealth managing firm if the firm's objective contains (1) a word related to wealth, e.g. wealth (*Vermögen*), capital investments (*Kapitalanlage*) or share in a company (*Unternehmensbeteiligung*), and (2) a word related to managing, e.g. managing (*Verwalten*), holding (*Holding*) or acquire (*Erwerben*). Similarly, a firm is classified as a real estate managing firm if the firm's objective contains (1) a word related to real estate, e.g. real estate (*Grundbesitz*), property (*Grundstück*) or properties (*Immobilien*), and (2) a word related to managing, e.g. managing (*Verwalten*), leasing (*Verpachten*) or letting (*Vermietung*).

A9 Large Tax Cuts and Local Tax Havens

The case study in Section 6.1 and the dynamic profit shifting estimations in Section 6.2 utilize large tax cuts in tax haven jurisdictions to quantify the amount of shifted profits. In the following, I will extend this approach to other municipalities, outlining possible limitations.

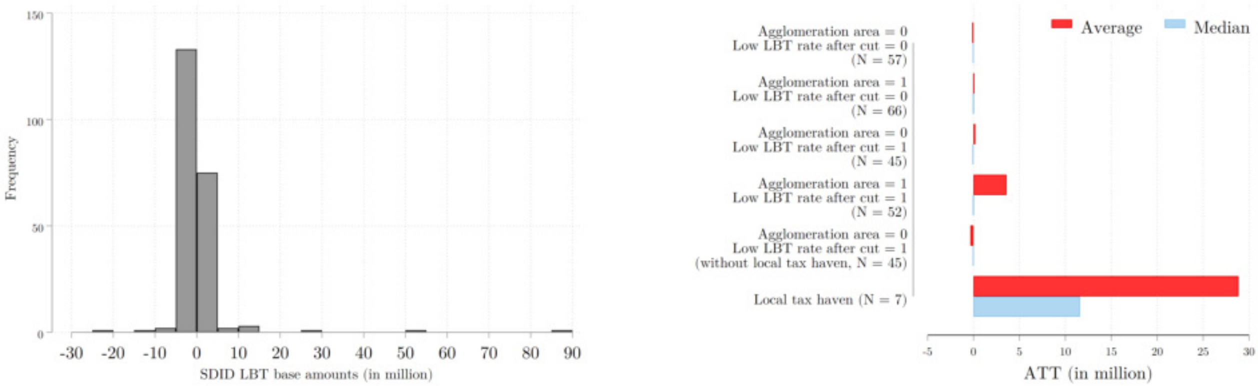
I explore the effect of large tax changes (see Giroud & Rauh, 2019), that is, reductions in the LBT multiplier of at least thirty basis points, on the municipal LBT base and the profit-to-wage sum ratio. This translates to a change in the LBT rate of at least 1.05 percentage points after 2008. Before 2008, the LBT rate depended on a firm's legal form. For corporations (*Kapitalgesellschaften*), a decrease of the LBT multiplier by thirty basis points would translate to a reduction of the LBT rate by 1.5 percentage points. I focus on tax changes between 2003 and 2019, so there are at least five periods before the tax cut occurs. A tax cut in year t which is preceded by a tax increase of at least thirty basis points in year $t-1$ is not treated as a relevant tax cut as it is simply a correction of the previous tax increase. If a municipality has several tax cuts that satisfy the foregoing conditions, I use the first tax cut as the relevant tax cut for the later event study. Applying the foregoing criteria, I identify 237 relevant tax cuts.[53]

Effect on LBT base amounts: I begin by examining the effect of large tax cuts on the LBT base amounts. Attracting a notable amount of LBT base to a jurisdiction is a necessary but not sufficient condition of becoming a local tax haven, as some of the relocation of the tax base may be explained by real economic substance. The left panel of Figure A11 depicts the histogram of Average Treatment Effects on the Treated (ATTs) when estimating the synthetic difference-in-difference estimator (see Equation 2) for each relevant tax cut. The average effect on the LBT base amounts is around 0.864 million Euro (median: -0.063). Most municipalities do not attract a substantial tax base by lowering their tax rate. The right panel depicts the average and median of the estimated ATT distribution for six different subgroups. *Agglomeration area* is a binary variable that indicates if the population in a 30-kilometer radius around a municipality in the year 1998 is above (1) or below (0) the sample median. *Low LBT rate after cut* is a binary variable that indicates if a municipality's post-cut LBT rate is above (1) or below (0) the sample median. *Local tax haven* is a binary variable that indicates if a municipality becomes a local tax

[53]Note that in the following estimations only municipalities without missing values in the dependent variable can be used, so that the number of treated municipalities decreases to 220 (LBT base amount) or 203 (ratio of profits to wage sum). Additionally, municipalities whose annual change in the profit-to-wage-sum ratio is below or above the most extreme 0.01 percent are dropped. This affects nineteen tiny municipalities, susceptible to strongly fluctuating outlier values in the aforementioned ratio. The synthetic control estimates become more stable by dropping these fluctuating outliers from the donor pool.

Figure A11: Effect on LBT base amounts

(a) Distribution of SDID estimates (b) SDID estimates by group



Note: The dependent variable in this figure is the municipal LBT base amounts measured in million Euros. The left panel depicts the distribution of the SDID estimate $\hat{\tau}$ when estimating Equation 2 for all municipalities that have a sufficiently large LBT cut between 2003 and 2019. The right panel depicts the average and median of the estimated ATT distribution for six different subgroups. The sample is split into four subgroups. *Agglomeration area* is a binary variable that indicates if the population in a 30-kilometer radius around a municipality in the year 1998 is above (1) or below (0) the tax cut sample median. *Low LBT rate after cut* is a binary variable that indicates if a municipality's LBT rate is above (1) or below (0) the tax cut sample median. *Local tax haven* is a binary variable that indicates if a municipality becomes a local tax haven in the years after the tax cut. Note that for all observed local tax havens *Agglomeration area* and *Low LBT rate after cut* are equal to one. The numbers depicted in brackets indicate the number of unique municipalities that are contained in the associated subgroup.

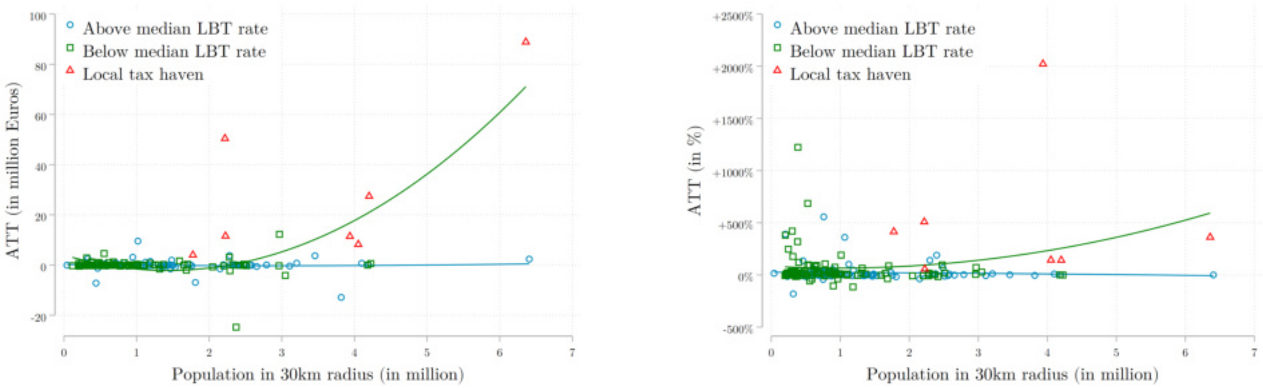
haven in the years after the tax cut. The numbers depicted in brackets indicate the number of unique municipalities that are contained in the associated subgroup. The results show that only municipalities located in an agglomeration area and cutting their tax rate to a relatively low level attract a notable amount of tax base. This result can be attributed entirely to the presence of the seven local tax havens in this group. This finding indicates that creating subgroups through median splits may mask some of the underlying non-linearities. These non-linearities are further explored in Figure A12a. The figure illustrates the relationship between the estimated ATT and the population in a 30-kilometer radius around the municipality. For the group of municipalities with an above median LBT rate after the tax cut, the relationship is entirely flat (blue line). For municipalities with a below-median LBT rate, we observe a non-linear relationship, i.e., the positive correlation increases with the surrounding areas' population size. This result is driven by a few municipalities in close proximity to large agglomerations and a high ATT. Most of these jurisdictions belong to the set of local tax havens.

Effect on profit-to-wage sum ratio: This section extends the foregoing analysis, deploying the profit-to-wage sum ratio as the dependent variable. The left panel of Figure A15 depicts the histogram of Average Treatment Effects on the Treated (ATTs) when estimating the synthetic difference-in-difference estimator (see Equation 2) for each relevant tax cut. The average effect

Figure A12: The role of agglomeration areas

(a) SDID estimates LBT base

(b) SDID estimates profit-to-wage sum ratio

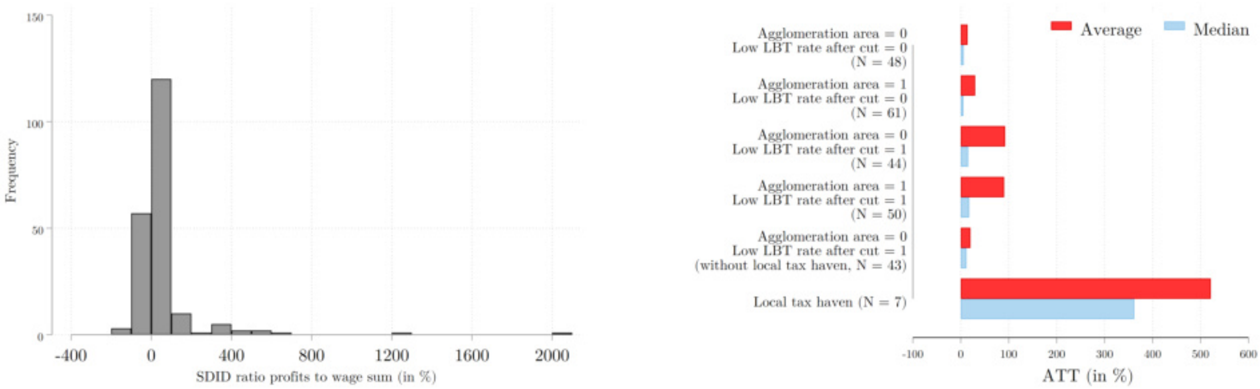


Note: The dependent variables in the left and right panels are the municipal LBT base amounts measured in million Euros and the profit-to-wage ratio measured in percent, respectively. The left panel depicts the estimated ATT on the vertical axis and the population in a 30-kilometer radius around a jurisdiction (in 1998) on the horizontal axis. The graph depicts three groups. The blue markers indicate municipalities where the post-cut LBT rate exceeds the tax cut sample median. The green markers indicate municipalities where the post-cut LBT rate is below the median of the tax cut sample. The green and blue line fit quadratic regression lines through the same colored dots. Note that the local tax haven jurisdictions are a subset of the *Below median LBT rate* group and thus contribute to the estimation of the green line. The right panel illustrates the same relationship as the left panel, deploying the profit-to-wage sum ratio as the dependent variable.

Figure A13: Effect on profit-to-wage sum ratio

(a) Distribution of SDID estimates

(b) SDID estimates by group

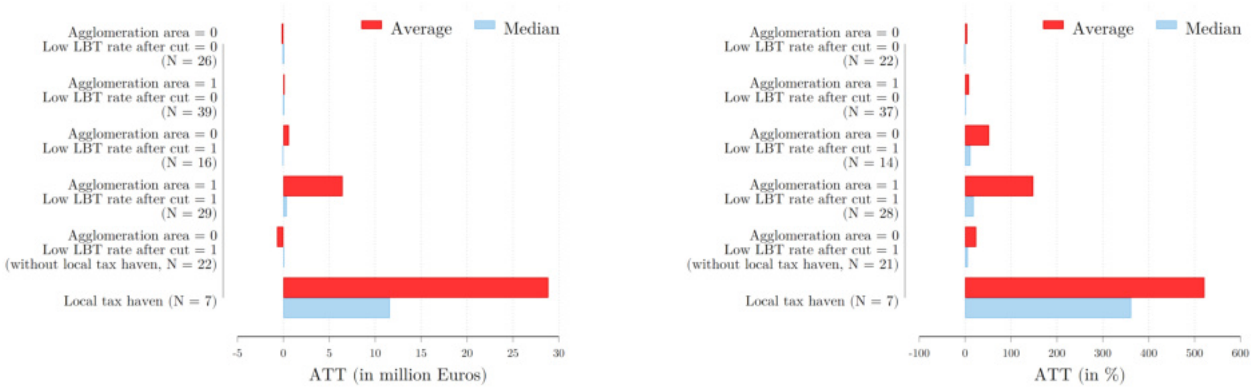


Note: The dependent variable in this figure is the municipal ratio of profits to wage sum measured in percent. The left panel depicts the distribution of the SDID estimate $\hat{\tau}$ when estimating Equation 2 for all municipalities that have a sufficiently large LBT cut between 2003 and 2019. The right panel depicts the average and median of the estimated ATT distribution for six different subgroups. The sample is split into four subgroups. *Agglomeration area* is a binary variable that indicates if the population in a 30-kilometer radius around a municipality in the year 1998 is above (1) or below (0) the tax cut sample median. *Low LBT rate after cut* is a binary variable that indicates if a municipality's LBT rate is above (1) or below (0) the tax cut sample median. *Local tax haven* is a binary variable that indicates if a municipality becomes a local tax haven in the years after the tax cut. The numbers depicted in brackets indicate the number of unique municipalities that are contained in the associated subgroup.

on the profit-to-wage ratio is around 54.569% (median: 9.406%). For most jurisdictions, the municipal profit-to-wage ratio remains essentially unchanged in the aftermath of a large tax cut. As before, the right panel depicts the average and median of the estimated ATT distribution for six different subgroups. The results document that only municipalities that cut their tax rate to a relatively low level show a notable increase in their profit-to-wage sum ratio. The results for the subset of low-tax jurisdictions located near agglomeration areas can be attributed to the presence of the seven local tax havens in this group. Nevertheless, we also find a positive effect for low-tax municipalities that are not in close proximity to an agglomeration area. Part of this result can be explained by small municipalities, which are often located in more remote areas (see Figure A12b). These municipalities have a relatively small working force, meaning that the (highly) fluctuating income tax base can have a substantial impact on the ratio of profit to total wages even though said profits are of a negligible size. Thus, excluding small municipalities from the sample reduces the average ATT of the profit-to-wage sum ratio for this group by roughly half, while the results for the LBT base stay unchanged (see Figure A14).

Figure A14: Excluding small municipalities

(a) SDID LBT base (b) SDID profit-to-wage sum ratio

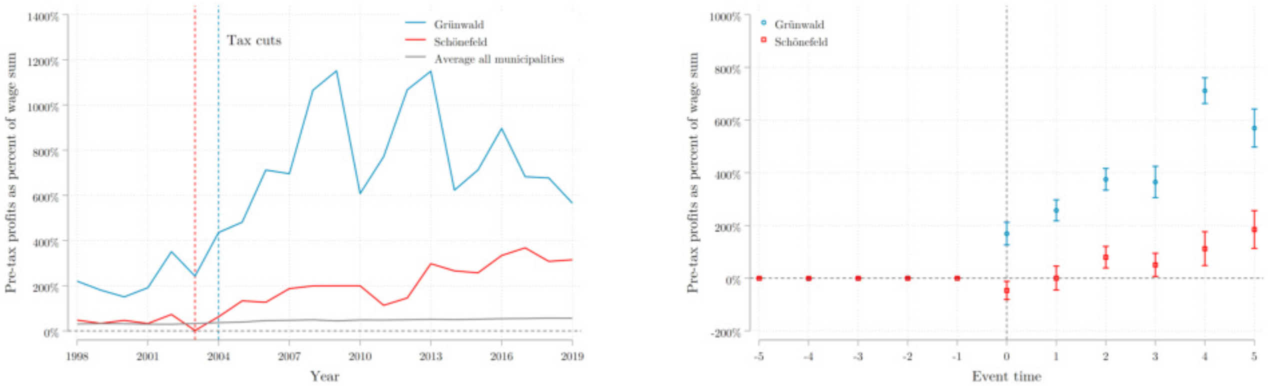


Note: The dependent variables in the left and right panels of this figure are the LBT base and the municipal ratio of profits to wage sum, respectively. The left panel depicts the average and median of the estimated ATT distribution for six different subgroups. The sample is split into four subgroups. *Agglomeration area* is a binary variable that indicates if the population in a 30-kilometer radius around a municipality in the year 1998 is above (1) or below (0) the tax cut sample median. *Low LBT rate after cut* is a binary variable that indicates if a municipality's LBT rate is above (1) or below (0) the tax cut sample median. *Local tax haven* is a binary variable that indicates if a municipality becomes a local tax haven in the years after the tax cut. The numbers depicted in brackets indicate the number of unique municipalities that are contained in the associated subgroup. The right panel depicts the same subgroups, deploying the profit-to-wage sum ratio as the dependent variable. The sample excludes municipalities with a population size below the median in 1998.

Limitations: The outlined approach has two important limitations. First, using large tax cuts as an event to identify the overall profit shifting to a municipality implicitly can only quantify the amount of profits shifted to a jurisdiction after the tax cut occurred. The left panel

Figure A15: Profit-to-wage sum ratio
- *Grünwald* and *Schönefeld* -

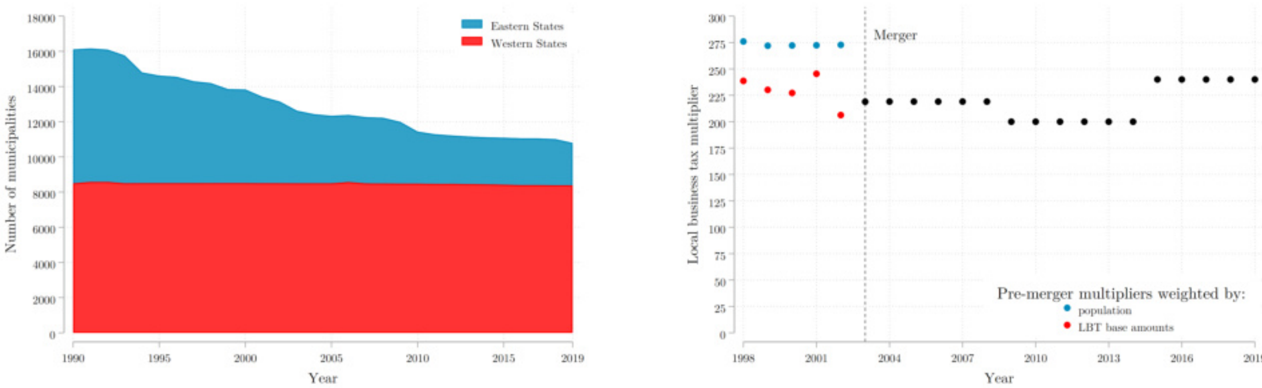
(a) Raw data (b) Dynamic effects



Note: The left panel depicts the development of the profit-to-wage sum ratio in the municipalities Grünwald, Schönefeld and the average across all municipalities between 1998 and 2019. The two vertical dashed lines indicate the years of the local business tax cut in Grünwald (blue) and Schönefeld (red). The left panel depicts the dynamic effect of large tax cuts on the profit-to-wage sum ratio in Grünwald and Schönefeld. The capped spikes depict the 95% confidence intervals based on 1000 placebo simulations.. The presented dynamic estimates are binned for periods which lead ($\leq +5$) or follow ($\geq +5$) the year of the tax cut by five years or more.

Figure A16: Role of municipal mergers

(a) Number of municipalities (b) *Schönefeld* LBT multiplier



Note: The left panel depicts the number of municipalities between 1990 (German reunification) and 2019. The number of municipalities are split by the Eastern and Western states. The Eastern states contain *Brandenburg*, *Mecklenburg-Western Pomerania*, *Saxony*, *Saxony-Anhalt* and *Thuringia*. The right panel depicts the development of the LBT multiplier in *Schönefeld* between 1998 and 2019. The vertical dashed line depicts the year of the municipal merger (2003). The blue (red) dots depict the scenario if the LBT multiplier is computed as a population (LBT base amounts) weighted average for the pre-merger period.

of Figure A15 illustrates the profits-to-wage sum ratio for the two local tax havens *Grünwald* and *Schönefeld* as well as the average across all municipalities between 1998 and 2019. The depicted ratio is remarkably high in *Grünwald* even before the stark increase after the tax cut. The high level of profits relative to the wage sum in the pre-period could be explained by some corporate profit shifting taking place even before the change in the LBT rate. Shifted profits are computed by subtracting the observed taxable profits from the counterfactual. The counterfactual is constructed by assuming that in the absence of the tax cut the pre-period trend of the profit-to-wage sum ratio would follow the same post-trend as the synthetic control group. Profit shifting taking place in pre-period is ignored by this procedure, which would lead to an underestimation of the overall amount of shifted profits in the municipality. Second, municipal mergers make identifying tax cuts in a pre-merger period challenging. Municipal mergers mainly affect municipalities in eastern Germany (see left panel of Figure A16).[54] For municipalities which merge at a certain point in time T, the LBT rate for the pre-merger period, i.e. $1998 \leq t < T$, is computed as a population-weighted average of the LBT rates of the municipalities which merge together (see Section A1). An alternative approach would be to compute use LBT base amounts as weights to compute the pre period LBT rate. The two procedures are illustrated in the right panel of Figure A16 for the case of *Schönefeld*. The municipality is the largest tax haven in eastern Germany and is located in the south of *Berlin*. In 2003, the municipalities *Großziethen*, *Kiekebusch*, *Selchow*, *Waltersdorf* und *Waßmannsdorf* were merged to *Schönefeld*.[55] Using the population-weighted approach (blue) the tax cut is identified right in the year of the tax cut (2003), while the LBT base amounts-weighted approach (red) would identify the tax cut already one year earlier. Using the LBT base amounts as weights leads to more pre-merger LBT rate fluctuation as corporate profits are usually less stable than population numbers. This fluctuation in the deployed weights would lead to an artificially high amount of identified tax cuts in the pre-merger period.

[54] There are only a few municipal mergers between the years 2013 to 2019. Thus, none of the local tax havens is affected by a municipal merger during the period of observation for our main estimation in Section 6.2.

[55] Note that in some of the municipalities in *Brandeburg* and *Saxony-Anhalt*, the merged municipalities were allowed to use their own LBT rate for a certain number of post-merger years to tax the LBT base in their (sub-municipal) jurisdiction. In this case, the municipality's LBT rate is computed as the mean value weighted by the LBT base amount. This is the case in *Schönefeld*, for example, where the merged municipalities were allowed to set their own (sub-municipal) LBT rates until 2008. The dynamic effect on the profit-to-wage sum ratio presented in Figure A13 is robust to dropping the two local tax havens affected by municipal mergers, that is, *Schönefeld* and *Lützen*.

A10 Micro-Level vs Macro-Level Estimates

In the following, I will briefly outline the differences in estimated profit shifting based on micro-level (firm) and macro-level (sector) profits. profit shifting equations are usually estimated based on a log-linear model. The log-linear has two central advantages. First, it eases the interpretation of the estimates as it allows for estimating the semi-elasticity of corporate profits with regard to the tax rate. Second, the log transformation stabilizes the variance and skewness of the profit distribution by compressing the scale. This reduces the influence of outliers. Given the log-linear specification of standard profit shifting estimation equations, I will show that differences between micro-level and macro-level estimates may occur if firms' profits in tax havens are more dispersed than those in non-havens. By way of example, this can be the case if profit shifting is concentrated among a relatively small number of a few large firms (Wier & Erasmus, 2023; Clifford et al., 2025).

The role of firm's profit dispersion: Assume only one sector and two municipalities exist: one local tax haven and one non-haven. There are M firms in the local tax haven and N firms in the non-haven municipality. We denote the profit of a firm located in the tax haven as $\pi_{i,\text{haven}} \forall i \in \{1, ..., M\}$, while the profits of a non-haven firm are denoted as $\pi_{j,\text{non-haven}} \forall j \in \{1, ..., N\}$. For simplicity, we assume that relevant determinants of a firm's profits, such as the number of employees, assets, and productivity, do not differ between firms in tax havens and non-havens. We assume that the number of firms in the tax haven and non-haven are the same $M = N$. Thus, we abstract from possible size effects, i.e., the overall number of firms in a tax haven may, in reality, be larger than those in the non-haven. This size effect would otherwise be picked up by the sector-level profit measure but not on the firm level.

Firm-level: Estimating the excess profits using firm-level data boils down to a simple mean comparison between the log profits of firms located in the tax haven and those located in the non-haven.

$$\Delta_{\text{firm level}} = \frac{1}{M} \sum_{i=1}^{M} \log(\pi_{i,\text{haven}}) - \frac{1}{N} \sum_{j=1}^{N} \log(\pi_{j,\text{non-haven}}) \tag{21}$$

Sector-level: Moving to the sector level, one would aggregate firms' profits to the sector-municipality-level before computing a mean comparison.

$$\Delta_{\text{sector level}} = \log\left(\sum_{i=1}^{M} \pi_{i,\text{haven}}\right) - \log\left(\sum_{j=1}^{N} \pi_{j,\text{non-haven}}\right) \tag{22}$$

It can be shown that the two terms, i.e. the difference in average log profits at the firm level ($\Delta_{\text{firm level}}$) and the difference in the log of sector profits ($\Delta_{\text{sector level}}$), are equal if and only if the distribution of profits is perfectly uniform across all firms in each group. If $\pi_{i,\text{haven}} = \pi_{\text{haven}} \forall i \in \{1, ..., M\}$ and $\pi_{j,\text{non-haven}} = \pi_{\text{non-haven}} \forall j \in \{1, ..., M\}$ then two terms can be simplified to

$$
\begin{aligned}
\Delta_{\text{firm level}} &= \frac{1}{M} \sum_{i=1}^{M} \log(\pi_{i,\text{haven}}) - \frac{1}{N} \sum_{j=1}^{N} \log(\pi_{j,\text{non-haven}}) \\
&= \frac{1}{M} \cdot M \log(\pi_{\text{haven}}) - \frac{1}{N} \cdot N \log(\pi_{\text{non-haven}}) \\
&= \frac{1}{M} \cdot M \log(\pi_{\text{haven}}) - \frac{1}{N} \cdot N \log(\pi_{\text{non-haven}}) \\
&= \log(\pi_{\text{haven}}) - \log(\pi_{\text{non-haven}})
\end{aligned} \tag{23}
$$

$$
\begin{aligned}
\Delta_{\text{sector level}} &= \log\left(\sum_{i=1}^{M} \pi_{i,\text{haven}}\right) - \log\left(\sum_{j=1}^{N} \pi_{j,\text{non-haven}}\right) \\
&= \log\left(\sum_{i=1}^{M} \pi_{\text{haven}}\right) - \log\left(\sum_{j=1}^{N} \pi_{\text{non-haven}}\right) \\
&= \log\left(M \cdot \pi_{\text{haven}}\right) - \log\left(N \cdot \pi_{\text{non-haven}}\right) \\
&= \log\left(M\right) + \log\left(\pi_{\text{haven}}\right) - \log\left(N\right) - \log\left(\pi_{\text{non-haven}}\right) \\
&= \log\left(\pi_{\text{haven}}\right) - \log\left(\pi_{\text{non-haven}}\right)
\end{aligned} \tag{24}
$$

In reality, corporate profits are not uniformly distributed but often depict large heterogeneity in firms' profitability. Allowing for a non-uniform distribution of profits across all firms in each group, the difference between the firm-level and sector-level aggregate can be expressed as

$$
\begin{aligned}
\Delta_{\text{firm level}} - \Delta_{\text{sector level}} &= \left(\frac{1}{M} \sum_{i=1}^{M} \log(\pi_{i,\text{haven}}) - \frac{1}{N} \sum_{j=1}^{N} \log(\pi_{j,\text{non-haven}})\right) \\
&\quad - \left(\log\left(\sum_{i=1}^{M} \pi_{i,\text{haven}}\right) - \log\left(\sum_{j=1}^{N} \pi_{j,\text{non-haven}}\right)\right) \\
&= \left(\frac{1}{M} \sum_{i=1}^{M} \log(\pi_{i,\text{haven}}) - \log\left(\sum_{i=1}^{M} \pi_{i,\text{haven}}\right)\right) \\
&\quad - \left(\frac{1}{N} \sum_{j=1}^{N} \log(\pi_{j,\text{non-haven}}) - \log\left(\sum_{j=1}^{N} \pi_{j,\text{non-haven}}\right)\right)
\end{aligned} \tag{25}
$$

Applying Jensen's Inequality for a concave function, we can show that

$$\log\left(\sum_{i=1}^{M}\pi_{i,\text{haven}}\right) > \log\left(\frac{1}{M}\sum_{i=1}^{M}\pi_{i,\text{haven}}\right) \geq \frac{1}{M}\sum_{i=1}^{M}\log(\pi_{i,\text{haven}}) \tag{26}$$

Let $\mu_{haven} = \frac{1}{M}\sum_{i=1}^{M}\pi_{i,\text{haven}}$ denote the mean of firms' profits in the tax haven. A Taylor expansion of $\log(\pi_{i,\text{haven}})$ around the mean μ_{haven} yields

$$\log(\pi_{i,\text{haven}}) = \log(\mu_{haven}) + \frac{\pi_i - \mu_{haven}}{\mu_{haven}} - \frac{(\pi_i - \mu_{haven})^2}{2\mu_{haven}^2} + \text{higher-order terms} \tag{27}$$

where $\log(\mu_{haven})$ is the logarithm of the mean. $\frac{\pi_i - \mu_{haven}}{\mu_{haven}}$ captures the deviation of $\pi_{i,\text{haven}}$ from the mean μ_{haven}. The third term $-\frac{(\pi_i-\mu_{haven})^2}{2\mu_{haven}^2}$ captures the curvature of the log function and is related to the variance of $\pi_{i,\text{haven}}$. The higher-order terms are typically small and can be ignored for this approximation. Taking the average of the Taylor expansion across all $i \in \{1, ..., M\}$ yields

$$\frac{1}{M}\sum_{i=1}^{M}\log(\pi_{i,\text{haven}}) \approx \log(\mu_{haven}) + \frac{1}{M}\sum_{i=1}^{M}\frac{\pi_{i,\text{haven}} - \mu_{haven}}{\mu_{haven}} - \frac{1}{M}\sum_{i=1}^{M}\frac{(\pi_{i,\text{haven}} - \mu_{haven})^2}{2\mu_{haven}^2} \tag{28}$$

where $\frac{1}{M}\sum_{i=1}^{M}\frac{\pi_{i,\text{haven}}-\mu_{\text{haven}}}{\mu_{\text{haven}}} = 0$ and $\frac{1}{M}\sum_{i=1}^{M}\frac{(\pi_{i,\text{haven}}-\mu_{\text{haven}})^2}{2\mu_{\text{haven}}^2} = \frac{\text{Variance}(\pi_{i,\text{haven}})}{2\mu_{\text{haven}}^2}$ so that we can simplify the equation to

$$\frac{1}{M}\sum_{i=1}^{M}\log(\pi_{i,\text{haven}}) \approx \log(\mu_{haven}) - \frac{\text{Variance}(\pi_{i,\text{haven}})}{2\mu_{\text{haven}}^2} \tag{29}$$

We can plug taking the difference of equation (26) before plugging in equation (29) to get

$$\begin{aligned}
\frac{1}{M}\sum_{i=1}^{M}\log(\pi_{i,\text{haven}}) - \log\left(\frac{1}{M}\sum_{i=1}^{M}\pi_{i,\text{haven}}\right) &\approx \log(\mu_{haven}) - \frac{\text{Variance}(\pi_{i,\text{haven}})}{2\mu_{\text{haven}}^2} - \log\left(\frac{1}{M}\sum_{i=1}^{M}\pi_{i,\text{haven}}\right) \\
&= \log(\mu_{haven}) - \frac{\text{Variance}(\pi_{i,\text{haven}})}{2\mu_{\text{haven}}^2} - \log(\mu_{haven}) \\
&= -\frac{\text{Variance}(\pi_{i,\text{haven}})}{2\mu_{\text{haven}}^2}
\end{aligned}$$

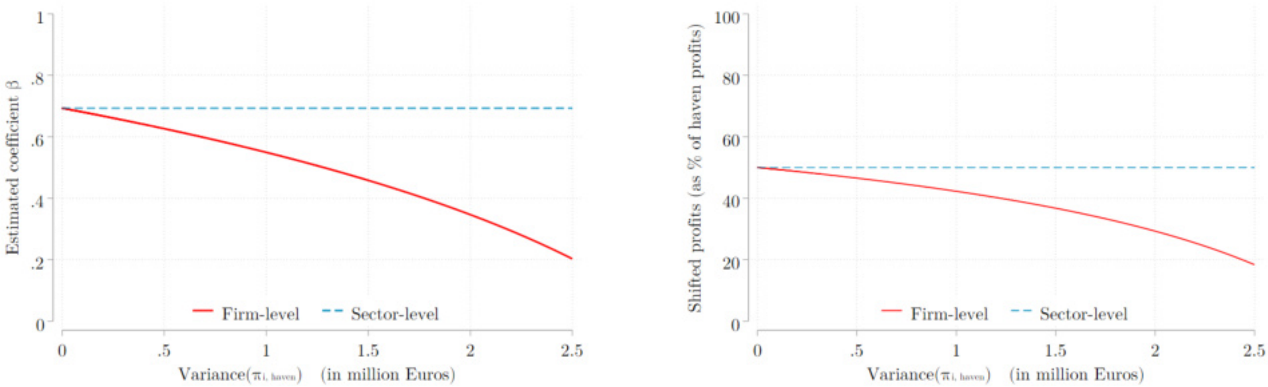
The log function's concavity means it penalizes lower values more than it rewards higher ones. Therefore, if profits are widely dispersed, i.e., the variance of profits is high, the lower values pull down the average of the logs more, leading to a widening gap between the firm-level average of log profits and the aggregated sector-level log profits. Finally, we can plug in the derived approximation in equation (30) to specify the difference between the firm-level and sector-level estimate as

$$
\begin{aligned}
\Delta_{\text{firm level}} - \Delta_{\text{sector level}} &= -\frac{\text{Variance}(\pi_{i,\text{haven}})}{2\mu^2_{\text{haven}}} + \frac{\text{Variance}(\pi_{j,\text{ non-haven}})}{2\mu^2_{\text{non-haven}}} \\
\implies \Delta_{\text{firm level}} \leq \Delta_{\text{sector level}} &\iff \frac{\text{Variance}(\pi_{j,\text{non-haven}})}{2\mu^2_{\text{non-haven}}} \leq \frac{\text{Variance}(\pi_{i,\text{haven}})}{2\mu^2_{\text{haven}}}
\end{aligned}
\tag{30}
$$

As we can see, the first and second differences in equation (30) depend on the mean and variance of firms' profits in both groups, i.e., firms located in the tax haven and those located in the non-haven. Holding the mean of profits at the same level for both groups ($\mu_{\text{haven}} = \mu_{\text{non-haven}}$), the estimation based on the sector-level data yields a higher estimate if firms' profits in the tax haven $\pi_{i,\text{haven}}$ have a higher variance, i.e. are more dispersed than the profits of firms located in a non-haven municipality $\pi_{j,\text{non-haven}}$.

Figure A17 illustrates a simple numerical exercise, illustrating the foregoing argument. I constructed a dataset containing two municipalities, one as a tax haven the other one as a non-haven. Firms in both municipalities operate in just one sector. The average profits of firms located in the tax haven are double the profits of firms in the non-haven jurisdiction. The profits in the non-haven are set to be uniform that is, the variance of profits in the non-haven municipality equals zero. As a starting point, I assume that the profits of firms located in the tax haven jurisdiction are also distributed uniformly. As we have shown, for a uniform distribution of profits within each group, the firm-level and sector-level yield the same estimate. Subsequently, I steadily increase the variance of profits in the tax haven municipality by deploying a mean-preserving spread of the profit distribution. The sector-level estimate does not change as it is not affected by the underlying dispersion of firm profits. The firm-level estimate declines as the variance of tax haven profits increases, diverging more and more from the sector-level estimate.

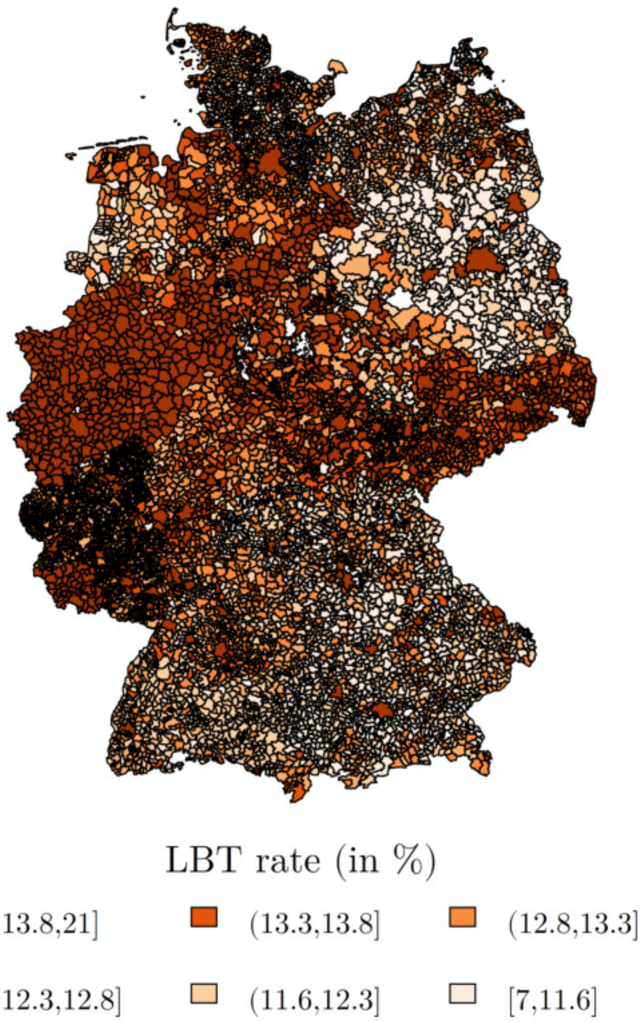
Figure A17: Dispersion of Profits and Profit Shifting Estimates



Note: The left panel illustrates the estimated coefficient when regressing the logarithm of firms' profits on a tax haven dummy. The red line indicates the results for the estimation based on sector-level, i.e., aggregated, data, while the blue line depicts the estimated coefficient based on firm-level data. The variance of the profits of firms located in the tax haven is gradually increased based on a mean-preserving split. The right panel illustrates the estimated shifted profits based on the coefficients depicted in the left panel. The shifted profits are stated as a percentage of overall profits located in tax havens. For this simulation, average profits in non-haven and tax haven municipalities are assumed to be 1000 and 2000 Euros, respectively.

B Additional Figures

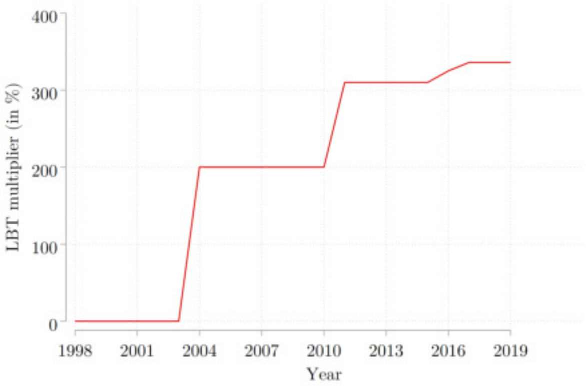
Figure B1: LBT rates in Germany (2019)



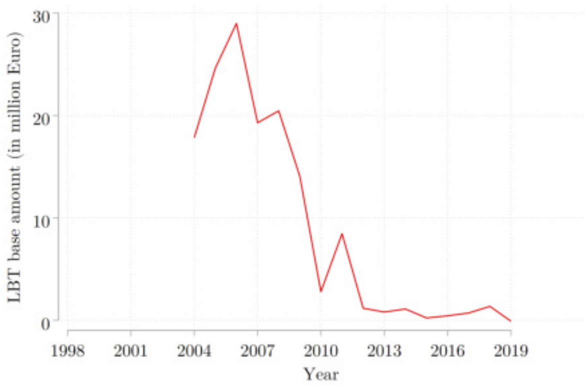
Note: The figure illustrates distribution of LBT rates in Germany in 2019. The blank areas within Germany are non-municipal territories (*gemeindefreie Gebiete*) or municipalities with missing population counts or missing information on local business tax rates.

Figure B2: Dissolution of a local tax haven

(a) Norderfriedrichskoog LBT multiplier

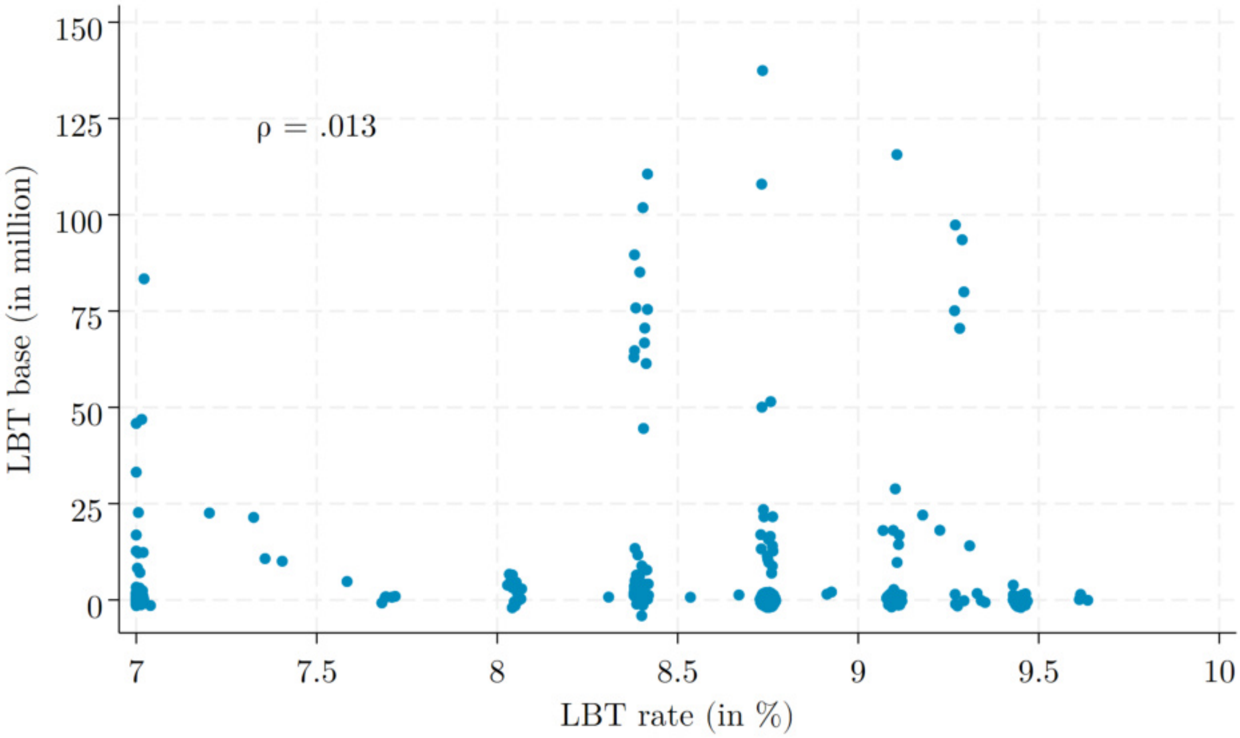


(b) Norderfriedrichskoog LBT base amount



Note: The figure illustrates the development of the LBT multiplier and LBT base in *Norderfriedrichskoog*.

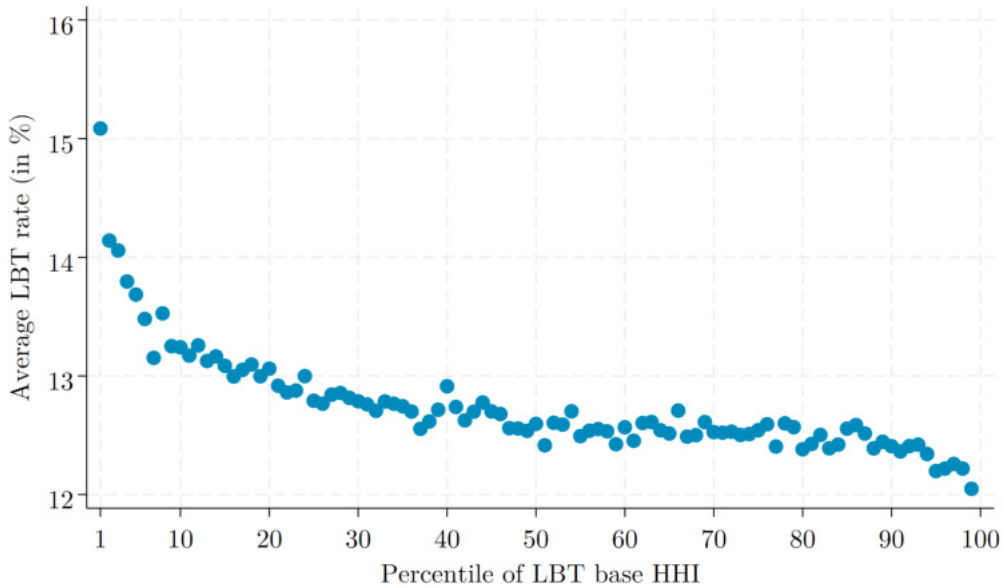
Figure B3: LBT rate and base (low-tax municipalities)



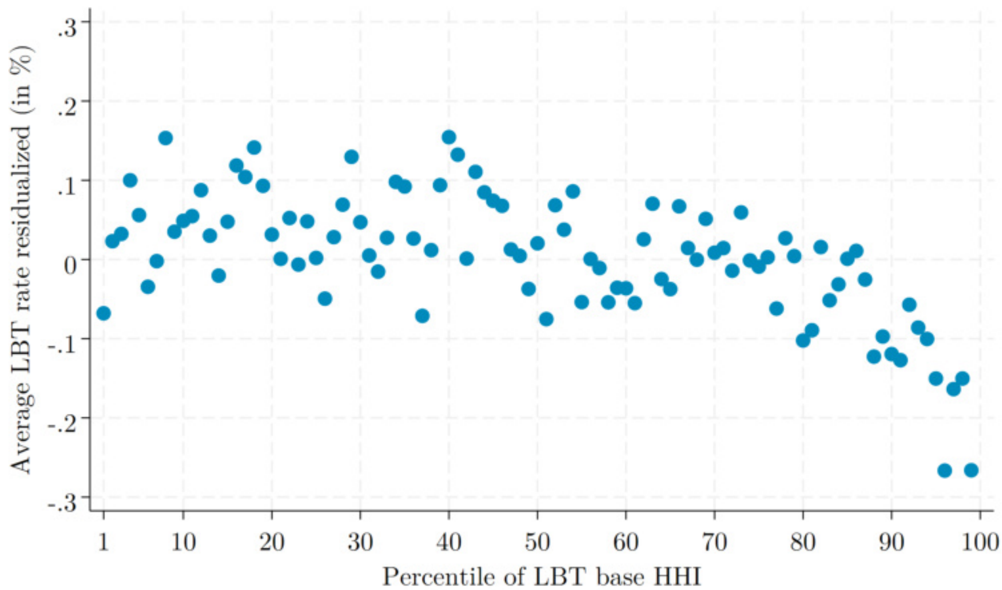
Note: The figure illustrates a scatter plot of the LBT rate and base for the estimation sample covering the years 2013 to 2019. ρ depicts the correlation coefficient for the two variables. A small number of random noise is added to the markers to enhance visibility (STATA command: jitter(1)).

Figure B4: LBT rate and LBT base concentration

(a) LBT rate

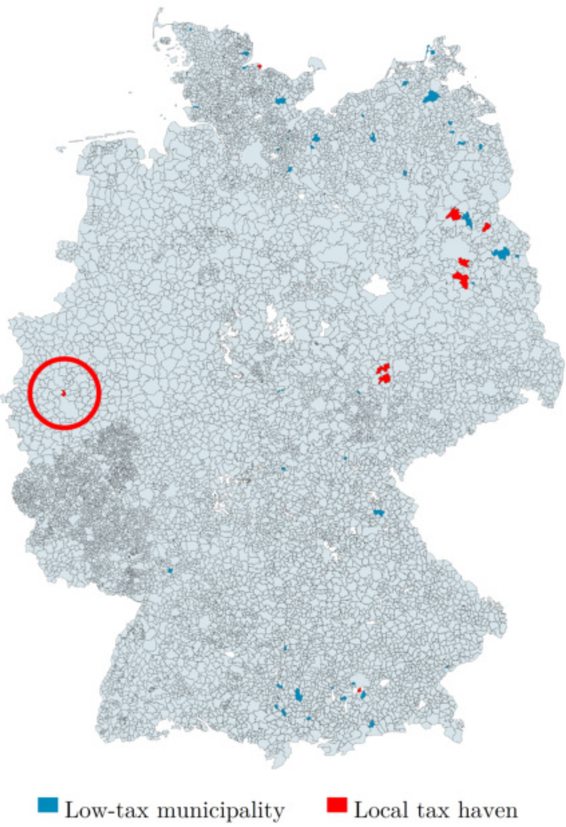


(b) LBT rate residualized

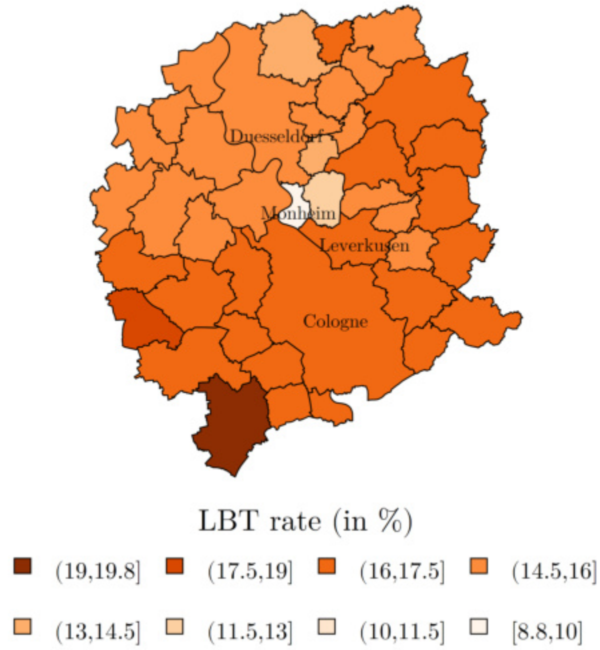


Note: The first panel illustrates the average LBT rate for each LBT base concentration percentile. The second panel illustrates the average LBT rate residualized for each LBT base concentration percentile. The residualized LBT rate is computed by regressing the LBT base concentration on the overall size of the LBT base and population (both as linear and squared terms) as well as year×state fixed effects. The LBT base concentration is measured by computing the Herfindahl-Hirschman index for each municipality-year observation. All data is from the years 2013 to 2019.

Figure B5: Location Monheim am Rhein



(a) Germany

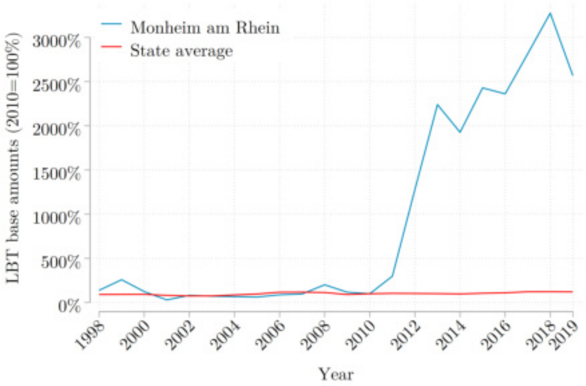


(b) Close neighborhood

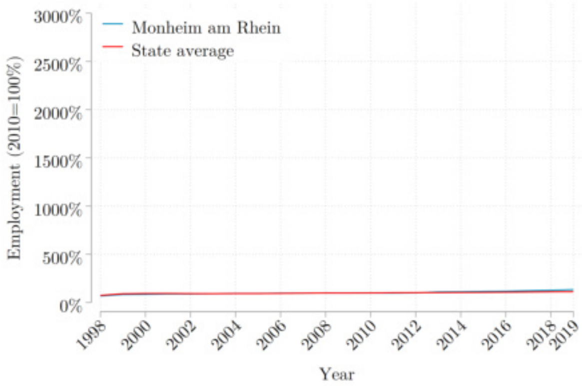
Note: The figure illustrates the location of Monheim am Rhein in Germany (left panel) as well as in its close neighborhood (right panel). All data refer to the year 2019. The blank areas within Germany are non-municipal territories (*gemeindefreie Gebiete*) or municipalities with missing population counts or missing information on local business tax rates.

Figure B6: LBT base amount increase vs real economic activity (normalized 2010 = 100%)

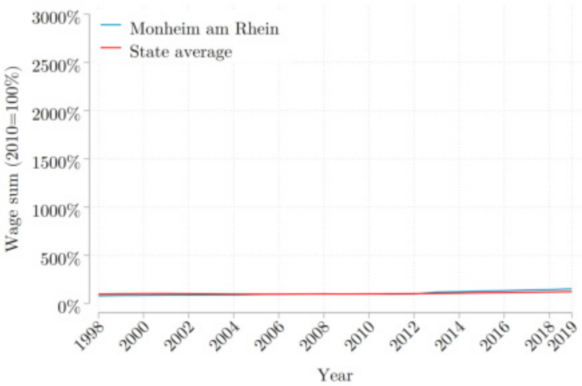
(a) LBT base amount



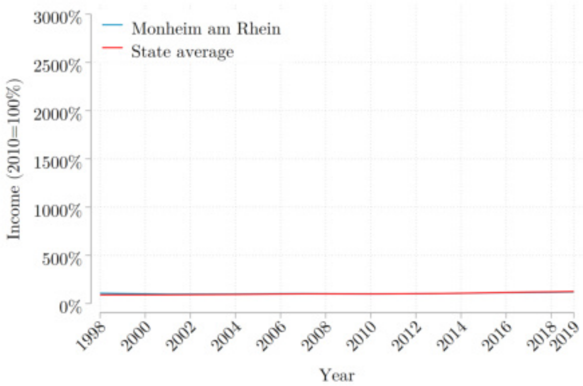
(b) Employment



(c) Wage sum

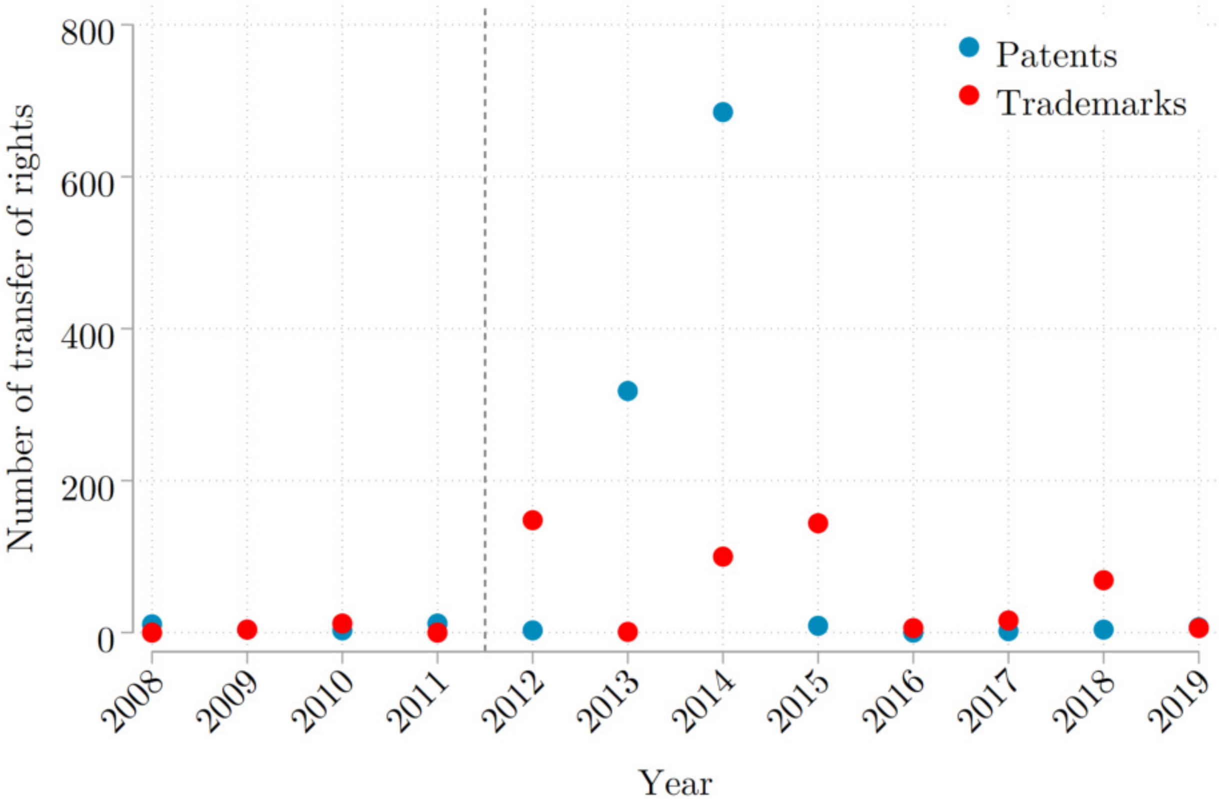


(d) Income



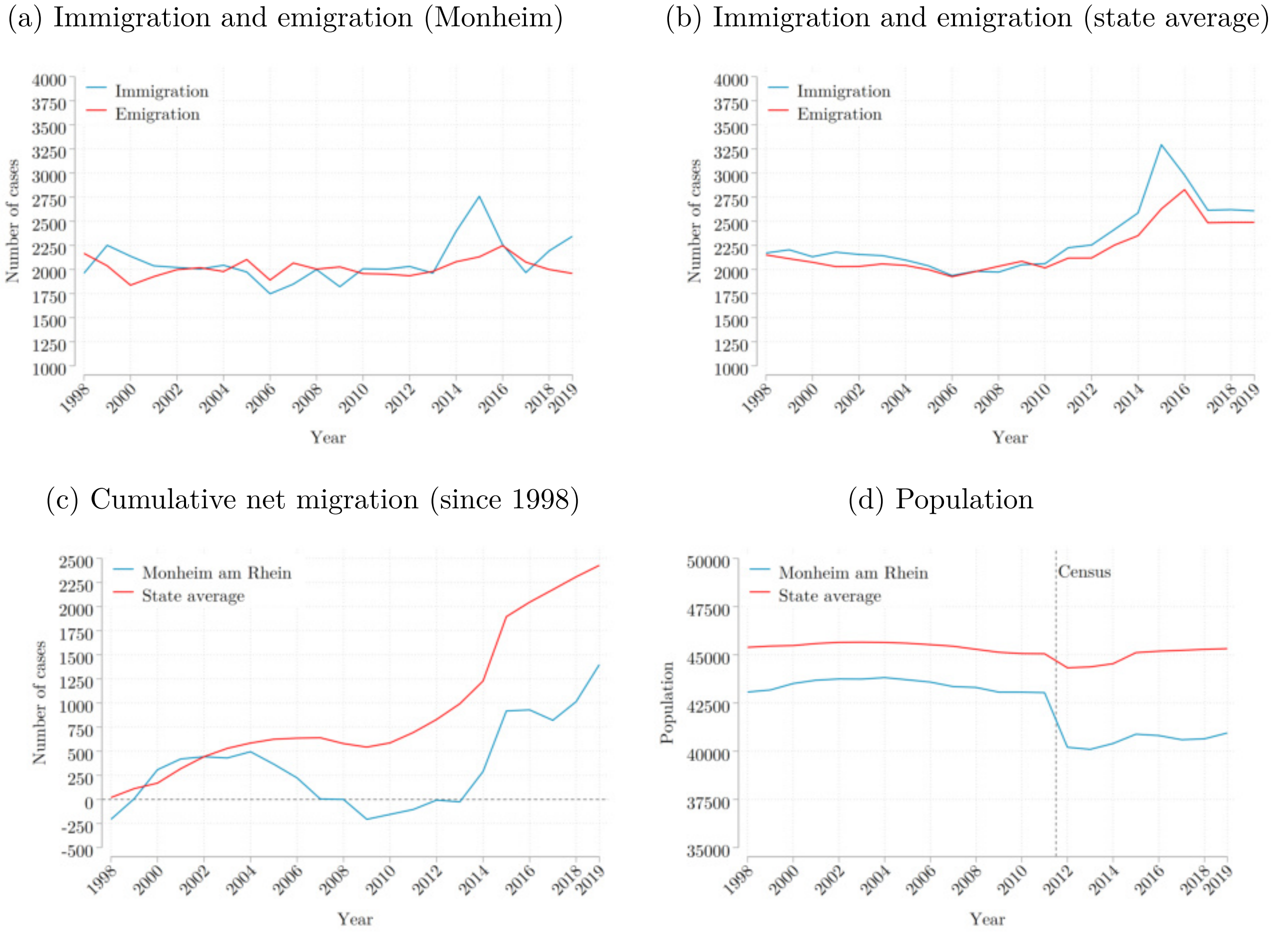
Note: The figure illustrates the development of the LBT base amount (upper left), employment (upper right), wage sum (lower left) and income (lower right) in Monheim am Rhein and the state average between 1998 and 2019. All values are normalized relative to 2010. Employment and wage sums are based on the Establishment History Panel (BHP), which covers all firms with at least one employee liable to social security. The income variable is based on the wage and income tax statistics. It constitutes the sum of all income liable to personal income or payroll tax of individuals resident in the municipality.

Figure B7: Transfer of patents and trademarks to Monheim (2008-2019)



Note: The figure illustrates the number of transfers of rights of patents and trademarks to individuals and firms located in *Monheim*. The dataset only includes patents and trademarks that were not previously located in the municipality but were transferred from outside its jurisdiction into the municipality. The data is based on information from the German Patent and Trademark Office (DPMA) for the years 2008 to 2019.

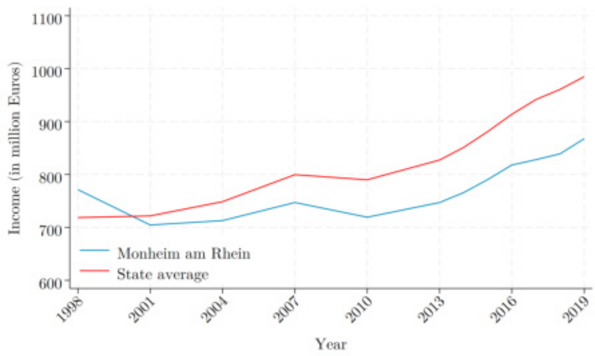
Figure B8: Population and migration (1998-2019)



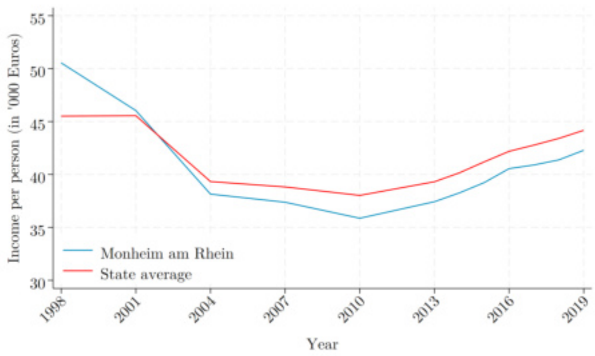
Note: The figure illustrates the development of the immigration, emigration, and population numbers in Monheim am Rhein and the state average between 1998 and 2019. Immigration and emigration are measured as the relocation of the main place of residence across municipal boundaries. The upper left panel depicts the immigration and emigration cases in Monheim. The upper right panel depicts the immigration and emigration cases as an average across the state's municipalities. The lower left panel depicts the cumulative net migration for Monheim and the average municipality. The lower right panel depicts the population development for the two groups. Note that there was a census in 2011, which explains the sudden jump in the population statistics. Additionally, note that the increase in immigration around 2015 may partly be attributed to the increase in the number of refugees who came to Germany. The data does not distinguish by refugee status.

Figure B9: Income and unemployment (1998-2019)

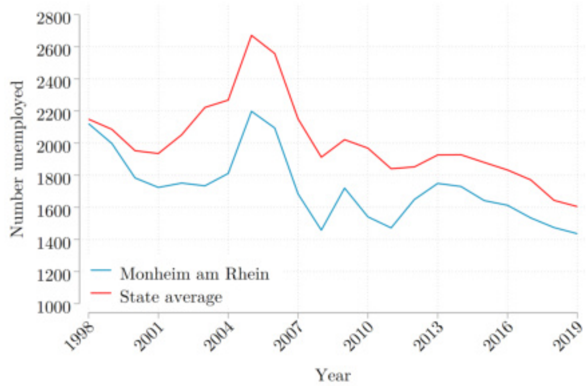
(a) Sum of income



(b) Average income



(c) Number of unemployed

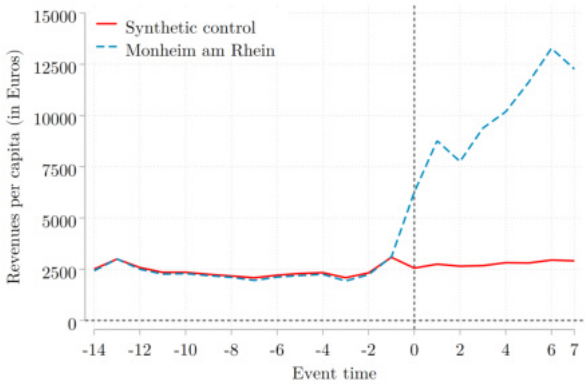


Note: The figure illustrates the development of residents' income and the number of unemployed in Monheim am Rhein and the state average between 1998 and 2019. The income information is based on the payroll and income tax statistics (*Lohn- und Einkommensteuerstatistik*), providing information on the income of all natural persons liable to payroll or income tax residing in a specific municipality. The upper left panel depicts the sum of residents' income in Monheim. The upper right panel depicts the sum of residents' income divided by the number of cases. The lower panel depicts the number of unemployed individuals. This information is provided by the German Federal Employment Agency (*Bundesagentur für Arbeit*).

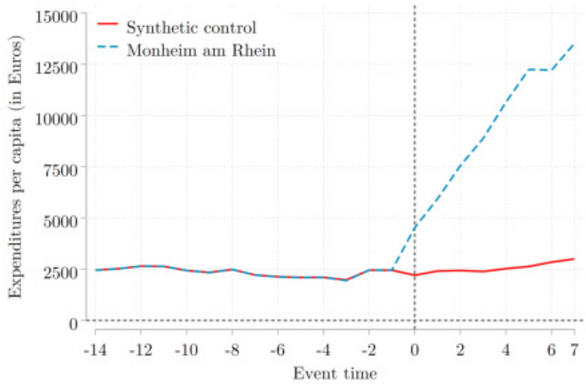
Figure B10: Letterbox companies in Monheim am Rhein (December 2024)

Figure B11: Public finances
- Monheim and its synthetic control -

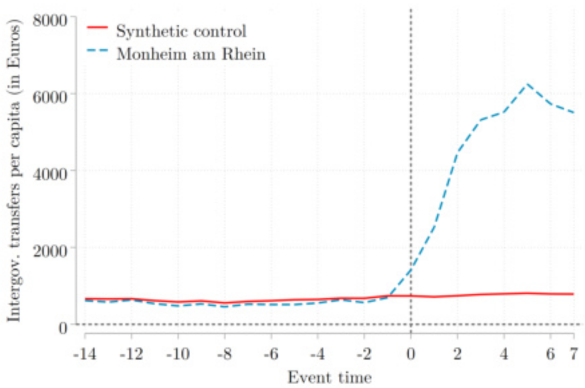
(a) Revenues



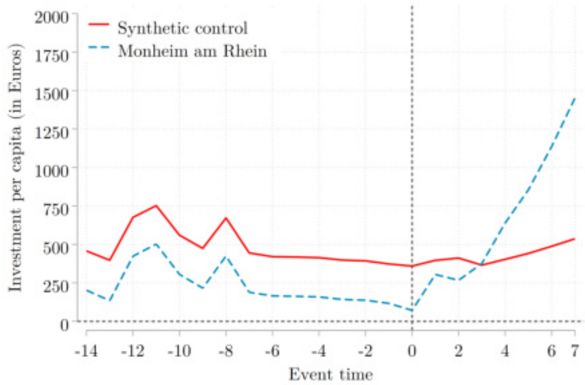
(b) Expenditures



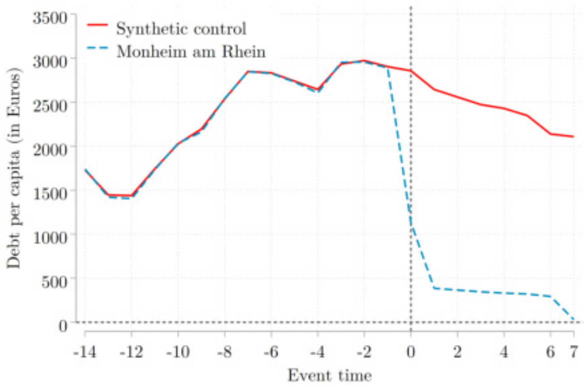
(c) Payment to intergovernmental transfer schemes



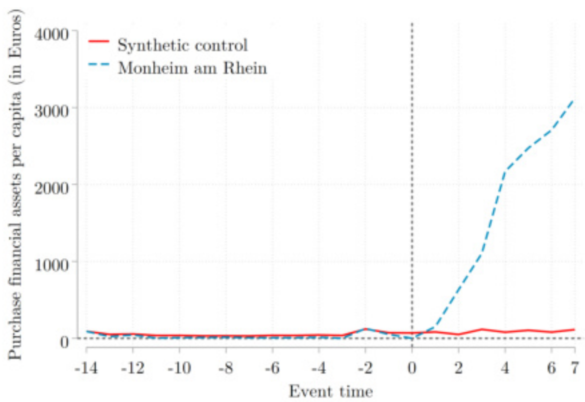
(d) Investment



(e) Debt



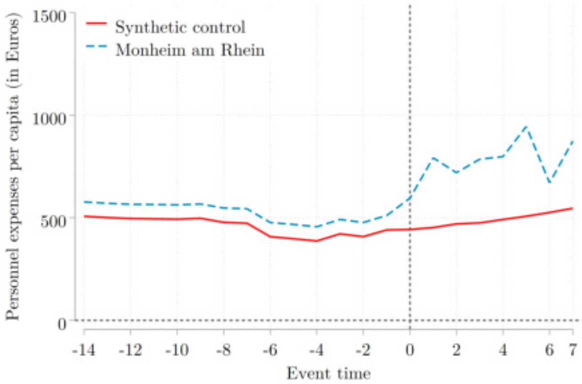
(f) Purchase of financial assets



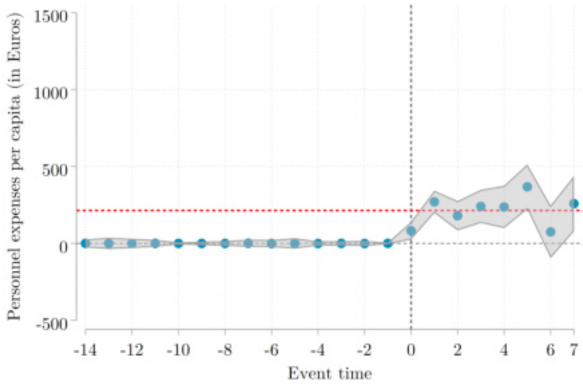
Note: The figure illustrates the development of the public finance variables in *Monheim* and its synthetic control. All variables are depicted in Euros per capita. Event time zero corresponds to the year 2012.

Figure B12: Personnel and material expenses
- Monheim and its synthetic control -

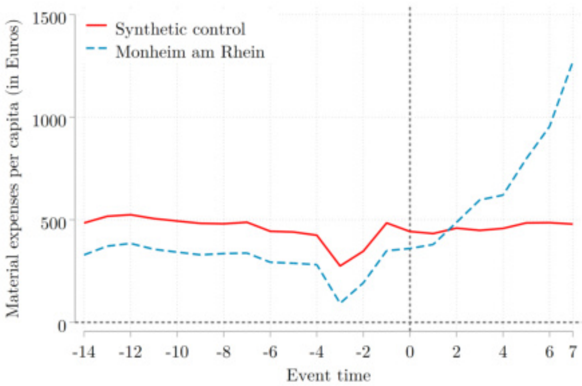
(a) Personnel expenses (levels)



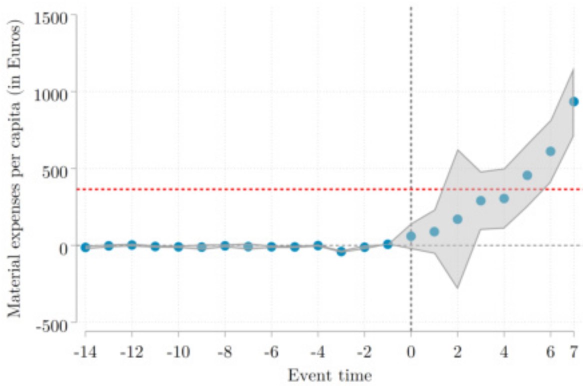
(b) Personnel expenses (difference)



(c) Material expenses (levels)



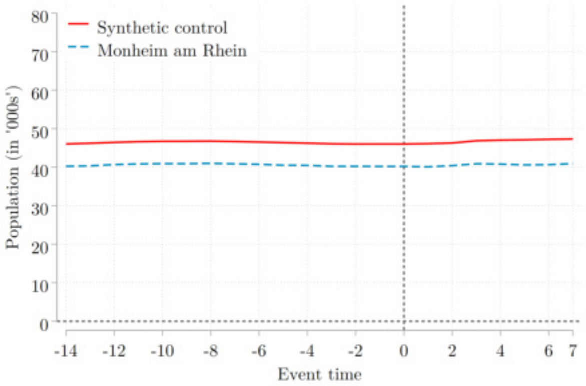
(d) Material expenses (difference)



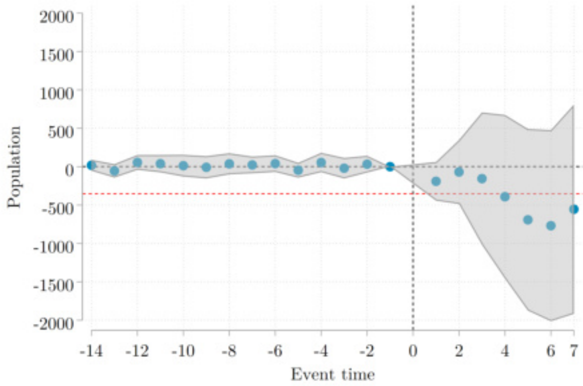
Note: The upper left panel illustrates the development of the municipal personnel and material expenses in *Monheim* and its synthetic control. The upper right panel illustrates the difference between the two groups. All variables are depicted in Euros per capita. Event time zero corresponds to year 2012. The gray lines depict the 95% confidence intervals based on 1000 placebo simulations.

Figure B13: SDID population and migration

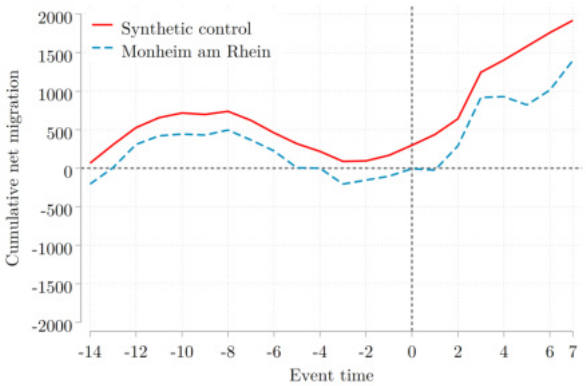
(a) Population (levels)



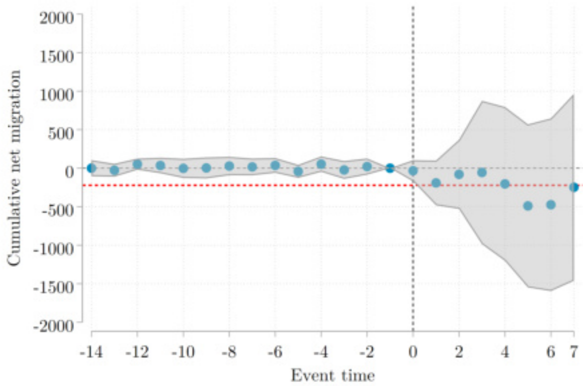
(b) Population (difference)



(c) Cumulative net migration (levels)



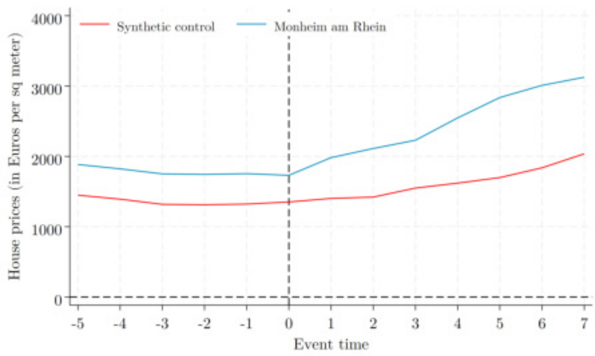
(d) Cumulative net migration (difference)



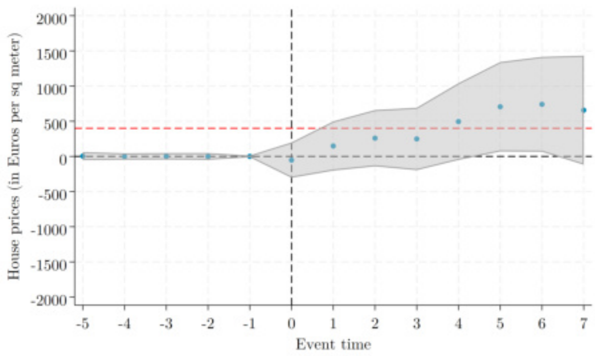
Note: The upper left panel illustrates the development of the population in *Monheim* and its synthetic control. The upper right panel illustrates the difference between the two groups. Note that there was a census in 2011. The effect of the census is adjusted by subtracting the 2011 to 2012 population difference for each municipality from all years. The year 2011 is dropped due to this normalization. Additionally, note that the increase in immigration around 2015 may partly be attributed to the increase in the number of refugees who came to Germany. The data does not distinguish by refugee status. The lower left panel illustrates the development of the cumulative net migration in *Monheim* and its synthetic control. The lower right panel illustrates the difference between the two groups. Immigration and emigration are measured as the relocation of the main place of residence across municipal boundaries. Event time zero corresponds to year 2012. The gray lines depict the 95% confidence intervals based on 1000 placebo simulations.

Figure B14: SDID house and rent prices

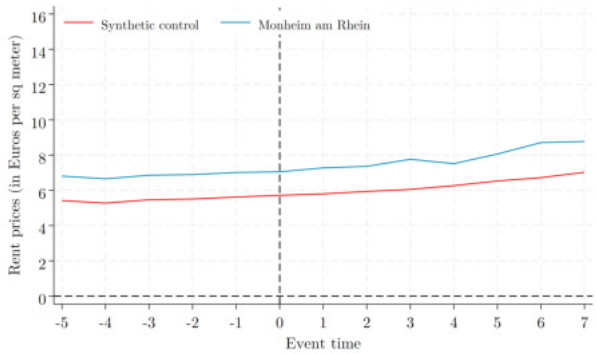
(a) House prices (levels)



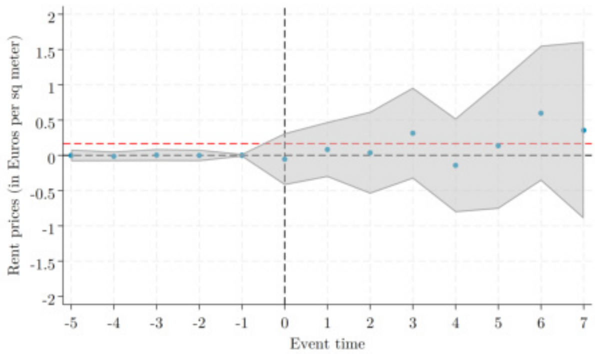
(b) House prices (difference)



(c) Rent prices (levels)



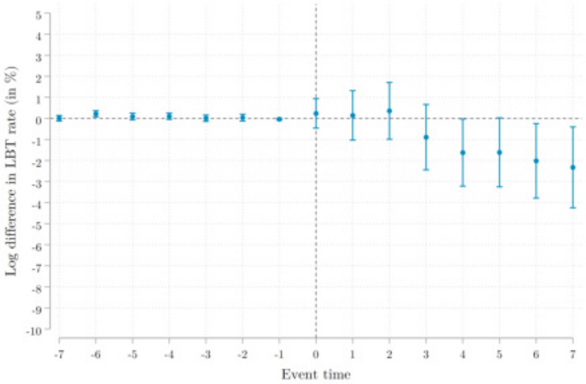
(d) Rent prices (difference)



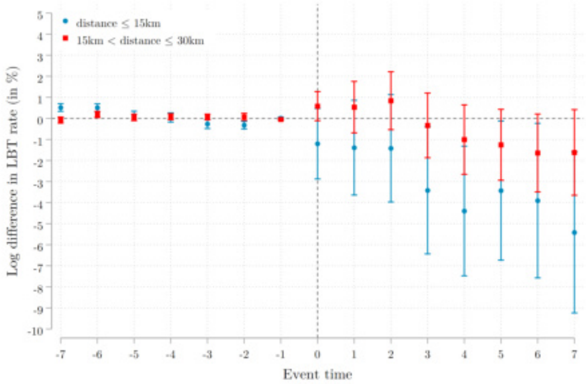
Note: The upper left panel illustrates the development of the house prices in *Monheim* and its synthetic control. The upper right panel illustrates the difference between the two groups. The lower left panel illustrates the development of the rent prices in *Monheim* and its synthetic control. The lower right panel illustrates the difference between the two groups. Event time zero corresponds to year 2012. The gray lines depict the 95% confidence intervals based on 1000 placebo simulations. The house and rent prices are based on Ahlfeldt et al. (2023).

Figure B15: SDID tax competition

(a) Baseline



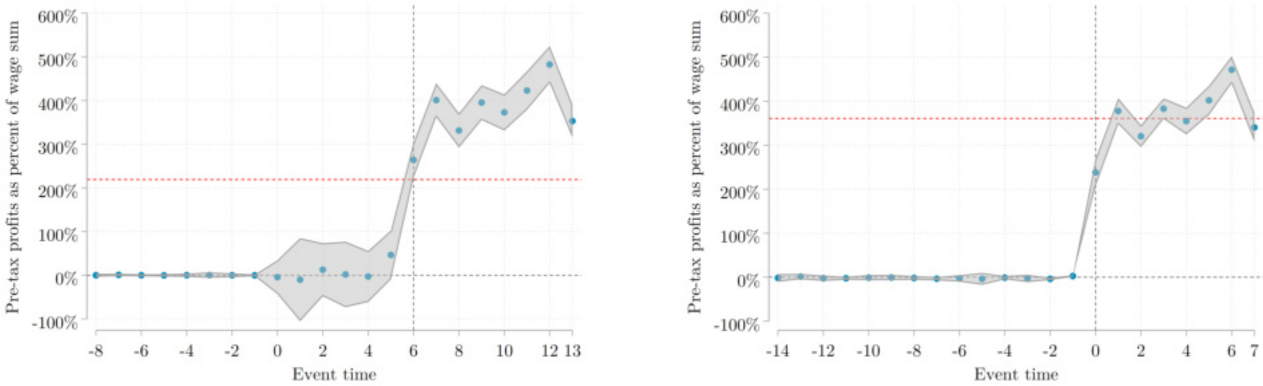
(b) By distance



Note: The figure depicts the dynamic effect of *Monheim*'s tax cut on the LBT rates in the surrounding municipalities. The left panel depicts the baseline specification, where all municipalities within a thirty kilometers radius of *Monheim* are labeled as treated. The right panel splits the treated units by their distance to *Monheim*, that is, municipalities which are fifteen or less kilometers away (blue) and municipalities which are between fifteen and thirty kilometers away. The donor pool contains all municipalities in *North Rhine-Westphalia* whose distance to *Monheim* is larger than thirty kilometers. The capped spikes depict the 95% confidence intervals based on 1000 placebo simulations.

Figure B16: SDID Robustness Tests Monheim am Rhein

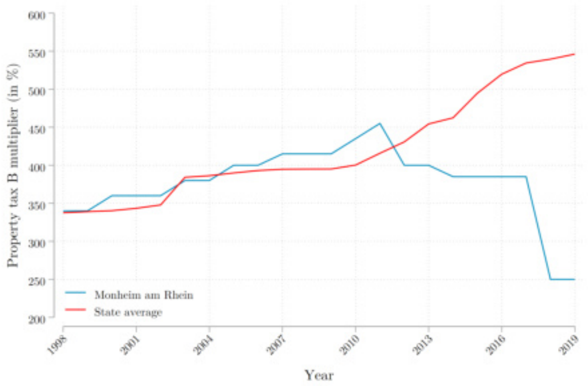
(a) Placebo in time (b) Drop 30km surrounding from donor pool



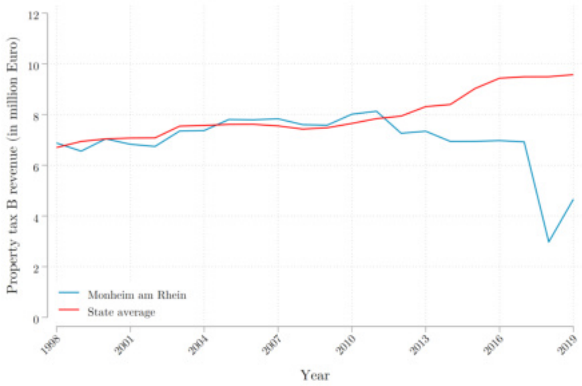
Note: The left panel illustrates the dynamic SDID when the treatment year is artificially moved six years before the actual treatment year. Event time zero corresponds to 2006. The right panel illustrates the dynamic SDID when municipalities located within a thirty-kilometer radius around the treated unit are excluded from the donor pool. Event time zero corresponds to year 2012. The dependent variable is the ratio of pretax profits to wage sum. The red dashed lines depict the static SDID. The gray lines depict the 95% confidence intervals based on 1000 placebo simulations.

Figure B17: Property Tax Cut in Monheim am Rhein

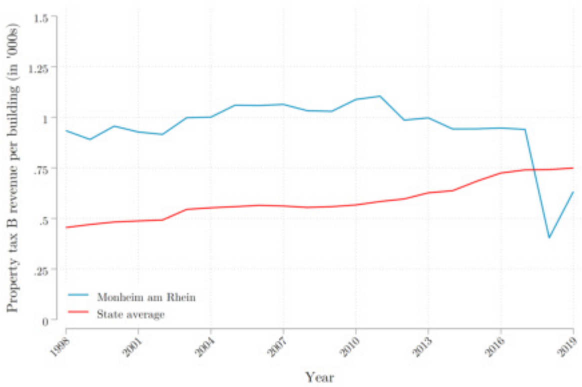
(a) Property tax multiplier



(b) Property tax revenue

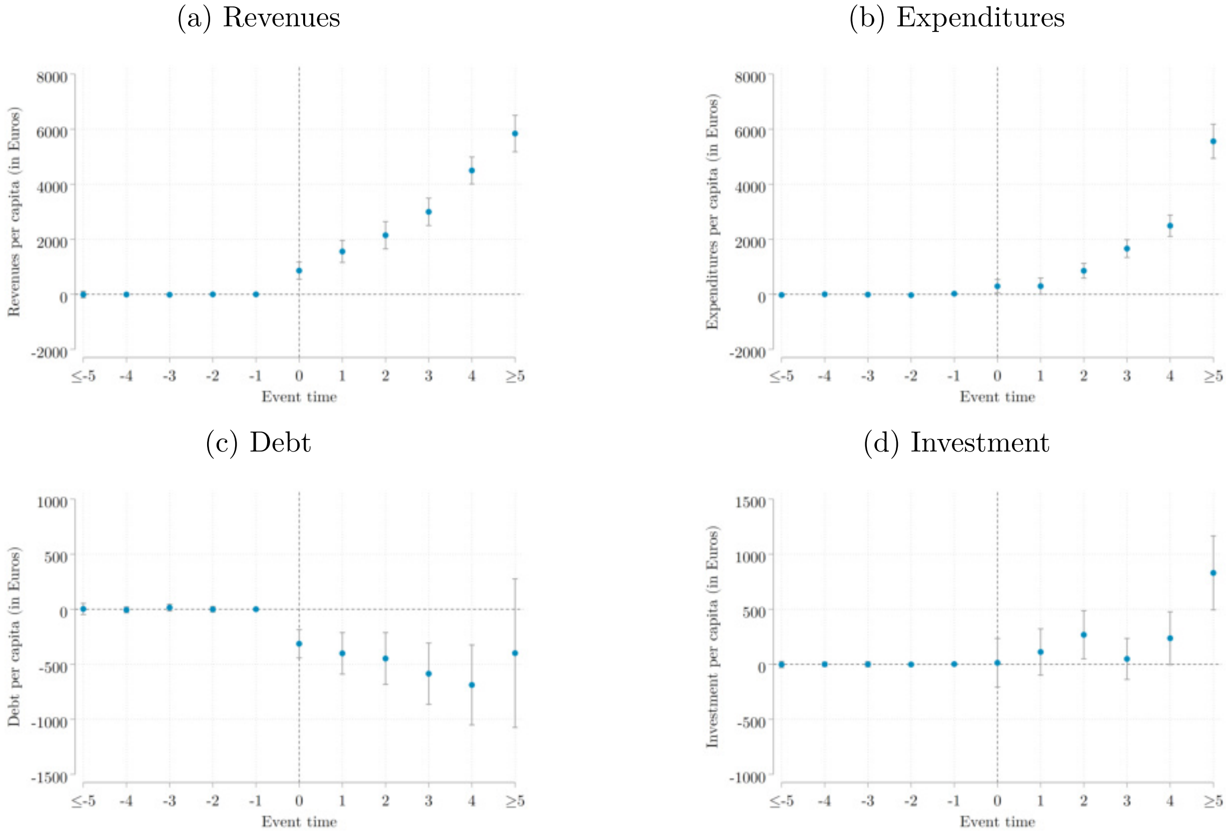


(c) Property tax revenue per building (2011 census)



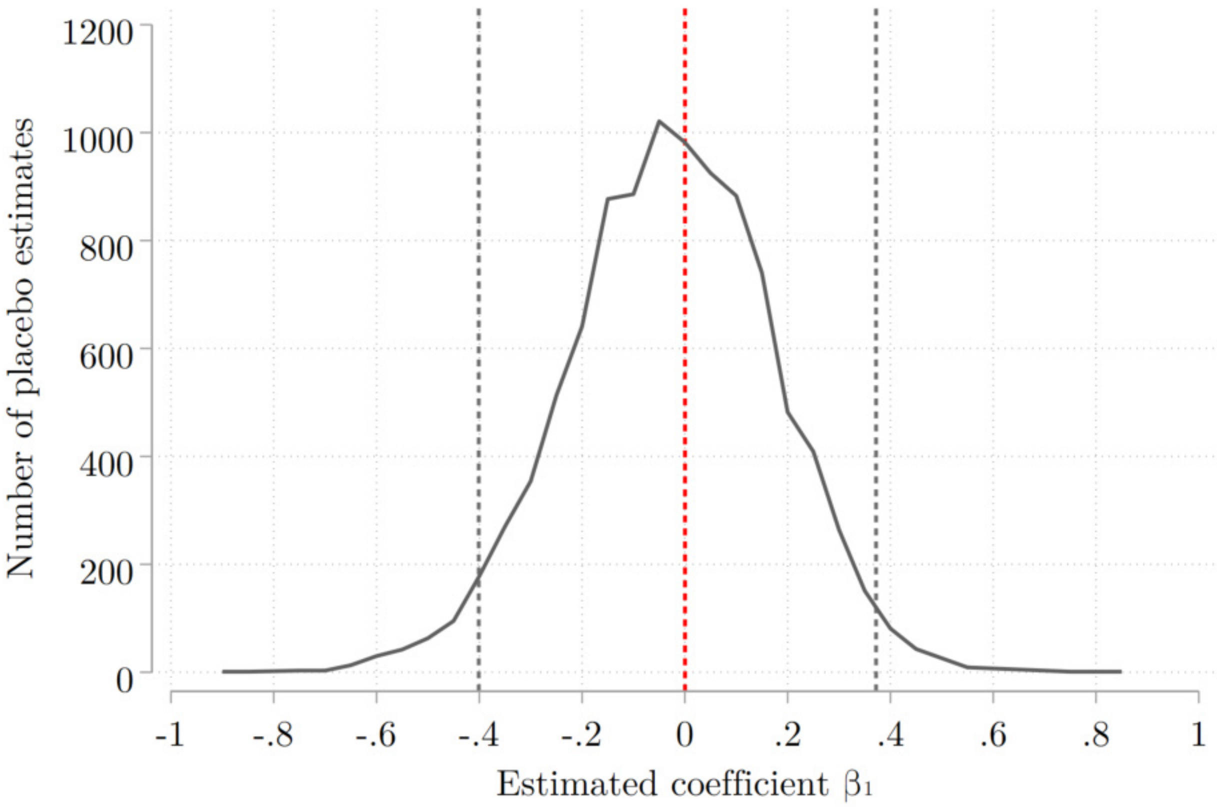
Note: The upper left panel illustrates the property tax (*Grundsteuer B*) multiplier in Monheim am Rhein (blue) and the state average (red). The upper right panel illustrates the property tax multiplier in Monheim am Rhein and the state average. The lower panel illustrates the property tax revenues per building in Monheim am Rhein and the state average. The number of buildings is based on 2011 census data and kept fixed during the whole period of observation. The period of observation ranges from 1998 to 2019.

Figure B18: Event study estimates for public finances (2003-2019)



Note: The figure illustrates the dynamic SDID estimates deploying municipal revenues, expenditures, debt, and investment as the dependent variables. The local tax havens had their first large LBT cut at event time zero. A large LBT cut is defined as a year-by-year reduction thirty basis points. The gray lines depict the 95% confidence intervals based on 1000 placebo simulations.

Figure B19: Distribution of placebo estimations



Note: The figure illustrates the distribution of estimation Equation 5 based on $10,000$ placebo estimation samples. The horizontal axis depicts the $\hat{\beta}_1$ estimate for the placebo sample, while the vertical axis indicates the number of placebo samples with this estimate. In each placebo sample, tax haven status is randomly assigned to non-haven municipalities. The overall number of local tax havens per year is identical to the number in the real estimation sample. The leftmost and rightmost dashed lines indicate the $2.5th$ and $97.5th$ percentiles, respectively. The red dashed line indicates the median of the distribution.

C Additional Tables

Table C1: List of local tax havens (2013-2019)

Name	Sum LBT BA	Avg Annual LBT BA	Avg LBT rate	Years	Nearby City
Grünwald	603.70	86.24	8.40	2013 2014 2015 2016 2017 2018 2019	Munich
Monheim am Rhein, Stadt	459.66	114.91	8.97	2016 2017 2018 2019	Cologne/Düsseldorf
Schönefeld	406.35	58.05	8.00	2013 2014 2015 2016 2017 2018 2019	Berlin
Lützen, Stadt	154.69	22.10	7.46	2013 2014 2015 2016 2017 2018 2019	Leipzig/Halle (Saale)
Zossen, Stadt	111.97	16.00	7.00	2013 2014 2015 2016 2017 2018 2019	Berlin
Leuna, Stadt	99.63	16.60	9.22	2014 2015 2016 2017 2018 2019	Leipzig/Halle (Saale)
Liebenwalde, Stadt	90.59	12.94	8.50	2013 2014 2015 2016 2017 2018 2019	Berlin
Pullach i.Isartal	88.66	17.73	9.1	2015 2016 2017 2018 2019	Munich
Gadebusch, Stadt	8.76	2.19	7.35	2013 2014 2015 2018	-

Note: The second column shows the total local business tax base amounts (in millions of 2019 Euros) across all years a municipality is identified as a tax haven. The third and fourth columns show the average LBT base amounts and LBT rate, respectively, across all years a jurisdiction is labeled as a local tax haven. The column *Years* lists the specific years when the municipality was identified as a tax haven. *Nearby city* shows the closest large city, and *Avg LBT rate (nearby city)* is the city's average LBT multiplier from 2013 to 2019.

Table C2: Profit shifting to local tax havens (2013-2019)
-only Monheim am Rhein-

	(1)	(2)	(3)
Tax haven	2.709	2.500	2.439
	(0.060)	(0.079)	(0.087)
State × Year FE	Yes	Yes	Yes
Sector × Year FE	Yes	Yes	Yes
Sector × Municipality × Year variables	No	Yes	Yes
Municipality × Year variables	No	No	Yes
Sectors	10	10	10
Municipalities	6504	6504	6504
Observations	337999	337999	337999

Note: The table depicts the estimation results of Equation 5. The dependent variable is the log of the sum of pretax profits at the sector×municipality×year level. The tax haven variable is a binary indicator, taking on the value one if, in a given year, the municipality is classified as a local tax haven and zero otherwise. The sector×municipality×year covariates include the wage sum, the value of sales, and equity. The municipality×year covariates contain the municipality's population and the gross domestic product on the district level. All of the foregoing covariates are included as a second-order polynomial. Standard errors are clustered at the municipality level and stated in parentheses. Only the municipality *Monheim am Rhein* is included in the set of local tax havens.

Table C3: Profit shifting to local tax havens (2013-2019)
-only large tax havens-

	(1)	(2)	(3)
Tax haven	3.921	3.591	3.240
	(0.461)	(0.492)	(0.233)
State × Year FE	Yes	Yes	Yes
Sector × Year FE	Yes	Yes	Yes
Sector × Municipality × Year variables	No	Yes	Yes
Municipality × Year variables	No	No	Yes
Sectors	10	10	10
Municipalities	6506	6506	6506
Observations	338139	338139	338139

Note: The table depicts the estimation results of Equation 5. The dependent variable is the log of the sum of pretax profits at the sector×municipality×year level. The tax haven variable is a binary indicator, taking on the value one if, in a given year, the municipality is classified as a local tax haven and zero otherwise. The sector×municipality×year covariates include the wage sum, the value of sales, and equity. The municipality×year covariates contain the municipality's population and the gross domestic product on the district level. All of the foregoing covariates are included as a second-order polynomial. Standard errors are clustered at the municipality level and stated in parentheses. Only the municipalities *Monheim am Rhein*, *Grünwald*, and *Schönefeld* are included in the set of local tax havens.

Table C4: Profit shifting to local tax havens (2013-2019)
-without labor market variables-

	(1)	(2)	(3)
Tax haven	3.040	2.781	2.544
	(0.522)	(0.467)	(0.399)
State × Year FE	Yes	Yes	Yes
Sector × Year FE	Yes	Yes	Yes
Sector × Municipality × Year variables	No	Yes	Yes
Municipality × Year variables	No	No	Yes
Sectors	10	10	10
Municipalities	10744	10744	10744
Observations	556920	556920	556920

Note: The table depicts the estimation results of Equation 5. The dependent variable is the log of the sum of pretax profits at the sector×municipality×year level. The tax haven variable is a binary indicator, taking on the value one if, in a given year, the municipality is classified as a local tax haven and zero otherwise. The sector×municipality×year covariates include the value of sales, and equity. The municipality×year covariates contain the municipality's population and the gross domestic product on the district level. All of the foregoing covariates are included as a second-order polynomial. Standard errors are clustered at the municipality level and stated in parentheses.

Table C5: Profit shifting to local tax havens (2013-2019)
-with two consecutive years condition-

	(1)	(2)	(3)
Tax haven	2.673	2.520	2.364
	(0.455)	(0.411)	(0.322)
State × Year FE	Yes	Yes	Yes
Sector × Year FE	Yes	Yes	Yes
Sector × Municipality × Year variables	No	Yes	Yes
Municipality × Year variables	No	No	Yes
Sectors	10	10	10
Municipalities	6509	6509	6509
Observations	338465	338465	338465

Note: The table depicts the estimation results of Equation 5. The dependent variable is the log of the sum of pretax profits at the sector×municipality×year level. The tax haven variable is a binary indicator, taking on the value one if, in a given year, the municipality is classified as a local tax haven and zero otherwise. The sector×municipality×year covariates include the value of sales, and equity. The municipality×year covariates contain the municipality's population and the gross domestic product on the district level. All of the foregoing covariates are included as a second-order polynomial. Standard errors are clustered at the municipality level and stated in parentheses. The tax haven definition used in this estimation only imposes two consecutive years of being a low-tax municipality with a high dependence on shifting sectors.

Table C6: Profit shifting to local tax havens (2013-2019)
-without consecutive years condition-

	(1)	(2)	(3)
Tax haven	2.614	2.468	2.319
	(0.436)	(0.395)	(0.309)
State × Year FE	Yes	Yes	Yes
Sector × Year FE	Yes	Yes	Yes
Sector × Municipality × Year variables	No	Yes	Yes
Municipality × Year variables	No	No	Yes
Sectors	10	10	10
Municipalities	6509	6509	6509
Observations	338465	338465	338465

Note: The table depicts the estimation results of Equation 5. The dependent variable is the log of the sum of pretax profits at the sector×municipality×year level. The tax haven variable is a binary indicator, taking on the value one if, in a given year, the municipality is classified as a local tax haven and zero otherwise. The sector×municipality×year covariates include the value of sales, and equity. The municipality×year covariates contain the municipality's population and the gross domestic product on the district level. All of the foregoing covariates are included as a second-order polynomial. Standard errors are clustered at the municipality level and stated in parentheses. The tax haven definition used in this estimation does not impose any consecutive years condition.

Table C7: Profit shifting to local tax havens (2013-2019)
-include linear LBT rate covariate-

	(1)	(2)	(3)
Tax haven	4.225	3.437	2.608
	(0.470)	(0.427)	(0.336)
State × Year FE	Yes	Yes	Yes
Sector × Year FE	Yes	Yes	Yes
Sector × Municipality × Year variables	No	Yes	Yes
Municipality × Year variables	No	No	Yes
Sectors	10	10	10
Municipalities	6509	6509	6509
Observations	338465	338465	338465

Note: The table depicts the estimation results of Equation 5. The dependent variable is the log of the sum of pretax profits at the sector×municipality×year level. The tax haven variable is a binary indicator, taking on the value one if, in a given year, the municipality is classified as a local tax haven and zero otherwise. The sector×municipality×year covariates include the value of sales, and equity. The municipality×year covariates contain the municipality's population and the gross domestic product on the district level. All of the foregoing covariates are included as a second-order polynomial. Standard errors are clustered at the municipality level and stated in parentheses. The estimation equation includes a first-order polynomial of the LBT rate as a control variable.

Table C8: Profit shifting to local tax havens (2013-2019)
-include squared LBT rate covariate-

	(1)	(2)	(3)
Tax haven	3.174	3.198	3.178
	(0.500)	(0.440)	(0.370)
State $\times$ Year FE	Yes	Yes	Yes
Sector $\times$ Year FE	Yes	Yes	Yes
Sector $\times$ Municipality $\times$ Year variables	No	Yes	Yes
Municipality $\times$ Year variables	No	No	Yes
Sectors	10	10	10
Municipalities	6509	6509	6509
Observations	338465	338465	338465

Note: The table depicts the estimation results of Equation 5. The dependent variable is the log of the sum of pretax profits at the sector$\times$municipality$\times$year level. The tax haven variable is a binary indicator, taking on the value one if, in a given year, the municipality is classified as a local tax haven and zero otherwise. The sector$\times$municipality$\times$year covariates include the value of sales, and equity. The municipality$\times$year covariates contain the municipality's population and the gross domestic product on the district level. All of the foregoing covariates are included as a second-order polynomial. Standard errors are clustered at the municipality level and stated in parentheses. The estimation equation includes a second-order polynomial of the LBT rate as a control variable.

D Derivations and Proofs

Derivation best response correspondences ($c_{AB} = c_{BA} = 0$): I follow Kanbur & Keen (1991) in deriving the optimal solution to the unconstrained optimization problem in two steps: (1) derive the optimal solutions to the artificially constrained problems and (2) compare the maximized tax revenues of the constrained problems to identify the optimum of the unconstrained problem.

(1.1) Assume that $\tau_A \geq \tau_B$. The optimal tax rate τ_A can be stated as:

$$\tau_A^{C1}(\tau_B) = \begin{cases} \frac{1}{2}\left(ad_{AB} + \tau_B\right) & \text{if} \quad \tau_B \leq ad_{AB} & (31a) \\ \tau_B & \text{if} \quad \tau_B \geq ad_{AB} & (31b) \end{cases}$$

The corresponding maximized tax revenues are given by:

$$R_A^{C1}(\tau_A^{C1}(\tau_B), \tau_B) = \begin{cases} \left(\frac{\rho_A}{ad_{AB}}\right)\left(\frac{ad_{AB} + \tau_B}{2}\right)^2 & \text{if} \quad \tau_B \leq ad_{AB} & (32a) \\ \rho_A \tau_B & \text{if} \quad \tau_B \geq ad_{AB} & (32b) \end{cases}$$

(1.2) Assume that $\tau_A \leq \tau_B$. The optimal tax rate τ_A can be stated as:

$$\tau_A^{C2}(\tau_B) = \begin{cases} \tau_B & \text{if} \quad \tau_B \leq ad_{AB}\theta_{AB} & (33a) \\ \frac{1}{2}\left(ad_{AB}\theta_{AB} + \tau_B\right) & \text{if} \quad \tau_B \geq ad_{AB}\theta_{AB} & (33b) \end{cases}$$

The corresponding maximized tax revenues are given by:

$$R_A^{C2}(\tau_A^{C2}(\tau_B), \tau_B) = \begin{cases} \rho_A \tau_B & \text{if} \quad \tau_B \leq ad_{AB}\theta_{AB} & (34a) \\ \left(\frac{\rho_B}{ad_{AB}}\right)\left(\frac{ad_{AB}\theta_{AB} + \tau_B}{2}\right)^2 & \text{if} \quad \tau_B \geq ad_{AB}\theta_{AB} & (34b) \end{cases}$$

(2) Compare the maximized revenues of the constrained problems (1.1) and (1.2) for different ranges of τ_B to identify the solution of the unconstrained optimization problem.

(2.1) For $\tau_B \leq min(ad_{AB}, ad_{AB}\theta_{AB})$, taking the difference of Equation 32a and Equation 34a gives us:

$$R_A^{C1}(\tau_A^{C1}(\tau_B), \tau_B) - R_A^{C2}(\tau_A^{C2}(\tau_B), \tau_B) = \frac{\rho_A}{ad_{AB}}\left(\frac{ad_{AB} - \tau_B}{2}\right)^2 \geq 0 \tag{35}$$

thus the best response is defined as $\tau_A(\tau_B) = \frac{1}{2}\left(ad_{AB} + \tau_B\right)$ for this interval.

(2.2) For $\tau_B \geq max(ad_{AB}, ad_{AB}\theta_{AB})$, taking the difference of Equation 32b and Equation 34b gives us:

$$R_A^{C1}(\tau_A^{C1}(\tau_B),\tau_B) - R_A^{C2}(\tau_A^{C2}(\tau_B),\tau_B) = -\frac{\rho_B}{ad_{AB}}\left(\frac{ad_{AB}\theta_{AB}-\tau_B}{2}\right)^2 \leq 0 \tag{36}$$

thus the best response is defined as $\tau_A(\tau_B) = \frac{1}{2}\left(ad_{AB}\theta_{AB} + \tau_B\right)$ for this interval.

(2.3) If $\theta_{AB} \geq 1$, taking the difference of Equation 32b and Equation 34a gives us for $\tau_B \in [ad_{AB}, ad_{AB}\theta_{AB}]$:

$$R_A^{C1}(\tau_A^{C1}(\tau_B),\tau_B) - R_A^{C2}(\tau_A^{C2}(\tau_B),\tau_B) = 0 \tag{37}$$

thus, if $\theta_{AB} \geq 1$, the best response is defined as $\tau_A(\tau_B) = \tau_B$ for this interval.

(2.4) If $\theta_{AB} \leq 1$, taking the difference of Equation 32a and Equation 34b gives us for $\tau_B \in [ad_{AB}\theta_{AB}, ad_{AB}]$:

$$R_A^{C1}(\tau_A^{C1}(\tau_B),\tau_B) - R_A^{C2}(\tau_A^{C2}(\tau_B),\tau_B) = \frac{\rho_B}{4ad_{AB}}\left(1-\theta_{AB}\right)\left((ad_{AB})^2\theta_{AB} - \tau_B^2\right) \tag{38}$$

Note that $\frac{\rho_B}{4ad_{AB}}\left(1-\theta_{AB}\right) \geq 0$ as $\theta_{AB} \leq 1$. Consequently, the sign of the expression depends only on the last term $((ad_{AB})^2\theta_{AB} - \tau_B^2)$. The term is positive iff $\tau_B \leq ad_{AB}\sqrt{\theta_{AB}}$ and negative iff $\tau_B \geq ad_{AB}\sqrt{\theta_{AB}}$. Thus, if $\theta_{AB} \leq 1$, the best response for this interval is defined as:

$$\tau_A(\tau_B) = \begin{cases} \dfrac{1}{2}\left(ad_{AB} + \tau_B\right) & \text{if } \; ad_{AB}\theta_{AB} \leq \tau_B \leq ad_{AB}\sqrt{\theta_{AB}} \quad \text{(39a)} \\ \dfrac{1}{2}\left(ad_{AB}\theta_{AB} + \tau_B\right) & \text{if } \; ad_{AB}\sqrt{\theta_{AB}} \leq \tau_B \leq ad_{AB} \quad \text{(39b)} \end{cases}$$

Combining (2.1) to (2.4), the best response correspondence of municipality A, that is, the solution to the unconstrained optimization problem, if $\theta_{AB} \leq 1$ is given by:

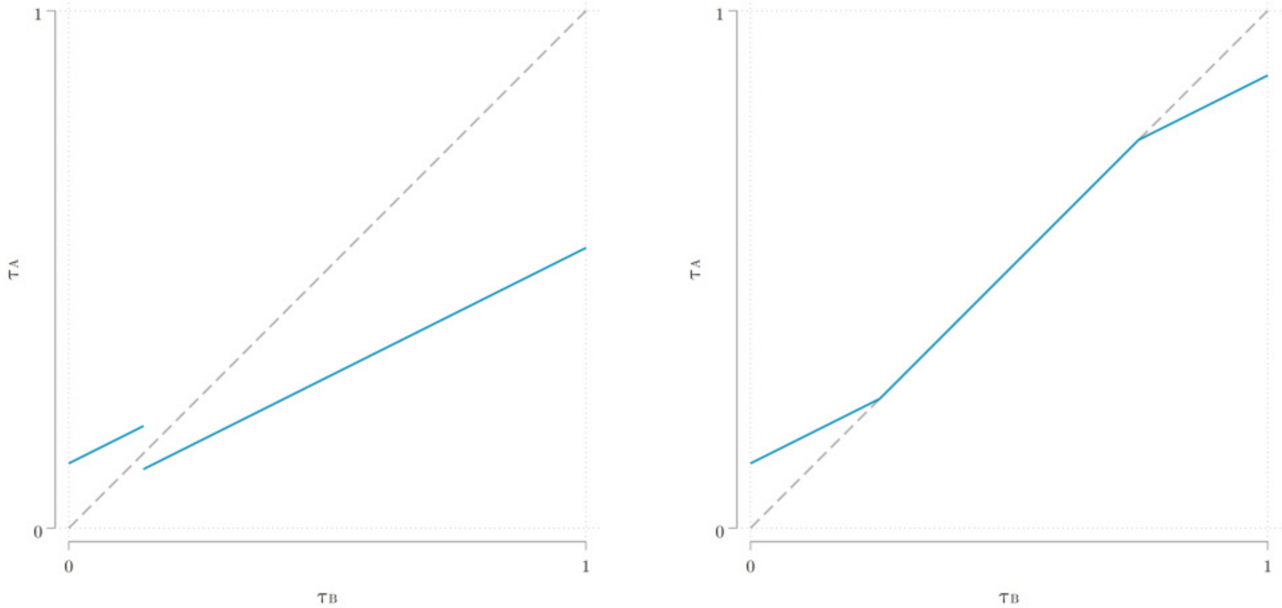
$$\tau_A(\tau_B) = \begin{cases} \frac{1}{2}\left(ad_{AB} + \tau_B\right) & \text{if } \tau_B \leq ad_{AB}\sqrt{\theta_{AB}}, \\ \\ \frac{1}{2}\left(ad_{AB}\theta_{AB} + \tau_B\right) & \text{if } \tau_B \geq ad_{AB}\sqrt{\theta_{AB}}. \end{cases} \tag{40}$$

while the best response correspondence if $\theta_{AB} \geq 1$ is given by:

$$\tau_A(\tau_B) = \begin{cases} \frac{1}{2}\left(ad_{AB} + \tau_B\right) & \text{if } \tau_B \leq ad_{AB}, \\ \\ \tau_B, & \text{if } ad_{AB} \leq \tau_B \leq ad_{AB}\theta_{AB} \\ \\ \frac{1}{2}\left(ad_{AB}\theta_{AB} + \tau_B\right) & \text{if } \tau_B \geq ad_{AB}\theta_{AB}. \end{cases} \tag{41}$$

Figure D1: Best response correspondence of municipality A

(a) $\theta_{AB} \leq 1$ (b) $\theta_{AB} \geq 1$



Note: The figure illustrates the best response correspondence of municipality A. The chosen parameters are $a = 0.25$, $d_{AB} = 1$. In the left panel we set $\rho_A = 1$ and $\rho_B = 3$ (i.e. $\theta_{AB} = \frac{1}{3}$). In the left panel we set $\rho_A = 3$ and $\rho_B = 1$ (i.e. $\theta_{AB} = 3$).

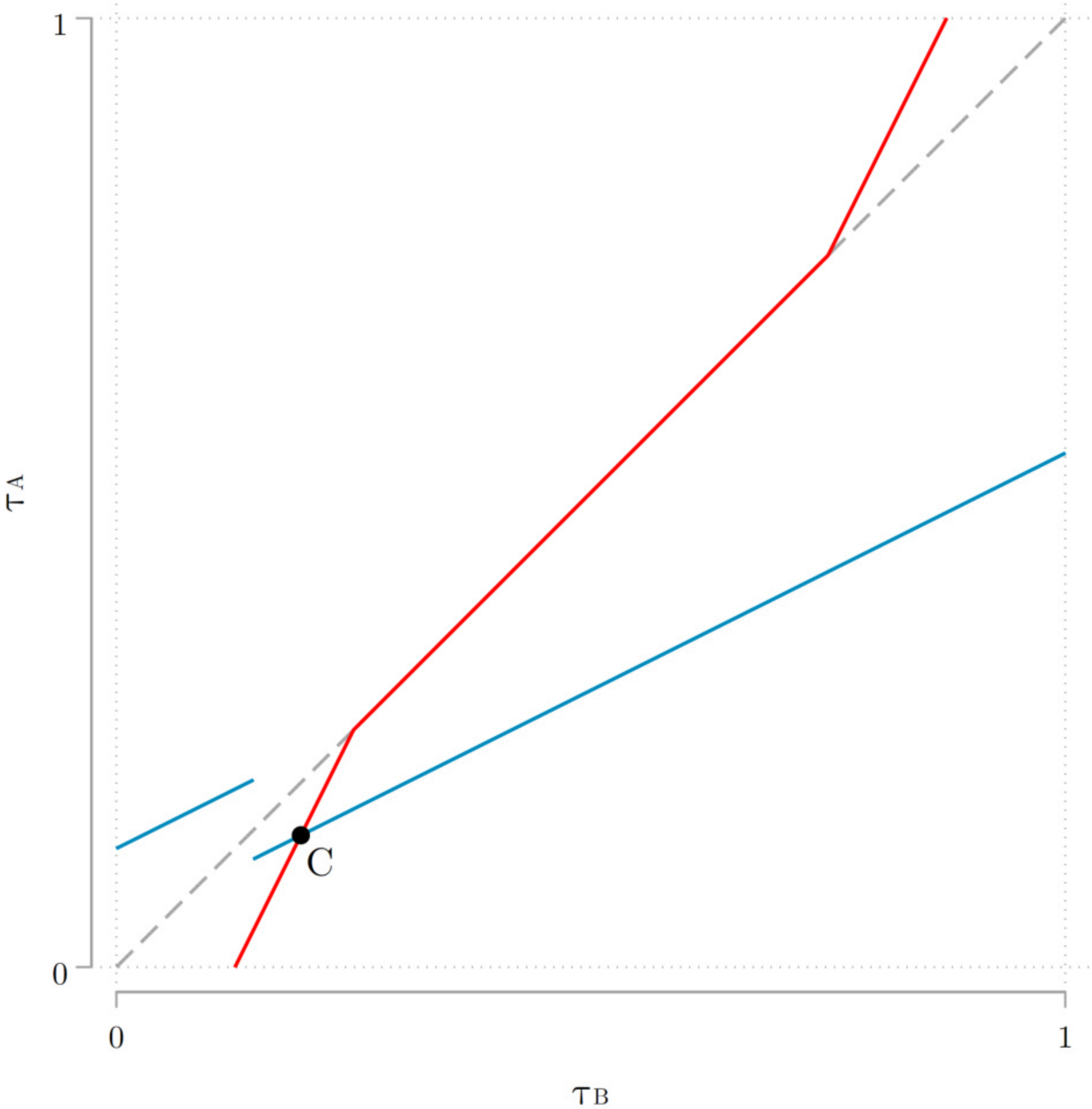
The best response correspondence of municipality A is depicted in Figure D1. We can derive the best response correspondence of municipality B analogue. The solution to the unconstrained optimization problem, if $\theta_{AB} \leq 1$ is given by:

$$\tau_B(\tau_A) = \begin{cases} \frac{1}{2}\left(ad_{AB} + \tau_A\right) & \text{if } \tau_A \leq ad_{AB}, \\ \\ \tau_A, & \text{if } ad_{AB} \leq \tau_A \leq \frac{ad_{AB}}{\theta_{AB}} \\ \\ \frac{1}{2}\left(\frac{ad_{AB}}{\theta_{AB}} + \tau_A\right) & \text{if } \tau_A \geq \frac{ad_{AB}}{\theta_{AB}}. \end{cases} \tag{42}$$

while the best response correspondence if $\theta_{AB} \geq 1$ is given by:

$$\tau_B(\tau_A) = \begin{cases} \frac{1}{2}\left(ad_{AB} + \tau_A\right) & \text{if } \tau_A \leq \frac{ad_{AB}}{\sqrt{\theta_{AB}}}, \\ \\ \frac{1}{2}\left(\frac{ad_{AB}}{\theta_{AB}} + \tau_A\right) & \text{if } \tau_A \geq \frac{ad_{AB}}{\sqrt{\theta_{AB}}}. \end{cases} \tag{43}$$

Figure D2: Equilibrium tax rates τ_A and τ_B



Note: The figure illustrates the best response correspondence of municipality A (blue) and B (red). The intersection of the two best response correspondences depicts the equilibrium. The chosen parameters are $a = 0.25$, $d_{AB} = 1$, $\rho_A = 1$ and $\rho_B = 3$ (i.e. $\theta_{AB} = \frac{1}{3}$).

Proof Proposition 1: In the following, we (1) show that $\tau_A > \tau_B$ cannot be a Nash equilibrium, (2) compute the equilibrium tax rates if $\theta_{AB} < 1$, (3) compute the equilibrium tax rates if $\theta_{AB} = 1$, (4) identify conditions on parameters a, d_{AB} and θ_{AB} such that equilibrium tax rates $\tau_A, \tau_B \in [0, 1]$, and (5) show that in equilibrium for each firm A and B the amount of shifted profits is lower than the firm's overall profits.

(1) We know from Equation 40 and Equation 42 that municipality A (B) will choose a strictly higher (lower) tax rate than municipality B (A) only in the area where $\tau_B < ad_{AB}\sqrt{\theta_{AB}}$ ($\tau_A > \frac{ad_{AB}}{\theta_{AB}}$). Thus, the equilibrium tax rates are defined by:

$$\tau_A(\tau_B) = \frac{1}{2}\left(ad_{AB} + \tau_B\right) \tag{44}$$

$$\tau_B(\tau_A) = \frac{1}{2}\left(\frac{ad_{AB}}{\theta_{AB}} + \tau_A\right) \tag{45}$$

Solving by substitution, we get:

$$\tau_A(\tau_B) = \left(\frac{ad_{AB}}{\theta_{AB}}\right)\left(\frac{1 + 2\theta_{AB}}{3}\right) \leq \frac{ad_{AB}}{\theta_{AB}} \tag{46}$$

As $\theta_{AB} \leq 1$ the foregoing expression is smaller than $\frac{ad_{AB}}{\theta_{AB}}$, which violates the condition for municipality B to choose a strictly lower tax rate than municipality A. Thus $\tau_A > \tau_B$ cannot be an equilibrium.

(2) We know from Equation 40 and Equation 42 that municipality A (B) will choose a strictly lower (higher) tax rate than municipality B (A) only in the area where $\tau_B > ad_{AB}\sqrt{\theta_{AB}}$ ($\tau_A < ad_{AB}$). Thus, the equilibrium tax rates are defined by:

$$\tau_A(\tau_B) = \frac{1}{2}\left(ad_{AB}\theta_{AB} + \tau_B\right) \tag{47}$$

$$\tau_B(\tau_A) = \frac{1}{2}\left(ad_{AB} + \tau_A\right) \tag{48}$$

Solving by substitution, we get:

$$\tau_A(\tau_B) = ad_{AB}\left(\frac{1}{3} + \frac{2}{3}\theta_{AB}\right) < ad_{AB} \tag{49}$$

$$\tau_B(\tau_A) = ad_{AB}\left(\frac{2}{3} + \frac{1}{3}\theta_{AB}\right) > ad_{AB}\sqrt{\theta_{AB}} \tag{50}$$

If $\theta_{AB} < 1$, we know that $\left(\frac{2}{3} + \frac{1}{3}\theta_{AB}\right) > \sqrt{\theta_{AB}}$, so that the condition for A to choose a strictly lower tax rate than B is satisfied. Simlarly, if $\theta_{AB} < 1$, we see that $\tau_A(\tau_B) < ad_{AB}$, so that the condition for B to choose a strictly higher tax rate than A is satisfied. Thus, if $\theta_{AB} < 1$, we have defined the unique equilibrium where $\tau_A < \tau_B$.

(3) We can directly see from Equation 40 and Equation 42, that if the municipalities are of equal size ($\theta_{AB} = 1$), the equilibrium tax rates are identical and collapse to the product of the cost parameter a and distance parameter d_{AB} ($\tau_A = \tau_B = ad_{AB}$).

(4) The set of parameters a and d_{AB} has to be restricted so that the equilibrium tax rates $\tau_A, \tau_B \in [0,1]$. We know that if $\theta \leq 1$ in equilibrium $\tau_A \leq \tau_B$, thus it is sufficient to choose parameters such that $\tau_A \in [0,1]$. It is straightforward to show that this condition is satisfied if $ad_{AB} \leq \frac{3}{1+2\theta_{AB}}$. As $a, d_{AB} \in [0,1]$ and $\theta_{AB} \leq 1$ the foregoing condition is always satisfied.

(5) We have shown in (1) that in equilibrium municipality A chooses a tax rate which is at least as low as in municipality B. Thus, firm A will not shift any profits ($\phi_{AB} = 0$). It is straightforward to show that in equilibrium $0 \leq \phi_{BA} \leq \rho_B$. In equilibrium we have:

$$
\begin{aligned}
\phi_{BA} &= \frac{(\tau_B - \tau_A)}{ad_{AB}}\rho_B \\
\frac{\phi_{BA}}{\rho_B} &= \frac{ad_{AB}\left(\frac{2}{3} + \frac{1}{3}\theta_{AB}\right) - ad_{AB}\left(\frac{1}{3} + \frac{2}{3}\theta_{AB}\right)}{ad_{AB}} \\
\frac{\phi_{BA}}{\rho_B} &= \left(\frac{1}{3} - \frac{1}{3}\theta_{AB}\right)
\end{aligned} \tag{51}
$$

as $\theta_{AB} \leq 1$, we know that the amount of shifted profits ϕ_{BA} as a share of overall profits ρ_B is bounded by $\frac{\phi_{BA}}{\rho_B} \in [0, \frac{1}{3})$.

Proof Proposition 2: We prove the first part of Proposition 2 by defining the unique Nash equilibrium depending on a_A and a_B for (1) $\theta_{AB} < 1$ and (2) $\theta_{AB} = 1$.

(1) If $\theta_{AB} < 1$, the unique Nash equilibrium is defined by the tax rates:

$$\tau_A^{NE}(\tau_B, a_A, a_B) = \frac{2}{3}a_A d_{AB}\theta_{AB} + \frac{1}{3}a_B d_{AB} < a_B d_{AB} \tag{52}$$

$$\tau_B^{NE}(\tau_A, a_A, a_B) = \frac{1}{3}a_A d_{AB}\theta_{AB} + \frac{2}{3}a_B d_{AB} > a_A d_{AB}\sqrt{\theta_{AB}} \tag{53}$$

It can be shown that the foregoing statements hold if $a_A < min\left(\frac{a_B}{\theta_{AB}}, \frac{a_B}{\frac{3}{2}\sqrt{\theta_{AB}} - \frac{1}{2}\theta_{AB}}\right) = \frac{a_B}{\frac{3}{2}\sqrt{\theta_{AB}} - \frac{1}{2}\theta_{AB}}$. As $\theta_{AB} < 1$, $a_A < \frac{a_B}{\frac{3}{2}\sqrt{\theta_{AB}} - \frac{1}{2}\theta_{AB}}$ is satisfied for all $a_A \leq a_B$. Finally, it is straightforward to show that if $a_l \leq a_h$, then $\tau_A^{NE}(\tau_B, a_l, a_h) \leq \tau_A^{NE}(\tau_B, a_h, a_h)$ and $\tau_B^{NE}(\tau_A, a_l, a_h) \leq \tau_B^{NE}(\tau_A, a_h, a_h)$.

(2) If $\theta_{AB} = 1$, the unique Nash equilibrium is defined by the tax rates:

$$\tau_A^{NE}(\tau_B, a_A, a_B) = \frac{2}{3}a_A d_{AB} + \frac{1}{3}a_B d_{AB} \tag{54}$$

$$\tau_B^{NE}(\tau_A, a_A, a_B) = \frac{1}{3}a_A d_{AB} + \frac{2}{3}a_B d_{AB} \tag{55}$$

It is straightforward to show that if $a_l \leq a_h$, then $\tau_A^{NE}(\tau_B, a_l, a_h) < \tau_A^{NE}(\tau_B, a_h, a_h)$ and $\tau_B^{NE}(\tau_A, a_l, a_h) < \tau_B^{NE}(\tau_A, a_h, a_h)$.

We prove the second part of Proposition 2 by applying the results from the first part. For $\theta_{AB} \leq 1$, the difference of the equilibrium tax rates can be written as:

$$\left(\tau_B^{NE}(\tau_A, a_l, a_h) - \tau_A^{NE}(\tau_B, a_l, a_h)\right) \tag{56}$$

$$= \frac{1}{3}d_{AB}\theta_{AB}(a_h - a_l) > 0 \tag{57}$$

Taking the derivative gives us that $\frac{\partial}{\partial a_l}\left[\frac{1}{3}d_{AB}(a_h - a_l\theta_{AB})\right] = -\frac{1}{3}d_{AB}\theta_{AB} < 0$. Thus, lowering a_l leads to an increase of the equilibrium tax differential.

Lemma D1. *$\tau_A(\tau_B) \in [\tau_B, \tau_B + \delta_{AB})$ cannot be a best response of municipality A and $\tau_B(\tau_A) \in [\tau_A, \tau_A + \delta_{BA})$ cannot be a best response of municipality B.*

Proof: We proof by contradiction. Suppose that municipality A chooses to play $\tau_A \in [\tau_B, \tau_B + \delta_{AB})$. Firm B will not shift profits to A as $\tau_A \geq \tau_B$. Firm A will not shift profits to B as long as $\tau_A - \tau_B \leq \delta_{AB}$. Municipality A can always increase its revenue $R(\tau_A(\tau_B), \tau_B) = \rho_A\tau_A$ by choosing $\tau_A = \tau_B + \delta_{AB}$. Thus, $\tau_A \in [\tau_B, \tau_B + \delta_{AB})$ cannot be a best response. Proof for municipality B is identical.

Lemma D2. *$\tau_A(\tau_B) \in (\tau_B - \delta_{BA}, \tau_B]$ cannot be a best response of municipality A and $\tau_B(\tau_A) \in (\tau_A - \delta_{AB}, \tau_A]$ cannot be a best response of municipality B.*

Proof: We proof by contradiction. Suppose that municipality A chooses to play $\tau_A \in (\tau_B - \delta_{BA}, \tau_B]$. Firm B will not shift profits to A as long as $\tau_B - \tau_A \leq \delta_{BA}$. Firm A will not shift profits to B as $\tau_A \leq \tau_B$. Municipality A can always increase its revenue $R(\tau_A(\tau_B), \tau_B) = \rho_A\tau_A$ by choosing $\tau_A = \tau_B$. Thus, $\tau_A \in (\tau_B - \delta_{BA}, \tau_B]$ cannot be a best response. Proof for municipality B is identical.

Lemma D3. *$\tau_A(\tau_B) \in (\tau_B - \delta_{BA}, \tau_B + \delta_{AB})$ cannot be a best response of municipality A and $\tau_B(\tau_A) \in (\tau_A - \delta_{AB}, \tau_A + \delta_{BA})$ cannot be a best response of municipality B.*

Proof: Immediate from Lemma D1 and Lemma D2.

Derivation best response correspondences ($c_{AB} > 0$ and $c_{BA} > 0$): As before we derive the optimal solution to the unconstrained optimization problem in two steps: (1) derive the optimal solutions to the artificially constrained problems[56] and (2) compare the maximized tax revenues of the constrained problems to identify the optimum of the unconstrained problem.

(1.1) Assume that $\tau_A \geq \tau_B + \delta_{AB}$. The optimal tax rate τ_A can be stated as:

$$\tau_A^{C3}(\tau_B) = \begin{cases} \frac{1}{2}\left(ad_{AB} + \tau_B\right) & \text{if} \quad \tau_B \leq ad_{AB} - 2\delta_{AB} \quad (58a) \\ \tau_B + \delta_{AB} & \text{if} \quad \tau_B \geq ad_{AB} - 2\delta_{AB} \quad (58b) \end{cases}$$

The corresponding maximized tax revenues are given by:

$$R_A^{C3}(\tau_A^{C3}(\tau_B), \tau_B) = \begin{cases} \left(\frac{\rho_A}{ad_{AB}}\right)\left(\frac{ad_{AB} + \tau_B}{2}\right)^2 & \text{if} \quad \tau_B \leq ad_{AB} - 2\delta_{AB} \quad (59a) \\ \rho_A\left(\tau_B + \delta_{AB}\right) & \text{if} \quad \tau_B \geq ad_{AB} - 2\delta_{AB} \quad (59b) \end{cases}$$

(1.2) Assume that $\tau_A \leq \tau_B - \delta_{BA}$. The optimal tax rate τ_A can be stated as:

$$\tau_A^{C4}(\tau_B) = \begin{cases} \tau_B - \delta_{BA} & \text{if} \quad \tau_B \leq ad_{AB}\theta_{AB} + 2\delta_{BA} \quad (60a) \\ \frac{1}{2}\left(ad_{AB}\theta_{AB} + \tau_B\right) & \text{if} \quad \tau_B \geq ad_{AB}\theta_{AB} + 2\delta_{BA} \quad (60b) \end{cases}$$

The corresponding maximized tax revenues are given by:

$$R_A^{C4}(\tau_A^{C4}(\tau_B), \tau_B) = \begin{cases} \rho_A\left(\tau_B - \delta_{BA}\right) & \text{if} \quad \tau_B \leq ad_{AB}\theta_{AB} + 2\delta_{BA} \quad (61a) \\ \left(\frac{\rho_B}{ad_{AB}}\right)\left(\frac{ad_{AB}\theta_{AB} + \tau_B}{2}\right)^2 & \text{if} \quad \tau_B \geq ad_{AB}\theta_{AB} + 2\delta_{BA} \quad (61b) \end{cases}$$

(2) Compare the maximized revenues of the constrained problems (1.1) and (1.2) for different ranges of τ_B to identify the solution of the unconstrained optimization problem.

(2.1) For $\tau_B \leq min(ad_{AB} - 2\delta_{AB}, ad_{AB}\theta_{AB} + 2\delta_{BA})$, taking the difference of Equation 59a and Equation 61a gives us:

$$R_A^{C3}(\tau_A^{C3}(\tau_B), \tau_B) - R_A^{C4}(\tau_A^{C4}(\tau_B), \tau_B) = \frac{\rho_A}{ad_{AB}}\left(\frac{ad_{AB} - \tau_B}{2}\right)^2 + \rho_A\delta_{BA} \geq 0 \quad (62)$$

thus the best response is defined as $\tau_A(\tau_B) = \frac{1}{2}\left(ad_{AB} + \tau_B\right)$ for this interval.

(2.2) For $\tau_B \geq max(ad_{AB} - 2\delta_{AB}, ad_{AB}\theta_{AB} + 2\delta_{BA})$, taking the difference of Equation 59b and Equation 61b gives us:

[56] The constraints imposed on the choice set of $\tau_A(\tau_B)$ are derived in Lemma D3.

$$R_A^{C3}(\tau_A^{C3}(\tau_B),\tau_B) - R_A^{C4}(\tau_A^{C4}(\tau_B),\tau_B) = \rho_A\delta_{AB} - \frac{\rho_B}{ad_{AB}}\left(\frac{ad_{AB}\theta_{AB}-\tau_B}{2}\right)^2 \lesseqgtr 0 \tag{63}$$

Equation 63 is negative if:

$$\tau_B < ad_{AB}\theta_{AB} - 2\sqrt{ad_{AB}\theta_{AB}\delta_{AB}} \quad \vee \quad ad_{AB}\theta_{AB} + 2\sqrt{ad_{AB}\theta_{AB}\delta_{AB}} < \tau_B \tag{64}$$

we can ignore the first case as $\tau_B \geq max(ad_{AB}-2\delta_{AB}, ad_{AB}\theta_{AB}+2\delta_{BA})$ and $\delta_{BA} > -\sqrt{ad_{AB}\theta_{AB}\delta_{AB}}$. Thus, municipality A's best response is defined as $\tau_A(\tau_B) = \frac{1}{2}(ad_{AB}\theta_{AB} + \tau_B)$ for $\tau_B \geq ad_{AB}\theta_{AB} + 2\sqrt{ad_{AB}\theta_{AB}\delta_{AB}}$.

Equation 63 is positive if:

$$ad_{AB}\theta_{AB} - 2\sqrt{ad_{AB}\theta_{AB}\delta_{AB}} < \tau_B < ad_{AB}\theta_{AB} + 2\sqrt{ad_{AB}\theta_{AB}\delta_{AB}} \tag{65}$$

as $\tau_B \geq max(ad_{AB} - 2\delta_{AB}, ad_{AB}\theta_{AB} + 2\delta_{BA})$ and $\delta_{BA} > -\sqrt{ad_{AB}\theta_{AB}\delta_{AB}}$ we can tighten the left bound:

$$max(ad_{AB} - 2\delta_{AB}, ad_{AB}\theta_{AB} + 2\delta_{BA}) < \tau_B < ad_{AB}\theta_{AB} + 2\sqrt{ad_{AB}\theta_{AB}\delta_{AB}} \tag{66}$$

Municipality A's best response in this interval is defined as $\tau_A(\tau_B) = \tau_B + \delta_{AB}$. The existence of such an interval depends on $max(ad_{AB} - 2\delta_{AB}, ad_{AB}\theta_{AB} + 2\delta_{BA})$.

If $(1-\theta_{AB}) \leq \frac{2(\delta_{AB}+\delta_{BA})}{ad_{AB}}$, then $ad_{AB} - 2\delta_{AB} \leq ad_{AB}\theta_{AB} + 2\delta_{BA}$. Thus, such an segment exists iff $\delta_{BA} \leq \sqrt{ad_{AB}\theta_{AB}\delta_{AB}}$. If $(1-\theta_{AB}) \geq \frac{2(\delta_{AB}+\delta_{BA})}{ad_{AB}}$, then $ad_{AB} - 2\delta_{AB} \geq ad_{AB}\theta_{AB} + 2\delta_{BA}$. Thus, such an interval exists iff $(1-\theta_{AB}) \leq \frac{2\left(\delta_{AB}+\sqrt{ad_{AB}\theta_{AB}\delta_{AB}}\right)}{ad_{AB}}$.

(2.3) If $(1-\theta_{AB}) \leq \frac{2(\delta_{AB}+\delta_{BA})}{ad_{AB}}$, taking the difference of Equation 59b and Equation 61a gives us for $\tau_B \in [ad_{AB} - 2\delta_{AB}, ad_{AB}\theta_{AB} + 2\delta_{BA}]$:

$$R_A^{C3}(\tau_A^{C3}(\tau_B),\tau_B) - R_A^{C4}(\tau_A^{C4}(\tau_B),\tau_B) = \rho_A(\tau_B+\delta_{AB}) - \rho_A(\tau_B-\delta_{BA}) = \rho_A(\delta_{AB}+\delta_{BA}) \geq 0 \tag{67}$$

Thus, the best response is defined as $\tau_A(\tau_B) = \tau_B + \delta_{AB}$ for this interval. As $\frac{2(\delta_{AB}+\delta_{BA})}{ad_{AB}} \geq 0$, a sufficient condition for $(1-\theta_{AB}) \leq \frac{2(\delta_{AB}+\delta_{BA})}{ad_{AB}}$ to hold is $\theta_{AB} \geq 1$.

(2.4) If $(1-\theta_{AB}) \geq \frac{2(\delta_{AB}+\delta_{BA})}{ad_{AB}}$, taking the difference of Equation 59a and Equation 61b gives us for $\tau_B \in [ad_{AB}\theta_{AB} + 2\delta_{BA}, ad_{AB} - 2\delta_{AB}]$:[57]

[57] Note that a necessary condition for $(1-\theta_{AB}) \geq \frac{2(\delta_{AB}+\delta_{BA})}{ad_{AB}}$ is that $\theta_{AB} \leq 1$ as $\frac{2(\delta_{AB}+\delta_{BA})}{ad_{AB}} \geq 0$.

$$R_A^{C3}(\tau_A^{C3}(\tau_B),\tau_B) - R_A^{C4}(\tau_A^{C4}(\tau_B),\tau_B) = \frac{\rho_B}{4ad_{AB}}(1-\theta_{AB})\left((ad_{AB})^2\theta_{AB} - \tau_B^2\right) \tag{68}$$

Note that $\frac{2(\delta_{AB}+\delta_{BA})}{ad_{AB}} \geq 0$, so that $(1-\theta_{AB}) \geq \frac{\delta_{AB}+\delta_{BA}}{ad_{AB}}$ implies directly $\theta_{AB} \in (0,1]$. Thus, $\frac{\rho_B}{4ad_{AB}}(1-\theta_{AB}) \geq 0$ as $\theta_{AB} \in (0,1]$. Consequently, the sign of the expression depends only on the last term $((ad_{AB})^2\theta_{AB} - \tau_B^2)$. The term is positive iff $\tau_B \leq ad_{AB}\sqrt{\theta_{AB}}$ and negative iff $\tau_B \geq ad_{AB}\sqrt{\theta_{AB}}$. Thus, the best response for this interval is defined as:

$$\tau_A(\tau_B) = \begin{cases} \frac{1}{2}(ad_{AB}+\tau_B) & \text{if } \; ad_{AB}\theta_{AB} + 2\delta_{BA} \leq \tau_B \leq ad_{AB}\sqrt{\theta_{AB}} \quad (69a) \\ \frac{1}{2}(ad_{AB}\theta_{AB}+\tau_B) & \text{if } \; ad_{AB}\sqrt{\theta_{AB}} \leq \tau_B \leq ad_{AB} - 2\delta_{AB} \quad (69b) \end{cases}$$

A sufficient condition to ensure that the ordering $ad_{AB}\theta_{AB}+2\delta_{BA} \leq ad_{AB}\sqrt{\theta_{AB}} \leq ad_{AB}-2\delta_{AB}$ holds true is $(\sqrt{\theta_{AB}} - \theta_{AB}) \geq max(\frac{2\delta_{AB}}{ad_{AB}}, \frac{2\delta_{BA}}{ad_{AB}})$.

Combining (2.1) to (2.4), the best response correspondence of municipality A, that is, the solution to the unconstrained optimization problem, if $(1-\theta_{AB}) \geq \frac{2(\delta_{AB}+\delta_{BA})}{ad_{AB}}$ and $\delta_{BA} \geq \sqrt{ad_{AB}\theta_{AB}\delta_{AB}}$ is given by:[58]

$$\tau_A(\tau_B) = \begin{cases} \frac{1}{2}(ad_{AB}+\tau_B) & \text{if } \tau_B \leq ad_{AB}\theta_{AB} + 2\delta_{BA}, \\ \frac{1}{2}(ad_{AB}+\tau_B) & \text{if } ad_{AB}\theta_{AB} + 2\delta_{BA} \leq \tau_B \leq ad_{AB}\sqrt{\theta_{AB}}, \\ \frac{1}{2}(ad_{AB}\theta_{AB}+\tau_B) & \text{if } ad_{AB}\sqrt{\theta_{AB}} \leq \tau_B \leq ad_{AB} - 2\delta_{AB}, \\ \frac{1}{2}(ad_{AB}\theta_{AB}+\tau_B) & \text{if } \tau_B \geq ad_{AB} - 2\delta_{AB}. \end{cases} \tag{70}$$

while the best response correspondence if $(1-\theta_{AB}) \leq \frac{2(\delta_{AB}+\delta_{BA})}{ad_{AB}}$ and $\delta_{BA} \geq \sqrt{ad_{AB}\theta_{AB}\delta_{AB}}$

[58] Assume that $(1-\theta_{AB}) \geq \frac{2(\delta_{AB}+\delta_{BA})}{ad_{AB}}$ holds, then $\delta_{BA} \geq \sqrt{ad_{AB}\theta_{AB}\delta_{AB}}$ is a sufficient condition such that $(1-\theta_{AB}) \geq \frac{2\left(\delta_{AB}+\sqrt{ad_{AB}\theta_{AB}\delta_{AB}}\right)}{ad_{AB}}$ is satisfied. In general, the second condition ensures that $ad_{AB} - 2\delta_{AB} \geq ad_{AB}\theta_{AB} + 2\sqrt{ad_{AB}\theta_{AB}\delta_{AB}}$. Thus, there exists no interval $[ad_{AB} - 2\delta_{AB}, ad_{AB}\theta_{AB} + 2\sqrt{ad_{AB}\theta_{AB}\delta_{AB}}]$ for which municipality A would like to play $\tau_A = \tau_B + \delta_{AB}$ as a best reponse. $\delta_{BA} \geq \sqrt{ad_{AB}\theta_{AB}\delta_{AB}}$ ensures that the fixed cost of shifting profits from A to B are sufficiently small, such that A is always better of choosing the lower tax rate $\tau_A = \frac{1}{2}(ad_{AB}\theta_{AB}+\tau_B)$ over $\tau_A = \tau_B + \delta_{AB}$.

is given by:

$$\tau_A(\tau_B) = \begin{cases} \frac{1}{2}\left(ad_{AB} + \tau_B\right) & \text{if } \tau_B \leq ad_{AB} - 2\delta_{AB}, \\ \\ \tau_B + \delta_{AB}, & \text{if } ad_{AB} - 2\delta_{AB} \leq \tau_B \leq ad_{AB}\theta_{AB} + 2\delta_{BA} \\ \\ \frac{1}{2}\left(ad_{AB}\theta_{AB} + \tau_B\right) & \text{if } \tau_B \geq ad_{AB}\theta_{AB} + 2\delta_{BA}. \end{cases} \tag{71}$$

We can derive the best response correspondence of municipality B analog. The solution to the unconstrained optimization problem, if $(1 - \frac{1}{\theta_{AB}}) \leq \frac{2(\delta_{AB}+\delta_{BA})}{ad_{AB}}$ and $\delta_{AB} \geq \sqrt{\frac{ad_{AB}}{\theta_{AB}}\delta_{BA}}$ is given by:

$$\tau_B(\tau_A) = \begin{cases} \frac{1}{2}\left(ad_{AB} + \tau_A\right) & \text{if } \tau_A \leq ad_{AB} - 2\delta_{BA}, \\ \\ \tau_A + \delta_{BA}, & \text{if } ad_{AB} - 2\delta_{BA} \leq \tau_A \leq \frac{ad_{AB}}{\theta_{AB}} + 2\delta_{AB} \\ \\ \frac{1}{2}\left(\frac{ad_{AB}}{\theta_{AB}} + \tau_A\right) & \text{if } \tau_A \geq \frac{ad_{AB}}{\theta_{AB}} + 2\delta_{AB}. \end{cases} \tag{72}$$

while the best response correspondence if $(1 - \frac{1}{\theta_{AB}}) \geq \frac{2(\delta_{AB}+\delta_{BA})}{ad_{AB}}$ and and $\delta_{AB} \geq \sqrt{\frac{ad_{AB}}{\theta_{AB}}\delta_{BA}}$ is given by:

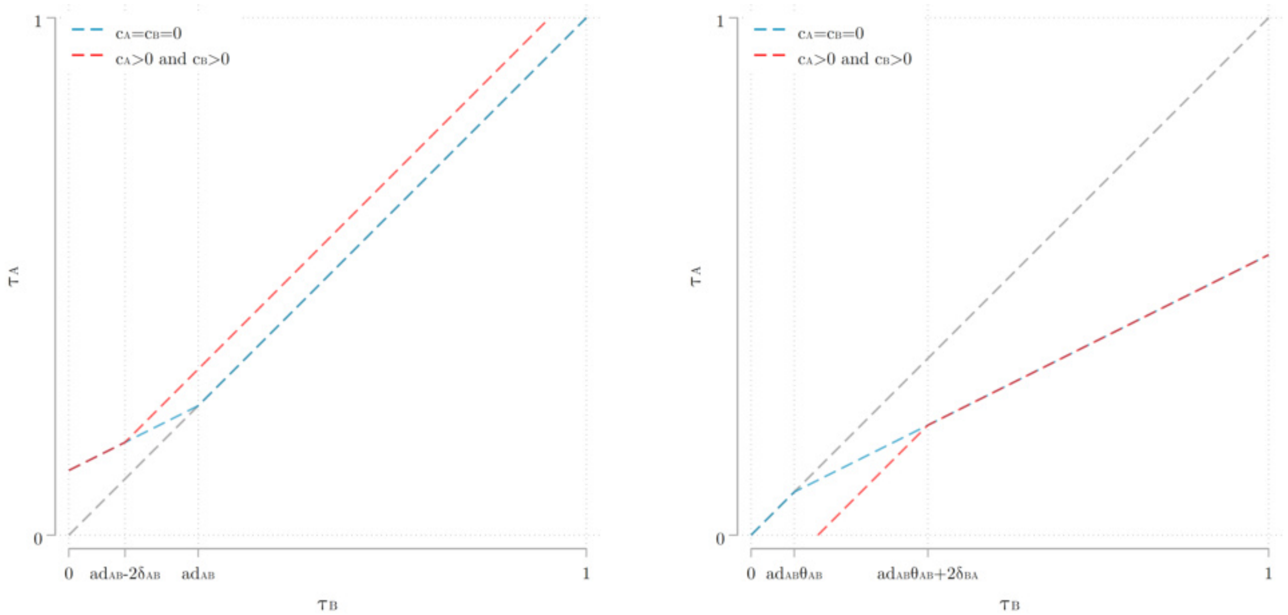
$$\tau_B(\tau_A) = \begin{cases} \frac{1}{2}\left(ad_{AB} + \tau_A\right) & \text{if } \tau_A \leq \frac{ad_{AB}}{\theta_{AB}} + 2\delta_{AB}, \\ \\ \frac{1}{2}\left(ad_{AB} + \tau_A\right) & \text{if } \frac{ad_{AB}}{\theta_{AB}} + 2\delta_{AB} \leq \tau_A \leq \frac{ad_{AB}}{\sqrt{\theta_{AB}}}, \\ \\ \frac{1}{2}\left(\frac{ad_{AB}}{\theta_{AB}} + \tau_A\right) & \text{if } \frac{ad_{AB}}{\sqrt{\theta_{AB}}} \leq \tau_A \leq ad_{AB} - 2\delta_{BA}, \\ \\ \frac{1}{2}\left(\frac{ad_{AB}}{\theta_{AB}} + \tau_A\right) & \text{if } \tau_A \geq ad_{AB} - 2\delta_{BA}. \end{cases} \tag{73}$$

Lemma D4. *Let $\tau_A(\tau_B)$ and $\tau_B(\tau_A)$ denote the best response correspondences if $c_{AB} = c_{BA} = 0$. Denote $\tau_A^{FC}(\tau_B)$ and $\tau_B^{FC}(\tau_A)$ as municipality A and B's best response correspondence in a setup with positive fixed costs, i.e., $c_{AB} > 0$ and $c_{BA} > 0$. It can be shown that $\forall \tau_B \in [0,1] : \tau_A^{FC}(\tau_B) \geq \tau_A(\tau_B)$ and $\forall \tau_B \in [0,1] : \tau_B^{FC}(\tau_A) \geq \tau_B(\tau_A)$.*

Proof: Figure D3 illustrates municipality A's optimal choice for the constrained problems with ($C3$ and $C4$) and without ($C1$ and $C2$) fixed cost. The optimal tax rate τ_A^C is always higher or equal in the setting with fixed cost compared to a setup without fixed cost. The only exception is the region $\tau_B \in [0, ad_{AB}\theta_{AB} + 2\delta_{BA}$ in the constrained problem $C4$. In this region, the optimal choice of A is defined as $\tau_A^{C4}(\tau_B) = \tau_B - \delta_{BA}$. Section (2) of the derivation of municipality A's

Figure D3: Optimal τ_A constrained problems ($C1$ to $C4$)

(a) $\tau_A^{C1}(\tau_B)$ and $\tau_A^{C3}(\tau_B)$ (b) $\tau_A^{C2}(\tau_B)$ and $\tau_A^{C4}(\tau_B)$



Note: The figure illustrates the optimal tax rate τ_A^C for the constrained problems with ($C3$ and $C4$) and without ($C1$ and $C2$) fixed cost. The parameterization is: $a = 0.25$, $d_{AB} = 1$, $\rho_A = 1$, $\rho_B = 3$, $c_{AB} = 0.01$ and $c_{BA} = 0.1$.

best response correspondence, reveals that municipality A will never choose $\tau_A^{FC}(\tau_B) = \tau_B - \delta_{BA}$ as a best response. Consequently, $\forall \tau_B \in [0,1] : \tau_A^{FC}(\tau_B) \geq \tau_A(\tau_B)$. Proof for municipality B is analog.

Lemma D5. *For a given set of parameters $\{a, d_{AB}, \rho_A, \rho_B\}$, denote $\{\tau_A^{FC}, \tau_B^{FC}\}$ as the Nash equilibrium with positive fixed costs ($c_{AB} > 0$ and $c_{BA} > 0$) and $\{\tau_A^{NE}, \tau_B^{NE}\}$ as the Nash equilibrium with fixed costs equal zero. It can be shown that $\tau_A^{FC} \geq \tau_A^{NE}$ and $\tau_B^{FC} \geq \tau_B^{NE}$.*

Proof: Immediate from Lemma D4.

Proof Proposition 3: In the following we (1) show that $\tau_A > \tau_B$ cannot be a Nash equilibrium, (2) compute the equilibrium tax rates if $(1 - \theta_{AB}) \geq \frac{2(\delta_{AB}+\delta_{BA})}{ad_{AB}}$ and $\delta_{BA} \leq min(\sqrt{ad_{AB}\theta_{AB}\delta_{AB}}, 2\delta_{AB})$, (3) show that $\tau_A = \tau_B$ cannot be a Nash equilibrium, (4) identify conditions on parameters a, d_{AB} and θ_{AB} such that equilibrium tax rates $\tau_A, \tau_B \in [0,1]$, and (5) show that in equilibrium for each firm A and B the amount of shifted profits is lower than the firm's overall profits.

(1) We know from Equation 70 and Equation 72 that municipality A (B) will choose a strictly higher (lower) tax rate than municipality B (A) only in the area where $\tau_B < ad_{AB}\theta_{AB} + 2\delta_{BA}$ or $ad_{AB}\theta_{AB} + 2\delta_{BA} < \tau_B < ad_{AB}\sqrt{\theta_{AB}}$ ($\tau_A > max(\frac{ad_{AB}}{\theta_{AB}} + 2\delta_{AB}, \frac{ad_{AB}}{\theta_{AB}} + 2\sqrt{\frac{ad_{AB}}{\theta_{AB}}\delta_{BA}})$). Thus, the equilibrium tax rates are defined by:

$$\tau_A(\tau_B) = \frac{1}{2}\left(ad_{AB} + \tau_B\right) \tag{74}$$

$$\tau_B(\tau_A) = \frac{1}{2}\left(\frac{ad_{AB}}{\theta_{AB}} + \tau_A\right) \tag{75}$$

Solving by substitution, we get:

$$\tau_A(\tau_B) = \left(\frac{ad_{AB}}{\theta_{AB}}\right)\left(\frac{1+2\theta_{AB}}{3}\right) \leq \frac{ad_{AB}}{\theta_{AB}} \tag{76}$$

As $\theta_{AB} \leq 1$ the foregoing expression is smaller than $\frac{ad_{AB}}{\theta_{AB}}$, which violates the condition for municipality B to choose a strictly lower tax rate than municipality A. Thus, $\tau_A > \tau_B$ cannot be an equilibrium.

(2) We know from Equation 70 and Equation 72 that municipality A (B) will choose a strictly lower (higher) tax rate than municipality B (A) only in the area where $ad_{AB}\sqrt{\theta_{AB}} < \tau_B < ad_{AB} - 2\delta_{AB}$ or $\tau_B > ad_{AB} - 2\delta_{AB}$ ($\tau_A < ad_{AB} - 2\delta_{BA}$). Thus, the equilibrium tax rates are defined by:

$$\tau_A(\tau_B) = \frac{1}{2}\left(ad_{AB}\theta_{AB} + \tau_B\right) \tag{77}$$

$$\tau_B(\tau_A) = \frac{1}{2}\left(ad_{AB} + \tau_A\right) \tag{78}$$

Solving by substitution, we get:

$$\tau_A(\tau_B) = ad_{AB}\left(\frac{1}{3} + \frac{2}{3}\theta_{AB}\right) \tag{79}$$

$$\tau_B(\tau_A) = ad_{AB}\left(\frac{2}{3} + \frac{1}{3}\theta_{AB}\right) \tag{80}$$

As $\theta_{AB} < 1$, we know that $\left(\frac{2}{3} + \frac{1}{3}\theta_{AB}\right) > \sqrt{\theta_{AB}}$, so that the condition for A to choose a strictly lower tax rate than B is satisfied. Finally, as we assume that $(1-\theta_{AB}) \geq \frac{2(\delta_{AB}+\delta_{BA})}{ad_{AB}}$, a sufficient condition for $ad_{AB}\left(\frac{1}{3} + \frac{2}{3}\theta_{AB}\right) \leq ad - 2\delta_{BA}$ to hold is that $\delta_{BA} \leq 2\delta_{AB}$. Thus, if $(1-\theta_{AB}) \geq \frac{2(\delta_{AB}+\delta_{BA})}{ad_{AB}}$ and $\delta_{BA} \leq min(\sqrt{ad_{AB}\theta_{AB}\delta_{AB}}, 2\delta_{AB})$, we have defined the unique equilibrium where $\tau_A < \tau_B$.

(3) Follows directly from Lemma D3. **(4)** and **(5)** See proof for case without fixed cost.