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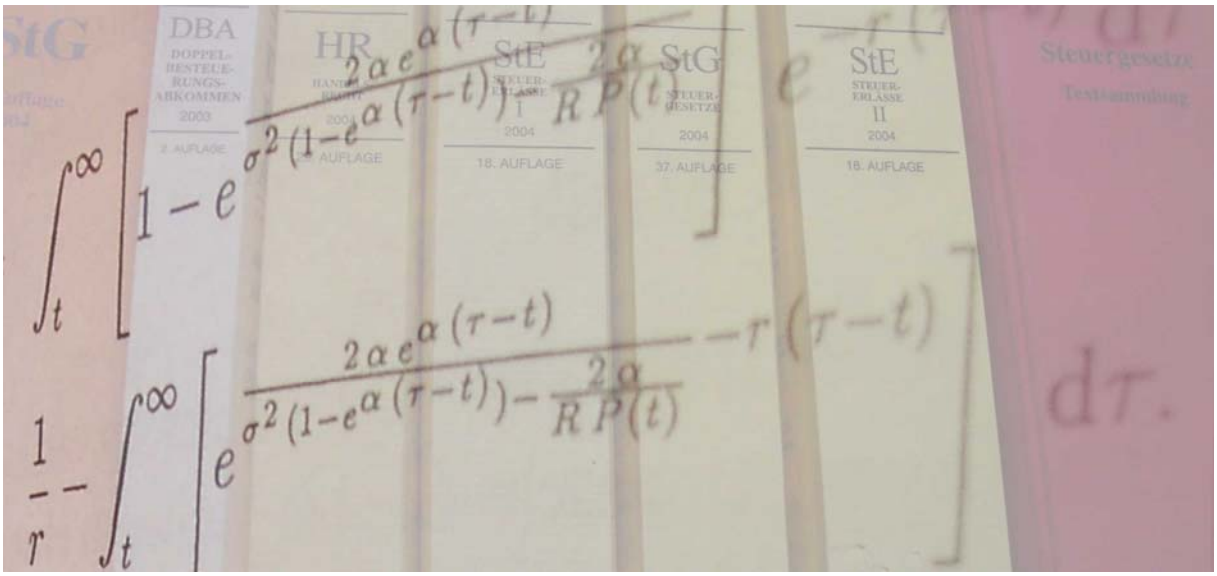

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It's All About Tax Rates
An Empirical Study of Tax Perception

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It's All About Tax Rates

An Empirical Study of Tax Perception

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In this paper we apply conjoint analysis to study the influence of changes in the tax rate and the tax base on the perceived tax burden. Our results show that the majority of individuals do not make rational tax decisions based on the actual tax burden, but rather use simple decision heuristics. This leads to the importance of the tax rate being significantly overestimated and the importance of the tax base being significantly underestimated. Furthermore we determine framing effects and show that under specific assumptions, a rise in the actual tax burden can lead to a electoral success.

Keywords Behavioral public finance · Decision heuristics · Framing effects · Perceived tax burden · Tax-cut-cum-base-broadening · Tax complexity · Tax illusion

JEL Classification D03 · G11 · H20 · H30 · K34 · M41

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1 Introduction

It is a common international trend for governments to decrease nominal tax rates and simultaneously broaden the tax base. *Devereux et al.* (2002) determined that when EU and G7 nations reduced the nominal tax rates for corporations, the effective marginal tax rates remained virtually unchanged because the tax base was broadened at the same time. This cannot be explained using traditional tax competition models, since the majority of models predict a reduction of effective tax rates on mobile production factors (see *Griffith und Klemm* , 2004).

A possible explanation for the behavior of nations facing tax competition is that for budgetary reasons, they attempt to reduce not the actual but simply the perceived burden of taxpayers (see *Krishna und Slemrod* , 2003).[1] *Mill* presumed as early as 1848 that individuals perceive the tax burden not rationally but rather in a distorted manner, therefore underestimating the burden of indirect taxes ("hidden taxes") compared to that of direct taxes. In addition, marketing research has shown that price complexity influences buyers' price perception and demand. It has been shown that breaking down the price into several components (e.g. base price and shipping costs) leads to a decrease in the perceived price and an increased demand for the corresponding commodity (see *Morwitz et al.* , 1998). The type of necessary mathematical operations used in pricing (addition/subtraction versus multiplication) also has a significant influence on the perceived price (see *Estelami* , 2003a,b) and on price expectations in connection with a marketing campaign (*DelVecchio et al.* , 2007).

Krishna und Slemrod (2003) were the first to discuss the potential meaning of these price research results for tax policy. Recently, the idea that tax presentation could affect the perceived tax burden was picked up by *Chetty et al.* (2009), who showed that using prices plus sales tax instead of the net amounts leads to a significant reduction in demand. The following article is also based on this idea and is, to our knowledge, the first to examine whether the perceived tax burden is dependent upon which price component (tax rate or tax base) is changed.

This question is highly relevant from a both theoretical and practical perspective. The impact of decisions based on taxes may be wrongly predicted if tax perceptions are in reality distorted rather than rational. As a result, the deadweight losses of taxation would also be estimated incorrectly. In addition, price research has shown that the perception of prices in complex descriptions depends upon the cognitive ability of the individuals, their need for cognition and their level of education (see *Kim und Kramer* , 2006). Therefore, different presentations of tax changes through tax rates or tax bases may have implications on the allocation of tax burdens to taxpayers. The question is also of interest from a political economics perspective because the distorted perception of changes in tax base and tax rates can be systematically used by politicians to reduce the perceived burden and thereby increase the likelihood of their being elected.

This article is organized in the following manner. In section 2 we will present a review of the current literature and in section 3 we will derive our hypotheses. In order to test our hypotheses, we then applied conjoint analysis. For this purpose we conducted personal inter-

[1] For alternative explanations within the context of international tax competition see *Devereux et al.* (2002); *Haufler und Schjelderup* (2000).

views of working individuals. The sample was selected to match the following characteristics of the working population in Germany: gender, age, education, and monthly net income. The sample, method, and results are presented in section 4. A discussion of the results and the implications for tax policy and research is carried out in section 5.

2 Literature Review

We base our article both in terms of content and method on previous marketing research work. In terms of content, the article is related to price complexity studies, which analyze the influence of multidimensional price descriptions on consumers' price perception (see for example *Morwitz et al.* , 1998). In terms of method, we use conjoint analysis, which is a well-established marketing research method. Thus far this method has only been applied to tax questions by *Milliron und Toy* (1988); *Blaufus und Ortlieb* (2009); *Hundsdoerfer und Sichtmann* (2009).

In addition to the references to marketing research, our article relates to a body of literature in tax research which addresses questions of tax illusion, i.e. the distorted perception of tax burdens. Analyses of economic tax effects have thus far been routinely carried out under the premise of a rational individual, *homo oeconomicus*. However, a series of articles also address errors in tax perception by limited rational decision makers. A prominent example is the Mill Hypothesis, mentioned in the introduction, which causes causes the tax burden to be underestimated through "hidden" taxes. The Mill Hypothesis has been extensively tested and, in the majority of studies, confirmed (for example by *Eckel et al.* , 2005; *Sausgruber und Tyran* , 2005; *Chetty et al.* , 2009; *Finkelstein* , 2009; it was not confirmed by *Menges und Traub* , 2009).

In addition, surveys, experiments, and economic studies show that numerous individuals inaccurately predict their own income tax burden. *Enrick* (1963, 1964); *Gensemer et al.* (1965); *Fujii und Hawley* (1988) used surveys in the USA to determine that most people underestimate their personal tax rates. One possible reason could be that individuals frequently base their calculations on the average tax rate rather than their marginal tax rate, as shown in an experiment by *de Bartolome* (1995). However, some studies have also found that marginal tax rates are overestimated (e.g. *Rupert und Fischer* , 1995; *Hundsdoerfer und Sichtmann* , 2009).

Three experiments (*Rupert und Wright* , 1998; *Rupert et al.* , 2003; *Boylan und Frischmann* , 2006) and one conjoint analysis (*Blaufus und Ortlieb* , 2009) demonstrate that errors in the perceived tax burden increase with higher tax complexity.

In addition to surveys and experiments, empirical analyses have also been carried out to test the existence of tax illusion and in particular, to examine labour supply decisinos. The results of these studies are inconsistent. Whereas *Rosen* (1976); *Brännäs und Karlsson* (1996) failed to establish a distorted perception of tax rates, *König et al.* (1995); *Arrazola et al.* (2000) concluded that the measured employment decisions were not based on definite knowledge of the individual marginal tax rate.

The mentioned articles indicate that a multitude of individuals—in contrast to the assumptions of the *homo oeconomicus* models—either do not know or inaccurately estimate their

individual tax burden and that errors in tax perception increase with increasing tax complexity. In an econometric analysis of the location decision of German multinationals *Buettner und Ruf* (2007) showed that investors react more to changes in the nominal tax rates than they do to changes in the effective tax rates. This indicates that individuals fail to accurately recognize differences in tax bases. Building on these results, we test systematically the influence of the tax rate on tax illusion relative to that of the tax base, and examine what influencing factors determine the degree of tax illusion.

3 Theory

How do individuals choose between alternatives which differ exclusively in terms of tax burden? To resolve this question, we assume that individuals can choose between different tax reform alternatives, which for a given income differ only in terms of tax rate and the underlying tax base.

It is important to note that we are not looking at tax reform models that differ such that certain economic activities are taxable in one alternative but not the other. As is well known from literature (e.g. *Willner und Granqvist* , 2002) a base-broadening, rate-reducing policy that taxes previously untaxed opportunities whilst reducing the tax rate on all taxable opportunities could lead to efficiency gains even if tax payments remain the same. By contrast, we are studying the effect of taxing a single (already taxable) economic activity differently in each reform alternative. One can think of reform models regarding interest taxation where the alternatives solely differ in tax rates and tax bases.

According to traditional economic theory, decision makers are assumed to be rationally acting individuals. A rational individual would choose between these alternative based on the actual tax burden B_i which can be written for the i-th alternative as

$$B_i = \tau_i Y - \tau_i D_i \tag{1}$$

where τ_i is the tax rate, D_i is the deduction of income-related expenses, and $Y > D_i$ is taxable revenue (identical for all alternatives).

Traditional theory further assumes that economic subjects do not make arithmetic errors and that the calculations included in the decision making process do not require a great deal of cognitive effort. The question of whether it is worth accurately calculating asset values and tax burdens, etc. does not arise from the given information for a *homo oeconomicus*. Moreover, traditional theory assumes descriptive invariance, which means that the presentation and description of alternative actions (framing) does not affect decision-making.

The assumption of rational individuals leads to our first hypothesis to be tested:

H1: The decision between alternatives is made based exclusively on the actual tax burden.

However, if one considers the possibility that individuals are not fully rational, then, one arrives at differing predictions about their decision behavior. For instance, one might assume that humans' cognitive ability is limited and that the calculation of decision variables such as

tax burdens causes cognitive strain, making it reasonable for individuals to use simple decision heuristics rather than exact calculations (see *Tversky und Kahneman* , 1974).

Individuals can reduce their cognitive effort and/or cut information costs by choosing a decision heuristic instead of an optimization (see *Shah und Oppenheimer* , 2008). Furthermore, in certain decision situations, optimizations are analytically not feasible; in other words optimal solution strategies do not generally stand above decision heuristics due to estimation inaccuracies, which are often unavoidable in real situations (see *Gigerenzer und Goldstein* , 1996; *Gigerenzer* , 2008). The latter is only conceivable when the consequences of the decision are uncertain (e.g. uncertain future stock price development). However, in this analysis individuals must choose between alternatives that differ solely in terms of certain tax burden. In this case, choosing a decision heuristic leads to a suboptimal but individual satisfactory solution (*Simon* , 1990). The advantage of selecting a decision heuristic therefore consists solely of lower cognitive strain and less time spent on the decision problem.

One possible decision heuristic for the existing decision problem is is what is known as the anchor heuristic ("Anchoring and Adjustment"), which has been observed empirically in several other contexts (see *Tversky und Kahneman* , 1974; *McCaffery und Baron* , 2003; *Epley und Gilovich* , 2006). According to this heuristic, individuals who wish to estimate a certain value, such as the actual tax burden, begin with a starting value which serves as an anchor for finding the estimated value. The disadvantage of this heuristic is that the anchor is continuously overweighted and additional information is not adequately included.

The anchor is often chosen by selecting either the information with which the individual is first confronted (see *Hogarth und Einhorn* , 1992) or the information which is considered most important (*Yadav* , 1994). The anchor value is then adjusted (inadequately) based on later information which is considered less important.

In our opinion, there are several reasons why the tax rate and not the amount of the deduction of income-related expenses should serve as the anchor.

First, information about the nominal tax rate τ_i is in reality much more readily available than information about the deductibility of single expenditures. Comparisons of nominal tax rates, e.g. from alternative locations, are therefore less complex than comparisons which account for differences in tax bases.

Second, in general tax liability reacts more elastically to changes in the tax rate than to changes in income-related expenses. Therefore a one percent increase in tax rate always leads to a one percent increase in tax liability, whereas a one percent drop in the deduction of income-related expenses leads to a tax increase in the amount of $\frac{D_i}{Y-D_i}$ percent and therefore is always less than one percent if $Y > 2D_i$, which is typically the case. The amount of income-related expenses to be deducted could therefore be considered less important by some individuals. In addition, the effects of different tax rates on a given income can be easily recognized, such that individuals can determine the positive correlation between tax rate and income without cognitive strain. By contrast, with the influence of the deduction of income-related expenses there is a negative correlation between tax base and income-related expenses as well as a positive correlation between tax base and tax liability. The marginal necessary cognitive effort compared to the tax rate effects also supports the fact that the tax rate and not the income-related expenses act as an anchor.

Besides the anchor heuristic, there are a number of other conceivable heuristics (for an

overview see *Gigerenzer und Goldstein* , 1996, pp. 657ff.; *Shah und Oppenheimer* , 2008, p. 214). In particular the use of a lexicographical heuristic seems reasonable (e.g. *Brandstätter et al.* , 2006). Individuals reduce their cognitive effort through the use of this heuristic by first evaluating the alternatives based on only one criterion, and if no decision is possible with this criterion they then apply other criteria. Based on the high relevance of the tax rate presumed above, it is assumed that individuals who use a lexicographical heuristic will first evaluate alternatives based on the tax rate; only when information regarding tax rates is equivalent will they then consider the deduction of income-related expenses.

The use of the mentioned heuristics in combination with the assumption of the perceived high relevance of the tax rate leads to the following hypothesis:

H2: The effect of changes in the tax rate (changes in the tax base) is overestimated (underestimated).

Since the use of heuristics is only worthwhile when the costs of exact calculation (cognitive effort, time) exceed the expected advantage of selecting the optimal alternative, we expect that when the advantage increases the number of individuals using heuristics will decrease. This leads to:

H3: As differences in the tax rate and the tax base increase between the alternative tax systems, the likelihood increases that individuals will make decisions based on the actual tax burden.

Previous studies of price complexity have shown that when prices are presented in a complex manner, price perception depends upon individuals' cognitive ability and therefore upon their level of education (see *Kim und Kramer* , 2006). We assume, moreover, that the perception of tax burden is dependent upon the individual's tax knowledge. For individuals who are familiar with tax law it should be easier to correctly calculate the tax burden, such that this group of people will be less likely to go back to heuristics. This leads to the following two hypotheses:

H4: The higher the individual's education level, the more likely they will make decisions based on the actual tax burden.

H5: The better the individual's tax knowledge, the more likely they will make decisions based on the actual tax burden.

4 Conjoint Analysis

4.1 Method and Design

In order to test the hypotheses derived in the previous section, we conducted a conjoint analysis. The procedure is based on *Luce und Tukey* (1964). The aim of conjoint analysis is to derive the influence of respective attributes (and their levels) on the total utility of a combination of attributes (stimuli). For this purpose, subjects were given various stimuli to evaluate.

Conjoint analysis is a decomposition method, because the estimation of influence (part-worth utilities of attribute levels, relative importance of attributes) is based on empirically collected total utility of the respective stimuli (see *Hair et al.* , 2008).

This procedure has so far been mainly used in marketing research. Thus far the following authors appear to be the only ones to have applied conjoint analysis to study tax payers' subjective evaluation of characteristics of the tax system: *Milliron und Toy* (1988); *Blaufus und Ortlieb* (2009); *Hundsdoerfer und Sichtmann* (2009). The research concept is to define tax characteristics as attributes of products. With the help of traditional conjoint analysis, the part-worth utility of various attributes can be separated and measured at the subject level (see *Green und Srinivasan* , 1978, p. 104). In the current study, it is especially important to estimate preferences on the individual level because this allows for a comparison between the perceived and actual tax burden. For this purpose, the part-worth utility of a tax characteristic for a "rational" tax payer will be compared with the actual measured part-worth utility.

A further advantage of conjoint analysis is the simultaneous evaluation of the attributes. The subjects must keep in mind the trade off effects between attributes which also exist in reality. Alternatively, one could directly ask subjects for the value they attach to an attribute. This sequential evaluation has the disadvantage that subjects tend to neglect the trade off effects. All attributes are considered to be very important and the importance of the individual attributes is overrated. Overall, the (traditional) conjoint analysis seems to be well suited to this study.[2]

4.2 Sample

A total of 467 working individuals were interviewed who matched the population in terms of the following attributes: gender, age, education, and monthly net income. The selection of working individuals ensured that the subjects already had experience with income taxation.

Sixteen trained interviewers conducted standardized face-to-face interviews between December 2008 and April 2009. The interviews lasted an average of 20 minutes. In addition to conjoint analysis, subjects were asked questions regarding demographic attributes, general attitude towards tax policy, current German income tax law, and tax complexity.

The sample was drawn based on a quota schedule[3] because a pure random sample was not feasible due to financial reasons. The quota parameters were based on the following four attributes: age, gender, education, and monthly net income. The corresponding frequency in the population for 2006 was taken from the 2008 Statistical Yearbook of the Federal Statistical Office in Germany, which covers the 37 million people who make up Germany's working population. For the purpose of this study, a working individual is defined as any employee, public

[2]Other conjoint analysis procedures (e.g. Choice Based Conjoint Analysis) do not allow for an estimation of preferences on the individual level and are therefore unsuitable for the purpose of our study. Related models for preference measurement such as the Rank-Ordered Logit allow for estimation on the individual level but require subject specific attributes in addition to the attributes of the stimuli, which distinguish the evaluation of the stimuli attributes by the subjects. See *Allison und Christakis* (1994, p. 202).

[3]Quota samples do not strictly fulfill the requirements of a pure random selection. Nevertheless it is the most widely used procedure in marketing research and continuously yields good results in comparative studies with pure random selection (see *Green et al.* , 1988, pp. 325–327).

Attribute	Value	Frequency	Percent	Percent (population)
Gender	Female	209	44.8	45.2
	Male	258	55.2	54.8
Age	Under 20	15	3.2	3.5
	20 – 29	96	20.6	17.5
	30 – 39	112	24.0	24.0
	40 – 49	125	26.8	29.6
	50 – 59	94	20.1	20.5
	Over 60	25	5.4	5.1
Education	University degree	81	17.3	16.0
	University-entrance qualification	80	17.1	14.5
	Secondary school leaving certificate	126	27.0	26.8
	Lower secondary school leaving certificate	136	29.1	31.4
	No school leaving certificate	8	1.7	2.2
	Other	36	7.7	9.1
Monthly net income	Under € 1,000	161	34.5	32.7
	€ 1,000 – 2,000	206	44.1	44.8
	€ 2,000 – 3,000	65	13.9	14.6
	Above € 3,000	30	6.4	8.0
	Not stated	5	1.1	—

Table 1: Distribution of quota attributes in sample

official or self-employed worker. Short interruptions of employment, for instance relating to parental leave, are not considered in this case. In addition to the given quota, membership of the German working population was the sole prerequisite for participation in the sample.

Compliance with the quota was statistically tested. With a margin of error of 5%, no significant difference between population and sample could be detected. In this respect the sample can be seen as representative of the working population in Germany. The distribution of attributes in the sample is given in Table 1.

Results of the conjoint analysis showed that 33 of the 467 polled individuals favored high tax rates and/or a ban on the deduction of income-related expenses. Since the sincerity of this stated preference was doubtful,[4] these individuals were not included in the analysis. The adjusted sample therefore included 434 individuals who also matched the population in terms of gender, age, education, and monthly income.

[4]For instance, some subjects simply ranked the stimuli alphabetically. An examination showed that the exclusion of these so called reversals had no influence on the presented results.

4.3 Research Design and Operationalization of the Hypotheses

Subjects were asked to rank various tax systems according to their own personal preferences.[5] They assigned the stimulus with the highest preference the lowest rank. Accordingly, the stimulus with the lowest preference received the highest rank. Subjects were asked to assume they received taxable earnings (an interest payment) of € 10,000 and beared income-related expenses of € 2,000 (€ 1,000). The individual tax systems differed solely in terms of tax rate τ_i and allowable deduction of income-related expenses D_i and therefore in terms of tax burden B_i, which can be calculated using the following equation (1):

$$B_i = \tau_i(10,000 - D_i)$$

The stimuli were presented using the Full Profile Method. Each stimulus exhibited a combination of the two attributes (tax rate and deduction of income-related expenses). Three different levels were chosen to express the tax rate (low, medium, high), and two levels were selected for income-related expenses (no deduction, full deduction). This combination of levels yields a maximum of six (3x2) different stimuli.[6] The corresponding complete design is presented in Figure 1.

The individual stimuli were given to the subjects in the form of randomly ordered laminated cards. The random issuance of the stimuli ensured that the order of presentation had no influence on the valuation (regarding the "sequencing effect" see e.g. *Tourangeau und Rasinski* , 1988, p. 301).

Subjects were asked to arrange the cards on a magnetic board in previously numbered positions according to their preferences. Before the subjects began, the interviewer explained the terms "tax rate" and "income-related expenses" as well as their effects on the tax burden using the numbers given in the actual decision task. Furthermore, subjects were made aware of the "objectively best tax reform alternative", which is shown on card D (see Figure 1).[7] They then had to rank only the remaining alternatives. After the subject conducted the ranking, the interviewer offered them a chance to review their choice. After the subject made their final choice, the interviewer recorded the final preference ranking.

The subjects' rankings served to test whether the individuals conducted the rankings rationally—according to the actual tax burden—(hypothesis H1) or whether they used decision heuristics.

In order to test whether changes in tax rates were overestimated (hypothesis H2), the ranking was used to estimate part-worth utilities and relative importances. As mentioned in the the-

[5] This ranking is the most common valuation procedure after the rating scale. An overview of various procedures is given in *Green und Srinivasan* (1978, p. 104).

[6] In addition to the two attributes of tax rate and tax base, the stimuli contained a third attribute ("time required for the tax return"), which is not relevant in the current study. This attribute had two traits, such that the complete design contained 12 stimuli. Among the six underlying stimuli in this study, the trait is identical for this attribute for all stimuli and is therefore irrelevant to decision making. The same applies to the other six stimuli, which are not presented here for the sake of clarity and which only serve as a control in the current study. It shows that all subsequently presented results confirm these six control stimuli in terms of valuation of the sequence.

[7] The indication of the objectively best alternative, and in the case of the six control cards (see Fn. 6) also of the objectively worst alternative, served to reduce the work of the subjects.

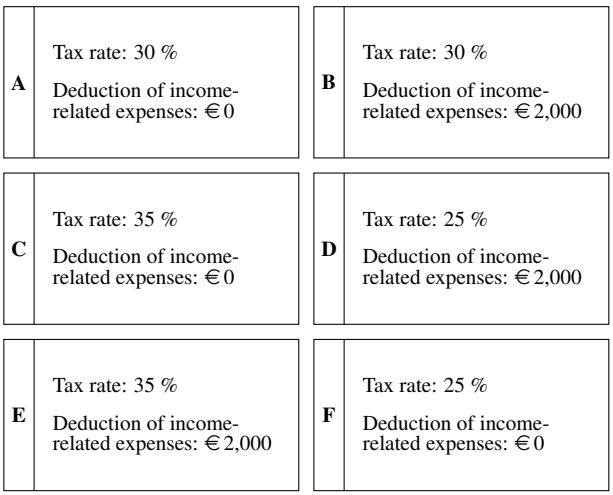

Figure 1: Stimuli

oretical discussion (see section 3), information which is stated first often serves as an anchor and has a higher relative importance attached to it, which can lead to a bias in the sequence of attributes within the stimulus. This is often referred to as the position effect (see e.g. *Chrzan* , 1994; *Moran und Meyer* , 2006; *Blaufus und Ortlieb* , 2009). To ensure that the order of the two attributes did not distort the estimation of the relative importance of the tax rate, the subjects were divided into two groups. In one group the tax rate was given first (see Figure 1), while in the other group it was listed as the second attribute in the stimuli.

To test the influence of education level on the decision between the tax reform alternatives (hypothesis H4), the education level was measured based on type of school leaving qualification. For the operationalization of tax knowledge (hypothesis H5), we use self-assessments by the subjects, their knowledge of German income tax rates, and a question about the self-preparation of their own tax return.

Consistent with hypothesis H3, the likelihood that an individual decided based on the actual tax burden rose with an increase in differences in tax rate and income-related expenses between the available alternatives ("niveau effect"). To test this, the two groups which had already been formed due to the position effect were subdivided again. One sub-group received stimuli with high, the other low differences in tax rate and income-related expenses. A summary of the attribute levels used is presented in Table 2. The differences between the tax burdens were on average € 300 (€ 130) for a high (low) niveau effect.

Four groups result from the combination of settings to control both position effects and niveau effects. The stimuli used in the first group are given in Figure 1 (tax rate mentioned first, high differences in tax rates and income-related expenses). The stimuli of the remaining three groups and their corresponding attribute levels result from the values in Table 2.

Subjects were randomly divided into the four groups. In regard to the quota attributes, no systematic differences could be identified between the groups on a 5% level. Table 3 below shows an overview of the number of subjects in each group.[8] The table should be read in

[8]The fact that the groups are of different sizes is due to different interviewers' performances, i.e. number of

Factor	Number of levels	High differences in tax rates and income-related expenses	Low differences in tax rates and income-related expenses
Nominal tax rate	3	25%; 30%; 35%	25%; 27%; 29%
Allowable deduction of income-related expenses	2	€0; €2,000	€0; €1,000

Table 2: Factors and factor levels of stimuli

Niveau effect	Position effect		Total
	Tax rate named first	Tax rate named last	
High differences in tax rates and income-related expenses	66	148	214
Low differences in tax rates and income-related expenses	124	96	220
Total	190	244	434

Table 3: Number of subjects in each group

the following manner: the 66 subjects in the first group were first presented with the attribute "nominal tax rate", the tax rates amounted to 25, 30, or 35%, and the deduction of income-related expenses is €0 or €2,000 (high differences in both attributes).

4.4 Results

4.4.1 Analysis of Ranking Behavior (Hypothesis H1)

To test hypothesis H1, it was analyzed whether the empirically observed rank order of the stimuli matched the prediction of the rational model (*net income maximizing homo oeconomicus*).

The aim of a "calculating" rational investor is to minimize their tax burden. The tax burdens of the six stimuli can be calculated using equation (1) and are shown in Table 4 below.

The rational ranking is given as follows:

$$D \succ B \succ F \succ E \succ A \succ C.$$

This ranking applies to both the setting with the high and the setting with the low differences in tax rates and income-related expenses.

To reduce their cognitive strain, the individuals may have use a simple heuristic instead of computation. In section 3 the anchor heuristic and lexicographical heuristic were highlighted. One can only recognize whether the ranking is lexicographical.

conducted interviews.

Stimulus	Tax burden niveau effect “high” (€)	Tax burden niveau effect “low” (€)
A	3,000	2,700
B	2,400	2,430
C	3,500	2,900
D	2,000	2,250
E	2,800	2,610
F	2,500	2,500

Table 4: Tax burden

Sequence	Subjects (%)
Rational	9.4
Lexikographical	
1st tax rate, 2nd income-related expenses	35.0
1st income-related expenses, 2nd tax rate	21.7
Other sequences	33.9
Total	100.0

Table 5: Percentage of subjects per ranking

If individuals rank lexicographically first according to tax rate and subsequently according to income-related expenses, then the following ranking results, which differs from the rational ranking:

$$D \succ F \succ B \succ A \succ E \succ C.$$

Although our theory predicts that the lexicographical ranking should first follow the tax rate, it should be tested whether there are individuals whose lexicographic ranking uses income-related expenses as the primary decision criterion. If the stimuli are lexicographically ranked first according to deduction of income-related expenses and then to tax rate, then the following ranking results, which also differ from the rational ranking:

$$D \succ B \succ E \succ F \succ A \succ C.$$

The values were chosen in such a manner that there is a clear distinction between rational and lexicographical ranking.

An overview of the proportion of rankings in the sample is shown in Table 5.

From Table 5 it is apparent that a surprising number, more than 90% of subjects, decided against the rational ranking. Only 9.4% (41 individuals) followed the predictions based on the

model of rational net income maximization.[9] Hypothesis H1 is therefore rejected. The model of homo oeconomicus, which dominates in economic research, cannot explain the behavior of most individuals.

Table 5 also shows that more than half of the subjects ranked the stimuli lexicographically. A good third of all subjects ordered the tax reform alternatives lexicographically by tax rate. Contrary to our assumption, 21.7% of the individuals used a lexicographical heuristic in which income-related expenses were the dominant criterion. The probability of randomly achieving one of the two lexicographical sequences is 1.7%. Of the group of 434 subjects, seven could have arrived at a lexicographical sequence by randomly ordering the stimuli. One can therefore assume that the two lexicographical heuristics were consciously chosen.[10] For the majority of individuals it appears unattractive, even under these highly simplified fiscal conditions, to determine the tax burden precisely. Instead they prefer to rely on a simple heuristic.

4.4.2 Overestimation of the Importance of Changes in Tax Rate (Hypothesis H2)

According to hypothesis H2, the use of heuristics leads to an overestimation of the relative importance of the tax rate. In order to test H2 a conjoint analysis was conducted. For this purpose, the total utility of the stimuli was first derived from the individual ranking order of each subject. To this end the stimulus with the lowest rank was assigned the highest utility, while the stimulus with the highest rank was given the lowest total utility. Metric part-worth utility for the attribute levels was determined using the calculated total utility and the ordinary least squares method.[11]

In general, an additive model is recommended for the correlation between total utility and part-worth utility, which means that the sum of the part-worth utilities of a stimulus corresponds to its total utility. This follows from the basic assumption that the explanatory variables do not interact (see *Hair et al.* , 2008). This leads to the following relationship:

$$\hat{U}_{i,j} = \hat{\beta}_{0,i} + \hat{\beta}_{1,i} x_{1,j} + \hat{\beta}_{2,i} x_{2,j} + \hat{\beta}_{3,i} x_{3,j}$$

where $\hat{U}_{i,j}$ represents the estimated total utility of the i-th subject in the j-th tax system. $\hat{\beta}_{0,i}$ is the estimated constant and $\hat{\beta}_{1,i}$ to $\hat{\beta}_{3,i}$ are the estimations of the part-worth utilities. The dummy variables $x_{1,j}$, $x_{2,j}$ and $x_{3,j}$ take on a value of one if the observed stimulus contains the low tax rate, the middle tax rate, and the full deduction of income-related expenses, respectively.

However, an (at least theoretical) interaction between the two attributes tax rate and income-related expenses results from equation (1) for the tax burden

[9] The probability of randomly achieving a rational sequence is 0.83%. A binomial test shows that the percentage of the rational sequence cannot be the result of pure random selection ($p < 0.01$).

[10] In this case a binomial test also confirms that the percentage of lexicographical sequences cannot be the result of pure random selection ($p < 0.01$).

[11] The subjects' preference judgments, expressed through their rank ordering, have an ordinal measurement level. Hence, one can apply a monotone variance analysis. However, the least squares method has proven to be very robust in the estimation of part-worth utility values also in the case of ordinally scaled dependent variables (see e.g. *Green und Krieger* , 1993, p. 478).

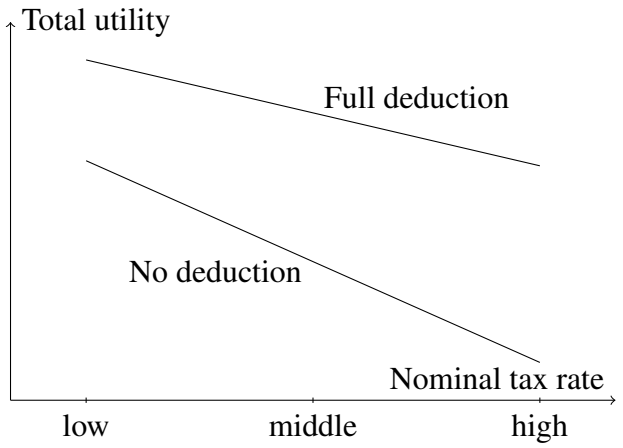

Figure 2: Interaction effect between tax rate and deduction of income-related expenses

$$B_i = \tau_i Y - \tau_i D_i.$$

This interaction can be incorporated in the regression equation, in analogy to a linear model, by multiplying the explanatory variables (see *Louviere* , 1988). Alternatively, interaction effects can be incorporated sequentially by estimating the interaction effects right after the main effects (see e.g. *Green et al.* , 1978).

If one assumes the rational ranking of a homo oeconomicus, then it results in the interaction between the attributes tax rate and deduction of income-related expenses shown in Figure 2. The figure shows the total utility of the respective stimuli for the various tax rates depending on the deduction of income-related expenses. Without interaction effect the two functions would run parallel. Since the deduction of income-related expenses has a greater impact on the tax burden for high tax rates than for low tax rates, the distance between the functions widens as the tax rate increases.

However, since the two lines in figure 2 do not intersect, there is no crossover interaction (see *Green und Devita* , 1974, p. 56).[12] Thus, in line with previous research the interaction can be neglected in the following analysis (see *Carmone und Green* , 1981, p. 93).

The relative importance of the attributes can be derived from the estimated part-worth utilities from the least squares method (*Hair et al.* , 2008) and is a measurement of the value that a subject attaches to a attribute. The greater the change in the total utility of a stimulus when the level changes for a given attribute, the higher the relative importance.

The standardized[13] part-worth utility as well as the relative importance which results from the sample of working individuals in Germany, are shown below in Table 6 along with the part-worth utility and relative importance of a homo oeconomicus.

[12] The collected data displayed the same non-crossover interaction effect.

[13] Standardized means that the part-worth utilities were transformed based on a uniform scale of measurement and zero-point.

	Estimated Part-worth		Relative importance	
	Rational	Sample	Rational	Sample
Low tax rate	0.5625	0.6331		
Medium tax rate	0.2812	0.3166	0.5625	0.6331
High tax rate	0.0000	0.0000		
High deduction of income-related expenses	0.4375	0.3669	0.4375	0.3669
Low deduction of income-related expenses	0.0000	0.0000		

Table 6: Part-worth and relative importance of a rational sequence

Table 6 shows that subjects noticeably overestimated the relative importance of the tax rate.[14] Whereas for an economically rational acting individual one could determine a relative importance of the tax rate of 56%, the corresponding relative importance of the subjects was on average 63%. This difference is highly significant ($p < 0.01$), as shown by a t-Test. Hypothesis H2 is therefore confirmed: the importance of changes in tax rates is overestimated, and the importance of changes in the tax base is underestimated.

However, it must be pointed out that the degree of overestimation can vary widely. The relative importance of the tax rate for individuals who conduct rankings lexicographically based primarily on the tax rate can amount to 80%, whereas the relative importance for the tax rate for other types of ranking only amounts to 63%. In addition, there were individuals (32.5% of the total sample) who underestimated the relative importance of the tax rate. These individuals included especially those who ranked the stimuli first according to income-related expenses and therefore attached a relative importance of only 40% to the tax rate.

4.4.3 Analysis of the Influential Factors (Hypotheses H3-H5)

In order to identify factors which explain the importance of the tax rate, we first calculate the relative importance for the four groups—corresponding to the differences in niveau and position effects. The resulting values are shown in Table 7 below.

It becomes obvious that the importance of the tax rate was overestimated, and conversely that the importance of the deduction of income-related expenses was underestimated in all groups. With the exception of the group that was told the tax rate last and had low differences in tax rates and income-related expenses, the deviations from the rational conclusion are highly significant ($p < 0.01$).

One can also see from Table 7 that the overestimation of the importance of the tax rate is

[14] In the following, solely the relative importance of the attribute "nominal tax rate" will be examined, since this can be used to derive all further values. The relative importance values add up to one. Hence the relative importance of the attribute "allowable deduction of income-related expenses" is given by: 1 minus the relative importance of the "nominal tax rate." In addition, the largest standardized part-worth utility of a attribute trait always corresponds to the relative importance of this attribute. The standardized part-worth utility of the middle tax rate can be calculated as half of the relative importance of the tax rate.

Niveau effect	Position effect	
	Tax rate named first	Tax rate named last
High differences in tax rates and income-related expenses	0.6996^{***}	0.6021^{***}
Low differences in tax rates and income-related expenses	0.6736^{***}	0.5829

Table 7: Relative importances of tax rate (compared to a rational value of 0.5625)

highly significantly larger ($p < 0.01$) when the subjects are presented with the tax rate first. The relative importance of the tax rate amounted to 70% (67%) when mentioned first and only 60% (58%) when mentioned last. This confirms that information mentioned first often acts as an anchor (see *Hogarth und Einhorn* , 1992). The importance of the attribute tax rate is dependent upon its position within the stimulus. This is consistent with the definition of the position effect in section 3. This effect can be quantified through the difference in relative importances for the two settings "tax rate mentioned first" and "tax rate mentioned last" and amounts to between nine and ten percentage points. This shows that—contrary to traditional economic theory—no descriptive invariance exists, but rather that framing effects can have a considerable impact on preferences about tax reforms.

According to hypothesis H3, the overestimation of the relative importance of the tax rate must increase when differences between the tax rates and deductions of income-related expenses increase. The theoretical explanation for this is that when the advantage of optimization declines, the use of heuristics increases. Table 7 reveals that there is no such niveau effect because, given an increasing niveau effect, the relative importance for the tax rate went up rather than down. Hypothesis H3 can therefore not be confirmed. The differences are not significant, as two sample t-Tests show ($p = 0.385$ and $p = 0.440$ respectively). To directly test the theory behind hypothesis H3 that a higher advantage of an exact calculation leads to a greater likelihood of a rational ranking, we separately calculated the percentages of the rational, lexicographical, and other rankings for the individual groups and presented them in Table 8.

It emerged that, as predicted, the the percentage of individuals who decide rationally increases when the differences in tax rate and income-related expenses increase. However, this increase is only significant when the tax rate is mentioned last.

It remains to be explained why despite the decrease in the use of heuristics with an increase in the niveau effect hypothesis H3 cannot be confirmed, but rather that the relative importance for the tax rate actually rises on average. The answer can be found by analyzing the distribution of the type of rankings (Table 8) and the relative importance of the various types of ranking. Indeed, the high percentage of "rational decision makers" leads in the case of a high niveau effect to a lower overestimation of the relative importance of the tax rate. However, this effect is overcompensated in the sense that when differences in tax rates increase, the tax rate serves even more as an anchor and causes a greater relative importance of the tax rate. The

Niveau effect	Sequence	Position effect	
		Tax rate named first (%)	Tax rate named last (%)
High differences in tax rates and income-related expenses	Rational	4.5	18.9
	1st τ, 2nd D	43.9	24.3
	1st D, 2nd τ	15.2	21.0
	Other	36.4	35.8
Low differences in tax rates and income-related expenses	Rational	2.4	7.3
	1st τ, 2nd D	50.8	25.0
	1st D, 2nd τ	12.1	39.6
	Other	34.7	28.1

Table 8: Percentage of rational, lexiographical, and other sequences

latter is shown in the groups where the tax rate is mentioned first, compared to the relative importance of the tax rate for the other rankings. In this case the relative importance of the tax rate increases significantly from 59.16% to 72.01%. In the groups where the tax rate was mentioned last, the percentage of individuals who ranked lexicographically according to income-related expenses dropped significantly with an increase in differences in tax rate.

In addition, one can see from Table 8 that the percentage of individuals who ranked rationally increases when the tax rate is mentioned last. With a high (low) niveau effect the increase in rational decision makers is highly (slightly) significant. One possible explanation for the increased percentage of rational decision makers could be that the individuals consider the tax rate to be more important, as predicted in theory. If they receive the information regarding the deduction of income-related expenses first, this conflicts with their subjective classification of importance, which causes them to conduct exact calculations rather than to rely on a heuristic.

According to hypothesis H4, individuals are more likely to decide based on the actual tax burden when they have a higher education level. Table 9 illustrates that individuals with (at least) a university-entrance qualification are more likely to arrive at a rational ranking than individuals without. The percentage of individuals with a university-entrance qualification who rank rationally amounts to 41%, compared to 35% of individuals who do not rank rationally. It appears that higher education has the theoretically predicted effect. However, a logistic regression (see Table 10) shows that the influence of a school leaving certificate is not significant ($p > 0.4$). Hypothesis H4 can therefore not be confirmed. The education level has no significant influence on the probability of creating a rational sequence.

Besides tax knowledge, the likelihood of ranking rationally is significantly influenced only by the time spent on the ranking as well as the fact that additional calculations are made.

[15] We asked the individuals for an estimation of the actual German income tax rate for some specific levels of income. Individuals are considered "very good" whose estimation errors are less than by 95% of the remaining individuals.

	Rational sequence	
	Yes	No
With university-entrance qualification	41 %	35 %
Above average knowledge of tax law (self-assessment)	12%	10%
Very good[15] knowledge of tax law (income tax rates)**	48.01	47.13
Tax return self-prepared*	37%	23%
Time required for sequence (average in minutes)***	10.55	7.24
Additional calculation conducted*	44%	9%
Gender (male)	51%	54%
Age (average in years)	38	40
Self-employed	12%	15%
Net income $<$ €1,000/month	41%	34%

Table 9: Influential factors "rational decision" (descriptive analysis)

Education, gender, age, income, and the type of occupation (self-employed/not self-employed) have no significant influence over whether someone behaves rationally based on economic theory or uses decision heuristics (see Table 10).

4.4.4 Simulation of voters' percentage

The subjects were presented with the various alternatives as possible options for a future tax policy. Accordingly, it makes sense to conduct an simulated election based on the collected preference judgments of the conjoint analysis. To determine the voters' percentage for the individual alternatives, an assumption must be made about the correlation between the ranking order (preference) of the individual and their actual voting behavior. It must be determined whether the subject always chooses the most preferred tax system or if every tax system has a positive probability of election.

The first case is considered a deterministic model ("first choice"). Thereby the probability of voting for the most strongly preferred stimulus is one. All other stimuli have an election probability of zero. The total voters' percentage of a tax system corresponds to the number of subjects with first preference for this tax system divided by the total number of subjects. The percentages using the first choice model are shown in Table 11.[17] It shows that the absolute majority of votes are allotted to stimulus F, although this does not have the lowest actual tax burden[18]. If the first choice model accurately describes voting behavior, then politicians could

[16]Nagelkerke's R^2 is about 20% for all three logistic regressions. The estimation can therefore be considered acceptable. The variance inflation factor (VIF) assumes the values 1.07 and 1.25 for all variables. Multicollinearity is therefore not given.

[17]Stimulus D was eliminated from the analysis. Since we gave this as the first preference, its voters' percentage in the first choice model would be 100%. A comparison of the other stimuli is therefore only possible without considering this tax system.

[18]The tax burdens for a high niveau effect are presented. The tax burdens for a low niveau effect are shown in

Dependent variable: Rational sequence (dummy)			
Independent variable	β coefficients (Standard error)		
Constants	-3.396^{***} (0.820)	-3.350^{***} (0.805)	-3.252^{***} (0.798)
With university-entrance qualification	0.254 (0.394)	0.178 (0.400)	0.313 (0.390)
Above average knowledge of tax law (self-assessment)			0.552 (0.564)
Very good knowledge of tax law (income tax rates)		1.852^{***} (0.605)	
Tax return self-prepared	0.836^{**} (0.410)		
Time required for sequence	0.097^{**} (0.039)	0.107^{***} (0.039)	0.097^{**} (0.038)
Additional calculation conducted	1.557^{***} (0.411)	1.676^{***} (0.415)	1.610^{***} (0.410)
Gender	-0.262 (0.372)	-0.175 (0.366)	-0.191 (0.370)
Age	-0.011 (0.015)	-0.011 (0.015)	-0.009 (0.015)
Self-employed	-0.234 (0.588)	-0.063 (0.592)	-0.251 (0.583)
Net income $<$ €1,000/month	0.488 (0.404)	0.262 (0.393)	0.303 (0.391)
N	425	425	425
Nagelkerke's R^2	0.194	0.210	0.180

Table 10: Influential factors "rational decision" (results of logistic regression[16])

Position	Stimulus	Votes (%)	Tax burden (€)
1	F	55.10	2,500
2	B	44.40	2,400
3	E	0.50	2,800
4	A	0.00	3,000
5	C	0.00	3,500

Table 11: Percentages of votes (first choice model)

combine increasing tax revenues with a drop in the perceived tax burden by broadening the tax base and decreasing the tax rate.

By contrast, if one considers it more realistic for individuals to assign a positive probability of election to every tax system, then a probabilistic model must be used.[19] Among such models, the logit model and the Bradley-Terry-Luce (BTL) model are the most widely used (see *Green und Krieger* , 1988). The logit model assumes a logistic correlation between the estimated total utility and the probability of election. Stimuli with small total utility therefore receive a lower probability of election than in the Bradley-Terry-Luce model. Stimuli with higher total utility receive a higher probability of election accordingly. The BTL model assumes a linear relationship between the estimated total utility and the probability of election. The estimated total utility of the stimulus is set in relation to the sum of the total utility of all stimuli. The probabilities are determined on an individual level in analogy to the first choice model. The voters' percentage is calculated as the average probability of all subjects.

The results by use of the two probabilistic models are shown in Tables 12 and 13[20]. Similar to the first choice model, in the logit model the voters' percentage for stimulus F (lower tax rate, no deduction of income related expenses) is higher than the voters' percentage for stimulus B (middle tax rate, full deduction of income related expenses), although the actual tax burden is lower for the latter stimulus (see Table 12). It is therefore possible within the logit model to raise the voters' percentage and simultaneously increase tax revenue. Only in the BTL model do the election results match the rational ranking (see Table 13).

5 Discussion

The aim of this article was to test whether changes in the nominal tax rate influence the perceived tax burden differently than do changes in the tax base. We consider hypothetical tax

Table 4.

[19]The biggest advantage of the first choice model is its invariance compared to linear transformation of the utility values. The disadvantage is that only the most strongly preferred stimuli have a positive probability of election. By contrast, so-called probabilistic models assign every tax system a positive probability of election. Therefore they are not invariant compared to linear transformation (see e.g. *Green und Krieger* , 1988, p. 116).

[20]The tax burdens for a high niveau effect are presented. The tax burdens for a low niveau effect are shown in Table 4.

Position	Stimulus	Votes (%)	Tax burden (€)
1	D	74.10	2,000
2	F	19.81	2,500
3	B	16.84	2,400
4	E	5.00	2,800
5	A	3.33	3,000
6	C	0.74	3,500

Table 12: Percentages of votes (logit model)

Position	Stimulus	Votes (%)	Tax burden (€)
1	D	28.12	2,000
2	B	20.82	2,400
3	F	19.81	2,500
4	E	13.53	2,800
5	A	12.52	3,000
6	C	5.22	3,500

Table 13: Percentages of votes (BTL model)

reform alternatives, which differed in terms of the amount of the nominal tax rate and the allowed deduction of income-related expenses for a given income. This setting could reflect, for example, the decision between a final and a non-final withholding tax on interest income as well as the decision to discontinue the option for workers to itemize deductions of income-tax purposes. If an individual behaves rationally according to traditional economic theory, it makes no difference whether their tax rate or (by equal measure) their tax base changes. The actual (effective) tax burden is solely relevant for the *homo oeconomicus*. By contrast, if one takes into account that individuals tend to avoid cognitive strain and instead use simplified decision heuristics that (may) lead to suboptimal but individually satisfying solutions, changes in the tax rate may influence the perceived tax burden more strongly than do changes in the tax base.

In order to empirically test the hypothesis about the use of heuristics and the resulting overestimation of the importance of changes in tax rates, we conducted a conjoint analysis covering 467 German working individuals. The sample was drawn in such a manner that the criteria gender, age, education, and monthly net income matched the total German working population. The results revealed that the *homo oeconomicus* model that prevails in economic theory predicted the behavior of less than 10% of the subjects accurately. The majority of the subjects used decision heuristics. Hypothesis H1, which states that individuals decide rationally, must therefore be rejected. As predicted in theory (hypothesis H2), the use of heuristics led to a noticeable overestimation of the relative importance of changes in tax rates

and to an underestimation of the importance of changes in the tax base.

It follows from our theoretical discussion that the use of heuristics should decrease when an exact calculation is more valuable. We assumed therefore that with increasing differences in the tax rate and in income-related expenses between the alternatives and hence increasing differences in tax burdens, the overestimation of the relative importance of the tax rate should also decline (hypothesis H3). This hypothesis could not be confirmed. Indeed it was shown according to our assumption that individuals are more likely to decide rationally when there is an increase in the advantage of exact calculations. However, large differences in tax rates between the alternatives simultaneously increased the importance of the tax rate as "anchor information". This led to an opposing effect, which actually led to a (non-significant) rise in the overestimation of the relative importance of the tax rate.

Framing effects were of particular importance in the overestimation of the effects of tax rate changes. We were able to show that the overestimation increased considerably when information about the tax rate was mentioned first. The relative importance of the tax rate increased by nine to ten percentage points due to this position effect alone. In contrast to traditional theory, in reality there is no descriptive invariance.

An analysis of the influential factors on the decision making behavior of the subjects yielded that the probability of deciding rationally based on the actual tax burden increased with a rise in tax knowledge. This corresponds to our hypothesis H5, which we formulated based on the assumption that with an increase in tax knowledge the cognitive strain involved in an exact calculation should decrease. Along a similar train of thought, we assumed a positive correlation between education level and the probability to decide rationally (hypothesis H4). It became apparent from the data that the measured effect is consistent with our hypothesis. However a significant correlation could not be established. Further research is needed in this area, as it is unclear whether the lack of significance is due to the low number of rationally acting individuals or whether the education level truly has no influence on the choice between rational optimization and heuristic (regarding the influence of intelligence on the use of heuristics see *Bröder* , 2003).

According to the existing data, the influence of education level on the probability of rational decision making is not significant; neither is the influence of gender, age, income, and kind of employment (self-employed/not self-employed).

What relevance do the results have for fiscal policy? We were able to show that politicians could simultaneously increase tax revenues and reduce the perceived tax burden for taxpayers. In a simulated election, a tax policy including a decrease in the nominal tax rates and simultaneous broadening of the tax base ("tax-cut-cum-base-broadening") could win against a tax system with a lower actual tax burden. Consistent with the identified position effect, politicians who emphasize a decrease in the nominal tax rate when presenting their fiscal policy program can reduce the perceived tax burden solely through the display format.

These results offer starting points for further research. It could be tested, for example, how basic conditions are institutionally developed in order to encourage a rational perception of tax policy or at least to inhibit the exploitation of taxpayers' biased perceptions by politicians.

The results are also important in the analysis of economic decision effects. Since models in tax research mostly assume that individuals act rationally and integrate the actual tax burden into their decisions, predictions from these models should be regarded with caution. It is to

be expected, based on the existing results, that an individual facing a drop in income tax rate and a simultaneous reduction by equal measure in their amount of deductable income-related expenses would perceive a lower tax burden and therefore increase their labor supply, although traditional economic theory predicts that labor supply would remain unchanged. The biased perception of tax burdens in reality also implies that calculations of tax induced changes in welfare are inapplicable when they are based on the assumption of rationality. However, the welfare consequences of non-rational decision behavior are ambiguous. On the one hand, an increase in tax burden which is not perceived as such leads to lower demand elasticity, thus increasing efficiency. On the other hand, "spending too much on the good with a hidden tax will leave less income for subsequent purchases—distorting individual consumption and decreasing welfare" (*Congdon et al.* , 2009).

Finally, one should also consider the limitations of our study. The current study is a mere preference measurement. Yet it is possible that stated preferences and actual decision making behavior will differ. In order to test whether the subjects seriously considered the questions, the time required for the preference ranking was measured. Subjects spent on average 7.6 minutes ranking the tax reform alternatives. This shows that subjects, despite the lack of monetary incentives, took some time to rank the alternatives according to their preferences. In addition, to increase the involvement of subjects we included the possibility for them to be informed of the results of the research project.

Future research could address these limitations. In order to test whether the lack of monetary consequences influenced the current results, experimental tests could be conducted for which incentive-compatible compensation would be paid. Further studies could also analyze the impact of learning effects. For example, both *Collins und Murphy* (1995); *Boylan und Frischmann* (2006) were able to show that with increased practice non-rational behavior diminishes but does not disappear entirely.

Moreover, we see a need for further research especially on whether the overestimation of the importance of the nominal tax rate can also be confirmed for specialized decision makers in companies. The findings of *Buettner und Ruf* (2007) already indicate that in this case, too, it's all about tax rates.

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