Firms' Tax Perception - Survey-Based Studies

Der Fakultät für Wirtschaftswissenschaften der

Universität Paderborn

zur Erlangung des akademischen Grades

Doktor der Wirtschaftswissenschaften

- Doctor rerum politicarum -

vorgelegte Dissertation

von

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geboren am 14. Januar 1994 in Ankum

2024

Danksagung

Zuerst möchte ich meiner Doktormutter, Prof. Dr. Dr. h.c. Dr. h.c. Caren Sureth-Sloane, herzlich für ihre Betreuung danken. Ihre wertvollen fachlichen Anregungen, ihre Unterstützung und insbesondere ihre herzliche Art haben entscheidend dazu beigetragen, dass diese Arbeit entstanden ist.

Ebenso gilt ein großer Dank den Mitgliedern meiner Prüfungskommission Prof. Dr. Urska Kosi, Prof. Dr. Stefan Betz, Prof. Dr. Michael Ebert und Prof. Dr. René Fahr. Ein besonderer Dank gilt Prof. Dr. Urska Kosi für die Übernahme des Zweitgutachtens und für die Unterstützung während meiner Promotionszeit.

Auch bei meinen Projektpartnern Dr. Martin Fochmann, Dr. Henning Giese, Dr. Hans-Peter Huber und Prof. Dr. Ralf Maiterth möchte ich mich vielmals bedanken. Ihre Expertise und Erfahrungen haben diese Arbeit maßgeblich bereichert. Darüber hinaus hat mir die Zusammenarbeit immer große Freude bereitet.

Bei allen Kolleginnen und Kollegen aus dem TAF-Department und dem TRR 266 B08-Team möchte ich mich ebenfalls von Herzen bedanken. Insbesondere Adrian, Annika, Arndt, Daniel, Henning, Julia, Kim, Pia, Regina, Rey, Steffie, Theresa und Yuri sowie Aaron, Hansi, Karina und Leonie haben mich nicht nur fachlich unterstützt, sondern meine Promotionszeit durch viele gemeinsame Erlebnisse und unzählige Gespräche bereichert. Teil solch toller Teams zu sein und die freundschaftliche Arbeitsatmosphäre haben wesentlich zum Gelingen dieser Arbeit beigetragen. Ich danke Euch.

Auch möchte ich allen studentischen und wissenschaftlichen Hilfskräften vielmals für ihre Unterstützung danken.

Mein herzlicher Dank gilt zudem meinen Eltern, die mich stets ermutigt haben, meinen eigenen Weg zu gehen. Ich danke ihnen auch für ihre Unterstützung, ihre Geduld und ihr Verständnis. Gleiches gilt für meine Freundinnen und Freunde. Zu guter Letzt möchte ich meinem Mann Hendrik von ganzem Herzen für seine unverzichtbare Unterstützung danken. Danke, dass Du immer an meiner Seite bist, mich auch in schwierigen Zeiten zum Lachen bringst und immer an mich glaubst.

CONTENTS

I INTRODUCTION

Taxes have a significant impact on firms' decision-making (e.g., Erickson et al., 2020). Standard models analyzing firm behavior are based on the assumption that decision-makers in firms are perfectly informed about the tax implications of their decisions, thus that their decisions are based on the information provided by regulators through tax laws and tax guidelines (e.g., MacKie-Mason, 1989; Graham, 1996; Faccio and Xu, 2015; Dobbins and Jacob, 2016). However, decision-makers of the firm may not be able to process this information accurately, resulting in a perception that differs from the provided information. This difference could bias their business decisions as well as their attitudes towards the tax system, as their perceptions influence how they incorporate taxes into their reasoning.[1]

With the growing emphasis on behavioral economics, tax researchers have increasingly focused on the perception of taxes and their impact on economic decisions over the last two decades (Blaufus et al., 2022). A substantial body of research on individuals has shown that provided and perceived tax information can differ significantly, and that these perceptions affect individuals' behavior. While much of the existing literature measures individuals' tax perception, research on the tax perception of decision-makers of firms, which I refer to as *firms' tax perception*[2], is scarce. Although decisions in firms are ultimately made by individuals, there are several reasons why the tax perception of firms may differ from that of individuals. These include, for example, the specific and complex tax environment, market competition or the influence of incentive systems on decision-makers. Therefore, identifying and quantifying firms' tax perception is crucial for understanding how firms perceive the tax system and tax reforms, and consequently, for how taxes and tax-related information affect firms' decision-making. In this dissertation, I employ *survey data* to determine the magnitude, identify the drivers, investigate possibilities for the prediction, and analyze the consequences of firms' tax perception. The specific focus on firms' tax perception allows for the examination of a component within the analysis of firms' decision-making that has been largely overlooked. Thus, the findings contribute to a more comprehensive understanding of firm behavior and provide insights for practitioners and policymakers.

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[1] The concept is inspired by the German Research Foundation (DFG) funded Collaborative Research Center (SFB/TRR) project number 403041268 – TRR 266 Accounting for Transparency. The author gratefully acknowledges the support of TRR 266.

[2] It is not possible for a firm as an entity to perceive information or make a decision. This is only possible for the decision-maker of the firm. In this dissertation, however, I focus exclusively on small and medium-sized firms and on the survey responses of firm representatives who are entrepreneurs or managers of these firms and who can therefore be said to embody the firm in the analyses. Therefore – and also for the sake of linguistic simplicity – I refer to firms' tax perception.

The three studies of this dissertation by Fochmann, Heinemann-Heile, Huber, Maiterth, and Sureth-Sloane (A)[3], Heinemann-Heile (B)[4], and Giese and Heinemann-Heile (C)[5], are embedded in this unified context and address the measurement ((A), (B)), the drivers ((A), (B), (C)), and the consequences of firms' tax perception ((A), (C)). In (A), we use survey data on German firms to contrast their perceived tax rates with actual tax rates, and subsequently refer to the differences as tax rate misperception. This approach allows us to investigate the extent, drivers, and consequences of firms' tax rate misperception. Given the lack of observations on firms' tax rate perception, which is due to the unavailability of such information in commercial databases, in study (B) I assess the potential of machine learning to generate reliable predictions of firms' perception of tax rates in a time- and cost-effective manner. In (C), we examine whether and to what extent firms' perception and the actual provision of public goods, as well as firms' perception of local governments' trustworthiness in handling tax revenues, are associated with firms' willingness to pay (WTP) local business tax. We measure firms' WTP local business tax by contrasting the actual local business tax rate with firms' perception of the appropriate local business tax rate.

All three studies focus on small- and medium-sized enterprises (SMEs), with a significant proportion of private firms in each sample. In general, SMEs account for more than 50% of the gross domestic product in most OECD countries (International Labour Organization, 2019). Moreover, an analysis of the United States, Canada, the United Kingdom, and Germany shows that SMEs represent the largest segment of the business landscape, allowing the generalization of the findings to other major economies (OECD, 2022). In the same way, private firms are particularly important for the economy of a country (Allee and Yohn, 2009; Lisowsky and Minnis, 2020). However, despite their important contribution to the economies of countries, SMEs and private firms have rarely been considered in the existing literature. The three studies respond to calls for more research on these (e.g., Hanlon and Heitzman, 2010; Lisowsky and Minnis, 2020).

Study (A) examines the extent, drivers, and consequences of *firms' tax rate misperception*. The term firms' tax rate misperception is used to describe the difference between the tax rate that firms perceive, as obtained from our survey, and the actual tax rate, determined based on the tax rate schedule and administrative tax return data for the surveyed firms. The motivation for study (A) is based on the observation that studies examining the impact of taxes on decision-making typically refer to actual tax rates, without considering the potential impact of tax rate misperception among firms. This is surprising given the extensive literature on individuals' tax behavior, which shows that tax misperception is widespread and affects their behavior (e.g.,

[3] Fochmann, Martin, Heinemann-Heile, Vanessa, Huber, Hans-Peter, Maiterth, Ralf & Sureth-Sloane, Caren. Firms' Tax Misperception. *TRR 266 Accounting for Transparency Working Paper Series No. 108, WU International Taxation Research Paper Series No. 2022-12*, http://dx.doi.org/10.2139/ssrn.4300919.

[4] Heinemann-Heile, Vanessa. Using Machine Learning to Predict Firms' Tax Perception. *Working Paper*.

[5] Giese, Henning & Heinemann-Heile, Vanessa. Firms' Willingness to Pay Local Business Tax – The Impact of Trust and Public Goods. *TRR 266 Accounting for Transparency Working Paper Series No. 158*, https://ssrn.com/abstract=4972829.

Schmölders, 1960; Jackson and Hatfield, 2005; Hoopes et al., 2015; Rees-Jones and Taubinsky, 2020; Moore and Slemrod, 2021; Stantcheva, 2021 and, for a review, Blaufus et al., 2022). Although, as noted above, the decisions made within firms are ultimately the responsibility of individuals, there are a number of reasons why the behavior of firms differs from that of individuals. These include, for example, the tax system and competition between firms (for a detailed discussion, see the introduction to (A)). We fill this research gap and show that over 60% (50%) of firms considerably misperceive their average tax rate (ATR) (marginal tax rate (MTR)). We identify firm size, tax system complexity, tax literacy, and dissatisfaction with the tax system as the main drivers of tax misperception. Furthermore, our results suggest that misperception is likely to distort investment decisions, especially under a progressive tax schedule, and influence firms' attitudes towards the tax system, namely their desire for tax cuts. Consequently, policymakers and researchers should consider firms' tax rate misperception when discussing and evaluating tax policy.

Conducting a survey of German SMEs in (A) allows us to gain insight into the extent and heterogeneity of firms' misperception, which contributes to parts of the objective of this dissertation: to identify and quantify firms' tax perception. In our survey, we ask firms to state the ATR and the MTR for a provided profit of a fictitious firm similar to their own. The profits are individually simulated based on the characteristics of the firms, including the number of employees, the industry in which they operate, and their legal form. Respondents are therefore expected to be familiar with the simulated firm's profit. To measure firms' tax rate misperception, we compare the tax rate perception stated in the survey with the actual tax rate. To determine the actual tax rate, we apply the corporate income tax schedule to the provided profit for corporations and likewise the income tax schedule to the provided profit for non-corporations. For the latter, we additionally use administrative tax return data to account for the peculiarities of determining taxable income.[6] This approach allows us to quantify firms' tax rate misperception and to analyze the consequences of tax rate misperception on firms' investment decisions and the extent of this desire for tax cuts.

Our results in (A) demonstrate that firms considerably misperceive their tax rates. Defining a perceived tax rate as accurate if it does not deviate more than five percentage points from the actual tax rate, 66% of the firms misperceive their average tax rate (ATR) and 55% of the firms misperceive their marginal tax rate (MTR). In this study, we examine both the marginal and the average tax rates, as both are important metrics for firms: While ATRs provide insight into a firm's tax burden (relative to its peers), MTRs are crucial for business decisions (Graham, 2003; Erickson et al., 2020). While non-corporations on average overestimate their ATR, corporations tend to overestimate tax rates on retained profits but underestimate tax

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[6]   Ideally, firm-specific tax return data or financial statement data would be used to determine the actual tax rate. But German tax return data of firms are only available in anonymized form, so that we cannot match them with our sample firms. Further, financial statement data are not available for a large part of our sample firms, since SMEs as well as non-corporations are not or less subject to disclosure requirements.

rates on distributed profits. The results of our regression analyses indicate that features of the tax system, in particular the inherent complexity, firm size and personal characteristics, tax literacy and dissatisfaction with the tax system, are significant drivers of firms' tax rate misperception. In addition, our initial analyses show that firms' misperception of tax rates can negatively affect entrepreneurs' decision-making, leading to distorted investment choices and firms' perception of being overtaxed, which is strongly correlated with their overestimation of tax rates. In view of the overarching objective of this dissertation, the results show that the information provided by the regulator is processed by the firms in a way that leads to tax rate perceptions that differ from the provided information and that these affect firms' decisions and attitudes towards the tax system.

In summary, in (A) we are the first to quantify firms' tax rate misperception, to identify the drivers of misperception, and to provide evidence on the consequences of such misperception, including its impact on investment decisions and firms' desire for tax cuts. In this way, our findings in (A) provide insights that can inform future research and contribute to more accurate predictions and understanding of firms' decision-making processes in response to taxes and tax reforms. Furthermore, we illustrate how survey data and calculations based on administrative data can be combined to quantify firms' tax rate misperception. In addition, the results of (A) can contribute to the development of strategies to improve the transparency of tax regulations and thus the provision of information.

In study (B), I analyze whether the use of a machine-learning based approach can lead to a reliable prediction of *firms' tax rate perception.* Furthermore, I investigate which variables contribute most to the prediction of firms' tax rate perception. Firms' tax rate perception is the stated tax rate perception by a firm's decision-maker in a survey. I rely on two data sources providing data on tax rate perceptions of German SMEs: First, I use data from Fochmann et al. (2024) and second, I use data from the fourth survey-wave of the German Business Panel.[7] In both surveys, firms were asked about their ATR and MTR perception. As previously stated in the introduction to this dissertation and highlighted by the results of study (A), firms' tax rate perception alter firms' decision-making as well as attitudes, and are thus important to consider.

Despite this, research on firms' tax rate perception and its consequences is still scarce. Presumably, this is mostly due to the lack of observations of firms' tax rate perception. While tax rate perception is a variable not covered in commercial databases, also survey or interview evidence is scarce. The process of collecting data on perceptions, either through surveys or interviews, represents a significant challenge, particularly when conducted with a large number of firms. This is due to the substantial time investment required and the fact

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[7] The author thanks the team of authors of Fochmann et al. (2024) as well as the team of the German Business Panel for the provision of the survey data.

that the success of the survey or interview is contingent on the willingness of firms to participate. Study (B) contributes to mitigate this issue by investigating the potential of machine learning to generate reliable tax rate perception predictions, based on existing data on firms' tax rate perception, for firms for which this data is lacking. Thus, this study contributes to the aim of this dissertation, by outlining a method for reliably predicting firms' tax rate perception that is both time- and cost-effective. In addition, this study contributes to the understanding of the variables that are important in predicting firms' tax rate perceptions. Overall, the approach provides a basis for further investigation of the implications of firms' tax rate perception by researchers and policy makers.

The application of a machine learning model is particularly well-suited to achieving the objective of study (B), as this method is designed to predict values. In contrast, traditional methods in accounting and taxation research, such as regression analysis, are designed to derive inferences. The strength of using a machine learning approach in this study is demonstrated by a comparison of the predictive accuracy of the proposed model with that of OLS regressions. I assess the predictive performance of the model using various criteria. These include the mean prediction error, which reflects the average accuracy of the prediction; the squared mean error, which reflects the precision of the predictions; and the explained variance. As machine learning models exhibit 'black box' features, I employ Shapley values to identify the features that contribute to the model's prediction (Shapley, 1953). For the purpose of prediction, XGBoost is trained on the basis of two data sets. The first data set is based on Fochmann et al. (2024) and encompasses both firm characteristics and personal characteristics of the surveyed decision-maker in the firm (*all variables*). The second data set, combining data of Fochmann et al. (2024) and the fourth survey-wave of the German Business Panel, contains only firm characteristics that are regularly publicly available for all firms (*public variables*). The procedure described allows for a comparison of the model performance and thus, to draw conclusions regarding the impact of a reduction in input factors on the model. The comparison is valuable in that it enables an evaluation of the model's potential for predicting future tax rates for firms with a limited number of available variables.

The results show that the application of XGBoost can yield valuable results in predicting firms' tax rate perception. The model's performance metrics show high accuracy, as evidenced by a consistently low mean prediction error of less than one percentage point for firms' perception of ATR and MTR compared to the mean ATR and MTR perception of more than 30%. The model also explains up to 23.20% (15.67%) of the variance for firms' ATR (MTR) perception. Compared to previous literature, Belnap et al. (2024) demonstrate that the R^2 for Cash ETR (GAAP ETR) does not exceed 38% (34%) even when including year, industry, firm, state, and manager fixed effects, this can be rated as (very) good results. Further, the root

mean square error is close to the standard deviation of the target variable ATR perception (MTR perception), and the model's prediction deviations are comparable to the standard deviation of the target value. Thus, the model does not make extreme errors and provides a good balance between mean prediction error and variance. Additionally, using XGBoost to predict firms' perceived tax rates leads to overall better results compared to the benchmark OLS regression. Comparing the models' performance using all variables with using public variables shows that the prediction performance declines when only public variables are employed, represented by a reduction in the precision of the prediction and the explained variance. The accuracy of the prediction remains approximately the same as for all variables. To conclude, even if the models' performance declines, reliable predictions can still be made using only public variables. The analysis of Shapley values is in line with these findings. In addition to firm characteristics, the cost of tax compliance, trust in the government's handling of tax revenues, and objective tax literacy as personal characteristics contribute considerably to the prediction. With regard to the overall objective of this dissertation, the results of study (B) offer an approach to reliably predict firms' tax rate prediction for future analyses and, by using Shapley values, offer insights into important factors regarding firms' tax rate perception.

Study (B) is the first to predict firms' tax rate perception and identify the variables contributing to the prediction. It presents evidence on how the lack of observations on firms' tax rate perception can be addressed and thus, enables further empirical analyses of the effects of firms' tax rate perception, such as on tax reforms, tax compliance, or business decisions. Further, it contributes to the literature by adding to a more comprehensive understanding of the extent to which machine learning methods can be applied to research in the field of taxation.

In (C), we analyze whether and to what extent the *provision of public goods* and firms' *trust in local governments' handling of local business tax revenues* are associated with *firms' WTP local business tax.* Furthermore, we investigate the association between firms' WTP local business tax and tax avoidance at the local level, thereby focusing on the consequences of firms' WTP local business tax revenue. We define firms' WTP as the difference between the actual local business tax rate, obtained from administrative data, and their perceived appropriate local tax rate, obtained from survey data. Given that taxes are levied at the federal and local level in about one-third of OECD countries, and that local taxes are an important source of revenue for local governments (Buettner & Poehnlein, 2024), the motivation for (C) is rooted in the question of how the provision of public goods and the building of trust can sustainably contribute to firms' WTP local business taxes.

While a substantial body of literature has examined the influence of the provision of public goods and trust in governments on individuals' tax compliance (e.g., Spicer and Lundstedt, 1976; Cowell and Gordon,

1988; Alm et al., 1992; Glaser and Hildreth, 1999; Kirchler et al., 2008; Beeri et al., 2022), surprisingly little is known about these effects for firms. As shown above, decisions in firms are ultimately made by individuals, but there are several reasons why the tax rate perception of firms may differ from that of individuals.[8] In (C), we address this research gap by showing that the perception of provided public goods related to the private sphere of firms' decision-makers and trust in the local government's handling of tax revenues are associated with an increase in firms' WTP local business taxes. To illustrate the implications of our findings for municipalities' tax revenue, we show that there is a significant association between firms' WTP local business taxes and the extent of tax avoidance at the municipal level. Thereby, (C) contributes to the goal of the dissertation in two ways. First, we demonstrate how the perceived utilization and handling of tax revenues influence firms' perception of appropriate tax rates. Second, it provides evidence on the tax revenue consequences of firms' perception of appropriate tax rates.

For our analysis in (C), we use the institutional framework of the German local business tax, the so-called trade tax rate, levied by municipalities. To conduct our analysis, we use survey data on German SMEs' perception of the appropriate local business tax rate and administrative data from the German Federal Statistical Office on the actual local business tax rate. To examine firms' perception of the trustworthiness of local governments in handling tax revenues, we also rely on our survey data. Regarding the provision of public goods, we distinguish between the perceived provision and the actual provision. The perceived provision represents firms' satisfaction with the provision of public goods, which we derive from survey data as well. To determine the actual provision, we use archival data from the INKAR-database[9]. We define the difference between both as salience of public goods and examine its effect on firms' WTP local business tax. Based on the findings of previous studies for individuals (Güth et al., 2005; Wahl et al., 2010; Iraman et al., 2021), we hypothesize, that the type of public good provided, is important for firms' WTP local business tax. Thus, we distinguish between private-related public goods, which mainly affect the personal sphere of the firm's decision-maker (kindergarten/daycare, primary schools, recreational areas, police stations, and hospitals), and business-related public goods, which mainly affect the business sphere (secondary schools, vocational schools, motorway connection, railway stations, and public transportation).

The results presented in (C) confirm a positive association between the level of trust in the municipalities' handling of local business tax revenues and firms' WTP local business tax. The effect of more than 20% is also economically significant, as it translates into a potential increase in tax revenue for municipalities of €5.61 billion (7.48% of the total local business tax revenue). The analysis also shows a positive effect for

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[8]   For a detailed discussion, see the introduction of (C).
[9]   The INKAR-database of the Federal Institute for Building, Urban and Regional Research is available at https://www.inkar.de/.

private-related public goods. A one standard deviation increase in firms' satisfaction with private-related public goods is associated with a 10% increase in the WTP local business tax. This is equivalent to an additional €2.8 billion in local business tax revenue for municipalities (3.74% of the total local business tax revenue). We point out that the economic effect of trust on firms' WTP local business tax is substantially larger than that observed for the provision of private-related public goods. This suggests that how tax revenues are handled has a greater impact on firms' willingness to pay than what the revenues are ultimately used for. An examination of the actual and salient provision of public goods reveals no significant association with firms' WTP local business tax. Hence, it is the perception of the provision of public goods, rather than the actual or salient provision, which is of primary importance. To analyze whether firms' stated WTP has actual economic consequences, we examine its correlation with tax avoidance within the respective municipality. We find a significant negative effect. An increase in firms' WTP local business tax is associated with a decrease in average tax avoidance within the municipality of about 10%. With regard to the overall objective of this dissertation, the results of study (C) emphasize the relevance of the consequences of firms' tax perception: Perceived trust in the municipality's handling of tax revenues significantly increases firms' WTP local business tax, which in turn leads to a reduction in tax avoidance in the municipality and thus to higher tax revenues.

Study (C) responds to the OECD's call for more information on the tax behavior of firms by providing insights into firms' WTP local business tax. As detailed in the introduction of (C), our findings suggest that local governments can increase tax revenues, maintain basic services, and ultimately ensure their self-governance by improving firms' perception of the trustworthy handling of tax revenues. Furthermore, our findings provide a basis for local governments to assess how the provision of public goods can contribute to firms' satisfaction and thus optimize the efficient use of tax revenues.

In conclusion, this dissertation contributes to research on how firms process tax-related information provided by policymakers. While research on individuals' tax perception is extensive, research on firms' tax perception is scarce. With this dissertation, I contribute to filling this gap. Both the motivation and the contribution of each study, as well as their results, highlight the need to integrate firms' tax perception into future research. The presented research lays the foundation for further research on corporate taxes or corporate tax effects by providing the first quantification of firms' tax rate misperception, by demonstrating a method for reliably predicting firms' tax rate perception, and by highlighting the consequences of firms' tax perception on their behavior.

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II   STUDIES OF THE DISSERTATION

Firms' Tax Misperception[*]

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Abstract

Firm managers consider tax implications when making business decisions. Their perception of the tax burden shapes how they incorporate taxes into their reasoning. We investigate how decision-makers in small and medium-sized firms perceive their firm's tax rates and how their perception differs from actual tax rates. We quantify their misperception of average tax rates (ATR) and marginal tax rates (MTR) and identify the main drivers of these misperceptions. We collect survey data on perceived tax rates of German firms of different legal forms and contrast them with actual tax rates derived from administrative tax return data. We find that the share of firm managers who considerably misperceive their ATR (MTR) is more than 66% (55%). We find that sole proprietorships and partnerships considerably overestimate their ATR on average. Corporate decision-makers, for their part, tend to overestimate tax rates on retained profits but underestimate ATRs and MTRs on distributed profits. Irrespective of the legal form, our results suggest that tax misperception is primarily influenced by the firm size, the complexity of the tax system, a lack of tax literacy, and a dissatisfaction with the tax system. We also find that misperception is likely to distort investment decisions, especially under a progressive tax schedule. Policymakers and researchers need to be aware of firms' tax misperception when discussing and evaluating tax policy.

Keywords:	Tax Misperception, Business Taxation, Tax Literacy, Tax Policy, Business Decisions, Tax Rates
JEL classification:	H25, H32, D91, M41

1 INTRODUCTION

We investigate the extent and drivers of the tax misperception of firm managers. We define tax misperception as the difference between the *perceived tax rates* of firm decision-makers, obtained from a survey, and the *actual tax rates* determined based on firm characteristics and administrative tax return data (e.g., Enrick, 1963; Auld, 1979; Gideon, 2017). Identifying and quantifying firms' tax misperception is crucial for understanding how managers (mis)perceive the tax system and tax reforms. It is also crucial for understanding how tax rates affect firms' business decisions. Therefore, we also examine how misperception of tax rates is reflected in the desire of firm managers for tax cuts and in their investment decisions.

Studies on the impact of taxes on decision-making typically refer to *actual tax rates* (e.g., MacKie-Mason, 1989; Graham, 1996; Jackson and Hatfield, 2005; Faccio and Xu, 2015; Dobbins and Jacob, 2016) and abstract from potential tax misperception among firm managers, who we will refer to for succinctness' sake as "firms" throughout this study. This is surprising because the literature on individual tax behavior shows, first, that tax misperception is widespread and, second, that it affects behavior (Schmölders, 1960; Jackson and Hatfield, 2005; Blaufus et al., 2015; Hoopes et al., 2015; Rees-Jones and Taubinsky, 2020; Gallemore et al., 2024; Moore and Slemrod, 2021; Stantcheva, 2021 and, for an overview, Blaufus et al., 2022). Decision-makers base their decisions on their perceptions derived from available information and their tax literacy,[1] and the *perceived tax rate* may substantially differ from the *actual tax rate.* This discrepancy could bias both business decisions and decision-makers' attitudes toward tax reforms. Along these lines, Gallemore et al. (2024) show that firm expectations about the U.S. Tax Cuts and Jobs Act, rather than the actual design and implementation of this tax reform, shaped firms' investments. Additionally, Neuman et al. (2020) highlight the relation of inaccurate information processing, tax uncertainty and corporate tax risk. Hence, it is important to understand how and to what extent firms misperceive tax rates, what drives their misperception, and how this misperception distorts their behavior.

To understand the magnitude and heterogeneity of firms' misperception, we surveyed German small and medium-sized firms (SMEs). We derive perceived tax rates from this survey and compare them with actual rates calculated based on firm characteristics, the tax schedule, and administrative tax return data. Our three-step approach allows us to capture the extent of tax rate misperception. We examine the heterogeneity of misperception across firms as well as the share of overestimating and underestimating firms. Our approach allows us to identify the main drivers of tax rate misperception and the types of firms that are most affected.

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[1] Following the approach of Genest-Grégoire et al. (2017, p. 4), we define *Tax Literacy* as "having the knowledge, skills and confidence to make responsible tax decisions." Below, we distinguish between *Subjective Tax Literacy*, which includes self-stated tax knowledge reported in the survey, and *Objective Tax Literacy*, which includes revealed knowledge of basic tax concepts.

In a first step, we ask firm decision-makers in our survey to report the average tax rate (ATR) and the marginal tax rate (MTR) for a profit of a fictitious firm that resembles theirs. We provide individually simulated profits based on firm characteristics provided by the respondents, such as number of employees, industry, and legal form. Thus, respondents are expected to be familiar with this simulated firm profit. To quantify their misperception in a second step, it would be ideal to contrast the perceived tax rates with the actual rates of the surveyed firm extracted from tax return data. However, we cannot match our survey participants with taxpayers in the tax return data or other data sources. To overcome this limitation, we calculate the *actual tax rate* of the surveyed firms by applying the income or corporate income tax schedule to the simulated profit and additionally use administrative tax return data for sole proprietorships and partnerships.[2] The tax return data provide extensive tax-related information for sole proprietorships and partnerships, and we extract details about additional income and special expenses that could affect the tax base and, in turn, the firms' progressive income tax rate.

Our approach allows us to quantify tax rate misperception and analyze its heterogeneity across firms. It also allows us to identify the main drivers of tax rate misperception and to identify the types of firms that are particularly affected by it.[3] Additionally, we examine the relation between the perceived ATR and the perceived MTR. Both tax rates are important to firms, but they serve different purposes. While ATRs provide information about a firm's tax burden relative to peers, MTRs matter for business decisions (Graham, 2003; Erickson et al., 2020). Graham et al. (2017) show that large firms often use inappropriate tax rates when making business decisions. Their findings suggest that, despite the expected high level of tax literacy among large firms, their decision-makers do not appropriately account for taxes.

Our results reveal that SMEs of different sizes and legal forms do considerably misperceive their tax rates. We find that over 66% (55%) of the firms misperceive their ATR (MTR) if we define *perceived tax rates* as accurate only when they do not deviate more than five percentage points from the *actual tax rate*. Sole proprietorships and partnerships better estimate their MTRs than their ATRs and show a fairly consistent pattern of misperception: ATRs are overestimated, while MTRs are underestimated on average. Consistent with our expectations, corporations better estimate their tax rates on retained earnings. This can be explained by the straightforward flat corporate tax. However, we find that about 45% of corporations misperceive

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[2] Following Gideon (2014, p. 1), who refers to relying on firms' tax return data as the "gold standard measure", we use administrative tax return data in our calculation of the actual tax rate. The tax return data is anonymized such we cannot link our survey data to firm tax returns. To obtain firms' actual tax rates, we could have asked the respondents about their firm's taxable income and tax burden. However, we decided not to for two reasons. First, we expected responses to be noisy because self-reported profits and losses might be erroneous and relevant details might be unknown to our respondent. Second, respondents might be reluctant to disclose this private information which then would result in non-response. We use this indirect approach to obtain the actual tax rates of sole proprietorships and partnerships.

[3] We use a broad definition of "misperception" that does not distinguish between unintentionally and intentionally stated biased tax rates reported in the survey. For more details on this aspect, see Section 3.

their ATR and MTR by more than five percentage points above or below the actual rate. The share of corporations that overestimate and underestimate their ATR and MTR is roughly equal. The picture differs for distributed profits. Here shareholder taxation adds a layer of complexity to corporate income taxation. We find that corporations tend to severely underestimate the combined tax rates. This is an important finding for incorporated SMEs, which are often owner managed, as the tax burden of their business activities should be assessed through both layers of taxation, that is, at both the firm and shareholder levels. The share of corporate decision-makers who misperceive the ATR and MTR on distributed profits amounts to over 65% of our respondents, presumably due to the higher complexity of taxation at the corporate and the shareholder levels.

To examine the influence of firm and personal characteristics on firms' tax rate misperception, we conduct regression analyses. Our results indicate that, in addition to differences in the tax system between corporations and non-corporations, the respondents' personal characteristics matter. Specifically, their tax literacy[4] and satisfaction with the tax system are negatively associated with ATR and MTR misperception. Initial analyses show that misperception of tax rates can harm entrepreneurs' decision-making, leading to distorted investment choices. Moreover, firms' perception of being overtaxed strongly correlates with overestimation of tax rates, highlighting the importance of considering misperception in tax policy discussions.

The literature almost exclusively analyzes individuals' tax misperception. For example, Schmölders (1960), a pioneer in this field, reports that about 50% of German individuals surveyed overestimate their ATR, 20% underestimate it, and about one-third correctly report it. Enrick (1963) notes that U.S. taxpayers tend to underestimate their ATR. Van Wagstaff (1965) confirms these results in a survey of U.S. employees and finds that about 10% have accurate beliefs about their ATR. However, overestimates and underestimates are almost balanced. Auld (1979) surveys Canadians and finds that low- and high-income respondents significantly overestimate their ATR, while members of the middle-income group estimate theirs almost accurately. Ballard and Gupta (2018) and Gideon (2014, 2017) find in surveys that U.S. individuals overestimate their ATR, on average. Moreover, Stantcheva (2021) finds that U.S. individuals tend to misunderstand the degree of progressivity of the U.S. tax system; i.e., they perceive less progressivity than is codified. Studies of individuals' ATRs for different income categories predominantly show a tendency to overestimate ATRs at low incomes and the opposite for higher incomes (Blaufus et al., 2015; Rees-Jones & Taubinsky, 2020). Williamson (1976) finds respondents overestimate ATRs in all income categories.

For MTRs, Gensemer et al. (1965) find, in their survey of U.S. high income earners, that about 30% of the respondents are unaware of their MTR. A survey of Scottish managers and workers by Brown (1969)

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[4]   Following Genest-Grégoire et al. (2017), *Objective Tax Literacy* includes revealed knowledge about basic tax concepts.

highlights that 80% do not report their MTR accurately, mostly overestimating it. Rupert and Fischer (1995) find consistent evidence that less than 10% of their respondents accurately report their MTR. According to Fujii and Hawley (1988), only one-third of their U.S. respondents report their MTRs accurately. Gideon (2017) likewise shows that U.S. individuals with higher incomes underestimate their MTRs. Blaufus et al. (2015) find that German individuals overestimate (underestimate) MTRs for a given low (high) income. They also find that ATRs are often confused with MTRs. Along similar lines, de Bartolome (1995) finds that respondents confuse ATRs and MTRs. However, all of these studies focus on individuals in non-business contexts.

We study firms. Although their decisions are ultimately made by individuals, there are four reasons why misperception in firms might differ from what we know about individuals. First, firms are subject to their own specific tax environment (code and regulatory framework). In our setting, firms must consider the corporate income tax or personal income tax but also other firm-level taxes, such as business or trade taxes. Compared to individuals, business income taxation might be more complex (e.g., McKerchar et al., 2005; Kamleitner et al., 2012; Hoppe et al., 2023). Second, firms must compete. This means that a misperception of tax rates that leads to suboptimal investment decisions can become a competitive disadvantage. Getting the tax picture right is therefore crucial for them. Third, managers are expected to make decisions consistent with incentive schemes (Armstrong et al., 2012) that might be affected by taxes. Therefore, getting the tax picture right might be more important for managers than for individual taxpayers. Fourth, many individual taxpayers only passively receive information about the amount of (payroll) taxes paid through their pay stubs. By contrast, firm owners must actively calculate, file, and pay their taxes (Kamleitner et al., 2012; Brühne and Schanz, 2022). Therefore, we assume that the firm owners are usually more involved in tax compliance. This view is supported by (Coolidge et al., 2009), who show that only 11% of surveyed SMEs outsource all of their tax compliance work. Against this background, a closer look at firms is necessary to understand how they misperceive taxes and what drives their misperception.

Some studies of tax misperception focus on individuals with specific kinds of business income. For example, Schmölders (1960) is the first to examine the tax perceptions of entrepreneurs. He finds that the majority of surveyed farmers and self-employed individuals overestimate their ATRs. Although they must pay income tax like employees, they are subject to a more pronounced misperception. In contrast, Blaufus et al. (2015) finds that the self-employed and employees are very similar in their tax (mis)perceptions. To the best of our knowledge, Hundsdoerfer and Sichtmann (2009) is the only study on entrepreneurs' MTR (mis)perceptions. They investigate self-employed German physicians' perceptions of their MTR. About 25% of the respondents report MTRs that do not exist according to German tax law. Graham et al. (2017) provide

survey evidence that tax managers in large firms often use the ATR or the statutory tax rate, instead of the MTR, in their decision-making. Their findings suggest that, even in large firms with in-house tax departments, decision-makers struggle to make appropriate use of tax information. Relatedly, in an experimental study, Amberger et al. (2023) find that in time-constrained scenarios, decision-makers in firms tend to overestimate the importance of tax rate information, compared to more complex tax base information, when deciding between equity and debt financing. However, while Graham et al. (2017) and Amberger et al. (2023) both find evidence of an inappropriate use of tax information in business decisions, in contrast to our study, they do not analyze the magnitude of tax rate misperception and the drivers of this misperception.

We are the first researchers to quantify tax rate misperception in firms, identify its drivers, and provide evidence on the tax rate choices of SME decision-makers, e.g., investment decisions as well as on firms' desire for tax cuts. Our contribution is fourfold. First, we provide a measurement approach that combines survey evidence with simulations based on administrative data, allowing us to quantify firms' tax rate misperception. Second, we connect analyses of individuals' tax rate misperception and managers' inappropriate use of tax rates in large firms (Graham et al., 2017) by studying misperception in SMEs and mostly private firms. Our sample provides the rare opportunity to study the firms that contribute a large share to OECD economies but have been understudied (OECD, 2022). Third, we not only show that tax rate misperception occurs in firms but also identify its drivers. Fourth, our results highlight the role of tax rate misperception in business decisions. By quantifying misperception and linking it to the use of inappropriate tax rates in business decisions, we extend the literature. In doing so, we provide insights that can help predict firms' behavior in response to taxes and tax reforms and help explain the heterogeneity of firms' tax behavior. We also highlight the importance of tax rate misperception in firms' desire for tax cuts.

Our research provides a measure of tax rate misperception and first insights into its consequences. In this sense, our findings serve as a starting point for future empirical analyses of tax misperception, e.g., in prominent areas of the tax code, such as anti-tax avoidance regulations and tax incentives and their effects on compliance and investments. Our analyses also suggest that poor understanding of tax regulations and tax burdens not only might undermine the effectiveness of tax reforms but also may distort voting. Our results can contribute to the development of strategies to improve the transparency of tax regulations. Reducing tax complexity and increasing tax literacy among SMEs seems a promising avenue in this respect.

2 SURVEY DESIGN AND SAMPLE

2.1 Survey Design

Our results are based on data collected from German SMEs via an online questionnaire. The questionnaire uses various methods for identifying misperception (e.g., Schmölders, 1960; Hundsdoerfer and Sichtmann, 2009; Blaufus et al., 2015; Graham et al., 2017). We conducted the survey using the online application LimeSurvey[5] in the period between January 11, 2021, and April 22, 2021. To obtain a rich sample, we approached firms with the help of various intermediaries, such as chambers of handicraft, manufacturing and trade; financial institutions; and consulting firms. We approached firms[6] either directly by e-mail or via our intermediaries, which sent out e-mails, or used their newsletter or website to contact the firms. We sent out a reminder where possible. We received answers from persons responsible for the firms' tax issues, such as the owners, heads of finance, and managing directors. As we distributed our questionnaire partially via intermediaries, we could not determine an overall response rate.

Our survey addresses the German tax system. We asked for all profit-oriented taxes. For sole proprietorships and partnerships, we refer to a compound income tax, which is made up of the progressive income tax plus solidarity surcharge[7] and the trade tax. The trade tax rate is levied on profits but can be offset against the income tax[8] and is thus entirely or at least largely compensated by an income tax credit. In case of corporations, taxation is also based on a compound tax, including the flat corporate tax, plus the solidarity surcharge and a not-offsetable trade tax. This compound corporate income tax corresponds to the corporate tax in other countries and amounts to approximately 30%. Although we concentrate on the German tax system, our results are relevant also for other countries, since Germany's tax law is based on the internationally common dual system of business taxation, shown in Figure 1 (Endres & Spengel, 2015).[9]

< Insert Figure 1 about here >

To develop the questionnaire, we gathered feedback upfront from several of our intermediaries. In addition, we conducted pre-tests with selected intermediaries, tax practitioners and students with knowledge of business taxation. We use filter questions at various points to ensure that small firms, in particular, only receive questions relevant for them. We also filter questions depending on the legal form. The final

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[5]   For more information, see https://www.limesurvey.org/de (08-19-2022).
[6]   We are aware of the fact that individuals respond to the survey on behalf of the firm. But for convenience and better readability, we refer to the firm as survey respondent, if not otherwise stated.
[7]   The solidarity surcharge is based on the income tax and amounts to 5.5% of the income tax (Section 4 Solidarity Surcharge Code).
[8]   Section 35 German Income Tax Code.
[9]   Sole proprietorships and partnerships are subject to the so-called pass-through principle, while corporations are subject to the separate entity principle.

questionnaire consists of seven sections. Depending on firm characteristics and response behavior, the number of questions to be answered may vary.[10] Our questions address seven aspects of firms and their taxation. (1) We ask for firm characteristics, such as legal form, number of employees, sales. (2) For the "tax burden block", we present a visualization of the legal form-specific taxation of firms. For sole proprietorships and partnerships, we illustrate the taxation with the trade tax and a transparent income tax. For corporations, we present the two-level taxation, with corporate income tax and trade tax at the corporate level and dividend income tax at the shareholder level (see Section 3.2 for details). Against this background, we ask the respondents to state their firm's ATR and MTR for a profit that we simulate and provide for each respondent individually based on relevant information about that respondent's firm. We ask respondents from corporations to report the ATR and MTR in two different settings, full retention of profits and full distribution to domestic shareholders (natural person). For sole proprietorships and partnerships, we do not apply this differentiation, as our sample firms' taxation does not depend on their distribution strategy.[11] To clearly emphasize the difference between the ATR and MTR and to avoid confusion, we ask respondents two separate questions. In case of the ATR, we ask about the tax on the provided profit. When asking for the MTR, we explicitly point out that we are interested in the additional tax on a profit increase. (3) We ask for firms' tax rate relative to peers. (4) We ask about whether and how firms consider taxes and specific tax rates in their business decisions. (5) We ask about the relative share of tax compliance costs in the firm's total compliance costs. (6) We ask about the complexity of the tax system, the provision of tax-relevant information by tax authorities, and trust in the government's expenditure policies. (7) We ask whether their firm is, has been, or is expected to be in a profit or loss situation and ask for several personal characteristics of the respondent.[12]

Our research design has limitations. We cannot rule out that our results are influenced by a self-selection bias and that respondents did not answer the questions seriously. However, as the median (mean) response time of around 14.1 (18.1) minutes is close to our estimate of 15 minutes, we believe the questionnaire was taken seriously. Also, since the survey grants full anonymity, we expect honest answers. As we used neutral language, framing effects should be minimized. We supplemented terms that might be unclear with explanations or visualizations to avoid differing interpretations by respondents. All this and a battery of robustness tests gives confidence about the high quality of our data.

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[10] See Appendix A1 for details of the survey.

[11] However, sec. 34a German Income Tax Code constitutes an exemption to this rule and allows firms to apply a preferential taxation for retained earnings. But, because of its complexity, this tax option is almost never exercised, and we excluded the few firms that chose this tax option from our sample.

[12] There are several reasons why we split the demographics into two parts, one in the beginning and one in the end. First, we need some firm characteristics for the determination of a firm's profit. Therefore, we ask for these characteristics upfront. Second, characteristics questions are easy to answer, which allows for a convenient start in the questionnaire. But so as to not bore respondents with demographics, we ask the second part at the end our survey. Furthermore, some easy-to-answer demographic questions are placed at the end to account for our relatively long survey.

2.2 Survey Sample

We survey SMEs, which allows our results to be extrapolated to other big economies around the world. Examinations of the United States, Canada, United Kingdom, and Germany show that SMEs are by far the biggest group of businesses (OECD, 2022). SMEs are responsible for more than 50% of the gross domestic product in most OECD countries (International Labour Organization, 2019). Yet even though SMEs and especially craft enterprises are an important factor to countries' economy, they have been hardly examined in the literature. In addition, our sample includes many private firms that, despite their major role in the business landscape (Allee and Yohn, 2009; Lisowsky and Minnis, 2020), have rarely been considered in the literature. With this study, we thus answer the calls of, for example, Hanlon and Heitzman (2010) and Lisowsky and Minnis (2020), to investigate this highly relevant sector.

In Table 1, we compare our sample with the official German Business Register 2020 (German Federal Statistical Office, 2020).

< Insert Table 1 about here >

The table shows a high degree of consistency between the sample companies and the German corporate landscape, which underscores the quality of the data. We received a total of 1,806 questionnaires back from respondents, of which 657 were completed in full. Since we focus on SMEs (less than or equal to 250 employees and sales of less than or equal to €40,000,000),[13] we exclude firms that do not qualify as an SME. We further exclude those with characteristics that, for example, allow them to apply a special tax treatment. That is, we exclude (1) firms that are a member of a tax group or fiscal unity, (2) sole proprietorships and partnerships that opt to be taxed like corporations (Section 34a German Income Tax Code) similar to the U.S. Check-the-Box regime, (3) firms that state they are partly or entirely exempted from the German trade tax, (4) firms with profits below €20,000,[14] (5) firms that report their ATR but not their MTR in the survey, and (6) firms that we cannot match in our propensity score matching (see Section 3.2.1).

This leaves us with a final survey sample of 493 German firms. In Table 2 we provide summary statistics of all survey variables.

< Insert Table 2 about here >

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[13] This is in general accordance with Section 267 of the German Commercial Code (HGB).
[14] We exclude firms with extremely low profits since we assume that this is only secondary income and therefore their actual income is not reliably predictable.

54.8% of these firms are sole proprietorships, 21.3% are partnerships (including mixed forms[15]), and 23.9% are corporations. Firms from the craft sector are particularly well represented (87.8% of our sample). Over 86% of our firms reported a profit in 2020. Around 92.1% make use of the services of an external tax consultant, and 1.4% have their own tax department. Of our respondents, 77.9% are male, 20.1% female and 0.2% diverse; 97.1% hold an executive position; 75.9% claim to have tax knowledge; 49.2% of them acquired their tax knowledge through training or studies, and 50.8% qualify as self-taught.[16]

3 MEASURING TAX RATE MISPERCEPTION

We quantify firms' ATR and MTR misperception by contrasting the *perceived tax rate* extracted from our survey with the *actual tax rate* determined based on information from different sources, such as administrative tax return data, data from the German Federal Bank, and the tax schedules as codified in the income tax code, corporate income tax code, and the trade tax code. The difference between the perceived and actual tax rates below denotes the extent of firms' ATR/MTR misperception:

$$ATR\ Misperception = Perceived\ ATR - Actual\ ATR, \tag{1}$$

$$MTR\ Misperception = Perceived\ MTR - Actual\ MTR. \tag{2}$$

We assume that this misperception is unintentional, i.e., not due to strategic responses. Even though we cannot rule out the possibility that respondents may be motivated by the hope or belief that they can influence the results of our study and thus indirectly influence tax policy in their favor, we consider this option unlikely. Respondents were informed that the results are for research, and they could not foresee whether the results would be incorporated into the political discourse.[17]

3.1 Perceived Tax Rate

The variable *perceived tax rate* describes each firm's answer when asked about its ATR and MTR. Since data on firms' profit is highly sensitive, we refrained from asking about that directly to avoid high dropout rates. Instead, we asked for firm characteristics that enabled us to simulate and provide a profit mimicking the actual profit of each firm in the survey. Accordingly, we asked firms to report their ATR for this *provided*

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[15]   Mixed forms are a special legal form that combines characteristics of partnerships and corporations such as GmbH & Co. KG and are taxed like partnerships.

[16]   Following the definition of Genest-Grégoire et al. (2017), self-stated tax knowledge within the survey is referred to as *Subjective Tax Literacy.*

[17]   Our findings also support these assumptions. We find a strong negative correlation between tax literacy and misperception, suggesting that misperception is unlikely to be strategic.

profit. To determine the MTR, we asked firms to report the tax rate on a 10% increase of the provided profit.[18] Our calculation of the *provided profit* is based on aggregated annual financial statement data from the Deutsche Bundesbank,[19] which contains average profits per employee at industry-level for different firm sizes[20] and legal forms. We used the latest available data from the Deutsche Bundesbank from 2018 and did not extrapolate the data to 2021 to avoid the impact of the coronavirus crisis. The *provided profits* in the survey were simulated on the basis of the median profits of firms in the same industry, with the same legal form and the same number of employees. The *provided profits* were automatically generated for each firm based on the respective company characteristics reported in the survey. We used median profits to avoid excessively high default rates and eliminate distortions, due to abnormal, highly fluctuating company profits. We assume that asking the firms about the tax burden of a median profit ensures that the respondents are familiar with this profit and thus able to provide an educated guess. The use of such a familiar profit is also helpful in that we are interested in the participants' perception of their tax burden rather than their ability to calculate tax burdens.[21]

3.2 Actual Tax Rate

Determining the *actual tax rate* as a benchmark is challenging, as most databases do not cover large parts of our sample firms. The most favorable option would be to apply the "gold standard approach" (Gideon, 2014, p. 1) and to compare *perceived tax rates* with rates derived from tax return data. However, German tax return data of firms (as well as of individuals) is only available in an anonymized form not allowing to identify single firms. Given the structure of our sample (SMEs, including many sole proprietorships and partnerships), we also cannot employ tax information provided in financial statements because the respective data is often missing, due to limited disclosure obligations of these firms. Similarly, for corporations, we mostly cannot exploit financial statement tax information, since most of them did not agree to our request to match the survey data with their financial statements. Hence, we must infer firms' tax rates using other sources (see Sections 3.2.1 and 3.2.2). Because of the differences in tax regulations applicable to sole proprietorships and partnerships on the one hand and corporations on the other, we develop legal form-specific approaches to determine *actual tax rates.*

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[18]   In addition to indicating the 10% increase, we also specify the increase in € (i.e., the absolute amount of the increase) to avoid any confusion with the percentage figure only.

[19]   We thank the Research Data and Service Center, in particular Prof. Dr. Stefan Bender, for providing the data.

[20]   We refrain from using sales as an alternative measure of firms' size, since sales are clustered in more inaccurate size categories.

[21]   The phrase "*their* tax burden" is used in this approach primarily for simplification purposes and reduces the complexity of the question without changing its content.

3.2.1 Sole Proprietorships and Partnerships

Determining the *actual tax rates* of sole proprietorships and partnerships is not straightforward, due to legal form-specific tax rules in Germany. Sole proprietorships and partnerships are subject to the so-called pass-through principle; i.e., firms' profits are attributed to firm owners and taxed according to their individual income tax rate. Firm owners' profits are included as business income in their *Taxable Income*, which is subject to a progressive income tax schedule[22] (including solidarity surcharge).[23] Since the *Taxable Income* does not include only business income but also other categories of *(Additional) Income* (e.g., income from employment or rental income) and *Special Expenses* (e.g., social security contributions) can be deducted, we must account for these tax base effects when calculating the actual income tax rate. To do that, we incorporate *Additional Income* and *Special Expenses* when determining the actual ATR and MTR.[24]

$$Taxable\ Income_i = Profit_i + Additional\ Income_i - Special\ Expenses_i. \qquad (3)$$

Here, $Profit_i$ is the *provided profit* of firm i in the survey. For partnerships, we divide the partnership's profit using the number of partners, due to lack of information on a partnership's profit distribution agreement.[25] We could not ask for *Additional Income* and *Special Expenses* within the survey, due to the sensitive nature of this information. Also, the respondent could be an employed manager who is unfamiliar with this private information of firm owners. Even firm owners might have difficulties reporting their tax-related *Additional Income* and *Special Expenses* accurately.[26] To account for these issues, we use the Factually Anonymized Data from Income Tax Statistics (FAST 2017) offered by the German Federal Statistical Office[27] to impute *Additional Income* and *Special Expenses* into our survey data. FAST 2017 is a 10% stratified sample of the Official Income Tax Statistics of 2017. It contains extensive tax information on German taxpayers (e.g., sources of income, *Special Expenses*, and tax liability). However, data protection regulations prevent us from matching single taxpayers to the corresponding firm owners of our sample firms. Therefore, we match each of our firms with a predefined number (10) of FAST 2017 observations that are as similar as possible based on

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[22] The income tax follows a progressive tax rate schedule, with marginal tax rates from 0% to 45%, according to Section 32a German Income Tax Code.

[23] The solidarity surcharge is added on the income tax and amounts to 5.5% of the income tax (Section 4 Solidarity Surcharge Code).

[24] Even though we provide a lot of guidance to the firms to ensure they focus only on business income, we have no guarantee that they do not incorporate *Additional Income* and *Special Expenses* when reporting their tax rate. To show the robustness of our results, we conduct a robustness check by running our analysis based on profits only; see Appendix S3.2 (see Appendix S3.2 in the Supporting Information).

[25] This decision might in some cases not exactly reflect the rule fixed in the partnership agreement. However, we accept this simplification because it allows us to control for this case and corresponds to what we consider to be a reasonable estimate.

[26] This is all the more true as entrepreneurs have the option of taking private health and old-age insurance and thus opting out of statutory social security insurance. To avoid potential confusion, we explicitly mentioned in the survey that we are only interested in the tax burden on their firm's profit (personal income tax and trade tax).

[27] Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, doi: 10.21242/73111.2017.00.00.3.1.0, own calculations.

the following characteristics: profit, industry, and legal form. We impute the median value of *Additional Income* and *Special Expenses* of the respective FAST 2017 observations into our data. Figure 2 illustrates how we derive the *Taxable Income* based on a *Profit* for a sole proprietorship or partnership.

< Insert Figure 2 about here >

To match our survey and the FAST 2017 observations we use propensity-score matching.[28] Our propensity scores (Rosenbaum & Rubin, 1983) are based on the following simple logistic regression equation:

$$Survey_i = \alpha_i + \beta_i X_i + \epsilon_i, \tag{4}$$

where $Survey_i$ is one if it is a survey observation and zero otherwise, and X_i is the set of our matching variables. X_i includes $Profit_i$, $Industry_i$, and $Legal\ Form_i$. $Profit_i$ is the natural logarithm of a firm's profit.[29] $Industry_i$ describes the industry the firm operates in. $Legal\ Form_i$ describes whether a firm is a sole proprietorship or a partnership. To determine tax rates, it is also relevant whether a firm owner files his or her tax return alone or jointly with a spouse (income tax splitting). Since we refrained from asking for the marital status of firm owners, due to the data protection regulation, we match our survey observations in two ways: with FAST 2017 for single taxpayers and with FAST 2017 for couples who filed for joint taxation. We use nearest neighbor matching within a 0.1 caliper radius without replacement.[30] Since we rely on a one-to-10 propensity score matching, we use the 10 closest comparable taxpayers within the FAST 2017 data based on the propensity score. For the matching, *Industry*, *Legal Form* and *Marital Status* need to be identical between the survey and the matched observation. Successful propensity score matching assumes that the remaining variables have no influence on the dependent variable (Stuart, 2010; Shipman et al., 2017; Bilicka, 2019). Although we cannot empirically test this assumption, due to (survey) data limitations, we follow Shipman et al. (2017) and carefully select the most influential variables on tax rates of sole proprietorships and partners based on theoretical considerations. We account for those characteristics (*Profit*, *Industry*, *Legal Form*, and *Marital Status*) that affect the level of the *actual tax rate* of a non-corporation.[31]

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[28] See Appendix A4 for results of the matching.

[29] Since FAST 2017 includes nominal 2017 values but the *provided profit* in the survey is based on 2018 values, we deflate the *provided profit* using inflation data from World Bank API for Germany to obtain comparable values.

[30] See Cochran and Rubin (1973) and Rosenbaum and Rubin (1985) for the determination of the optimal caliper. We define the caliper with 0.1 as small as possible to get a precise matching but large enough that we can get the 10 matches in the vast majority of cases. Nevertheless, we run robustness checks with a caliper of 0.2 on a 1:10 matching and a caliper of 0.1 on a 1:20 matching. The results are robust; there are no significant differences in the amount of *Additional Income* and *Special Expenses* for the respective groups ($p < 0.1$). Further, we see only marginal differences in the amount of misperception, see Appendix S1.

[31] In Germany, firms can use a tax loss carryback or -forward, which can influence the tax rate as well. Within our survey, we cannot define whether and to what extent respondents included carrybacks and -forwards in their perceived ATR. To rule out that we miss a potentially relevant factor, we compare perceived ATRs of firms that reported a loss for 2019 or 2020 with comparable firms that had profits in 2019 and 2020. The results show no significant difference in their perceived ATR, which is why we are confident neglecting losses does not affect our results.

Table 3 provides an overview of the mean effect of our imputation on the *Taxable Income* using propensity-score matching (one-to-10 nearest neighbor matching within a 0.1 caliper radius without replacement). The difference between *Taxable Income* (3) and a firm's *Profit* (1) depends on the marital status and the legal form. For our following analyses, we use the *Taxable Income* to determine the *actual tax rate*.[32] and *Special Expenses*. Since such profits already exceed the threshold at which tax progression has a noticeable effect on ATRs (and no effect on MTR), this approach does not bias our results.

< Insert Table 3 about here >

We employ the German Income Tax Schedule on a firm's *Taxable Income* to determine the *actual tax rate.* In addition to the personal income tax, profits of (commercial) sole proprietorships and partnerships are subject to trade tax. We determine the actual trade tax rate by multiplying a firm's profit by the trade tax rate, which we calculate based on the trade tax multiplier stated by the respective firm.[33] We also consider that the trade tax is entirely or at least largely compensated by an income tax credit.

The following equations sum up the determination of the actual ATR and MTR[34]:

$$Actual\ ATR_i = Personal\ Income\ Tax\ (Taxable\ Income_i) + Trade\ Tax_i\ (Profit_i)$$
$$-Income\ Tax\ Credit\ (TradeTax_i). \tag{5}$$

$$Actual\ MTR_i = Personal\ Income\ Tax\ (\Delta\ Profit_i) + Trade\ Tax_i\ (\Delta\ Profit_i)$$
$$-Income\ Tax\ Credit\ (\Delta\ TradeTax_i). \tag{6}$$

Due to the comprehensive neutralization of the trade tax by the income tax credit, both ATRs and MTRs of sole proprietorships and partnerships are almost entirely determined by the progressive income tax rate. We account for effects emerging from differences in the marital status (married versus single) of firm owners. We compare the deviation of the *perceived tax rate* from the *actual tax rate* for each marital status and then use the smaller deviation as our measure for tax misperception. We thus employ a conservative approach that provides a lower bound of the estimates of misperception. Also, with this approach we avoid identifying a misperception that is solely based on a false categorization of a firm owner as a single versus married person.

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[32] For high incomes exceeding €1,112,866, our matching process is inapplicable since FAST 2017 does not include such high income earners, due to data protection regulations. Nevertheless, we keep these observations in our sample but do not add *Additional Income.* In the Appendix S3.2, we show the robustness of our results for using profits or total income to compute the *actual tax rate.*

[33] In Germany, the local trade tax multiplier is set by each municipality separately, which is why we ask firms for this variable. If there is no entry or no plausible entry on the trade tax multiplier, we use 400%, which represents the weighted average of trade tax multipliers in Germany - as used by the OECD Tax Statistics (OECD, 2022).

[34] For the actual MTR, we use the profit and increase it by 10%. This way we ensure that there is just an increase in profit but no change in *Additional Income* and *Special Expenses*, which are unrelated to an increase in business income.

3.2.2 Corporations

We use the (flat) tax rates for corporate and shareholder taxation to determine the *actual tax rate* of corporations. Corporations are taxed according to the separate entity principle: Profits are subject to the corporate income tax (including the solidarity surcharge = 15.825%) and the trade tax (depending on the trade tax multiplier of a municipality, leading to a trade tax rate around 14%) at the firm level, irrespective whether profits are retained or distributed. In case of retained profits, we determine the *actual tax rate* as follows:

$$Actual\ ATR/MTR\ _{retained,i} = Corporate\ Income\ Tax + Trade\ Tax_i \tag{7}$$

If profits are distributed to natural persons as shareholders, they are subject to the income tax of the shareholder, which is generally the final withholding tax (including the solidarity surcharge = 26.4%).[35]

In case of distributed profits, we obtain the *actual tax rate* as follows:

$$Actual\ ATR/MTR\ _{distributed,i} = Corporate\ Income\ Tax + Trade\ Tax_i$$
$$+[1 - (Corporate\ Income\ Tax + Trade\ Tax_i)] \times Withholding\ Tax \tag{8}$$

As corporations' retained and distributed profits are subject to a flat tax rate, the actual MTR does not deviate from the corresponding ATR. Thus, in contrast to sole proprietorships and partnerships, the actual ATR and MTR are identical.

4 RESULTS

4.1 Extent of Tax Rate Misperception

To analyze whether and to what extent firms have tax rate misperception, we use two approaches. First, we quantify misperception metrically. We analyze overall misperception and also examine the overestimation and the underestimation of ATR and MTR separately. Second, we identify the share of misperceiving firms by using our metric measure of misperception. As we are interested in the share of misperceiving firms, we have to define when a *perceived tax rate* is accurate. We choose a conservative approach and accept deviations of the *perceived tax rates* within a broader corridor of plus or minus 10 percentage points from the actual ATR

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[35] In some cases, dividends are subject to the regular progressive income tax rate, but 40% of dividends are tax exempt to avoid excessive taxation of corporate profits. We do not account for this, because here the income tax rate is generally very close to the final withholding tax rate.

and MTR or a narrower corridor of plus or minus five percentage points as accurate.[36]

In Table 4, we show mean values of perceived and actual ATRs and MTRs. The firm-specific benchmark tax rates are determined as described in Section 3.2.

< Insert Table 4 about here >

Our results reveal that, on average, sole proprietorships and partnerships significantly overestimate their ATR.[37] In contrast, they tend to underestimate their MTR. Misperception is more pronounced for ATRs than MTRs, as indicated by the shares of misperceivers. Corporations, on average, only slightly overestimate their ATR on retained profits. Misperception increases considerably and turns into underestimation if corporations are asked about their ATR when profits are fully distributed. Likewise, they overestimate their MTR at the firm level and underestimate it when including shareholder taxation. Thus, sole proprietorships and partnerships show misperception similar to those of corporations for distributed profits. However, misperception is more pronounced for distributing corporations. To identify potential patterns of misperception induced by the legal form, in the subsequent sections, we examine misperception of non-corporations and corporations separately.

4.1.1 Sole Proprietorships and Partnerships

We display perceived ATRs of sole proprietorships and partnerships in Figure 3. The two dot-dashed lines show the actual ATRs determined on profits for married (lower line) and single (upper line) firm owners to illustrate the ATR trend.

< Insert Figure 3 about here >

Although perceived ATRs somewhat reflect the progressive slope of the German income tax schedule, we find many overestimates, especially in the direct progressive zone of the tax schedule (taxable income below around €57,000). Assuming a corridor of plus or minus five (10) percentage points of accepted deviation from the actual ATR, 71.5% (58.5%) of sole proprietorships misperceive their ATR, with 95.3% (97.5%) of them overestimating it. In case of partnerships, 76.2% (61%) misperceive their ATR, with 87.5% (87.5%) of them overestimating it.

< Insert Figure 4 about here >

Perceived MTRs of sole proprietorships and partnerships are displayed in Figure 4. We find that sole proprietorships and partnerships seem to misperceive their MTRs less than their ATRs. For a corridor of

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[36]   Blaufus et al. (2015) also apply a corridor of plus or minus five percentage points to classify *perceived tax rates* as accurate. In Figure 11 in Appendix S2.1, we show the effect of the range of the corridor on the share of misperceiving firms.

[37]   Even though we see outliers in our data, we refrain from removing them from the sample. The reason for this is that we cannot say with certainty whether an answer is reliable. Nevertheless, to address the issue of potentially dubious responses, we show robust results after excluding very fast responses that might have not taken the survey seriously in Appendix S3.1.

accepted deviation of plus or minus five (10) percentage points from the actual MTR, 58.9% (41.5%) of sole proprietorships and 52.4% (34.3%) of partnerships misperceive their MTR. Underestimation prevails for sole proprietorships (62.9% (67%)) as well as for partnerships (54.5% (63.9%)).

Our results document overall an economically significant tax rate misperception among sole proprietorships and partnerships. To understand this misperception further, we compare perceived ATRs and MTRs. This comparison allows us to draw conclusions on whether our respondents understand the concepts of ATR and MTR. In a direct progressive tax system, such as Germany's, except for the range of the personal allowance, MTRs always exceed the corresponding ATRs. Thus, for sole proprietorships and partnerships, we expect firms to consistently report an MTR larger than its ATR. In Figure 5, we plot average perceived ATRs and MTRs of sole proprietorships and partnerships on *provided profits*.

< Insert Figure 5 about here >

This figure reveals an interesting pattern: In many cases, firms' perceived MTRs fall below the corresponding ATR. Further, we find that 53.5% of sole proprietorships and partnerships that misperceive their ATR also misperceive their MTR.[38] Examining sole proprietors' and partnerships' average perceived ATRs and MTRs across the income range reveals a trend different from our expectations: On average, perceived MTRs are barely distinguishable from perceived ATRs.[39] The stated relation suggests that firms might have problems in understanding and applying a progressive income tax schedule. We also find that only 49.1% of firms state correctly that MTRs exceed the corresponding ATRs. About 20.8% even report ATRs larger than MTRs. These firms seem to have difficulties in understanding the concept of MTR. More than half of them provide single digit MTRs, although they report double digit ATRs.[40] One-third of sole proprietorships and partnerships use the same tax rate for ATR and MTR. This finding aligns with the results of Rees-Jones and Taubinsky (2020), who show that individuals tend to linearize the tax schedule based on their ATR (*ironing heuristic*). However, we are skeptical of whether these firms really base their perceived MTR on their ATR for two reasons. First, these firms are much better at estimating their MTR than their ATR.[41] Second, more than 17% of these firms report an ATR of 42% respectively 45%, which are the two MTRs codified in the German Income Tax Code and often mentioned in political debates.[42] Hence, we argue that this fraction of sole proprietorships and partnerships rather seem to anchor their ATRs on the more salient MTRs.

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[38] Based on a deviation of plus or minus five percentage points from the actual ATR/MTR.
[39] Paired t-test with $p > 0.10$.
[40] These firms may not have understood the question about the MTR. We perform additional analyses for subsamples excluding these firms; see Appendix S3.1.
[41] The average ATR misperception is 12.9%, and the average MTR misperception is -1.6%.
[42] In this regard, de Bartolome (1995) demonstrates that tax rates that are more salient in a tax table presented to respondents are used more often in economic decisions.

4.1.2 Corporations

In Figure 6, we show perceived ATRs for (1) retained profits of the corporation and (2) distributed profits, including taxation at the shareholder level. The dot-dashed line indicates the nominal tax rate, considering corporate, the solidarity surcharge, and the trade tax, of 29.825% as a reference line for the *actual tax rate* on retained profits.[43] In case of distributed profits, the reference line also includes dividend taxation, with a final withholding tax of 26.4% (25% + 5.5% of solidarity surcharge).

We find that, for retained profits, many firms report a tax rate close to the reference line. Nevertheless, there is considerable variation, especially within the lower profit area. When allowing for a deviation of plus or minus five (10) percentage points from the actual ATR, 45.8% (22.9%) of corporations misperceive their ATR on retained profits, with 64.8% (63%) of them overestimating it. These values are surprisingly high, given the flat and easy-to-determine tax rate on retained profits. The share of misperception substantially increases for distributed profits, as Figure 6 depicts. 66.1% (44.9%) of corporations misperceive their ATR on distributed profits, given a corridor of accepted deviation of plus or minus five percentage points (10 percentage points) from the actual ATR, with only 30.8% (28.3%) of them still overestimating the tax burden.

< Insert Figure 6 about here >

Comparing the perceived ATRs on retained and distributed profits allows us to deduce the misperception of dividend taxes. In contrast to retained profits, taxation of dividends is on average significantly misperceived. This is surprising, as dividends are regularly taxed at a flat tax rate of 26.4%, whereas our corporations, based on their mean perceived ATR and MTR, indicate an average dividend tax rate of 16.6%. Evidently, corporations are relatively accurate at reporting their ATR at the corporate level but have considerably less understanding of the ATR on distributed profits.

We provide perceived MTRs of corporations for retained and distributed profits in Figure 7. Reference lines show the actual MTR[44] in case of full profit retention and distribution. For a misperception defined as a deviation of more than plus or minus five (10) percentage points from the actual MTR, 49.2% (31.4%) of corporations misperceive their MTR on retained profits, with 67.2% (62.2%) overestimating it. For distributed profits, 65.3% (50.8%) of the corporations misperceive their MTR if misperception is defined as a deviation of more than plus or minus five (10) percentage points from the actual MTR. The share of overestimating firms amounts to only 31.2% (31.7%). Tolerating a deviation of plus or minus five percentage points, 94.4% (96.2%) of ATR misperceiving corporations also inaccurately report their MTR for retained (distributed) profits.

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[43] Despite the flat tax rate, the *actual tax rate* can vary between corporations due to different local trade tax multipliers. To simplify the figure, we use the mean value of 400%, which results in a tax rate of 29.8% (= 15% * (1 + 5.5%) + 400% * 3.5%).

[44] We use the mean trade tax multiplier of 400% to determine the reference line.

< Insert Figure 7 about here >

In comparison to the perceived ATR, corporations are less accurate in perceiving their MTR. For retained profits, misperception is clearly higher for MTRs than for ATRs. This result is interesting, as investments often employ retained profits and MTRs should be considered in investment decisions.

< Insert Figure 8 about here >

Our results document that corporations, on average and in line with our expectations, report very similar ATRs and MTRs. An illustration of the relation of ATR and MTR for corporations is provided in Figure 8. Nevertheless, we still find that 27.1% (39.8%) report MTRs different from their ATRs in the case of retained (distributed) profits. Although distributing profits does not change the proportionality of the tax schedule, more corporations report ATRs that differ from MTRs for distributed profits.

4.2 Drivers of Tax Rate Misperception

Our findings demonstrate that firms significantly misperceive their ATRs and MTRs. To analyze what drives these misperceptions, we include independent variables in our model that are based on research on individuals' tax misperception (see Blaufus et al. (2022)) as well as special characteristics of our firms. We analyze the potential drivers using our survey data and conducting a regression analysis of the following simplified form:

$$Misperception_i = \alpha + \beta_i Drivers_i + \epsilon_i. \tag{9}$$

We define misperception as the absolute value (in percentage points) of either ATR misperception or MTR misperception. In a first step, we are interested in what drives the magnitude of misperception, regardless of whether tax rates are overestimated or underestimated. Abstracting from overestimates and underestimates facilitates the interpretation of coefficients.[45] In a second step, we also investigate the heterogeneity in overestimations and underestimations separately.

Like Hanlon et al. (2022, p. 1150), who emphasize that accounting matters are shaped not only by economic incentives and accessible information but also by individual preferences, abilities, experiences, and other characteristics, we group the drivers into the following two categories:

Firm Characteristics. We analyze three firm characteristics. (1) *Employees:* The number of employees allows us to proxy a firm's size. As shown by Graham et al. (2017), larger firms often employ qualified tax personnel, due to facing more tax-related duties and responsibilities (e.g., fulfilling compliance requirements

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[45]   To prove that the results are not only due to the choice of method, we show robust results for the use of Tobit regressions in Appendix S3.3.

or exploiting tax planning opportunities). Following this argument, tax rate misperception should decrease with firm size. In addition, the tax schedule for non-corporations involves size-related calculation difficulties: Firms with lower profits are subject to the direct progressive part of the income tax schedule, inhibiting determination of their MTR as compared to firms with higher profits, which are subject to the proportional marginal tax rate of 42% or 45%. *Employees* is the natural logarithm of the number of employees. (2) *Loss:* Even though we cannot be certain whether and to what extent survey respondents include losses when estimating their ATR and MTR, we rule out this potentially relevant factor by comparing perceived ATRs of firms that reported a loss for 2019 or 2020 with firms that had profits in 2019 and 2020. The results show no significant difference in their perceived ATR, which is why we are confident that tax loss carryforwards do not directly affect our results. *Loss* is one if a *Loss* occurred in 2019 or 2020 and zero otherwise. (3) *Tax Assistance:* From the literature on individuals (Rupert and Fischer, 1995; Gideon, 2014; Ballard and Gupta, 2018), we know that using the assistance of a tax adviser in tax preparation increases misperception since tax knowledge is outsourced. We assume a similar pattern for firms and predict a positive relation between firms using (external) *Tax Assistance* and tax rate misperception. *Tax Assistance* is one if a firm gets support from a tax adviser and zero otherwise.

Personal Characteristics. We analyze three personal characteristics of the respondent. (4) *Tax Literacy*: Following Genest-Grégoire et al. (2017, p. 4) we define *Tax Literacy* as "having the knowledge, skills and confidence to make responsible tax decisions." Based on their approach, we use *Subjective Tax Literacy*, which captures self-stated tax knowledge within the survey. It is one for stating tax knowledge and otherwise zero. We also use *Objective Tax Literacy*, which captures revealed knowledge about basic tax concepts. Following Stantcheva (2021), we build a combined variable for *Objective Tax Literacy*. The variable includes the two components Tax Schedule and Tax Rate Choice. Tax Schedule is, for non-corporations, one if ATR is less than MTR and otherwise zero. For corporations, Tax Schedule is one if MTR equals ATR and otherwise zero. Tax Rate Choice is identical for both legal forms and is one when using the MTR in business decisions and otherwise zero. Using this composite, *Objective Tax Literacy* can be zero, one, or two. To achieve a simple interpretation of the variable and capture different levels of *Objective Tax Literacy*, we consider it as a factor variable within the regression. Thus, the two levels are represented as binary variables. In the regression, we therefore compare *Objective Tax Literacy* Level 1 (= 1) and *Objective Tax Literacy* Level 2 (= 2) with no *Objective Tax Literacy* (= 0). In general, findings from the literature on tax literacy are mixed. Although they do not refer to the term *Tax Literacy*, they do (at least partially) refer to the concept of tax literacy. Graham et al. (2017) report a positive effect of managers' educations[46] on the appropriate

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[46]   Given our approach, managers' educations would be part of *Subjective Tax Literacy*.

consideration of taxes in business decisions, whereas Amberger et al. (2023) show that, on average, making biased tax decisions is not influenced by the professional experience in accounting, taxation, or finance.[47] Further, Slemrod (2006) finds no effect of knowledge of tax terms[48] on individuals' misperception of tax schedule progressivity. Thus, the effect of tax literacy on tax rate misperception is unclear but, at least theoretically, should be positive. (5) *Tax Satisfaction:* The utility function of a firm manager may also include satisfaction considerations, which might affect their tax rate reports. We construct the variable *Tax Satisfaction*, which increases when firms are more satisfied with the tax system in Germany. It is comprised of the following components: Perceived Tax Complexity, Trust in Government, Peers' Tax Burden, and Tax Compliance Costs. Perceived Tax Complexity is the perceived level of tax complexity (1 to 5). Trust in Government is the level of trust in public spending (1 to 5).[49] Peer's Tax Burden is one if firms perceive their own tax burden to be higher than that of smaller and larger competitors and zero otherwise. And Tax Compliance Costs is the share of perceived tax compliance costs relative to total compliance costs (see Appendix A2 for more details). The variables are standardized (*Z*-scores (0/1)). *Tax Satisfaction* itself is standardized as well (*Z*-score). In line with results of Ballard and Gupta (2018), who examine individual misperception, we expect stronger misperception among firms less satisfied with the tax system. (6) *Female:* Building on the literature on individuals, there is mixed evidence here. Females tend to overestimate their ATR (Blaufus et al., 2015), and they underestimate tax schedule progressivity less than men (Slemrod, 2006). However, there is also evidence that gender does not influence individuals' tax misperception at all (Fujii and Hawley, 1988; Gideon, 2014; Ballard and Gupta, 2018). Hence, we cannot predict the effect of gender on firms' tax rate misperception. *Female* is one if a respondent's stated gender is female and zero otherwise.

We provide summary statistics of the variables in Table 5 for sole proprietorships and partnerships and in Table 6 for corporations.

< Insert Table 5 and Table 6 about here >

In Appendix A2, we show more details, variable definitions, and summary statistics. The correlation matrix of covariates and additional summary statistics for the overall sample and by size are provided in the Appendices S2.2, S2.3, and S2.4.

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[47] Given our approach, managers' professional experience in accounting, taxation, or finance would be part of *Subjective Tax Literacy.*

[48] Given our approach, knowledge of tax terms would be part of *Objective Tax Literacy.*

[49] Trust in the government also has a positive effect in other settings (see Eberhartinger et al. (2022), for a positive effect on tax bargaining; Kuehnhanss and Heyndels (2018) and Stantcheva (2021), for a positive effect on the attitudes toward redistributive policies, and Slemrod (2006) for the assessment of the U.S. tax system as fair).

4.2.1 Sole Proprietorships and Partnerships

In a first step, we analyze overall ATR and MTR misperception without distinguishing between overestimation and underestimation, using absolute values to capture the magnitude of the misperception. The results are shown in Table 7.

< Insert Table 7 about here >

The findings indicate that various factors are significantly associated with misperception of ATR and MTR. *Employees* is significantly negatively associated with ATR misperception ($p < 0.01$), which might be explained by a better tax-qualified workforce in larger companies being able to handle the inherent complexity of the progressive income tax schedule better. A one standard deviation increase in *Employees* corresponds to reduction of ATR misperception by about 17% of the mean ATR misperception.[50] However, this association only applies to ATR misperception but vanishes for MTR misperception. We argue that the overestimation of the ATR and the lack of clear separation between the ATR and the MTR in firms' perceptions blur the effect for the MTR, especially in the highly progressive part of the tax schedule for firms. Firms overestimate the ATR, while at the same time there is an anchoring effect between the ATR and the MTR. Therefore, firms of all sizes estimate their MTR, which is higher than the ATR for sole proprietorships and partnerships, relatively well. *Tax Assistance* is significantly positively associated with ATR misperception ($p < 0.05$); being assisted in tax matters leads to an increase in ATR misperception by 4.3 percentage points, which is about 32% of the sample mean of ATR misperception. This finding comports with the findings for individuals that outsourcing tax knowledge leads to more misperception (Rupert and Fischer, 1995; Gideon, 2014; Ballard and Gupta, 2018). Again (and following the same explanation as before), we find no such effect on MTR misperception. As expected, *Loss* is not significantly associated with ATR or MTR misperception.

With regard to personal characteristics, we find that *Subjective Tax Literacy* is significantly negatively associated with ATR misperception ($p < 0.05$). *Subjective Tax Literacy* is associated with a 2.7 percentage points reduction in ATR misperception. This reduction corresponds to about 20% of the mean ATR misperception. Further, *Objective Tax Literacy* is significantly negatively associated with MTR misperception on Level 1 and Level 2 ($p < 0.01$). *Objective Tax Literacy* decreases MTR misperception by up to 9.8 percentage points, corresponding to about 90% of the mean MTR misperception. The association with ATR misperception is less pronounced. Only *Objective Tax Literacy* (Level 2) is weakly significant for ATR misperception ($p < 0.1$). Overall, the results show an interesting pattern, indicating a negative association

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[50] To determine the economic effect of a dependent binary, factor, or standardized variable, we divide the respective coefficient by the mean ATR respectively MTR misperception. In case of a logged independent variable, we multiply the coefficient by the standard deviation of the logged variable and then divide by the mean ATR respectively MTR misperception.

between *Subjective Tax Literacy* and ATR misperception on the one hand and between *Objective Tax Literacy* and MTR misperception on the other. By distinguishing the effect of *Subjective and Objective Tax Literacy*, we confirm the results of Graham et al. (2017), who find a negative association with accounting-related education among corporate tax managers. *Tax Satisfaction* is significantly negatively associated with ATR misperception ($p < 0.01$). An increase of one standard deviation in *Tax Satisfaction* is associated with a decrease in ATR misperception by 1.9 percentage points, corresponding to about 14% of the mean ATR misperception. This is consistent with the results of Ballard and Gupta (2018), who examine individuals' ATR misperception and find stronger misperception among respondents who believe they are taxed too heavily or assume taxes are spent ineffectively. However, there is no association between *Tax Satisfaction* and MTR misperception.

In a second step, we investigate overestimation and underestimation of ATR and MTR. Detailed regression results are shown in Table 13 of Appendix A3. Highlighting the most important results, we find that the overall significant negative association of *Employees* with ATR misperception is reflected in less overestimation of ATR and MTR. Further, the underestimation of ATR increases with the number of *Employees*. The positive association between using *Tax Assistance* and having ATR misperception is reflected in significantly more overestimation and underestimation of ATR. *Objective Tax Literacy* on Level 1 shows a significantly negative association with MTR underestimation, as does *Objective Tax Literacy* on Level 2. Further, we find a significantly negative association between ATR overestimation and underestimation as well as MTR underestimation with *Objective Tax Literacy* on Level 2.

In sum, both firm and personal characteristics affect misperception. Our findings show that firm size, using a tax adviser, being satisfied with the tax system, and being tax literate are the most important factors. With regard to *Objective Tax Literacy*, it is important to understand that, beyond the mere effect of the large coefficient, less than 10% of respondents are fully tax literate (*Objective Tax Literacy (Level 2)*). Thus, the significant reduction in tax rate misperception occurs in reality only in one out of 10 cases.

4.2.2 Corporations

In a first step, we again analyze overall ATR and MTR misperception using absolute values to capture the magnitude of misperception. The results are shown in Table 8.

< Insert Table 8 about here >

Employees shows a weakly significant negative association with both $\text{ATR}_\text{retained}$ and $\text{MTR}_\text{retained}$ misperception ($p < 0.1$). A one standard deviation increase in *Employees* corresponds to reduction of ATR misperception by about 19% (13%) of the mean $\text{ATR}_\text{retained}$ ($\text{MTR}_\text{retained}$). This supports the finding of larger firms being able to employ qualified tax personnel, which can attenuate misperception. However, if profits are distributed, this effect vanishes. This might be because estimating tax rates is more difficult due to the increased complexity of the tax system, more precisely the interplay of the taxes on the corporate and shareholder levels. Further, since shareholder taxation is in general not relevant for firms' decision-making, also managers in larger firms may not be familiar with it. In contrast to non-corporations, we find no significant effect of tax assistance. Having experienced a *Loss* is insignificantly associated with tax rate misperception, with the exception of a weakly significant increased $\text{ATR}_\text{retained}$ misperception ($p < 0.1$). *Tax Assistance* is not significantly associated with tax rate misperception. With regard to personal characteristics, we find that *Subjective Tax Literacy* has no significant association with ATR or MTR misperception. However, *Objective Tax Literacy* on Levels 1 and 2 is significantly negatively associated with ATR and MTR misperception on retained and distributed profits: *Objective Tax Literacy* is associated with a significant decrease in $\text{ATR}_\text{retained}$ ($\text{ATR}_\text{distributed}$) by up to 2.9 (8.1) percentage points, corresponding to about 47% (71%) of the mean $\text{ATR}_\text{retained}$ ($\text{ATR}_\text{distributed}$) misperception ($p < 0.1$ ($p < 0.01$)). Further, *Objective Tax Literacy* is associated with a decrease in $\text{MTR}_\text{retained}$ ($\text{MTR}_\text{distributed}$) misperception by up to 10.4 (13.3) percentage points, corresponding to about 122% (105%) of the mean $\text{MTR}_\text{retained}$ ($\text{MTR}_\text{distributed}$) ($p < 0.01$ ($p < 0.01$)). The large effects underline the importance of being tax literate. As for non-corporations, differentiating between *Subjective Tax Literacy* and *Objective Tax Literacy* extends the findings of previous studies (e.g., Slemrod, 2006; Graham et al., 2017; Amberger et al., 2023). *Tax Satisfaction* is only significantly negative associated with MTR misperception for retained profits ($p < 0.05$). A one standard deviation increase in *Tax Satisfaction* decreases $\text{MTR}_\text{retained}$ misperception by 1.6 percentage points, corresponding to about 18% of the mean $\text{MTR}_\text{distributed}$ misperception. Again, this comports with our prediction based on the findings of Ballard and Gupta (2018).

In the second step, we analyze overestimation and underestimation of ATR and MTR. Results are shown in Table 14 of Appendix A3.[51] Highlighting the most important results, we find that *Employees* shows only a weakly significant negative association with $\text{ATR}_\text{retained}$ misperception. The strong negative association between *Objective Tax Literacy* on both levels and kinds of tax rate misperception is mirrored especially in tax rate underestimation. We find a strong negative association between ATR and MTR underestimation for retained and distributed profits. In case of overestimation, a significant association only exists between

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[51] In view of the small sample sizes in the various characteristics, the results must be interpreted with caution. However, they provide important initial findings that should be explored in greater depth as part of further research.

Objective Tax Literacy and MTR$_{\text{retained}}$. An overestimation of tax rates seems to be attenuated by satisfaction with the tax system: *Tax Satisfaction* is significantly negatively associated with MTR$_{\text{retained}}$, ATR$_{\text{distributed}}$, and MTR$_{\text{distributed}}$ misperception.

Again, our results show that firm and personal characteristics drive misperception. Our findings show that firm size, being tax literate, and the satisfaction with the tax system are the most important factors. As with non-corporations, it is also important to understand for corporations, beyond the mere effect of the large coefficient, that less than 15% of respondents have reached *Objective Tax Literacy* Level 2.

Overall, we find that tax rate misperception is driven by firm and personal characteristics in the case of non-corporations and corporations. For both legal forms, firm size, being objectively tax literate, and being satisfied with the tax system are associated significantly with the magnitude of tax rate misperception. Further, we find that the inherent complexity of the tax system contributes to firms' tax rate misperception. In the case of non-corporations, being assisted by a tax adviser is also important.

4.3 Consequences of Tax Rate Misperception

Our previous results clearly illustrate that firms struggle with accurately estimating their tax rates. In a next step, we analyze how their misperception might impact their behavior.

4.3.1 Tax Rate Choice

Like Graham et al. (2017), who demonstrate that even managers of large public and private corporations often do not use their firm's MTR in their decision-making,[52] in a first step, we investigate which tax rates our surveyed firms incorporate in their business decisions. We ask our respondents about which tax rate they use in investment decisions. Respondents had the option to choose ATR, MTR, STR, self-defined tax rate (self-set), or another tax rate (other). We find the ATR as the most common tax rate incorporated in investment decisions and confirm the results for private firms of Graham et al. (2017) for our sample of German SMEs. About 40% of the firms use their ATR in decision-making; less than 20% use their MTR.[53] We display the survey results on the chosen tax rate in Figure 9.

< Insert Figure 9 about here >

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[52] Depending on the type of business decision, only 8.8% to 12.5% of the surveyed managers use the MTR.

[53] Relatedly, Wittman (1989) illustrates that firms do not consider taxes appropriately in business decisions, and de Bartolome (1995) shows that individuals often use the ATR instead of the MTR as well. But using average instead of marginal figures appears not only in a tax setting. Shin (1985) finds that the average price predicts electricity demand better than the marginal price. Faulhaber and Baumol (1988) indicate, that at least until the 1970s, most firms use average rather than marginal costs in their pricing decisions.

However, it is unclear what role tax rate misperception plays in this context. Therefore, we perform regression analyses[54] of the following simplified form to identify associations between *Tax Rate Choice* in investment decisions and *Overall Tax Misperception*.[55]

$$Tax\ Rate\ Choice = \alpha + \beta_1 Overall\ Misperception + \beta_i Drivers_i + \epsilon_i \qquad (10)$$

The dependent variable *Tax Rate Choice* comprises the specification *Choice ATR* (equals one for firms that choose the ATR and zero otherwise), *Choice MTR* (equals one for firms that choose the MTR and zero otherwise), and *Choice STR* (equals one for firms that choose the statutory tax rate and zero otherwise) in investment decisions. We use the independent variables of our driver analysis,[56] which also show similarities with the independent variables used by Graham et al. (2017) in their analysis of tax rate choice, to examine the associations with firms' *Tax Rate Choice* for our sample of SMEs. Further, we account for tax rate misperception via *Overall Tax Misperception*. We calculate *Overall Tax Misperception* by adding the individual ATR and MTR misperception of each company and dividing the sum by two (see Appendix A2 for details).[57] Our results are displayed in Table 9.

< Insert Table 9 about here >

We focus on the impact of *Overall Tax Misperception* on *Tax Rate Choice* in investment decisions. Our results indicate that, for sole proprietorships and partnerships as well as for corporations, there is no significant association between misperception and choosing the ATR. However, an increase in *Overall Tax Misperception* is associated with sole proprietorships and partnerships being less likely to choose the (appropriate) MTR. This may be explained by the fact that less misperception indicates a better understanding of the complex individual income tax and thus the concept and use of the MTR.[58] For corporations, subject to the simple flat tax at the corporate level, we find no such association between tax rate misperception and the consideration of tax rates in business decisions. Further, for sole proprietorships and partnerships, an increase in *Overall Tax Misperception* is additionally linked to firms being more likely to use the statutory tax rate.

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[54] Despite the dependent variable being a binary variable, we use OLS regression instead of Logit regression for two reasons. First, the results are easier to interpret, and the analyses still perform very well (Angrist & Pischke, 2009). Second, we can deal with missing variation in some variables leading to exceptionally large standard deviations. Nevertheless, we also perform a Logit regression (untabulated) and find robust results.

[55] We find similar results for the association of tax rate misperception and tax rates employed in financing decisions (untabulated).

[56] For *Objective Tax Literacy*, we only consider Level 1 (knowledge of the relation between ATR and MTR) in the regression analysis, as Level 2 comprises the consideration of MTR in investment decisions themselves. As this corresponds to our dependent variable, we cannot include Level 2 as an independent variable.

[57] Since shareholder taxation is in general not relevant for firms' decision-making, we consider misperception at the level of retained profits in the following analyses.

[58] *Objective Tax Literacy Level 1*, which reflects the knowledge of the relation of ATR and MTR, is significantly positively associated with choosing the (appropriate) MTR for either legal form. This also indicates a better understanding of the concept and use of MTR.

4.3.2 Desired Tax Cut

To examine further consequences of tax rate misperception, we asked firms which tax burden they consider fair for their company and compare this to their perceived ATR. Figure 10 displays the tax rates used in investment decisions of the surveyed firms by legal form.

< Insert Figure 10 about here >

Further, we conduct regression analyses using the simplified form below.

$$Desired\ Tax\ Cut = \alpha + \beta_1 Overestimation + \beta_2 Underestimation + \beta Drivers_i + \epsilon_i \qquad (11)$$

Desired Tax Cut is the dependent variable. *Desired Tax Cut* describes the difference between *Perceived ATR* and *Fair ATR*, when *Perceived ATR* exceeds *Fair ATR*. This way we capture all firms that feel overly burdened by the tax system.[59] Again, our independent variables are based on our drivers analysis. Additionally, we include *Misperception Overestimation* and *Misperception Underestimation*[60] to account for the effect of ATR overestimation and underestimation on the *Desired Tax Cut*. *Misperception Overestimation* (*Misperception Underestimation*) is one if firms overestimate (underestimate) their ATR by more than 5 percentage points and zero otherwise. Our results are displayed in Table 10.

< Insert Table 10 about here >

Again, we focus on the impact of tax rate misperception, depicted by *Misperception Overestimation* and *Misperception Underestimation*. *Misperception Overestimation* shows a significant positive effect on *Desired Tax Cut* for both legal forms, independent of retained or distributed profits. For *Misperception Underestimation*, we find the opposite effect, except for retained profits in the case of corporations, where the coefficient is also negative but insignificant. Based on these results, we conclude that tax rate misperception has important policy implications, as the demand for tax cuts may partly be driven by this misperception.

Overall, our results should be seen as a first step in investigating the impact of tax misperception on corporate decision-making. They underscore the relevance of incorporating tax rate misperception into real effects studies; e.g., in studies on the effects of anti-tax avoidance regulations and tax incentives on compliance and investment behavior, since firms base their decisions on perceived rather than actual tax rates. Further, our results suggest that reducing tax rate misperception is crucial for effective tax reforms. Our analyses suggest that a lack of understanding of tax burdens may not only undermine the effectiveness of targeted tax

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[59] In our sample, more than 90% of the firms state a desire for a tax cut (N = 414).
[60] In the case of corporations, overestimation and underestimation are split between retained and distributed profits, depending on the dependent variable.

reforms but also might bias voting. Further research on the consequences of tax rate misperception by firms therefore appears to be necessary.

5   CONCLUSION

This study explores SMEs' tax rate misperception as well as its drivers and consequences. Our approach involves firms estimating their ATR and MTR based on a provided profit, and we calculate actual ATRs and MTRs to benchmark perceived tax rates using administrative data. This approach yields robust estimations of firms' tax rate misperception.

Our findings indicate that many firms misperceive their tax rates, with over 66% misperceiving their ATR and 55% misperceiving their MTR. Non-corporations show a clear pattern: ATRs are overestimated, while MTRs are underestimated. Overall, more than 71% (76%) of sole proprietorships (partnerships) misperceive their ATR and over 58% (52%) misperceive their MTR. Corporations exhibit less misperception when reporting their tax rates for retained profits, which may be attributed to the flat tax rate structure, versus the progressive income tax schedule for non-corporations. Nevertheless, over 45% of corporations misperceive their ATR and MTR by more than plus or minus five percentage points in the case of retained profits. This share increases to about two-thirds (65%) when distributed profits are considered. On average, corporations considerably underestimate the ATR and MTR on distributed profits. In the case of retained profits, both are slightly overestimated.

In a second step, we identify drivers of misperception: firm size, tax literacy, and satisfaction with the tax system. Further, we find that the inherent complexity of the tax system affects the magnitude of firms' tax rate misperception. Highlighting the significance of further analysis of tax rate misperception, we present initial findings on consequences. From an entrepreneurial perspective, we demonstrate that tax rate misperception can lead to distorted business decisions, especially under a progressive tax schedule. Specifically, misperception is positively associated with reduced use of MTR in investment decisions, resulting in non-optimal investments. Understanding the drivers and emergence of tax rate misperception is also relevant from a policy perspective, as our results show that the sense of overpaying taxes strongly relates to an overestimation of the tax rate. This misperception could lead to an overly pronounced desire for tax cuts.

Our findings contribute to closing the research gap on firms' tax misperception and respond to Blaufus et al.'s (2022) call for further research. Quantifying tax rate misperception for firms of different sizes and legal forms can help improve predictions of firms' responses to tax reforms. Although our study provides novel insights into tax misperception of firms and evidence of its consequences, further research is needed.

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FIGURES AND TABLES

FIGURE 1 Dual System of Business Taxation.

Dual system of business taxation

Pass-through principle	Separate entity approach
Sole proprietorship Partnership (no legal entity)	Corporation Partnership (legal entity)
	Corporate Income Tax
	Shareholder
Personal Income Tax	Personal Income Tax
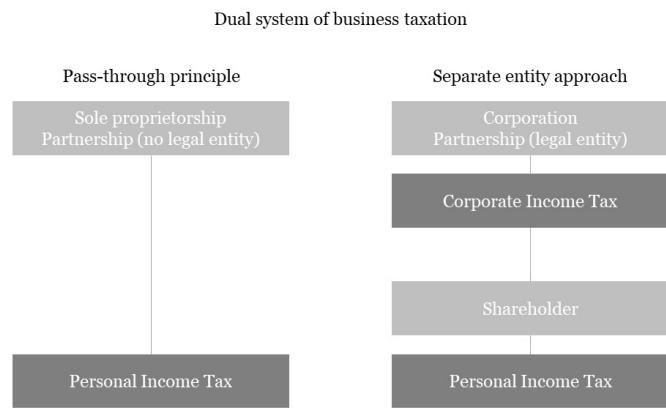
Notes: This figure illustrates the dual system of business taxation following Endres and Spengel (2015).

FIGURE 2 Approach to Determine Taxable Income.
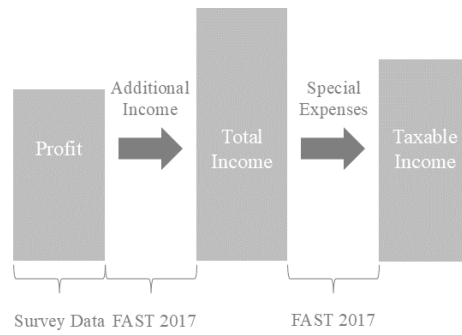
Notes: This figure illustrates the determination of the *Taxable Income* based on the *provided profit* from our survey, *Additional Income* (FAST 2017) and *Special Expenses* (FAST 2017). This stylized illustration only sketches the process of determining the *Taxable Income*, it is not supposed and does not reflect the actual size of *Additional Income* and *Special Expenses*. It is important to note that *Additional Income* can be negative.

FIGURE 3 Perceived ATRs of Sole Proprietorships and Partnerships.
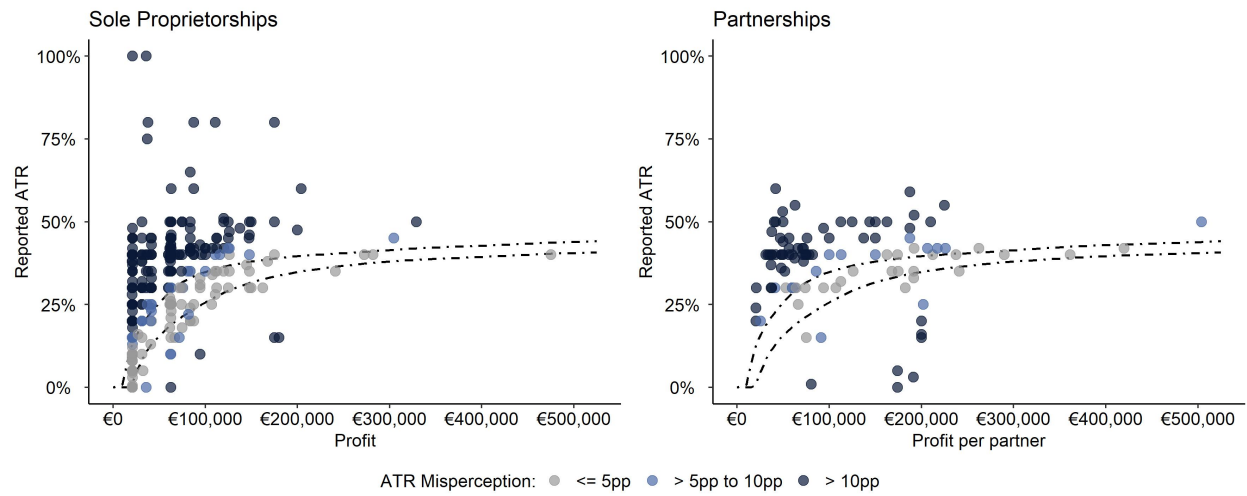
Notes: This figure shows perceived ATRs of sole proprietorships and partnerships. All points represent perceived ATRs, the dashed lines illustrate ATRs on profits of married (lower line) and single (upper line) taxpayers in Germany. The level of misperception is indicated by the color of each point, which ranges from gray to light blue to dark blue as the level of misperception increases. Misperception is identified based on ATRs of *Taxable Income*. For presentation reasons, the figure is limited to observations for profits below €500,000.

FIGURE 4 Perceived MTRs of Sole Proprietorships and Partnerships.
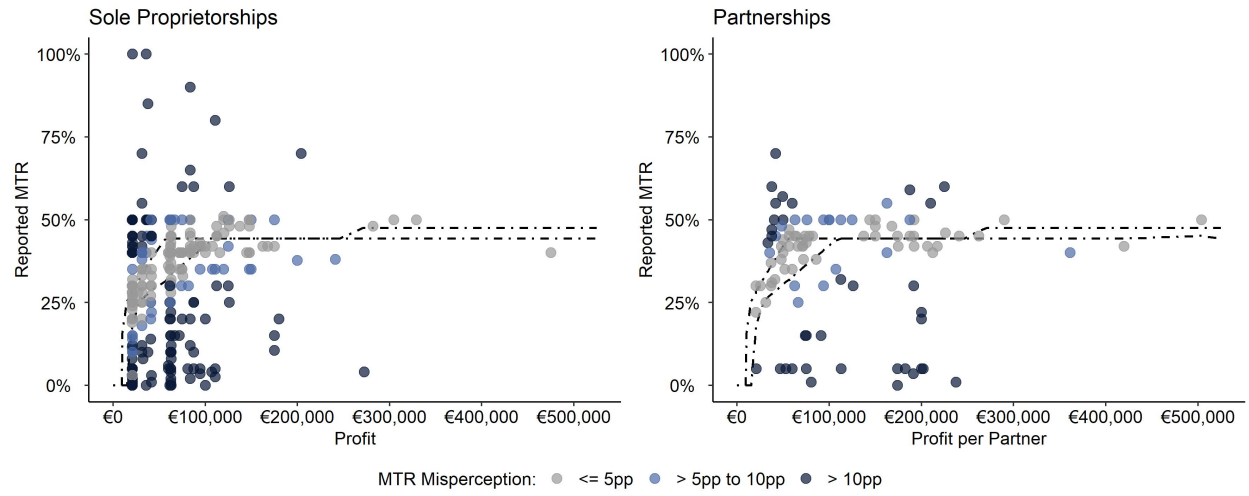
Notes: This figure shows perceived MTRs of sole proprietorships and partnerships. All points represent perceived ATRs, the dashed lines illustrate ATRs on profits of married (lower line) and single (upper line) taxpayers in Germany. The level of misperception is indicated by the color of each point, which ranges from gray to light blue to dark blue as the level of misperception increases. Misperception is identified based on ATRs of *Taxable Income*. For presentation reasons, the figure is limited to observations for profits below €500,000.

FIGURE 5 Perceived ATR-MTR Relation of Sole Proprietorships and Partnerships.
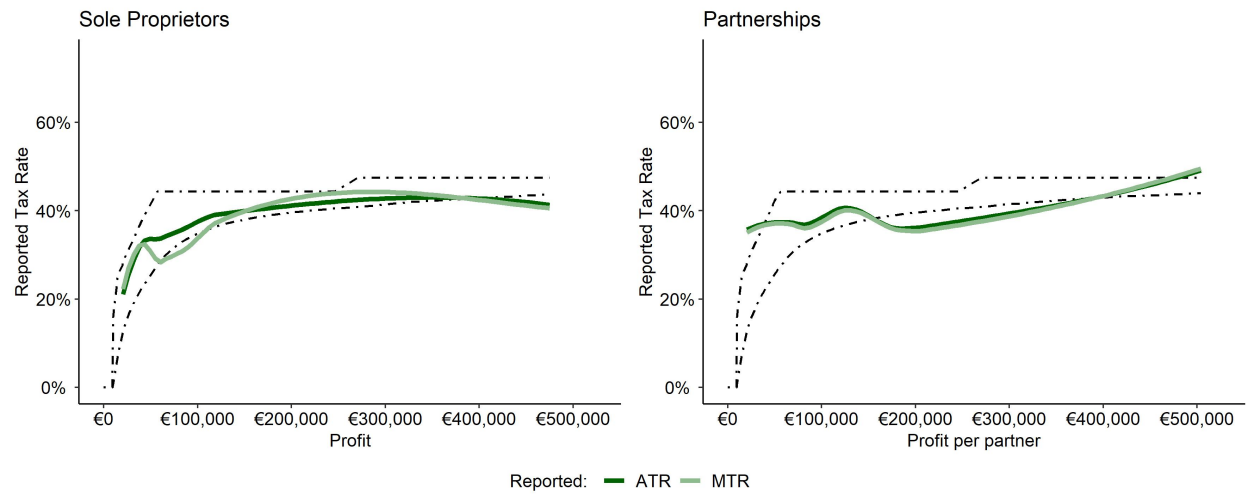
Notes: This figure shows mean perceived ATRs and MTRs for sole proprietorships and partnerships. The estimated mean (solid) lines are generated by locally estimated scatterplot smoothing. The dot-dashed lines are reference lines for the actual ATR (lower) and MTR (upper) for a single taxpayer. For presentation reasons, the figure does not include observations for profits above €500,000.

FIGURE 6 Perceived ATRs of Corporations.
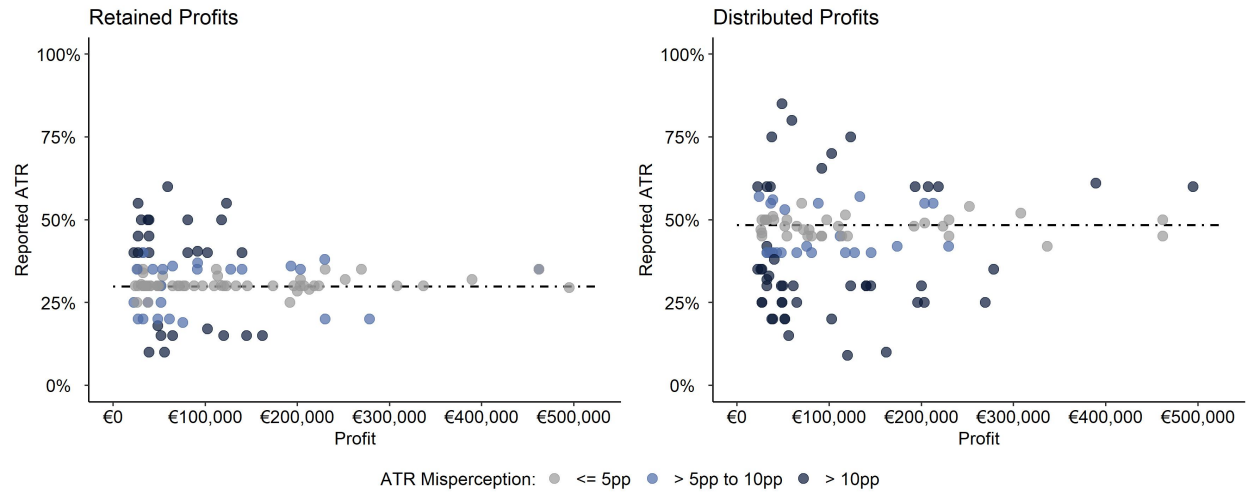
Notes: This figure shows ATR Misperception of corporations in case of retained and distributed profits. All points represent perceived ATRs, the dashed line indicates the respective corporate tax rate at a trade tax multiplier of 400%. The level of misperception is indicated by the color of each point. The level of misperception is indicated by the color of each point, which ranges from gray to light blue to dark blue as the level of misperception increases. For presentation reasons, the figure is limited to observations for profits below €500,000.

FIGURE 7 Perceived MTRs of Corporations.
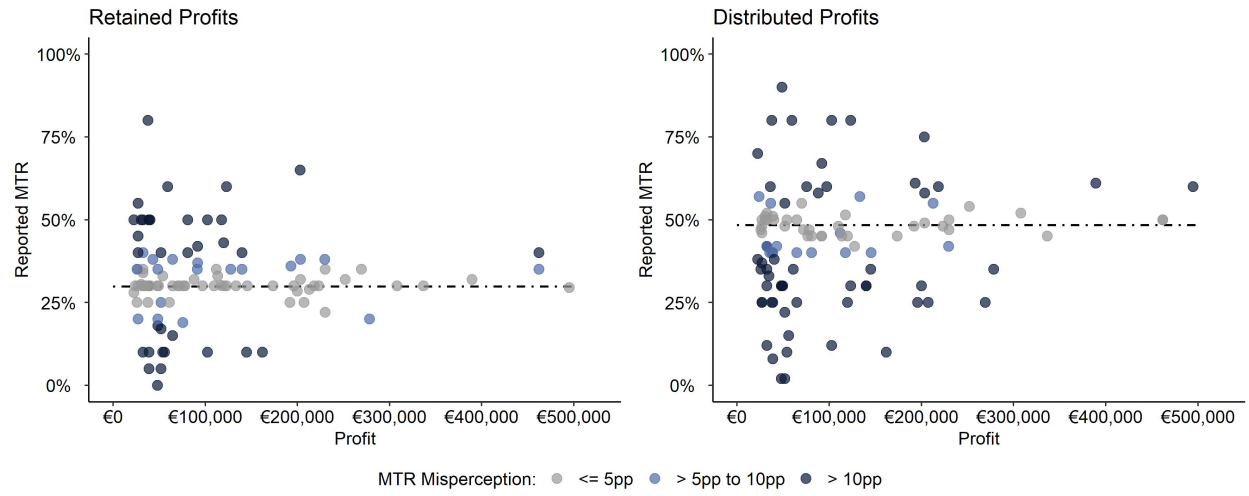
Notes: This figure shows ATR Misperception of corporations in case of retained and distributed profits. All points represent perceived ATRs, the dashed line indicates the respective corporate tax rate at a trade tax multiplier of 400%. The level of misperception is indicated by the color of each point. The level of misperception is indicated by the color of each point, which ranges from gray to light blue to dark blue as the level of misperception increases. For presentation reasons, the figure is limited to observations for profits below €500,000.

FIGURE 8 Perceived ATR-MTR Relation of Corporations.
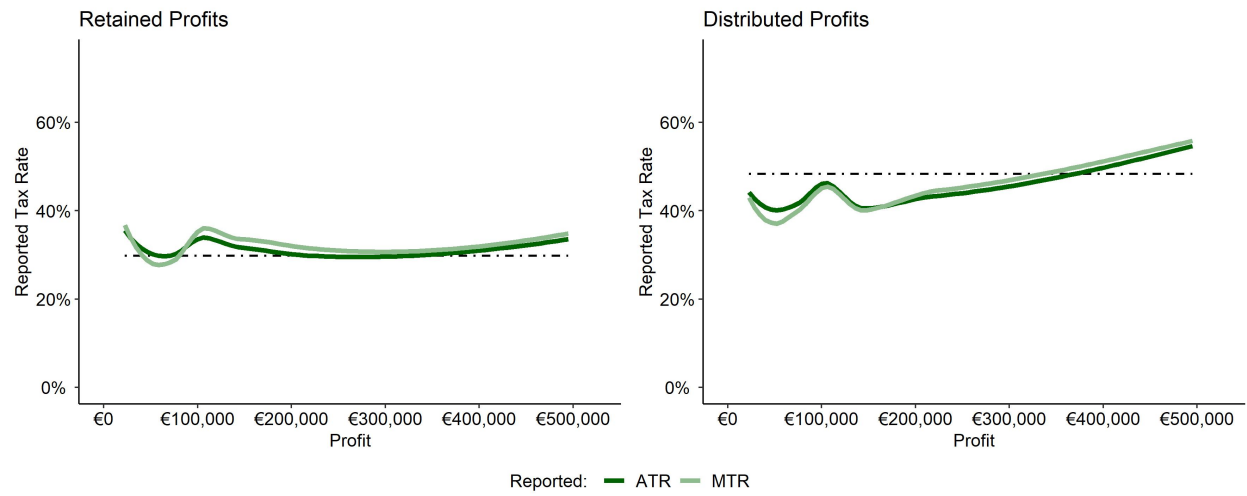
Notes: This figure shows mean perceived ATRs and MTRs for corporations in case of retained and distributed profits. The estimated mean (solid) lines are generated by locally estimated scatterplot smoothing. The dot-dashed line represents the average actual ATR and MTR. For presentation reasons, the figure does not include observations for profits above €500,000.

FIGURE 9 Tax Rate Choice by Legal Form.
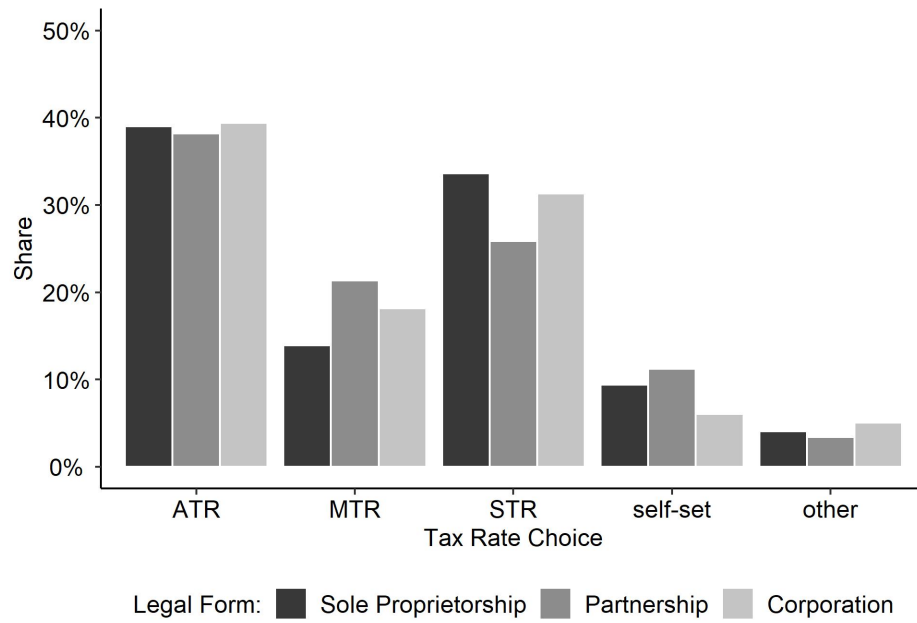
Notes: This figure shows the average shares of chosen tax rates in investment decisions (N = 411).

FIGURE 10 Desired Tax Cut by Legal Form.
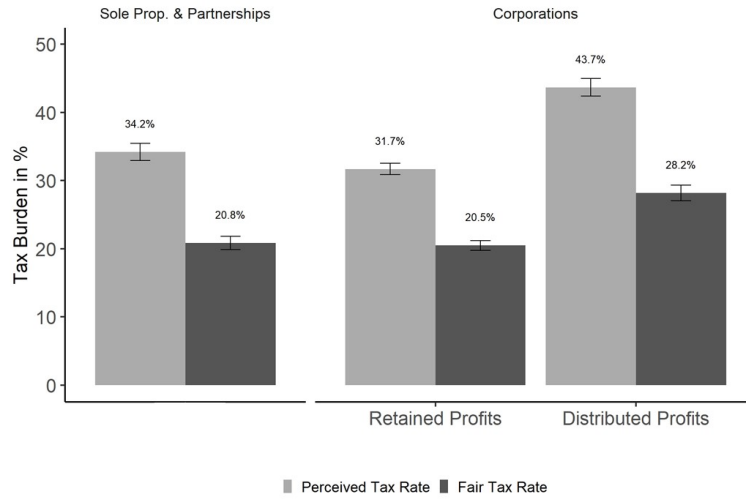
Notes: This figure shows the average perceived and fair tax rate (N = 448).

TABLE 1 Survey Sample Comparison.

	Sample in % N = 493	Business Register 2020 in % N = 3,374,583
Legal Form		
Sole Proprietorship	54.8	63.0
Partnership	21.3	12.8
Corporation	23.9	24.2
Employees		
0-9	66.5	86.9
10-49	26.8	10.4
50-250	6.7	2.2
more than 250	-	0.5

Notes: This table compares firm characteristics of our sample with the official German Business Register 2020. Our sample only includes companies with up to 250 employees. However, as only the categories '50-249' and '250 and more' are available in the German Business Register, we must accept a small inaccuracy by assigning observations from the German Business Register that have exactly 250 employees to the 'more than 250' category.

TABLE 2 Summary Statistics of Sample.

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
Profit	493	130,162.100	200,135.000	20,500	37,000	74,000	142,500	2,075,000
Employees	493	15.014	30.254	1	2	5	14	250
Corporation	493	0.239	0.427	0	0	0	0	1
Sole Proprietorship	493	0.548	0.498	0	0	1	1	1
Partnership	493	0.213	0.410	0	0	0	0	1
Profit in 2020	471	0.862	0.345	0.000	1.000	1.000	1.000	1.000
Tax Assistance	493	0.921	0.270	0	1	1	1	1
Tax Department	493	0.014	0.118	0	0	0	0	1
Subjective Tax Literacy	493	0.759	0.428	0	1	1	1	1
Perceived Tax Complexity	484	4.653	0.693	1.000	4.000	5.000	5.000	5.000
Trust in Government	488	1.797	0.905	1.000	1.000	2.000	2.000	5.000
Tax Compliance Costs	488	0.336	0.211	0.050	0.200	0.300	0.500	1.000
Male	493	0.779	0.415	0	1	1	1	1
Female	493	0.201	0.401	0	0	0	0	1
Manager	486	0.971	0.167	0.000	1.000	1.000	1.000	1.000

Notes: This table presents summary statistics of our sample. Variable definitions and a more detailed version of this summary statistics can be found in Appendix A2.

TABLE 3 Mean Profit and Taxable Income.

		Sole Proprietorships		Partnerships	
		Single	Married	Single	Married
①	Profit	100.0%	100.0%	100.0%	100.0%
	+ Additional Income	0.2pp	27.5pp	0.1pp	24.9pp
②	Total Income	100.2%	127.5%	100.1%	124.9%
	− Special Expenses	-15.3pp	-24.6pp	-8.9pp	-16.7pp
③	Taxable Income	85%	102.9%	91.2%	108.2%

Notes: This table shows mean imputed values of *Additional Income* and *Special Expenses* relative to Profit by the four identified groups using *Propensity Score Matching* (1:10 nearest neighbor matching within a 0.1 caliper radius without replacement). Profit is the *provided profit* in our survey that is attributed evenly among the number of partners.

TABLE 4 ATR and MTR Misperception.

	Sole Proprietorships N = 270	Partnerships N = 105	Corporations N = 118	
			retained	*distributed*
Perceived ATR	32.7%	37.4%	31.5%	43.4%
Actual ATR	19.7%	28%	29.8%	48.3%
ATR Misperception	**13.1pp*****	**9.4pp*****	**1.7pp****	**-4.9pp*****
Share >5pp (>10pp)	71.5% (58.5%)	76.2% (61%)	45.8% (22.9%)	66.1% (44.9%)
ATR Overestimation	15.9pp	13.5pp	6.3pp	9.1pp
Share >5pp (>10pp)	68.1% (57%)	66.7% (53.3%)	29.7% (14.4%)	20.3% (12.7%)
ATR Underestimation	-3.6pp	-9.3pp	-5.9pp	-12.9pp
Share >5pp (>10pp)	3.3% (1.5%)	9.5% (7.6%)	16.1% (8.5%)	45.8% (32.2%)
Perceived MTR	31.3%	37%	32.1%	43.4%
Actual MTR	34.7%	40.8%	29.8%	48.3%
MTR Misperception	**-3.4pp*****	**-3.8pp****	**2.3pp****	**-4.9pp*****
Share >5pp (>10pp)	58.9% (41.5%)	52.4% (34.3%)	49.2% (31.4%)	65.3% (50.8%)
MTR Overestimation	9.2pp	6pp	8.9pp	9.9pp
Share >5pp (>10pp)	21.9% (13.7%)	23.8% (12.4%)	33.1% (19.5%)	20.3% (16.1%)
MTR Underestimation	-14.1pp	-15.8pp	-7.7pp	-14.7pp
Share >5pp (>10pp)	37% (27.8%)	28.6% (21.9%)	16.1% (11.9%)	44.9% (34.7%)

Notes: This table shows descriptive evidence of ATR and MTR Misperception. Perceived ATR/MTR is the mean value of perceived ATRs by legal form. Actual ATRs/MTRs are calculated benchmark ATRs. ATR/MTR Misperception is calculated as perceived ATR/MTR minus Actual ATR/MTR. ***, **, and * denote significance at the 1%, 5%, and 10% levels of a two-sided t-test (ATR/MTR Misperception = 0). ATR/MTR Overestimation measures the average ATR/MTR Misperception in case of positive deviations, and ATR/MTR Underestimation measures the average ATR/MTR Misperception in case of negative deviations. Share >5pp (>10pp) gives the share of all firms that misperceive, overestimate, or underestimate the Actual ATR/MTR by more than plus or minus five (ten) percentage points.

TABLE 5 Sole Proprietorships and Partnerships - Driver Summary Statistics.

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
$ATR_{retained}$ Misp.	345	0.133	0.107	0.001	0.045	0.123	0.192	0.650
$MTR_{retained}$ Misp.	345	0.108	0.111	0.001	0.024	0.064	0.160	0.517
Employees	345	1.430	1.179	0.000	0.000	1.386	2.197	5.298
Loss	345	0.171	0.377	0	0	0	0	1
Tax Assistance	345	0.928	0.260	0	1	1	1	1
Subjective Tax Literacy	345	0.733	0.443	0	0	1	1	1
Objective Tax Literacy	345	0.658	0.651	0	0	1	1	2
Tax Satisfaction	345	0.000	1.000	−2.573	−0.648	−0.131	0.541	3.956
Female	345	0.206	0.405	0	0	0	0	1

Notes: This table presents summary statistics of our variables used in the regression analyses for sole proprietorships and partnerships. Variable definitions and a more detailed version of this summary statistics can be found in Appendix A2.

TABLE 6 Corporations - Driver Summary Statistics.

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
$\text{ATR}_{\text{retained}}$ Misp.	114	0.061	0.064	0.00005	0.008	0.042	0.098	0.295
$\text{MTR}_{\text{retained}}$ Misp.	114	0.085	0.091	0.00005	0.016	0.048	0.131	0.502
$\text{ATR}_{\text{distributed}}$ Misp.	114	0.113	0.095	0.001	0.032	0.083	0.183	0.393
$\text{MTR}_{\text{distributed}}$ Misp.	114	0.126	0.114	0.003	0.031	0.100	0.183	0.463
Employees	114	2.785	1.166	0.693	1.792	2.708	3.555	5.521
Loss	114	0.219	0.416	0	0	0	0	1
Tax Assistance	114	0.921	0.271	0	1	1	1	1
Subjective Tax Literacy	114	0.860	0.349	0	1	1	1	1
Objective Tax Literacy	114	0.877	0.640	0	0	1	1	2
Tax Satisfaction	114	0.000	1.000	−2.709	−0.684	−0.073	0.678	2.490
Female	114	0.132	0.340	0	0	0	0	1

Notes: This table presents summary statistics of our variables used in the regression analyses for corporations. Variable definitions and a more detailed version of this summary statistics can be found in Appendix A2.

TABLE 7 Sole Proprietorships and Partnerships - OLS Regression of ATR and MTR Misperception.

	Dependent variable:	
	ATR Misp.	MTR Misp.
	(1)	(2)
Employees	−0.020***	−0.001
	(−4.573)	(−0.136)
Loss	0.018	0.015
	(1.008)	(0.861)
Tax Assistance	0.043**	0.008
	(2.278)	(0.467)
Subjective Tax Literacy	−0.027**	−0.014
	(−1.975)	(−0.952)
Objective Tax Literacy Level 1	−0.015	−0.057***
	(−1.273)	(−4.416)
Objective Tax Literacy Level 2	−0.028*	−0.098***
	(−1.792)	(−7.015)
Tax Satisfaction	−0.019***	−0.004
	(−3.527)	(−0.791)
Female	−0.003	−0.005
	(−0.214)	(−0.415)
Constant	0.150***	0.146***
	(6.554)	(6.366)
Observations	345	345
R^2	0.130	0.113
Adjusted R^2	0.109	0.091

Notes: This table shows the OLS regression results of ATR and MTR misperception for sole proprietorships and partnerships. The dependent variables in columns (1) and (2) represent ATR and MTR. All variables are defined in more detail in the Appendix A2. Robust standard errors, t-statistics are in parentheses. * p < .1, ** p < .05, *** p < .01.

TABLE 8 Corporations - OLS Regression of ATR and MTR Misperception.

	Dependent variable:			
	$ATR_{ret.}$ Misp.	$MTR_{ret.}$ Misp.	$ATR_{dis.}$ Misp.	$MTR_{dis.}$ Misp.
	(1)	(2)	(3)	(4)
Employees	−0.010*	−0.010*	0.008	0.002
	(−1.934)	(−1.845)	(1.132)	(0.208)
Loss	0.035*	0.036	−0.004	−0.024
	(1.910)	(1.511)	(−0.199)	(−0.977)
Tax Assistance	0.011	0.024	0.002	0.032
	(0.486)	(1.250)	(0.056)	(1.318)
Subjective Tax Literacy	−0.003	−0.008	−0.039	−0.026
	(−0.133)	(−0.392)	(−1.611)	(−0.904)
Objective Tax Literacy Level 1	−0.029*	−0.104***	−0.052**	−0.101***
	(−1.907)	(−5.122)	(−2.257)	(−3.466)
Objective Tax Literacy Level 2	−0.024	−0.099***	−0.081***	−0.133***
	(−1.280)	(−4.624)	(−2.870)	(−4.254)
Tax Satisfaction	−0.003	−0.016**	−0.007	−0.001
	(−0.476)	(−2.131)	(−0.732)	(−0.111)
Female	−0.014	−0.016	0.036	0.027
	(−0.878)	(−0.908)	(1.313)	(0.873)
Constant	0.096***	0.168***	0.159***	0.194***
	(3.101)	(5.745)	(2.997)	(4.454)
Observations	114	114	114	114
R^2	0.153	0.420	0.143	0.230
Adjusted R^2	0.088	0.376	0.077	0.172

Notes: This table shows the OLS regression results of ATR and MTR misperception for corporations. The dependent variables in columns (1) and (2) represent the case where corporations report their ATR and MTR on retained profits (ret.), and the dependent variables in columns (3) and (4) represent the case where corporations report their ATR and MTR on distributed profits (dis.). All variables are defined in more detail in the Appendix A2. Robust standard errors, t-statistics are in parentheses. * p < .1, ** p < .05, *** p < .01.

TABLE 9 OLS Regression of Tax Rate Choice (Investment Decision).

| | Sole Proprietorships & Partnerships | | | Corporations | | |
| | Choice ATR | Choice MTR | Choice STR | Choice ATR | Choice MTR | Choice STR |
	(1)	(2)	(3)	(4)	(5)	(6)
Overall Tax Misperception	**0.221**	**−0.673*****	**0.627***	**−1.055**	**−0.088**	**0.910**
	(0.599)	**(−3.864)**	**(1.876)**	**(−1.484)**	**(−0.179)**	**(1.251)**
Employees	−0.019	0.059***	−0.045**	0.085**	0.015	−0.069*
	(−0.769)	(3.200)	(−2.200)	(2.012)	(0.469)	(−1.765)
Loss	0.069	−0.038	0.018	0.012	−0.167**	−0.011
	(0.860)	(−0.775)	(0.234)	(0.092)	(−2.489)	(−0.099)
Tax Assistance	0.075	−0.236**	0.098	0.543***	−0.490***	0.039
	(0.732)	(−2.227)	(1.065)	(6.236)	(−2.759)	(0.238)
Subjective Tax Literacy	−0.094	0.088**	−0.017	−0.167	−0.129	0.236*
	(−1.392)	(2.443)	(−0.270)	(−0.950)	(−0.967)	(1.724)
Objective Tax Literacy Level 1	0.034	0.071*	−0.035	−0.215	0.217**	0.117
	(0.585)	(1.771)	(−0.633)	(−1.487)	(2.481)	(0.955)
Tax Satisfaction	−0.007	−0.002	0.039	0.030	−0.024	−0.039
	(−0.231)	(−0.105)	(1.299)	(0.530)	(−0.572)	(−0.730)
Female	−0.040	0.009	−0.011	−0.104	−0.016	0.195
	(−0.600)	(0.186)	(−0.174)	(−0.734)	(−0.180)	(1.271)
Constant	0.358**	0.280**	0.248*	0.052	0.594**	0.078
	(2.566)	(2.401)	(1.947)	(0.228)	(2.552)	(0.318)
Observations	301	301	301	99	99	99
R^2	0.021	0.148	0.045	0.112	0.193	0.091
Adjusted R^2	−0.005	0.124	0.019	0.033	0.122	0.010

Notes: This table shows the OLS regression results *Choice ATR*, *Choice MTR* and *Choice STR* in investment decisions for sole proprietorships and partnerships (column (1) - (3)) as well as corporations (column (4) - (6)). All variables are defined in more detail in the Appendix A2. Robust standard errors, t-statistics are in parentheses. * $p < .1$, ** $p < .05$, *** $p < .01$.

TABLE 10 OLS Regression of Desired Tax Cut.

	Sole Proprietorships & Partnerships Desired Tax Cut$_{ret.}$	Corporations Desired Tax Cut$_{ret.}$	Desired Tax Cut$_{dis.}$
	Dependent variable:		
	(1)	(2)	(3)
Misperception Overestimation$_{(ret.)}$	**0.055*****	**0.085*****	
	(5.695)	**(4.818)**	
Misperception Underestimation$_{(ret.)}$	**−0.035***	**−0.022**	
	(−1.710)	**(−1.156)**	
Misperception Overestimation$_{dis.}$			**0.108*****
			(3.366)
Misperception Underestimation$_{dis.}$			**−0.060*****
			(−2.991)
Employees	0.007*	−0.004	0.0003
	(1.679)	(−0.737)	(0.045)
Loss	0.023	0.028	0.037
	(1.376)	(1.246)	(1.536)
Tax Assistance	0.005	−0.006	0.049
	(0.255)	(−0.299)	(1.091)
Subjective Tax Literacy	−0.002	−0.015	−0.030
	(−0.143)	(−0.637)	(−0.960)
Objective Tax Literacy Level 1	−0.035***	0.027	−0.009
	(−3.387)	(1.349)	(−0.415)
Objective Tax Literacy Level 2	−0.062***	0.004	−0.023
	(−5.061)	(0.179)	(−0.737)
Tax Satisfaction	−0.026***	−0.0004	−0.026***
	(−5.457)	(−0.048)	(−3.031)
Female	−0.006	−0.012	0.009
	(−0.554)	(−0.581)	(0.403)
Constant	0.111***	0.114***	0.168***
	(4.685)	(3.394)	(2.976)
Observations	315	99	99
R^2	0.238	0.336	0.452
Adjusted R^2	0.213	0.260	0.390

Notes: This table shows the OLS regression results of firm's Desired Tax Cut for sole proprietorships and partnerships in column (1) and corporations in case of retained profits (ret.) in column (2) and distributed profits (dis.) in column (3). All variables are defined in more detail in the Appendix A2. Robust standard errors, t-statistics are in parentheses. * $p < .1$, ** $p < .05$, *** $p < .01$.

APPENDIX

A1 Survey Questionnaire

The survey structure is explained in Section 2. The survey has seven parts and shows all questions relevant for the analyses.

Part I: Firm Characteristics

1. What is the legal form of your firm?

2. In which craft do you operate? [Craft]

   In which industry do you operate? [Industry]

3. Which handicraft chamber is your firm affiliated with? [Craft]

   In which federal state is your firm registered? [Industry]

4. Is your firm part of a corporate group?

5. How many employees do you have who are subject to social insurance contributions? Please provide the exact number.

   How many employees do you have who are subject to social insurance contributions? Please provide the range. [If no exact number provided]

6. Is your firm part of a tax group?

7. Which of the following intervals most accurately corresponds to your sales (in euros) in the 2019 financial year?

8. Can you specify the number of shareholders involved in your firm?

   Which of the following intervals most closely matches the number of shareholders involved in your firm? [If no exact number provided]

9. Does your firm use the support of a tax advisor?

   Does your firm have its own tax department?

Part II: Income Taxation

1. How high do you estimate the income tax burden (in %) if your firm were to achieve a domestic annual result before taxes in the amount of [profit] €?

2. Assume that your firm can increase this annual profit before tax by [10% profit] € (10%). How high do you estimate the income tax burden (in %) on this additional [10% profit] €?

3. What income tax burden (in %) do you feel would be appropriate if your firm were to achieve domestic annual earnings before taxes in the amount of [profit] €?

Part III: Comparison of Income Taxation

1. How would you rate your firm's income tax burden compared to smaller, larger, or differently legally structured firm?

2. How would you rate your firm's income tax burden compared to foreign competitors?

Part IV: Taxes in Business Decisions

1. Do you consider income taxes when making investment or financing decisions?

2. Do you seek professional advice on tax aspects (e.g., from a tax advisor) when making investment or financing decisions?

3. Which specific tax rate do you reference when making business decisions?

Part V: Compliance Costs

1. Please estimate the share of the tax-related administrative burden in the total tax-related administrative expenses in your firm.

Part VI: Tax System

1. To what extent do you agree with the following statement? "German corporate taxation is too complex".

2. To what extent do you agree with the following statement? "The state handles the taxes it collects responsibly".

Part VII: Firm & Personal Characteristics

1. Has your firm generated profits in the fiscal years 2018, 2019, and 2020?

2. Do you expect your firm to make a profit in the fiscal year 2021?

3. What is your firm's (weighted) local tax multiplier?

4. Please state your gender.

5. Do you have any tax knowledge?

6. Do you work in an executive position?

A2 Variable Definition and Summary Statistics

TABLE 11 Variable Definition.

Name	Definition	Values
Misperception		
ATR Misperception	= Perceived ATR - Actual ATR	metric
MTR Misperception	= Perceived MTR - Actual MTR	metric
Firm Characteristics		
Employees	= Natural logarithm of the exact number/the average value of the range selected	metric
Corporation	= 1, if legal form is corporation, 0 otherwise	binary
Loss	= 1, if loss occurred in 2019 or 2020, 0 otherwise	binary
Tax Assistance	= 1, if firm gets support from tax advisor, 0 otherwise	binary
Personal Characteristics		
Subjective Tax Literacy	= 1, if respondent states tax knowledge, 0 otherwise	binary
Objective Tax Literacy	= Comprising indicator variables:	metric
Tax Schedule	= 1, if relation ATR to MTR accurate, 0 otherwise	binary
Tax Rate Choice	= 1, if using MTR in business decisions, 0 otherwise	binary
Tax Satisfaction	= Standardized variable comprising indicator variables:	metric
Perceived Tax Complexity	= Perceived tax complexity	metric
Trust in Government	= Stated trust in government	metric
Peers' Tax Burden	= Perception of (larger and smaller) peers' tax burden	metric
Tax Compliance Cost	= Estimated tax compliance costs as share of all compliance costs	metric
Female	= 1, if stated gender is female, 0 otherwise	binary
Consequences		
Choice ATR	= 1, if ATR used in investment decisions, 0 otherwise	binary
Choice MTR	= 1, if MTR used in investment decisions, 0 otherwise	binary
Choice STR	= 1, if STR used in investment decisions, 0 otherwise	binary
Desired Tax Cut	= Perceived ATR - Fair ATR, in case Perceived ATR > Fair ATR	metric
Overall Tax Misperception	= (ATR Misperception + MTR Misperception) / 2	metric
Misperception Overestimation	= 1, if overestimation of ATR > 5pp, 0 otherwise	binary
Misperception Underestimation	= 1, if underestimation of ATR > 5pp, 0 otherwise	binary

Notes: This table presents definitions of drivers analyzed in our regression analysis.

TABLE 12 Summary Statistics.

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
$ATR_{retained}$ Misp.	459	0.115	0.102	0.00005	0.027	0.102	0.170	0.650
$ATR_{distributed}$ Misp.	459	0.128	0.104	0.001	0.038	0.117	0.186	0.650
$MTR_{retained}$ Misp.	459	0.103	0.107	0.00005	0.023	0.059	0.156	0.517
$MTR_{distributed}$ Misp.	459	0.113	0.112	0.001	0.024	0.067	0.167	0.517
Employees	459	1.767	1.313	0.000	0.693	1.609	2.639	5.521
Loss	459	0.183	0.387	0	0	0	0	1
Tax Assistance	459	0.926	0.262	0	1	1	1	1
Subjective Tax Literacy	459	0.765	0.425	0	1	1	1	1
Objective Tax Literacy	459	0.712	0.654	0	0	1	1	2
Tax Schedule	459	0.566	0.496	0	0	1	1	1
Tax Rate Choice	459	0.146	0.353	0	0	0	0	1
Tax Satisfaction	459	0.000	1.000	−2.925	−0.660	−0.136	0.577	3.868
Perceived Tax Complexity	459	0.000	1.000	−0.491	−0.491	−0.491	−0.491	5.518
Trust	459	0.000	1.000	−0.874	−0.874	0.247	0.247	3.608
Peers' Tax Burden	459	0.000	1.000	−2.111	−0.466	−0.466	1.179	1.179
Tax Compliance Cost	459	0.000	1.000	−3.177	−0.791	0.163	0.879	1.356
Female	459	0.187	0.391	0	0	0	0	1
Choice ATR	459	0.333	0.472	0	0	0	1	1
Choice MTR	459	0.146	0.353	0	0	0	0	1
Choice STR	459	0.275	0.447	0	0	0	1	1
Tax Cut$_{retained}$	414	0.142	0.091	0.005	0.080	0.120	0.200	0.700
Tax Cut$_{distributed}$	414	0.157	0.100	0.005	0.100	0.150	0.200	0.700
Overall Tax Misperception	459	0.109	0.084	0.000	0.049	0.088	0.154	0.584
$ATR_{retained}$ Overestimation	459	0.588	0.493	0	0	1	1	1
$ATR_{retained}$ Underestimation	459	0.074	0.262	0	0	0	0	1
$ATR_{distributed}$ Overestimation	459	0.566	0.496	0	0	1	1	1
$ATR_{distributed}$ Underestimation	459	0.146	0.353	0	0	0	0	1

Notes: This table presents summary statistics of our regression variables incl. standardized variables (z-score) incorporated Tax Satisfaction.

A3 Overestimation and Underestimation by Legal Form

We investigate overestimation and underestimation separately to decompose our findings on overall tax rate misperception. Therefore, we differentiate between overestimation and underestimation based on the absolute misperception.

TABLE 13 Sole Proprietorships and Partnerships - OLS Regression of ATR and MTR Over-/Underestimation.

	Dependent variable:			
	ATR Misp.		MTR Misp.	
	Over	Under	Over	Under
	(1)	(2)	(3)	(4)
Employees	−0.025***	0.011**	−0.014***	0.011
	(0.005)	(0.006)	(0.005)	(0.007)
Loss	0.043**	−0.013	0.021	0.012
	(0.021)	(0.022)	(0.022)	(0.024)
Tax Assistance	0.043**	0.048**	0.006	0.025
	(0.019)	(0.021)	(0.027)	(0.023)
Subjective Tax Literacy	−0.020	−0.035	−0.010	−0.011
	(0.015)	(0.028)	(0.016)	(0.021)
Objective Tax Literacy Level 1	−0.014	−0.021	0.015	−0.093***
	(0.013)	(0.022)	(0.016)	(0.017)
Objective Tax Literacy Level 2	−0.027*	−0.061***	−0.013	−0.142***
	(0.016)	(0.023)	(0.015)	(0.023)
Tax Satisfaction	−0.020***	0.010	−0.009	0.002
	(0.006)	(0.010)	(0.007)	(0.008)
Female	−0.008	0.014	−0.014	0.007
	(0.014)	(0.025)	(0.013)	(0.022)
Constant	0.158***	0.028	0.089***	0.146***
	(0.024)	(0.033)	(0.031)	(0.030)
Observations	296	49	170	175
R^2	0.166	0.239	0.096	0.200
Adjusted R^2	0.143	0.087	0.052	0.162

Notes: This table shows OLS regression results of ATR and MTR misperception for sole proprietorships and partnerships, which is divided into overestimation (columns (1) and (3)) and underestimation (columns (2) and (4)). Note, that underestimates like overestimates have a positive sign. All variables are defined in more detail in the Appendix A2. Robust standard errors are in parentheses. * $p < .1$, ** $p < .05$, *** $p < .01$.

TABLE 14 Corporations - OLS Regression of ATR and MTR Over-/Underestimation.

	Dependent variable:							
	$ATR_{ret.}$ Misp.		$MTR_{ret.}$ Misp.		$ATR_{dis.}$ Misp.		$MTR_{dis.}$ Misp.	
	Over	Under	Over	Under	Over	Under	Over	Under
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Employees	−0.012*	−0.009	−0.010	−0.010	−0.003	0.009	−0.003	−0.003
	(0.007)	(0.009)	(0.007)	(0.010)	(0.015)	(0.009)	(0.014)	(0.010)
Loss	0.050**	0.007	0.072**	−0.017	−0.001	−0.022	−0.013	−0.034
	(0.025)	(0.022)	(0.032)	(0.030)	(0.049)	(0.025)	(0.040)	(0.029)
Tax Assistance	0.036	−0.009	0.033*	0.001	0.023	−0.024	0.018	0.056
	(0.026)	(0.025)	(0.019)	(0.026)	(0.040)	(0.055)	(0.040)	(0.041)
Subjective Tax Literacy	−0.008	−0.020	−0.005	−0.017	0.019	−0.053*	0.006	−0.009
	(0.020)	(0.038)	(0.019)	(0.037)	(0.028)	(0.028)	(0.040)	(0.038)
Objective Tax Literacy Level 1	−0.001	−0.051***	−0.085***	−0.099***	0.003	−0.069**	−0.010	−0.159***
	(0.020)	(0.020)	(0.026)	(0.031)	(0.042)	(0.031)	(0.040)	(0.036)
Objective Tax Literacy Level 2	0.016	−0.068***	−0.069***	−0.123***	0.013	−0.110***	−0.021	−0.184***
	(0.022)	(0.022)	(0.025)	(0.030)	(0.071)	(0.036)	(0.048)	(0.037)
Tax Satisfaction	−0.008	−0.002	−0.026***	−0.005	−0.039**	−0.001	−0.051***	0.018
	(0.007)	(0.012)	(0.010)	(0.011)	(0.017)	(0.011)	(0.016)	(0.013)
Female	−0.060***	0.025	−0.060***	0.020	0.010	0.041	0.008	−0.007
	(0.017)	(0.020)	(0.020)	(0.024)	(0.024)	(0.031)	(0.025)	(0.039)
Constant	0.062*	0.144***	0.140***	0.193***	0.054	0.225***	0.092	0.238***
	(0.037)	(0.048)	(0.033)	(0.052)	(0.053)	(0.065)	(0.062)	(0.056)
Observations	72	42	69	45	42	72	46	68
R^2	0.245	0.359	0.489	0.500	0.173	0.252	0.257	0.412
Adjusted R^2	0.149	0.204	0.421	0.389	−0.027	0.157	0.096	0.332

Notes: This table shows OLS regression results of ATR and MTR misperception for corporations, which is divided into overestimation and underestimation. The dependent variables in columns (1)-(4) represent the case where corporations report their ATR and MTR on retained profits (ret.), and the dependent variables in columns (5)-(8) represent the case where corporations report their ATR and MTR on distributed profits (dis.). Note, that underestimates like overestimates have a positive sign. All variables are defined in more detail in the Appendix A2. Robust standard errors are in parentheses. * $p < .1$, ** $p < .05$, *** $p < .01$.

A4 Propensity Score Matching

In order to account for tax base effects when determining the actual tax rate, we match survey respondents with 10 observations from the official income tax statistics (FAST 2017, see Section 3.2). We are interested in *Additional Income* and *Special Expenses* of comparable entrepreneurs. After propensity score matching, we can check the balance of our covariates in Table 15.

TABLE 15 Summary of Balance for Matched Data.

	FAST 2017 N = 7,446	Survey N = 748
Profit		
Mean (SD)	99,300 (107,000)	102,000 (116,000)
Median [Min, Max]	68,600 [19,400; 11,300,000]	70,300 [20,200; 11,100,000]
Industry		
BC (Mining and quarrying and Manufacturing)	1,744 (23.4%)	176 (23.5%)
DE (Electricity, gas, steam and air conditioning supply and Water supply)	18 (0.2%)	2 (0.3%)
F (Construction)	3,386 (45.5%)	340 (45.5%)
G (Wholesale and retail trade)	800 (10.8%)	80 (10.7%)
I (Accommodation and food service activities)	20 (0.3%)	2 (0.3%)
J (Information and communication)	20 (0.3%)	2 (0.3%)
K (Financial and insurance activities)	40 (0.5%)	4 (0.5%)
L (Real estate activities)	40 (0.5%)	4 (0.5%)
M (Professional, scientific and technical activities)	160 (2.1%)	16 (2.1%)
N (Administrative and support service activities)	20 (0.3%)	2 (0.3%)
Q (Human health and social work activities)	20 (0.3%)	2 (0.3%)
S (Other services activities)	1,178 (15.8%)	118 (15.8%)
Legal		
Sole Proprietorship	5,400 (72.5%)	540 (72.2%)
Partnership	2,046 (27.5%)	208 (27.8%)
Married		
Single	3,707 (49.8%)	374 (50.0%)
Married	3,739 (50.2%)	374 (50.0%)

Notes: This table shows matched data of FAST 2017 and our survey observations. Industry is the 'Gewerbekennzahl (GKZ)' given in the official income tax statistics and can be derived from the industry asked in our survey. The number of observations (N = 748) represents twice of our matchable sole proprietorships and partnerships because we used them as both single and married taxpayers to account for the unknown marital status.

SUPPORTING INFORMATION

S1 Propensity Score Matching - Alternative Matching Approaches

In order to check the robustness of our matching results (1:10, caliper = 0.1) we run robustness checks for the *Propensity Score Matching* with a 1:10 matching and a caliper of 0.2 as well as a 1:20 matching with a caliper of 0.1.

TABLE 16 Robustness Check: ATR and MTR Misperception.

	Sole Proprietorships N = 270	Partnerships N = 105	Corporations N = 118	
			retained	*distributed*
	PSM 1:10 & caliper = 0.1 | PSM 1:10 & caliper = 0.2 | PSM 1:20 & caliper = 0.1			
ATR Misperception	**13.1pp*** | 13.1pp*** | 13.1pp***	**9.4pp*** | 9.4pp*** | 9.3pp***	**1.7pp** | 1.7pp** | 1.7pp**	**-4.9pp*** | -4.9pp*** | -4.9pp***
ATR Overestimation	15.9pp | 15.9pp | 15.6pp	13.5pp | 13.7pp | 13.8pp	6.3pp | 6.3pp | 6.3pp	9.1pp | 9.1pp | 9.1pp
ATR Underestimation	-3.6pp | -3.6pp | -3.8pp	-9.3pp | -8.9pp | -8.5pp	-5.9pp | -5.9pp | -5.9pp	-12.9pp | -12.9pp| -12.9pp
MTR Misperception	**-3.4pp*** | -3.4pp*** | -3.4pp***	**-3.8pp** | -3.8pp** | -3.9pp**	**2.3pp** | 2.3pp** | 2.3pp**	**-4.9pp*** | -4.9pp*** | -4.9pp***
MTR Overestimation	9.2pp | 9.2pp | 9.5pp	6pp | 6pp | 6pp	8.9pp | 8.9pp | 8.9pp	9.9pp | 9.9pp | 9.9pp
MTR Underestimation	-14.1pp | -14.1pp | -13.7pp	-15.8pp | -15.8pp | -15.6pp	-7.7pp | -7.7pp | -7.7pp	-14.7pp | -14.7pp | -14.7pp

Notes: This table shows descriptive evidence of ATR and MTR misperception based on different matching criteria: 1:10 matching with caliper of 0.1, 1:10 matching with caliper of 0.2 and 1:20 matching with a caliper of 0.2. ATR/MTR Misperception is calculated as Perceived ATR/MTR minus Actual ATR/MTR. ***, **, and * denote significance at the 1%, 5%, and 10% levels of a two-sided t-test (ATR/MTR Misperception = 0). ATR/MTR Overestimation measures the average ATR/MTR Misperception in case of positive deviations, and ATR/MTR Underestimation measures the average ATR/MTR Misperception in case of negative deviations.

S2 Additional Analysis

S2.1 Corridor Sensitivity

In Section 4.1 we define firms as misperceiving if they exceed the selected corridor of ± 5 or ± 10pp. We chose a plus or minus five (ten) percentage points corridor because this results into quite large deviations of more than 15% (30%) given average tax rates of 30%. For the sake of transparency, we show in Figure 11 how the chosen corridor affects the share of firms misperceiving their tax burden.

FIGURE 11 Corridor Sensitivity.
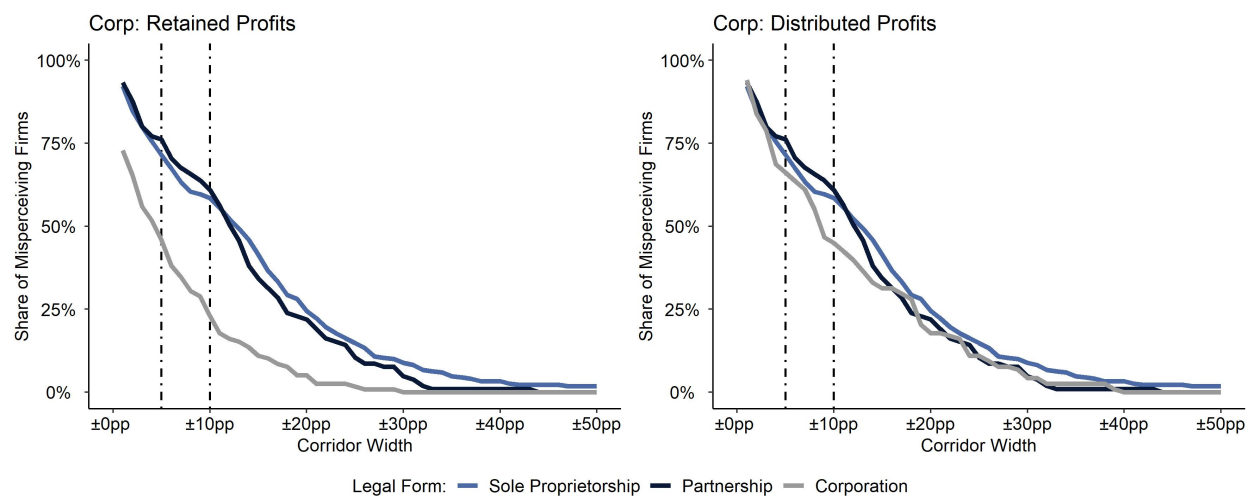
Notes: This figure shows the average share of ATR misperceiving firms on defined corridors by legal form. Corporations in case of retained profits. The dot-dashed lines indicate the corridors used within this study.

S2.2 Correlation of Covariates

TABLE 17 Correlation Matrix of Covariates.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log Employees (1)	1	-0.010	-0.034	0.020	0.144	0.158	-0.032
Loss (2)	-0.010	1	-0.038	0.001	-0.070	-0.085	0.004
Tax Assistance (3)	-0.034	-0.038	1	0.012	-0.098	-0.150	-0.035
Satisfaction (4)	0.020	0.001	0.012	1	-0.002	0.031	0.024
Subjective Tax Literacy (5)	0.144	-0.070	-0.098	-0.002	1	0.172	0.069
Objective Tax Literacy (6)	0.158	-0.085	-0.150	0.031	0.172	1	0.049
Female (7)	-0.032	0.004	-0.035	0.024	0.069	0.049	1

Notes: This table presents a correlation matrix of variables used in the regression analyses. The variance inflation factor does not indicate any problems regarding multicollinearity.

S2.3 Summary Statistics Entire Sample

We additionally provide summary statistics of variables used in our regressions for the whole sample, thus including non-corporations and corporations.

TABLE 18 Summary Statistics of Drivers.

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
$\text{ATR}_{\text{retained}}$ Misp.	459	0.115	0.102	0.00005	0.027	0.102	0.170	0.650
$\text{ATR}_{\text{distributed}}$ Misp.	459	0.128	0.104	0.001	0.038	0.117	0.186	0.650
$\text{MTR}_{\text{retained}}$ Misp.	459	0.103	0.107	0.00005	0.023	0.059	0.156	0.517
$\text{MTR}_{\text{distributed}}$ Misp.	459	0.113	0.112	0.001	0.024	0.067	0.167	0.517
Employees (log)	459	1.767	1.313	0.000	0.693	1.609	2.639	5.521
Loss	459	0.183	0.387	0	0	0	0	1
Tax Assistance	459	0.926	0.262	0	1	1	1	1
Subjective Tax Literacy	459	0.765	0.425	0	1	1	1	1
Objective Tax Literacy	459	0.712	0.654	0	0	1	1	2
Tax Satisfaction	459	0.000	1.000	−2.925	−0.660	−0.136	0.577	3.868
Female	459	0.187	0.391	0	0	0	0	1

Notes: This table presents summary statistics of our variables used in the regression analysis. For sole proprietorships and partnerships there is no difference between retained and distributed earnings. This display is only to illustrate differences in corporations' tax rate. Variable definitions and a more detailed version of this summary statistics can be found in Appendix A2.

S2.4 Summary Statistics by Size

We additionally provide summary statistics of variables used in our regressions for firms of different sizes (median split based on the number of employees) across all legal forms.

TABLE 19 Summary Statistics (5 or less Employees).

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
$ATR_{retained}$ Misp.	233	0.137	0.107	0.001	0.048	0.127	0.201	0.608
$ATR_{distributed}$ Misp.	233	0.139	0.108	0.001	0.047	0.126	0.206	0.608
$MTR_{retained}$ Misp.	233	0.112	0.102	0.001	0.029	0.075	0.174	0.455
$MTR_{distributed}$ Misp.	233	0.112	0.106	0.001	0.026	0.074	0.171	0.463
Employees	233	0.721	0.627	0.000	0.000	0.693	1.386	1.609
Loss	233	0.189	0.392	0	0	0	0	1
Tax Assistance	233	0.927	0.261	0	1	1	1	1
Subjective Tax Literacy	233	0.704	0.458	0	0	1	1	1
Objective Tax Literacy	233	0.648	0.613	0	0	1	1	2
Tax Satisfaction	233	−0.014	0.970	−2.295	−0.660	−0.147	0.525	3.868
Female	233	0.206	0.405	0	0	0	0	1

Notes: This table presents summary statistics of our variables used in the regression analyses.

TABLE 20 Summary Statistics (more than 5 Employees).

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
$ATR_{retained}$ Misp.	226	0.093	0.092	0.00005	0.022	0.066	0.139	0.650
$ATR_{distributed}$ Misp.	226	0.117	0.099	0.001	0.033	0.108	0.171	0.650
$MTR_{retained}$ Misp.	226	0.092	0.111	0.00005	0.018	0.046	0.124	0.517
$MTR_{distributed}$ Misp.	226	0.113	0.118	0.001	0.023	0.063	0.157	0.517
Employees	226	2.844	0.898	1.792	2.197	2.639	3.286	5.521
Loss	226	0.177	0.383	0	0	0	0	1
Tax Assistance	226	0.925	0.264	0	1	1	1	1
Subjective Tax Literacy	226	0.827	0.379	0	1	1	1	1
Objective Tax Literacy	226	0.779	0.689	0	0	1	1	2
Tax Satisfaction	226	0.014	1.032	−2.925	−0.639	−0.073	0.661	3.313
Female	226	0.168	0.375	0	0	0	0	1

Notes: This table presents summary statistics of our variables used in the regression analyses.

S3 Robustness Checks

The identification of firms' tax rate misperception is based on assumptions. We want to ensure that these assumptions do not erroneously inflate or deflate our baseline results. For this purpose, we conduct robustness checks for alternative samples, alternative identification of misperception and alternative regression methods.

S3.1 Samples

Subsample: Excluding Implausible MTRs

Comparing ATRs and MTRs, we find firms that reporting single digit MTRs although they report double digit ATRs. It may be that these firms did not understand the question about the marginal tax rate right. Therefore, we perform additional analyses for subsamples excluding these "implausible MTR" firms. Our results are robust to this variation.

TABLE 21 OLS Regression of ATR and MTR Misperception.

| | Sole Proprietorships & Partnerships | | Corporations | | | |
	ATR Misp.	MTR Misp.	$ATR_{ret.}$ Misp.	$MTR_{ret.}$ Misp.	$ATR_{dis.}$ Misp.	$MTR_{dis.}$ Misp.
	(1)	(2)	(3)	(4)	(5)	(6)
Employees	−0.018***	−0.007*	−0.010**	−0.009	0.007	0.006
	(0.005)	(0.004)	(0.005)	(0.006)	(0.007)	(0.008)
Loss	0.018	0.003	0.032*	0.039*	−0.004	−0.014
	(0.020)	(0.014)	(0.018)	(0.024)	(0.023)	(0.024)
Tax Assistance	0.050***	0.015	0.013	0.023	−0.0003	0.030
	(0.018)	(0.013)	(0.022)	(0.020)	(0.040)	(0.024)
Subjective Tax Literacy	−0.029*	−0.014	−0.007	−0.006	−0.031	−0.021
	(0.015)	(0.013)	(0.020)	(0.021)	(0.025)	(0.026)
Objective Tax Literacy Level 1	−0.026*	−0.015	−0.032**	−0.098***	−0.055**	−0.082***
	(0.013)	(0.012)	(0.015)	(0.021)	(0.024)	(0.028)
Objective Tax Literacy Level 2	−0.038**	−0.051***	−0.027	−0.093***	−0.085***	−0.114***
	(0.017)	(0.012)	(0.019)	(0.022)	(0.029)	(0.030)
Tax Satisfaction	−0.020***	−0.005	−0.004	−0.015*	−0.007	0.002
	(0.006)	(0.006)	(0.006)	(0.008)	(0.009)	(0.011)
Female	−0.0003	−0.013	−0.009	−0.018	0.028	0.019
	(0.013)	(0.011)	(0.017)	(0.017)	(0.028)	(0.028)
Constant	0.150***	0.109***	0.103***	0.156***	0.162***	0.158***
	(0.023)	(0.018)	(0.031)	(0.030)	(0.054)	(0.040)
Observations	315	315	111	111	111	111
R^2	0.138	0.063	0.168	0.382	0.130	0.172
Adjusted R^2	0.116	0.039	0.102	0.333	0.061	0.107

Notes: This table shows the OLS regression results of ATR and MTR misperception. The dependent variables in columns (1) and (2) represent sole proprietorships and partnerships. The dependent variables in columns (3) - (4) represent the case where corporations report their ATR and MTR on retained profits (ret.), and the dependent variables in columns (5) and (6) represent the case where corporations report their ATR and MTR on distributed profits (dis.). All variables are defined in more detail in the Appendix A2. Robust standard errors are in parentheses. * p < .1, ** p < .05, *** p < .01.

TABLE 22 OLS Regression of ATR and MTR Over-/Underestimation.

	Dependent variable:											
	Sole Proprietorships & Partnerships				Corporations							
	ATR Misp.		MTR Misp.		$ATR_{ret.}$ Misp.		$MTR_{ret.}$ Misp.		$ATR_{dis.}$ Misp.		$MTR_{dis.}$ Misp.	
	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Employees	−0.023***	0.012*	−0.011***	−0.009	−0.012	−0.009	−0.012	−0.003	−0.007	0.008	0.005	0.004
	(0.005)	(0.006)	(0.004)	(0.009)	(0.007)	(0.009)	(0.008)	(0.009)	(0.016)	(0.009)	(0.020)	(0.010)
Loss	0.050**	−0.014	−0.0004	−0.046	0.048*	0.007	0.070**	−0.012	−0.005	−0.022	−0.006	−0.025
	(0.022)	(0.023)	(0.016)	(0.036)	(0.026)	(0.022)	(0.032)	(0.026)	(0.049)	(0.026)	(0.057)	(0.026)
Tax Assistance	0.054***	0.049*	0.010	0.090**	0.037	−0.009	0.025	−0.009	0.017	−0.023	0.043	0.017
	(0.017)	(0.025)	(0.014)	(0.042)	(0.026)	(0.025)	(0.028)	(0.023)	(0.042)	(0.053)	(0.047)	(0.036)
Subjective Tax Literacy	−0.021	−0.044	−0.011	−0.065*	−0.010	−0.020	−0.001	−0.034	0.025	−0.045	0.014	−0.033
	(0.016)	(0.030)	(0.012)	(0.037)	(0.022)	(0.038)	(0.021)	(0.044)	(0.030)	(0.031)	(0.047)	(0.034)
Objective Tax Literacy Level 1	−0.026*	−0.023	−0.010	−0.064*	−0.005	−0.051***	−0.090***	−0.066**	0.002	−0.075**	−0.080	−0.077**
	(0.014)	(0.024)	(0.011)	(0.035)	(0.021)	(0.020)	(0.026)	(0.029)	(0.042)	(0.033)	(0.065)	(0.038)
Objective Tax Literacy Level 2	−0.037**	−0.064**	−0.032***	−0.166***	0.013	−0.068***	−0.076***	−0.088***	0.014	−0.117***	−0.086	−0.117***
	(0.017)	(0.027)	(0.011)	(0.034)	(0.023)	(0.022)	(0.028)	(0.029)	(0.072)	(0.038)	(0.097)	(0.038)
Tax Satisfaction	−0.021***	0.011	−0.011**	0.007	−0.007	−0.002	−0.023**	−0.002	−0.042**	−0.001	−0.012	0.006
	(0.006)	(0.010)	(0.005)	(0.015)	(0.007)	(0.012)	(0.010)	(0.011)	(0.017)	(0.011)	(0.033)	(0.012)
Female	−0.007	0.026	−0.010	−0.005	−0.056***	0.025	−0.071***	0.043**	0.008	0.033	0.022	0.023
	(0.014)	(0.029)	(0.010)	(0.040)	(0.019)	(0.020)	(0.023)	(0.021)	(0.024)	(0.034)	(0.043)	(0.036)
Constant	0.156***	0.034	0.100***	0.203***	0.067*	0.144***	0.156***	0.159***	0.066	0.228***	0.103	0.187***
	(0.023)	(0.035)	(0.019)	(0.046)	(0.039)	(0.048)	(0.043)	(0.051)	(0.054)	(0.066)	(0.074)	(0.048)
Observations	270	45	270	45	69	42	69	42	41	70	41	70
R^2	0.182	0.265	0.076	0.361	0.241	0.359	0.485	0.426	0.188	0.236	0.164	0.208
Adjusted R^2	0.157	0.102	0.048	0.219	0.140	0.204	0.416	0.287	−0.014	0.135	−0.044	0.104

Notes: This table shows OLS regression results of ATR and MTR misperception divided into overestimation and underestimation. The dependent variables in columns (1) - (4) represent the case for sole proprietorships and partnerships. Columns (5) - (8) where corporations report their ATR and MTR on retained profits (ret.), and the dependent variables in columns (9) - (12) represent the case where corporations report their ATR and MTR on distributed profits (dis.). Note, that underestimates like overestimates have a positive sign. All variables are defined in more detail in the Appendix A2. Robust standard errors are in parentheses. * p < .1, ** p < .05, *** p < .01.

Subsample: Excluding fast Respondents

In line with Fisman et al. (2020) and Stantcheva (2021), we drop very fast respondents in this additional analysis. We drop respondents in the bottom 5% of the survey time distribution. These respondents may not have taken the survey seriously. Our results are robust to this variation.

TABLE 23 OLS Regression of ATR and MTR Misperception.

	Dependent variable:					
	Sole Proprietorships & Partnerships		Corporations			
	ATR Misp.	MTR Misp.	$ATR_{ret.}$ Misp.	$MTR_{ret.}$ Misp.	$ATR_{dis.}$ Misp.	$MTR_{dis.}$ Misp.
	(1)	(2)	(3)	(4)	(5)	(6)
Employees	−0.019***	0.001	−0.010*	−0.011*	0.011	0.002
	(0.005)	(0.005)	(0.005)	(0.006)	(0.007)	(0.009)
Loss	0.017	0.018	0.033*	0.034	0.003	−0.021
	(0.019)	(0.018)	(0.018)	(0.024)	(0.023)	(0.025)
Tax Assistance	0.037*	0.004	0.027	0.022	0.037*	0.037
	(0.020)	(0.018)	(0.024)	(0.023)	(0.022)	(0.026)
Subjective Tax Literacy	−0.033**	−0.018	−0.009	−0.009	−0.042*	−0.025
	(0.014)	(0.015)	(0.020)	(0.022)	(0.024)	(0.031)
Objective Tax Literacy Level 1	−0.018	−0.061***	−0.023	−0.103***	−0.048**	−0.100***
	(0.012)	(0.013)	(0.016)	(0.021)	(0.022)	(0.030)
Objective Tax Literacy Level 2	−0.033**	−0.104***	−0.014	−0.095***	−0.072***	−0.133***
	(0.016)	(0.014)	(0.020)	(0.023)	(0.025)	(0.033)
Tax Satisfaction	−0.018***	−0.004	−0.003	−0.018**	−0.005	−0.003
	(0.006)	(0.006)	(0.006)	(0.008)	(0.009)	(0.011)
Female	−0.002	−0.001	−0.013	−0.017	0.046*	0.030
	(0.013)	(0.013)	(0.017)	(0.017)	(0.027)	(0.031)
Constant	0.157***	0.152***	0.082***	0.174***	0.111***	0.183***
	(0.024)	(0.023)	(0.032)	(0.033)	(0.037)	(0.048)
Observations	327	327	108	108	108	108
R^2	0.130	0.123	0.154	0.416	0.160	0.236
Adjusted R^2	0.108	0.101	0.085	0.369	0.092	0.174

Notes: This table shows the OLS regression results of ATR and MTR misperception. The dependent variables in columns (1) and (2) represent sole proprietorships and partnerships. The dependent variables in columns (3) - (4) represent the case where corporations report their ATR and MTR on retained profits (ret.), and the dependent variables in columns (5) and (6) represent the case where corporations report their ATR and MTR on distributed profits (dis.). All variables are defined in more detail in the Appendix A2. Robust standard errors are in parentheses. * p < .1, ** p < .05, *** p < .01.

TABLE 24 OLS Regression of ATR and MTR Over-/Underestimation.

	Dependent variable:											
	Sole Proprietorships & Partnerships				Corporations							
	ATR Misp.		MTR Misp.		$ATR_{ret.}$ Misp.		$MTR_{ret.}$ Misp.		$ATR_{dis.}$ Misp.		$MTR_{dis.}$ Misp.	
	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Employees	−0.024***	0.011*	−0.012**	0.012	−0.012*	−0.010	−0.011	−0.011	−0.004	0.012	−0.004	−0.002
	(0.005)	(0.006)	(0.005)	(0.008)	(0.007)	(0.009)	(0.007)	(0.011)	(0.015)	(0.009)	(0.014)	(0.011)
Loss	0.042**	−0.016	0.023	0.012	0.046*	0.009	0.069**	−0.018	−0.004	−0.014	−0.015	−0.027
	(0.022)	(0.023)	(0.023)	(0.024)	(0.025)	(0.022)	(0.032)	(0.030)	(0.049)	(0.026)	(0.041)	(0.029)
Tax Assistance	0.038**	0.058**	−0.001	0.021	0.039	0.011	0.032	0.003	0.023	0.028	0.018	0.062
	(0.019)	(0.028)	(0.027)	(0.024)	(0.025)	(0.029)	(0.027)	(0.028)	(0.041)	(0.027)	(0.040)	(0.051)
Subjective Tax Literacy	−0.027*	−0.035	−0.016	−0.015	−0.018	−0.019	−0.008	−0.015	0.020	−0.058**	0.007	−0.006
	(0.015)	(0.029)	(0.017)	(0.021)	(0.019)	(0.040)	(0.022)	(0.038)	(0.029)	(0.029)	(0.041)	(0.041)
Objective Tax Literacy Level 1	−0.016	−0.025	0.011	−0.095***	0.006	−0.046**	−0.082***	−0.098***	0.007	−0.063**	−0.007	−0.161***
	(0.013)	(0.024)	(0.016)	(0.018)	(0.020)	(0.020)	(0.027)	(0.031)	(0.043)	(0.030)	(0.041)	(0.038)
Objective Tax Literacy Level 2	−0.030*	−0.066***	−0.014	−0.146***	0.019	−0.056**	−0.069**	−0.117***	0.014	−0.096***	−0.021	−0.186***
	(0.016)	(0.025)	(0.014)	(0.023)	(0.021)	(0.025)	(0.028)	(0.031)	(0.072)	(0.031)	(0.049)	(0.042)
Tax Satisfaction	−0.019***	0.009	−0.008	0.002	−0.009	0.001	−0.027***	−0.005	−0.040**	0.002	−0.051***	0.017
	(0.006)	(0.010)	(0.008)	(0.008)	(0.007)	(0.015)	(0.010)	(0.013)	(0.017)	(0.010)	(0.016)	(0.015)
Female	−0.007	0.014	−0.010	0.013	−0.064***	0.028	−0.063***	0.019	0.008	0.055*	0.005	−0.003
	(0.014)	(0.026)	(0.013)	(0.022)	(0.017)	(0.020)	(0.021)	(0.025)	(0.025)	(0.030)	(0.026)	(0.040)
Constant	0.166***	0.023	0.096***	0.152***	0.067*	0.120**	0.146***	0.192***	0.055	0.154***	0.094	0.222***
	(0.024)	(0.031)	(0.032)	(0.031)	(0.037)	(0.058)	(0.041)	(0.054)	(0.053)	(0.041)	(0.062)	(0.069)
Observations	280	47	157	170	70	38	66	42	41	67	45	63
R^2	0.169	0.244	0.090	0.206	0.257	0.328	0.487	0.488	0.174	0.277	0.258	0.419
Adjusted R^2	0.145	0.084	0.041	0.166	0.159	0.143	0.415	0.364	−0.032	0.177	0.093	0.333

Notes: This table shows OLS regression results of ATR and MTR misperception divided into overestimation and underestimation. The dependent variables in columns (1) - (4) represent the case for sole proprietorships and partnerships. Columns (5) - (8) where corporations report their ATR and MTR on retained profits (ret.), and the dependent variables in columns (9) - (12) represent the case where corporations report their ATR and MTR on distributed profits (dis.). Note, that underestimates like overestimates have a positive sign. All variables are defined in more detail in the Appendix A2. Robust standard errors are in parentheses. * p < .1, ** p < .05, *** p < .01.

A - 69

S3.2 Identification of Tax Misperception

Profit as Taxable Income

In this section, we alternatively compute ATR and MTR misperception for the case where *provided profit* is used as taxable income. This reflects the idea that respondents do not necessarily consider the impact of *Additional Income* or *Special Expenses* on the tax base (see Section 3.2). Comparing these results to ATR and MTR misperception based on taxable income, shares of misperception vary only slightly. Our results are robust to this variation.

TABLE 25 ATR MTR Misperception (Profit).

	Sole Proprietorships N = 270	Partnerships N = 105	Corporations N = 118	
			retained	*distributed*
Perceived ATR	32.7%	37.4%	31.5%	43.4%
Actual ATR	24.1%	31.3%	29.8%	48.3%
ATR Misperception Share >5pp (>10pp)	**8.6pp*** 59.6% (40%)	**6.1pp*** 66.7% (43.8%)	**1.7pp** 45.8% (22.9%)	**-4.9pp*** 66.1% (44.9%)
ATR Overestimation Share >5pp (>10pp)	12.5pp 55.9% (38.1%)	10.5pp 55.2% (36.2%)	6.3pp 29.7% (14.4%)	9.1pp 20.3% (12.7%)
ATR Underestimation Share >5pp (>10pp)	-3.8pp 3.7% (1.9%)	-10.3pp 11.4% (7.6%)	-5.9pp 16.1% (8.5%)	-12.9pp 45.8% (32.2%)
Perceived MTR	31.3%	37%	32.1%	43.4%
Actual MTR	34.7%	40.8%	29.8%	48.3%
MTR Misperception Share >5pp (>10pp)	**-3.7pp*** 56.7% (39.3%)	**-4.1pp*** 50.5% (32.4%)	**2.3pp** 49.2% (31.4%)	**-4.9pp*** 49.2% (50.8%)
MTR Overestimation Share >5pp (>10pp)	9pp 19.6% (12.2%)	5.7pp 22.9% (9.5%)	8.9pp 33.1% (19.5%)	9.9pp 20.3% (16.1%)
MTR Underestimation Share >5pp (>10pp)	-12.8pp 37% (27%)	-14.8pp 27.6% (22.9%)	-7.7pp 16.1% (11.9%)	-14.7pp 44.9% (34.7%)

Notes: This table shows descriptive evidence of ATR and MTR Misperception. Perceived ATR/MTR is the mean value of perceived ATRs by legal form. Actual ATRs/MTRs are calculated benchmark ATRs. ATR/MTR Misperception is calculated as perceived ATR/MTR minus Actual ATR/MTR, given in percentage points (pp). ***, **, and * denote significance at the 1%, 5%, and 10% levels of a two-sided t-test (ATR/MTR Misperception = 0). ATR/MTR Overestimation measures the average ATR/MTR Misperception in case of positive deviations, and ATR/MTR Underestimation measures the average ATR/MTR Misperception in case of negative deviations. Share >5pp (>10pp) gives the share of all firms that misperceive, overestimate, or underestimate the Actual ATR/MTR by more than plus or minus five (ten) percentage points.

TABLE 26 OLS Regression of ATR and MTR Misperception.

| | Sole Proprietorships & Partnerships | | Corporations | | | |
| | ATR Misp. | MTR Misp. | $ATR_{ret.}$ Misp. | $MTR_{ret.}$ Misp. | $ATR_{dis.}$ Misp. | $MTR_{dis.}$ Misp. |
	(1)	(2)	(3)	(4)	(5)	(6)
Employees	−0.013***	0.003	−0.010*	−0.010*	0.008	0.002
	(0.004)	(0.005)	(0.005)	(0.006)	(0.007)	(0.009)
Loss	0.022	0.015	0.035*	0.036	−0.004	−0.024
	(0.016)	(0.016)	(0.018)	(0.024)	(0.023)	(0.024)
Tax Assistance	0.035**	0.003	0.011	0.024	0.002	0.032
	(0.016)	(0.017)	(0.023)	(0.019)	(0.041)	(0.024)
Subjective Tax Literacy	−0.026**	−0.012	−0.003	−0.008	−0.039	−0.026
	(0.013)	(0.014)	(0.019)	(0.021)	(0.024)	(0.029)
Objective Tax Literacy Level 1	−0.013	−0.057***	−0.029*	−0.104***	−0.052**	−0.101***
	(0.011)	(0.012)	(0.015)	(0.020)	(0.023)	(0.029)
Objective Tax Literacy Level 2	−0.029**	−0.100***	−0.024	−0.099***	−0.081***	−0.133***
	(0.013)	(0.013)	(0.019)	(0.022)	(0.028)	(0.031)
Tax Satisfaction	−0.014***	−0.003	−0.003	−0.016**	−0.007	−0.001
	(0.005)	(0.005)	(0.006)	(0.008)	(0.009)	(0.011)
Female	−0.008	−0.004	−0.014	−0.016	0.036	0.027
	(0.011)	(0.013)	(0.017)	(0.017)	(0.027)	(0.031)
Constant	0.112***	0.138***	0.096***	0.168***	0.159***	0.194***
	(0.019)	(0.022)	(0.031)	(0.029)	(0.053)	(0.044)
Observations	345	345	114	114	114	114
R^2	0.113	0.119	0.153	0.420	0.143	0.230
Adjusted R^2	0.091	0.098	0.088	0.376	0.077	0.172

Notes: This table shows the OLS regression results of ATR and MTR misperception. The dependent variables in columns (1) and (2) represent sole proprietorships and partnerships. The dependent variables in columns (3) - (4) represent the case where corporations report their ATR and MTR on retained profits (ret.), and the dependent variables in columns (5) and (6) represent the case where corporations report their ATR and MTR on distributed profits (dis.). All variables are defined in more detail in the Appendix A2. Robust standard errors are in parentheses. * p < .1, ** p < .05, *** p < .01.

TABLE 27 OLS Regression of ATR and MTR Over-/Underestimation.

	Dependent variable:											
	Sole Proprietorships & Partnerships				Corporations							
	ATR Misp.		MTR Misp.		$ATR_{ret.}$ Misp.		$MTR_{ret.}$ Misp.		$ATR_{dis.}$ Misp.		$MTR_{dis.}$ Misp.	
	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Employees	−0.019***	0.012*	−0.011**	0.015**	−0.012*	−0.009	−0.010	−0.010	−0.003	0.009	−0.003	−0.003
	(0.004)	(0.006)	(0.005)	(0.007)	(0.007)	(0.009)	(0.007)	(0.010)	(0.015)	(0.009)	(0.014)	(0.010)
Loss	0.038**	−0.009	0.023	0.011	0.050**	0.007	0.072**	−0.017	−0.001	−0.022	−0.013	−0.034
	(0.019)	(0.025)	(0.020)	(0.023)	(0.025)	(0.022)	(0.032)	(0.030)	(0.049)	(0.025)	(0.040)	(0.029)
Tax Assistance	0.035**	0.058***	0.009	0.017	0.036	−0.009	0.033*	0.001	0.023	−0.024	0.018	0.056
	(0.018)	(0.021)	(0.025)	(0.022)	(0.026)	(0.025)	(0.019)	(0.026)	(0.040)	(0.055)	(0.040)	(0.041)
Subjective Tax Literacy	−0.019	−0.047	−0.005	−0.011	−0.008	−0.020	−0.005	−0.017	0.019	−0.053*	0.006	−0.009
	(0.013)	(0.032)	(0.015)	(0.020)	(0.020)	(0.038)	(0.019)	(0.037)	(0.028)	(0.028)	(0.040)	(0.038)
Objective Tax Literacy Level 1	−0.011	−0.031	0.013	−0.093***	−0.001	−0.051***	−0.085***	−0.099***	0.003	−0.069**	−0.010	−0.159***
	(0.012)	(0.025)	(0.015)	(0.016)	(0.020)	(0.020)	(0.026)	(0.031)	(0.042)	(0.031)	(0.040)	(0.036)
Objective Tax Literacy Level 2	−0.025*	−0.060**	−0.019	−0.140***	0.016	−0.068***	−0.069***	−0.123***	0.013	−0.110***	−0.021	−0.184***
	(0.014)	(0.030)	(0.014)	(0.022)	(0.022)	(0.022)	(0.025)	(0.030)	(0.071)	(0.036)	(0.048)	(0.037)
Tax Satisfaction	−0.017***	0.010	−0.008	0.002	−0.008	−0.002	−0.026***	−0.005	−0.039**	−0.001	−0.051***	0.018
	(0.005)	(0.011)	(0.006)	(0.008)	(0.007)	(0.012)	(0.010)	(0.011)	(0.017)	(0.011)	(0.016)	(0.013)
Female	−0.012	0.008	−0.015	0.009	−0.060***	0.025	−0.060***	0.020	0.010	0.041	0.008	−0.007
	(0.013)	(0.030)	(0.012)	(0.022)	(0.017)	(0.020)	(0.020)	(0.024)	(0.024)	(0.031)	(0.025)	(0.039)
Constant	0.117***	0.043	0.073**	0.142***	0.062*	0.144***	0.140***	0.193***	0.054	0.225***	0.092	0.238***
	(0.022)	(0.037)	(0.029)	(0.029)	(0.037)	(0.048)	(0.033)	(0.052)	(0.053)	(0.065)	(0.062)	(0.056)
Observations	296	49	170	175	72	42	69	45	42	72	46	68
R^2	0.147	0.247	0.085	0.206	0.245	0.359	0.489	0.500	0.173	0.252	0.257	0.412
Adjusted R^2	0.124	0.096	0.040	0.168	0.149	0.204	0.421	0.389	−0.027	0.157	0.096	0.332

Notes: This table shows OLS regression results of ATR and MTR misperception divided into overestimation and underestimation. The dependent variables in columns (1)-(4) represent the case for sole proprietorships and partnerships. Columns (5) - (8) where corporations report their ATR and MTR on retained profits (ret.), and the dependent variables in columns (9)- (12) represent the case where corporations report their ATR and MTR on distributed profits (dis.). Note, that underestimates like overestimates have a positive sign. All variables are defined in more detail in the Appendix A2. Robust standard errors are in parentheses. * p < .1, ** p < .05, *** p < .01.

Total Income as Taxable Income

In this section, we alternatively compute ATR and MTR misperception for the case where *Total Income* is used as taxable income as in our baseline analysis. This reflects the idea that respondents do consider other *Additional Income* but not *Special Expenses* (see Section 3.2). Comparing these results to ATR and MTR misperception based on taxable income, shares of misperception vary only slightly. Our results are robust to this variation.

TABLE 28 ATR and MTR Misperception (Total Income).

	Sole Proprietorships N = 270	Partnerships N = 105	Corporations N = 118	
			retained	*distributed*
Perceived ATR	32.7%	37.4%	31.5%	43.4%
Actual ATR	24.4%	31.4%	29.8%	48.3%
ATR Misperception	**8.3pp*****	**6pp*****	**1.7pp****	**-4.9pp*****
Share >5pp (>10pp)	64.8% (40.7%)	65.7% (42.9%)	45.8% (22.9%)	66.1% (44.9%)
ATR Overestimation	12.3pp	10.4pp	6.3pp	9.1pp
Share >5pp (>10pp)	55.9% (37.8%)	55.2% (34.3%)	29.7% (14.4%)	20.3% (12.7%)
ATR Underestimation	-5pp	-10.7pp	-5.9pp	-12.9pp
Share >5pp (>10pp)	8.9% (3%)	10.5% (8.6%)	16.1% (8.5%)	45.8% (32.2%)
Perceived MTR	31.3%	37%	32.1%	43.4%
Actual MTR	34.7%	40.8%	29.8%	48.3%
MTR Misperception	**-5.4pp*****	**-4.8pp*****	**2.3pp****	**-4.9pp*****
Share >5pp (>10pp)	60.4% (45.6%)	52.4% (33.3%)	49.2% (31.4%)	65.3% (50.8%)
MTR Overestimation	9.3pp	5.7pp	8.9pp	9.9pp
Share >5pp (>10pp)	19.6% (12.2%)	22.9% (9.5%)	33.1% (19.5%)	20.3% (16.1%)
MTR Underestimation	-15.1pp	-15.1pp	-7.7pp	-14.7pp
Share >5pp (>10pp)	40.7% (33.3%)	29.5% (23.8%)	16.1% (11.9%)	44.9% (34.7%)

Notes: This table shows descriptive evidence of ATR and MTR Misperception. Perceived ATR/MTR is the mean value of perceived ATRs by legal form. Actual ATRs/MTRs are calculated benchmark ATRs. ATR/MTR Misperception is calculated as perceived ATR/MTR minus Actual ATR/MTR. ***, **, and * denote significance at the 1%, 5%, and 10% levels of a two-sided t-test (ATR/MTR Misperception = 0). ATR/MTR Overestimation measures the average ATR/MTR Misperception in case of positive deviations, and ATR/MTR Underestimation measures the average ATR/MTR Misperception in case of negative deviations. Share >5pp (>10pp) gives the share of all firms that misperceive, overestimate, or underestimate the Actual ATR/MTR by more than plus or minus five (ten) percentage points.

TABLE 29 OLS Regression of ATR and MTR Misperception.

	Dependent variable:					
	Sole Proprietorships & Partnerships		Corporations			
	ATR Misp.	MTR Misp.	$\text{ATR}_{\text{ret.}}$ Misp.	$\text{MTR}_{\text{ret.}}$ Misp.	$\text{ATR}_{\text{dis.}}$ Misp.	$\text{MTR}_{\text{dis.}}$ Misp.
	(1)	(2)	(3)	(4)	(5)	(6)
Employees	−0.014***	−0.003	−0.010*	−0.010*	0.008	0.002
	(0.004)	(0.005)	(0.005)	(0.006)	(0.007)	(0.009)
Loss	0.023	0.021	0.035*	0.036	−0.004	−0.024
	(0.016)	(0.017)	(0.018)	(0.024)	(0.023)	(0.024)
Tax Assistance	0.038**	−0.007	0.011	0.024	0.002	0.032
	(0.016)	(0.018)	(0.023)	(0.019)	(0.041)	(0.024)
Subjective Tax Literacy	−0.025**	−0.012	−0.003	−0.008	−0.039	−0.026
	(0.013)	(0.015)	(0.019)	(0.021)	(0.024)	(0.029)
Objective Tax Literacy Level 1	−0.012	−0.069***	−0.029*	−0.104***	−0.052**	−0.101***
	(0.011)	(0.013)	(0.015)	(0.020)	(0.023)	(0.029)
Objective Tax Literacy Level 2	−0.030**	−0.112***	−0.024	−0.099***	−0.081***	−0.133***
	(0.013)	(0.014)	(0.019)	(0.022)	(0.028)	(0.031)
Tax Satisfaction	−0.015***	−0.002	−0.003	−0.016**	−0.007	−0.001
	(0.005)	(0.006)	(0.006)	(0.008)	(0.009)	(0.011)
Female	−0.010	−0.003	−0.014	−0.016	0.036	0.027
	(0.011)	(0.014)	(0.017)	(0.017)	(0.027)	(0.031)
Constant	0.111***	0.174***	0.096***	0.168***	0.159***	0.194***
	(0.020)	(0.024)	(0.031)	(0.029)	(0.053)	(0.044)
Observations	345	345	114	114	114	114
R^2	0.118	0.135	0.153	0.420	0.143	0.230
Adjusted R^2	0.097	0.114	0.088	0.376	0.077	0.172

Notes: This table shows the OLS regression results of ATR and MTR misperception. The dependent variables in columns (1) and (2) represent sole proprietorships and partnerships. The dependent variables in columns (3) - (4) represent the case where corporations report their ATR and MTR on retained profits (ret.), and the dependent variables in columns (5) and (6) represent the case where corporations report their ATR and MTR on distributed profits (dis.). All variables are defined in more detail in the Appendix A2. Robust standard errors are in parentheses. * p < .1, ** p < .05, *** p < .01.

TABLE 30 OLS Regression of ATR and MTR Over-/Underestimation.

	Dependent variable:											
	Sole Proprietorships & Partnerships				Corporations							
	ATR Misp.		MTR Misp.		$\text{ATR}_{ret.}$ Misp.		$\text{MTR}_{ret.}$ Misp.		$\text{ATR}_{dis.}$ Misp.		$\text{MTR}_{dis.}$ Misp.	
	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Employees	−0.018***	0.006	−0.011**	0.003	−0.012*	−0.009	−0.010	−0.010	−0.003	0.009	−0.003	−0.003
	(0.004)	(0.007)	(0.005)	(0.007)	(0.007)	(0.009)	(0.007)	(0.010)	(0.015)	(0.009)	(0.014)	(0.010)
Loss	0.040**	−0.027	0.023	0.019	0.050**	0.007	0.072**	−0.017	−0.001	−0.022	−0.013	−0.034
	(0.019)	(0.028)	(0.021)	(0.024)	(0.025)	(0.022)	(0.032)	(0.030)	(0.049)	(0.025)	(0.040)	(0.029)
Tax Assistance	0.036**	0.073**	0.005	0.011	0.036	−0.009	0.033*	0.001	0.023	−0.024	0.018	0.056
	(0.018)	(0.028)	(0.024)	(0.025)	(0.026)	(0.025)	(0.019)	(0.026)	(0.040)	(0.055)	(0.040)	(0.041)
Subjective Tax Literacy	−0.020	−0.052	−0.003	−0.013	−0.008	−0.020	−0.005	−0.017	0.019	−0.053*	0.006	−0.009
	(0.013)	(0.033)	(0.016)	(0.022)	(0.020)	(0.038)	(0.019)	(0.037)	(0.028)	(0.028)	(0.040)	(0.038)
Objective Tax Literacy Level 1	−0.010	−0.033	0.013	−0.097***	−0.001	−0.051***	−0.085***	−0.099***	0.003	−0.069**	−0.010	−0.159***
	(0.012)	(0.027)	(0.015)	(0.018)	(0.020)	(0.020)	(0.026)	(0.031)	(0.042)	(0.031)	(0.040)	(0.036)
Objective Tax Literacy Level 2	−0.023*	−0.090***	−0.017	−0.153***	0.016	−0.068***	−0.069***	−0.123***	0.013	−0.110***	−0.021	−0.184***
	(0.014)	(0.029)	(0.014)	(0.023)	(0.022)	(0.022)	(0.025)	(0.030)	(0.071)	(0.036)	(0.048)	(0.037)
Tax Satisfaction	−0.017***	0.005	−0.008	0.002	−0.008	−0.002	−0.026***	−0.005	−0.039**	−0.001	−0.051***	0.018
	(0.005)	(0.012)	(0.006)	(0.008)	(0.007)	(0.012)	(0.010)	(0.011)	(0.017)	(0.011)	(0.016)	(0.013)
Female	−0.014	0.006	−0.016	0.013	−0.060***	0.025	−0.060***	0.020	0.010	0.041	0.008	−0.007
	(0.013)	(0.029)	(0.012)	(0.023)	(0.017)	(0.020)	(0.020)	(0.024)	(0.024)	(0.031)	(0.025)	(0.039)
Constant	0.114***	0.069*	0.076***	0.191***	0.062*	0.144***	0.140***	0.193***	0.054	0.225***	0.092	0.238***
	(0.022)	(0.042)	(0.028)	(0.032)	(0.037)	(0.048)	(0.033)	(0.052)	(0.053)	(0.065)	(0.062)	(0.056)
Observations	296	49	170	175	72	42	69	45	42	72	46	68
R^2	0.148	0.231	0.086	0.196	0.245	0.359	0.489	0.500	0.173	0.252	0.257	0.412
Adjusted R^2	0.124	0.077	0.041	0.157	0.149	0.204	0.421	0.389	−0.027	0.157	0.096	0.332

Notes: This table shows OLS regression results of ATR and MTR misperception divided into overestimation and underestimation. The dependent variables in columns (1)-(4) represent the case for sole proprietorships and partnerships. Columns (5) - (8) where corporations report their ATR and MTR on retained profits (ret.), and the dependent variables in columns (9)- (12) represent the case where corporations report their ATR and MTR on distributed profits (dis.). Note, that underestimates like overestimates have a positive sign. All variables are defined in more detail in the Appendix A2. Robust standard errors are in parentheses. * $p < .1$, ** $p < .05$, *** $p < .01$.

Robust Misperception

In this section, we alternatively compute ATR and MTR misperception based on *Taxable Income*. However, we take into account that introducing a *provided profit* plus adding average *Additional Income* and *Special Expenses* could lead to errors (see Section 3.2). Therefore, we adjust the perceived tax rate by allowing for additional errors of ± 2pp, that is perceived tax rates above the actual tax rate are adjusted by -2pp and perceived tax rates under the actual tax rate by +2pp. Comparing these results to ATR and MTR misperception based on *Taxable Income*, shares of misperception vary only slightly. Our results are robust to this variation.

TABLE 31 ATR and MTR Misperception (Robust).

	Sole Proprietorships N = 270	Partnerships N = 105	Corporations N = 118	
			retained	*distributed*
Perceived ATR	32.7%	37.4%	31.5%	43.4%
Actual ATR	19.7%	28%	29.8%	48.3%
ATR Misperception	**11.6pp*****	**8.1pp*****	**1.3pp***	**-4.3pp*****
Share >5pp (>10pp)	63.3% (52.2%)	67.6% (50.5%)	34.7% (16.1%)	61% (39.8%)
ATR Overestimation	15.3pp	12.6pp	6.9pp	9.5pp
Share >5pp (>10pp)	61.1% (50.7%)	58.1% (44.8%)	20.3% (8.5%)	18.6% (8.5%)
ATR Underestimation	-4.9pp	-11pp	-7.5pp	-12.5pp
Share >5pp (>10pp)	2.2% (1.5%)	9.5% (5.7%)	14.4% (7.6%)	42.4% (31.4%)
Perceived MTR	31.3%	37%	32.1%	43.4%
Actual MTR	34.7%	40.8%	29.8%	48.3%
MTR Misperception	**-3.2pp*****	**-3.9pp*****	**1.9pp***	**-4.4pp*****
Share >5pp (<10pp)	49.6% (39.3%)	41% (29.5%)	43.2% (27.1%)	60.2% (44.1%)
MTR Overestimation	9.6pp	6.3pp	9.3pp	11.6pp
Share >5pp (>10pp)	16.7% (12.6%)	15.2% (8.6%)	27.1% (16.1%)	18.6% (11.9%)
MTR Underestimation	-14pp	-16.9pp	-9.6pp	-14.4pp
Share >5pp (>10pp)	33% (26.7%)	25.7% (21%)	16.1% (11%)	41.5% (32.2%)

Notes: This table shows descriptive evidence of ATR and MTR Misperception. Perceived ATR/MTR is the mean value of perceived ATRs by legal form. Actual ATRs/MTRs are calculated benchmark ATRs. ATR/MTR Misperception is calculated as perceived ATR/MTR minus Actual ATR/MTR. ***, **, and * denote significance at the 1%, 5%, and 10% levels of a two-sided t-test (ATR/MTR Misperception = 0). ATR/MTR Overestimation measures the average ATR/MTR Misperception in case of positive deviations, and ATR/MTR Underestimation measures the average ATR/MTR Misperception in case of negative deviations. Share >5pp (>10pp) gives the share of all firms that misperceive, overestimate, or underestimate the Actual ATR/MTR by more than plus or minus five (ten) percentage points.

TABLE 32 OLS Regression of ATR and MTR Misperception.

| | Sole Proprietorships & Partnerships | | Corporations | | | |
| | ATR Misp. | MTR Misp. | $\text{ATR}_{\text{ret.}}$ Misp. | $\text{MTR}_{\text{ret.}}$ Misp. | $\text{ATR}_{\text{dis.}}$ Misp. | $\text{MTR}_{\text{dis.}}$ Misp. |
Dependent variable:						
	(1)	(2)	(3)	(4)	(5)	(6)
Employees	−0.020***	−0.0004	−0.009**	−0.010*	0.008	0.002
	(0.004)	(0.005)	(0.005)	(0.005)	(0.007)	(0.008)
Loss	0.018	0.014	0.033*	0.034	−0.005	−0.024
	(0.018)	(0.017)	(0.017)	(0.023)	(0.022)	(0.024)
Tax Assistance	0.042**	0.008	0.006	0.017	0.002	0.031
	(0.018)	(0.017)	(0.021)	(0.018)	(0.041)	(0.024)
Subjective Tax Literacy	−0.027**	−0.013	−0.002	−0.006	−0.038	−0.025
	(0.014)	(0.014)	(0.018)	(0.020)	(0.024)	(0.029)
Objective Tax Literacy Level 1	−0.015	−0.055***	−0.025*	−0.099***	−0.052**	−0.101***
	(0.012)	(0.013)	(0.014)	(0.020)	(0.023)	(0.029)
Objective Tax Literacy Level 2	−0.026*	−0.094***	−0.023	−0.097***	−0.080***	−0.131***
	(0.015)	(0.014)	(0.018)	(0.021)	(0.028)	(0.031)
Tax Satisfaction	−0.019***	−0.004	−0.004	−0.016**	−0.006	−0.001
	(0.005)	(0.006)	(0.006)	(0.007)	(0.009)	(0.010)
Female	−0.003	−0.006	−0.014	−0.018	0.035	0.026
	(0.012)	(0.013)	(0.015)	(0.017)	(0.027)	(0.030)
Constant	0.131***	0.127***	0.082***	0.154***	0.141***	0.176***
	(0.022)	(0.023)	(0.028)	(0.028)	(0.053)	(0.043)
Observations	345	345	114	114	114	114
R^2	0.130	0.109	0.153	0.414	0.143	0.232
Adjusted R^2	0.109	0.088	0.089	0.370	0.077	0.173

Notes: This table shows the OLS regression results of ATR and MTR misperception. The dependent variables in columns (1) and (2) represent sole proprietorships and partnerships. The dependent variables in columns (3) - (4) represent the case where corporations report their ATR and MTR on retained profits (ret.), and the dependent variables in columns (5) and (6) represent the case where corporations report their ATR and MTR on distributed profits (dis.). All variables are defined in more detail in the Appendix A2. Robust standard errors are in parentheses. * p < .1, ** p < .05, *** p < .01.

TABLE 33 OLS Regression of ATR and MTR Over-/Underestimation.

	Sole Proprietorships & Partnerships				Corporations							
	ATR Misp.		MTR Misp.		ATR$_{ret.}$ Misp.		MTR$_{ret.}$ Misp.		ATR$_{dis.}$ Misp.		MTR$_{dis.}$ Misp.	
	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Employees	−0.024***	0.010*	−0.013***	0.011	−0.012*	−0.007	−0.011	−0.009	−0.004	0.009	−0.004	−0.003
	(0.005)	(0.005)	(0.005)	(0.007)	(0.006)	(0.009)	(0.007)	(0.010)	(0.015)	(0.009)	(0.014)	(0.010)
Loss	0.043**	−0.015	0.021	0.012	0.049**	0.004	0.071**	−0.020	−0.0005	−0.023	−0.012	−0.034
	(0.021)	(0.021)	(0.022)	(0.023)	(0.024)	(0.020)	(0.031)	(0.029)	(0.048)	(0.025)	(0.040)	(0.028)
Tax Assistance	0.043**	0.044**	0.006	0.024	0.027	−0.014	0.025	−0.008	0.027	−0.026	0.021	0.052
	(0.019)	(0.019)	(0.026)	(0.023)	(0.022)	(0.022)	(0.017)	(0.023)	(0.039)	(0.053)	(0.039)	(0.041)
Subjective Tax Literacy	−0.021	−0.034	−0.008	−0.011	−0.008	−0.018	−0.003	−0.015	0.018	−0.051*	0.005	−0.009
	(0.014)	(0.027)	(0.016)	(0.021)	(0.018)	(0.036)	(0.019)	(0.036)	(0.028)	(0.028)	(0.039)	(0.038)
Objective Tax Literacy Level 1	−0.014	−0.018	0.017	−0.093***	0.001	−0.046**	−0.080***	−0.093***	0.003	−0.069**	−0.011	−0.157***
	(0.013)	(0.021)	(0.016)	(0.017)	(0.019)	(0.018)	(0.025)	(0.030)	(0.041)	(0.030)	(0.039)	(0.036)
Objective Tax Literacy Level 2	−0.026	−0.052**	−0.010	−0.139***	0.014	−0.064***	−0.068***	−0.119***	0.016	−0.108***	−0.017	−0.182***
	(0.016)	(0.021)	(0.014)	(0.022)	(0.021)	(0.020)	(0.025)	(0.029)	(0.068)	(0.035)	(0.047)	(0.037)
Tax Satisfaction	−0.020***	0.011	−0.009	0.002	−0.009	−0.003	−0.026***	−0.006	−0.039**	−0.0005	−0.050***	0.018
	(0.006)	(0.010)	(0.007)	(0.008)	(0.007)	(0.011)	(0.010)	(0.011)	(0.016)	(0.011)	(0.016)	(0.013)
Female	−0.008	0.011	−0.016	0.007	−0.058***	0.023	−0.062***	0.016	0.011	0.040	0.007	−0.007
	(0.014)	(0.024)	(0.012)	(0.022)	(0.016)	(0.018)	(0.020)	(0.024)	(0.023)	(0.031)	(0.025)	(0.039)
Constant	0.138***	0.018	0.068**	0.127***	0.054	0.124***	0.127***	0.179***	0.033	0.207***	0.073	0.221***
	(0.024)	(0.030)	(0.030)	(0.030)	(0.033)	(0.045)	(0.031)	(0.050)	(0.051)	(0.064)	(0.060)	(0.055)
Observations	296	49	170	175	72	42	69	45	42	72	46	68
R^2	0.165	0.236	0.095	0.199	0.254	0.356	0.490	0.492	0.178	0.255	0.260	0.413
Adjusted R^2	0.142	0.083	0.050	0.161	0.160	0.200	0.422	0.379	−0.022	0.160	0.100	0.333

Notes: This table shows OLS regression results of ATR and MTR misperception divided into overestimation and underestimation. The dependent variables in columns (1)-(4) represent the case for sole proprietorships and partnerships. Columns (5) - (8) where corporations report their ATR and MTR on retained profits (ret.), and the dependent variables in columns (9)- (12) represent the case where corporations report their ATR and MTR on distributed profits (dis.). Note, that underestimates like overestimates have a positive sign. All variables are defined in more detail in the Appendix A2. Robust standard errors are in parentheses. * p < .1, ** p < .05, *** p < .01.

S3.3 Regression Method

To account for close to zero values of overall ATR and MTR misperception, we additionally run Tobit regressions. Regression results can be found in Table 34. Our results are robust to this variation.

TABLE 34 Tobit Regression of ATR and MTR Misperception.

	Dependent variable:					
	Sole Proprietorships & Partnerships		Corporations			
	ATR Misp.	MTR Misp.	$ATR_{ret.}$ Misp.	$MTR_{ret.}$ Misp.	$ATR_{dis.}$ Misp.	$MTR_{dis.}$ Misp.
	(1)	(2)	(3)	(4)	(5)	(6)
Employees	−0.020***	−0.001	−0.010**	−0.010*	0.008	0.002
	(0.004)	(0.005)	(0.005)	(0.005)	(0.007)	(0.008)
Loss	0.018	0.015	0.035**	0.036	−0.004	−0.024
	(0.018)	(0.015)	(0.017)	(0.023)	(0.022)	(0.023)
Tax Assistance	0.043**	0.008	0.011	0.024	0.002	0.032
	(0.019)	(0.022)	(0.022)	(0.018)	(0.039)	(0.023)
Subjective Tax Literacy	−0.027**	−0.014	−0.003	−0.008	−0.039*	−0.026
	(0.014)	(0.013)	(0.019)	(0.020)	(0.023)	(0.028)
Objective Tax Literacy Level 1	−0.015	−0.057***	−0.029**	−0.104***	−0.052**	−0.101***
	(0.012)	(0.012)	(0.014)	(0.020)	(0.022)	(0.028)
Objective Tax Literacy Level 2	−0.028*	−0.098***	−0.024	−0.099***	−0.081***	−0.133***
	(0.015)	(0.021)	(0.018)	(0.021)	(0.027)	(0.030)
Tax Satisfaction	−0.019***	−0.004	−0.003	−0.016**	−0.007	−0.001
	(0.005)	(0.006)	(0.006)	(0.007)	(0.009)	(0.010)
Female	−0.003	−0.005	−0.014	−0.016	0.036	0.027
	(0.012)	(0.014)	(0.016)	(0.016)	(0.026)	(0.029)
Constant	0.150***	0.146***	0.096***	0.168***	0.159***	0.194***
	(0.023)	(0.027)	(0.030)	(0.028)	(0.051)	(0.042)
Observations	345	345	114	114	114	114
Log Likelihood	307.561	289.858	161.574	142.798	115.574	101.061
Wald Test (df = 8)	58.826***	43.746***	26.429***	58.938***	22.626***	29.901***

Notes: This table shows the Tobit regression results of ATR and MTR misperception. The dependent variables in columns (1) and (2) represent the case where corporations report their ATR and MTR on retained profits (ret.), and the dependent variables in columns (3) and (4) represent the case where corporations report their ATR and MTR on distributed profits (dis.). All variables are defined in more detail in the Appendix A2. Robust standard errors are in parentheses. * p < .1, ** p < .05, *** p < .01.

Using Machine Learning to Predict Firms' Tax Perception[*]

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Abstract

I investigate whether a machine learning model can reliably predict firms' tax rate perception. While standard models assume that decision-makers in firms are perfectly informed about firms' tax rates and tax implications, also their tax rate perception influences the way in which they incorporate taxes into their decision-making processes. However, studies examining firms' tax rate perception and its consequences remain scarce, mostly due to a lack of observations of firms' tax rate perception. Using a dataset of German SMEs, I apply machine learning in the form of Extreme Gradient Boosting, to predict firms' tax rate perception based on firm and personal characteristics of the decision-maker. The results show that Extreme Gradient Boosting outperforms traditional OLS regression. The model is highly accurate, as evidenced by a mean prediction error of less than one percentage point, produces reasonably precise predictions, as indicated by the root mean square error being comparable to the standard deviation, and explains up to 23.2% of the variance in firms' tax rate perception. Even based on firm characteristics only, the model maintains high accuracy, albeit with some decline in precision and explained variance. Consistent with this finding, Shapley values highlight the importance of firm and personal characteristics such as tax compliance costs, tax literacy, and trust in government for the prediction. The results show that machine learning models can provide a time- and cost-effective way to fill the information gap created by the lack of observations on firms' tax rate perception. This approach allows researchers and policymakers, to further analyze the impact of firms' tax rate perception on tax reforms, tax compliance, or business decisions.

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1 INTRODUCTION

In this study, I analyze whether the use of a machine-learning model can lead to a reliable prediction of firms' *tax rate perception*. Tax rates affect firms' behavior: Average tax rates (ATRs) represent firms' tax burden and thus influence, for example, the perception of peers' tax burden. Marginal tax rates (MTRs) are crucial for business decisions (Graham, 2003; Erickson et al., 2020). Standard models examining firms' decisions rely on the assumption that decision-makers in firms are perfectly informed about the tax implications of their decisions and thus abstain from the influence of the perceptions (e.g., MacKie-Mason, 1989; Graham, 1996; Dobbins and Jacob, 2016). However, a substantial body of research on individuals indicates that actual and perceived tax rates can differ considerably, individuals' tax rate perception influences their behavior and, as a result, is a crucial factor to consider when examining tax behavior (see e.g., Enrick, 1963; Fujii and Hawley, 1988; Jackson and Hatfield, 2005; Ballard and Gupta, 2018; Stantcheva, 2021).[1] It is therefore surprising that evidence of firms' tax rate perception[2] is limited to a small number of studies: Schmölders (1960) shows based on survey evidence that entrepreneurs perceive to be subject to a higher tax rate than they actually are. Blaufus et al. (2015), using survey-data, compare tax rate perception of entrepreneurs with those of employees. They find that the two groups are very similar in their perception. Hundsdoerfer and Sichtmann (2009) find that about 25% of surveyed entrepreneurs perceive their own tax rate to be above or below the range of possible tax rates set by law. Fochmann et al. (2024) quantify firms' tax rate misperception and find that more than half of the surveyed firms misperceive their tax rate by more than five percentage points. They show that tax rate misperception affects firms' investment behavior and desire for tax cuts. Taken together, these results highlight the discrepancy between firms' perceived and the actual tax rate. Therefore, researchers and policymakers need to consider firms' tax rate perception when analyzing firms' business decisions, discussing tax reform expectations, or evaluating tax policies.

Given the importance of firms' perception of their tax rates, the little empirical evidence is puzzling at first glance. However, the lack of observations on firms' tax rate perception elucidates the limited number of studies in this field: data on the perception of tax rates are not available in commercial databases. The collection of data on perceptions through surveys or interviews is particularly challenging, especially when the survey or interview is conducted with a large number of firms. This is due to the considerable time investment required and the fact that the success of the survey or interview depends heavily on the willingness of firms

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[1]   For more literature, see Blaufus et al., 2022, who provide an extensive literature review.
[2]   Although a firm as an entity is incapable of perceiving information or making decisions, I refer to firms' tax rate perception for the sake of linguistic simplicity. As the study focuses exclusively on small and medium-sized firms, and the responses of firm representatives who are entrepreneurs or managers of these firms can be regarded as the embodiment of the firm in the analyses, the simplification is also appropriate in terms of content.

to participate. Some studies, e.g., Eberbach et al. (2021), use proxies to account for tax perception. Since there is no known proxy for firms' tax rate perception, and data are generally scarce, this approach is not suitable to address the problem related to my research question. Although this approach provides useful results, it has the disadvantage that the proxy data must be available for all firms. Thus, the objective of this study is to investigate whether the use of a machine learning approach, based on existing data on firms' tax rate perception, can generate reliable predictions regarding tax rate perception for firms for which such data are not available. This approach can help to overcome the issue of limited data availability in a way that is both time- and cost-effective.

Recent studies have demonstrated the efficacy of machine learning models in forecasting, including the prediction of fraudulent tax behavior, tax gaps or future tax rates (e.g., Abedin et al., 2021; Baghdasaryan et al., 2022; Guenther et al., 2023) and perceptions (e.g., (Bhatia, 2019; Aka and Bhatia, 2022; Fan Zhang et al., 2018). However, to the best of my knowledge, there are no studies that have utilized machine learning to predict (firms') tax rate perception. To be able to predict firms' tax rate perception, which I define as the stated perception of tax rates by a firm's decision-maker in a survey *(survey-based tax rate perception)*, I rely on two data sources providing data on tax rate perceptions of German small- and medium-sized firms (SMEs). First, I use data from Fochmann et al. (2024)[3], where firm decision-makers are asked about their perception of their average tax rate (ATR) and marginal tax rate (MTR). Second, I use data from the fourth survey-wave of the German Business Panel[4] in which firm decisions-makers were likewise asked to state their perception of firms' ATR and MTR.[5] To expand my database, I merge the two aforementioned data into a combined database. Both surveys were conducted in a German setting and focused on SMEs.[6] SMEs are by far the largest group of businesses in the United States, Canada, the United Kingdom, and Germany (OECD, 2022). They make up more than 50% of the gross domestic product in most OECD countries (International Labour Organization, 2019) and are therefore an important factor for these countries' economies. However, SMEs have hardly been studied in the literature. The same applies for private firms (Allee and Yohn, 2009; Lisowsky and Minnis, 2020). Using a dataset of SMEs and private firms, I respond to the calls for more research on them by Hanlon and Heitzman (2010) and Lisowsky and Minnis (2020).

I use a machine learning based approach to predict firms' tax rate perception (*predicted tax rate perception*). In general, machine learning approaches are particularly suited for my study because they

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[3]   The author would like to thank the team of authors for providing the data.

[4]   The German Business Panel is a long-term survey panel of the DFG-funded transregional project "TRR 266 Accounting for Transparency". The author would like to thank the German Business Panel for providing the data.

[5]   The authors of Fochmann et al. (2024) were able to integrate a number of questions from their first survey in the fourth wave of the German Business Panel. Consequently, the questions are identical and permit a comparison of the observations.

[6]   A small number of responding firms do not meet the criteria for SMEs, particularly in the German Business Panel survey, which is why I do not include them in the analysis. Detailed information on this can be found in Section 3.

focus on predictions, and I aim to provide a novel approach to predict firms' perceived tax rates, while classical models such as linear regression focus on inference analysis (Bzdok et al., 2018). To substantiate this assumption for my study, I use ordinary least square (OLS) regressions' prediction performance as a benchmark for my machine-learning approach. More specific, in line with Guenther et al. (2023), I use Extreme Gradient Boosting (XGBoost) by Chen and Guestrin (2016), an implementation of gradient boosted regression trees. Further, I use Shapley values to identify features that contribute to the model prediction (Shapley, 1953). Machine learning models often exhibit 'black box' features, which can be addressed through this approach.

In my analysis, I use two different sets of input variables to train XGBoost. In a first step, I use data provided by Fochmann et al. (2024). In line with Hanlon et al. (2022), who emphasize that accounting matters are shaped, among other things, by individual preferences, abilities, experiences, and other characteristics, these include firm characteristics (e.g., legal form, number of employees, sales) as well personal characteristics of the firm respondent (e.g., education, gender, trust in government). In comparison to using *all variables*, in a second step, I employ a significantly reduced set of variables for the purpose of training the model. The variables included are those typically found in commercial databases, such as legal form, number of employees, sales, and local tax factor[7]. For this reason, I refer to them as *public variables*.[8]

In order to train the model, I use the data from Fochmann et al. (2024) for both sets of variables. This procedure enables a comparison of the model performance between using all and public variables and the drawing of conclusions regarding the impact of a reduction in input factors on the model. It is expected that including all variables will result in superior prediction performance compared to the use of public variables. This is due to the fact that XGBoost can accommodate a greater number of variables during the learning process, which should facilitate better predictions.[9] However, the comparison is particularly useful as it allows for an evaluation of the performance of the model in predicting future tax rates for firms with limited available variables, a frequently occurring issue for SMEs and private firms. Furthermore, I examine whether the predictive performance of XGBoost can be enhanced by using a more observations for the models' training. To this end, XGBoost is trained using public variables with a larger dataset comprising the data from Fochmann et al. (2024) and the German Business Panel. Finally, I use Shapley values to determine which variables contribute to the prediction in all analyses.

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[7]   The local tax factor resembles the local trade tax multiplier of the firm.
[8]   I assign the local tax factor to the public variables because it can be determined with relative simplicity based on the location of the firm, more specifically the zip code of the firm's headquarters, and is specifically not determined by the firm's profit, which is often unavailable or unknown.
[9]   This is despite the fact that XGBoost is generally capable of functioning with missing data.

The model's performance metrics based on all variables demonstrate a very high degree of accuracy, as evidenced by a notably low mean prediction error of less than one percentage point for firms' ATR and MTR perception compared to the mean ATR perception (MTR perception) of 33.6% (33.0%). In addition, the model explains up to 23.20% (15.67%) of the variance for firms' ATR (MTR) perception. Compared to previous literature, Belnap, Kroeger, and Thornock (2024) demonstrate that the R^2 for Cash ETR (GAAP ETR) does not exceed 38% (34%) even when including year, industry, firm, state, and manager fixed effects, this can be rated as (very) good results. The root mean square error is considerably less than the mean (33.8%) of the target variable, and the prediction deviations align with the standard deviation of the data. This speaks to the model's precise predictions. Overall, the model does not make any extreme errors and provides a good balance between the mean prediction error and the variance. Further, the performance is superior to that of the OLS regression.[10] While further improvements could be sought in future research, the results already demonstrate that the prediction of tax rate perception using a machine learning approach yields reliable results.

With regard to the differing sets of variables employed for model training, namely all variables vs. public variables, it can be observed that the quality of prediction declines in accordance with expectations when only public variables are utilized. This result can be explained by making use of the Shapley values. In addition to firm characteristics, the cost of tax compliance, trust in the government's handling of tax revenues, and objective tax literacy make a substantial contribution to the prediction. The absence of these variables from the public variables results in a decline in prediction performance, as evidenced by a reduction in both the precision of the prediction and the explanatory power. Nevertheless, the accuracy of the prediction remains approximately consistent with that observed previously. Contrary to expectations, the performance of XGBoost in predictive modelling does not appear to benefit from the use of a larger dataset. This may be due to the fact that the available dataset is of limited capacity to facilitate a sufficiently large expansion of the dataset. In conclusion, the findings demonstrate that the utilization of a machine learning based approach can facilitate the time- and cost-effective and reliable prediction of firms' tax rate perception, particularly in comparison to conducting surveys or interviews. Researchers and policymakers can thus incorporate firms' tax rate perceptions into their analysis of firms' decisions, for instance, in the context of tax reform expectations or the evaluation of tax policies.

This study is the first to predict firms' tax rate perception and to identify the variables contributing to the prediction. First, I present evidence on how to address the issue of missing data for firms' tax rate

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[10] In order to ensure the entire picture is presented, it is necessary to point out that there is a deviation. The results obtained by the OLS with the use of public variables and sample I for predicting firms' ATR perception are slightly more precise than those achieved by XGBoost.

perception, thereby facilitating the incorporation of these in future research. Second, I integrate previous findings from the prediction of perceptions and the prediction of parameters in accounting and tax settings. This way, my findings also contribute to a more comprehensive understanding of the extent to which machine learning methods can be applied to research in the field of taxation.

My analysis is based on data for German SMEs. Consequently, the ability to predict firms' tax rate perception is currently constrained to German SMEs. Further research could expand the scope of this analysis by incorporating observations from firms in other countries or larger firms within the existing dataset. In this regard, the findings offer valuable insights for future research that extend beyond the prediction itself. The results demonstrate that reasonably good predictions can be achieved with a sample size of approximately 450 firms, which is a relatively modest number compared to the total number of SMEs (3.1 million in Germany[11]). This suggests that a significantly reduced amount of data may be sufficient to predict firms' tax rate perception in other countries using machine learning models.

Overall, this study offers insights into the potential of using machine learning for predicting firms' tax rate perception. In this way, I present a low-time and -cost method for addressing the issue of missing observations on firms' tax rate perception. Future research can build on this approach by using it to predict firms' tax rate perception for datasets where such data are not available. This enables further empirical analyses of the effects of firms' tax rate perception, such as on tax reforms, tax compliance, or business decisions. In light of the aforementioned considerations, it may be of interest to reexamine existing analyses that have employed actual tax rates as independent variables, with the inclusion of perceived tax rates.

2 RELATED LITERATURE

In general, "(m)achine learning can be broadly defined as computational methods using experience to improve performance or to make accurate predictions. Here, experience refers to the past information available to the learner, which typically takes the form of electronic data collected and made available for analysis" (Mohri et al., 2012, p. 1). There are different algorithms used in machine learning (Mahesh, 2020).[12] In recent years, a wide range of accounting issues have been increasingly investigated using machine learning approaches. The following studies focus on machine learning based predictions.[13]

Perols (2011) compares logistic regression and different machine learning methods (artificial neural networks, support vector machines, decision trees, ensemble learner) in detecting financial statement fraud

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[11]   See https://www.destatis.de/DE/Themen/Branchen-Unternehmen/Unternehmen/Kleine-Unternehmen-Mittlere-Unternehmen/aktuell-beschaeftigte.html.
[12]   Appendix A1 provides an overview of commonly used algorithms in machine learning.
[13]   For more literature, see, for example, Ranta et al. (2023) or Booker et al. (2024).

and examines fraud predictors. Bao et al. (2020) employ an ensemble learner, RUSBoost, to examine its performance in predicting accounting fraud of U.S. firms and find that it performs better than previously used methods like logistic regression model or support vector machine model. Bertomeu (2020) use different machine learning methods (GBRT, random forest, RUSBoost) to detect, among others, accounting misstatements and show that GBRT and RUSBoost exceed logit models. Brown et al. (2020) also focus on predicting misreporting but employ a Bayesian topic modeling algorithm to extract and quantify the content of 10k-filings. Fukas et al. (2022) as well focus on the detection of financial fraud and compare the performance of different models (logistic regression, support vector machine, ensemble learner) to detect fraud. In the area of audit, Todorovic et al. (2023) show that an XGBoost model optimized by metaheuristics algorithms is well suited to predict audit opinions. Hunt et al. (2022) use random forest to predict future earnings and abnormal returns. They find that random forest performs better or at least as good as stepwise logit regressions. Similarly, Ding et al. (2020) compare the accuracy and precision of accounting estimates of managers and different machine learning methods (linear regression, random forest, gradient boosting, artificial neural network) and find that machine learning methods outperform managers. Gu et al. (2020) examine the prediction performance of different machine learning algorithms (boosted regression trees, random forest, neural networks) for asset risk premiums and compare it to regression-based approaches. They show that machine learning algorithms (trees, neural networks) outperform regression-based approaches mostly due to their ability to include non-linear interactions.

In the area of tax research, there are fewer studies to date. de Roux et al. (2018), e.g., examine the ability of unsupervised machine learning techniques to detect fraudulent taxpayer behavior. Similar, Zumaya et al. (2021) rely on deep neural networks and random forest to identify individual tax evaders in Mexico. Baghdasaryan et al. (2022) also employ different machine learning methods to detect taxpayers' fraudulent behavior and find gradient boosting to have the best predictive performance. Abedin et al. (2021) focus on implications of tax evasion and address worldwide tax gaps using different machine learning methods (single classifiers and ensemble classifiers) to predict the amount of these unpaid taxes. Battaglini et al. (2022) examine the use of machine learning (random forest) in tax audit and find that it can substantially improve tax audits effectiveness. Abrell et al. (2019) analyze the effectiveness of the implementation of the UK carbon tax. Using a novel approach combining economic theory and machine learning, they overcome the limitations of a missing control group. Jennings et al. (2020) predict the likelihood of future tax settlements in firms by using different machine learning methods (support vector machine model, supervised latent Dirichlet allocation and random forest). Guenther et al. (2023) use XGBoost to forecast firms' future effective tax rates (ETR) based on financial statement data and find that prediction accuracy and precision using machine

learning is higher than that of analysts.

The literature indicates that studies in the field of accounting and taxation have thus far been limited to the prediction of objective key figures. Subjective perceptions are not taken into account. Furthermore, the research has primarily focused on large, public firms. Consequently, the forecasts have typically been based on financial statement data. This study, therefore, addresses two research gaps: firstly, it focuses on the prediction of firms' tax rate perception and, secondly, it considers SMEs for which no or hardly any financial statement data is available.

I will also briefly discuss a selection of studies that have already shown that machine learning models are suitable for predicting subjective perceptions compared to objective facts in other fields of research. Bhatia (2019) examine the prediction performance of different machine learning methods with regard to individuals' risk perception using experimental data. They highlight that, in contrast to other methods in risk perception research, their approach eliminates the need for specific participant data and can apply learned mappings to predict novel (out-of-sample) risks quantitatively. Aka and Bhatia (2022) employ different machine learning methods (word and sentence embedding, LASSO, support vector machine model, random forest) to quantitatively predict lay health perception.[14] Using a support vector machine model Fan Zhang et al. (2018) predict individuals' perception of street view images. I make use of these findings and apply them for the first time to the prediction of the firms' tax rate perception.

As machine learning models often exhibit 'black box' features, other approaches are usually used to explain them. A well-used approach within the accounting literature, that is also applicable to machine learning models, are Shapley values (Shapley, 1953). E.g., McInnis et al. (2018) use Shapley values in their analysis of the importance of fair value assets for stock prices. Fukas et al. (2022) utilize Shapley values to measure important features contributing to the prediction of fraud. Todorovic et al. (2023) use Shapley values to measure the importance of different features for the prediction of audit opinions. Gunn et al. (2024) employ Shapley values to analyze the impact of audit firms' corporate social responsibility activities on auditor reputation. In the area of taxation, Guenther et al. (2023) rely on Shapley values to identify the disclosure features that contribute (most) to the prediction of ETRs and Belnap, Hoopes, and Wilde (2024) utilize Shapley values to identify the importance of internal and external actors in corporate taxation. Further, Belnap, Kroeger, and Thornock (2024) also use Shapley values to measure numerous features contribution to tax avoidance.

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[14] Lay perceptions of health show a surprising number of similarities with tax rate perception. In the area of lay perceptions of health, it is also evident that reality and perception often diverge. Likewise, perceptions are influenced by the available, salient information (Aka & Bhatia, 2022).

The summary shows that the use of machine learning models has established itself as a useful tool for predicting metrics in the accounting literature, and to some extent in the tax literature as well, usually outperforming traditional models such as linear regression. The same applies to the use of Shapley values to explain machine learning models. Research in other disciplines also shows that machine learning models are useful for predicting perceptions, which, unlike objective metrics, are also influenced by subjective factors. This study extends the existing research by combining existing findings and investigating whether machine learning models can predict firms' tax rate perception.

3 RESEARCH DESIGN AND SAMPLE

3.1 Research Design

To predict firms' ATR and MTR perception I use a machine learning approach. I rely on XGBoost developed by Chen and Guestrin (2016).[15] XGBoost is a "scalable machine learning system for tree boosting" (Chen and Guestrin, 2016, p. 785), an implementation of state-of-the-art gradient boosted decision trees algorithm. It combines advantages known from decision trees and (gradient) boosting (Freund and Schapire, 1997; Friedman et al., 2000; Breiman, 2001; Friedman, 2001). In general, several weak learners, simple decision trees, are combined into an ensemble. Unlike other methods, such as random forest, where each tree operates independently, XGBoost trains trees iteratively, with each new tree trained to minimize the error of the preceding tree. To minimize these errors efficiently, the algorithm calculates the gradient of the loss function. The predictions of the new tree are then added to the ensemble. This iterative process continues until the model reaches a specified level of performance or meets a stopping condition. In the field of gradient boosted decision trees algorithms, XGBoost is especially useful due its scalability and therefore faster computation time (Chen & Guestrin, 2016).

For analysis purposes, I split my data into 80% training data and 20% test data. This methodology allows for the training of the model on the training dataset and subsequent testing on the test dataset, thereby enabling the evaluation of the model's prediction performance. When splitting the data, I create balanced splits of the data.[16] This ensures that the distribution of the data remains representative with regard to the target variable. For the hyperparameter tuning, I use a grid search. Within the hyperparameter tuning, I use five-fold cross-validation for each hyperparameter combination to avoid overfitting: From the training data, I

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[15]   For my analysis, I use the open source *xgboost* R package provided by Chen and Guestrin (2016); https://xgboost.readthed ocs.io/en/stable/R-package/index.html.

[16]   Sampling is done within each class and should preserve the overall class distribution of the target variable (*ATR and MTR perception*).

generate five different folds, in each of which 80% of the data is used for training and 20% of the data is used to validate the hyperparameter tuning models.[17] Using cross-validation reduces the risk of overfitting and also helps to obtain a more robust estimate of model performance. I use the hyperparameters with the best performance on the cross validated RMSE to train the full training dataset and for the final prediction on the test data. Details on the grid search and results of the hyperparameter tuning are provided in Appendix A2.

In a next step, I measure the performance of the model by calculating the root mean square error (RMSE), the mean prediction error (MPE), and the coefficient of determination (R^2) for the test data.[18] The RMSE quantifies the average size of the prediction errors and thus provides an indication of the precision of the model predictions. The MPE measures the average error between the survey-based and predicted tax rate perception. It indicates whether the model systematically over- or underestimates the target variable, which speaks to the accuracy of the prediction. R^2 indicates how well the model explains the variance of the dependent variable. Using the RMSE, MPE, and R^2 is common practice when evaluating the prediction performance of a model (see, e.g., Friedman, 2001, Guenther et al., 2023).

To identify the features that contribute most to the model's prediction, I further use Shapley values. In previous tax studies, Shapley values have been found to be a reliable approach to measure the importance of input variables in predicting ETRs, for corporate tax outcomes or tax avoidance (Guenther et al., 2023; Belnap, Hoopes, and Wilde, 2024; Belnap, Kroeger, and Thornock, 2024). Shapley values are based on coalition game theory and used to fairly distribute the payout among players who have contributed to the total gain (Shapley, 1953). Štrumbelj and Kononenko (2010) extend this approach so that it is able to "explain how the given feature values contribute to the prediction difference between the classifiers prediction for this instance and the expected prediction if no feature values are given" (Štrumbelj and Kononenko, 2010, p. 5). In other words, the game represents the prediction task for a single instance of the dataset, the players represent the feature values of the instance, cooperating to receive the gain and the gain represents the prediction for that single instance less the average prediction for all instances (Molnar, 2024). The values can be positive or negative. Within the analysis I use mean absolute Shapley values to examine each features' contribution to the prediction of firms' perceived ATR and MTR.[19] This approach enables me to address the limitation of the machine learning model, its 'black box' nature, by making the predictions explainable.

In addition to this, I use linear regression analysis (OLS regression) to predict firms' tax rate perception. Following the literature (see e.g., Perols, 2011; Ding et al., 2020; Gu et al., 2020), I utilize the outcomes of the

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[17] It is important to note that the validation data does not resemble the test data. The test data never enters the model training process.

[18] Please see Appendix A2 for detailed instructions on how to calculate the metrics.

[19] For my analysis, I use the open source *iml* R package; https://cran.r-project.org/web/packages/iml/index.html.

OLS regression to establish a benchmark for evaluating the predictive performance of XGBoost in comparison. To be able to compare the models with each other, I follow the same procedure: I start by dividing my data into 80% training data and 20% test data. I also use 5-fold cross-validation to validate and train the model on different subsets of the training dataset. Then I run the OLS regression and use the model to generate predictions for firms' tax rate perception based on the training data. I calculate the RMSE, MPE, and R^2 to measure the performance of the model. While methods from statistics, such as the OLS regression, are known for their focus on inference, machine learning methods focus on prediction (Bzdok et al., 2018) and are thus well suited for this study. I expect my machine learning approach to outperform the OLS regression.

For my prediction I rely on German survey data. The first dataset comprises survey data on German SMEs collected by Fochmann et al. (2024).[20] The second dataset comprises of survey data on German firms from the fourth survey-wave of the German Business Panel.[21] Both surveys were conducted with German firms, which is why the German tax system is relevant for the perception of tax rates. In Germany non-corporations, which comprise sole proprietor and partnerships, are subject to a compound income tax, including the progressive income tax plus solidarity surcharge[22] and the trade tax. Corporations are subject to a compound corporate tax, including the flat corporate tax, plus the solidarity surcharge and the trade tax.[23] In general, Germany's tax law is based on the internationally common dual system of business taxation allowing to compare the study results to other countries as well.[24]

In the first survey, Fochmann et al. (2024) survey German SMEs via an online survey (LimeSurvey). The survey took place in the period between Jan 11, 2021, and April 22, 2021. They asked questions regarding firms' perception of their ATR and MTR, perceptions of the tax system, and firm characteristics. I provide a brief description of the survey design in the following; a more detailed description of the survey and procedure can be found in Fochmann et al. (2024). The survey consists of seven question blocks. In the first block, firms are asked about their characteristics like legal size, number of employees, industry, and sales. The second block consists of a visualization of the legal-form specific tax system. Afterwards firms are asked to state their ATR and MTR, their tax rate perception, based on a provided profit. As the profit, essential in determining the tax rate, is a very sensitive figure, firms were not asked to state it in the survey. Therefore, the authors simulated the profit individually for each firm in the survey, based on relevant firm characteristics

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[20]   This survey data is also part of Fochmann et al. (2021) and Fochmann et al. (2023) (in German).
[21]   The fourth wave of the German Business Panel is titled "Accounting Transparency and Reporting, Tax Misperceptions, Key Financial Performance Indicators, and Changing Business Conditions During and Beyond the COVID-19 Crisis" and includes a large number of different questions. For more information see https://backend.gbpanel.org/app/uploads/2022/11/Codebook_Welle4_2022_10_28.pdf.
[22]   The solidarity surcharge is based on the income tax (5.5% of the Income Tax (Section 4 Solidarity Surcharge Code)).
[23]   When profits are distributed, they are also subject to taxes at the shareholder level. However, since taxes at the corporate level are most important for, e.g., investment decisions, I focus only on them.
[24]   Non-corporations are subject to the so-called pass-through principle; corporations to the separate entity principle.

provided.[25] Corporations are asked to state their tax rate for retained (taxation only on corporate level) and distributed profits (taxation on corporate and shareholder level). In the third to fifth section, firms are asked about their perception of the tax system in more general. They are asked about their perception of peers' tax burden, the relative share of tax compliance costs compared to all compliance costs, the complexity of the tax system, the provision of tax-related information, and government's handling of tax revenues. The seventh section concludes the survey by asking for additional characteristics such as the profitability of the firm, the local tax factor, the subjective tax literacy of the responding firm's decision-maker, and his or her gender.

The second survey, the fourth survey-wave of the German Business Panel, uses an online survey (Qualtrics) to survey German firms on various (tax) topics. It started on Dec 28, 2021, and was rolled out over a period of six months. The team of authors from Fochmann et al. (2024) were able to integrate some of the questions from their survey in the German Business Panel. As before, firms are asked for characteristics like the legal form, number of employees, industry, local tax factor, and sales. Further, they used the same procedure (displaying the provided profit) and questions to ask firms for their perceived ATR and MTR.[26] To differentiate the samples in the following I will refer to data based on Fochmann et al. (2024) as *sample I*, data based on the German Business Panel as *sample II*.

The advantage of using two datasets is that I can increase the sample size, which allows me to compare the prediction performance based on the sample size used for training the model. An issue might be that the comparability of the predictions is limited by significant differences in the datasets. To address this, I compare the means and distributions of the two samples. The results show no statistically significant differences on the 5% level except for the size of the firms. The firms in *sample II* have on average more employees and generate more sales (untabulated). However, since all firms can be classified as SMEs, this should be of little to no concern. Appendix A3 provides details of the variables used. Further, as is common with survey data, there are limitations. For both surveys, self-selection bias cannot be completely ruled out. The same goes for respondents not answering truthfully. However, since both surveys guarantee anonymity, I expect truthful answers. Furthermore, framing effects should be avoided as neutral language was used. Terms that might be unclear were supported by explanations or visualizations to avoid different interpretations.

Two distinct sets of input variables are employed for the training of XGBoost. Initially, *all variables* collected in sample I are utilized to train XGBoost, encompassing both firm characteristics and the personal

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[25] See Fochmann et al. (2024) for a more pronounced description and discussion of this approach.

[26] There are some minor deviations in the questions, but these only concern the survey of firm characteristics. For example, the industry a firm works in and the legal form are asked at a higher level of detail by default in the German Business Panel than in the Fochmann et al. (2024) survey. However, since it can be assumed that these differences only concern questions whose answers are not critical from the point of view of the firms and which do not lead to changes in the firms' behavior in the survey, I will ignore these differences in the following.

characteristics of the firms' decision-maker. Subsequently, XGBoost is trained with a reduced set of variables, including the legal form, the number of employees, the sales, and the local tax factor. As these variables are typically accessible within commercial databases, they are designated as *public variables*. Table 1 presents a comparison of the *all variables* and *public variables*. Furthermore, the use of Shapley values enables the identification of the relevant variables for prediction for each variable set. These insights are valuable because the prediction of firms' tax rate perceptions for firms beyond those in my datasets is based on the assumption that the variables contributing to the prediction are also available for these "new" firms. To account for the fact that very little information (public variables) is available for some firms, I am investigating the extent to which reliable predictions of firms' tax rates can still be made.

< Insert Table 1 about here >

Using *public variables* also enables me to combine *sample I* and *sample II*[27], creating a sample with more observations (*sample I + II*) for my analysis.[28] This also allows me to analyze whether model performance can be increased if more data is used for training. For all of my analyses, I use Shapley values to determine which variables contribute most to the prediction.

3.2   Sample

Sample I comprises 1,806 observations, of which 657 are complete. For the purpose of the analysis I follow the procedure of Fochmann et al. (2024). I exclude firms that are part of a tax group, use a special tax treatment (Section 34a German Income Tax Code), are partially exempted from trade tax, have a profit below €20.000[29] or do not classify as a SME.[30] I also only include firms that state that an decision-maker in an executive position (manager) is answering. This leaves me with 448 observations for the analysis. Table 2 provides summary statistics of *sample I*.

< Insert Table 2 about here >

Of these firms, 54.2% are sole proprietors, 20.8% are partnerships (including mixed forms[31]), and 25.0% are corporations. On average (median), the surveyed firms employ 16 (5) employees. 87.5% of the firms

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[27]   The German Business Panel survey is of a lesser scope than the Fochmann et al. (2024) survey, which is why not all variables are available.

[28]   I cannot completely rule out the possibility that there are firms that responded to both surveys. However, as the study by Fochmann et al. (2024) focuses mainly on handicraft firms, whereas the German Business Panel does not, overlaps are less likely.

[29]   I assume that for firms having a profit of less than €20.000 is only secondary income, thus I cannot be sure to proxy the actual income accurately.

[30]   I define SMEs as firms that employ less than or equal to 250 employees and have sales of less than or equal to €40,000,000. This is in general accordance with Section 267 of the German Commercial Code (HGB).

[31]   Mixed forms are a special legal form that combines characteristics of partnerships and corporations such as GmbH & Co. KG and are taxed like partnerships.

operate in the craft sector. The mean (median) profit is €118,128 (€63,000). On average, sales range between €300.001-400.000. Of the surveyed firms, 18.3% experienced a loss in 2019 or 2020. Most of the firms surveyed receive external tax advice (92.9%). Of the firm decision-maker, 76.3% state to have tax knowledge.[32]

Sample II comprises 1,092 observations, of which 355 answered all questions relevant for this analysis. I then apply the same criteria for preparing the data as for *sample I*. This leaves me with 258 observations. After combining *sample I* and *sample II*, I end up with 732 observations[33] for my *sample I + II*. Table 3 provides summary statistics of *sample I + II* including only *public variables.*

< Insert Table 3 about here >

Of these firms, 42.3% are sole proprietors, 18.4% are partnerships (including mixed forms), and 39.2% are corporations. On average (median), the surveyed firms employ 16 (6) employees and sales range on average (median) between €400.001 – 500.000 (€500.001 – 1 million).[34] Both datasets show a high degree of consistency with the German corporate landscape. Based on the German Business Register 2022, 59.2% of all firms are sole proprietors, 12.1% are partnerships, and 23.7% are corporations. Most of these firms employ a maximum of 9 employees (86.8%). 12.7% employ 10 to 250 and only 0.5% more than 250 employees (German Federal Statistical Office, 2020). Likewise, 86.3% report sales of less than €1 million. The high level of agreement speaks to the quality of the survey data. Only the number of corporations in *sample I + II* is comparatively higher.

4   PREDICTION RESULTS

In the following, I use XGBoost to predict firms' ATR and MTR perception. First, the model is trained using *all variables* and *sample I*. Secondly, the model is trained using *public variables* and *sample I* with the objective of examining the impact of a notable reduction in input variables on the models' predictive performance. Thirdly, the model is trained using *public variables* and *sample I + II* with the objective of examining the impact of a larger sample. I start by describing the results of each approach and end with a combined discussion.

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[32]   Following the definition of Genest-Grégoire et al. (2017), self-stated tax knowledge is referred to as *Subjective Tax Literacy.*
[33]   Since I only consider a selection of the variables, *sample I* increases to 474 observations.
[34]   Within the two surveys, the range of sales differs. To be able to combine both datasets, data from *sample II* was adjusted to fit the *original survey* data.

4.1 All Variables

In a first step, I use *all variables* to predict firms' tax rate perception. These include various firm and personal characteristics, as shown in Table 1. I define the variable of interest, the perception, as either the ATR perception (in %) or MTR perception (in %) of a firm. For corporations, I use ATR and MTR perceptions based on retained earnings, thus excluding dividend taxation. This approach is selected due to the limited impact dividend taxation has on firms. For instance, retained profits are frequently utilized as a foundation for investment decisions. Firm characteristics include the following variables: (1) Legal form, which comprises the binary variables *Corporations* being one if a firm is a corporation and zero otherwise, *Sole Proprietors* being one if a firm is a sole proprietorship and zero otherwise, *Partnerships* being one if a firm is a partnership and zero otherwise. *Corporations* is used as reference group within the regression analysis. (2) *Profit* is the provided profit in €.[35] (3) *Sales* displays firm's sales in €. (4) *Employees* is the number of employees and in case of the OLS the natural logarithm of employees. (5) *Handicraft* is one if a firm is a handicraft business and zero otherwise. (6) *Local Tax Factor* displays the stated trade tax multiplier in %. (7) *Loss* is one if a loss occurred in 2019 or 2020 and zero otherwise. (8) *Tax Assistance* is one if firm gets support from tax advisor and zero otherwise.

Personal characteristics include (1) *Tax Complexity* displaying the perceived tax system complexity. (2) *Tax Compliance Costs* displays the estimated tax compliance costs as share of all compliance costs in %. (3) *Trust* displays the stated trust in government's handling of tax revenue based on a Likert-Scale from 1 to 5. (4) *Larger Peers* is one if a firm perceived to be taxed higher than larger peers and zero otherwise. (5) *Smaller Peers* is one if a firm perceived to be taxed higher than smaller peers and zero otherwise. (6) *Subjective Tax Literacy* is one if respondent states tax knowledge and zero otherwise. (7) *Objective Tax Literacy* includes the binary variables *Tax Schedule* (one, if relation ATR to MTR is accurate and zero otherwise) and *Tax Rate Choice* (one, if using MTR in business decisions and zero otherwise). Given that, *Objective Tax Literacy* can be zero, one, or two. (8) *Gender* is one if stated gender is female and zero otherwise.[36]

4.1.1 Model Performance

To train XGBoost, I proceed in accordance with the methodology described in Section 3.1.1 and Appendix A2. In a first step, I use *all variables* and *sample I* for the purpose of training the model. The model performance metrics of this process are illustrated in Figure 1.

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[35] In case of *Partnerships* it is the profit per partner.
[36] Summary statistics are shown in Table 2 and an overview of the variable definitions is given in Appendix A3.

< Insert Figure 1 about here >

With regard to the ATR perception of firms, the RMSE is 13.08 percentage points for the test data.[37] The MPE is 0.85 percentage points for the test data. The model accounts for 23.20% of the variance in the test data, as indicated by the R^2.[38] In order to evaluate the model's performance, a comparison is made with the benchmark, namely the predictions based on the OLS regression.[39] For the OLS, the RMSE for the test data is 14.24 percentage points, the MPE is -0.13 percentage points, and the R^2 is 8.99%. Both models demonstrate a high level of performance with regard to the MPE, successfully predicting firms' ATR perception with an average bias of less than one percentage point. Given that the mean ATR perception is 33.6%, the MPE is very low, speaking to a high accuracy. The RMSE, depicting the precision of the prediction, is approximately 10% lower for XGBoost compared to the OLS. In comparison to the mean (33.6%) of the target variable, the RMSE is considerably smaller. Further, the prediction deviations align with the standard deviation (12.9%) of the data. Similarly, the R^2 value for XGBoost is approximately two and a half times greater than that of the OLS, which further confirms that XGBoost clearly outperforms the OLS. These results indicate that the model achieves reliable prediction performance.

For the prediction of firms' MTR perception, a similar picture emerges. Using XGBoost, the RMSE is 14.71 percentage points on the test data. The MPE is 0.69 percentage points for the test data. The model accounts for 15.67% of the variance in the test data, as indicated by the R^2. Again, I compare it to the model performance of the OLS regression. The RMSE for the test data is 15.63 percentage points, the MPE is 0.05 percentage points, and the R^2 is 4.81%. As before, the application of both models results in a high prediction accuracy, depicted by the very low MPE compared to the mean MTR perception of 33.0%. The use of XGBoost results in better performance in terms of the precision, shown by the RMSE, which is 9.41% lower compared to the OLS regression. Again, compared to the mean MTR perception and the standard deviation of 16.2%, indicate that the model achieves reliable prediction performance. Likewise, the R^2 using XGBoost is about three times larger than for the OLS, which emphasizes the overall better performance.

To gain a more detailed understanding of the predictive performance of XGBoost with regard to firms' ATR and MTR perception, and to identify potential limitations, I compare the predicted and survey-based tax rate perception graphically. The results are illustrated in Figure 2 and Figure 3.

< Insert Figure 2 & Figure 3 about here >

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[37]   Results for test and training data are shown in Appendix A6.

[38]   I use R^2 instead of the commonly used adjusted R^2 since adjusted R^2 is more relevant for training and comparing models with different complexities. However, there is no variation in the variables between training and test data.

[39]   Since I focus on prediction and not inference, the results of the OLS regression are shown and discussed briefly in Appendix A4.

The graphical comparison illustrates the reliable performance of XGBoost, with a notable degree of overlap between the survey-based tax rate perception and the predicted tax rate perception. In particular, for perceived tax rates ranging between 20% and 50%, where the observations are concentrated, there is a high degree of overlap between the survey-based tax rate perception and predicted tax rate perception. The accuracy and precision of the predictions diminish slightly when the survey-based tax rate perception is located at the upper or lower limits of the distribution. An examination of the tax rate predictions reveals that they do not simply align with the tax rate schedule (dashed line). This lends support to the assumption that, in addition to firm characteristics, personal characteristics of the decision-maker also affect firms' perception of tax rates.

4.1.2   Shapley Values

To investigate the contributions of the different variables to the prediction further and open the 'black box' inherent to this machine learning method, I use Shapley values. The results are shown in Figure 4 for the prediction of firms' ATR perception and in Figure 5 for firms' MTR perception.

< Insert Figure 4 & Figure 5 about here >

The results show that *Profit*, *Employees*, *Local Tax Factor*, *Corporations*, *Trust*, and *Tax Compliance Costs* are the variables that contribute most to the prediction of firms' ATR perception. With regard to the firm characteristics, the results are in line with what can be expected from the taxation procedure. *Profit* forms the basis of taxation and is essential for sole proprietors and partnerships in particular, as the tax rate is significantly influenced by profit due to the progressive tax rate schedule. For corporations, which are subject to a flat tax, profit is less relevant. In this respect, it seems reasonable that the variable *Corporations* is contributing considerably to the prediction, as it reflects a distinct feature in the taxation process. Since the *Local Tax Factor* likewise has a direct impact on the tax rate, its contribution to the prediction is reasonable. Given that all three factors contribute to the determination of the actual tax rate, it is unsurprising that they also contribute to the prediction of the perception of such. The number of *Employees* can be seen as a proxy for the size of the firm. The assumption that in larger companies, taxes are managed by qualified tax personnel (Graham et al., 2017) and thus information regarding actual tax rates is more salient than in smaller companies where taxes are not handled separately lends support to the conclusion that *Employees* represents a significant factor in predicting the perception of firms' tax rates. In addition to these 'hard facts' of taxation, the variables *Tax Compliance Costs* and *Trust* in government's handling of tax revenues contribute in a significant manner to the prediction. Both variables are more likely to be classified as subjective 'soft facts', which should have no effect on the actual tax rate but are important when it comes

to perception.

For the prediction of firms' MTR perception this finding is even more prevalent. While *Employees*, *Profit*, and *Corporations* are the second to fourth most important contributing variables, *Objective Tax Literacy* is the most important one. Further, *Tax Compliance Costs* is also an important variable. Again, variables that from an objective point of view are not necessary to determine the actual tax rate, are important for predicting the perceived tax rate. These findings are in line with the findings of Fochmann et al. (2024) and Hanlon et al. (2022), who state that individual preferences, abilities, experiences, and other characteristics are relevant in accounting matters.

4.2 Public Variables

In a second step, I use only *public variables* to predict firms' tax rate perception in *sample I* and *sample I + II*. These include only firm characteristics, as shown in Table 1. Again, I define the variable of interest, the perception, as either the ATR perception (in %) or MTR perception (in %) of a firm. Firm characteristics include the following variables: (1) Legal form, which comprises the binary variables *Corporation*, *Sole Proprietors*, *Partnership*. *Corporations* is used as reference group within the regression analysis. (2) *Sales*, displaying firms' sales in €. (3) *Employees*, being the number of employees and in case of the OLS the natural logarithm of employees. (4) *Local Tax Factor*, displaying the stated trade tax multiplier in %.[40]

4.2.1 Model Performance

Using only *public variables*, I follow the same procedure as before. The results for *sample I* are shown in Figure 6.

< Insert Figure 6 about here >

With regard to firms' ATR perception, the RMSE is 14.16 percentage points for the test data.[41] The MPE is −0.26 percentage points for the test data. The model accounts for 9.98% of the variance in the test data, as indicated by the R^2. The OLS yielded a RMSE of 13.78 percentage points, a MPE of −0.83 percentage points, and a R^2 is −5.06% for the test data. Again, in light of the notably low MPE in comparison to the mean ATR perception (33.8%), both models demonstrate a very high degree of predictive accuracy. Surprisingly the OLS results in a by 2.76% lower RMSE than XGBoost. However, upon evaluation against the mean and standard deviation (13.7%) of ATR perception, the RMSE demonstrates that both models

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[40]   Summary statistics are provided in Table 3 and variable definitions in Appendix A3.
[41]   The results for the test and training data are presented in Appendix A6.

offer reliable predictions. The RMSE is considerably less than the mean (33.8%) of the target variable, and the prediction deviations align with the standard deviation of the data. Regarding R^2, XGBoost exhibits a considerably higher degree of explained variance compared to the OLS, which yields a negative result. The discrepancy in the OLS performance metrics, RMSE and R^2, could be attributed to overfitting or the potential inadequacy of the linear assumptions underlying the OLS. Consequently, it can be inferred that XGBoost offers a more balanced and therefore more reliable performance.

For the MTR perception, using XGBoost, the RMSE is 15.84 percentage points on test data. The MPE is 0.14 percentage points for the test data. The model accounts for 2.30% of the variance in the test data, as indicated by the R^2. Using the OLS, the RMSE for the test data is 16.71 percentage points, the MPE is 0.74 percentage points, and the R^2 is -2.00%. Once more, both models show a very good prediction accuracy compared to the mean MTR perception of 33.0%. Further, the prediction deviations align with the standard deviation of the MTR perception (16.8%), indicating reliable predictions. Again, the 5.49% lower RMSE and the considerably higher R^2 of XGBoost in comparison to the OLS model indicate that the performance of XGBoost is superior.

Relying on the same approach and to analyze the tax rate prediction more precisely as well as to uncover any weaknesses, I compare it with the survey-based tax rate perception. The results are shown in 7 and Figure 8.

< Insert Figure 7 & Figure 8 about here >

As in the case of *all variables*, the graphical comparison illustrates the reliable performance of XGBoost, with a notable degree of overlap between the survey-based tax rate perception and the predicted tax rate perception. For perceived tax rates ranging between 20% and 50%, where the observations are concentrated, I find a high degree of overlap between the survey-based tax rate perception and predicted tax rate perception. Compared to *all variables*, the predictions based on *public variables* show a reduction in the degree of variation and spread over a narrower range, which is also reflected in the increase in the RMSE and decrease in R^2. For corporations, predicted ATR perception follow almost a straight line, the variation of the survey-based tax rate perceptions is hardly mapped. For the predicted MTR perception, a similar picture emerges but the predictions show more variance, both for non-corporations and corporations.

Next, I proceed as before and analyze the results for *sample I + II* as shown in Figure 9.

< Insert Figure 9 about here >

Trained with *public variables* and *sample I + II* for the prediction of firms' ATR perception, XGBoost

yields a RMSE of 12.34 percentage points, a MPE of 0.87 percentage points and a R^2 of 8.57%. Using the OLS, the RMSE for the test data is 12.74 percentage points, the MPE is -1.24 percentage points, and the R^2 is 6.62%. As before, both models show a good accuracy, as indicated by the low MPE compared to the mean ATR perception of 33.4%. Furthermore, comparing the RMSE shows that XGBoost performs slightly better (3.24%) than the OLS. The RMSE, measured against the mean and standard deviation (13.6%) of ATR perception, demonstrates that both models offer reliable predictions in terms of prediction precision. Lastly, XGBoost performs also better in explaining the variance of the model (R^2). Overall, XGBoost outperforms the OLS.

Investigating XGBoost's prediction of firms' MTR perception shows a RMSE of 17.15 percentage points, a MPE of -0.59 percentage points and a R^2 of 6.39% for the test data. The OLS yields a RMSE of 17.63 percentage points, a MPE of 0.68 percentage points and a R^2 of 1.03%. Again, comparing the RMSE shows that XGBoost performs slightly better (2.80%) than the OLS. Given that both models show a very good accuracy, measured by the MPE, but XGBoost performs slightly better with regard to the prediction precision (RMSE) and better in explaining the variance (R^2), I again conclude that it outperforms the OLS.

The results of the graphical comparison of the predicted tax rate perception with the survey-based tax rate perception are shown in 10 and Figure 11.

< Insert Figure 10 & Figure 11 about here >

Once again, I observe that predicted ATR perceptions range mostly between 25% and 40% for non-corporations and slightly above 30% for corporations. Thus, they concentrate in the area where most survey-based tax rate perceptions are located. The variation of the survey-based tax rate perception is hardly mapped by the predictions. For the prediction of MTR perception, the results are very similar. In case of non-corporations, the predicted MTR perceptions depict more variation than in case of the predicted ATR perception. This is in line with more variance in the survey-based MTR perceptions. For corporations, there is little difference between predicted ATR and MTR perceptions. Given that survey-based tax rate perceptions for corporations are also very similar for ATR and MTR, this result is not surprising.

4.2.2 Shapley Values

Again, I use Shapley values to investigate the contributions of the different variables on the prediction of ATR and MTR perception using only *public variables*. I start by examining the results for *sample I* shown in Figure 12 for the prediction of firms' ATR perception and in Figure 13 for firms' MTR perception.

< Insert Figure 12 & Figure 13 about here >

The results show that *Employees*, *Sales* and *Corporations* are the important characteristics for predicting firms' ATR perception. Given that *Employees* and *Sales* can be seen as proxies for firms' profits, and that being a *Corporation* determines the tax rate due to the flat tax rate schedule, the results seem very reasonable. Surprisingly, the *Local Tax Factor* does not contribute to the prediction of the ATR perception, despite its effect on the actual tax rate. For the prediction of firms' MTR perception *Employees*, *Sales* and *Corporations* are important. Additionally, *Partnerships* and the *Local Tax Factor* contribute significantly to the prediction. Given that all these factors also contribute directly to the actual tax rate, the results are plausible.

The results for predicting firms' ATR and MTR perception based on *sample I + II* are shown in Figure 14 and Figure 15.

< Insert Figure 14 & Figure 15 about here >

As before, *Employees* and *Corporations* contribute to the prediction of firms' ATR perception. Surprisingly, neither *Sales* nor the *Local Tax Factor*, being important factor for calculating the actual tax rate, contribute to the prediction. In case of predicting firms' MTR perception being a *Corporation*, *Employees* and *Sales* are important variables. Again, since these variables are also used to determine the actual tax rate, the results are plausible.

4.3   Discussion

In light of the aforementioned results, a number of conclusions can be drawn regarding the use of machine learning, specifically XGBoost, in predicting firms' perception of their tax rates. It can be stated that XGBoost exhibits an overall higher level of prediction performance than OLS regression. Given that OLS regression is primarily used to test inferences, while XGBoost is optimized for predictions, this result is as expected. However, the results show not only that XGBoost outperforms OLS, but also that it achieves good overall results in terms of accuracy, precision, and explained variance of the prediction. For instance, the explanatory power ranging between 6% and 23% in the various predictions (with the exception of the prediction of MTR perception based on *public variables* and *sample I*) also indicates a high level of performance with regard to the models' ability to describe this real-world phenomenon. For comparison, Belnap, Kroeger, and Thornock (2024) demonstrate that the R^2 for Cash ETR (GAAP ETR) does not exceed 38% (34%) even when including year, industry, firm, state, and manager fixed effects. Unsurprisingly, R^2 is particularly high for the predictions of firms' tax rate perception when XGBoost is trained with *all variables*. Compared to the results of Guenther et al. (2023), who use XGBoost to predict future ETRs for large firms based on extensive financial statement data, both the accuracy and precision of the prediction can be considered good. Given

the lack of evidence on the ability to predict firms' tax rate perception, the results presented here represent a significant contribution to the existing literature on this topic.

With regard to the different training approaches of XGBoost (*all variables* vs. *public variables*; *sample I* vs. *sample I + II*), further conclusions can be drawn about the performance of XGBoost and its future applicability.[42] In general, the performance of the model is improved when it is trained on the basis of *all variables.* Using only *public variables* results in a decrease in the prediction performance of XGBoost for *sample I.* This finding suggests that personal characteristics play a crucial role in predicting tax rate perception. This conclusion is further supported by the mean absolute Shapley values, which show that *Tax Compliance Costs* and *Trust* have a significant impact on predicting ATR perception, while *Objective Tax Knowledge* and *Tax Compliance Costs* contribute significantly to the prediction of MTR perception. Thus, the prediction of firms' tax rate perception is also feasible based on public variables, although it is essential to acknowledge the limitations in capturing the variance of perception. To address this, future surveys and interviews aimed at measuring perceptions or expanding the data base for predictions should incorporate questions on personal characteristics, particularly *Tax Compliance Costs*, *Trust* in governments' handling of tax revenues, and *Objective Tax Literacy.* If XGBoost is trained with a larger database, *sample I + II*, performance improves for ATR perception but decreases for MTR perception. The results are therefore ambiguous in terms of predictive performance and do not allow the formulation of a generalizable conclusion. Nevertheless, the results demonstrate that improvements are generally feasible. Future research should focus on this aspect in order to identify potential areas for improvement in prediction performance based on only *public variables.*

As described, the model encounters some difficulties in mapping the variance observed in the survey-based tax rate perceptions. This issue becomes apparent when only *public variables* are included in the model training. This circumstance could be mainly due to the concentration of the data, i.e. imbalanced data, or the small number of observations in the sample. In this study, imbalanced data refers to the increased number of tax rate perceptions between 25% and 50% and significantly fewer data points in the area above or below these thresholds. Imbalanced data incentives XGBoost to perform well on the majority of the training data, but not so much on other data points. While this approach is valid, it can result in an increased RMSE, because the model is sensitive to outliers and assigns greater weight to larger errors. This raises the question of whether the few data points outside the sample are outliers or whether there are (coincidentally) too few of these types of observations in the sample. If they are outliers, XGBoost will be unable to predict them

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[42]   In general, comparisons between the performance of XGBoost can only be drawn if the underlying sample is identical. Therefore, comparing XGBoost trained on *all and public variables* while using *sample I* is not a problem. But, using *sample I + II* changes the sample. However, since statistically significant differences are found only for firm size (see Section 3.1.2), I proceed to draw cautious conclusions from this comparison as well.

precisely and accurately, even when trained with more data. This would represent noise in the data. However, if the expansion of the database results in a more even distribution of the data, i.e. a problem of too few observations, then an increase in prediction performance can be expected.

In terms of model performance and Shapley values, I show that the inclusion of variables that can be classified as personal characteristics, such as those described above, contribute to the model's performance in predicting tax rate perception. Therefore, it can be concluded that predictions will be most reliable if these variables are also available for other firms for which tax rate perception is to be predicted using the presented XGBoost approach. The results also highlight the potential value of including questions about relevant personal characteristics, such as tax compliance costs, trust in the government's handling of tax revenues, or objective tax literacy, in future surveys or interviews. Because this study focused only on two extremes, the use of all variables and the use of only public variables, future research could extend the results. It would be possible to examine the performance of other combinations of variables (see, for example, Belnap, Kroeger, and Thornock (2024) for a similar approach).

In terms of my research questions, I conclude that XGBoost, as a machine learning approach, can provide reliable predictions of firms' tax rate perception and thus show a way to mitigate the problem of missing data. Furthermore, my results show that both firm as well as a selection of personal characteristics contribute to the prediction. Should further surveys or interviews be conducted, for instance, to expand the database used for predictive modeling, the variables outlined thus far should be incorporated. My analysis is based on data for German SMEs, which limits the ability to predict firms' tax rate perception to SMEs. Further research could expand the scope of this analysis by incorporating, e.g., survey evidence from firms in other countries or larger firms. In this regard, my findings provide valuable insights for future research that extend beyond the prediction itself: Reliable predictions can be achieved with a sample size of about 450 firms, which is a relatively modest number compared to the total number of SMEs (3.1 million in Germany). This suggests that a significantly reduced amount of data may be sufficient to predict firms' tax rate perception in other countries using machine learning models. Furthermore, future research should focus on expanding the analysis of the variables that contribute to the prediction by using a range of variable combinations.

5 CONCLUSION

The objective of this study is to determine whether the use of a machine learning-based approach can lead to a reliable prediction of firms' tax rate perception. Furthermore, I investigate which variables are useful for predicting firms' tax rate perceptions. I use survey data on firms' perceived ATR and MTR as a base to train my machine learning model XGBoost.

The results show that the application of XGBoost can yield valuable results in predicting firms' tax rates, outperforming the predictive performance of OLS regression. The model's performance metrics show high accuracy, as evidenced by a consistently low MPE of less than one percentage point for firms' perception of ATR and MTR. The model also explains up to 23.20% (15.67%) of the variance in the test data for firms' ATR (MTR) perception. For each analysis, the RMSE is close to the standard deviation of the target variable ATR perception (MTR perception). Thus, the model does not make extreme errors and provides a good balance between mean prediction error and variance. The model encounters some difficulties in mapping the high degree of variance observed in firms' ATR and MTR perception when only public variables are used for training. Regarding the use of different sets of variables to train the model, the prediction quality deteriorates as expected when only public variables are used. The use of a larger database may lead to an improvement in prediction performance, but the results are ambiguous for ATR and MTR perception. An examination of the Shapley values reveals that, in addition to firm characteristics, tax compliance costs, trust in the government's handling of tax revenues, and objective tax literacy are significant factors.

I contribute to the literature by providing the first evidence on how to address the lack of data on firms' tax rate perception. Future research can build on this approach by using it to predict firms' tax rate perception for datasets where such data are not available. This will allow for further empirical analyses of the impact of firms' tax rate perception on, e.g., tax reforms, tax compliance, or business decisions.

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FIGURES AND TABLES

Figure 1: Error of ATR and MTR Prediction XGBoost and OLS – All Variables (Sample I).
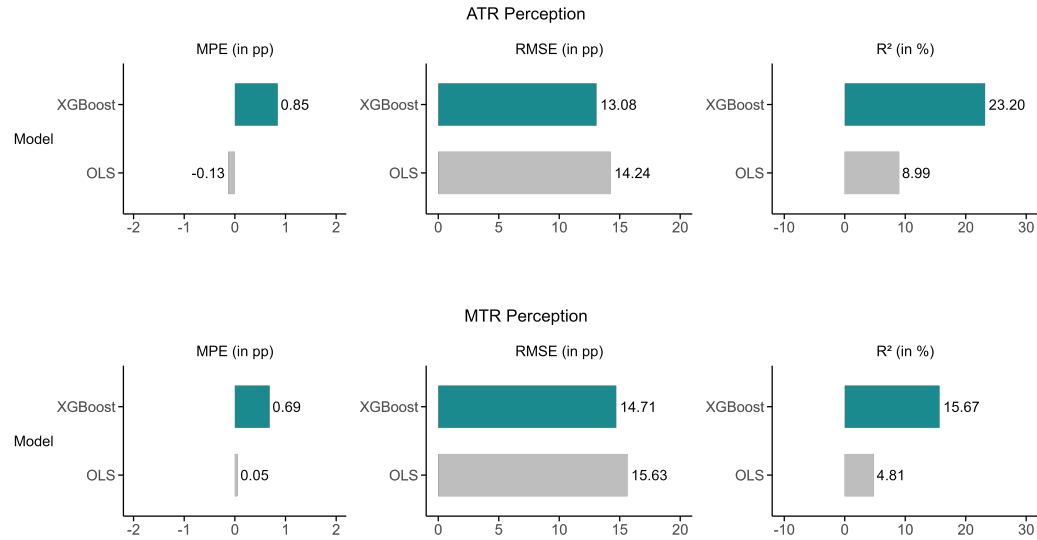
Notes: This figure compares the predictive performance of XGBoost and OLS regression based on *all variables* and *sample I* (N = 448). MPE illustrates the average accuracy of the prediction by depicting the mean error of prediction in percentage points. The RMSE illustrates the precision of the prediction depicted by the extent to which the variance in the dependent variable can be explained by the model (in percentage points). R^2 indicates the extent to which the variance in the dependent variable can be explained by the model (in %).

Figure 2: Survey-based and Predicted Perception ATR Perception – All Variables (Sample I).
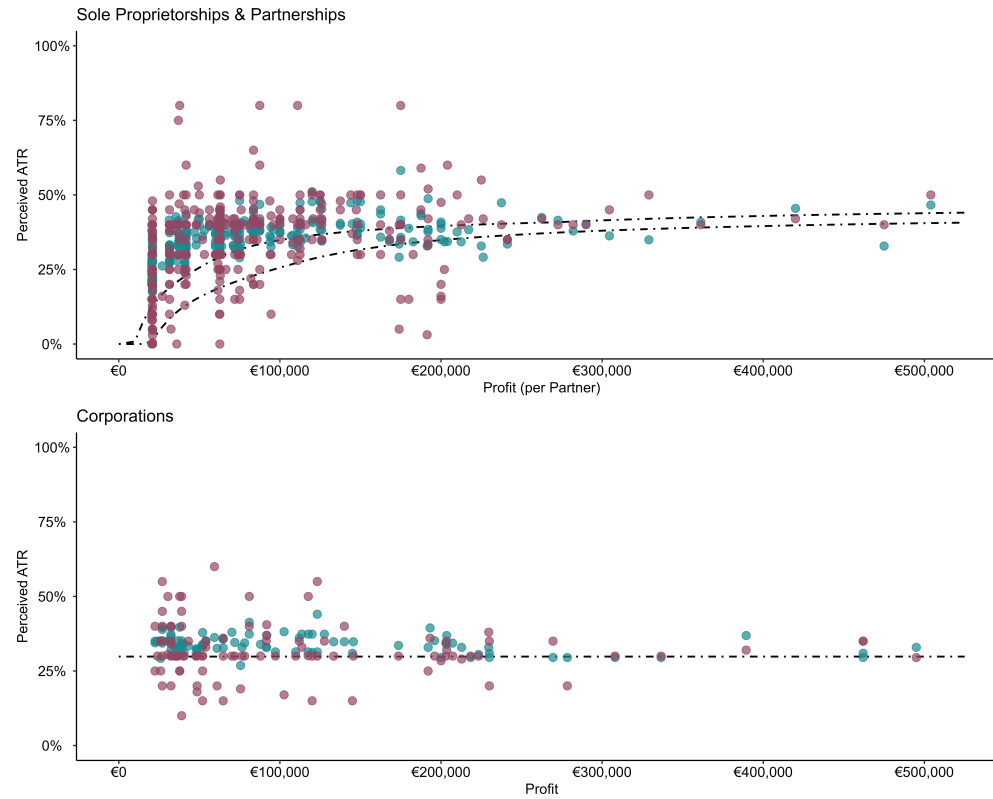
Notes: The dots show survey-based ATR perceptions in red and predicted ATR perception using XGBoost in teal. The dashed lines illustrate ATRs on profits of married (lower line) and single (upper line) taxpayers in Germany in case of sole proprietors and partnerships with a trade tax of 400%. In case of corporations, the dashed line indicates the corporate tax rate at a trade tax multiplier of 400%. For presentation reasons, the figure is limited to observations for profits below €500,000 (N = 448).

Figure 3: Survey-based and Predicted MTR Perception – All Variables (Sample I).



Sole Proprietorships & Partnerships

Corporations
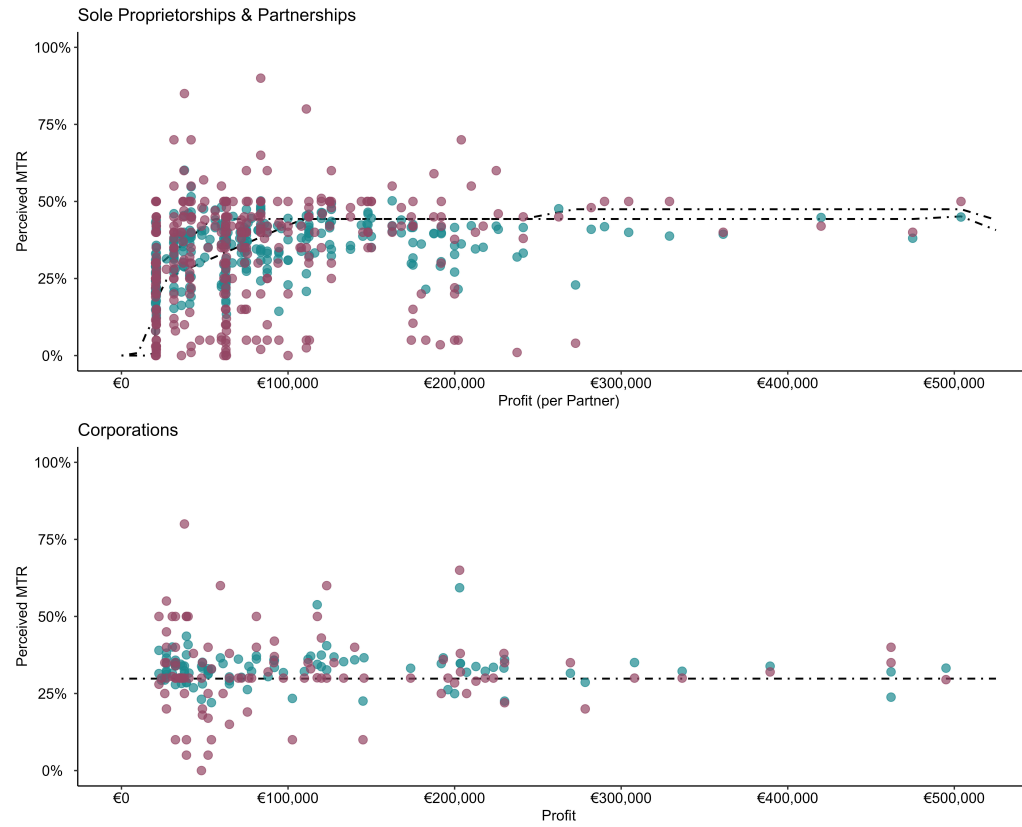
Notes: The dots show survey-based MTR perceptions in red and predicted predicted MTR perception using XGBoost in teal. The dashed lines illustrate ATRs on profits of married (lower line) and single (upper line) taxpayers in Germany in case of sole proprietors and partnerships with a trade tax of 400%. In case of corporations, the dashed line indicates the corporate tax rate at a trade tax multiplier of 400%. For presentation reasons, the figure is limited to observations for profits below €500,000 (N = 448).

Figure 4: Mean Absolute Shapley Values – ATR Perception – All Variables (Sample I).
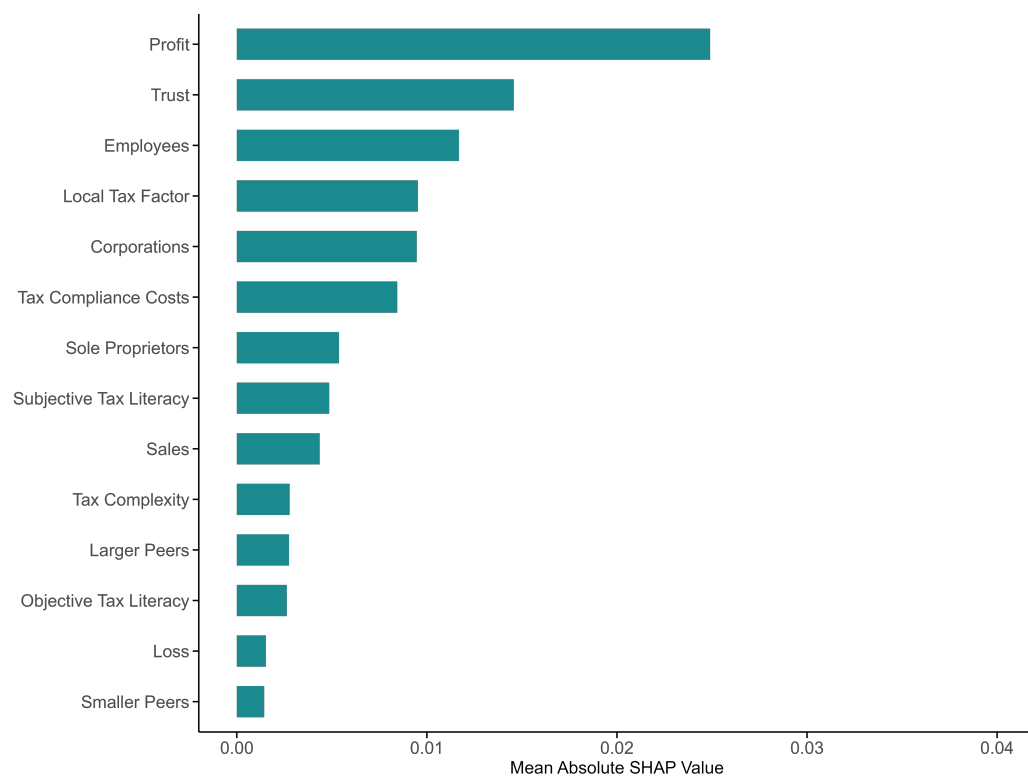
Notes: This figure shows the mean absolute Shapley values for the prediction of firms' ATR perception using XGBoost trained on *sample I* (N = 448).

Figure 5: Mean Absolute Shapley Values – MTR Perception – All Variables (Sample I)
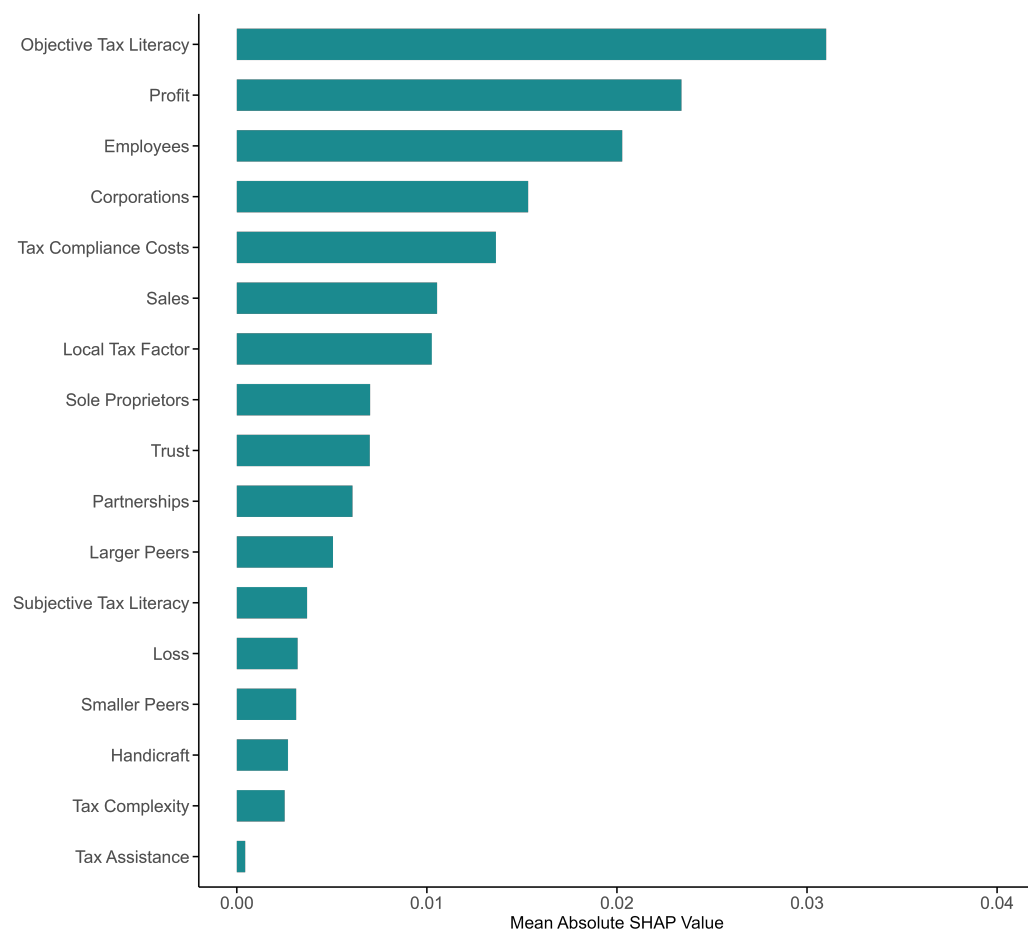
Notes: This figure shows the mean absolute Shapley values for the prediction of firms' MTR perception using XGBoost trained on *sample I* (N = 448).

Figure 6: Error of ATR and MTR Prediction XGBoost and OLS – Public Variables (Sample I).
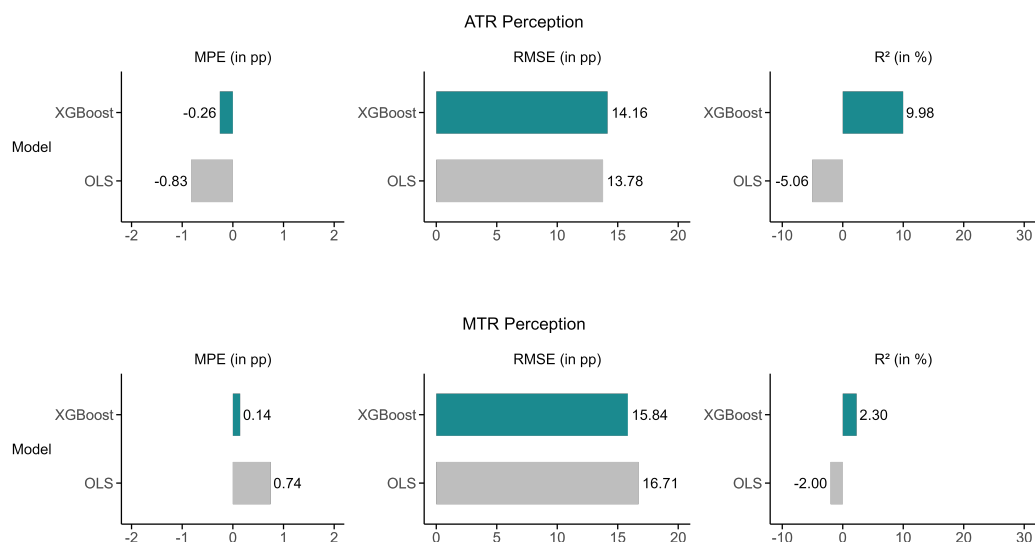
Notes: This figure compares the predictive performance of XGBoost and OLS regression based on *public variables* and *sample I* (N = 448). MPE illustrates the average accuracy of the prediction by depicting the mean error of prediction in percentage points. The RMSE illustrates the precision of the prediction depicted by the extent to which the variance in the dependent variable can be explained by the model (in percentage points). R^2 indicates the extent to which the variance in the dependent variable can be explained by the model (in %).

Figure 7: Survey-based and Predicted ATR Perception – Public Variables (Sample I).
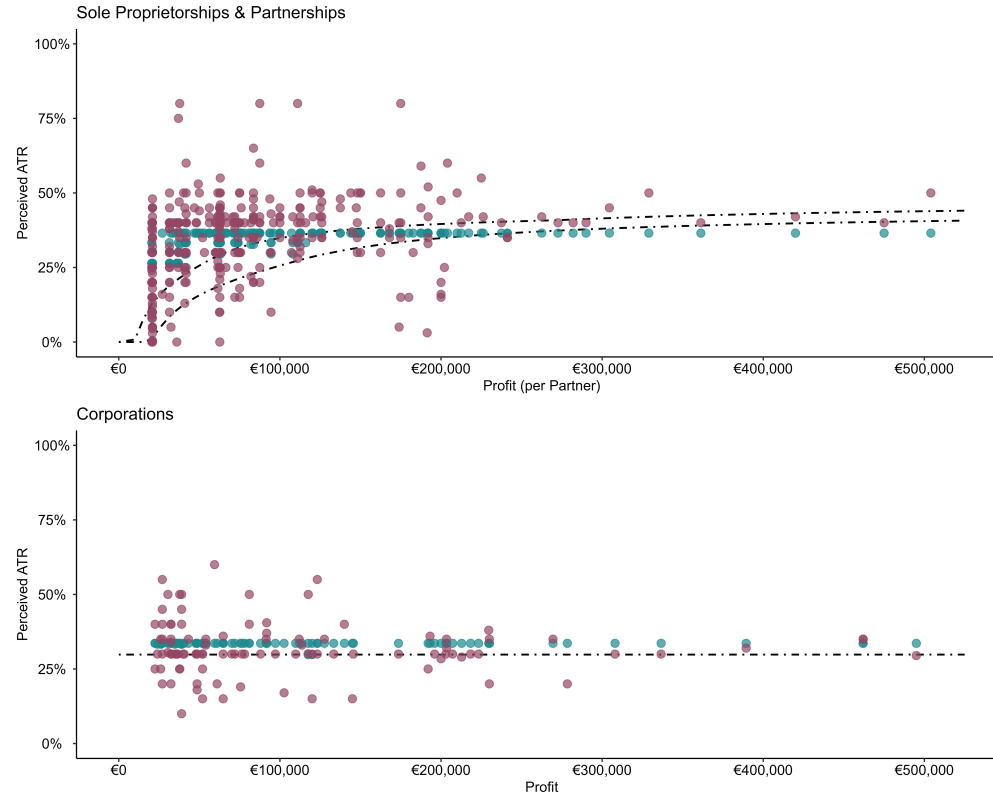
Notes: The dots show survey-based ATR perceptions in red and predicted ATR perception using XGBoost in teal. The dashed lines illustrate ATRs on profits of married (lower line) and single (upper line) taxpayers in Germany in case of sole proprietors and partnerships with a trade tax of 400%. In case of corporations, the dashed line indicates the corporate tax rate at a trade tax multiplier of 400%. For presentation reasons, the figure is limited to observations for profits below €500,000 (N = 448).

Figure 8: Survey-based and Predicted MTR Perception – Public Variables (Sample I).

Notes: The dots show survey-based MTR perceptions in red and predicted MTR perception using XGBoost in teal. The dashed lines illustrate ATRs on profits of married (lower line) and single (upper line) taxpayers in Germany in case of sole proprietors and partnerships with a trade tax of 400%. In case of corporations, the dashed line indicates the corporate tax rate at a trade tax multiplier of 400%. For presentation reasons, the figure is limited to observations for profits below €500,000 (N = 448).

Figure 9: Error of ATR and MTR Prediction XGBoost and OLS – Public Variables (Sample I + II).
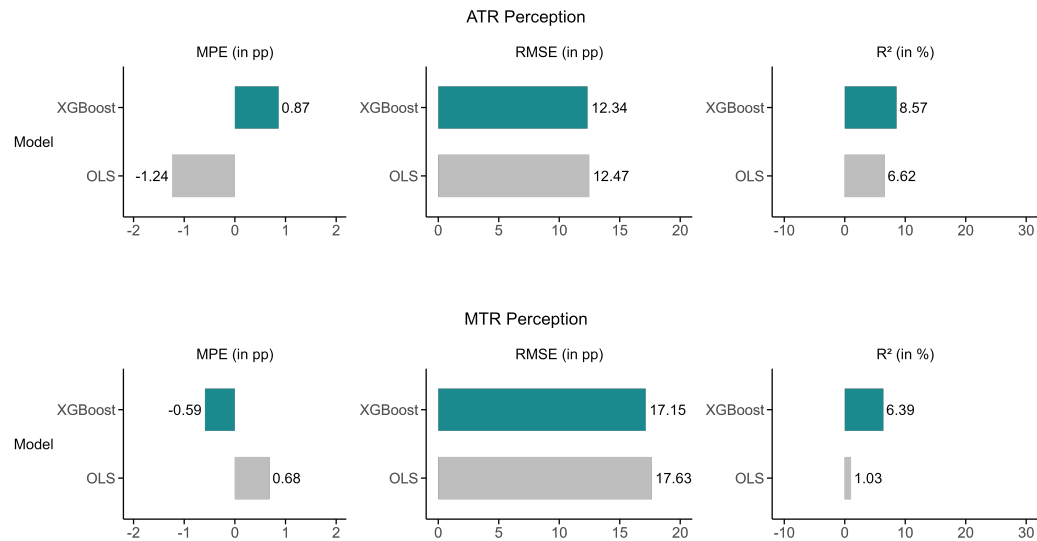
Notes: This figure compares the predictive performance of XGBoost and OLS regression based on *public variables* and *sample I + II* (N = 732). MPE illustrates the average accuracy of the prediction by depicting the mean error of prediction in percentage points. The RMSE illustrates the precision of the prediction depicted by the extent to which the variance in the dependent variable can be explained by the model (in percentage points). R^2 indicates the extent to which the variance in the dependent variable can be explained by the model (in %).
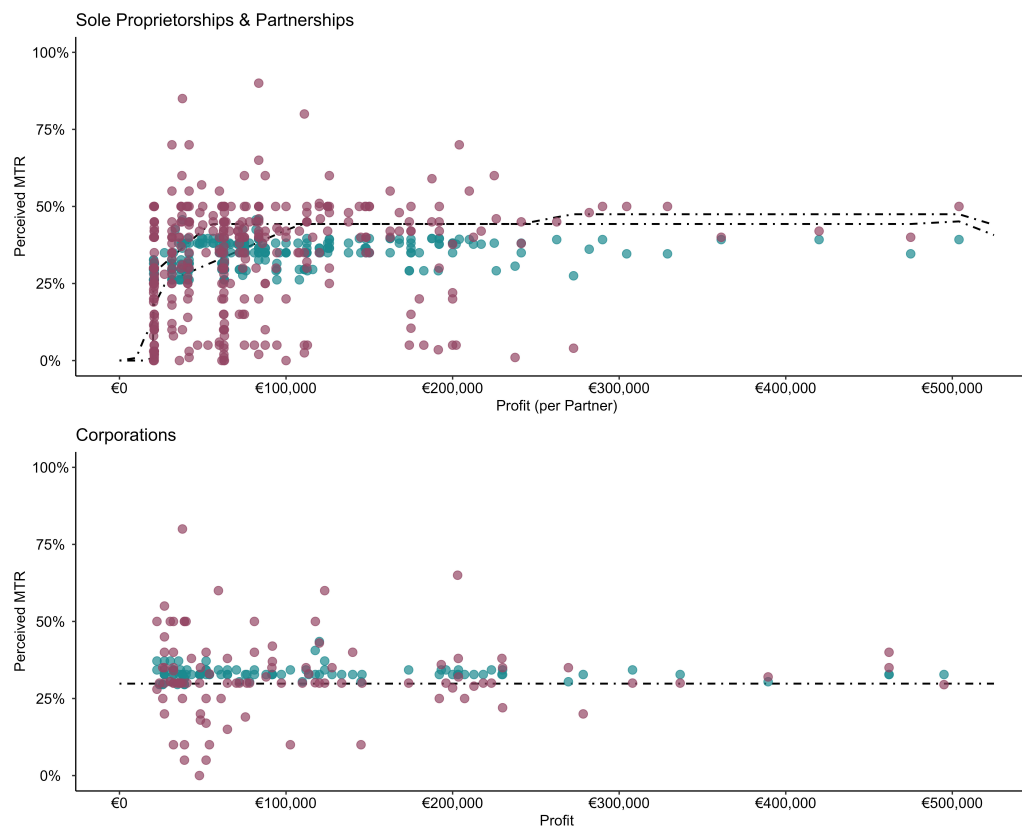
Figure 10: Survey-based and Predicted ATR Perception – Public Variables (Sample I + II).


Notes: The dots show survey-based ATR perceptions in red and predicted ATR perception using XGBoost in teal. The dashed lines illustrate ATRs on profits of married (lower line) and single (upper line) taxpayers in Germany in case of sole proprietors and partnerships with a trade tax of 400%. In case of corporations, the dashed line indicates the corporate tax rate at a trade tax multiplier of 400%. For presentation reasons, the figure is limited to observations for profits below €500,000 (N = 732).

Figure 11: Survey-based and Predicted MTR Perception – Public Variables (Sample I + II).
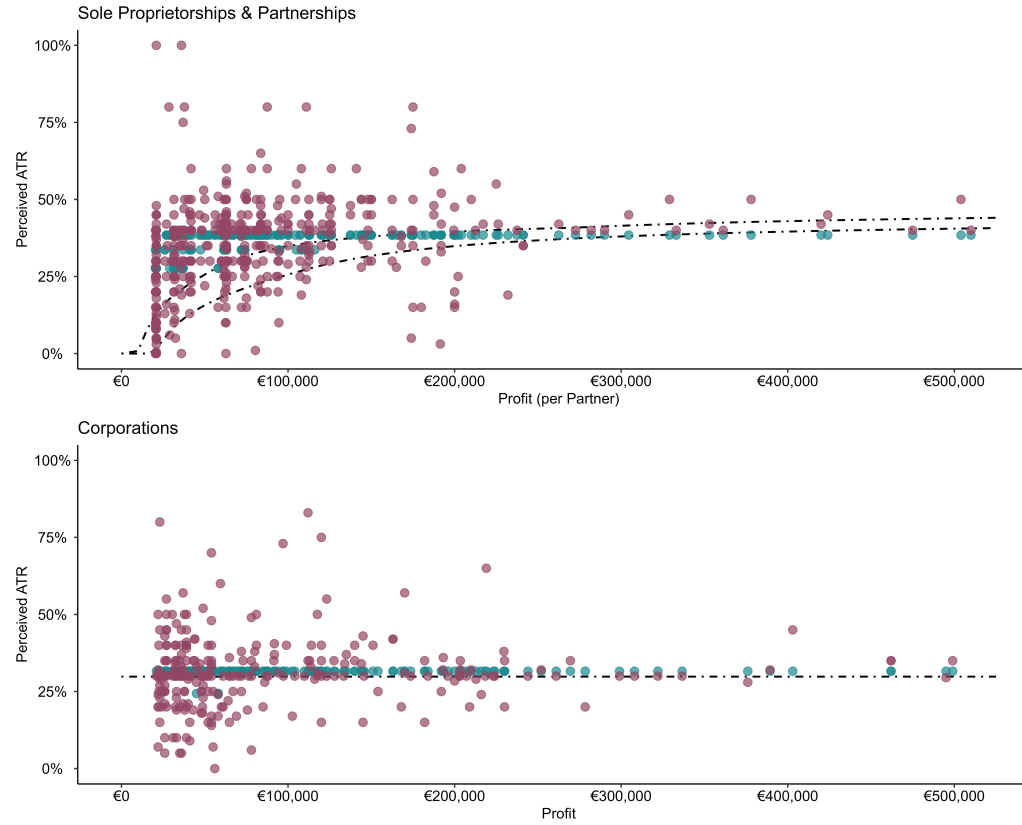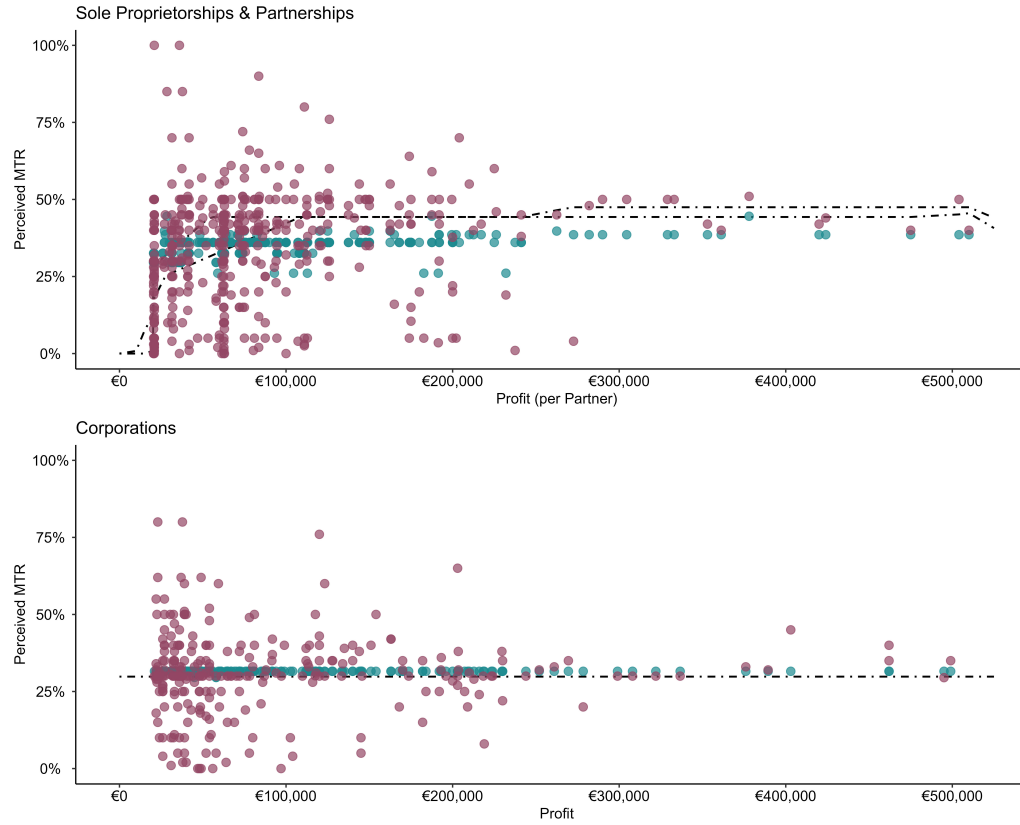

Notes: All dots show survey-based MTR perceptions in red and predicted MTR perception using XGBoost in teal. The dashed lines illustrate ATRs on profits of married (lower line) and single (upper line) taxpayers in Germany in case of sole proprietors and partnerships with a trade tax of 400%. In case of corporations, the dashed line indicates the corporate tax rate at a trade tax multiplier of 400%. For presentation reasons, the figure is limited to observations for profits below €500,000 (N = 732).

Figure 12: Mean Absolute Shapley Values – ATR Perception – Public Variables (Sample I).
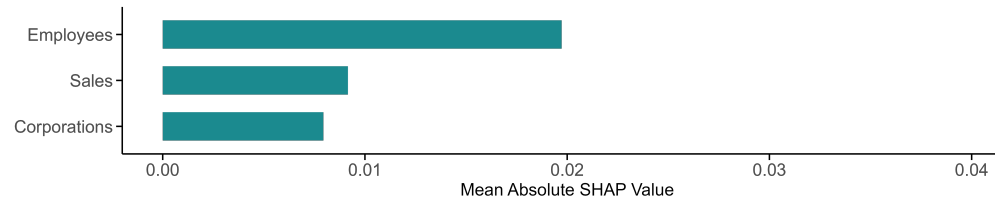
Notes: This figure shows the mean absolute Shapley values for the prediction of firms' ATR perception using XGBoost trained on *sample I* (N = 448).

Figure 13: Mean Absolute Shapley Values – MTR Perception – Public Variables (Sample I).
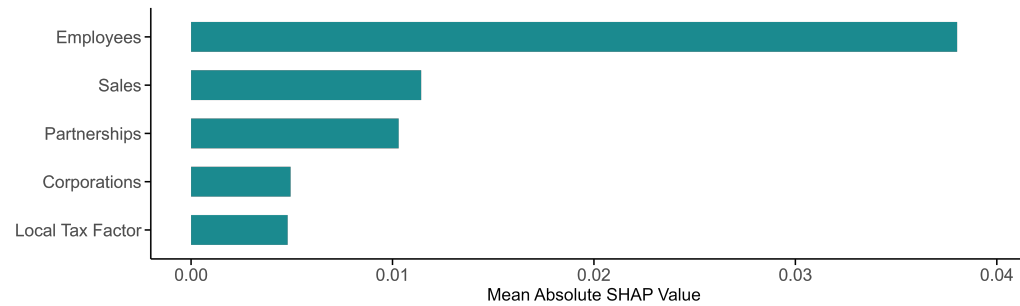
Notes: This figure shows the mean absolute Shapley values for the prediction of firms' MTR perception using XGBoost trained on *sample I* (N = 448).

Figure 14: Mean Absolute Shapley Values – ATR Perception – Public Variables (Sample I + II).
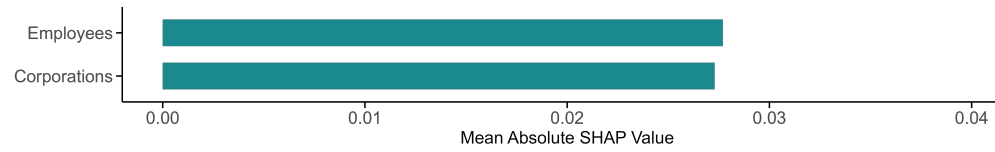
Notes: This figure shows the mean absolute Shapley values for the prediction of firms' ATR perception using XGBoost trained on *sample I + II* (N = 732).

Figure 15: Mean Absolute Shapley Values – MTR Perception – Public Variables (Sample I + II).
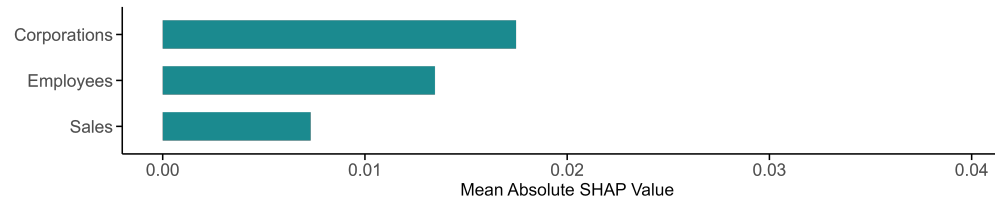
Notes: This figure shows the mean absolute Shapley values for the prediction of firms' MTR perception using XGBoost trained on *sample I + II* (N = 732).

Table 1: Categorization of Variables.

All variables	Public variables
Legal Form	Legal Form
Profit	-
Sales	Sales
Employees	Employees
Handicraft	-
Local Tax Factor	Local Tax Factor
Loss	-
Tax Assistance	-
Tax Complexity	-
Tax Compliance Costs	-
Larger Peers	-
Smaller Peers	-
Subjective Tax Literacy	-
Objective Tax Literacy	-
Gender	-

Notes: The table shows the variables used for prediction based on XGBoost– differentiated into *all and public variables*.

Table 2: Summary Statistics– Sample I.

Statistic	N	Mean	St. Dev.	Min	Median	Max
ATR Perception	448	0.336	0.129	0.000	0.350	0.800
MTR Perception	448	0.330	0.162	0.000	0.350	0.900
Corporations	448	0.250	0.433	0	0	1
Sole Proprietors	448	0.542	0.499	0	1	1
Partnerships	448	0.208	0.406	0	0	1
Profit	448	118,128.10	193,927.20	20,500.00	63,000.00	2,075,000.00
Sales	448	6.701	2.661	1	8	12
Employees	448	15.513	31.291	1	5	250
Handicraft	448	0.875	0.331	0	1	1
Local Tax Factor	448	403.833	47.501	245	400	750
Loss	448	0.183	0.387	0	0	1
Tax Assistance	448	0.929	0.258	0	1	1
Tax Complexity	448	4.679	0.658	1	5	5
Tax Compliance Costs	448	0.333	0.209	0.050	0.300	1.000
Trust	448	1.786	0.897	1	2	5
Larger Peers	448	0.379	0.486	0	0	1
Smaller Peers	448	0.342	0.475	0	0	1
Subjective Tax Literacy	448	0.763	0.425	0	1	1
Objective Tax Literacy	448	0.710	0.656	0	1	2
Female	448	0.176	0.382	0	0	1

Notes: This table presents summary statistics of *sample I*. Variable definitions can be found in Appendix A3.

Table 3: Summary Statistics– Sample I + II.

Statistic	N	Mean	St. Dev.	Min	Median	Max
Sample I						
ATR Perception	474	0.338	0.137	0.000	0.350	1.000
MTR Perception	474	0.330	0.169	0.000	0.350	1.000
Corporations	474	0.243	0.429	0	0	1
Sole Proprietors	474	0.549	0.498	0	1	1
Partnerships	474	0.209	0.407	0	0	1
Sales	474	6.654	2.728	1	7.5	14
Employees	474	15.840	32.296	1	5	250
Local Tax Factor	474	403.608	47.399	245	400	750
Sample II						
ATR Perception	258	0.327	0.134	0.000	0.300	0.830
MTR Perception	258	0.330	0.152	0.000	0.310	0.850
Corporations	258	0.667	0.472	0	1	1
Sole Proprietors	258	0.194	0.396	0	0	1
Partnerships	258	0.140	0.347	0	0	1
Sales	258	7.899	2.182	2	9	13
Employees	258	15.612	27.062	0	6	240
Local Tax Factor	258	401.333	57.342	240	400	550
Sample I + II						
ATR Perception	732	0.334	0.136	0.000	0.320	1.000
MTR Perception	732	0.330	0.163	0.000	0.330	1.000
Corporations	732	0.392	0.489	0	0	1
Sole Proprietors	732	0.423	0.494	0	0	1
Partnerships	732	0.184	0.388	0	0	1
Sales	732	7.093	2.616	1	8	14
Employees	732	15.760	30.535	0	6	250
Local Tax Factor	732	402.806	51.097	240	400	750

Notes: This table presents summary statistics of *sample I + II*. Variable definitions can be found in Appendix A3. I cannot completely rule out the possibility that there are firms that responded to both surveys. However, as the study by Fochmann et al. (2024) focuses mainly on handicraft firms, whereas the German Business Panel does not, overlaps are less likely.

APPENDIX

A1 Machine Learning Models

Figure 16: Machine Learning Algorithms.
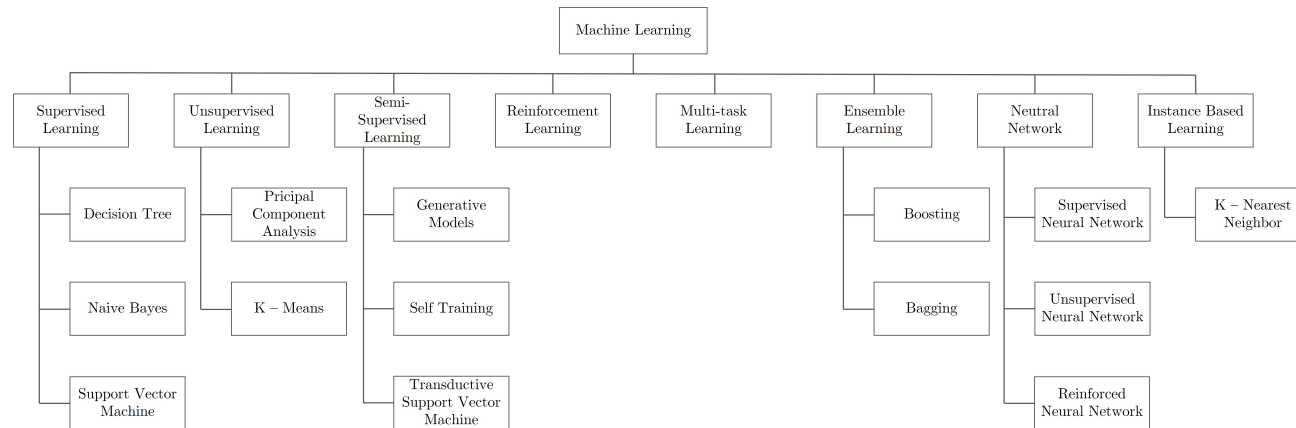
Notes: The figure illustrates commonly used machine learning algorithms. Source: Mahesh (2020).

A2 Procedure XGBoost

XGBoost is short for Extreme Gradient Boosting and is an implementation of state-of-the-art gradient boosted decision trees algorithm, developed by Chen and Guestrin (2016). I use the open source *xgboost* R package provided by Chen and Guestrin (2016) for my analysis. As part of the hyperparameter tuning, I use a five-fold cross-validation and a grid search for hyperparameter tuning. These input parameters[43] include:

Parameter	Definition (Range)
eta	Learning rate based on step size shrinkage used in update to prevent overfitting $[0,1]$
gamma	Minimum loss reduction required to make a further partition on a tree's leaf node $[0,\infty]$
max_depth	Maximum depth of a tree $[0,\infty]$
min_child_weight	Minimum sum of instance weight (hessian) needed in a child $[0,\infty]$
subsample	Subsample ratio of the training instances $(0,1]$
colsample_bytree	Subsample ratio of columns when constructing each tree $(0,1]$
early_stopping_rounds	Stops training if the validation error did not improve in the number of specified rounds $(0,\infty]$
n_rounds	The number of rounds for boosting $(0,\infty]$

Since I rely on two different sets of variables (*all variables* vs. *public variables*) and two dataset *sample I* vs. *sample I + II* for training XGBoost to predict firms' ATR and MTR perception, I need to tune the parameters for each prediction separately. In the following I show the grid for hyperparameter tuning and the results including the best number of iterations after cross-validation (best_iteration).

All Variables– Sample I

Parameter	Range for Grid (Steps)	ATR Perception	MTR Perception
eta	0 - 0.6 (12)	0.44	0.27
gamma	0 - 0.5 (3)	0	0
max_depth	4 - 10 (4)	4	4
min_child_weight	1 - 3 (3)	3	1
subsample	0.8 - 1 (3)	0.9	1
colsample_bytree	0.8 - 1 (3)	0.9	0.9
early_stopping_rounds	50	50	50
n_rounds	20 - 100 (3)	60	20
best_iteration	-	5	11

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[43] Source: https://xgboost.readthedocs.io/en/stable/parameter.html.

Public Variables– Sample I

Parameter	Range for Grid (Steps)	ATR Perception	MTR Perception
eta	0 - 0.6 (12)	0.381	0.327
gamma	0 - 0.5 (3)	0.25	0.25
max_depth	4 - 8 (3)	4	4
min_child_weight	1 - 3 (3)	1	3
subsample	0.8 - 1 (3)	0.8	0.8
colsample_bytree	0.8 - 1 (3)	0.9	1
early_stopping_rounds	50	50	50
n_rounds	20 - 100 (3)	100	100
best_iteration	-	66	84

Public Variables– Sample I + II

Parameter	Range for Grid (Steps)	ATR Perception	MTR Perception
eta	0 - 0.6 (12)	0.6	0.436
gamma	0 - 0.5 (3)	0.25	0.25
max_depth	4 - 8 (3)	4	6
min_child_weight	1 - 3 (3)	2	3
subsample	0.8 - 1 (3)	0.8	0.8
colsample_bytree	0.8 - 1 (3)	0.8	1
early_stopping_rounds	50	50	50
n_rounds	20 - 100 (3)	100	20
best_iteration	-	55	12

Model Prediction Performance

To evaluate the model's prediction performance, I use three metrics: RMSE, MPE, and R^2. The RMSE can be employed to ascertain the precision of a prediction. The MPE demonstrates the average accuracy of a prediction. The R^2 indicates the extent to which the variance in the dependent variable can be explained by the model. The metrics are calculated as follows:

$$\text{RMSE} = \sqrt{\frac{1}{n} \sum_{i=1}^{n} (y_i - \hat{y}_i)^2} \tag{1}$$

$$\text{MPE} = \frac{1}{n} \sum_{i=1}^{n} (y_i - \hat{y}_i) \tag{2}$$

$$R^2 = 1 - \frac{\sum_{i=1}^{n} (y_i - \hat{y}_i)^2}{\sum_{i=1}^{n} (y_i - \bar{y})^2} \tag{3}$$

with:

- n: number of observations

- y_i: survey-based value

- $\hat{y}_i$: predicted value

- $\bar{y}$: average of all survey-based values

A3 Variable Definition

Table 4: Variable Definition.

Name	Definition	Values
Perception		
ATR Perception	= Perceived average tax rate (on retained profits in case of corporations)	metric
MTR Perception	= Perceived marginal tax rate (on retained profits in case of corporations)	metric
Firm Characteristics		
Corporation	= 1, if legal form is corporation, 0 otherwise	binary
Sole Proprietors	= 1, if legal form is sole proprietor, 0 otherwise	binary
Partnership	= 1, if legal form is partnership, 0 otherwise	binary
Profit	= Provided profit (per partner)	metric
Sales	= Range of sales*	metric
Employees	= Number of employees/the average value of the range selected	metric
Handicraft	= 1, if firm is a craft business, 0 otherwise	binary
Local Tax Factor	= Stated local trade tax multiplier	metric
Loss	= 1, if loss occurred in 2019 or 2020, 0 otherwise	binary
Tax Assistance	= 1, if firm gets support from tax advisor, 0 otherwise	binary
Personal Characteristics		
Tax Complexity	= Perceived tax complexity	metric
Tax Compliance Cost	= Estimated tax compliance costs as share of all compliance costs	metric
Trust	= Stated trust in government's handling of tax revenue	metric
Larger Peers	= Perception of larger peers' tax burden	metric
Smaller Peers	= Perception of smaller peers' tax burden	metric
Subjective Tax Literacy	= 1, if respondent states tax knowledge, 0 otherwise	binary
Objective Tax Literacy	= Comprising indicator variables:	metric
Tax Schedule	= 1, if relation average to marginal tax rate accurate, 0 otherwise	binary
Tax Rate Choice	= 1, if using marginal tax rate in business decisions, 0 otherwise	binary
Female	= 1, if stated gender is female, 0 otherwise	binary

Notes: This table presents definitions for *all variables* used in the analysis. * The definition of ranges is shown in Table 5.

Table 5: Range of Sales.

Name	Range in €
Sales	1 = less than 17.500
	2 = 17.501-50.000
	3 = 50.001-100.000
	4 = 100.001-200.000
	5 = 200.001-300.000
	6 = 300.001-400.000
	7 = 400.001-500.000
	8 = 500.001-1.000.000
	9 = 1.000.000-5.000.000
	10 = 5.000.001-12.000.000
	11 = 12.000.000-40.000.000
	12 = 40.000.001-100.000.000
	13 = 100.000.001-500.000.000
	14 = more than 500.000.00

Notes: This table shows the range used for sales within the survey.

A4 OLS Regression– All Variables

Following, I show the OLS regression based on all observations and for *all variables* used as a benchmark to evaluate XGBoost's performance. To conduct the OLS regression, I use a regression of the following simplified form:

$$Perception_i = \alpha + \beta_i \ Characteristics_i + \epsilon_i. \tag{4}$$

Since the focus of this study is on predicting tax rate perception, rather than on inferences, the results are described just briefly. First of all, I find that the *legal form* matters for firms' ATR and MTR perception. Being a *sole proprietor* or *partnership* shows a significant positive association with the ATR perception ($p < 0.01$), which is in line with the progressive tax rate schedule up to 45% compared to the flat tax rate for corporations of 30%. Further receiving *tax assistance* is significantly positively associated with ATR and MTR perception ($p < 0.01$ ($p < 0.05$)). *Trust* in government's handling of tax revenue is significantly negatively associated with firms' ATR and MTR perception ($p < 0.1$ ($p < 0.05$)). *Tax Complexity* and *Tax Compliance Costs* are both significantly positively associated with firms' ATR and MTR perception ($p < 0.05$ ($p < 0.1$) / $p < 0.01$ ($p < 0.5$)). Lastly, *Objective Tax Literacy* shows a significant negative association with MTR perception ($p < 0.01$). Overall, the results highlight, that firm as well as personal characteristics contribute to firms' ATR and MTR perception. The total explanatory power (adjusted R^2) of the OLS regression is 14.4% in case of firms' ATR perception and 13.6% in case of firms' MTR perception.

Table 6: OLS-regression– All Variables– Sample I.

	Dependent variable:	
	ATR Perception	MTR Perception
	(1)	(2)
Sole Proprietors	0.051***	0.026
	(2.642)	(1.056)
Partnerships	0.065***	0.065***
	(4.404)	(3.247)
Log Profit	0.019	0.022
	(1.366)	(1.247)
Sales	0.005	0.0003
	(1.247)	(0.049)
Handicraft	0.025	0.029*
	(1.615)	(1.661)
Local Tax Factor	0.0001	0.0002
	(0.696)	(1.392)
Loss	0.0005	0.0005
	(0.028)	(0.022)
Log Employees	0.011	0.004
	(0.800)	(0.216)
Tax Assistance	0.060***	0.062**
	(2.946)	(2.355)
Female	−0.007	−0.006
	(−0.500)	(−0.349)
Trust	−0.011*	−0.017**
	(−1.664)	(−2.288)
Smaller Peers	−0.010	0.008
	(−0.802)	(0.478)
Larger Peers	0.002	0.001
	(0.189)	(0.087)
Tax Complexity	0.020**	0.018*
	(2.474)	(1.686)
Tax Compliance Costs	0.103***	0.082**
	(3.663)	(2.300)
Subjective Tax Literacy	−0.012	0.001
	(−0.771)	(0.036)
Objective Tax Literacy	−0.003	0.075***
	(−0.387)	(6.554)
Constant	−0.181	−0.253
	(−1.195)	(−1.362)
Observations	448	448
R^2	0.176	0.169
Adjusted R^2	0.144	0.136

Notes: This table shows the OLS regression results of ATR perception in column (1) and MTR perception in column (2). All variables are defined in more detail in Appendix A3. Robust standard errors, t-statistics are in parentheses. ***, ** and * label statistical significance at 1%, 5% and 10% level, respectively.

A5 OLS Regression– Public Variables

Following, I show the OLS regression based on *sample I* and *sample I + II* for *public variables* used as a benchmark to evaluate XGBoost's performance. Again, to conduct the OLS regression, I use a regression of the following simplified form:

$$Perception_i = \alpha + \beta_i \ Characteristics_i + \epsilon_i. \tag{5}$$

Based on *sample I*, being a *Sole Proprietor* is significantly positively associated with ATR perception ($p < 0.01$). Being a *Partnership* is significantly positively associated with ATR (MTR) perception ($p < 0.01$ ($p < 0.01$)). Additionally, the number of *Employees* shows a significant positive association with ATR perception ($p < 0.05$). As expected, the total explanatory power (adjusted R^2) is lower than for *all variables* due to significantly fewer input variables. In the case of firms' ATR perception, it is 8.1% and in case of firms' MTR perception it is 3.8%.

Table 7: OLS-regression– Public Variables– Sample I.

	Dependent variable:	
	ATR Perception	MTR Perception
	(1)	(2)
Sole Proprietors	0.059***	0.031
	(3.659)	(1.439)
Partnerships	0.070***	0.057***
	(4.868)	(2.842)
Sales	0.007	0.005
	(1.529)	(0.973)
Local Tax Factor	0.0001	0.0003
	(0.805)	(1.595)
Log Employees	0.017**	0.013
	(2.118)	(1.299)
Constant	0.169***	0.133*
	(2.626)	(1.674)
Observations	448	448
R^2	0.091	0.049
Adjusted R^2	0.081	0.038

Notes: This table shows the OLS regression results of ATR perception in column (1) and MTR perception in column (2). All variables are defined in more detail in Appendix A3. Robust standard errors, t-statistics are in parentheses. ***, ** and * label statistical significance at 1%, 5% and 10% level, respectively.

Using *sample I + II*, being a *Sole Proprietor* or *Partnership* is significantly positively associated with ATR (MTR) perception ($p < 0.01$ / $p < 0.01$). Additionally, the number of *Employees* shows a significant positive association with ATR (MTR) perception ($p < 0.01$ ($p < 0.05$)). As expected, the total explanatory power (adjusted R^2) is lower than for *all variables* due to significantly fewer input variables. In the case of firms' ATR perception, it is 6.9% and in case of firms' MTR perception it is 3.6%.

Table 8: OLS Regression– Public Variables– Sample I + II.

	Dependent variable:	
	ATR Perception	MTR Perception
	(1)	(2)
Sole Proprietors	0.059***	0.056***
	(5.046)	(3.859)
Partnerships	0.064***	0.062***
	(5.247)	(3.932)
Sales	0.005	0.005
	(1.269)	(1.138)
Local Tax Factor	0.00004	0.0001
	(0.446)	(0.777)
Log Employees	0.019***	0.015**
	(3.383)	(2.180)
Constant	0.212***	0.198***
	(4.232)	(3.418)
Observations	732	732
R^2	0.075	0.042
Adjusted R^2	0.069	0.036

Notes: This table shows the OLS regression results of ATR perception in column (1) and MTR perception in column (2). All variables are defined in more detail in Appendix A3. Robust standard errors, t-statistics are in parentheses. ***, ** and * label statistical significance at 1%, 5% and 10% level, respectively.

A6 Model Performance Metrics

Table 9: Model Performance Metrics– All and Public Variables.

	RMSE in percentage points				MPE in percentage points				R^2 in %			
All Variables– Sample I												
	XGBoost		OLS		XGBoost		OLS		XGBoost		OLS	
	train	test	train	test	train	test	train	test	train	test	train	test
ATR	9.29	13.08	11.02	14.24	1.06	0.85	0.00	-0.13	43.07	23.20	19.79	8.99
MTR	10.95	14.71	14.68	15.63	0.62	0.69	0.00	0.05	54.53	15.67	18.29	4.81
Public Variables– Sample I												
	XGBoost		OLS		XGBoost		OLS		XGBoost		OLS	
	train	test	train	test	train	test	train	test	train	test	train	test
ATR	11.38	14.16	11.94	13.78	0.01	-0.26	0.00	-0.83	14.45	9.98	11.85	-5.06
MTR	14.95	15.84	15.60	16.71	0.14	0.14	0.00	0.74	15.18	2.30	6.21	-2.00
Public Variables– Sample I + II												
	XGBoost		OLS		XGBoost		OLS		XGBoost		OLS	
	train	test	train	test	train	test	train	test	train	test	train	test
ATR	12.93	12.34	13.19	12.47	-0.19	0.87	0.00	-1.24	11.06	8.57	7.39	6.62
MTR	15.29	17.15	15.54	17.63	0.05	-0.59	0.00	0.68	7.90	6.39	4.88	1.03

Notes: This table presents the model performance metrics for the prediction of ATR and MTR perception using XGBoost and OLS regression. The displayed model performance metrics include RMSE, MPE, and R^2, and include results for both test and training data (Sample I, N = 448. Sample I + II, N = 732).

Firms' Willingness to Pay Local Business Tax –
The Impact of Trust and Public Goods*

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Abstract

This study analyzes whether and to what extent the provision of public goods and firms' trust in local governments' handling of local business tax revenues are associated with firms' willingness to pay local business tax. Using survey data on German small- and medium-sized firms, we find that the average perceived provision of public goods is not associated with the willingness to pay local business tax. Separating public goods into private- and business-related public goods, we find that the perception of public goods related to the private sphere of firms' decision-makers is associated with an increase in firms' willingness to pay local business tax by about 10%. However, public goods related to the business sphere show no similar association. Contradictory to the perceived provision of public goods, we find surprisingly no association between firms' willingness to pay local business tax and the actual provision of public goods. Trust in local governments' handling of tax revenue increases firms' willingness to pay local business tax significantly, with an effect size of about twice as large as for the perception of provided private-related public goods. These findings indicate that the handling of tax revenues exerts a more pronounced influence on firms' willingness to pay than the actual utilization of these revenues. Documenting tax revenue implications, we further show that the average willingness to pay local business tax within a local government is associated with a significant decrease in tax avoidance by about 10%. Our results inform local governments about how the provision of public goods and the building of trust can sustainably contribute to firms' willingness to pay local business tax. Thus, our results contribute to the understanding of how taxes can be efficiently collected and effectively used.

Keywords:	Tax Perception, Business Taxation, Tax Avoidance, Public Goods, Tax Revenue
JEL classification:	H25, H26, H41, H71, D91

1 INTRODUCTION

This study examines the extent to which the provision of public goods and firms' trust in local governments' handling of local business tax revenues are related to firms' willingness to pay (WTP) local business taxes. We define firms' WTP local business tax as the difference between the *perceived appropriate local business tax rate* of firm decision-makers, obtained from a survey, and the *actual local business tax rate*, obtained from administrative data. WTP local taxes is important from the perspective of firms and local governments. On the one hand, taxes can influence firms' location and investment decisions (Barrios et al., 2012; Dobbins and Jacob, 2016). Since local business taxes are the main financial resources of local administrative units, such as federal states, provinces, and municipalities, firms' WTP can, on the other hand, impact policy initiatives of regulators (Beeri et al., 2022; OECD, 2019). In general, local taxes make up an important share of tax revenue in many countries (Brülhart et al., 2024) and local governments often rely heavily on local business tax revenues. At the same time, they have the possibility to set the tax rate at their discretion. Therefore, the question arises as to how firms' WTP local business taxes can be sustained (or even increased) to generate stable (higher) revenues for local governments. As local governments are also responsible for tax revenue spending, we investigate how firms' WTP local business tax is influenced by the provision of locally provided public goods. Further, we examine if firms' trust in local governments' handling of business tax revenues is associated with firms' WTP local business tax. By distinguishing between perceived public goods, the utilization of tax revenues, and trust, the handling of tax revenue, we are able to separate these two effects. To demonstrate the tax revenue implications of our findings, we show that firms' WTP local business tax is significantly associated with the extent of tax avoidance on a local level.

A large strand of analytical and empirical tax research shows that the provision of public goods and trust in authorities can influence the tax-paying behavior of individuals (Spicer and Lundstedt, 1976; Cowell and Gordon, 1988; Alm, Jackson, and McKee, 1992a; Kirchler et al., 2008) and that the WTP taxes is closely linked to the type of public goods provided (e.g., Glaser and Hildreth, 1999; Anderson, 2017; Beeri et al., 2022). However, surprisingly little is known about these effects for firms.[1] We fill this research gap by investigating determinants of small- and medium-sized enterprises' (SMEs') WTP local business tax and its local tax revenue consequences.

We extend the literature on individual's WTP, public goods provision, and trust in authorities with findings on firm behavior. Although individuals ultimately make decisions in firms, there are firm-specific aspects that influence the behavior of firms: First of all, they are subject to their own specific tax environment.

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[1]   One exception is Ng et al. (2020). They use a small sample of SMEs in Malaysia to analyze the influence of awareness of penalties, ethics, perceived government spending, and quality of service influencing SMEs' WTP taxes.

In our setting, firms are subject to the local business tax, which is handled by and used within the municipality to generate tax revenue, being essential for the provision of public goods. Second, firms are subject to multiple taxes. Therefore, taxation may be more complex (e.g., McKerchar et al., 2005; Kamleitner et al., 2012; Hoppe et al., 2023).[2] It seems reasonable to assume that firms' perception of the tax burden, and thus also their WTP, is affected by their experience of dealing with complex tax procedures. Third, firms compete with one another. The level of the local business tax rate can impact a firm's competitiveness – especially when tax rates vary across local governments. It is possible that the positive effect of providing more (better) public goods may be offset by the resulting competitive advantage of higher tax rates. Fourth, other differences between firms and individuals include firms' facing (board) reputation as well as differences in their structure, size, compliance costs, and risk preferences (OECD, 2019). All of these aspects could shape the views of firm decision-makers and lead them to value the provision of public goods and the spending of tax revenues differently in comparison to individual taxpayers. By clearly focusing on firms, our study contributes to closing this research gap. The relevance of this topic is stressed by an OECD report stating that a "better understanding of what motivates taxpayers to participate in, and comply with, a tax system is valuable for all countries and stakeholders" (OECD, 2019, p. 3). Our study directly answers the OECD's call for further research on firm behavior.

Moreover, we address the call for research on SMEs and private firms, e.g., Hanlon and Heitzman (2010) and Lisowsky and Minnis (2020) by focusing on these highly relevant firms. Survey data on SMEs is particularly scarce. We contribute to providing insights into the most represented group of firms in OECD-countries (OECD, 2017). In most OECD-countries, SMEs are responsible for more than 50% of the gross domestic product (International Labour Organization, 2019). However, although SMEs, in our case craft firms, are important to countries' economies, studies of them are rare in the accounting literature. Our sample also includes many private firms. Again, despite their importance in the business landscape (Allee and Yohn, 2009; Lisowsky and Minnis, 2020), they are rarely the focus of the accounting literature.

In general, the primary objective of taxes is to generate government revenue – then used to maintain the state budget. In about one third of all OECD-countries, including e.g., the US, Canada, and Germany, taxes are collected at the federal and the local level (Bundesministerium für Finanzen, 2024; Government of Canada, 2024; PwC, 2024).[3] The federal government levies income and corporate tax, and the local governments levy local business taxes. For local governments, these business taxes are an important source of revenue to fund their expenses (Buettner & Poehnlein, 2024). In Germany, e.g., local municipalities provide almost 50% of all public investment and thus significantly contribute to basic services (Fratzscher, 2023). Since the local

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[2]   See Hofmann et al. (2008) for an overview of the impact of complexity on individuals tax compliance behavior.
[3]   Appendix A2 provides an overview of local business taxes in OECD-countries.

business tax is paid by firms located in a municipality[4], the collection of local business tax corresponds to an exchange relationship (Spicer and Lundstedt, 1976; Glaser and Hildreth, 1999). From a firm's (municipality's) perspective, this relationship is as follows: paying (receiving) taxes and receiving (providing) public goods. To ensure the long-term viability of this relationship, it is essential that both parties perceive the exchange as appropriate. This concerns the amount of taxes to be paid and the public goods to be received, as well as the trustworthiness of municipalities in handling tax revenues. This is particularly important for SMEs, which are rarely in a position to provide traditional public goods such as infrastructure themselves. They are heavily dependent on the provision of public goods by local governments. Local governments face a trade-off in this exchange-relationship. They can either lower the local business tax rate or increase the provision of public goods to match firms' demand. Both alternatives have limits. The local governments need to raise sufficient revenues to maintain (necessary) expenditures and offer basic services, restricting it to set the tax rate below a certain threshold. At the same time, local tax competition may also be a factor, necessitating municipalities to respond to tax rate reductions by other municipalities to maintain their attractiveness for firms (Wildasin, 2003; Langenmayr and Simmler, 2021; Buettner and Poehnlein, 2024). Another option is to optimize the provision of public goods so that firms perceive their tax rate as adequate (Beeri et al., 2022). Despite the widespread use of local business taxes in OECD-countries, there is little evidence on whether and to what extent the provision of public goods affects firms' WTP local business tax and which public goods firms consider important. The same is true for the impact of trust in local governments' handling of tax revenues on firms' WTP local business taxes.

We test these associations for firms using the institutional framework of the German local business tax. Each municipality, the local government[5], levies a local business tax on firms, the so-called trade tax. The German trade tax is well-suited for our analysis for several reasons. First, there is considerable variation in tax rates at the municipal level,[6] which allows us to estimate the association of the provision of public goods as well as the trust in municipalities' handling of tax revenues. Second, municipalities are important providers of public goods, with high levels of public investment financed mainly by local business tax revenues, providing a testable direct link between local business tax revenues and the provision of public goods. Third, municipalities can change the tax rate – through the business tax multiplier[7] – but not the tax base, which allows for easy comparisons across municipalities (Fuest et al., 2018). Finally, although municipalities are largely independent in terms of their trade tax rate and public goods provision, they all share the same

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[4] See Fuest et al. (2017) for a differentiated consideration of the bearers of trade tax (increases) in Germany.
[5] Throughout this paper, we refer to municipalities as one example of a local government.
[6] We follow Fuest et al., 2018, p. 395, who highlight the advantage of using "substantial within-country variation in statutory municipal tax rates."
[7] The trade tax rate is determined by multiplying the so-called trade tax multiplier by the basic trade tax of 3.5% (German Trade Tax Act).

institutional background of being part of Germany, which reduces unobservable confounding factors (Buettner & Holm-Hadulla, 2008).

For our analysis, we combine survey data on German handicraft SMEs with administrative data on the actual public goods provision and local business tax rates. To measure firms' WTP local business tax, we examine differences between the tax rate that firms consider to be appropriate and the actual tax rate. We label this as the *additional local business tax rate*. To determine the additional local business tax rate, we rely on our survey data for the appropriate tax rate and archival data from the German Federal Statistical Office for the actual tax rate.[8] For our variable of interest, trust, we rely on our survey data. We ask firms to indicate how much they trust municipalities to handle tax revenues. For the other variable of interest, the provision of public goods, we distinguish two forms: First, the *perceived provision of public goods*, which represents firms' satisfaction with the public goods provided. For firms' perceptions of the provision of public goods in the municipality in which they are located, we rely on our survey data. Second, the *actual provision of public goods*. We determine the actual provision of public goods based on archival data from the INKAR-database[9]. With regard to the actual provision, we also examine the effect of the salience of public goods. We define salience as the difference between firms' perceptions of the provision of public goods (satisfaction) and the actual provision of public goods in the municipality. Since we are also interested in the types of public goods that impact firms' WTP local business tax, we distinguish between *private-related public goods*, which mainly affect the personal sphere of the firm's decision-makers (kindergarten/daycare, primary schools, recreational areas, police stations, and hospitals), and *business-related public goods*, which mainly affect the business sphere (secondary schools, vocational schools, motorway connection, railway stations, and public transportation).

We find that firms' average satisfaction with the provision of all public goods has no impact on firms' WTP local business tax. However, differentiating by the type of public good, we find significant associations for private-related public goods, but not for business-related public goods. In our baseline regression, a one standard deviation increase in firms' satisfaction with private-related public goods increases the WTP local business tax by 10%. Using total local business tax revenues of €75 billion for 2023, this translates into additional local business tax revenues for municipalities of more than €2.8 billion (3.74% of total local business tax revenues).[10] From the different effects of *private- and business-related public goods*, we conclude

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[8] Fochmann et al. (2023) use a similar approach but focus on the (mis)perception of the actual tax rate whereas we exclude any misperception by using administrative data on the actual tax rate.

[9] The INKAR-database of the Federal Institute for Building, Urban and Regional Research is available at https://www.inkar.de/.

[10] We do not infer any cost-benefit estimates for municipalities in this study. Also, when considering the magnitude, it is important to note that the provision of public goods has diminishing marginal utility. Above a certain threshold, the provision of public goods does not lead to additional benefits for firms, i.e. the WTP the local business tax, and thus, the tax revenue does not change.

that public goods are valued differently. As we can assume in the case of SMEs that a large proportion of the decision-makers in firms surveyed not only work but also live in the respective municipality, the appreciation of private-related public goods is a non-surprising result. What is surprising, however, is that public goods, which are associated with firms' activities, are valued less, even though they are usually not substitutable by firms themselves (e.g., highway access or vocational schools). In contrast, the actual provision of public goods, has neither for all nor for private- or business-related public goods, an impact on firms' WTP local business tax. Leading to the conclusion that the subjective perception is more relevant than the actual provision. We also document a strong association between firms' trust in municipalities' handling of local business tax revenues and their WTP local business taxes of up to 21%, based on total local business tax revenues of €75 billion for 2023, this translates into additional tax revenues for municipalities of €5.61 billion (7.48% of total local business tax revenues). It is particularly striking that the (economic) effect of trust on firms' WTP local business tax is considerably larger, about twice the size, than that for the provision of private-related public goods. This suggests that the handling of tax revenues impacts firms' WTP local business tax more than the actual utilization of these revenues. Finally, we show a (also economically) significant correlation between the stated WTP local business taxes and tax avoidance in the municipality. An increase in the absolute additional local business tax rate (relative additional local business tax rate) leads to an increase in the average ETR of about 10% (11%), highlighting the tax revenue consequences of firms' WTP.

Our research provides first insights into SMEs' WTP local business tax and drivers of such. In this way, we provide important evidence that can contribute to a long-term, sustainable, and (perceived) appropriate exchange relationship between firms and local governments. These findings are particularly important for policymakers. We highlight the importance of firms' satisfaction with provided private-related public goods and the building of trust between firms and local governments. Future research can build on our findings and further investigate the importance of the provision of public goods and trust for firms' WTP local business tax, especially for large firms.

2   LITERATURE AND HYPOTHESES DEVELOPMENT

Several strands of the literature examine drivers of taxpayers' WTP taxes. However, there is still no clear definition of WTP. The main question is whether firms' WTP reflects their willingness to pay the legally required amount of taxes (tax compliance) or whether it is solely a matter of the firms' willingness to pay more taxes (see e.g., Hofmann et al., 2008; Zhang et al., 2016; Iraman et al., 2021). In this study, we adopt the more expansive view of what constitutes WTP, including firms' tax compliance. Thus, we build our

hypothesis both on the literature on tax compliance and WTP taxes, focusing on the provision of public goods and WTP, as well as on the relationship between trust in local governments' handling of tax revenues and WTP.

A first strand of the literature examines the relationship between public goods provision and WTP taxes for individual taxpayers. Prior studies show that the provision of public goods influences the tax-paying behavior of individuals – especially in small (local) economic systems. E.g., Spicer and Lundstedt (1976) show in an extension of the Allingham-Sandmo-Model (Allingham & Sandmo, 1972) that tax evasion becomes more likely if taxpayers perceive the exchange of public goods and tax payments as not appropriate – i.e., their contribution as too high. Cowell and Gordon (1988) extend the Allingham-Sandmo-Model by adding the benefits of public goods for taxpayers. In small economies, where taxpayers perceive their contribution as relevant, they show that the provision of public goods can limit tax evasion if the benefits are sufficiently high. Several laboratory experiments support these theoretical results for individuals. Alm, Jackson, and McKee (1992a) show that introducing a public good increases the tax compliance of taxpayers and Alm, Jackson, and McKee (1992b) find that the extent of tax evasion decreases with the introduction of public goods. Additionally, Alm, Jackson, and McKee (1992c) provide evidence that the existence of public goods reduces the extent of tax evasion. Alm, McClelland, and Schulze (1992) show that the higher the benefit a taxpayer derives from public goods, the less tax is evaded. However, this effect is limited. These results are in line with Torgler (2004) showing that the higher the benefit taxpayers can generate from public goods, the less taxes they evade. However, increasing deterrent measures, such as the audit probability or penalties, leads to a decrease in tax compliance. We go beyond these findings for individuals and focus on firms. Given the structural differences between firms and individuals, (e.g., firms' specific tax environment, tax complexity, market competition) as well as the economic significance of firms and corporate taxes, prior results on individuals cannot be transferred directly to our setting. We enhance the literature by examining the effect of the provision of public goods on firms' WTP local business tax. We expect that firms' WTP local business tax, especially in the context of small economies (at the municipal level), is positively influenced by the provision of public goods and therefore hypothesize that the provision of public goods shows a positive association with firms' WTP local business tax.

In addition to the provision of public goods, the literature has also investigated the explicit use of public goods. Güth et al. (2005) show that the way tax revenues are used impacts tax compliance. Taxpayers evade less taxes if tax revenue spending is restricted to public goods in the local area compared to when several regions are financed jointly. This is of importance since municipalities are characterized by regionality. Iraman et al. (2021) show that individuals' WTP taxes increases with the provision of information on government

spending, but only if the tax revenue generated is allocated to specific causes, such as healthcare. Wahl et al. (2010) also show that individuals who are involved in the decision-making process regarding the utilization of tax revenue exhibit a higher WTP taxes. In this line, Li et al. (2011) show similar negative effects on individuals' WTP taxes when citizens are not involved in the process. We add to this literature by not only examine the general provision of public goods, but also differentiating the type of public good provided. While we expect a positive association between the provision of public goods and firms' WTP local business tax, we hypothesize that the strength of this association varies with the type of public good provided.

The presented literature mostly examines the relationship between public goods and firms' WTP in laboratory experiments. It can thus be assumed that the participants were presented with information regarding the provision of public goods that corresponds to the actual provision of public goods. But a substantial body of literature indicates that tax-related perceptions often differ significantly from reality – especially for perceptions of tax rates. For individuals, there are numerous studies identifying and quantifying individuals' tax rate perception (e.g., Schmölders, 1960; Enrick, 1963; Gensemer et al., 1965; Brown, 1969; Auld, 1979; Fujii and Hawley, 1988; Rupert and Fischer, 1995; Jackson and Hatfield, 2005; Gideon, 2014; Gideon, 2017; Blaufus et al., 2015; Ballard and Gupta, 2018; Stantcheva, 2021, and an extensive literature review by Blaufus et al. (2022)) showing that perceptions affect investment and financing decisions, risk-taking and tax planning, real effort, consumption, and retirement saving strategies.

The evidence for firms is less extensive. However, there is evidence that this phenomenon is also applicable to firms (Graham et al. (2017); Fochmann et al. (2024)). To account for this, we examine both the relationship between the perceived and the actual provision of public goods and firms' WTP local business taxes. Following prior studies documenting the significance of perceptions, we hypothesize that the perception of provided public goods is the crucial metric, rather than the actual provision of public goods. Taken together, we formulate the following two hypotheses concerning the association of public goods and firms' WTP local business tax.

> *H1a: Higher satisfaction with the provision of public goods increases firms' WTP local business*
> *tax – the strength of the association varies with the type of public good.*

> *H1b: The actual provision of public goods does not increase firms' WTP local business tax.*

Another strand of literature, based on the slippery slope model by Kirchler et al. (2008), shows a positive relationship between trust in tax authorities and individuals' tax compliance. Torgler (2003), Torgler et al. (2008), Wahl et al. (2010), Batrancea et al. (2019), D'Attoma (2020), and Matthaei et al. (2023) empirically

demonstrate that trust in authorities increases tax compliance.[11] Aktaş Güzel et al. (2019) show that this is also true for independent accounting professionals. Muehlbacher et al. (2011) further show that "trust in tax authorities [is] the strongest predictor of voluntary tax compliance" (Muehlbacher et al., 2011, p. 95). Batrancea et al. (2019) confirm this result and show that for trustworthy authorities – perceived as benevolent and promoting the common good – voluntary compliance is the highest. Studies focusing on the concept of tax morale and individuals' WTP taxes, confirm the positive effect of trust (Beeri et al., 2022). Anderson (2017) also documents that trust has a significant positive impact on WTP taxes for public goods – but the effect can vary across different types. So far, this literature mostly ignores firms. We address this research gap and investigate the influence of trust, more specific trust in local governments' handling of tax revenues, on firms' WTP. Applying prior studies' findings to our setting, we hypothesize that trust and firms' WTP local business tax are positively associated. Thus, we put forward the following hypothesis:

> *H2: Higher trust in municipality's spending of local business tax revenue increases firms' WTP local business tax.*

3   SURVEY DESIGN AND SAMPLE

We built our analysis on data from a survey on German SMEs developed and collected in cooperation with the German Confederation of Skilled Crafts. Our questions are based on insights from existing literature on analyzing the behavior of taxpayers (e.g., Schmölders, 1960; Blaufus et al., 2022; Fochmann et al., 2024). The questions were integrated into a special survey of the German Confederation of Skilled Crafts.[12] The online survey was conducted between August 21 and 28, 2023. This questionnaire was used to survey craft firms throughout Germany. The firms were contacted via the German Confederation of Skilled Crafts. Due to the broad distribution of the questionnaire, we only know the characteristics of the responding firms. We do not know the characteristics of all contacted firms, but we refer to the Census of Crafts evaluations for a description of these characteristics.[13] Participation in the survey was anonymous.

Our study builds on the characteristics of the German local business tax system, the so-called trade tax. The trade tax is part of a compound tax levied on businesses. The trade tax rate is determined by multiplying the reported trade tax multiplier by the basic trade tax of 3.5% (German Trade Tax Act). While

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[11]   We concentrate on the trust taxpayers have in authorities rather than taxpayers being treated trustfully by the authorities, which is another important strand of literature, see e.g., Feld and Frey (2002).

[12]   For more information on the special survey ("Sonderumfrage") see: https://www.zdh.de/ueber-uns/fachbereich-wirtschaft-energie-umwelt/sonderumfragen/zdh-umfragen-zu-den-auswirkungen-des-ukraine-kriegs/umfrage-zur-den-aktuellen-herausforderungen-kw-34/2023/.

[13]   In addition, we cannot determine how many enterprises were aware of our survey. Therefore, it is not possible to calculate a response rate.

the base trade tax is fixed at 3.5%, the trade tax multiplier is set separately by each municipality and can vary, with a minimum of at least 200% up to 650% in 2022. Therefore, the amount of revenue generated within a municipality is largely determined by the trade tax multiplier set by each municipality. As the trade tax multiplier is the decisive characteristic for determining the trade tax rate, we focus on this in our survey. Figure 1 highlights the differences of the multiplier across German municipalities. The darker the color, the higher the tax rate multiplier in the respective municipality. Overall, there is a wide variation in multipliers across Germany, with lower levels in eastern Germany and Bavaria and higher multipliers especially in North Rhine-Westphalia.

< Insert Figure 1 about here >

In general, the compound tax for non-corporations, namely sole proprietorships and partnerships, is made up of the progressive income tax plus solidarity surcharge[14] and the trade tax. For corporations, it includes the flat corporate tax, plus the solidarity surcharge and the trade tax. Non-corporations are subject to the transparency principle, so that profits are generally considered for income tax purposes at the level of the involved partners. The only exception is the trade tax: This is incurred at the level of the partnership itself. To avoid double taxation, arising from trade tax at the partnership level and income tax at the partner level, the legislator allows a credit of trade tax[15] at the partner level. The tax credit is to avoid double taxation but does not lead to lower trade tax revenues for the municipality, as the trade tax is paid as usual, but is taken into account when calculating the income tax burden of the respective partner. As a result, the municipalities do not suffer any disadvantage from this tax credit. Nevertheless, this special regulation has the potential to alter the perception of the tax burden among non-corporations. On the one hand, the procedure may not be fully comprehended, leading to the erroneous impression that no trade tax is payable as a consequence of the tax credit. Alternatively, the tax credit may have a purely psychological effect, whereby the burden is perceived as lower due to the fictitious reduction (which, in reality, only represents an avoidance of double taxation). Conversely, the burden may be perceived as higher if there is a feeling of double taxation, that is, if the effect of the tax credit is not fully understood.[16] Corporations, on the other hand, are subject to the separation principle. Profits are subject to both corporate and trade tax at the firm

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[14] The solidarity surcharge is based on the income tax and is 5.5% of the income tax (Section 4 Solidarity Surcharge Code).
[15] According to § 35 German Income Tax Act.
[16] As a complete credit is only possible up to a levy rate of approximately 400%, we examine in additional tests (untabulated) the difference in the additional local business tax rate for non-corporations located in municipalities with a levy rate of over and under 400%. We find a significant difference in the perceived additional local business tax rate. Both the absolute and relative additional local business tax rate is higher for non-corporations in municipalities with a levy rate of > 400%. However, this significant difference is equally evident for corporations. No difference between the legal forms is observed, suggesting that the effect is not due to (insufficient) allocation.

level. In both cases, the trade tax is to be paid to the municipality.[17]

In developing the survey, we received feedback from the German Confederation of Skilled Crafts. The survey consists of three main parts being the basis for this study: (1) We ask for firm characteristics, such as legal form, number of employees, sales, industry, and the federal state. (2) We ask firms about the trade tax multiplier they perceive as appropriate within their municipality.[18] To determine the actual trade tax multiplier, we ask for the zip code of the municipality where the firm is located. (3) We are interested in firms' perception of public goods provided in their municipality. Therefore, we ask firms how they would rate the provision of public goods (kindergartens/daycare, primary schools, secondary schools, vocational schools, hospitals, recreational areas, police stations, efficient municipal administration, motorway connection, railway connection, public transportation)[19] in their municipality. Finally, firms were asked how much they trust their municipality to handle the trade tax revenues responsibly.[20]

For the ease of interpretation, from now on, we will rely on the trade tax rate as the local business tax rate, calculated by applying the basic trade tax to the trade tax multiplier. Further, we will refer to the trade tax rate as the local business tax rate. The chosen research design has some limitations. As is common in surveys, self-selection bias (see e.g., Bethlehem, 2010) cannot be completely ruled out. However, this is less likely because the questionnaire included questions on topics other than the local business tax. Similarly, we cannot definitively verify whether the respondents answered the questions seriously. However, honest answers are to be expected as the survey guarantees full anonymity. We avoid framing effects by using neutral language.

In total, 2,496 firms responded to the survey. After excluding firms that did not answer questions relevant to this study, we are left with 1,695 observations (firms). Of these, we exclude 1,152 due to missing administrative information, leaving us with 543 observations for our main analysis. Of these firms, 41.6% are sole proprietorships, 9.6% are partnerships (24.5% mixed forms), and 24.3% are corporations. On average (median), the surveyed firms employ 37 (10) employees. 34.2% of the firms have a turnover of up to €500,000,

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[17] If a firm has multiple operating sites in different municipalities, the trade tax assessment base is apportioned among the municipalities according to the share of total wages, see e.g., Eichfelder et al. (2023). Given the size of the firms surveyed, this plays a minor role in our study. Additionally, the municipalities receive 15% of the revenue from income tax as well as 12% of the revenue from capital gains tax (German Municipal Finance Reform Act).

[18] We refrain from asking for the tax rate since the trade tax multiplier is more salient, and this way we avoid bias in the statement due to computational difficulties (Chirvi et al., 2021).

[19] Within the survey, we also asked for the category university. Due to a comparably small number of responses and the small number of municipalities with universities in general, we exclude this variable from our analysis.

[20] The full set of questions is listed in Appendix A1 of this paper in more detail.

54.1% between €500,000 and €5 million and 13.6% over €5 million. We consider all firms to be SMEs.[21] There are regional concentrations in Hesse (23.4%), Northrhine-Westphalia (18.6%), and Lower Saxony (16.2%). Among the skilled trades, metal workers (17.7%), electricians (9.9%), and plumbers and fitters (8.7%) are the most strongly represented in the survey. Overall, the survey sample represents the German craft firm landscape very well as illustrated in Table 1.

< Insert Table 1 about here >

Based on our survey design, we collect firm characteristics, information on the local business tax rate perceived to be appropriate, and the satisfaction with and actual provision of public goods, as well as the trust in the use of tax revenues in the municipality. Table 2 provides an overview of the survey variables.

< Insert Table 2 about here >

4 MEASURING APPROACH

First, we measure firms' WTP local business tax. Since for our main analysis we are primarily interested in the amount of taxes firms are willing to pay, rather than whether they want to pay it at all (some would call this tax compliance (Iraman et al., 2021)), we focus on the difference between the actual tax rate and the perceived appropriate tax rate. Therefore, to measure firms' WTP, we use the additional local business tax rate as a proxy and define it as follows:

$$Additional\ local\ business\ tax\ rate_i = \tag{1}$$
$$Actual\ local\ business\ tax\ rate_j - Perceived\ appropriate\ local\ business\ tax\ rate_i.$$

The additional local business tax rate corresponds to the difference between the actual local business tax rate within the municipality j and the one deemed appropriate by the firm i. The subjectively perceived difference between the actual and the perceived appropriate local business tax rate is the important metric[22], since it measures the amount of taxes firms perceive to pay too much or (in rare cases) too little. To determine the additional local business tax rate, we supplement the questionnaire data with the local business tax rate for each municipality.[23] We match this information based on the zip code provided in the survey using the

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[21]   Based on Section 267 (2) No. 2 German commercial code of the German Commercial Code (HGB), firms are SMEs if they have fewer than 250 employees and generate sales of less than €10 million. In the survey, however, we only asked about 50 or more employees and revenues of €10 million or more. Therefore, the number of SMEs cannot be determined with certainty. However, since 93.7% of the firms surveyed already fall into the category of less than 50 employees and less than €10 million in turnover, and the results of the official craft structural data 2021 show that 99.6% of all craft firms can be classified as SMEs (https://www.destatis.de/DE/Themen/Branchen-Unternehmen/Handwerk/aktuell-struktur-handwerk.html), we are confident that the firms surveyed are SMEs.

[22]   See e.g., Blaufus et al. (2010); Blaufus et al. (2022), Körösi and Maiterth (2022) for the relevance of perceived tax rates.

[23]   The summary statistics for the actual local business tax rate are shown in Appendix A5.

latest administrative data (2022) from the Federal Statistical Office (Statistische Ämter des Bundes und der Länder, 2023). We rely on this matching approach, rather than asking for the actual tax rate, to eliminate the influence of potential tax rate misperception (Fochmann et al., 2024). The summary statistics for the additional local business tax rate are shown in Table 2.[24]

To investigate our research questions, we also measure firms' trust in the municipality's handling of tax revenue, firms' perception of the provision of public goods, and the actual provision of public goods. To measure trust, we built on our survey data. We rely on the firm's individual assessment of how trustworthy the municipality is in handling tax revenues. To measure firms' perception of the provision of public goods, the satisfaction with public goods, we use our survey observations. To determine the actual provision of public goods, we use two measures: First, the actual provision of public goods within the respective municipality. To proxy for the objective, actual provision of public goods, we use administrative data from the INKAR-database provided by the German Federal Institute for Research on Building, Urban Affairs and Spatial Development. The publicly accessible database provides up-to-date regional statistical information on topics such as education, demographics, the labor market, the economy, housing, transportation, and the environment – both for Germany and for Europe.[25] To determine the actual provision of public goods within a municipality, we identify those public goods within the database that we also cover in our survey. See Appendix A4 for an overview of the matched public goods. In the next step, we transform the administrative data from INKAR to be able to compare it to the survey data. First, we scale all public goods by the size of the municipality (population in 2022).[26] This allows us to compare municipalities of different sizes. Second, we adjust the INKAR-data to match a 6-point Likert scale as used in the survey. We divide the values for the actual public goods (N = ~10.000) into six percentiles. Municipalities with the highest scores are assigned a six, while those with the lowest scores are assigned a one.[27] Afterwards, we match our survey data with the INKAR-data based on the municipality code from our survey data.[28] Second, we are also interested in the difference between our survey observations, the perception of public goods, and the actual provision. We define this difference as a measure of objective *salience.* We illustrate our proceedings with a fictitious example of the provision of elementary schools in Table 3.

< Insert Table 3 about here >

With regard to the satisfaction with and actual provision of public goods, we are particularly interested

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[24]   We provide variable definitions of all variables used in Appendix A3.
[25]   For information see https://www.inkar.de/.
[26]   Some of the data is already available in scaled form. In this case we do not scale them again.
[27]   See Appendix A5 for the results of this procedure.
[28]   In some cases, the provision of public goods is only available at the district level. When this is the case, we use the district code to match the public goods to the municipality level.

in which public goods are important for the firms surveyed. For this purpose, we group the variables into *private-* and *business-related* public goods. We assign to the *private-related* group those variables that are increasingly related to the firm decision-makers' personal sphere of life, focusing on children and general supply. Variables that are more relevant to the firms are assigned to the *business-related* group, focusing on infrastructure and vocational training. Even if no definite categorization is possible, there are clear tendencies in the individual variables that lead to the grouping in (1) private-related: *kindergarten/daycare, primary schools, recreational areas, police stations, hospitals* and (2) business-related: *secondary schools, vocational schools, motorway connection, railway stations, public transportation.*[29] To substantiate our assignment, we consider the pairwise correlations of these variables. The results in Appendix A6 show that there are particularly high correlations between *motorway connection, railway stations and public transportation.* The same applies to *secondary schools* and *vocational schools.* The classification into a group of *business-related public goods* therefore appears legitimate. We also find a high correlation between *kindergarten/daycare* and *primary schools*, as well as between *primary schools* and *recreational areas.* Furthermore, *police stations* show a high correlation not only with *recreational areas* and *primary schools*, but also with *hospitals.* The assignment to a common group therefore also appears legitimate for the *private-related public goods.*

5   RESULTS

5.1   Public Goods and Trust

Theoretical and empirical studies have already shown that the provision of public goods influences individual taxpayers' behavior (see e.g., Spicer and Lundstedt, 1976; Cowell and Gordon, 1988; Alm, McClelland, and Schulze, 1992; Alm, Jackson, and McKee, 1992b and Torgler, 2004). To measure the impact of the provision of public goods on firms' WTP local business tax, we first consider the perceived provision of public goods by the surveyed firms. In the survey, we asked firms about the provision of various public goods: kindergartens/daycare, primary schools, secondary schools, vocational schools, hospitals, police stations, recreational areas, efficient municipal administration, motorway connections, railway stations, and public transportation.[30] Figure 2 shows the distribution of ratings for each public good, providing deeper insights into firms' satisfaction with the provision of public goods.

< Insert Figure 2 about here >

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[29]   At this point, we refrain from categorizing *'efficient municipal administration'* because it can be equally associated with both the private- and business spheres, and unlike the considered variables, no tendency towards one area can be derived.
[30]   The average values and medians of the ratings are displayed in Table 2.

Our results illustrate the differences in satisfaction with the provision of public goods in the municipalities of the surveyed firms. A left-skewed distribution indicates higher satisfaction than a right-skewed distribution. Accordingly, the surveyed firms are most satisfied with *recreational areas*, *primary schools*, *railway stations* and *motorway connections*. In contrast, the surveyed firms are least satisfied with the provision of *efficient municipal administration*, *vocational schools*, and *public transportation*. Public goods associated with childcare and leisure activities tend to be rated more favorably. This also applies to infrastructure, except for public transportation. Public goods that ensure general supply, such as the presence of police stations and hospitals, receive mixed ratings. The same applies to schools beyond the primary level. The efficient municipal administration, which we name as a separate category, is the least satisfactory. Categorizing public goods into *private- and business-public goods* we find no differences in the overall degree of satisfaction with the provision of these public goods. The results are shown in Table 4.

< Insert Table 4 about here >

Referring to our definition of actual public goods, we illustrate the *provision of actual and salient public goods* in a next step. Again, we first examine all public goods individually. Table 5 shows the results.

< Insert Table 5 about here >

The results show that the average provision of public goods varies depending on the public good. We find particularly high average values for *vocational schools*, *efficient municipal administration*, and *hospitals*. Comparatively low values are found for *recreational areas* and *public transportation*. With regard to salience, our results show that the provision of public goods is mostly overestimated – supporting the idea that public goods are rather salient. Exceptions are *efficient municipality administration, vocational schools, and hospitals*. On average, they are perceived to be provided less than they actually are (less salient). We find positive values of 0.83 and 1.2 for *private- and business-related public goods*, suggesting that the provision of both is perceived by respondents to be more comprehensive than it actually is. According to our definition, both *private- and business-related public goods* are perceived as salient. However, the results show a significant difference in the magnitude of salience between *private- and business-related public goods*, with *business-related public goods* being more salient ($p < 0.01$).

5.2 Firms' WTP

In relation to our research question, namely whether the provision of public goods and trust influence firms' WTP local business tax, we have already outlined firms' satisfaction with and provision of public goods in the previous section. We proceed to examine the second component, firms' WTP local business tax.

Table 6 shows our measure of WTP the average additional local business tax rate for all surveyed firms. Since the taxation procedure depends on the legal form of the firm, as shown in Section 2, we distinguish between non-corporations and corporations. The results in Table 6 illustrate that both non-corporations and corporations are confronted with a significant perceived additional local business tax rate. Regardless of the legal form, firms consider a reduction in the local business tax rate of, on average, 37.4% to be appropriate. Concerning the legal form, non-corporations consider an average reduction of around 38.5% and corporations consider an average reduction of 35.4% to be appropriate.[31]

< Insert Table 6 about here >

Our analysis shows that non-corporations perceive a higher additional local business tax rate than corporations. The findings indicate that the trade tax credit for non-corporations outlined in section 3 does not result in non-corporations perceiving a reduction in their overall tax burden. Conversely, the results indicate that non-corporations misjudge the effect of the tax credit, leading to the perception of a higher tax burden. This is also reflected in the desire for a greater reduction in the tax burden. However, our results are in line with Fochmann et al. (2023) who also demonstrate that non-corporations perceive a higher additional income tax rate (total income taxes) than corporations.[32] This suggests that the observed difference in behavior between non-corporations and corporations is not primarily attributable to the trade tax credit.

Further, Cowell and Gordon (1988) show that for small economies in which taxpayers perceive their contribution as relevant, the provision of public goods can have a restrictive effect on individual tax evasion. Surprisingly, the comparison between the total additional income tax rate and the extracted additional local business tax rate shows that non-corporations (corporations) perceive a reduced combined income tax rate of 37.6% (33.0%) versus 38.5% (35.4%) as appropriate. This comparison suggests that firms are about equally willing to pay local business tax compared to taxes at the federal level. This difference in behavior between firms and individuals confirms the need for a separate investigation.

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[31] However, the difference in the additional local business tax rate is not statistically significant on conventional levels.

[32] In the case of distributing corporations, the effect is reversed. Here, Fochmann et al. (2023) conclude that the effect is a result of the addition of a further tax (income tax at shareholder level). As local business tax remains unaffected by this, we refer to reinvesting corporations as a comparison group.

5.3 Effect of Public Goods and Trust on Firms' WTP

In the previous sections, we have shown in detail how the surveyed firms perceive the provision of various public goods in their municipality. In doing so, we provide an overview of trust in municipalities' handling of tax revenue, the average satisfaction with and actual (salient) provision of public goods and demonstrate differences between different categories of public goods. In addition, we determined the additional local business tax rate of the surveyed firms. In line with the existing literature, we show that firms would consider a substantial reduction in local business tax as appropriate. We now examine the relationship between the satisfaction with and actual (salient) provision of public goods, trust in the municipality, and the additional local business tax rate using a two-step approach. First, we examine the relationship using univariate analysis, specifically by looking at correlations. Second, we use multivariate analysis, OLS regressions, for our investigation.

5.3.1 Univariate Analysis

Starting with our univariate analysis, Figure 3 shows Pearson correlation coefficients for the correlation between the additional local business tax rate (our measure of WTP), the satisfaction with provided public goods, and *trust* in the handling of local business revenues by the municipality.

< Insert Figure 3 about here >

The results in Figure 3 partially confirm Hypothesis 1a, that the satisfaction with the provision of public goods is negatively associated with the additional local business tax rate. We find a significant correlation between the perceived satisfaction with the provision of the following public goods and the additional local business tax rate: *kindergartens/daycare, primary schools, recreational areas,* and *efficient municipal administration* ($p < 0.05$). There is also a significant correlation between the additional local business tax rate and *trust* in municipalities' handling of tax revenue ($p < 0.05$) confirming Hypothesis 2. There is no significant correlation between the perceived provision of *secondary schools, vocational schools, police stations, hospitals, motorway connections, railway stations, and public transportation.*

As shown in Section 4, we also group public goods into *private-related* and *business-related public goods.* This categorization reduces dimensions and enables us to understand more clearly which categories of public goods correlate with the additional local business tax rate, allowing us to deduce in which areas investments by the municipality can result in a decrease in additional local business tax rate and thus an increased WTP local business tax at the firm level. Figure 4 shows the results of the correlation matrix.

< Insert Figure 4 about here >

Private-related public goods and the *trust* in municipality's handling of local business tax revenue correlate significantly negative with the additional local business tax rate ($p < 0.05$), while there is no significant correlation for *business-related public goods*. This is in line with Hypotheses 1a. We repeat this procedure and show Pearson correlation coefficients for the correlation between the additional local business tax rate and all actual/salient public goods in Figure 5 and actual/salient private- and business-related public goods in Figure 6.

< Insert Figures 5 and 6 about here >

The results partially reject Hypothesis 1b, that actual/salient public goods are not correlated with the additional local business tax rate. We find a significant correlation between additional local business tax rate and *actual primary schools, actual vocational schools, salient hospitals, actual motorway connection, actual transport* as well as *salient kindergartens/daycare, salient secondary schools, salient vocational schools, salient hospitals,* and *salient efficient municipal administration* ($p < 0.05$). However, with regard to *private- and business-related public goods*, we find no significant association for the *actual provision of public goods*. The results show a significant negative correlation between *salient private-related public goods* and the additional local business tax rate ($p < 0.05$), but no such for *salient business-related public goods*, partially rejecting Hypothesis 1b.

Almost all correlations are negative. Even though the results represent correlations and do not allow any causal conclusions to be drawn, we assume that especially the *satisfaction with and salience of private-related public goods* and *trust* positively increase firms' WTP local business tax as the results are consistent with the existing theoretical and empirical literature. Overall, these results confirm the importance of categorizing public goods, as they are of different importance in terms of their impact on firms' WTP. Overall, our initial findings using univariate analysis (partially) support Hypotheses 1a and 2, but partially reject Hypothesis 1b.

5.3.2 Multivariate Analysis

To investigate the presented correlations more closely, we specify our analysis of the potential effects by conducting multivariate analysis. As specified in Section 4, we use the absolute additional local business tax rate as our proxy for firms' WTP local business tax. Therefore, we use the following multiple OLS-regression of the simplified form:

$$\textit{Additional local business tax rate}_i = \alpha + \beta_1 \ \textit{public goods}_i + \beta_2 \ \textit{trust}_i + \beta_4 \eta_m + \beta_5 \kappa_i + \varepsilon_i \qquad (2)$$

We define firms' WTP local business tax (1) as the absolute additional local business tax rate (in percentage points) and (2) as the relative additional local business tax rate (in %). Additionally, we use the perceived appropriate local business tax rate (in %) and the actual local business tax rate (in %) to identify the reason for changes in firms' WTP local business tax.[33] Public goods comprises the satisfaction with the provision of public goods, the actual provision of public goods and the salient provision of public goods. For firms' satisfaction with the provision of public goods, we use the perception of all provided public goods (*satisfaction average public goods*) as well as of private- (*satisfaction private public goods*) and business-related public goods (*satisfaction business-related public goods*). For the *actual provision of public goods*, we use INKAR-data and for the *salience of provided public goods*, we rely on the difference between the actual and the perceived provision of public goods. The same applies to *actual private-/business-related public goods* and *salient private-/business-related public goods*. The second variable of interest is firms' *trust* in municipalities' handling of tax revenue. We consider municipality- and district-related controls (*population* in 2022, *ground area* in km^2, *district debt*[34], *local business tax revenue* in € per capita, allocation of *investment promotion measures* to the municipality, and the *unemployment rate*[35]) and use fixed effects for municipality-size classes[36] based on population[37] and legal form fixed effects. Based on our Hypotheses 1a and 2, we expect that both, the *satisfaction with the provision of public goods* and *trust*, to show a negative association with the absolute additional local business tax rate and therefore positively impact firms' WTP. Based on Hypotheses 1b we do not expect a significant association between the *actual/salient provision of public goods* and the absolute additional local business tax rate.

Satisfaction with the Provision of Public Goods and Trust

The results of the baseline regression analysis of associations between firms' satisfaction with provided public goods in the municipality and the additional local business tax rate are shown in Table 7.

< Insert Table 7 about here >

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[33]   Summary statistics for all variables can be found in Appendix A7.

[34]   Unfortunately, the INKAR-database does not provide a measure of municipality debt. Hence, we use the closest aggregation level of this item, i.e., the district-level debt.

[35]   We use the unemployment rate in the municipality to control for social spending, which could lead to budget constraints in the municipality that alter spending behavior on public goods.

[36]   The use of municipality-size class fixed effects assumes an inherent effect of municipalities of approximately the same size that cannot be explained by observables. Therefore, we compare the effects within municipality-size classes. In a robustness test (Appendix A9), we use a stronger fixed effects structure and employ municipality fixed effects, comparing within-municipality effects. This approach compares responses within a municipality, holding all municipality-related factors constant. While this approach provides the most precise estimates, it is computationally demanding as it only allows us to use municipalities with at least two survey respondents, reducing our sample further to 350 observations. Therefore, we do not use this fixed effect structure for all of our estimations.

[37]   We define our municipality-size classes based on size classes used by the Federal Statistical Office, see https://www.destatis.de/DE/Themen/Laender-Regionen/Regionales/Gemeindeverzeichnis/Administrativ/08-gemeinden-einwohner-groessen.html. We adapt these by combining the large number of size classes into larger categories.

Our baseline regression results indicate that using the average satisfaction with all public goods, the *satisfaction average public goods*, has no significant association with the absolute additional local business tax rate and, therefore, on firms' WTP local business tax. *Trust* in municipality's handling of local business tax revenue, on the other hand, has a significant negative association with firms' absolute additional local business tax rate ($p < 0.01$). The effect of *trust* is also significant in economic terms, as a one standard deviation increase in *trust* is associated with a decrease of additional local business tax rate by almost 1.0 percentage point. This reduction corresponds to more than 21% of the absolute additional local business tax rate, translating into an increase in firms' WTP local business tax. Using the trade tax revenues of €75 billion[38] for all municipalities in 2023, this translates into additional tax revenues for municipalities of €5.61 billion (7.48% of total trade tax revenues)[39]. To confirm that the effect is indeed due to firms' increased WTP and not to a lower actual local business tax rate, we also show the effect of *trust* on the perceived appropriate and actual local business tax rate in columns (2) and (3). The results emphasize that the effect of firms' increased WTP is due to an increase in the perceived appropriate local business tax rate.

To analyze the association between the *satisfaction with average public goods* and firms' WTP local business tax in more detail, we split them into *satisfaction with private-related public goods* and *satisfaction with business-related public goods* shown in Section 4 (columns (4) – (6)). We only find a significant negative association between the *satisfaction with private-related public goods* and the absolute additional local business tax rate ($p < 0.1$), which translates into more WTP local business tax. The effect is also relevant in economic terms. A one standard deviation increase in the *satisfaction with private-related public goods* is associated with a decrease in the absolute additional local business tax rate by approximately 0.6 percentage points. This reduction corresponds to more than 10% of the absolute additional local business tax rate (€2.81 billion additional trade tax revenue), translating into an increase in firms' WTP local business tax. Again, our results confirm that this is mainly due to an increase in the perceived appropriate local business tax rate (column (5)). For the *satisfaction with business-related public goods*, we do not find a significant association. With regard to *trust*, we confirm our previous results, showing a significant negative effect on the absolute additional local business tax rate. In particular, it is noticeable that the coefficient of *trust* is about twice as large as that of *satisfaction with private-related public goods*, about 0.9 percentage points. A one standard deviation increase in *trust* corresponds to a reduction of more than 20% of the absolute additional local business tax rate. Again, the results only show correlations and do in general not allow any causal conclusions. However, as the results are consistent with the existing theoretical and empirical literature, we assume that

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[38]   See https://de.statista.com/statistik/daten/studie/77610/umfrage/einnahmen-aus-der-gewerbesteuer-seit-1999/.
[39]   To come up with this estimate, we multiply the trade tax revenues by absolute additional business tax rate scaled by the actual local business tax rate, multiplied with the effect size of *trust*.

the satisfaction with the provision of *private-related public goods* and *trust* in municipalities' handling of tax revenue positively affect firms' WTP local business tax.

Actual Provision of Public Goods and Trust

Next, we analyze the effect of the *actual* and *salient provision of public goods*. First, we analyze *actual/salient average public goods*. Second, we split the public goods in *actual/salient private-related public goods* and *actual/salient business-related public goods*. We use the same control variables as before as well as municipality-size and legal form fixed effects. The results for *actual* and *salient provision of public goods* are shown in Table 8.

< Insert Table 8 about here >

The results show that neither *actual average public goods* nor *salient average public goods* have a statistically significant association with absolute additional local business tax rate. *Trust* on the other hand is again associated highly significant with the absolute additional local business tax rate ($p < 0.01$). The effect size is similar in magnitude compared to the previous findings. Next, we analyze the effect of *actual/salient private-related public goods* and *actual/salient business-related public goods*. The regression results in column (1) show that, in contrast to the univariate results, the provision of *actual private-related public goods* as well as *salient private-related public goods* has no significant association with the absolute additional local business tax rate. For the provision of *actual business-related public goods* and *salient business-related public goods*, we also find no significant association. The results for *trust* are again significantly negative ($p < 0.01$) and the effect size is similar in magnitude compared to the previous findings. The results in column (2) support the assumption that *trust* leads to an actual increase in firms' WTP local business tax. To check the robustness of our results, we do another sample split and separate firms that overestimate and underestimate the provision of public goods. We find the same results as in Table 8 (untabulated).

In summary, we can partially confirm Hypothesis 1a – the *satisfaction with the provision of public goods* increases firms' WTP local business tax and the type of public good is of crucial importance. We only find a significant impact for private-related public goods. Since in the case of SMEs it can be assumed that a large proportion of the decision-makers in the firms surveyed not only work in the municipality but also live there, the higher impact of private-related public goods is a reasonable result. What is surprising, however, is that public goods that are increasingly associated with the activities of the firms are valued less, even though they are usually not substitutable by the firms themselves. Further, we find no significant association between the *actual* and *salient provision of public goods* (average, private- and business-related) and firms' WTP local

business tax. We therefore confirm Hypothesis 1b, which suggests that firms' *satisfaction with the provision of public goods*, in this regard their subjective perception, is particularly relevant.[40] *Trust* in municipalities' handling of local business tax revenue is consistently very important for firms' WTP local business tax, confirming Hypothesis 2. We conclude that municipalities can increase firms' WTP local business tax rate by providing *private-related public goods* and by establishing greater *trust* in municipalities' handling of local business tax revenues.

Robustness Check

Lastly, we check the robustness of our findings by replacing the additional local business tax rate, which is measured as an absolute difference with the relative additional local business tax rate. We determine the relative measure by scaling the additional local business tax rate with the actual business tax rate. This measure is independent from the magnitude of the local business tax rate, i.e., we can compare additional local business tax rates across municipalities with different local business tax rates. The corresponding results are shown in Table 9.

< Insert Table 9 about here >

In line with our prior findings, the average of all public goods, the *satisfaction with average public goods*, has no significant association with the relative additional local business tax rate. However, *trust* in the municipality's handling of local business tax revenues has a significant negative association with firms' relative additional local business tax rate ($p < 0.01$). Splitting public goods into *private-related public goods* and *business-related public goods*, we again find a significant association only for *satisfaction with private-related public goods* ($p < 0.1$). For the *satisfaction with business-related public goods*, we find no significant results. With regard to *trust*, we confirm our previous results and show a significant negative association with relative additional local business tax rate, again, being about twice as large as the effect for *satisfaction with private-related public goods*.

5.4   Consequences of Firms' WTP

In a final step, we examine the extent to which firms' WTP local business tax stated in the survey is reflected in local tax payments, to test whether firms' WTP is actually reflected in local business tax revenues of the municipalities. By examining the relationship between firms' WTP stated in the survey and firms' actual WTP local business tax in their municipality, or in other words, the degree of tax avoidance, we can

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[40]   This finding is in line with previous literature, showing that perceptions of tax rates matter for firms (e.g., Graham et al. (2017); Blaufus et al. (2022); Fochmann et al. (2024); Körösi and Maiterth (2022)).

investigate real effects of our findings.

We use equation 3 to investigate this question. As a proxy for firms' tax avoidance, we follow existing literature (see e.g., Dyreng et al. (2008); Graham et al. (2014)) and use firms' average three-year effective tax rate (ETR).[41] Since we do not observe ETRs for our surveyed firms[42], we use a more indirect approach. We use the DAFNE database to collect archival data on firms that are located in the municipalities of the surveyed firms and, therefore, have access to the same public goods. We then match our survey and archival data based on the municipality. This allows us to assign the survey-based average *additional local business tax rate_m* to the firms from the archival data. To ensure that we only use firms that correspond to our survey sample firms, we proceed as follows: First, we limit our sample to firms that are located in the same municipality as our surveyed firms. Second, we only use firms that are not part of a group. Third, we restrict these firms to be SMEs.[43] We end up with a sample of 165 firms for the following OLS-regression analysis of the simplified form:

$$Tax\ avoidance_j = \alpha + \beta_1\ Additional\ local\ business\ tax\ rate_m + \beta_3\Phi_j + \beta_4\eta_m + \beta_5\gamma_j + \varepsilon_{j,m}. \qquad (3)$$

We measure tax avoidance by firms' average three-year ETR.[44] We define firms' average WTP local business tax rate within the municipality as the *absolute additional local business tax rate_m* (percentage points) and (2) as the *relative additional local business tax rate_m* (in %). Additionally, we use the average *perceived appropriate local business tax rate_m* (in %) and the *actual local business tax rate_m* (in %) to identify the changing component in firms' WTP local business tax. We include municipality- and district-related controls by using the municipality mean of *population_m*, *ground area_m* in km², *district debt_m*, allocation of *investment promotion measures_m* to the municipality, and *unemployment rate_m* over a three-year period derived from the INKAR-database.[45] We also use firm specific controls (*total assets*, natural logarithm of *ROA*, *leverage*, *intangible intensity* and natural logarithm of *number of employees* derived from the DAFNE database). We use fixed effects for municipality-size classes based on population and industry fixed effects to

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[41] Even though we are only interested in firms' local business tax rate, we rely on the ETR, including the corporate tax as well as the local business tax (see Section 3.1 for more information on the taxation procedure) as we do not have separate data for the amount of local business tax for the individual companies, only the aggregated tax rate from DAFNE. However, this does not affect our estimates since the profit base for corporate and local business tax is similar. Deviations only occur due to trade-tax-specific additions and deductions. These are mostly related to leasing, capital structure, and rental income. Given that Heckemeyer and Overesch (2017) show that tax avoidance is mostly driven by transfer pricing manipulations, which are not impacted by these additions and deductions, these changes to the tax base do not affect our analysis. As this analysis focuses on SMEs that are not part of a group, the municipal business tax rate is reflected rather accurately in the ETR, as SMEs are unlikely to operate in more than one municipality.

[42] Since a firm's ETR is a highly sensitive number, we refrained from asking for it within the survey to avoid high drop-out rates.

[43] Due to the availability of the data, there is one limitation: We can only use corporations, as tax return data for non-corporations are mostly anonymized. Despite these data limitations, we believe this approach is best suited to measure the impact of firms' WTP local business tax on tax avoidance.

[44] To minimize the influence of outliers, we winsorize the variable at the 1st and 99th percentile.

[45] We do not use *local business tax revenues* of the municipality within these regressions as the ETR, at least partially, reflects these revenues.

account for systematic differences in the tax rate due to industry-specific characteristics.[46] The results of the baseline regression analysis are shown in Table 10.

< Insert Table 10 about here >

Our results show that an increase in the *absolute additional local business tax rate*, i.e., an increase in firms' WTP local business tax, is associated with the level of the three-year ETR, i.e., tax avoidance decreases. For the *absolute additional local business tax rate*, the association is marginally not significant at the 10% level (column (1)), but for the relative measure (*relative additional local business tax rate*), we find a correspondingly significant effect ($p < 0.1$) shown in column (2). This finding is also supported by the results in columns (3) – (4), where we show that the three-year ETR increases significantly ($p < 0.1$) as the *perceived appropriate local business tax rate* increases. Thus, an increase in the perceived appropriate local business tax rate is associated with less tax avoidance by firms within the same municipality. These results are also economically significant. A one standard deviation increase in the *relative additional local business tax rate* (*absolute additional local business tax rate*) is associated with an increase in the average ETR of about 11% (10%). To verify our results, we also use the one-year ETR as a measure of tax avoidance as shown in Appendix A10. The results are in line with the previous regression analyses: If companies indicate an increased WTP local business tax, this is significantly associated with a higher average one-year ETR of firms in the same municipality and thus with less tax avoidance.

Overall, we conclude that firms' WTP local business tax stated by the surveyed firms has a significant effect on the extent of tax avoidance in municipalities. Influencing firms' WTP, for example through the targeted provision of certain public goods or measures to increase trust in the handling of tax revenues by municipalities, can have a direct impact on municipal tax revenues.

6   CONCLUSION

Our study examines the association between trust in municipality's handling of local business tax revenue, the satisfaction with and the actual provision of public goods and firms' WTP local business tax. Therefore, we use survey data on firms' and administrative data on the actual provision of public goods.

In line with our hypotheses, we show that trust in municipality's handling of local business tax revenue is associated with an increase of in firms' WTP local business tax by more than 20%. With total local business tax revenues of €75 billion for 2023 this translates into additional tax revenues for the municipalities of €5.61 billion (7.48% of total local business tax revenues). The same holds partially for the satisfaction with

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[46]   Summary statistics for the DAFNE data can be found in Appendix A8.

provided goods within a firm's municipality. However, we only find a positive effect for private-related public goods, i.e., public goods related to the private sphere of the firm's decision-maker. A one standard deviation increase in firms' satisfaction with private-related public goods increases the WTP local business tax by 10%. This amounts to additional local business tax revenues for municipalities of more than €2.8 billion (3.74% of total local business tax revenues). Surprisingly, for business-related public goods, more important for the firm itself, we find no significant impact on firms' WTP local business tax. Focusing on the actual as well as the salient provision of public goods, we find no significant association with firms' WTP local business tax. This highlights the importance of perceptions with regard to tax issues. In our study, the perception of provided public goods is the most important parameter compared to the actual or salient provision of public goods. To proof that firms' stated WTP has actual economic consequences, we test it's correlation with tax avoidance within the respective municipality and find a significant negative effect. An increase in firms' WTP local business tax leads to a decrease in the average tax avoidance within the municipality of about 10% of the three-year ETR. Our results highlight the importance of providing the *right* public goods, e.g., primary schools or recreational areas, at the municipal level to enhance firms' WTP local business tax. Furthermore, it is particularly striking that the (economic) effect of trust on firms' WTP local business tax is considerably larger than that for the provision of private-related public goods. This suggests that the handling of tax revenues affects firms' WTP to a greater extent than the manner in which they are ultimately utilized.

We contribute to the prior literature by providing insights on firms' behavior with respect to their WTP local business tax. We respond to the OECD's call for more information on firms' tax behavior, respectively, and calls for more studies of SMEs and private firms. Given that about one-third of all OECD-countries have a local business tax, these results are of great interest to many local governments: Enhancing trust, e.g., through transparent and accountable local governments, could be an important future goal to maintain or increase firms' WTP local business tax and thus maintain tax revenues, basic services, and ultimately municipality's self-administration. In addition, our findings can be used by local governments as an indication of how the provision of public goods can sustainably contribute to firms' satisfaction and thus support the efficient use of tax revenues. Our study highlights several areas for future research. To increase the internal validity of the results, one could think about conducting field experiments in different municipalities, states or regions. Furthermore, more evidence on firms of e.g., different sizes, like big or multinational enterprises, is of interest.

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FIGURES AND TABLES

Figure 1: Trade Tax Multipliers of German Municipalities.
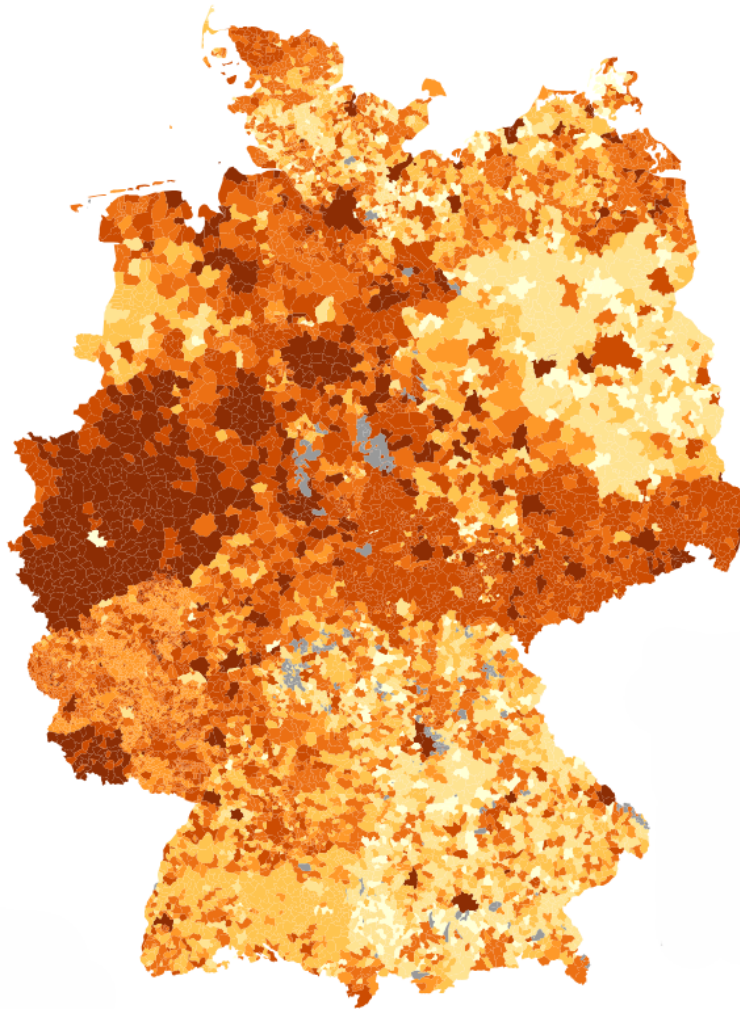
Notes: This map shows the trade tax multipliers across German municipalities in 2022. The darker the coloration, the higher the multiplier. Grey areas indicate areas that are not assigned to a municipality; these areas are subject to the district or federal state, e.g., state forests, military training areas, and wasteland. Source: German Federal and State Statistical Offices, www.statistikportal.de/de/karte-hebesaetze.

Figure 2: Perceived Provision of Public Goods.
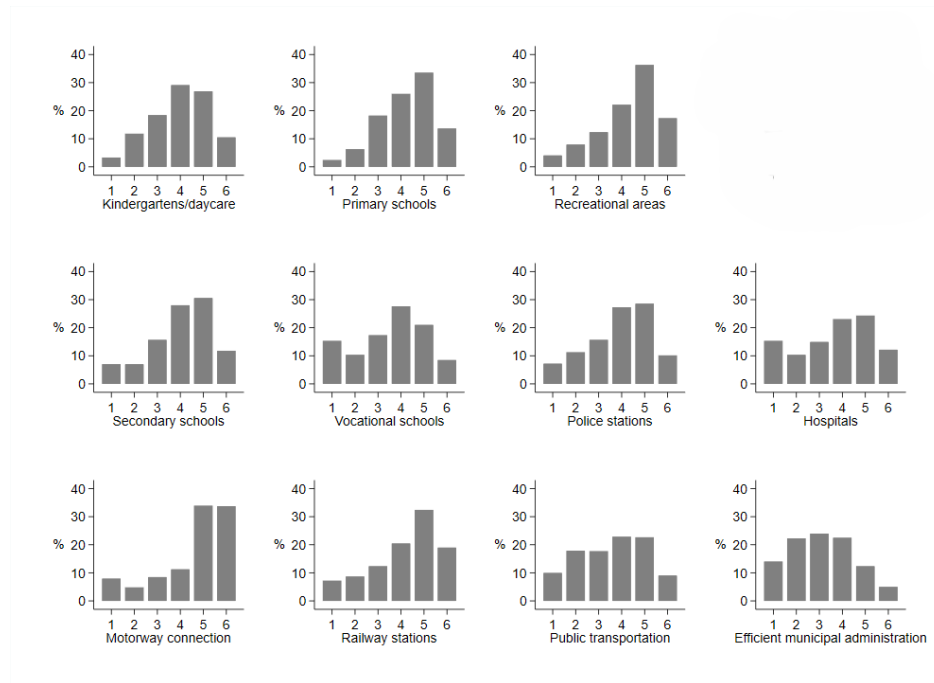
Notes: This figure shows the distribution for the provision of each public good separately (N = 543). The 6-point Likert-scale ranges from 1 (not good at all) to 6 (very good). Answering the question was voluntary, resulting in a changing base population (N) for the different ratings. The exact questions can be found in the Appendix A1.

Figure 3: Correlation Matrix – Satisfaction with Public Goods.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Actual local business tax rate (1)	1.00*												
Kindergartens/daycare (2)	-0.19*	1.00*											
Primary schools (3)	-0.17*	0.76*	1.00*										
Secondary schools (4)	-0.08	0.35*	0.52*	1.00*									
Vocational schools (5)	-0.06	0.17*	0.26*	0.62*	1.00*								
Recreational areas (6)	-0.16*	0.38*	0.43*	0.36*	0.30*	1.00*							
Police stations (7)	-0.08	0.25*	0.34*	0.52*	0.50*	0.44*	1.00*						
Hospitals (8)	-0.06	0.18*	0.25*	0.50*	0.62*	0.37*	0.48*	1.00*					
Efficient municipal administration (9)	-0.19*	0.40*	0.34*	0.23*	0.21*	0.33*	0.31*	0.18*	1.00*				
Motorway connection (10)	-0.00	0.09*	0.17*	0.28*	0.20*	0.22*	0.29*	0.29*	0.15*	1.00*			
Railway stations (11)	-0.02	0.16*	0.22*	0.32*	0.35*	0.24*	0.36*	0.36*	0.22*	0.53*	1.00*		
Public transportation (12)	-0.02	0.15*	0.19*	0.28*	0.31*	0.19*	0.29*	0.35*	0.24*	0.40*	0.61*	1.00*	
Trust (13)	-0.27*	0.43*	0.39*	0.32*	0.25*	0.35*	0.28*	0.23*	0.66*	0.15*	0.20*	0.18*	1.00*

Notes: This figure shows Pearson correlation coefficients for the satisfaction with public goods (N = 543). * represents significance at the 5% level.

Figure 4: Correlation Matrix – Satisfaction with Private- and Business-Related Public Goods.
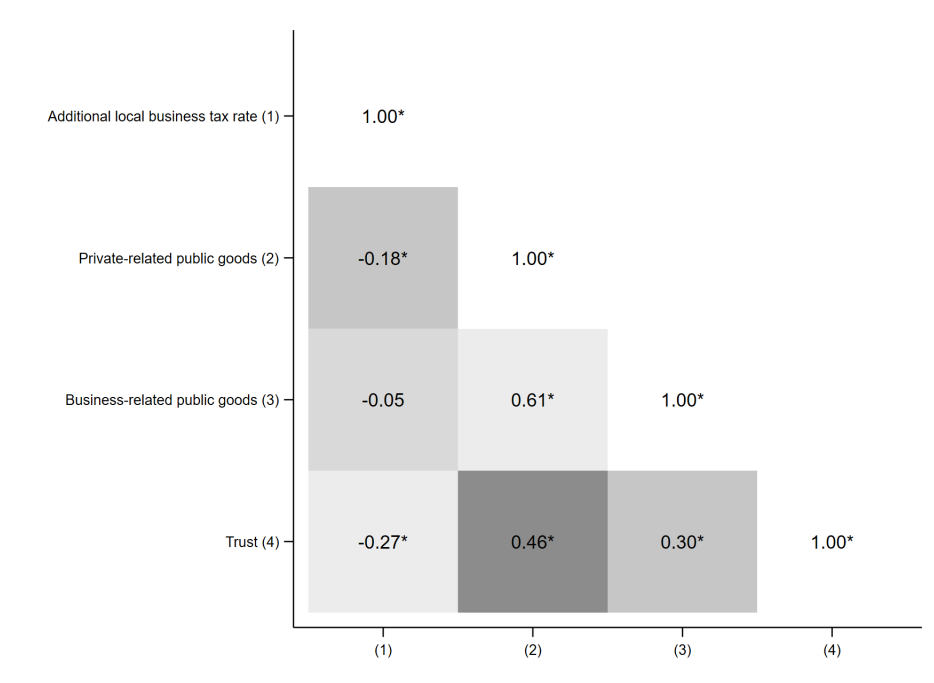
Notes: This figure shows Pearson correlation coefficients for the satisfaction with private- and business-related public goods (N = 543). * represents significance at the 5% level.

Figure 5: Correlation Matrix – Actual and Salient Public Goods.
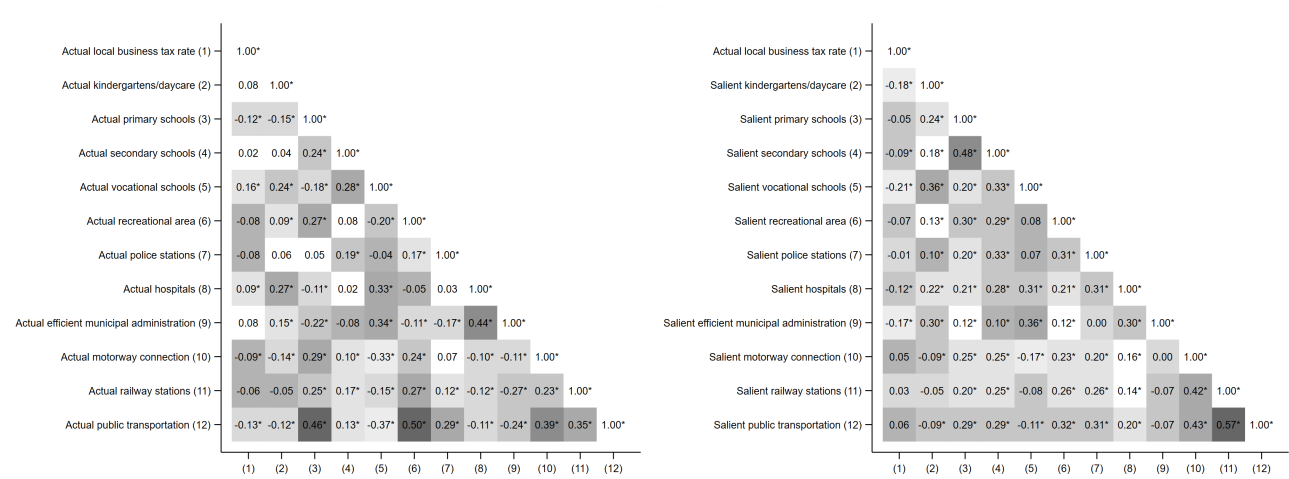
Notes: This figure shows Pearson correlation coefficients for salient public goods (N = 543). * represents significance at the 5% level.

Figure 6: Correlation Matrix – Actual and Salient Private- and Business-Related Public Goods.

	(1)	(2)	(3)
Additional local business tax rate (1)	1.00*		
Actual private-related public goods (2)	0.03	1.00*	
Actual business-related public goods (3)	-0.00	0.26*	1.00*

	(1)	(2)	(3)
Additional local business tax rate (1)	1.00*		
Salient private-related public goods (2)	-0.17*	1.00*	
Salient business-related public goods (3)	-0.04	0.46*	1.00*
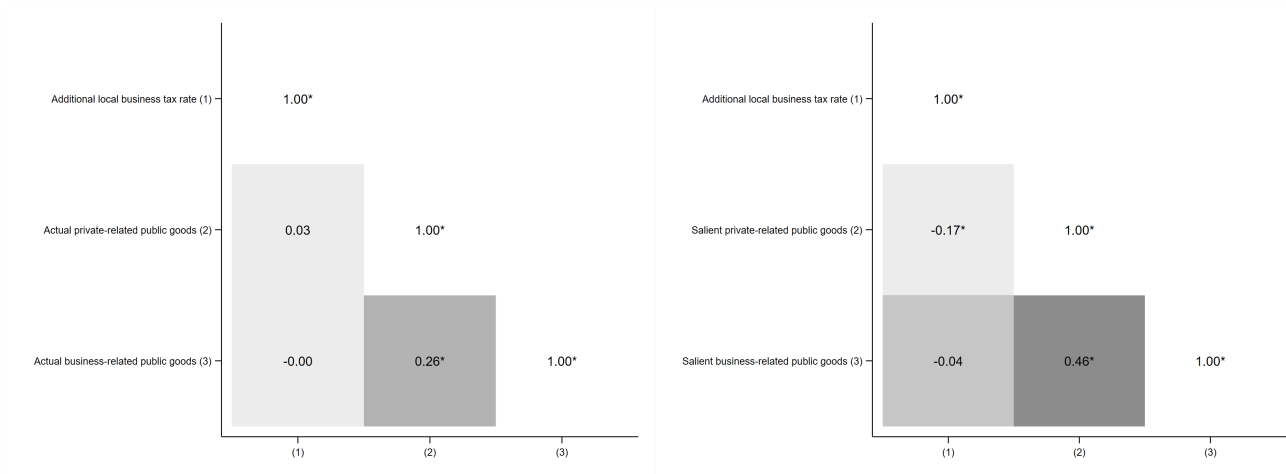
Notes: This figure shows Pearson correlation coefficients for salient private- and business-related public goods (N = 543). * represents significance at the 5% level.

Table 1: Survey Sample Comparison.

	Sample N = 543	Handicraft Census 2021 N = 568,314
Legal Form		
Sole proprietorship	41.6%	67.9%
Partnership	9.6%	8.0%
Mixed forms (e.g., GmbH & Co. KG)	*24.5%*	-
Corporation	24.3%	23.5%
Other	-	0.7%
Employees		
0-9	48.1%	80.1%
10-49	41.3%	17.6%
50 and more	10.7%	2.4%
Sales*		
up to 50.000 €	3.8%	14.4%
50.001 − 150.000 €	10.6%	20.5%
150.001 − 300.000 €	7.9%	17.5%
300.001 − 500.000 €	11.9%	16.4%
500.001 − 5 Mio. €	54.1%	27.7%
more than 5 Mio. €	13.6%	3.4%

Notes: This table compares the characteristics of firms in our sample to the Handicraft Census 2021. *14 firms chose the 'no information' option. Additionally, there are minor deviations between the revenue categories in the survey and the Crafts Census 2021. In the Handicraft Census the following categories are used: up to €50,000, €50,000 to €125,000, €125,000 to €250,000, €250,000 to €500,000, €500,000 to €5 million, more than €5 million. Source: https://www.zdh.de/ueber-uns/fachbereich-wirtschaft-energie-umwelt/statistik/handwerkszaehlung/handwerkszaehlung-2021/.

Table 2: Summary Statistics of Sample and Variable Definition.

Name	Definition / Measurement	Group	N	Mean	Median
Trade tax rate					
Perceived appropriate local business tax rate	= Perceived appropriate trade tax rate	-	543	9.0%	10.5%
Satisfaction with the provision of public goods					
Kindergartens/daycare	6-point Likert scale	private-related	543	4.0	4
Primary schools	6-point Likert scale	private-related	543	4.2	4
Secondary schools	6-point Likert scale	business-related	543	4.0	4
Vocational schools	6-point Likert scale	business-related	543	3.5	4
Recreational areas	6-point Likert scale	private-related	543	4.3	5
Police stations	6-point Likert scale	private-related	543	3.9	4
Hospitals	6-point Likert scale	private-related	543	3.7	4
Efficient municipal administration	6-point Likert scale	-	543	3.1	3
Motorway connection	6-point Likert scale	business-related	543	4.6	5
Railway stations	6-point Likert scale	business-related	543	4.2	5
Public transportation	6-point Likert scale	business-related	543	3.6	4
Individual factors					
Trust	6-point Likert scale	-	543	3.2	3

Notes: This table lists the survey variables. All 6-point Likert scales are sorted as follows: 1 = unsatisfactory to 6 = very good. The exact wording of the questions can be found in the Appendix A1.

Table 3: Matching Example – Salience of Public Goods.

Municipality	No. of kindergartens	Population	Scaled no. of kindergartens	Calculated tiles	Matching firm's survey obs.	Salience level
M1	10	10,000	0.0010	3	2	1
M2	6	4,000	0.0015	5	6	-1
M3	2	3,000	0.0007	2	1	1
M4	1	500	0.0020	6	4	2
M5	4	3,000	0.0013	4	4	0
M6	8	16,000	0.0005	1	2	-1

Notes: This table presents a fictitious example of our determination of the difference between the actual and perceived provision of public goods.

Table 4: Perceived Public Goods – Private and Business-Related Public Goods.

Variable	Definition	N	Mean	Median
Private-related public goods	6-point Likert scale	543	4.0	4.2
Business-related public goods	6-point Likert scale	543	4.0	4.2

Notes: This table lists the two categories private- and business-related public goods and provides the mean and median values. All 6-point Likert scales are sorted as follows: 1 = unsatisfactory to 6 = very good. The exact questions can be found in the Appendix A1.

Table 5: Actual Provision of Salience of Public Goods.

Name	Definition	Group	N	Mean	Median
Actual public goods					
Actual kindergartens/daycare	6-point scale	private-related	543	3.1	3
Actual primary schools	6-point scale	private-related	543	2.5	2
Actual secondary schools	6-point scale	business-related	543	3.5	4
Actual vocational schools	6-point scale	business-related	543	4.3	6
Actual recreational areas	6-point scale	private-related	543	2.1	2
Actual police stations	6-point scale	private-related	543	3.1	3
Actual hospitals	6-point scale	private-related	543	4.1	4
Actual efficient municipal administration	6-point scale	-	543	4.2	5
Actual motorway connection	6-point scale	business-related	543	2.3	2
Actual railway stations	6-point scale	business-related	543	2.4	1
Actual public transportation	6-point scale	business-related	543	2.1	2
Actual private- and business-related public goods					
Actual private-related public goods	6-point scale		543	3.2	3.3
Actual business-related public goods	6-point scale		543	2.9	2.8
Salience of public goods					
Kindergartens/daycare$_{salient}$	= Difference perceived – actual public goods	private-related	543	0.8	1
Primary schools$_{salient}$	= Difference perceived – actual public goods	private-related	543	1.8	2
Secondary schools$_{salient}$	= Difference perceived – actual public goods	business-related	543	0.5	1
Vocational schools$_{salient}$	= Difference perceived – actual public goods	business-related	543	−0.8	−1
Recreational areas$_{salient}$	= Difference perceived – actual public goods	private-related	543	2.2	2
Police stations$_{salient}$	= Difference perceived – actual public goods	private-related	543	0.7	1
Hospitals$_{salient}$	= Difference perceived – actual public goods	private-related	543	−0.4	−1
Efficient municipal administration$_{salient}$	= Difference perceived – actual public goods	-	543	−1.1	−1
Motorway connection$_{salient}$	= Difference perceived – actual public goods	business-related	543	2.3	3
Railway stations$_{salient}$	= Difference perceived – actual public goods	business-related	543	1.8	2
Public transportation$_{salient}$	= Difference perceived – actual public goods	business-related	543	1.5	2
Salience of private- and business-related public goods					
Salience private-related public goods	= Difference perceived – actual public goods		543	0.8	0.833
Salience business-related public goods	= Difference perceived – actual public goods		543	1.1	1.200

Notes: This table lists the actual provided public goods and salient provision of all and private- and business-related public goods.

Table 6: Extent of the Additional Local Business Tax Rate.

	N	Actual local business tax rate	appropriate local business tax rate	Additional local business tax rate
Non-corporations	411	14.3%	8.9%	5.5%-points
Corporations	132	14.4%	9.3%	5.1%-points

Notes: This table shows the average deviation of the actual local business tax rate from the perceived appropriate local business tax rate measured as additional local business tax rate by legal form. Non-Corporations also include mixed forms such as GmbH & Co. KG.

Table 7: Baseline Regression.

	(1) Absolute additional local business tax rate	(2) Perceived appropriate local business tax rate	(3) Actual local business tax rate	(4) Absolute additional local business tax rate	(5) Perceived appropriate local business tax rate	(6) Actual local business tax rate
Satisfaction average public goods	−0.2388 (−0.73)	0.2970 (0.93)	0.0582 (0.92)			
Satisfaction private-related public goods				−0.5626* (−1.78)	0.5803* (1.87)	0.0177 (0.29)
Satisfaction business-related public goods				0.2979 (1.01)	−0.2546 (−0.88)	0.0433 (0.70)
Trust	−0.9128*** (−3.97)	0.7961*** (3.53)	−0.1167*** (−2.86)	−0.8840*** (−4.04)	0.7692*** (3.58)	−0.1148*** (−2.88)
Population	0.0000* (1.94)	−0.0000 (−0.64)	0.0000*** (4.05)	0.0000* (1.82)	−0.0000 (−0.55)	0.0000*** (4.03)
Ground area (km²)	0.0001 (0.03)	0.0034 (0.75)	0.0036** (2.56)	0.0014 (0.32)	0.0022 (0.49)	0.0036** (2.58)
District debt	0.0002 (0.84)	−0.0001 (−0.26)	0.0001* (1.72)	0.0002 (0.73)	−0.0000 (−0.16)	0.0001* (1.70)
Local business tax revenue (€per capita)	−0.0001 (−0.17)	−0.0004 (−0.97)	−0.0005*** (−3.04)	−0.0001 (−0.20)	−0.0004 (−0.97)	−0.0005*** (−3.04)
Investment promotion measures	0.0011 (0.51)	0.0000 (0.00)	0.0011 (1.53)	0.0013 (0.58)	−0.0002 (−0.07)	0.0011 (1.52)
Unemployment rate	0.1879 (0.99)	0.1671 (0.87)	0.3550*** (5.40)	0.2008 (1.06)	0.1551 (0.81)	0.3560*** (5.41)
Constant	7.4149*** (4.96)	4.4780*** (3.04)	11.8928*** (27.51)	7.3059*** (4.84)	4.5564*** (3.06)	11.8624*** (27.17)
Municipality-Size & Legal Form FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	543	543	543	543	543	543
Adj. R-sq	0.0829	0.0442	0.5726	0.0856	0.0468	0.5720

Notes: This table shows the OLS regression results for the absolute additional local business tax rate. The dependent variables in columns (1)-(3) represent the case with only the average perception of public goods and trust, columns (4)-(6) represent the case where we divide by private- and business-related public goods. t-statistics are given in parentheses, and standard errors are heteroscedasticity-robust and clustered at the municipality level. ***, ** and * label statistical significance at 1%, 5% and 10% level, respectively.

Table 8: OLS-Regression – Actual and Salient Public Goods.

	(1) Absolute additional local business tax rate	(2) Perceived appropriate local business tax rate	(3) Actual local business tax rate	(4) Absolute additional local business tax rate	(5) Perceived appropriate local business tax rate	(6) Actual local business tax rate
Panel A						
Actual average public goods	0.0583	0.1386	0.1969			
	(0.13)	(0.31)	(1.41)			
Actual private-related public goods				0.1802	−0.1668	0.0135
				(0.52)	(−0.50)	(0.15)
Actual business-related public goods				−0.1587	0.3602	0.2015
				(−0.38)	(0.85)	(1.55)
Trust	−0.993***	0.9030***	−0.0963**	−0.9896***	0.8885***	−0.1011**
	(−5.39)	(4.91)	(−2.70)	(−5.23)	(4.75)	(−2.79)
Constant	6.5048***	5.0895***	11.5943***	6.4492***	5.0979***	11.5970***
	(4.02)	(3.18)	(23.90)	(4.00)	(3.17)	(23.86)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Municipality-Size & Legal Form FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	543	543	543	543	543	543
Adj. R-sq	0.0828	0.0433	0.5720	0.0826	0.0426	0.5717
Panel B						
Salient average public goods	−0.1949	0.1789	−0.0160			
	(−0.74)	(0.69)	(−0.26)			
Salient private-related public goods				−0.3049	0.2594	−0.0455
				(−1.19)	(1.03)	(−0.77)
Salient business-related public goods				0.0676	−0.0358	0.0318
				(0.33)	(−0.18)	(0.63)
Trust	−0.9293***	0.8393***	−0.0900**	−0.9198***	0.8289***	−0.0908**
	(−4.33)	(3.95)	(−2.37)	(−4.42)	(4.02)	(−2.44)
Constant	6.7936***	5.2979***	12.0914***	6.8685***	5.2231***	12.0916***
	(5.73)	(4.25)	(31.13)	(5.72)	(4.13)	(31.22)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Municipality-Size & Legal Form FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	543	543	543	543	543	543
Adj. R-sq	0.0828	0.0433	0.5720	0.0826	0.0426	0.5717

Notes: This table shows the OLS regression results for the absolute additional local business tax rate. Panel A displays results for the actual provision of public goods, Panel B for the salient provision of public goods. t-statistics are given in parentheses, and standard errors are heteroscedasticity-robust and clustered at the municipality level. ***, ** and * label statistical significance at 1%, 5% and 10% level, respectively.

Table 9: Robustness OLS-Regression – Relative Measure.

	(1) Relative additional local business tax rate	(2) Relative additional local business tax rate
Satisfaction average public goods	−0.0118	
	(−0.52)	
Satisfaction private-related public goods		−0.0399*
		(−1.81)
Satisfaction business-related public goods		0.0258
		(1.26)
Trust	−0.0633***	0.0608***
	(−4.01)	(−4.02)
Constant	0.5685***	0.5599***
	(5.46)	(5.33)
Controls	Yes	Yes
Municipality-Size & Legal Form FE	Yes	Yes
Observations	543	543
Adj. R-sq	0.0542	0.0577

Notes: This table shows the OLS regression results of the relative additional local business tax rate. The dependent variables in column (1) represent the case with only the average perception of public goods and trust, (2) represents the case where we divide public goods into private- and business-related public goods. t-statistics are given in parentheses, and standard errors are heteroscedasticity-robust and clustered at the municipality level. ***, ** and * label statistical significance at 1%, 5% and 10% level, respectively.

Table 10: OLS-Regression – Tax Avoidance (Three-Year ETR) and Firms' WTP.

	(1) Three-year ETR	(2) Three-year ETR	(3) Three-year ETR	(4) Three-year ETR
Absolute additional local business tax rate$_m$	−0.0044 (−1.39)			
Relative additional local business tax rate$_m$		−0.0773* (−1.73)		
Perceived appropriate local business tax rate$_m$			0.0056* (1.80)	
Actual local business tax rate$_m$				0.0212 (1.60)
Trust$_m$	−0.0257** (−2.42)	−0.0258** (−2.49)	−0.0261** (−2.50)	−0.0159 (−1.49)
Total assets	−0.0509* (−1.93)	−0.0512* (−1.93)	−0.0515* (−1.93)	−0.0473* (−1.79)
ROA	0.0398 (0.73)	0.0404 (0.75)	0.0426 (0.81)	0.0422 (0.75)
Leverage	−0.1710** (−2.04)	−0.1725** (−2.07)	−0.1731** (−2.07)	−0.1767** (−2.19)
Intangible intensity	−0.3416 (−0.66)	−0.3468 (−0.67)	−0.3631 (−0.71)	−0.4758 (−0.91)
Employees	0.0751*** (6.75)	0.0754*** (6.78)	0.0759*** (6.74)	0.0747*** (6.53)
Population$_m$	−0.0000 (−0.79)	−0.0000 (−0.81)	−0.0000 (−0.83)	−0.0000 (−1.50)
Ground area$_m$ (km²)	−0.0002 (−0.90)	−0.0002 (−0.93)	−0.0002 (−0.95)	−0.0002 (−0.99)
District debt$_m$	−0.0000 (−1.50)	−0.0000 (−1.60)	−0.0000 (−1.63)	−0.0000 (−1.39)
Investment promotion measures$_m$	−0.0001 (−1.23)	−0.0001 (−1.34)	−0.0001 (−1.39)	−0.0001 (−0.75)
Unemployment rate$_m$	0.0114 (1.25)	0.0115 (1.30)	0.0110 (1.27)	0.0023 (0.28)
Constant	0.2534 (0.95)	0.2625 (0.98)	0.1852 (0.68)	−0.0918 (−0.28)
Municipality-Size & Industry FE	Yes	Yes	Yes	Yes
Observations	165	165	165	165
Adj. R-sq	0.6393	0.6417	0.6442	0.6455

Notes: This table shows the OLS regression results for the three-year ETR. The dependent variables in column (1) represent the results for the average absolute additional local business tax rate within the municipality, column (2) for the average relative additional local business tax rate within the municipality. Columns (3) and (4) show the results for the average perceived appropriate local business tax rate in the municipality and the actual local business tax rate in the municipality. t-statistics are given in parentheses, and standard errors are heteroscedasticity-robust and clustered at the municipality level. ***, ** and * label statistical significance at 1%, 5% and 10% level, respectively.

APPENDIX

A1 Survey Questionnaire

The structure of the survey is explained in Section 3. The survey is divided into three parts and includes all questions relevant for the analysis.

Part I: Firm Characteristics

1. What is the legal form of your firm?

2. In which craft do you operate?

3. How many employees do you have who are subject to social insurance contributions (in full-time positions)? Please provide the exact number.

4. Which of the following intervals most closely corresponds to your turnover (in €) in the 2022 financial year?

Part II: Trade Taxation

1. Please enter the municipality in which your firm is based.

2. What trade tax multiplier (in %) would you consider appropriate in the municipality in which your firm is based?

Part III: Perception of Public Goods

1. Regarding the municipality in which your firm is based, how do you rate the provision of:

   - Kindergartens/daycare   – Hospitals
   - Primary schools   – Effectiveness of municipal administration
   - Secondary schools   – Motorway connection
   - Vocational schools   – Railway stations
   - Recreational areas   – Public transportation
   - Police stations

2. To what extent do you agree with the following statement? *"The municipality in which my firm is based handles the trade tax revenue responsibly."*

A2 Implementation of Local Business Tax

Table 11: Local Business Tax in OECD-Countries

OECD-country	Local Business Tax	Details
Australia	No	-
Austria	No	-
Belgium	No	-
Canada	Yes	All provinces and territories impose income tax on income attributable to a permanent establishment in the province or territory, ranging from 2.5% to 16%.
Chile	No	-
Columbia	Yes	All municipalities levy a Industry and Commerce Tax on income derived from the exercise of industrial, commercial, or service activities. The rate ranges from 0.2% to 1%.
Costa Rica	Yes	Municipalities levy a local tax. The rate depends on the municipality, but the most common method of calculation is to apply a percentage to net income or sales.
Czech Republic	No	-
Denmark	No	-
Estonia	No	-
Finland	No	-
France	No	-
Germany	Yes	The trade tax rate is a combination of a uniform tax rate of 3.5% (base rate) and a municipal tax rate. The municipal tax rate varies from 200% to 650%.
Greece	No	-
Hungary	Yes	The local business tax is similar to a sales tax, the rate varies by municipality up to a maximum of 2%.
Iceland	No	-
Israel	No	-
Ireland	No	-
Italy	Yes	The regional production tax, known as imposta regionale sulle attività produttive (IRAP), is 3.9%. Regions may increase or decrease the standard IRAP rate by up to 0.92%.

OECD-country	Local Business Tax	Details
Japan	Yes	The inhabitants' tax is levied on a corporation's income allocated to each prefecture and city (or municipality), ranging from 1% to 8.4%.
Korea, Republic of	Yes	The local income tax is a separate income tax with its own tax base, exemptions and credits, and rates. Local income tax rates for corporations, ranging from 0.9% to 2.4%.
Latvia	No	-
Lithuania	No	-
Luxembourg	Yes	Municipal business tax is levied by the communes and varies from municipality to municipality, e.g., for Luxembourg City it is 6.75%.
Mexico	No	-
The Netherlands	No	-
New Zealand	No	-
Norway	No	-
Poland	No	-
Portugal	Yes	A local surtax (Derrama) of up to 1.5% of taxable income (before deduction of any available tax loss carryforwards) is levied in certain municipalities. A regional surtax (Derrama Regional) is applied in the autonomous region of Madeira and autonomous region of Azores, ranging from 2.1% to 7.2%.
Slovakia	No	-
Slovenia	No	-
Spain	Yes	The business and professional activities tax is a local tax levied annually on the exercise of business, professional or artistic activities in Spain with a tax rate of up to 15%.
Sweden	No	-
Switzerland	Yes	Each canton has its own tax law and levies cantonal and communal corporate income and capital taxes at different rates.
Turkey	No	-
The United Kingdom	No	-
The United States of America	Yes	Corporate income tax rates vary from state to state, ranging from 1% to 10%.

Notes: This table provides an overview of the implementation of local business taxes in OECD-countries and their specific characteristics. The data set utilizes information sourced from PwC Worldwide Tax Summaries, https://taxsummaries.pwc.com/.

A3 Variable Definition

Table 12: Variable Definition of all Variables.

Variable	Definition	Source
Perceived appropriate local business tax rate	Perceived appropriate trade tax rate	Survey data
Actual local business tax rate	Actual trade tax rate	Administrative data
Satisfaction with provision of public goods	Perceived provision of public goods within the municipality the firm is located	Survey data
Actual provision of public goods	Actual provision of public goods within the municipality the firm is located	INKAR data
Trust	Trust in municipality's handling of tax revenues	Survey data
Population	Municipality population in 2022	INKAR data
Ground area	Municipality ground area in km²	INKAR data
District debt	Scaled district debt the municipality is located in	INKAR data
Local business tax revenue	Tax revenue of the municipality in € per capita	INKAR data
Investment promotion measures	Scaled investment promotion measures of the municipality	INKAR data
Unemployment rate	Scaled unemployment rate within the municipality	INKAR data
Three-year ETR	Average three-year ETR of firms in a municipality	DAFNE data
One-year ETR	Average one-year ETR of firms in a municipality	DAFNE data
Total assets	Average three-year ETR of firms in a municipality	DAFNE data
ROA	Return on assets of a firm	DAFNE data
Leverage	Leverage of a firm	DAFNE data
Intangible intensity	Intangible intensity of a firm	DAFNE data
Employees	Number of employees in a firm	DAFNE data

Notes: The table shows variable definition for all variables used. For public goods the definition applies to all public goods examined within the study.

A4 Matching of Public Goods

Table 13: Matching Survey and Archival data – Public Goods.

Survey data	INKAR-database
Kindergartens/daycare	Childcare rate for small children
Primary schools	Primary schools
Secondary schools	Secondary schools
Vocational schools	Vocational schools
Recreational areas	Recreational areas
Police stations	Police stations
Hospitals	Hospital beds
Efficient municipal administration	Municipal Staff
Motorway connection	Motorway connection
Railway stations	Accessibility of Railway stations (IC/ICE)
Public transportation	Public Transportation Stops

Notes: This table shows the corresponding INKAR-database items for the public goods from the survey.

A5 Provision of Public Goods

Table 14: Archival Data – Summary Statistics of Data & Variable Definition.

Name	Definition / Measurement	Group	N	Mean	Median
Trade tax rate					
Actual trade tax rate	= Actual trade tax rate	-	543	14.3%	14%
Actual public good					
Actual kindergartens/daycare	6-point Scale	private-related	543	3.1	3
Actual primary schools	6-point Scale	private-related	543	2.5	2
Actual secondary schools	6-point Scale	business-related	543	3.5	4
Actual vocational schools	6-point Scale	business-related	543	4.3	6
Actual recreational areas	6-point Scale	private-related	543	2.1	2
Actual police stations	6-point Scale	private-related	543	3.1	3
Actual hospitals	6-point Scale	private-related	543	4.1	4
Actual efficient municipal administration	6-point Scale	-	543	4.2	5
Actual motorway connection	6-point Scale	business-related	543	2.3	2
Actual railway stations	6-point Scale	business-related	543	2.4	1
Actual public transportation	6-point Scale	business-related	543	2.1	2

Notes: This table lists all variables for which archival data is used in the matching process as described in Chapter 4. All 6-point Likert scales are sorted as follows: 1 = unsatisfactory to 6 = very good.

A6 Correlation Matrix

Table 15: Pairwise Correlation of Public Goods.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) Motorway connection	1									
(2) Railway stations	0.528*	1								
(3) Secondary schools	0.196*	0.355*	1							
(4) Recreational areas	0.225*	0.242*	0.297*	1						
(5) Primary schools	0.167*	0.220*	0.258*	0.430*	1					
(6) Kindergartens/daycare	0.091*	0.157*	0.172*	0.379*	0.757*	1				
(7) Hospitals	0.295*	0.362*	0.617*	0.373*	0.252*	0.175*	1			
(8) Public transportation	0.402*	0.609*	0.315*	0.187*	0.185*	0.150*	0.348*	1		
(9) Police stations	0.295*	0.358*	0.497*	0.436*	0.336*	0.252*	0.484*	0.286*	1	
(10) Vocational schools	0.280*	0.316*	0.620*	0.362*	0.524*	0.348*	0.500*	0.280*	0.518*	1

Notes: This table presents Pearson correlation coefficients for the public goods (N = 543). * represents significance at the 5% level.

A7 Summary Statistics

Table 16: Summary Statistics of Regression Variables.

Variables	N	Mean	St. Dev.	p5	p95
Absolute additional local business tax rate	543	5.370	5.340	−1.610	14.700
Relative additional local business tax rate	543	0.370	0.369	−0.101	1
Perceived appropriate local business tax rate	543	8.972	5.234	0.000	17.500
Actual local business tax rate	543	14.342	1.720	10.500	17.150
Satisfaction average public goods	543	3.919	0.883	2.455	5.273
Satisfaction private-related public goods	543	4.011	0.970	2.400	5.600
Satisfaction business-related public goods	543	3.987	1.053	2	5.600
Trust	543	3.245	1.267	1	5
Actual average public goods	543	3.068	0.566	2.000	5.600
Actual private-related public goods	543	3.195	0.665	2.000	4.167
Actual business-related public goods	543	2.916	0.770	1.600	4.200
Salient average public goods	543	0.851	1.043	−1.000	2.636
Salient private-related public goods	543	0.817	1.134	−1.033	2.600
Salient business-related public goods	543	1.072	1.354	−1.400	3.200
Population	543	153,741	288,988	3,798	770,112
Ground area (km²)	543	109.5	79.97	19	248
District debt	543	1,694	1,090	398.5	3,625
Local business tax revenue (€ per capita)	543	639.3	485.0	193.1	1,978
Investment promotion measures	543	95.31	89.33	7.560	244.7
Unemployment rate	543	5.477	1.793	3.070	9.050

Notes: This table lists all variables and provides sample size, mean and median values, as well as standard deviation and 5%- and 95%-percentile.

A8 Summary Statistics Tax Avoidance

Table 17: Summary Statistics of DAFNE Sample (Three-Year ETR).

Variables	N	Mean	St. Dev.	p5	p95
Three-year ETR	165	0.165	0.196	0.00308	0.488
One-year ETR	165	0.162	0.216	0	0.512
Absolute additional local business tax rate$_m$	165	5.797	3.872	-0.175	11.97
Relative additional local business tax rate$_m$	165	0.371	0.250	-0.0112	0.720
Perceived appropriate local business tax rate$_m$	165	9.730	3.807	3.500	15.750
Actual local business tax rate	165	15.530	1.479	12.600	17.150
Trust$_m$	165	2.976	1.063	1	5
Total assets	165	10.11	0.812	8.556	10.96
ROA	165	0.192	0.271	0.0204	0.636
Leverage	165	0.561	0.219	0.186	0.899
Intangible intensity	165	0.00761	0.0277	4.20e-08	0.0371
Employees	165	8.387	1.436	5.921	10.53
Population$_m$	165	368,929	380,139	24,919	1.509e+06
Ground area$_m$ (km²)	165	177.1	92.99	45	311
District debt$_m$	165	1,914	1,421	330.2	5,169
Investment promotion measures$_m$	165	125.4	101.8	26.45	379.4
Unemployment rate$_m$	165	6.738	2.157	3.990	11.11

Notes: This table lists all variables and provides sample size, mean and median values, as well as standard deviation and the 5%- and 95%-percentile.

A9 Robustness Test: Within Municipality Fixed Effects

Table 18: Baseline OLS-regression – Municipality Fixed Effects.

	(1) Absolute additional local business tax rate	(2) Perceived appropriate local business tax rate
Satisfaction private-related public goods	−1.0819**	1.0819**
	(−2.06)	(2.06)
Satisfaction business-related public goods	−0.3037	0.3037
	(−0.56)	(0.56)
Trust	−0.3474	0.3474
	(−0.88)	(0.88)
Constant	−12.7261***	2.1291
	(7.69)	(1.29)
Controls	Yes	Yes
Industry FE	Yes	Yes
Observations	270	270
Adj. R-sq	0.0988	0.0791

Notes: This table shows the OLS regression results for the dependent variables absolute additional local business tax rate and perceived appropriate local business tax rate with municipality fixed effects. t-statistics are given in parentheses, and standard errors are heteroscedasticity-robust and clustered at the municipality level. ***, ** and * label statistical significance at 1%, 5% and 10% level, respectively.

A10 Robustness Test: One-Year ETR

Table 19: OLS-Regression – Tax Avoidance (One-Year ETR) and Firms' WTP.

	(1) One-year ETR	(2) One-year ETR	(3) One-year ETR	(4) One-year ETR
Absolute additional local business tax rate$_m$	−0.0077** (−2.19)			
Relative additional local business tax rate$_m$		−0.1273** (−2.51)		
Perceived appropriate local business tax rate$_m$			0.0094*** (2.67)	
Actual local business tax rate$_m$				0.0294* (1.92)
Trust$_m$	−0.0353** (−2.35)	−0.0347** (−2.29)	−0.0349** (−2.24)	−0.0199 (−1.26)
Constant	0.4509 (1.12)	0.4574 (1.14)	0.3270 (0.81)	−0.0428 (−0.10)
Controls	Yes	Yes	Yes	Yes
Municipality-Size & Industry FE	Yes	Yes	Yes	Yes
Observations	159	159	159	159
Adj. R-sq	0.4885	0.4919	0.4979	0.4929

Notes: This table shows the OLS regression results for the dependent variable one-year ETR. The independent variable in column (1) represents the average absolute additional local business tax rate within the municipality, in column (2) the average relative additional local business tax rate within the municipality. Columns (3) and (4) show the results for the average perceived appropriate local business tax rate in the municipality and the actual local business tax rate in the municipality. t-statistics are given in parentheses, and standard errors are heteroscedasticity-robust and clustered at the municipality level. ***, ** and * label statistical significance at 1%, 5% and 10% level, respectively.