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# Testing taxpayers´ cognitive abilities - Survey-based evidence

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## Abstract

*Our paper assesses the accuracy of individuals´ tax perceptions. Based on personal interviews, we aim to find out how tax complexity affects the capability of respondents to calculate income tax liability. Tax complexity is measured by interacting multiple tax rates, applied to one or more tax bases. Empirical results question the traditional view of taxpayers having a comprehensive understanding of taxation rules. Our findings support the view that increasing complexity affects the capability of taxpayers to accurately calculate income tax liability. For tax policy, there is also a need to determine how taxpayers erroneously deviate in terms of extent and direction, when facing increasing tax complexity. Our research design allows us to analyze extent and possible direction of the calculation bias. Approximating an empirical distribution of erroneous calculated effective tax rates could be helpful to design a more effective income tax system.*


**Keywords:** Tax Complexity, Survey Data, Estimated Tax Rates

**JEL classification:** C83, H 21, H24

## 1. Introduction

The standard economic approach of how individuals respond to taxes is based on Ramsey´s (1927) analysis of optimal commodity taxation. He assumes that tax changes are perceived in the same way as price changes. His pioneer work has triggered a rich body of subsequent literature. The basic assumption is that agents are fully aware of the tax system. Based on comprehensive knowledge of the tax system, economic models are helpful to develop optimal decision strategies with respect to taxes. For example, seminal contributions by Harberger (1964), Mirrlees (1971), Atkinson and Stiglitz (1976) rely on the idea that taxpayers have a comprehensive knowledge of the tax system. They have been successful in identifying principles of efficient taxation. Over the last decades, several

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studies on behavioral economics have often proved this standard economic assumption about omniscient agents wrong. As Congdon et al. (2009) point out: "…standards assumptions are so consistently violated as to be neither literally true nor useful as modeling assumption."[1] In the literature, the opinion prevails that taxpayers have all necessary information regarding the underlying tax system and the cognitive ability to calculate the personal tax burden. If the view of behavioral agents finds its way into the literature, it is undoubted that many rules governing how to design an efficient tax system need to be tested for validity and are likely to be reconsidered.

The purpose of our study is to gain new insights into how multiple combinations of tax rates affect the ability of taxpayers to calculate personal income tax liability for a given tax base. In reality, there are several cases where different tax rates interact with each other. In the US tax code, local and federal taxes coexist. The German income tax code contains several special rules and tax rates (solidarity surcharge, church tax rate) that additionally apply to income tax base. In international terms, there are even more interacting tax rates which determine effective tax burden. Therefore, this study is of high practical and scientific relevance from an international perspective.

Our contribution to the existing literature addresses the question how severe taxpayers´ miscalculations are, when facing increasing tax complexity. We do not only provide an approach to determine the extent and direction of the gap between taxpayers´ empirical, i.e. real, behavior and its theoretical counterpart. We also account for socio-demographic heterogeneity and its influence on taxpayers´ decision-making, i.e. the individual capability to calculate effective tax rates.

Our concept is straightforward and simple to understand. It tests the validity of the canonical model of taxation. We carried out a survey with 289 participants to determine equivalent tax-free payments for a given payment liable to income taxation. Participants were randomly assigned to one of four tax rate complexity groups. By calculating equivalent tax free payment, we basically test the ability of taxpayers to determine the amount of taxes they pay, which is considered a desirable attribute of any tax system (Madeo et al., 1995). Our contribution to the existing literature on tax complexity provides an easily applicable framework to test the ability of the taxpayer to calculate the personal tax burden while controlling for possible systematic errors in decision-making, e.g. determining equivalent tax-free payments. Our findings suggest that a higher degree of complexity reduces significantly the ability of taxpayers to calculate tax liability, contradicting economic theory of omniscient individuals with regard to taxes. We are able to determine if and how multiple interacting tax rates conceal tax liability, even if the tax base is known. This simple framework is appealing since it accurately outlines whether interdependent multiple tax rates - holding effective tax burden for each combination constant – might prevent participants from calculating their tax burden properly. The remainder of the paper is divided into five sections. The first section of which contains relevant literature. The following section provides a description of the research method and states the hypothesis.

[1] We recommend the study of Congdon et al. (2009) for a detailed discussion.

The results of hypothesis testing are presented in the fourth section. We have also carried out a more elaborate analysis of tax complexity by applying logit regression to our data. The fifth section is devoted to a discussion of the major findings and their implications for tax policy.

## 2. Previous Research on Tax Complexity

In the last decades, theoretical as well as empirical contributions on behavioral economics have been established to question the traditional view of perfectly informed and rational agents. Tax complexity is considered as a possible reason for why individuals do not behave as economic models imply. However, there is still no consensus regarding what constitutes tax complexity (Slemrod, 2005). For example, complexity can arise in measuring income tax base(s), the extent of deduction possibilities, and the constant change in tax law. In general, tax complexity is costly since taxpayers seek to understand the lax law and its application to their activities. Edmiston et al. (2003) argue that tax complexity can be also associated with the number of tax rates. The coexistence of multiple tax rates and their proper application to the same tax base distorts economic behavior by reducing the return of any given investment. The vast majority of recent studies on behavioral economics question taxpayers´ capability to correctly infer and incorporate marginal tax rates.

Literature on behavioral taxation aims to gain insights into how tax rules, e.g. tax rates, are perceived and used by taxpayers when making economic decisions. Rational calculus in economic decision making frequently relies on marginal considerations. While traditional economic theory assumes that individuals use ‘true’ marginal tax rates, a rich body of empirical literature emerged that analyzed how average and marginal tax rates are perceived and applied in economic decisions.

Steuerle (1992) argues that the marginal tax rate is the most important variable affecting individual behavior. From a theoretical perspective, the impact of marginal tax rates is straightforward. However, empirical evidence is not consistent in providing support for these theoretical considerations. Rupert and Fischer (1995) investigate how accurately individuals can estimate the true marginal tax rate. They find that perceived and ‘true’ marginal tax rates differ significantly. His results confirm previous findings by Gensemer et al. (1965), Morgan et al. (1977) and Fujii and Hawley (1988) whose studies indicate that awareness of marginal tax rates among individuals is low. An experiment by de Bartolome (1995) tests if individuals use the average tax rate as reference point for the marginal tax rate. He finds that individuals have difficulties in calculating marginal tax rates if they are not explicitly shown but rely on average tax rates. His results provide strong support for the view that average tax rates are (more) important variables for individuals (than marginal tax rates). Rupert and Wright (1998) address the question as to how individual decision performance is affected by tax rate visibility. Their findings indicate that increased tax rate visibility is associated with better decision performance. In an experimental setting, Rupert et al. (2003) assign each participant to one of three tax systems and ask them to maximize after-tax income via two different investment decisions. The results identify increasing complexity as a main driver of inaccurate decision making. Participants facing low complexity perform significantly better than those in more complex systems.

Blaufus and Ortlieb (2009) provide empirical evidence on tax complexity affecting preferences for pension plans. In their experimental framework, tax complexity is modeled by the time needed for understanding taxation rules, applied to pension plans. Their results show that tax system simplifications would significantly ease decision making for taxpayers, figuring out pension plans with the highest after-tax return.

Chetty et al. (2009) analyze tax complexity in terms of different degrees of tax liability salience. Their approach aims to test economic theory by determining the effect of taxes on consumption bundles. Comparing consumption choices in supermarkets, they distinguish between non-salient taxes and fully salient taxes to derive tax-demand and price-demand curves which are used to calculate welfare effects of (lacking) tax salience. Their findings contradict the canonical theory of taxation which is traditionally used for policy analysis. They suggest reconsidering optimal taxation rules when agents optimize imperfectly[2].

We have added another dimension to empirical analysis of tax complexity by interacting multiple tax rates and their application to one or more tax bases. To our knowledge, this approach has not been yet used to model different degrees of tax system complexity which is intuitive and of practical relevance.

Our survey-based approach tests the taxpayers´ ability to determine the amount of taxes they pay. This ability is considered a desirable attribute of any tax system (Madeo et al., 1995). We propose an easily applicable framework to test the taxpayers´ ability to recognize tax consequences. This approach provides new evidence on how and to what extent economic theory of taxation and real individual behavior diverge. Our survey identifies tax complexity as one important reason why tax policy relying on canonical model assumptions most likely needs to be reconsidered.

## 3. Research Method and Hypotheses

### 3.1 Research Method

As Schoenberger (1991) highlights “the […] interview method is particularly appropriate in periods of economic and social change that challenge traditional analytical categories and theoretical principles”. Our goal is to test the validity of the canonical model of taxation and how tax complexity prevents individuals from identifying their personal tax burden. We conducted personal interviews with 289 employees who are assumed to have at least basic knowledge of income taxation. Subjects participated on a voluntary basis. Table 1 provides information on the demographic composition of our sample.

[2] Slemrod (1990) provides a detailled discussion of the Optimal Taxation Theory.

**Table 1: Demographic sample composition**

| Category | Value | Frequency | % |
|---|---|---|---|
| Gender | Male | 154 | 53.3 |
| | Female | 135 | 46.7 |
| Age | Younger than 30 | 96 | 33.2 |
| | 30 - 39 years | 63 | 21.8 |
| | 40 -49 years | 52 | 18.0 |
| | 50 - 59 years | 65 | 22.5 |
| | Older than 59 | 13 | 4.5 |
| Education | Primary School | 2 | 0.7 |
| | Secondary School | 14 | 4.8 |
| | Intermediate School | 100 | 34.6 |
| | A level | 62 | 21.5 |
| | University degree | 111 | 38.4 |
| Income Class | Less than 1,000 € | 43 | 14.9 |
| | 1,000 – 2,000 € | 81 | 28.0 |
| | 2,000 – 3,000 € | 78 | 27 |
| | More than 3,000 € | 87 | 30.1 |

We created four tax systems (A, B, C, D) with different levels of difficulty in terms of interacting tax rates. The effective tax rate of each system is equal, amounting to 40%. Tax systems only differ in the number of tax rates (one, two or three) and in how the tax rules of each system are formulated. We model tax complexity through necessary calculation requirements to determine effective tax rates. Tax system A contains ne tax rate, which applies to one tax base. B contains three additive tax rates, which all apply to the same tax base. Its effective tax rate can be calculated by a simple addition of the three tax rates. Respondents face higher complexity in tax systems C and D. C consists of two different tax rates, which are applied to different tax bases. D however is assumed to be most complex because it has two different tax rates applied to two tax bases with self-deductibility. Table 2 presents the characteristics of each system[3].

[3] Phrases are based on German Income Tax Code wording. Tax system B is equivalent to the combination of income tax rate and solidarity surcharge in Germany. Tax system C corresponds to the interaction of income tax rate and church tax rate. Tax system D decomposes effective taxation into three additive tax rates.

**Table 2: Tax Systems**

| Tax System | Tax Rule | Effective Tax Rate |
|---|---|---|
| A | Income tax payment on tax base is 40%. | 40% |
| B | Overall tax burden on tax base consists of income tax, the additional tax and a wage based tax. Income tax payment on tax base is 15%. The additional tax applies to tax base and amounts to 10%. The wage based tax applies to tax base and is 15%. | 40% |
| C | Income tax payment on tax base is 32%. There is an additional tax of 25%, which applies to the income tax payment. | 40% |
| D | Income tax payment on tax base is 36%. There is an additional tax of 18.5%, which applies to the income tax payment. This additional tax is deductible from tax base[4]. | 40% |

Each participant was randomly assigned to one tax system, a description of which was also handed out to the participants. On the basis of this tax system and a given payment of 20,000 € which is subject to income taxation, each individual was asked to calculate the equivalent tax-free payment. The correct answer for each system is 12,000 €. The difficulty of determining the equivalent tax-free payment derives from understanding the taxation rules and properly applying the tax rates to the tax base. Instead of a single tax payment calculation, we consciously asked participants to determine equivalence between a tax-free and a taxable payment. This task is more realistic when determining taxpayers´ ability to deal with tax planning issues. The purpose of our survey is to determine systematic over- or underestimation of tax burden and its causes, depending on different degrees of tax complexity[5].

[4] Total tax rate calculation for tax base deduction (tax system C):

$$(I): \mathrm{T}_{AT} = \tau_{AT} \cdot \mathrm{T}_{IT};\ \ (II): \mathrm{T}_{IT} = \tau_{IT} \cdot (TB - \mathrm{T}_{AT});\ \ (I\ in\ II): \mathrm{T}_{IT} = \frac{\tau_{IT}}{1+\tau_{IT}\cdot\tau_{AT}} \cdot TB$$

$$(in\ I): \mathrm{T}_{AT} = \frac{\tau_{AT}\cdot\tau_{IT}}{1+\tau_{IT}\cdot\tau_{AT}};\ \ \mathrm{T}_{total} = \mathrm{T}_{IT} + \mathrm{T}_{AT} = \frac{\tau_{IT}+\tau_{AT}\cdot\tau_{IT}}{1+\tau_{IT}\cdot\tau_{AT}} \cdot TB;\ \ \tau_{total} = \frac{\tau_{IT}\cdot(1+\tau_{AT})}{1+\tau_{IT}\cdot\tau_{AT}}$$

[5] To ensure a high response rate, participants were told that in case they were not able to calculate the equivalent tax-free payment, it is still important how their decision making was done.

### 3.2 Hypotheses

We pose four hypotheses to examine potential effects of tax complexity on taxpayers´ behavior. First, it is straightforward to assume that the share of correct calculations of income tax liability depends negatively on the underlying tax system.

> $H_1$: *Increased complexity in the tax system will lead to greater difficulty in accurately calculating income tax liability.*

Our implicit assumption is that increasing tax complexity affects the calculation of the income tax liability but does not itself affect individual calculation effort. Since our interview does not contain real effort decision-making, we can rule out possible pure tax complexity aversion. We do not only expect that errors resulting from increased tax complexity will become more likely, we also test the direction and extent of misperceptions by the two following hypotheses.

> $H_2$: *The ratio of over- and underestimations is on average not equal across all tax systems.*

To control for further heterogeneity, we are interested in identifying the influence of education on dealing with tax complexity. Knowledge and experience of German tax law is assumed to reduce the difference between the correct and the self-calculated tax-free payment. The hypotheses are:

> $H_3$: *The higher their level of education, the more likely the respondent will accurately determine tax liability.*

> $H_4$: *Better knowledge of German tax law reduces deviations between correct and estimated tax-free payment.*

## 4. Empirical Findings

### 4.1 Group-specific complexity analysis

Our empirical strategy is based on three steps. First, we test whether the ratio of correct and incorrect answers depends on the tax system. Our second step is a more detailed analysis of how the distribution of answers (mean and standard deviation) is affected by the underlying tax system. The last step compares the absolute values of the tax system-specific estimation biases to find possible differences of erroneous calculations, i.e. underestimations and overestimations. Our goal is to gather detailed evidence about both the extent and the direction of the estimation bias. Our analysis is based on the calculated effective tax rates, which are directly derived from the calculation of the tax free payment[6].

Table 3 presents the number of correct and incorrect calculations of the effective tax rate[7]. Increasing tax complexity (A to D) indicates that the number of correct estimations decreases. Despite being subject to the most straightforward tax system (A), only 79% of the respondents calculated the tax rate accurately. For tax systems C and D, the percentage of correct answers equals 59% and 23%. Tax system B consists of merely adding-up different tax rates. This additive tax system was recognized and applied correctly by 73% of the participants.

**Table 3: Errors in decision making**

| Tax system | Partici-pants | No. of under-estimations | No. of over-estimations | No. of correct estimations | Mean | Median | Std. dev. |
|---|---|---|---|---|---|---|---|
| A | 78 | 8 | 8 | 62 | 0.4048 | 0.4 | 0.06071 |
| B | 62 | 10 | 7 | 45 | 0.3973 | 0.4 | 0.06947 |
| C | 69 | 14 | 14 | 41 | 0.4055 | 0.4 | 0.07495 |
| D | 60 | 19 | 27 | 14 | 0.3893 | 0.4 | 0.07107 |
| **Total** | **269** | **51** | **56** | **162** | **0.3998** | **0.4** | **0.06882** |

Testing statistical significance, we perform different two-sample proportion tests. A two-sample proportion -test is helpful to determine whether differences between two proportions of independent samples are significant. We conduct pairwise comparisons of each tax system. The +null hypothesis of our test is equal to:

$H_0$: *Comparing two tax systems, the percentage of correct answers do not differ significantly from each other.*

On a 5% level of significance, p-values (0.014, 0.001, 0.007) indicate that the percentage of correct estimations between the tax systems (A and C, A and D, C and D) are statistically significantly different[8]. The two-sample p-test provides support for $H_1$. Tax complexity affects taxpayers´ capability to accurately calculate the tax burden. Taxpayers are less capable of determining personal tax burden if more than one tax rate applies. Decomposing effective tax rate of 40% (A) into three additive components (B) increases the amount of erroneous calculations (from 21% to 27%). However, this increase is not significant from a statistical point of view.

[6] Underestimating tax free payment is equal to overestimating effective tax rate and vice versa.

[7] Outliers are excluded from our sample.

[8] Comparing the percentages of correct answers between A and B, p-value amounts to 0.39, indicating no statistically significant difference.

When analyzing tax system-specific sample means, Table 3 shows that differences between the means are negligible. This implies that increasing tax rate complexity and mean calculation are not likely to be interdependent. Using Kruskal-Wallis-test, we find no statistically significant differences between tax system-specific means[9]. Taking the standard deviation into account (see last column of Table 3), we find that the sample dispersion of answers and increased tax rate complexity are likely related. Comparing A to B (to C, to D), the sample specific deviation of estimated tax rates increases by 14.43% (by 23.46%, by 17.06%). Levene´s test is useful to assess the equivalence of variances in different tax systems. The null hypothesis assumes the variances of the populations from which the different samples are drawn to be equal. Pairwise tests indicate statistically significant differences between tax systems A and C (p-value: 0.085) as well as between A and D (p-value: 0.016) for a 10% level of confidence, leading to a rejection of the null hypothesis. Our empirical findings show that the estimated tax rates are balanced in means but differ significantly in variance. In most cases taxpayers estimate their tax burden correctly but make more mistakes when complexity increases. Our results indicate that the extent of taxpayers' erroneous decisions (e.g. work-leisure-decision) can be reasonably approximated by deviations from the mean. These deviations are directly influenced by the complexity of the income tax system. For tax policy purposes, these distortions are needed to be taken into account when deciding about new (more complex or simplified) tax rules.

Finally, we analyze the absolute value of tax rate calculation errors. Table 4 presents separate descriptive statistics for over- and underestimations, indicating differences between average under- and overestimations. Comparing tax system specific dispersions, we have observed that standard deviation is always higher for taxpayers who underestimate the effective tax rate than for those who overestimate it.

**Table 4: Degree of over- and underestimation in percentage points**

| Tax system | Mean of underestimations | Standard deviation | Mean of overestimations | Standard deviation |
|---|---|---|---|---|
| A | 0.0969 | 0.0633 | 0.1437 | 0.0495 |
| B | 0.0980 | 0.0840 | 0.1157 | 0.0830 |
| C | 0.0884 | 0.0637 | 0.1157 | 0.0514 |
| D | 0.0891 | 0.0631 | 0.0388 | 0.0400 |
| **Sum** | **0.0919** | **0.0658** | **0.0827** | **0.0659** |

For statistical significance, we perform Mann-Whitney-U-Test to assess whether one tax system group tends to have larger absolute values for underestimation than for overestimation. The null hypothesis is that the distribution of underestimations is stochastically not different from the distribution of overestimations.

[9] The p-value amounts to 0.808.

Within tax systems A, B and C, p-values indicate no statistically significant difference between underestimations and overestimations, implying a rejection of $H_2$. However, the difference between underestimation and overestimation is significant on a 1% level of confidence (p-value is 0.004), providing empirical support for $H_2$. Regarding the validity of $H_2$, no clear picture can be drawn from the empirical analysis. Except for D, the most complex tax system, absolute values of incorrect estimations do not depend on the estimation direction. A possible explanation could be a risk premium. If participants are not able to calculate income tax liability correctly, they add a risk premium[10].

### 4.2 Results from Logit Regression

Logit regression is a nonlinear probability model. In general, it is used to estimate the effect of particular variables of interest on a binary response when potentially confounding variables are controlled for. We estimate a logit model to predict the probability of accurately calculating equivalent tax free payment, depending on different socio-demographic characteristics. Logit regression is a more elaborate approach to identify individual factors which determine the capability to provide an accurate calculation. In particular, we are interested in how the level of education and knowledge of German tax law affect taxpayers´ capability to determine the tax burden (testing H3 and H4). On the individual level, our estimation equation is specified as

$$\text{logit } Y_i = \beta_0 + \beta X_i + \varepsilon_i \text{ with } X_i = \left\{ \begin{array}{l} education \\ knowledge \\ complexity \\ income \\ risk\ attitude \\ age \\ gender \\ calculator \end{array} \right\}.$$

[10] The personal interview contains questions on personal risk attitudes. On a scale from 1 (risk averse) to 10 (risk seeking), participants are asked to assess their risk-taking propensity. Furthermore, we have conducted a test using the personal risk attitude to explain the amount of the tax free payment. This, however, produced no result. A possible explanation is that our respondents participated on a voluntary basis. In a risk free framework (in terms of lacking monetary incentives), identifying true risk preferences might be challenging. Providing monetary incentives and different identification strategies of measuring risk preferences could provide promising insights and will be addressed in upcoming work. An indirect query of personal risk preferences via Arrow Pratt measure could be a valuable alternative. See, Huang and Litzenberger (1988) for further information.

Our outcome variable $Y_i$ is dichotomous. There are only two possible outcomes: Y=1, if the respondent accurately calculates equivalent tax free payment and 0 otherwise. $\beta_0$ is the unknown intercept, $\beta$ is a row vector of unknown parameters. $X_i$ denotes a column vector of predictors for the i-th observation, containing individual socio-demographic characteristics. The variable age – measured in years – is metric; gender is binary and equals 1 for male respondents and 0 for female respondents. The latter is our base category. Further explanatory variables are information on level of education and income. The basic categories are "no certificate or secondary school certificate" and "income less than 1,000 €". Self-estimated personal risk attitude is also included as a regressor. Respondents with values between 1 and 3 are considered risk averse, whereas values between 4 and 7 (8-10) are labeled as risk neutral (risk seeking). To account for heterogeneity caused by different degrees of tax complexity, we include a categorical variable "complexity" as a control with values between 1 and 4, corresponding to tax systems A (base category) to D. Finally, we include self-estimated knowledge of German tax law with "above-average knowledge" as base category. Our binary variable "calculator" indicates the use of calculator which is 1 when calculator was used and 0 otherwise. It is assumed that using a calculator and having better knowledge of German tax law will positively affect the probability of accurately estimating tax free payment.

Our estimation results are presented in Table 5, containing point estimates and standard error of each covariate. For the sake of intuitive interpretation, the last column reports odds-ratios. Odds-ratios are defined as the ratio of the probability of success, i.e. accurate calculation of tax free payment, over the probability of failure, wrong calculation of tax free payment. In general, most logit coefficients are significant and have the expected sign. Our findings indicate that the level of education and the individual probability of accurate calculation are clearly related, providing strong support for $H_3$. All coefficients for level of education are significant and positive. Respective odds ratios show that the higher the level of education, the higher the probability of correct calculation. Regarding the knowledge of German tax law, findings are rather ambiguous. Although both the coefficient for "no tax law knowledge" and "average tax law knowledge" are statistically insignificant, there is a significant difference between "above-average tax law knowledge" and "low tax law knowledge". The point estimate amounts to -1.083 and odds-ratio is 0.339, indicating that respondents with low self-estimated tax law knowledge are less likely to provide an accurate calculation. This finding provides relatively weak empirical support for $H_4$. Being confronted with increasing tax complexity lowers the probability of correct calculation. Estimated parameters are negative.

**Table 5: Estimation Results**[11]

| Covariate | Coefficient | Standard error | Exp(B) |
|---|---|---|---|
| Intermediate school certificate | 1.283** | 0.621 | 3.608 |
| „A“ level | 1.485** | 0.691 | 4.415 |
| University degree | 1.722*** | 0.639 | 5.594 |
| No tax law knowledge | -0.782 | 0.651 | 0.457 |
| Low tax law knowledge | -1.083* | 0.575 | 0.339 |
| Average tax law knowledge | -0.605 | 0.580 | 0.546 |
| Tax system B | -0.458 | 0.386 | 0.633 |
| Tax system C | -1.017*** | 0.379 | 0.362 |
| Tax system D | -3.074*** | 0.464 | 0.046 |
| Income between 1,000 – 2,000 | -1.090** | 0.499 | 0.336 |
| Income between 2,000 – 3,000 | -0.410 | 0.517 | 0.664 |
| Income > 3,000 | -0.958* | 0.541 | 0.384 |
| Risk neutral | -0.393 | 0.311 | 0.675 |
| Risk seeking | -0.400 | 0.472 | 0.670 |
| Age | -0.008 | 0.014 | 0.992 |
| Gender | 0.616** | 0.290 | 1.851 |
| Calculator | 0.846*** | 0.308 | 2.329 |
| Constant | 1.120 | 1.151 | 3.064 |

For tax systems C and D, this effect is statistically significant on 1% level of confidence. This finding is in line with our results from two-sample t-test, where tax complexity negatively affects taxpayers´ capability to determine the correct income tax burden. There is no statistically significant difference between tax systems A (base category) and B. The latter is only the sum of four additive tax rates.

The relation between income and our binary dependent variable is estimated to be rather negative. Two of three coefficients are negative and at least statistically significant on a 10% level of confidence. Controlling for level of education, we have found that taxpayers with medium and highest incomes (income between 1,000 – 2,000 and income

[11] Note: Asterisks denote the respective significant level at 95% (*), 99% (**) and 99.9% (***).

> 3,000) are less likely to provide an accurate calculation of tax free payment. Assuming that respondents with more income have higher opportunity cost, we suppose that this surprising result is possibly driven by less motivation. Nevertheless, the chosen income classification might hamper identifying the expected relation between a high probability of accurate calculation and disposable income. Our survey only queries disposable household income of each taxpayer, possibly concealing a significant effect. Estimates for age and gender indicate that accurate calculation is not affected by taxpayers´ age but their gender. Male respondents are more likely to determine the correct tax free payment. They might benefit from more experience in declaring income taxes. We have found that taxpayers using a calculator have a statistically significantly higher probability of estimating the correct tax free payment. Respective odds-ratios amount to 2.329.

Summing up, logit analysis allows us to estimate the impact of socio-demographic factors on the probability of determining the correct tax free payment. Finally, our results provide strong empirical evidence supporting H3. A higher level of education positively affects the capability of taxpayers to determine the effective tax rate. Coexistence of multiple tax rates and their proper application is negatively influenced by increased tax complexity as well as low knowledge of German tax law.

Overall, our findings provide empirical evidence of the hypothesis that taxpayers´ miscalculations of effective tax rates are more pronounced, when faced with increasing tax complexity. The extent and direction of erroneous is determined by the degree of complexity. Taxpayers will be benefit from a transparent tax system, i.e. reduced complexity, in two ways: (1) Taxpayers will have less difficulty to estimate individual tax liability. (2) Taxpayers´ planning costs will be lowered. Although this theoretical lucidity appeals to howl with the wolves, several practical stumbling stones need to be accounted for.

The vices and virtues of implementing a tax simplification are discussed in detail by James und Edwards (2008). They show that changing one part of a tax system will likely affect the operation of other parts. Mere simplification of a tax system might not improve matters overall. When requesting for a simple(r) tax system, we need to consider that tax simplification is often accompanied by a loss of fairness. Taxing all people in the same way is simple and practicable but not fair. Modern tax systems are complex to increase fairness by developing special norms for individual tax cases. As the literature points out, fairness is an important factor for tax morale (e.g. Schmölders, 2006) and tax compliance (e.g. Adams, 1965; Andreoni, Erard and Feldstein, 1998; Wenzel, 2003). Perceived fairness may increase tax compliance (Kirchler, 2007). This effect may work in the opposite direction of a pure simplification and has to be taken account when interpreting our results. Nevertheless, fairness as well as complexity are individual perceived values. Our results show that a complex tax system leads to distortions and analyses their extent and direction. Further research should not only address the issue of tax simplification on taxpayers´ behaviour but also the interaction between reduced tax complexity and fairness and tax morale. The avoidance of miscalculations might be likely under- or overcompensated by an accompanied loss of fairness.

## 5. Conclusion

Examining self-collected data on determinants of understanding tax complexity, we carried out a survey with 289 participants. Our approach is to use an easily applicable framework to test the taxpayers´ ability to calculate the personal tax burden. Participants were randomly assigned to one of four tax complexity groups. Complexity is measured by varying amounts of interacting tax rates across the four groups. Our results have shown that increasing complexity significantly affects taxpayers´ capability to accurately calculate income tax liability. Furthermore, we analyzed the extent and direction of the incorrectly estimated tax rates. While the sample means are almost identical, sample standard deviations are significantly different across the tax systems. Regarding the total absolute value of the errors, there is no statistically significant difference between underestimations and overestimations (except for tax system D).

Deploying logit analysis, we are able to identify level of education, knowledge of German tax law and gender as driving factors with regard to probability of correct estimations. We contribute to the existing literature on measuring tax complexity and its impact on taxpayer behavior. Our findings provide strong support for proponents of tax simplification, which would ease tax planning problems considerably. Moreover, our survey questions theoretical results regarding efficient taxation of individuals. The main assumption in taxation literature is that taxpayers have all necessary information or can use cognitive abilities to carry out simple calculations to determine effective taxation. Our results suggest to think outside the box and follow more recent literature (Congdon et al., 2009), where this prominent mindset appears to be not generally valid and needs to be reconsidered.

For tax policy purposes, income tax revenue estimation could be improved. Instead of using a ‘real’ effective tax rate, a distribution of perceived (erroneously calculated) tax rates would account for likely calculation limitations caused by tax complexity. Furthermore, we discussed possible contra arguments against a pure simplification of the tax system. Opposite effects in form of simplification costs and the loss of fairness have to be taken into account. To address the question if implementing a simple tax system is overall preferable needs further research about possible trade-off effects. To our knowledge, our contribution pioneers in the development of an approach to approximating distorted tax rate perceptions. Further research is needed to develop more elaborate tax models, which account for taxpayers´ cognitive limitations. These models may help derive strategies to tax people more effectively.

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