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# When the agency wants too much: Experimental evidence on unfair audits and tax compliance

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## ABSTRACT

This research investigates how unfairness in tax enforcement affects tax compliance. We study how unfair audits that overestimate a taxpayer's true income affect the aggregate compliance level and the post-audit tax compliance of audited taxpayers. Using an online experiment with a representative sample of UK taxpayers, we find that introducing unfair audits has a positive effect on the aggregate compliance level. However, increasing the amount by which audits overestimate true income has no effect. Moreover, we find that the experience of unfairness in tax enforcement reduces post-audit tax compliance in the subsequent tax declaration by at least 7 percentage points. Our findings suggest that threatening taxpayers with unfair audits increases compliance in the aggregate, but behavioral responses to experiencing unfair audits undermine this effect.

## 1. Introduction

Tax audits have a strong effect on tax compliance (Slemrod, 2019). For example, a recent literature review suggests that a 10% increase in the audit probability typically increases compliance by 2% to 4% (Alm, 2019), and 80% of recently surveyed tax experiments find that, all else equal, an increase in the audit probability increases aggregate compliance levels (Malézieux, 2018). However, studies using field data (Beer et al., 2020; Erard et al., 2020; Gemmel and Ratto, 2012; Kotsogiannis et al., 2021) and laboratory experiments (Mittone, 2006; Mittone et al., 2017) find that the experience of a tax audit may in fact decrease the post-audit tax compliance of audited taxpayers. Different potential explanations for such counter-deterrent effects of tax audits have been proposed in the literature. In particular, some studies suggest that perceived unfairness in the audit process might explain the decline in post-audit tax compliance (Feld and Frey, 2002; Kirchler et al., 2008; Mendoza et al., 2017). Other studies find that this decline is due to misperception of the probability of a future audit (Mittone, 2006; Mittone et al., 2017) or loss-repair motivations (Andreoni et al., 1998; Maciejovsky et al., 2007). More recent work by Kasper and Alm (2022b) investigates to what extent audits that underestimate a taxpayer's true income affect behavioral responses and this study finds that such ineffective audits reduce post-audit tax compliance.

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However, while some prior work investigates the effect of audits that underestimates a taxpayer's true income, the effect of audits that *overestimate* a taxpayer's income remains largely unknown. Indeed, there is a strong indication that audits frequently result in a tax assessment that overestimates the taxpayer's true income. For example, in fiscal year 2018, US taxpayers challenged over 10 billion USD in additional taxes recommended by the Internal Revenue Service (IRS) (Internal Revenue Service, 2019). Similarly, UK taxpayers filed an average of 9104 appeals per year between 2010 and 2014 only in the first tier tribunal for taxation.<sup>1</sup> And in the Netherlands the entire government resigned in 2021 after media reports revealed that the Dutch Tax Authority had over years wrongfully accused thousands of families of dishonesty (Berg, 2021).

A tax audit that results in an overestimation of a taxpayer's true income might affect tax compliance through its effect on fairness perceptions. For example, prior work finds that unfair treatment undermines trust and thus reduces taxpayers' propensity to comply (Kirchler et al., 2008). Similarly, the experience of an unfair audit might induce "reactance" in taxpayers (Frey, 1997; Lederman, 2018; Mendoza et al., 2017), and motivate them to "get back at" the tax agency by reducing their subsequent compliance (Andreoni et al., 1998), thus leading to more evasion (Spicer and Becker, 1980). Even though many taxpayers experience audits that overestimate their true tax liability, prior work does not investigate the causal effect of unfair treatment on tax compliance. Specifically, it remains unclear to what extent the existence of unfairness in tax enforcement affects aggregate compliance levels and whether the experience of an audit that overestimates a taxpayer's true income, an *unfair tax audit*, affects post-audit tax compliance.

This study addresses these gaps in the literature and investigates how unfairness in tax enforcement affects tax compliance. We extend the standard portfolio model of tax evasion by allowing audits to overestimate the taxpayer's income, and we also develop an alternative model that incorporates behavioral determinants of tax compliance. We test these models in a preregistered online experiment with a representative sample of UK taxpayers. Our study follows the conventions of the canonical tax evasion game (Alm and Malézieux, 2020). The crucial feature of our design is the addition of unfairness to the audit mechanism, where we define unfairness as a tax audit that overestimates a taxpayer's true income. In particular, we experimentally manipulate two dimensions of unfairness. First, we systematically vary the probability  $q$  that an audit overestimates the taxpayer's true income, and second, we systematically vary the factor  $\alpha$  by which the audit overestimates a taxpayer's income. This design allows us to examine the effect of unfairness in tax enforcement on the aggregate compliance level (general deterrence) as well as the post-audit tax compliance of audited taxpayers (specific deterrence). Addressing these questions with field data is challenging because tax agencies typically do not know a taxpayer's true taxable income and the audit outcome is not an exact measure of a taxpayer's true compliance (Kasper and Alm, 2022b). In contrast to field data, data generated from an online experiment allows us to introduce variation in the probability and magnitude of unfair audits, thereby allowing clean identification of the causal effects of these changes on compliance.

Our study differs from the existing literature on the effect of tax audits by making contributions in three important dimensions. First, and most importantly, unlike most existing work, we account for the possibility that tax audits might detect cheating when it is not in fact present or detect more cheating than is present. This allows us to investigate the general and specific deterrence effects of unfair tax audits. Second, we investigate behavioral responses to different aspects of fairness in tax enforcement. Specifically, we study whether tax reporting reflects changes in the probability of an audit that overestimates a taxpayer's income as well as changes in the magnitude of such overestimation in line with standard and behavioral models of tax compliance. Finally, our study design allows us to investigate how audits affect taxpayers who differ in their motivation to comply. We do this by distinguishing three types of taxpayers, based on their responses in the post-experimental questionnaire: Honest taxpayers are defined as taxpayers who indicated that they were motivated by the goal of being honest, retaliating taxpayers are taxpayers who indicated that they were motivated by the desire to make up for earlier rounds, and fine-averse taxpayers were those who indicated that they were motivated by the goal of avoiding fines. Finally, we investigate to what extent these self-reported motivations correspond to actual reporting behavior.

Our results show that unfair tax audits affect aggregate compliance levels as well as the post-audit compliance of audited taxpayers. In particular, we find that increasing the probability  $q$  that an audit overestimates the taxpayer's true income increases compliance, but the degree of unfairness (i.e., the factor  $\alpha$  by which the audit overestimates a taxpayer's income) has no effect. Moreover, we find that the experience of unfairness in tax enforcement reduces post-audit tax compliance. Specifically, taxpayers who experienced an unfair audit reduce compliance in their subsequent reporting decision relative to unaudited taxpayers and taxpayers who experienced a fair audit. This result is independent of the fine that results from the audit and is robust to different modeling techniques, sample inclusion criteria, and a reformulation of the dependent variable. Finally, our findings indicate that taxpayers' motivations, as reflected in their general propensity to comply, affects the behavioral response to audits. While taxpayers who are mostly compliant throughout the experiment hardly respond to the experience of an audit, taxpayers with a lower propensity to comply respond to the audit experience by reducing their post-audit compliance.

Our study adds to the understanding of the effects of unfairness in tax enforcement. In particular, our findings suggest that taxpayers respond to the introduction of unfair audits by increasing their compliance. However, behavioral responses to the experience of unfair treatment have the opposite effect and undermine the direct revenue effect of audits. These results provide a new perspective on the counter-deterrent effect of tax audits that has been found in some prior studies and suggest that taxpayers respond to the experience of unfair treatment by reducing compliance.

<sup>1</sup> The outstanding case load for the same tribunal between 2010 and 2021 averaged to 25166 cases per year <https://www.gov.uk/government/statistics/tribunal-statistics-quarterly-january-to-march-2021>.

## 2. Related literature

Tax audits have direct and indirect effects on taxpayers. Audits have *direct effects* on audited taxpayers by raising revenue through the assessment of additional taxes, interest, and penalties. Additionally, tax audits have *indirect effects* by deterring noncompliance among both audited taxpayers (*specific-*, or *direct deterrence*) and unaudited taxpayers (*general-* or *indirect deterrence*).<sup>2</sup>

The effect of audits on tax compliance is typically analyzed within an expected utility framework that follows Becker (1968) economics-of-crime approach, as formalized by Allingham and Sandmo (1972), Srinivasan (1973), and Yitzhaki (1974) as a decision under risk. The standard model of tax evasion assumes that a taxpayer decides how much income to report to the tax agency by weighing the benefits of successful cheating against the potential costs of being audited and fined. The taxpayer faces the risk of being audited and in case of an audit, the agency assesses the taxpayer's true income and imposes a fine on the undeclared taxes. In case of no audit, the taxpayer simply pays taxes on reported income. All relevant parameters are fixed and known to the taxpayer, and the model assumes that taxpayers only pay taxes because they are afraid of getting caught and fined if they do not declare all income correctly. Consequently, the standard model of tax evasion predicts that an increase in the audit probability or the penalty rate translates into greater compliance.<sup>3</sup>

However, the standard model of tax evasion does not provide clear predictions on the effect of audits on subsequent, or post-audit, tax compliance. Instead, within this framework audits affect post-audit tax compliance only when they provide new information to the taxpayer (Kleven et al., 2011; Snow and Warren, 2007). For example, if the audit detects more non-compliance than expected, the taxpayer may increase their prior on the risk of detection and thus increase their post-audit compliance. Conversely, if the audit detects less evasion than expected, then the taxpayer may decrease his or her prior on the risk of detection and thus decrease post-audit compliance (Slemrod, 2019). The tax audit would have a specific deterrent effect in the former case and a specific counter-deterrent effect in the latter case. In light of these considerations some studies have suggested introducing audit effectiveness, or the share of undeclared income that the tax agency detects in an audit, in models of tax compliance. Heterogeneity in the effectiveness of tax examiners was first discussed by Feinstein (1991), who suggested a “fractional detection model” that accounts for variation in audit effectiveness and thus reflects the audit process more accurately than the standard model of tax evasion. In related theoretical work, Rablen (2014) argues that tax agencies face resource constraints and thus have to trade-off the frequency against the effectiveness of audits. The study finds that a tax agency's funding determines whether fewer more effective, or a higher number of less effective audits are optimal. In sum, these studies point out that audits do not always identify a taxpayer's true income correctly and suggest that variation in audit effectiveness might affect the deterrent effect of audits.

Indeed, recent empirical work finds that the behavioral responses to audits are more complicated than the standard portfolio model of tax compliance predicts. For example, Gemmel and Ratto (2012) and Beer et al. (2020) analyze tax return data from the UK and the US and these studies find that the post-audit tax compliance of audited taxpayers depends on the audit outcome. While taxpayers who have been assessed additional taxes as a result of their audit increase their compliance in subsequent years, taxpayers who have not been assessed additional taxes show the opposite response. Similarly, studies by Erard et al. (2020) and Kotsogiannis et al. (2021) suggests that the audit type determines whether or not audited taxpayers increase their post-audit tax compliance. Specifically, these studies find that more thorough face-to-face audits increase post-audit tax compliance while less thorough correspondence or desk audits have the opposite effect.

These findings raise important and unanswered questions about the drivers of behavioral responses to audits. Recent studies use laboratory experiments to investigate three potential explanations for these differential effects. The first strand of research investigates how variation in audit effectiveness affects compliance. In particular, the effect of audits that do not detect a taxpayer's entire under-reporting. For example, Bernasconi and Bernhofer (2020) study taxpayers' response to variation in audit effectiveness, where audits result in certain detection in some cases and in no detection in others. The study finds that the introduction of ineffective audits increases aggregate compliance levels, possibly because taxpayers misperceive compound detection lotteries where audits do not result in certain detection. Another study investigates behavioral responses to variation in audit effectiveness (Kasper and Alm, 2022b). This study finds that aggregate compliance levels respond to variation in audit effectiveness as predicted by the standard model. However, the effect of audits on post-audit tax compliance depends on audit effectiveness. While effective audits increase post-audit tax compliance, ineffective audits have the opposite effect. To what extent audits that overestimate a taxpayer's true income affect compliance remains unclear, however.

The second strand of research investigates how fairness perceptions affect compliance. Prior work indicates that taxpayers are more likely to comply when they are treated with dignity, respect, and fairness (Andreoni, 1992; Murphy, 2009; Murphy and Tyler, 2008; Tyler, 2006), when they are able to express their views, and when they can influence the outcome of the agency's decision (Tyler and Allan Lind, 2002). Several studies also show that procedural fairness, or the transparency, consistency, and neutrality of treatment affects compliance (Kogler et al., 2016; Murphy et al., 2016; van Dijke and Verboon, 2010) and that unfair treatment can undermine trust (Feld and Frey, 2002; Kirchner et al., 2008), increase the propensity for non-compliant behavior (Hu and Ben-Ner, 2020), and decrease the intrinsic motivation to pay taxes (Alm and Torgler, 2006; Torgler et al., 2007). Another strand of research investigates the effect of unequal treatment on taxpayer behavior. For example, an early paper found that tax compliance decreases among the “victims”, but increases among the “beneficiaries” of unfairness (Spicer and Becker, 1980), suggesting that

<sup>2</sup> While most authors use the terms *direct* and *indirect deterrence* (e.g., Alm et al., 2009), other terms, such as *corrective deterrence* and *preventive deterrence*, have also been suggested (Gemmel and Ratto, 2012).

<sup>3</sup> There is ample evidence that increasing the audit probability and the penalty rate increases compliance. Alm (2019) and Slemrod (2019) provide comprehensive surveys of the literature.

fairness perceptions and behavioral responses depend on the favorability of the outcome of unfairness (Niesiobędzka and Kołodziej, 2020). Similarly, Bazart and Bonein (2014) and Fortin et al. (2007) find that the behavioral response to unfair treatment depends on whether the individual benefited from unfairness or not.

Taken together, these findings suggest that tax audits might reduce post-audit tax compliance if they are perceived as unfair. In particular, audits might induce reactance in taxpayers (Frey, 1997; Lederman, 2018; Mendoza et al., 2017) and motivate them to “get back at” the tax agency by reducing their subsequent compliance (Andreoni et al., 1998). In light of the large number of audits that are disputed by taxpayers because they believe that the tax agency acted incorrectly (Internal Revenue Service, 2019; HMRC, 2021), perceived unfairness in tax enforcement might contribute to the counter-deterrent effect of audits that has been found in some prior studies. However, despite the demonstrated inability of audits to always correctly assess a taxpayer’s true income, the causal effect of unfairness in tax enforcement on tax compliance remains unknown.

The third strand of research investigates whether the effect of audits depends on the motivations that underlie a taxpayer’s compliance decision. Taxpayers comply for different reasons (Braithwaite, 2009; Erard and Feinstein, 1994; Torgler, 2003) and the experience of an audit might induce different responses in these different types of taxpayers. For example, honest taxpayers may perceive being audited as unfair, see the audit as a breach of trust, or experience negative emotions (Enachescu et al., 2019; Olsen et al., 2018). Conversely, other taxpayers base their reporting decisions on strategic considerations and these taxpayers may respond to experiencing an audit by reducing their post-audit tax compliance because they try to make up for the losses that they have incurred as a result of their audit (Kastlunger et al., 2009; Maciejovsky et al., 2007). Yet other taxpayers might respond to an audit by increasing their compliance because the experience of being punished motivates them to comply more in the future (Braithwaite, 2003; Kirchler et al., 2008). A recent laboratory experiment analyzes the effects of audits on different types of taxpayers and this study finds that audits have a strong effect on relatively compliant taxpayers, while audits have no effect on relatively non-compliant taxpayers. Moreover, the study finds that audits do not reduce compliance among taxpayers who have a history of honest reporting (Kasper and Alm, 2022b). However, to the best of our knowledge prior work does not investigate to what extent, if at all, the motivations that underlie a taxpayer’s reporting behavior affect the response to unfair tax audits.

Our study contributes to all three strands of literature. Specifically, it contributes to understanding the effect of audit effectiveness by investigating behavioral responses to unfair audits that might overestimate a taxpayer’s true income. Moreover, our study allows us to identify the causal effect of experiencing an unfair tax audit on post-audit tax compliance and to examine whether unfairness in tax enforcement has heterogeneous effects among taxpayers who differ in their motivations to comply. In the next section, we develop the theoretical framework to study these effects.

### 3. Theoretical predictions

Our theoretical predictions are based on the standard model of tax evasion (Allingham and Sandmo, 1972), where a taxpayer earns gross income  $I$ , reports income  $R$ , and pays a taxes at rate  $t$  on reported income. The tax agency observes  $I$  through audits with a certain probability  $p$ , and if caught cheating, the taxpayer faces a fine  $f > 1$ . This results in the following expected utility  $EU$

$$EU = (1 - p)U(X) + p(U(Z)), \tag{1}$$

where

$$\begin{aligned} X &= I - tR, \\ Z &= I - tR - tf[I - R] \end{aligned}$$

#### 3.1. Portfolio model with unfair audits

We extend this standard portfolio model by allowing for the tax agency to overestimate income  $I$ , thereby incorporating unfairness into the model similar to Fortin et al. (2007). As a result, in our model the taxpayer is not only confronted with the audit probability  $p$  but also with the conditional probability  $q$  of an unfair audit that overestimates the taxpayer’s income  $I$ . The size of the overestimation of  $I$  is  $\alpha$ .

This gives the utility function:

$$EU = (1 - p)U(X) + p[qU(Y) + (1 - q)U(Z)], \tag{2}$$

where,

$$\begin{aligned} X &= I - tR, \\ Y &= I - tR - tf[(1 + \alpha)I - R], \\ Z &= I - tR - tf[I - R]. \end{aligned}$$

Where, similar to Allingham and Sandmo (1972)  $p \in [0, 1]$  is the probability that a taxpayer is audited, and  $U(X)$  and  $U(Z)$  are the taxpayer’s utility functions if not audited or audited fairly, respectively. We extend this model with  $U(Y)$  which occurs with the compound probability  $p * q \in [0, 1]$ , which is identical to  $U(Z)$  except for the overestimation  $\alpha \in [0, 1]$  of income  $I$  by the tax

agency. We estimate the relationship of  $q$  and  $\alpha$  with respect to optimal reporting behavior by taking the partial derivative of the optimal reporting function  $R_*$  (derived from equation (2)) with respect to  $q$  or  $\alpha$  and *ceteris paribus* all other variables. We expect optimal reporting behavior  $R_*$  to be dependent on the probability of overestimation  $q$  (as long as  $\alpha \neq 0$ ) and  $\alpha$  (as long as  $q \neq 0$ ) hence  $R = R(q, \alpha)$ . For brevity, we only report the results here. The full mathematical derivation with respect to  $q$  and  $\alpha$  can be found in Appendix A.

As the probability  $q$  of an overestimation of income  $I$  increases, the optimal reported income  $R_*$  increases. This relationship holds given that  $\alpha > 0$ , and under the assumption of a risk averse taxpayer, where the utility function is increasing and concave. As a result, a rational taxpayer increases (decreases) their reported income when facing a higher (lower) probability of an audit that overestimates their income.

The optimal level of reported income  $R_*$  also increases when the size of the overestimation  $\alpha$  increases. This relationship holds given that  $q > 0$ , and the functional form is the same for  $U(X), U(Y), U(Z)$ . We expect that a rational taxpayer will increase (decrease) reported income as the size of the overestimation increases (decreases).

### 3.2. Portfolio model with behavioral considerations

Equation (2) introduced unfairness in the audit process to the standard portfolio model of tax evasion. In this section we additionally introduce behavioral considerations, based on the extensive literature on behavioral factors that affect taxpayer’s reporting decisions (for a comprehensive overview see Alm, 2019). To this end, we extend equation (2) by including a non-monetary behavioral element that enters the expected utility of the portfolio model as  $B$ .<sup>4</sup> As a result the original model becomes:

$$EU_2 = (1 - p)U(X) + p\left[q(U(Y) - U(B)) + (1 - q)U(Z)\right], \tag{3}$$

where

$$X = I - tR,$$

$$Y = I - tR - tf[(1 + \alpha)I - R],$$

$$Z = I - tR - tf[I - R],$$

$$B = B(R, I)$$

where  $B > 0$  is the behavioral utility agents get from experiencing an unfair audit. We make no assumptions on the functional form of the behavioral utility here but discuss different scenarios in Appendix A. We expect that  $B$  depends on  $R$  and  $I$  (e.g.  $B = B(R, I)$ ), hence the decrease in expected utility is dependent on both reported income and actual income. Given that  $R$  is dependent on  $q$  and  $\alpha$ ,  $B$  is thus indirectly dependent on both the probability and the extent of overestimation. We assume the dependency on  $R$  to reflect that the utility of an unfair audit is dependent on a taxpayer’s reporting behavior. For example, the utility from an unfair audit might be different for honest and dishonest taxpayers. We also include the dependency on  $I$  since  $\alpha$  is a percentage of  $I$ . As a result, the utility of  $B$  is a function of being audited and the possibility of experiencing an unfair audit that overestimates the true income. Since an increase in  $q$  increases optimal reporting levels  $R_*$ , we expect that the size of  $B$  from an (unfair) audit increases in  $q$ . Similarly, considering the positive relationship between  $\alpha$  and optimal reporting levels  $R_*$ , we expect the dis-utility to be stronger if  $\alpha$  increases.

To predict the effects of introducing behavioral considerations, we follow a similar procedure as in section 3.1 where we first derive the optimal reporting function from equation (3) and thereafter take the partial derivative with respect to  $q$  and  $\alpha$  separately. Introducing  $U(B)$  in equation (3) gives the result that an increase in  $q$  does not have a uniform effect on optimal reporting levels  $R_2$  \*.<sup>5</sup> Whether the taxpayer will increase or decrease their reported income depends on the relative effect of “economic” vs “behavioral” considerations in their compliance decision as well as the functional form of the taxpayer’s utility function of  $B$ . For example, if only economic considerations determine the compliance decision of a rational risk-neutral taxpayer, the optimal level of reporting compliance increases when the utility from economic factors, i.e.,  $U(Y)$  and  $U(Z)$ , change in response to changes in  $q$  and/or  $\alpha$ . However if only behavioral considerations determine behavior, i.e., only  $U(B)$  changes in response to changes in  $q$  and/or  $\alpha$ , the model predicts a decrease in compliance.<sup>6</sup> Our assumption of  $U'(B)$  increasing in  $R$  remains constant for all scenarios.

Similar to the case of  $q$ , the change in optimal reported income in response to changes in  $\alpha$  will be determined by whether the effect of economic or behavioral considerations are stronger. In conclusion, we find that for the behavioral model the predictions for changes for  $q$  and  $\alpha$  are not clear cut. Contrary to the uniform predictions of the extended standard model, the predictions derived from the alternative model with behavioral considerations depend on which considerations (economic or behavioral) are stronger in a taxpayer’s compliance decision. As such, an increase in either  $\alpha$  or  $q$  could lead to 1) a smaller increase in reported income than

<sup>4</sup> Non-monetary considerations for tax compliance have also been considered previously by Sandmo (2005) who proposes to incorporate the dis-utility individuals have from evading. In line with Sandmo (2005), we make no assumptions on any particular behavioral driver, as they all have similar predictions in terms of modeling.

<sup>5</sup> Where we use  $R_2$  \* to distinguish the optimal reporting with behavioral considerations. For the deviation of  $R_2$  \* please refer to equation (11), the optimal reporting derived from the portfolio model with behavioral considerations in Appendix A.

<sup>6</sup> In Appendix A equations (13) and (17) show the optimal reporting behavior depending on our parameters  $q$  and  $\alpha$ . Additionally, we analyze here the effects of different functional forms of  $U(B)$  for both the  $q$  and  $\alpha$  dependencies.

the extended standard model predicts, 2) no change in reported income after a change in either  $q$  or  $\alpha$ , or 3) a decrease in reported income after an increase in either  $q$  or  $\alpha$ . The full derivations can be found in Appendix A. Our theoretical considerations lead to the following hypotheses.

### 3.2.1. Hypothesis 1: Effect of unfair audits on the aggregate compliance level

If the traditional portfolio model holds, we hypothesize:

**Hypothesis 1a (predictions of the rational model):** *An increase in the probability of an unfair audit  $q$  that overestimates the taxpayer's true income or an increase in the magnitude of such overestimation  $\alpha$  will increase taxpayer compliance.*

However, if the behavioral model holds, the predictions are less clear-cut. Specifically, the behavioral model predicts that compliance depends on the subjective weights of economic versus behavioral considerations. If a taxpayer cares only about economic incentives, compliance will increase as  $q$  and  $\alpha$  increase. However, if behavioral considerations affect the taxpayer's reporting decision, this effect will be reduced or the taxpayer might not adjust his or her behavior at all. Finally, if compliance is mostly determined by behavioral considerations, compliance will decrease in response to an increase in  $q$  or  $\alpha$ . Therefore, we hypothesize the following:

**Hypothesis 1b (predictions of the behavioral model):** *An increase in the probability of an unfair audit  $q$  that overestimates the taxpayer's true income or an increase in the magnitude of such overestimation  $\alpha$  will either have no effect or decrease taxpayer compliance.*

### 3.2.2. Hypothesis 2: Effect of unfair audits on post-audit tax compliance

The standard portfolio model of tax compliance predicts that audits do not affect post-audit tax compliance of audited taxpayers because the audit does not provide the taxpayer with new information. Specifically, under a random audit scheme, a previous audit does not affect the risk of a future audit, and it also does not affect the fines for future noncompliance. As taxpayers base their reporting decisions only on the probability of an audit and the fine for noncompliance they face in their current reporting decision, a past audit should not affect compliance. We thus hypothesize

**Hypothesis 2a (predictions of the standard portfolio model):** *The experience of an audit has no effect on subsequent tax compliance.*

However, prior work shows that the experience of an audit can affect compliance, even when the relevant tax system parameters do not change. For example, several laboratory experiments find that taxpayers who have been randomly selected for an audit decrease their compliance in the subsequent reporting decision, a phenomenon coined the “bomb-crater” effect (Guala and Mittone, 2005; Mittone, 2006). One potential explanation for this decrease in reported income after an audit is “loss-repair”, where taxpayers reduce their post-audit tax compliance to make up for the loss they have incurred as a result of their audit (Andreoni et al., 1998; Kastlunger et al., 2009). Another explanation for this decline is that individuals estimate the likelihood of an event based on how often they have experienced it in the past (Clotfelter and Cook, 1993; Mittone et al., 2017). Specifically, taxpayers might believe that a random audit “is more likely to occur because it has not happened for a while or it is less likely to occur because it recently happened” (Maciejovsky et al., 2007, p.2). These results motivate the following hypothesis:

**Hypothesis 2b (predictions of the behavioral model):** *The experience of any audit will decrease taxpayer compliance in the next round.*

An alternative explanation for behavioral responses to audits that are not in line with the predictions of the standard economic model is that the subjective experience of the audit affects taxpayers' subsequent compliance (Beer et al., 2020). In particular, prior work finds that procedural fairness, or the quality of treatment and the quality of the decisions that authorities make, affects compliance (Murphy, 2017). For example, people who are treated with dignity, respect, and fairness are more likely to evaluate the agency positively and comply (Hartner et al., 2008; Murphy, 2009; Murphy and Tyler, 2008; Tyler, 2006; van Dijke and Verboon, 2010). In contrast, unfair treatment can undermine trust (Kirchler et al., 2008) and the intrinsic motivation to pay taxes (Alm and Torgler, 2006; Torgler et al., 2007), and thus reduce taxpayers' propensity to comply in the future. In sum, these findings suggest that unfair tax audits might reduce post-audit tax compliance. Specifically, unfair audits might induce reactance in taxpayers (Frey, 1997; Lederman, 2018; Mendoza et al., 2017) and motivate them to “get back at” the tax agency by reducing their compliance (Andreoni et al., 1998). In light of this prior work on the effect of audits on post-audit tax compliance we hypothesize:

**Hypothesis 2c (predictions of the behavioral model):** *An unfair audit, which overestimates a taxpayer's true income, will decrease taxpayer compliance in the next round compared to a fair audit (without overestimation).*

**Table 1**  
Prediction of optimal reporting levels.

| $q$ | $\alpha$ | $R_*$  | Frequency |
|-----|----------|--------|-----------|
| 0   | 0        | 59.70% | 4 times   |
| 0.1 | 0.1      | 60.94% | 3 times   |
| 0.5 | 0.1      | 65.65% | 4 times   |
| 0.1 | 0.5      | 69.16% | 4 times   |
| 0.5 | 0.5      | 95.21% | 3 times   |

**Notes:**  $q$  is the probability of overestimation and  $\alpha$  the extent of overestimation.  $R_*$  is the optimal reporting level derived from the standard portfolio model with unfair audits following Alm (2019). *Frequency* is frequency of these parameters in the experiment.

#### 4. Experimental design

Our experiment implements the fundamental elements of a voluntary income tax reporting game, following Alm and Jacobson (2007).<sup>7</sup> Participants started by reading the introductions to the experimental task, then proceeded to play three practice rounds. After this they were asked to answer two questions on the experimental setup before they could proceed to the experiment.<sup>8</sup> Each round of the experiment comprised a reporting decision where participants received a random amount of income between 20,000 – 30,000 Experimental Currency Units (ECU) in increments of 100.<sup>9</sup> Participants then had to decide how much income they reported to the tax agency. Reported income was taxed at a rate  $t = 0.25$  and unreported income was not taxed. To facilitate the compliance decision, we provided a calculator that allowed participants to compute how reported income translates into after-tax income conditional on whether or not they were selected for an audit.

After submitting their tax declaration, participants faced the probability of being randomly selected for an audit, this probability was fixed at  $p = 0.40$ .<sup>10</sup> If audited, the tax agency “estimated” the taxpayer’s income and compared it to their declared income. However, with a probability  $q$  (of either: 0, 0.1, or 0.5), the tax agency overestimated the taxpayer’s received income by factor  $\alpha$  (of either: 0.1 or 0.5) of allocated income  $I$ .<sup>11</sup> Thus, even fully compliant taxpayers could be fined if they were audited and their income was overestimated by the tax agency (since  $\alpha I - R \geq 0$ ). Conversely, non-compliant taxpayers could receive an unfairly high fine, if they were audited and the audit overestimated their income  $I$ . The fine  $f$  for noncompliance was twice the estimated evaded amount detected by the tax authorities. After submitting their tax declaration, participants were informed about whether they had been audited or not and the result of the audit. Participants faced 18 tax reporting decisions, i.e., they played 18 experimental rounds. In each round they were endowed with income as described above and they faced a set of tax system parameters ( $p$ ,  $q$ , and  $\alpha$ ) as detailed in Table 1. The order of the rounds was randomized at the individual level and participants played all possible combinations of  $q$  and  $\alpha$  several times. To prevent last round effects, participants were not informed about the exact number of rounds.<sup>12</sup>

Once participants had completed all 18 rounds, they were directed to an exit survey. The first part of the exit survey consisted of demographic questions. The second part retrieved one round where the participants were audited with overestimation and asked questions about the reasoning, motivation, and strategy they used to determine their reported income in this round. Finally, we included a short survey on risk aversion (Menkhoff and Sakha, 2016), tax morale (World Value Survey, 2017), and procedural fairness (Kirchler and Wahl, 2010).

We recruited five hundred and one ( $n = 501$ ) participants via Prolific. The sample is representative of the UK population, with demographics of the sample matching the demographic composition of the UK in age (mean = 44.62), race, and gender (50.50% female, 47.90% male, 1.60% other).<sup>13</sup> Participants took on average 20.5 minutes (18 median) to complete the study. They received a show-up fee of £1.8 (£5.4 per hour). Additionally, participants could receive a bonus payment of up to £8.71 (£26.13 per hour)

<sup>7</sup> The experiment ran on Prolific <https://www.prolific.co/>. Compared to other online platforms Prolific produces high-quality data (Eyal et al., 2021; Peer et al., 2017). This study was preregistered before collecting any data at [https://aspredicted.org/blind.php?x=13Z\\_MGK](https://aspredicted.org/blind.php?x=13Z_MGK). Screenshots of the experiment and a transcription of the instructions are in Appendix C.

<sup>8</sup> 451 participants answered both questions correctly (90%), those that did not got redirected to an explanation and an additional practice round. This indicates our participants had a high understanding and low-nativity of the game.

<sup>9</sup> We based our distribution on the median income for UK residents for the 2018-2019 tax year that is £25,000: <https://www.gov.uk/government/statistics/distribution-of-median-and-mean-income-and-tax-by-age-range-and-gender-2010-to-2011>.

<sup>10</sup> Parameters  $p$  and  $q$  were calibrated such that they provide sufficient statistical power to investigate the effects of overestimation. With  $p$  combined with  $q$  [0, .1, .5], participants experience an audit with overestimation in 10% of their tax declarations.

<sup>11</sup> Given our work’s exploratory character, we use a high and a low level of  $\alpha$  to see if the magnitude of overestimation affects tax compliance.

<sup>12</sup> Note that we employ a within-subjects design. Such a design is frequently used in laboratory and online experiments because it provides the high levels of statistical power needed to identify the causal effect of interest. In this study a within-subjects design also reflects the possibility that taxpayers might experience different types of audits (fair or unfair) over time. However, this design feature might also increase the salience of variation in tax system parameters. Even so, with random audits that do not provide the taxpayer with new information, behavioral responses to audits should be unaffected by variation in the audit probability and audit fairness. We believe that the benefits of a within-subjects design outweigh its potential caveats.”

<sup>13</sup> The overview of the general characteristics of the sample is in Table 6 in Appendix B.

**Table 2**  
Summary statistics of the experiment.

| Variable                                | Description                          | Mean   | SD    |
|---|--------------------------------------|--------|-------|
| <i>Dependent Variable</i>               |                                      |        |       |
| Compliance rate                         | Ratio of reported to received income | .79    | .31   |
| <i>Experimental Treatment Variables</i> |                                      |        |       |
| Income                                  | Income received in ECU               | 24,933 | 2,870 |
| Audited                                 | 1 if participant is audited          | .41    | .49   |
| $q$                                     | Probability of being overestimated   | .10    | .30   |
| $\alpha$                                | Magnitude of overestimation          | .26    | .20   |
| Fine                                    | Fine after audit                     | 3,486  | 4,333 |
| Relative fine                           | Fine relative to gross-income        | .14    | .17   |

**Notes:**  $q$  is probability of overestimation,  $\alpha$  the extent of overestimation, *audited* is a dummy variable that reflects whether a reporting decision was audited or not, and *relative fine* is the ratio of fine to gross income in audited rounds.

from their after-tax income in a randomly selected round. The average bonus was £0.54 which is equivalent to a 27.7% increase on the guaranteed income. The average final payment (show-up fee + bonus) was £2.41, which is equivalent to £7.23 per hour.<sup>14</sup>

## 5. Results

### 5.1. Summary statistics

We observe a total of 9,018 compliance decisions from 501 individuals. Out of these 9,018 decisions, 5,333 (59%) were not audited, 2,757 (31%) were audited fairly, and 928 (10%) were audited unfairly and thus resulted in an overestimation of the taxpayer's true income. Participants declared their entire income in 4,345 decisions (48% of all reporting decisions), and 86 participants (17%) declared their entire income in every single reporting decision, whereas only two participants never reported any income. The mean compliance rate was 79%. Table 2 provides descriptive statistics.<sup>15</sup>

### 5.2. Hypotheses 1: What is the effect of unfair audits on the aggregate compliance level?

The first set of hypotheses (1a and 1b) investigate the effect of the probability  $q$  that an audit overestimates a taxpayer's true income and the effect of variation in the magnitude  $\alpha$  of such overestimation on the aggregate compliance level. Hypothesis 1a predicts that taxpayers follow the rational extended portfolio model and Table 1 shows the rational behavioral responses for a risk-averse (CRRA) taxpayer, where an increase in  $q$  or  $\alpha$  increases taxpayer compliance, with a larger response to a change in  $\alpha$  compared to a change in  $q$ . Hypothesis 1b predicts that the weight given by the taxpayer to economic and behavioral considerations determines their behavioral response. If the taxpayer considers both factors, the economic and behavioral considerations could counteract each other and result in no or a small response to a change in  $q$  or  $\alpha$ . If only behavioral considerations influence taxpayer behavior, the model predicts that compliance decreases after an increase in  $q$  or  $\alpha$ . If only non-behavioral factors affect the reporting decision H1a holds.

Fig. 1 shows that compliance is lowest for individuals who faced a zero probability of an unfair audit. Although the rate of compliance increases as  $q * \alpha$  increases, the increments in which it does so are not proportional. Specifically, mean compliance increases by approximately 3 percentage points when  $q * \alpha$  increases from 0 to 0.01. However, an additional increase in  $q * \alpha$  only marginally affects compliance.

To investigate the effect of unfair audits on the aggregate compliance level, we ran a linear regression by Generalized Least Squares (GLS) of the compliance rate on  $\alpha$  and  $q$  with a subject-specific random effect.<sup>16</sup> Table 3 shows the results.<sup>17</sup> Models (1)-(2) show the combined effect of  $q * \alpha$ , and Models (3)-(6) disentangle the effects of  $q$  and  $\alpha$ . In general, our different estimations provide more support for H1b than for H1a: Although the introduction of unfairness ( $q > 0$ ) increases compliance, a further increase in  $q$  does not have a strong additional effect (Models (3) and (4)). Furthermore, the extent of unfairness,  $\alpha$  does not seem to impact taxpayer behavior (Models (5) and (6)).

Model (1) shows the effect of the different types of unfair audits ( $q * \alpha$ ), with fair audits ( $q * \alpha = 0$ ) being the reference category. When participants are confronted with a positive probability of an unfair audit, they increase their compliance by approximately 3 percentage points, which is even more than the rational model (Table 1) predicts. However, contrary to the predictions of the rational model, we find no significant differences between  $q * \alpha = .01$ ,  $q * \alpha = .05$ , and  $q * \alpha = .25$  in Model (1), suggesting a non-linear effect

<sup>14</sup> The mean income was equivalent to the wage suggested by Prolific.

<sup>15</sup> Table 8 in the Appendix B provides additional descriptive statistics.

<sup>16</sup> The choice for random versus fixed effects was based on the results of a Hausman test (untabulated) and is in line with much prior experimental work on tax compliance (e.g., Abbiati et al., 2020; Alm and McKee, 2006; Blumkin et al., 2012; Coricelli et al., 2010; Torgler et al., 2007). We also re-estimated the model with individual fixed effects (untabulated), the results remain unchanged.

<sup>17</sup> Complete output including demographic, round and income effects is available in Appendix B.

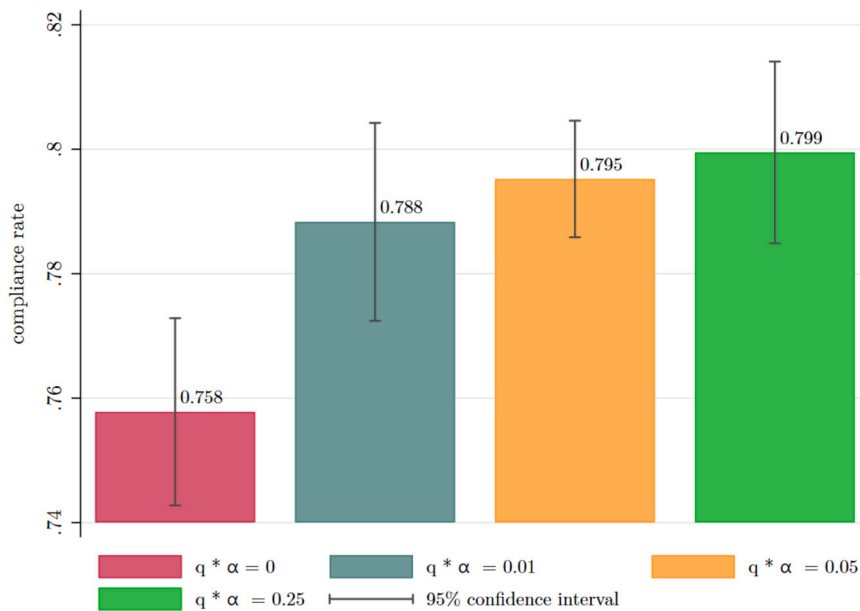


Fig. 1. The effect of unfair audits on the aggregate compliance level.

**Table 3**  
The effect of the probability and magnitude of overestimation on aggregate tax compliance.

|                    | (1)                 | (2)                 | (3)                 | (4)                 | (5)                 | (6)                 |
|--------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| $q * \alpha = 0$   | ref                 | ref                 |                     |                     |                     |                     |
| $q * \alpha = .01$ | 0.0305***<br>(4.25) | 0.0301***<br>(4.20) |                     |                     |                     |                     |
| $q * \alpha = .05$ | 0.0374***<br>(6.50) | 0.0374***<br>(6.51) |                     |                     |                     |                     |
| $q * \alpha = .25$ | 0.0417***<br>(5.80) | 0.0416***<br>(5.80) |                     |                     |                     |                     |
| $q = 0$            |                     |                     | ref                 | ref                 |                     |                     |
| $q = .1$           |                     |                     | 0.0277***<br>(4.57) | 0.0274***<br>(4.53) |                     |                     |
| $q = .5$           |                     |                     | 0.0437***<br>(7.59) | 0.0438***<br>(7.61) | ref<br>(3.18)       | ref<br>(3.26)       |
| $\alpha = .1$      |                     |                     |                     |                     | ref                 | ref                 |
| $\alpha = .5$      |                     |                     |                     |                     | -0.00426<br>(-0.88) | -0.00431<br>(-0.89) |
| Constant           | 0.758***<br>(67.01) | 0.795***<br>(14.15) | 0.758***<br>(67.02) | 0.795***<br>(14.15) | 0.788***<br>(71.35) | 0.818***<br>(14.54) |
| Demographics       | NO                  | YES                 | NO                  | YES                 | NO                  | YES                 |
| Observations       | 9,018               | 9,018               | 9,018               | 9,018               | 7,014               | 7,014               |

Notes: Random effects model with individual random effects. Where  $q$  refers to the probability of overestimation and  $\alpha$  to the extent of overestimation.  $t$  statistics in parentheses. \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

of unfairness on compliance. To illustrate, for the average income of 25,000 ECU, the taxpayer faces an expected overestimation of their true income of 250 ECU when  $q * \alpha = .01$ . In this case, the average compliance level increases by approximately 3 percentage points relative to a fair audit where  $q * \alpha = 0$ . Yet, when the taxpayer faces an expected overestimation of 6,250 ECU ( $q * \alpha = .25$ ), compliance only increases by one additional percentage point. This additional increase in compliance is insignificant at conventional levels, suggesting that taxpayers are not only influenced by the expected overestimation and the accompanying fines. To conclude, the behavioral response to the introduction of audit unfairness, that is, a change from a zero to a positive probability of overestimation of a taxpayer's true income  $q$ , supports H1a. However, in line with H1b, an additional increase in the expected audit unfairness ( $q * \alpha$ ) does not affect taxpayer compliance, because economic incentives and behavioral considerations counteract each other and diminish the behavioral response to unfair audits. The results in Model 2 include demographic controls and remain stable.

Models (3)-(6) disentangle the effects of  $q$  and  $\alpha$ . Models (3) and (4) show the effect of increasing the probability of an unfair audit  $q$ . The results suggest that increasing the probability of an unfair audit from 0 to 0.1 increases compliance by approximately 3 percentage points. Moreover, we find that increasing  $q$  from 0.1 to 0.5 increases compliance by an additional 1.6 percentage points. This difference is statistically significant ( $z = 3.16$ ,  $p < 0.002$ ), but smaller than Table 1 predicts.

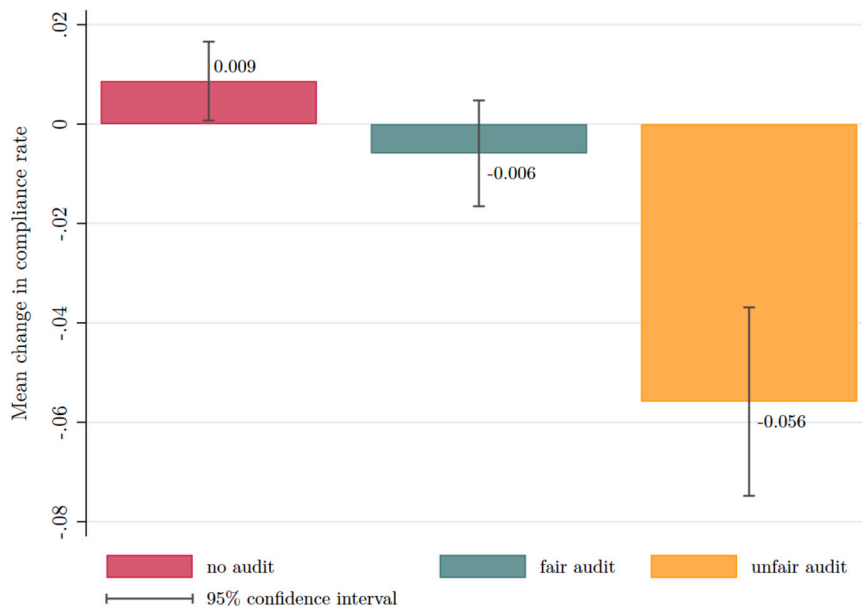


Fig. 2. Post-audit change in compliance rate.

In Models (5) and (6) we analyze the effect of an increase in  $\alpha$  from .1 to .5 controlling for  $q$ .<sup>18</sup> We find no significant effect of the size of the overestimation ( $\alpha = .1$  versus .5) on the aggregate compliance level. In line with H1a, our results thus suggest that taxpayers increase their compliance when  $q$  increases, but in contrast to the predictions derived from H1a, they ignore the magnitude  $\alpha$  of the overestimation, even though the rational model predicts a larger behavioral response to a change in  $\alpha$  relative to  $q$ . Models (5) and (6) thus support H1b and suggest that behavioral considerations diminish the effect of economic incentives. In sum, these results support H1b: the aggregate compliance level predominantly reflects economic incentives, yet taxpayers are not “fully rational”.

### 5.3. Hypotheses 2: What is the effect of unfair audits on post-audit tax compliance?

The second set of hypotheses (2a, 2b, and 2c) investigate the effect of the experience of an unfair audit on post-audit tax compliance. We define post-audit as the first reporting decision after an audit. In line with the standard portfolio model of tax evasion, Hypothesis 2a predicts that experiencing an audit does not affect subsequent compliance because taxpayer compliance is determined only by the enforcement parameters of the current tax reporting decision and not by past experiences. Hypothesis 2b predicts that taxpayers will generally decrease their compliance after they have experienced an audit. Finally, Hypothesis 2c predicts that the experience of an unfair audit will result in a stronger decline in compliance than the experience of a fair audit.

Fig. 2 illustrates the change in compliance between the rounds that are (un-) audited and the first subsequent rounds. Taxpayers increase their compliance very slightly (but statistically significant) after not experiencing an audit, while taxpayers who were audited decrease their compliance. Importantly, however, compliance decreases more after an unfair audit than after a fair audit, suggesting that unfair audits have a strong negative effect on post-audit tax compliance.

We test our hypotheses on the effect of unfair audits on post-audit tax compliance by running a linear regression by GLS of  $\Delta$  tax compliance, i.e., the change in compliance between the audited round and the subsequent round, on experienced audit (again, including a subject-specific random effect). “Fair audit” indicates whether or not the taxpayer experienced a fair audit in the previous round and “unfair audit” indicates whether or not the taxpayer experienced an unfair audit in the previous round. Our findings are reported in Table 4. Models (1)–(3) test H2a versus H2b, Models (4) and (5) test H2c. Overall, we find strong support for rejecting H2a and confirming H2b and H2c. In Model (1) we show the effects of being audited (fairly and unfairly) in the previous round, compared to not being audited. Both types of audits significantly decrease post-audit tax compliance relative to not experiencing an audit. The difference in post-audit tax compliance between those who experienced a fair audit and those who experienced an unfair audit is approximately 7 percentage points and significant at all conventional levels ( $z = -4.23$ ,  $p < 0.001$ ). These results provide no support for H2a. Instead, and in line with prior experimental work on the effect of audits, our results indicate that taxpayers decrease their subsequent tax compliance after experiencing an audit. When including demographic controls, in Model (2), the results remain stable. Model (3) controls for received gross income and  $q * \alpha$  in the current round in order to prevent any potential “regression to the mean” effects (Kasper and Alm, 2022a). The results remain stable and therefore support H2b.

<sup>18</sup> In order to compare the size of  $\alpha$ , the case of no probability of unfairness, ( $q * \alpha = 0$ ) is excluded. Therefore when controlling for  $q$  the reference categories are  $q = .1$  and  $\alpha = .1$ .

**Table 4**  
Post-audit effect on compliance of audit.

|               | (1)                   | (2)                   | (3)                   | (4)                   | (5)                   |
|---------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| no audit      | ref                   | ref                   | ref                   |                       |                       |
| fair audit    | −0.0145*<br>(−2.12)   | −0.0148*<br>(−2.16)   | −0.0150*<br>(−2.18)   | ref                   |                       |
| unfair audit  | −0.0645***<br>(−6.21) | −0.0645***<br>(−6.21) | −0.0642***<br>(−6.17) | −0.145***<br>(−14.06) |                       |
| $\alpha = 0$  |                       |                       |                       |                       | ref                   |
| $\alpha = .1$ |                       |                       |                       |                       | −0.0764***<br>(−6.62) |
| $\alpha = .5$ |                       |                       |                       |                       | −0.303***<br>(−19.39) |
| $q * \alpha$  |                       |                       | 0.0642<br>(1.77)      | 0.0935*<br>(1.98)     | 0.0935*<br>(1.97)     |
| relative fine |                       |                       |                       | 0.859***<br>(29.59)   | 1.056***<br>(33.98)   |
| Constant      | 0.00866*<br>(2.17)    | 0.0588<br>(1.85)      | 0.0540<br>(1.70)      | 0.00487<br>(0.10)     | −0.0154<br>(−0.33)    |
| Demographics  | NO                    | YES                   | YES                   | YES                   | YES                   |
| Observations  | 8,517                 | 8,517                 | 8,517                 | 3,469                 | 3,469                 |

**Notes:** Random effects model with individual random effects. The dependent variable is change in compliance between the audited and the subsequent round. Where  $q$  refers to the probability of overestimation,  $\alpha$  to the extent of overestimation, and *relative fine* is the ratio of fine to gross income in audited rounds.  $t$  statistics in parentheses. \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

In Model (4) we control for the fine that results from the last round's audit to further investigate the effect of experiencing an unfair audit irrespective of its monetary outcome (H2c).<sup>19</sup> When accounting for the fine that the taxpayer paid as a result of the audit in the previous round, we still find that the coefficient of *unfair audit* is still significant at all conventional levels. This result indicates that irrespective of how much the taxpayer has to pay as a result of the audit, the reason why the taxpayer has to pay influences compliance behavior in the subsequent reporting decision. The effect of an unfair audit with overestimation versus a fair audit without overestimation is equivalent to a 14 percentage points decrease in tax compliance when accounting for the fine paid in the last round relative to income. This result supports H2c and suggests that the experience of unfairness in tax enforcement has a strong and negative effect on post-audit tax compliance.

Finally, in Model (5) we account for the magnitude  $\alpha$  of overestimation by the tax agency. We find that the extent to which audits overestimate a taxpayer's true income  $\alpha$  affects post-audit tax compliance, even when controlling for the fine that the taxpayer had to pay in the previous round. Specifically, we find that an unfair audit with an overestimation of  $\alpha = .10$  reduces post-audit tax compliance by 8 percentage points compared to a fair audit. In comparison, an unfair audit that overestimates income by  $\alpha = .50$  decreases post-audit tax compliance by approximately 30 percentage points. The difference in the behavioral response to different levels of audit unfairness is significant at all conventional levels ( $z = -12.64$ ,  $p < 0.001$ ). Our results indicate that increasing the unfairness of tax audits decreases the compliance rate of audited taxpayers in the subsequent reporting decision. Furthermore, we find in both models a positive effect of the fine that the taxpayer had to pay in the last round, indicating a deterrent effect of the size of the fine. Specifically, our results suggest that a 1 percentage point increase in the relative fine that a taxpayer had to pay in the last round (i.e., the fine that the taxpayer had to pay as a result of the audit divided by his or her income in that round) increases compliance by 9 percentage points.

#### 5.4. Exploratory results

Our theoretical model makes no assumptions on the behavioral drivers of taxpayer compliance. As a result, our main hypotheses only investigate changes in taxpayer behavior without making any predictions on the underlying motivations. This section explores motivational drivers of taxpayers' compliance decisions. To assess participants motivation, we included a question on the taxpayer's main motivation when declaring their income in the post-experimental questionnaire ("What was your main objective while participating? Being honest, Avoiding fines, Compensating for earlier rounds, Revenge, Contributing to the collective, Other").<sup>20</sup>

The results reveal that a large share of our sample was motivated by honesty and contributing to the collective (45%). In contrast, others were motivated mainly by the goal of avoiding fines (33%). The third group of taxpayers in our sample indicated that they

<sup>19</sup> When controlling for the fine, we compare taxpayers that had equal fines, while one was audited fairly and the other unfairly. The possibility of equal fines is due to two reasons 1) we could be comparing two taxpayers with equal compliance levels, who did not report their full income but were allocated different gross incomes for this tax declaration, or 2) we could be comparing two taxpayers with different levels of compliance in the last round.

<sup>20</sup> The instructions stated that taxes had to be paid over income. Even though income was not redistributed in the game, we gave this option in the post-survey given that contribution is the main objective for many taxpayers in real life.

**Table 5**  
Post-audit effect on compliance of audit - per tertile.

|              | top tertile         | medium tertile        | bottom tertile       |
|--------------|---------------------|-----------------------|----------------------|
| no audit     | ref                 | ref                   | ref                  |
| fair audit   | 0.000191<br>(0.03)  | -0.0562***<br>(-4.87) | -0.0236*<br>(-2.48)  |
| unfair audit | -0.00685<br>(-0.80) | -0.0905***<br>(-5.22) | -0.0467**<br>(-3.25) |
| Constant     | 1.035***<br>(32.05) | 1.032***<br>(14.68)   | 0.483***<br>(4.46)   |
| Demographics | YES                 | YES                   | YES                  |
| Observations | 2,992               | 2,754                 | 2,771                |

**Notes:** Random effects model with individual random effects. The dependent variable is change in compliance between the audited and the subsequent round. Round number and gross-income are absorbed by the demographics term. *t* statistics in parentheses. \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

were motivated by retaliation, taking revenge, or compensating for earlier rounds (17%).<sup>21</sup> To investigate the relationship between self-reported motivations and actual reporting behavior, we divide our sample into compliance tertiles. The highest tertile reports 97% of their income on average, the medium tertile reports 80% on average, and the bottom tertile reports 58%, on average. Table 22 in Appendix B shows the distribution of the self-reported motivations across compliance tertiles. We find that the self-reported motivations correspond closely to taxpayers reporting behavior. In particular, the group of honest and contributing taxpayers are predominantly in the top compliance tertile, those who indicated fine-aversion are predominantly in the medium compliance tertile, and those taxpayers who stated that they were motivated by retaliation are predominantly in the bottom compliance tertile. Overall, these results suggest that reporting behavior reflects self-reported motivations.

To analyze the relationship between taxpayer motivations and compliance decisions in greater detail, we investigate the behavioral response to experiencing an audit separately for each tertile.<sup>22</sup> Table 5 presents the results. We find that the top compliance tertile, that comprises mostly taxpayers who describe themselves as being motivated to be honest or to contribute to the collective, do not respond to the experience of an audit (either fair or unfair). In contrast, the medium compliance tertile, that mostly comprises fine-averse taxpayers, shows the strongest response of the three groups. In this group the average compliance rate is 84% in rounds that follow an unaudited reporting decision. But while compliance drops by 6 percentage points after a fair audit and by 9 percentage points after an unfair audit, the difference in the behavioral response to fair and unfair audits is not significant. Finally, taxpayers in the bottom compliance tertile respond to both fair and unfair audits, but audit fairness does not affect this response.

Finally, we investigate responses from two open-ended questions. The first question addressed the taxpayer's motivation in a randomly selected round that resulted in an unfair audit ("Please explain why you declared X ECU in round X"). The second question addressed whether the taxpayer used the same strategy throughout the game ("Is the strategy you used for this round "X" different or similar to the one used in other rounds? If so, explain how"). These questions were designed to obtain a more detailed picture of taxpayers' motivations during the study. Participants that point out that they were motivated by the desire of being honest typically provided answers like the following: "I have always declared the income I have received. In my opinion the over-estimations are unfair, but that does not justify 'cheating'. Being honest is one of my core values!". Participants who indicated that they were motivated by the goal of avoiding fines, appeared to be making their decision by weighing the benefits of successful cheating against the risk of audits and fines. For example: "With no overestimated income to worry about there was a chance to not be hit too hard by declaring only 11,500 ECU here compared to anything higher. I didn't go lower than 11,500 as 40% odds are still likely enough in my head - I didn't want to bet "all or nothing" in this scenario. I wanted some leeway and 11,500 was the number I chose for this". Finally, the taxpayers who indicated revenge or compensation for earlier rounds as their main motivation were also explicit about retaliation influencing their compliance decisions.<sup>23</sup> For example: "If there is a possibility of overestimation I'm going to attempt to claw back a lot of it purely as a fine for incompetence. As the rounds progressed I felt less and less inclined to give accurate reports as the audits seemed to appear more than 40% of the time it became a situation of how much could I claw back from an unfair system." In sum, these results suggest that not all taxpayers are the same and that underlying motivations contribute to heterogeneity in tax compliance. We consider studying the effect of taxpayer's motives on their compliance decisions to be a fruitful avenue for future research.

## 6. Robustness checks

To assess the robustness of our results, we ran our models with different specifications and sub-samples. The experimental literature on tax compliance generally finds that participants are more honest than the standard model of tax evasion predicts (Alm and Malézieux, 2020). Hence, as a first check we exclude from our analyses participants who were fully honest and declared their entire income in every round. These *pathologically honest* taxpayers account for 17% of our sample and appear to be motivated solely

<sup>21</sup> The answers and distribution of the self-reported motivations of our sample are in Table 21, we merged categories that had a similar sentiment and ended up with 3 groups.

<sup>22</sup> We chose to analyze this relationship with tertiles rather than the motivation categories for statistical power; by definition tertiles are of equal size.

<sup>23</sup> The remaining 5% self-selected as "other".

by the intrinsic desire to be honest, despite financial incentives to underreport their income (Erard and Feinstein, 1994). Tables 14 and 16 in Appendix B show the results from Tables 3 and 4 but without these individuals. We find that the results do not differ in a meaningful or statistically significant way. Additionally, we re-estimated Model (5) of Table 4 without taxpayers that were fully compliant in the previous round. Table 17 in Appendix B shows similar effect sizes for  $\alpha_{(t-1)}$  and the relative fine of the last round while the effect size of  $\alpha * q$  in the current round increases marginally.

As a second robustness check, we test if the results in Tables 3 and 4 are robust to using different estimation strategies. First, for our tests of Hypothesis 1 (Table 3), we re-estimate the average treatment effect with a fractional logit model. The advantages of this approach are that 1) it corrects for our zero-inflated (honest responses) data distribution and 2) it fits through quasi maximum likelihood a multinomial logit model, without making strict assumptions about the underlying distribution of the data. Our fractional regression results are presented in Table 15 of Appendix B. The coefficients of the initial OLS and the fractional logit estimations are approximately identical.

As a third robustness check we use a double hurdle model (Belotti et al., 2015).<sup>24</sup> The finding of a large share of *pathologically honest* participants suggests that taxpayers face two separate issues in their compliance decisions: whether to report their entire income correctly and, if the answer is no, how much to evade? If a taxpayer's compliance decision is indeed the result of a two-step process, OLS estimations might be biased (Zuur et al., 2009).<sup>25</sup> Thus, the first stage of the double hurdle model accounts for the mass of observations at zero compliance by fitting a binary choice model on the probability of observing a compliant or a non-compliant reporting decision through a logistic model. The second stage then estimates the extent of evasion with a standard linear regression after the decision to evade or not has been made. The results are reported in Table 19 in Appendix B. The logistic stage shows that when the possibility of overestimation is present, participants are more likely to evade part of their income. Once this decision has been made, the probability and the magnitude of overestimation have a positive effect on compliance. The second stage OLS regression results are comparable to the results reported in Table 3.<sup>26</sup>

Finally, we investigate the robustness of the results presented in Table 4. In contrast to our analysis of H1, a fractional model is not suitable here since  $\Delta$  can be  $< 0$ . Therefore, we transform tax compliance into an ordered variable where  $-1$  indicates tax compliance decreased relative to the previous round,  $0$  indicates no change in compliance, and  $+1$  indicates that tax compliance increased. We present the results in Table 18 of Appendix B. Although we do not observe a decline in compliance after a fair audit using this estimation strategy, the direction of the results is overall stable. The finding that compliance decreases significantly in the round after an unfair audit is robust for the ordered logit estimation and significant at the 1% level ( $t = -3.91$ ). Model (4) shows that the effects of  $\alpha = .1$  and  $\alpha = .5$  are larger than in our initial estimation, albeit there is a smaller difference between the coefficients of these two variables. These results suggest that the propensity to comply decreases after unfair audits, and that this effect is stronger for  $\alpha = .5$ . Moreover, Table 18 confirms our results on the differential responses to fair and unfair audits and the finding of higher compliance levels when the relative fine in the last round was higher.

## 7. Discussion

Tax audits are an essential tool to deter underreporting of income. However, audits do not always result in a fair assessment of a taxpayer's true income. This study investigates the effects of unfair audits, or audits that overestimate a taxpayer's true income. In particular, we study how variation in audit fairness affects aggregate compliance levels and we also study the effect of experiencing an unfair audit on post-audit tax compliance. To the best of our knowledge, our study is the first to investigate experimentally the effects of unfair tax audits.

Our first main finding is that the introduction of audit unfairness increases the aggregate compliance level. However, when disentangling the effects of the probability of an unfair audit ( $q$ ) from the extent of unfairness ( $\alpha$ ), we find that the probability of an unfair audit, but not the magnitude of unfairness affects compliance: Taxpayers increase their compliance in response to an increase in the probability of an unfair audit, but they ignore the effect of an increase in the magnitude of unfairness. This result is consistent with the finding that fines have a smaller effect on compliance than the audit probability (Alm and Malézieux, 2020). A potential explanation for this result is that taxpayers overestimate the difference between a zero and a small probability ("*certainty effect*" Tversky and Kahneman, 1979). Thus, our results suggest that behavioral considerations affect compliance decisions and that tax system parameters are not always reflected accurately in taxpayer behavior.

We also analyzed the effect of audits on post-audit tax compliance. Contrary to the standard model of tax evasion, but in line with prior work on the "bomb-crater" effect (Guala and Mittone, 2005; Mittone, 2006; Mittone et al., 2017), we find that experiencing an audit reduces post-audit tax compliance, and that audit fairness moderates this effect. Specifically, unfair audits that overestimate the taxpayer's true income induce a stronger decline in post-audit tax compliance than fair audits. This finding indicates that fairness perceptions affect compliance decisions and that the experience of an unfair audit could motivate taxpayers to get back at the tax

<sup>24</sup> Double hurdle or two stage models are better suited to account for outcomes that are mixed discrete-continuous random variables, and thus have a mass point at zero. This is the case for the evasion decision where a big percentage of participants always evade zero percent of their income. We thank Dr. Elena Fumagalli for her suggestions on the use of this model.

<sup>25</sup> Feinstein (1991) applied a fractional detection model, consisting of a first stage tobit to model compliance followed by a model of the detection process. However, this is applied on the side of the tax agency's decision and not the taxpayer's compliance decision. Alm and Malézieux (2020) also discuss the intensive (compliance from evaders) and extensive margins (probability of full compliance) in their meta-study. However, most laboratory experiments do not account for the often highly skewed distribution of compliance.

<sup>26</sup> In additional analyses we use a probit rather than a logit model in the first stage. The results are unaffected.

agency by reducing their subsequent compliance. To increase the effectiveness of audits, tax administrations should aim to establish fairness in the process and the outcome of audits.

To further investigate the role of taxpayers' motivations in their compliance decisions, we analyze survey responses and open-ended questions. We find that taxpayers differ considerably in their motivational postures and that taxpayer motivations correspond to reporting behavior. Our results suggest that not all taxpayers are the same and that tax authorities should acknowledge the role of taxpayers' motivations in behavioral responses to enforcement to increase the effectiveness of tax collection efforts (Alm et al., 2020; Braithwaite, 2003).

One common criticism of laboratory experiments on tax compliance is the frequent use of student samples (Richardson and Sawyer, 2001). To alleviate this concern, we conducted an online experiment with a representative sample of UK taxpayers. However, the quality of data obtained from online samples is sometimes questioned. For example, a growing concern with MTurk pertains to the "professionalization" and non-naivety of participants (Chandler et al., 2015), which can affect participant behavior and potentially reduces data quality (Hillygus et al., 2014). In contrast to participants recruited via MTurk, Prolific participants have been found to be more naive (Peer et al., 2017) and are thus expected to produce less biased data. We assess naivety by asking participants whether they had previously participated in a tax experiment, and only a small fraction (1.5%) state that they had indeed participated in a tax experiment before.

Another critical aspect of laboratory experiments pertains to their external validity. At first glance the average compliance rate in our experiment (75.8%) appears to be much higher than that typically found in the literature. However, our experimental design differs from prior work on three crucial dimensions and when accounting for these differences, the compliance rate we find in our experiment is in fact comparable to the results obtained in prior work. First, most laboratory experiments use student samples, who do not pay income tax, and these participants have been found to be less compliant in these studies than "real" taxpayers (Choo et al., 2016). Second, the probability of audit in our experiment is higher than in much prior work, resulting in more compliance. For example, Alm and Malézieux (2020) find in their meta-analysis an average compliance rate of 65% (for a mean audit probability of 0.2 and a fine rate of 2). And more recently, Kasper and Alm (2022b) report a compliance rate of close to 70% for a detection rate of 0.4 (and a fine rate of 2). And third, the loaded framing of our experiment (studying "tax reporting behavior") might have contributed to the high compliance levels we observe in our study. We acknowledge that these experimental features, and the high compliance rate they entail, might have restricted taxpayers' ability to change their reporting behavior after experiencing an audit (see Kasper and Rablen, 2023) for a detailed discussion of censoring effects in tax compliance experiments). However, we believe that this effect cannot explain the differential responses to fair and unfair audits we observe in our study.

## 8. Conclusions

Tax authorities face trade-offs in balancing audit frequency and audit effectiveness (Rablen, 2014) and despite facing substantial resource constraints (Geithner et al., 2021), they are increasingly under pressure to maximize collected revenue (Feria, 2020; Weffe, 2020), sometimes resulting in unfair treatment of taxpayers (Berg, 2021). Therefore, our finding that behavioral responses to unfair treatment undermine the direct revenue effect of tax audits has important policy implications: To maximize revenue, collection efforts should be free of bias. Specifically, tax audits should neither be unfair (i.e. they should not overestimate the taxpayer's true income), nor should they be ineffective (i.e. audits should not underestimate the taxpayers true income, see Kasper and Alm, 2022b), in order to ensure a positive effect on post-audit tax compliance.

Based on the results of this paper, we believe that studying the effects of procedural and distributive fairness in tax compliance decisions is a promising avenue for future research. For example, it remains unclear under which conditions taxpayers perceive an audit that results in an additional tax assessment as unfair and to what extent perceptions of procedural fairness mitigate this effect. Similarly, future work could investigate the effect of unfairness in tax enforcement on taxpayers' motivations. Since in reality most taxpayers rarely interact with the tax agency, the experience of unfair treatment might have a meaningful effect on the motivation to comply. Finally, we believe that studying behaviors to mitigate the risk of unfair treatment, such as overreporting income, could be a fruitful avenue for future research.

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## Declaration of competing interest

None.

## Data availability

Data can be found at: [https://osf.io/xqe43/?view\\_only=155cd32bcfaf74b77b65cc1001465813b](https://osf.io/xqe43/?view_only=155cd32bcfaf74b77b65cc1001465813b).

**Appendix A. Appendix theoretical predictions – extended version**

We base our theoretical predictions on the Allingham and Sandmo (1972), “Income tax evasion: A theoretical analysis,” model. In it a taxpayer earns a gross income  $I$  and reports income  $R$ , and pays a tax  $t$  on this reported income. The tax authority observes  $I$  through audits with a certain probability  $p$ , and if caught cheating, the taxpayer faces a fine  $f > 1$ .

$$EU = (1 - p)U(X) + p(U(Z)),$$

where

$$\begin{aligned} X &= I - tR, \\ Z &= I - tR - tf[I - R]. \end{aligned}$$

**A.1. Portfolio model with unfair audits**

We start by extending the portfolio model by adding the possibility of the tax authority overestimating income  $I$ . As a result, in our model, the taxpayer is not only confronted with the  $p$  probability of audit but also the  $q$  probability that the tax authority will overestimate their income  $I$ . The size of the overestimation of  $I$  is  $\alpha I$ .<sup>27</sup>

**A.1.1. Expectation value of the utility function**

The expectation value of the utility function is

$$EU = (1 - p)U(X) + p[qU(Y) + (1 - q)U(Z)],$$

where

$$\begin{aligned} X &= I - tR, \\ Y &= I - tR - tf[(1 + \alpha)I - R], \\ Z &= I - tR - tf[I - R]. \end{aligned}$$

Where, similar to Allingham and Sandmo (1972)  $p$  is the probability that a taxpayer gets audited  $[0, 1]$ , and  $U(X)$  and  $U(Z)$  are the utility a taxpayer has when they are not audited, and when they are correctly audited, respectively. We extend our model with  $U(Y)$  which occurs with probability  $p * q [0,1]$ , which is identical to  $U(Z)$  except for the overestimation  $\alpha [0,1]$  of income  $I$  by the tax authority. In expectation,  $U(Y)$  takes place with the compound probability of  $(p * q)$ . For simplicity we only discuss the scenario of a risk averse tax payer here.

**A.1.2. Probability of overestimation - $q$ - dependency**

The following steps show how the model predicts changes in optimal reporting behavior  $R_*$  with respect to the probability  $q$  of overestimation taking place. The derivative of the optimal value  $R_*$  with respect to  $q$ ,<sup>28</sup> i.e.

$$\dot{R} \equiv \frac{\partial R_*}{\partial q}$$

Where  $\dot{R}$  reflects the optimal reporting behavior given a change in  $q$  and *ceteris paribus* all other variables, including the size of the overestimation  $\alpha$ . Where  $\dot{R} \leq 0$  indicates that optimal reporting behavior will decrease as probability  $q$  increases, and  $\dot{R} > 0$  predicts the opposite.

The optimal value of EU as a function of  $R$  is obtained by

$$\left. \frac{\partial EU}{\partial R} \right|_{R=R_*} = 0 \tag{4}$$

Where  $R_*$  is the value of  $R$  that optimizes the utility function. The latter can be obtained from Eq. (4) as

$$-t(1 - p)U'(X_*) + pqt(f - 1)U'(Y_*) + p(1 - q)t(f - 1)U'(Z_*) = 0 \tag{5}$$

where  $X_* = X|_{R=R_*}$  for all parameters. Solving Eq. (5) informs us about the optimal reporting behavior  $R_*$ . We are interested in finding the sign of the derivative of  $R_*$  w.r.t.  $q$  to find  $\dot{R}$ . Let us derive (5) with respect to  $q$ . We expect optimal reporting behavior to be dependent on the probability of overestimation  $q$  hence  $(R = R(q))$  as long as  $\alpha \neq 0$ .

<sup>27</sup> The parameter use is similar to the Bernasconi and Bernhofer (2020), however in their case  $\beta(q)$  represents the effectiveness and can only take the value of either 0 or 1.

<sup>28</sup> An optimal solution  $x_*$  is a point in  $\Omega$  that satisfies:  $f(x_*) \geq f(x), \forall x \in \Omega$ . The optimal solution may not exist and may not be unique. However, given our assumption of the risk-averse taxpayer (see also Alm, 2019) we assume a concave utility function and thus have a unique solution for  $f(x_*) \geq f(x), \forall x \in \Omega$ .

$$t^2(1-p)U''(X_*)\dot{R} + pt(f-1)\left[U'(Y_*) + qt(f-1)U''(Y_*)\dot{R}\right] + pt(f-1)\left[-U'(Z_*) + (1-q)t(f-1)U''(Z_*)\dot{R}\right] = 0 \tag{6}$$

By rearranging, we find

$$\dot{R} = \frac{p(f-1)[U'(Z_*) - U'(Y_*)]}{(1-p)tU''(X_*) + pqt(f-1)^2U''(Y_*) + p(1-q)t(f-1)^2U''(Z_*)}, \tag{7}$$

where  $X_* = X|_{R=R_*}$  for all parameters. Since  $\alpha > 0$  if  $q > 0$  we have by definition  $U'(Z_*) \geq U'(Y_*)$ . Given our assumption of a risk averse tax payer,  $U'(X)$  is increasing and concave, we have by definition  $U''(Z_*) \leq U''(Y_*)$ .

All values  $(p, q, t, f - 1, I)$  are by definition positive, thus assuming concavity, we see that the numerator of Eq. (7) has the same (negative) sign as the denominator. That means  $\dot{R} > 0$ , the model thus predicts that an increase (decrease) in probability  $q$  of an audit with overestimation ( $\alpha > 0$ ) by the tax authority leads to an increase (decrease) of optimal taxpayer reporting behavior. A rational risk-averse taxpayer thus increases their tax reporting choice when faced with a higher probability of an audit that would overestimate their income. Because in the margins, it is optimal to increase reporting to minimize the fine given  $f > 1$

### A.1.3. Magnitude of overestimation - $\alpha$ -dependency

Additionally, we test the effect of an increase (decrease) in  $\alpha$ , the size of the audit overestimation. Similar to our hypothesis of  $q$  we are interested in how optimal reporting behavior  $R_*$  changes with respect to the size of the overestimation  $\alpha$ . We refer to  $R'$  as the derivative of the optimal value  $R_*$  with respect to  $\alpha$  (given  $q > 0$ ), i.e.

$$R' \equiv \frac{\partial R_*}{\partial \alpha}$$

Where  $R' < 0$  indicates that optimal reporting behavior will decrease as  $\alpha$  increases, and  $R' > 0$  predicts the opposite. Similar to the section above we base our analysis on Eq. (5) the optimal reporting behavior. Summarizing, we are interested in finding the sign of the derivative of  $R_*$  w.r.t.  $\alpha$ . Similar to the section above we derive Eq. (5) w.r.t.  $\alpha$  (and assume that  $R = R(\alpha)$  given  $q > 0$ ),

$$t^2(1-p)U''(X_*)R' + pqt^2(f-1)^2U''(Y_*)R' + p(1-q)t^2(f-1)^2U''(Z_*)R' = pqt^2f(f-1)U''(Y_*)I. \tag{8}$$

Rearranging  $R'$  gives

$$R' = \frac{pqt^2f(f-1)U''(Y_*)I}{t^2(1-p)U''(X_*) + pqt^2(f-1)^2U''(Y_*) + p(1-q)t^2(f-1)^2U''(Z_*)}, \tag{9}$$

where  $X_* = X|_{R=R_*}$ , for all parameters. Given our prior assumption of the risk averse tax payers, and given that all values  $(p, q, t, f - 1, I)$  are positive, we find that the numerator of Eq. (9) has the same sign as the denominator. This means  $R' > 0$  for all values of  $\alpha$  as long as  $\alpha$  happens with a positive probability  $q$ . Therefore we expect that a rational taxpayer will increase (decrease) tax reporting behavior as the size of the overestimation increases (decreases), under the assumptions of the extended economics of crime model.

### A.2. Portfolio model with behavioral considerations

The section above introduced an extension to the Allingham and Sandmo classic portfolio model of tax evasion. The following section introduces our alternative predictions incorporating behavioral considerations that might influence taxpayer behavior into the standard portfolio model with overestimation. The incorporation of behavioral considerations to the study of tax compliance in economics is not new (For a recent overview see: Alm, 2019; Mascagni, 2018; Kirchler and Wahl, 2010). We extend subsection 3.1 to include a non-monetary behavioral element that drives taxpayer behavior. This element groups the behavioral considerations and enters the expected utility of the portfolio model as a dis-utility.<sup>29</sup> To some extent, we could interpret this element as an “overestimation aversion” whereby the behavioral responses enter the expected utility calculations of the individual. To model this we include an element  $B$  that captures the dis-utility that a taxpayer gets when the tax authority overestimates its income.<sup>30</sup> As a result, modifying the original model so it becomes:

$$EU_2 = (1-p)U'(X) + p\left[q(U'(Y) - U'(B)) + (1-q)U'(Z)\right],$$

where

$$X = I - tR,$$

<sup>29</sup> The incorporation of non-monetary considerations to tax compliance is not new, for example, Sandmo (2005) proposes to incorporate the dis-utility individuals have from evading into the portfolio model.

<sup>30</sup> We make no assumptions on which behavioral driver is at play, as  $B$  captures different dis-utility factors that all have similar predictions in terms of modeling.

$$Y = I - tR - tf[(1 + \alpha)I - R],$$

$$Z = I - tR - tf[I - R],$$

$$B = B(R, I)$$

where  $B > 0$  is the behavioral (dis)utility agents get from being mistaken on. We assume that  $B = B(R, I)$ , in that the dis-utility is dependent on both optimal reporting and allocated income. We impose this dependency, since we work under the assumption that the experienced dis-utility is dependent on reporting behavior, such that the dis-utility might not be the same for a completely honest individual as for an individual who has not complied. Similarly, we include the dependency on  $I$  since  $\alpha$  is a percentage of  $I$ . Thus the dis-utility is a function of being audited and overestimated. We assume that the following relationships hold:

1.  $\frac{\partial B}{\partial R} = \Gamma > 0$ ; if  $R$  increases  $B$  increases
2.  $\frac{\partial \Gamma}{\partial q} = \dot{\Gamma} > 0$ ; if  $q$  increases  $\Gamma$  increases
3.  $\frac{\partial \Gamma}{\partial \alpha} = \Gamma' > 0$ ; if  $\alpha$  increases  $\Gamma$  increases

Where  $\Gamma$  is the renaming of the derivative for the remainder of this chapter. The first relationship rests on our assumption that an honest taxpayer that reports all of their income, could potentially feel a “larger dis-utility” when being treated unfairly. Our second and third relationships hold given that we assume  $R = R(q)$  and  $R = R(\alpha)$  (see also A.1.3). Thus, the reporting behavior changes with  $q$  and  $\alpha$ , similarly it is a reasonable assumption to presume that the dis-utility of mistakes increases when either the probability or size of the overestimation increases. The next section will show the predictions of the model for our alternative hypothesis. In section 4 we will describe the experimental design that will test which of the 2 suggested models best predicts taxpayer behavior.

### A.3. Alternative $q$ dependency

Similar to the traditional model, we use the expected utility model and first predict optimal reporting behavior  $R_2^*$ . Thereafter we will calculate how optimal reporting behavior  $R_2^*$  will change with respect to changes in  $q$  probability of overestimation and  $\alpha$  the extent of the overestimation. The optimal value of  $EU_2$  as a function of  $R$  is obtained doing

$$\left. \frac{\partial EU_2}{\partial R} \right|_{R=R_2^*} = 0, \tag{10}$$

where  $R_2^*$  is the value of  $R$  that optimizes the utility function. Assuming that  $U'(B)$  is increasing in  $R$ , performing the differentiation yields:

$$-t(1 - p)U'(X_*) + pqt(f - 1)U'(Y_*) + p(1 - q)t(f - 1)U'(Z_*) - pqU'(B_*)\Gamma = 0 \tag{11}$$

where  $X_2^* = X|_{R=R_2^*}$  for all parameters, and  $\Gamma = \frac{\partial B}{\partial R}$ . Similar to Eq. (7), let us derive Eq. (11) w.r.t.  $q$  (given  $R = R(q)$ ), since this will predict how tax payer behavior will change as a response to a change in the probability  $q$  of an audit with overestimation  $\alpha > 0$ . However, in this alternative model we also include the behavioral dis-utility  $B$  from an increase in probability  $q$  rather than solely the monetary utility that is included in the traditional portfolio model.

$$\begin{aligned} & t^2(1 - p)U''(X_*)\dot{R} + pt(f - 1)[U'(Y_*) + qt(f - 1)U''(Y_*)\dot{R}] \\ & - pq[U^2U''(B_*)\dot{R} + U'(B_*)\dot{\Gamma}] - p\Gamma U'(B_*) \\ & + pt(f - 1)[-U'(Z_*) + (1 - q)t(f - 1)U''(Z_*)\dot{R}] = 0 \end{aligned} \tag{12}$$

where  $X_2^* = X|_{R=R_2^*}$  for all parameters,  $\dot{R} = \frac{\partial R}{\partial q}$  and  $\dot{\Gamma} = \frac{\partial \Gamma}{\partial q}$

Rearranging leads to:

$$\dot{R} = \frac{p(f - 1)[U'(Z_*) - U'(Y_*)] + p\Gamma U'(B_*) + pqU'(B_*)\dot{\Gamma}}{(1 - p)tU''(X_*) + pqt(f - 1)^2U''(Y_*) + p(1 - q)t(f - 1)^2U''(Z_*) - pq\Gamma^2U''(B_*)}. \tag{13}$$

Given positive ( $p, f, q$ ) and the assumption that  $U'(B)$  is increasing in  $R$ , the numerator is negative given:

$$(f - 1)[U'(Z_*) - U'(Y_*)] > \Gamma U'(B_*) + qU'(B_*)\dot{\Gamma}, \tag{14}$$

and positive otherwise.

With respect to the denominator, the sign depends on the taxpayers' utility function of  $B$ . We do so for a risk-averse taxpayer and we look at 3 scenarios, if we assume that functional form of  $U''(B_*)$  is:

- **linear**: the denominator is always negative

- **convex**: the denominator is always negative
- **concave**: the denominator is negative if:

$$(1 - p)tU''(X_*) + pqt(f - 1)^2U''(Y_*) + p(1 - q)t^2(f - 1)^2U''(Z_*) > pq\Gamma^2U''(B_*), \tag{15}$$

else positive

We will test these assumptions in the experimental design. Intuitively, whether the taxpayer will increase or decrease tax reporting behavior depends on which of the contributions (“economic” vs “behavioral”) of the previous equations are stronger, and on the functional form of the utility function of the taxpayer.

#### A.4. Alternative $\alpha$ dependency

Following exactly the same procedure, denoting this time  $R' \equiv \partial R / \partial \alpha$ , we build on the alternative optimal reporting model of  $R_*$  in Eq. (11) and take the derivative w.r.t.  $\alpha$  (given  $R = R(\alpha)$ ).

$$t^2(1 - p)U''(X_*)R' + pqt^2(f - 1)^2U''(Y_*)R' + p(1 - q)t^2(f - 1)^2U''(Z_*)R' - pqt^2f(f - 1)U''(Y_*)I - pqU''(B_*)\Gamma^2R' - pqU'(B_*)\Gamma' = 0 \tag{16}$$

where  $X_2^* = X|_{R=R_2^*}$  for all parameters,  $R' = \frac{\partial R}{\partial \alpha}$  and  $\Gamma' = \frac{\partial \Gamma}{\partial \alpha}$ .

Rearranging leads to:

$$R' = \frac{pqt^2f(f - 1)U''(Y_*)I + pqU'(B_*)\Gamma'}{t^2(1 - p)U''(X_*) + pqt^2(f - 1)^2U''(Y_*) + p(1 - q)t^2(f - 1)^2U''(Z_*) - pq\Gamma^2U''(B_*)}. \tag{17}$$

Given the assumption of  $U''(B_*) > 0$  and  $\Gamma' > 0$  the numerator is negative given:

$$pqt^2f(f - 1)U''(Y_*)I > pqU'(B_*)\Gamma', \tag{18}$$

else positive.

As with respect to the denominator, all values ( $p, q, t, f - 1, I$ ) are positive ( $\Gamma^2$  by definition also always positive). Similarly to the dependency on  $q$  we make no assumptions on the functional form of  $U'(B)$  and consider the three most common utility shapes.

If we assume that functional form of  $U''(B_*)$  is:

- **linear**: the denominator is always negative
- **convex**: the denominator is always negative
- **concave**: the denominator is negative given

$$t^2(1 - p)U''(X_*) + pqt^2(f - 1)^2U''(Y_*) + p(1 - q)t^2(f - 1)^2U''(Z_*) > pq\Gamma^2U''(B_*), \tag{19}$$

else positive

Similar to the case of  $q$ , taxpayer behavior will be determined by which contributions of the previous equation are stronger and the functional form of the utility function of  $B$ . For the Hypothesis development of (H1c) We do not make any assumptions on the functional form of the taxpayer’s reporting function  $B$ , we assume that the situation of [negative numerator & positive denominator] or [positive numerator & negative denominator] is least likely and therefore we expect opposite predictions of the alternative model. However, if we do see a ‘rational’ increase in taxpayer compliance – in line with the portfolio model –, we cannot entirely rule out that behavioral factors affect compliance choices, because we disregard the functional form of  $B$ .

## Appendix B. Complete output

### B.1. Sample characteristics

**Table 6**  
General characteristics of sample.

| Variable          | Categories    | N <sup>o</sup> | Percent |
|-------------------|---------------|----------------|---------|
| <i>Gender</i>     | Female        | 253            | 50.50%  |
|                   | Male          | 240            | 47.90%  |
|                   | Other         | 8              | 1.60%   |
| <i>Occupation</i> | Employed      | 262            | 52.30%  |
|                   | Self-employed | 57             | 11.38%  |
|                   | Student       | 42             | 8.38%   |

**Table 6** (continued)

| Variable               | Categories          | N°  | Percent |
|------------------------|---------------------|-----|---------|
|                        | Unemployed          | 50  | 9.98%   |
|                        | Other               | 90  | 17.96%  |
| <i>Education</i>       | High-school         | 108 | 21.56%  |
|                        | Vocational training | 89  | 17.76%  |
|                        | Bachelor            | 210 | 41.92%  |
|                        | Masters             | 65  | 12.97%  |
|                        | PhD                 | 15  | 2.99%   |
|                        | Other               | 14  | 2.79%   |
| <i>Income</i>          | 0-1500 GBP          | 220 | 43.91%  |
|                        | 1501-3000 GBP       | 174 | 34.73%  |
|                        | 3001-5000 GBP       | 54  | 10.78%  |
|                        | ≥ 5000 GBP          | 31  | 6.20%   |
|                        | I don't know        | 22  | 4.39%   |
| <i>Region of birth</i> | Africa              | 9   | 1.83%   |
|                        | Americas            | 13  | 2.64%   |
|                        | Asia                | 25  | 5.08%   |
|                        | Europe              | 33  | 6.71%   |
|                        | Oceania             | 1   | 0.20%   |
|                        | United Kingdom      | 411 | 83.54%  |
| <i>Ethnicity</i>       | Asian               | 43  | 8.74%   |
|                        | Black               | 25  | 5.08%   |
|                        | Mixed               | 16  | 3.25%   |
|                        | White               | 395 | 80.28%  |
|                        | Other <sup>1</sup>  | 13  | 2.64%   |

<sup>1</sup> Other includes any other ethnicity and Arab.

**B.2. Summary statistics**

**Table 7**

Summary statistics.

|                               | mean  | sd    | min   | max   |
|-------------------------------|-------|-------|-------|-------|
| compliance rate               | 0.79  | 0.31  | 0.00  | 1.00  |
| received gross income         | 24.93 | 2.87  | 20.00 | 29.90 |
| probability of overestimation | 0.26  | 0.22  | 0.00  | 0.50  |
| magnitude of overestimation   | 0.21  | 0.21  | 0.00  | 0.50  |
| audit                         | 0.41  | 0.49  | 0.00  | 1.00  |
| age                           | 44.63 | 15.11 | 18.00 | 76.00 |
| gender                        | 1.51  | 0.53  | 1.00  | 3.00  |
| education                     | 2.66  | 1.20  | 1.00  | 6.00  |
| experience                    | 2.45  | 0.60  | 1.00  | 3.00  |
| risk aversion                 | 4.07  | 2.23  | 1.00  | 9.00  |
| tax morale                    | 1.98  | 1.65  | 1.00  | 9.00  |
| perception of fairness        | 5.39  | 2.08  | 1.00  | 9.00  |

**Table 8**

Average compliance per type.

|                  | Percentage of sample | Mean compliance | sd     |
|------------------|----------------------|-----------------|--------|
| Fully honest     | 17.17%               | 1.0000          | 0.0000 |
| Sometimes honest | 68.06%               | 0.8031          | 0.2964 |
| Never honest     | 14.77%               | 0.4616          | 0.3085 |

**Table 9**

Type of contributions per person.

| Per person consistent contributions |       |
|-------------------------------------|-------|
| Never any contribution              | 0.4   |
| Switching                           | 82.43 |
| Always full contribution            | 17.17 |

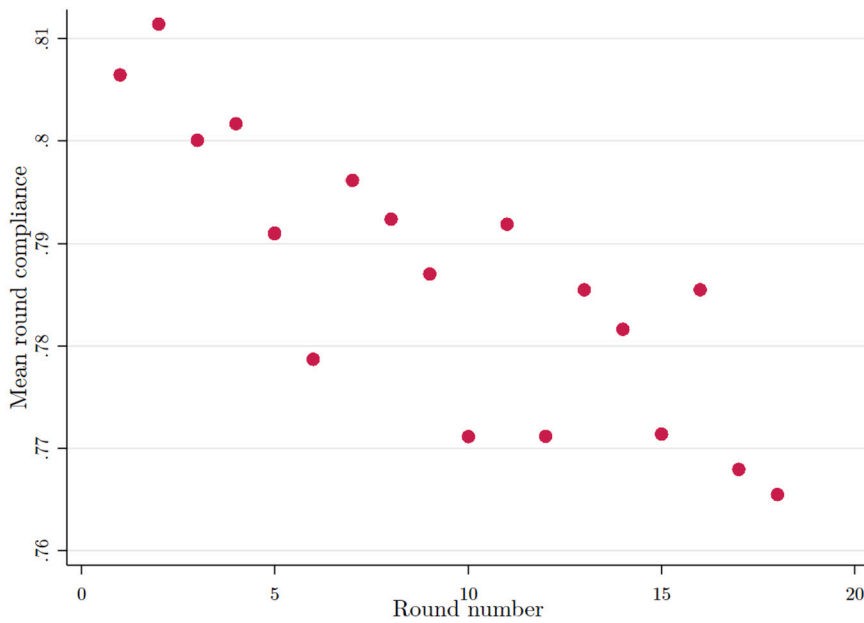


Fig. 3. Average compliance per round.

B.3. Extended models H1

Table 10  
The effect of the probability and magnitude of overestimation on tax compliance – demographic variables.

|                       | (1)                 | (2)                    | (3)                 | (4)                    | (5)                 | (6)                    |
|-----------------------|---------------------|------------------------|---------------------|------------------------|---------------------|------------------------|
| $q * \alpha = 0$      | ref                 | ref                    |                     |                        |                     |                        |
| $q * \alpha = .01$    | 0.0305***<br>(4.25) | 0.0301***<br>(4.20)    |                     |                        |                     |                        |
| $q * \alpha = .05$    | 0.0374***<br>(6.50) | 0.0374***<br>(6.51)    |                     |                        |                     |                        |
| $q * \alpha = .25$    | 0.0417***<br>(5.80) | 0.0416***<br>(5.80)    |                     |                        |                     |                        |
| gender                |                     | -0.0578**<br>(-2.89)   |                     | -0.0578**<br>(-2.89)   |                     | -0.0591**<br>(-2.99)   |
| education             |                     | 0.00916<br>(1.04)      |                     | 0.00916<br>(1.04)      |                     | 0.0106<br>(1.22)       |
| income                |                     | -0.0114<br>(-1.16)     |                     | -0.0114<br>(-1.16)     |                     | -0.00893<br>(-0.92)    |
| age                   |                     | 0.00178**<br>(2.58)    |                     | 0.00178**<br>(2.58)    |                     | 0.00159*<br>(2.33)     |
| round                 |                     | -0.00212***<br>(-4.96) |                     | -0.00213***<br>(-4.99) |                     | -0.00219***<br>(-4.73) |
| received gross income |                     | -0.000462<br>(-0.58)   |                     | -0.000448<br>(-0.56)   |                     | -0.000102<br>(-0.12)   |
| $q = 0$               |                     |                        | ref                 | ref                    |                     |                        |
| $q = .1$              |                     |                        | 0.0277***<br>(4.57) | 0.0274***<br>(4.53)    | ref                 | ref                    |
| $q = .5$              |                     |                        | 0.0437***<br>(7.59) | 0.0438***<br>(7.61)    | 0.0154**<br>(3.18)  | 0.0158**<br>(3.26)     |
| $\alpha = .1$         |                     |                        |                     |                        | ref                 | ref                    |
| $\alpha = .5$         |                     |                        |                     |                        | -0.00426<br>(-0.88) | -0.00431<br>(-0.89)    |
| Constant              | 0.758***<br>(67.01) | 0.795***<br>(14.15)    | 0.758***<br>(67.02) | 0.795***<br>(14.15)    | 0.788***<br>(71.35) | 0.818***<br>(14.54)    |
| Observations          | 9018                | 9018                   | 9018                | 9018                   | 7014                | 7014                   |

t statistics in parentheses.  
\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

**Table 11**  
The effect of the probability and magnitude of overestimation on tax compliance – survey variables.

|   | (1)                   | (2)                   | (3)                   |
|---|-----------------------|-----------------------|-----------------------|
| $q * \alpha = 0$                            | ref                   |                       |                       |
| $q * \alpha = .01$                          | 0.0305***<br>(4.25)   |                       |                       |
| $q * \alpha = .05$                          | 0.0374***<br>(6.50)   |                       |                       |
| $q * \alpha = .25$                          | 0.0417***<br>(5.80)   |                       |                       |
| $q = 0$                                     |                       | ref                   |                       |
| $q = .1$                                    |                       | 0.0277***<br>(4.57)   | ref                   |
| $q = .5$                                    |                       | 0.0437***<br>(7.59)   | 0.0154**<br>(3.18)    |
| $\alpha = .1$                               |                       |                       | ref                   |
| $\alpha = .5$                               |                       |                       | -0.00426<br>(-0.88)   |
| experience                                  | 0.0147<br>(0.84)      | 0.0147<br>(0.84)      | 0.0147<br>(0.84)      |
| perception of fairness                      | 0.000159<br>(0.03)    | 0.000159<br>(0.03)    | 0.0000864<br>(0.02)   |
| risk aversion                               | -0.0186***<br>(-3.80) | -0.0186***<br>(-3.80) | -0.0168***<br>(-3.47) |
| tax morale                                  | 0.00270<br>(0.34)     | 0.00270<br>(0.34)     | 0.000114<br>(0.01)    |
| propensity to cheat                         | -0.00670<br>(-0.95)   | -0.00670<br>(-0.95)   | -0.00490<br>(-0.70)   |
| perception of HMRC                          | -0.00629<br>(-1.38)   | -0.00629<br>(-1.38)   | -0.00624<br>(-1.38)   |
| perception of value contribution to society | 0.00901<br>(1.88)     | 0.00901<br>(1.88)     | 0.00827<br>(1.74)     |
| Constant                                    | 0.785***<br>(11.70)   | 0.785***<br>(11.70)   | 0.814***<br>(12.22)   |
| Observations                                | 9018                  | 9018                  | 7014                  |

t statistics in parentheses.  
\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

B.4. Extended models H2

**Table 12**  
Post-audit effect on compliance of audit - demographics.

|                       | (1)                   | (2)                   | (3)                   | (4)                   | (5)                   |
|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| no audit              | ref                   | ref                   | ref                   |                       |                       |
| fair audit            | -0.0145*<br>(-2.12)   | -0.0145*<br>(-2.12)   | -0.0150*<br>(-2.18)   | ref                   |                       |
| unfair audit          | -0.0645***<br>(-6.21) | -0.0646***<br>(-6.21) | -0.0641***<br>(-6.17) | -0.144***<br>(-14.00) |                       |
| $\alpha = 0$          |                       |                       |                       |                       | ref                   |
| $\alpha = .1$         |                       |                       |                       |                       | -0.0759***<br>(-6.57) |
| $\alpha = .5$         |                       |                       |                       |                       | -0.301***<br>(-19.28) |
| gender                |                       | 0.000298<br>(0.05)    | 0.000281<br>(0.05)    | -0.0575***<br>(-5.42) | -0.0615***<br>(-5.59) |
| education             |                       | -0.000240<br>(-0.09)  | -0.000319<br>(-0.12)  | 0.00257<br>(0.55)     | 0.00309<br>(0.64)     |
| income                |                       | -0.000185<br>(-0.06)  | -0.000111<br>(-0.04)  | -0.0114*<br>(-2.18)   | -0.0132*<br>(-2.45)   |
| age                   |                       | -0.0000716<br>(-0.35) | -0.0000750<br>(-0.37) | 0.00118**<br>(3.27)   | 0.00134***<br>(3.56)  |
| received gross income |                       |                       | -0.00178<br>(-1.66)   | -0.00175<br>(-1.18)   | -0.00162<br>(-1.13)   |

(continued on next page)

Table 12 (continued)

|                          | (1)                | (2)              | (3)              | (4)                 | (5)                 |
|--------------------------|--------------------|------------------|------------------|---------------------|---------------------|
| $q * \alpha$             |                    |                  | 0.0641<br>(1.77) | 0.0945<br>(1.93)    | 0.0907<br>(1.91)    |
| last round relative fine |                    |                  |                  | 0.856***<br>(29.50) | 1.051***<br>(33.84) |
| Constant                 | 0.00866*<br>(2.17) | 0.0124<br>(0.79) | 0.0529<br>(1.69) | -0.0156<br>(-0.34)  | -0.0390<br>(-0.85)  |
| Observations             | 8517               | 8517             | 8517             | 3469                | 3469                |

t statistics in parentheses.

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

Table 13

Post-audit effect on compliance of audit – survey variables.

|   | (1)                   | (2)                   | (3)                    | (4)                   | (5)                   |
|---|-----------------------|-----------------------|------------------------|-----------------------|-----------------------|
| no audit                                    | ref                   | ref                   | ref                    |                       |                       |
| fair audit                                  | -0.0145*<br>(-2.12)   | -0.0146*<br>(-2.12)   | -0.0150*<br>(-2.18)    | ref                   |                       |
| unfair audit                                | -0.0645***<br>(-6.21) | -0.0646***<br>(-6.21) | -0.0641***<br>(-6.17)  | -0.147***<br>(-14.25) |                       |
| $\alpha = 0$                                |                       |                       |                        |                       | ref                   |
| $\alpha = .1$                               |                       |                       |                        |                       | -0.0763***<br>(-6.62) |
| $\alpha = .5$                               |                       |                       |                        |                       | -0.310***<br>(-19.78) |
| experience                                  |                       | -0.0000275<br>(-0.01) | -0.00000170<br>(-0.00) | 0.00486<br>(0.51)     | 0.00760<br>(0.77)     |
| perception of fairness                      |                       | 0.0000823<br>(0.05)   | 0.0000613<br>(0.04)    | 0.00121<br>(0.44)     | 0.000741<br>(0.26)    |
| risk aversion                               |                       | -0.000729<br>(-0.50)  | -0.000695<br>(-0.47)   | -0.0134***<br>(-5.04) | -0.0155***<br>(-5.61) |
| tax morale                                  |                       | 0.000601<br>(0.26)    | 0.000655<br>(0.28)     | 0.00226<br>(0.53)     | 0.00202<br>(0.46)     |
| propensity to cheat                         |                       | 0.000309<br>(0.15)    | 0.000267<br>(0.13)     | -0.00548<br>(-1.43)   | -0.00607<br>(-1.53)   |
| perception of HMRC                          |                       | 0.000113<br>(0.08)    | 0.0000954<br>(0.07)    | -0.00254<br>(-1.02)   | -0.00330<br>(-1.28)   |
| perception of value contribution to society |                       | -0.000205<br>(-0.14)  | -0.000183<br>(-0.13)   | 0.00355<br>(1.36)     | 0.00507<br>(1.87)     |
| received gross income                       |                       |                       | -0.00177<br>(-1.65)    | -0.00181<br>(-1.22)   | -0.00167<br>(-1.17)   |
| $q * \alpha$                                |                       |                       | 0.0642<br>(1.77)       | 0.104*<br>(2.12)      | 0.0992*<br>(2.10)     |
| last round relative fine                    |                       |                       |                        | 0.873***<br>(29.71)   | 1.078***<br>(34.23)   |
| Constant                                    | 0.00866*<br>(2.17)    | 0.0101<br>(0.50)      | 0.0499<br>(1.49)       | -0.0307<br>(-0.60)    | -0.0554<br>(-1.07)    |
| Observations                                | 8517                  | 8517                  | 8517                   | 3469                  | 3469                  |

t statistics in parentheses.

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

B.5. Robustness

B.5.1. Robustness H1

Table 14

The effect of the probability and magnitude of overestimation on tax compliance – without honest subsample.

|                    | (1) | (2)                 | (3) |
|--------------------|-----|---------------------|-----|
| $q * \alpha = 0$   |     | ref                 |     |
| $q * \alpha = .01$ |     | 0.0367***<br>(4.24) |     |
| $q * \alpha = .05$ |     | 0.0449***<br>(6.48) |     |
| $q * \alpha = .25$ |     | 0.0502***<br>(5.80) |     |

Table 14 (continued)

|               | (1)                 | (2)                 | (3)                 |
|---------------|---------------------|---------------------|---------------------|
| $q = 0$       |                     | ref                 |                     |
| $q = .1$      |                     | 0.0331***<br>(4.53) | ref                 |
| $q = .5$      |                     | 0.0527***<br>(7.60) | 0.0189**<br>(3.23)  |
| $\alpha = .1$ |                     |                     | ref                 |
| $\alpha = .5$ |                     |                     | -0.00537<br>(-0.92) |
| Constant      | 0.763***<br>(12.36) | 0.763***<br>(12.36) | 0.792***<br>(12.72) |
| Demographics  | YES                 | YES                 | YES                 |
| Observations  | 7470                | 7470                | 5810                |

t statistics in parentheses.

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

Table 15

The effect of the probability and magnitude of overestimation on tax compliance - fractional logit.

|                      | (1)                   | (2)                   | (3)                 |
|----------------------|-----------------------|-----------------------|---------------------|
| ATE                  |                       |                       |                     |
| $\alpha * q = .01$   | -0.0302***<br>(-3.99) |                       |                     |
| $\alpha * q = .05$   | -0.0374***<br>(-4.20) |                       |                     |
| $\alpha * q = .25$   | -0.0416**<br>(-3.27)  |                       |                     |
| $q = .1$             |                       | -0.0275***<br>(-3.56) |                     |
| $q = .5$             |                       | -0.0437***<br>(-4.24) |                     |
| $q = .5$ vs $q = .1$ |                       |                       | -0.0156*<br>(-2.21) |
| POmean               |                       |                       |                     |
| $q * \alpha = 0$     | 0.242***<br>(18.24)   |                       |                     |
| $q = 0$              |                       | 0.242***<br>(18.24)   |                     |
| $q = .5$ vs $q = .1$ |                       |                       | 0.214***<br>(18.66) |
| OME1                 |                       |                       |                     |
| $\alpha = .1$        |                       |                       | ref                 |
| $\alpha = .5$        |                       |                       | 0.0215<br>(0.44)    |
| OME0                 |                       |                       |                     |
| $\alpha = .1$        |                       |                       | ref                 |
| $\alpha = .5$        |                       |                       | 0.0325<br>(0.74)    |
| Observations         | 9018                  | 9018                  | 7014                |

t statistics in parentheses.

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

B.5.2. Robustness H2

Table 16

Post-audit effect on compliance of audit – without honest subsample.

|               | (1)                   | (2)                   | (3)                   | (4)                   | (5)                   |
|---------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| no audit      | ref                   | ref                   | ref                   |                       |                       |
| fair audit    | -0.0176*<br>(-2.12)   | -0.0175*<br>(-2.12)   | -0.0181*<br>(-2.19)   | ref                   |                       |
| unfair audit  | -0.0778***<br>(-6.21) | -0.0779***<br>(-6.21) | -0.0774***<br>(-6.17) | -0.161***<br>(-13.17) |                       |
| $\alpha = 0$  |                       |                       |                       |                       | ref                   |
| $\alpha = .1$ |                       |                       |                       |                       | -0.0834***<br>(-6.02) |
| $\alpha = .5$ |                       |                       |                       |                       | -0.324***             |

(continued on next page)

**Table 16** (continued)

|                | (1)     | (2)    | (3)      | (4)      | (5)      |
|----------------|---------|--------|----------|----------|----------|
| received gross |         |        | -0.00211 | -0.00179 | (-17.73) |
| income         |         |        | (-1.63)  | (-1.01)  | -0.00197 |
| $q * \alpha$   |         |        | 0.0781   | 0.118*   | (-1.15)  |
|                |         |        | (1.79)   | (2.01)   | 0.110    |
| last round     |         |        |          | 0.935*** | (1.94)   |
| relative fine  |         |        |          | (28.54)  | 1.117*** |
| Constant       | 0.0104* | 0.0152 | 0.0631   | -0.0347  | -0.0514  |
|                | (2.17)  | (0.82) | (1.68)   | (-0.64)  | (-0.95)  |
| Demographics   | NO      | YES    | YES      | YES      | YES      |
| Observations   | 7055    | 7055   | 7055     | 2866     | 2866     |

t statistics in parentheses.

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

**Table 17**

Post-audit effect on compliance of audit – only column 5 without compliant (in last round) tax reporters.

|                | (1)        |
|----------------|------------|
| no audit       |            |
| fair audit     |            |
| unfair audit   |            |
| $\alpha = 0$   | ref        |
| $\alpha = .1$  | -0.0789*** |
|                | (-4.70)    |
| $\alpha = .5$  | -0.270***  |
|                | (-11.95)   |
| gender         | -0.0485**  |
|                | (-2.60)    |
| education      | 0.00401    |
|                | (0.50)     |
| income         | -0.0131    |
|                | (-1.41)    |
| age            | 0.00109    |
|                | (1.69)     |
| round          | -0.00221   |
|                | (-1.90)    |
| last round     | 1.094***   |
| relative fine  | (23.36)    |
| received gross | -0.00181   |
| income         | (-0.89)    |
| $q * \alpha$   | 0.159*     |
|                | (2.34)     |
| Constant       | -0.0364    |
|                | (-0.51)    |
| Observations   | 1788       |

t statistics in parentheses.

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

**Table 18**

Post-audit effect on compliance of audit – ordered logit.

|                | (1)       | (2)       | (3)       | (4)       |
|----------------|-----------|-----------|-----------|-----------|
| main           |           |           |           |           |
| no audit       | ref       | ref       |           |           |
| fair audit     | -0.0147   | -0.0174   |           |           |
|                | (-0.33)   | (-0.39)   | ref       |           |
| unfair audit   | -0.265*** | -0.264*** | -0.801*** |           |
|                | (-3.91)   | (-3.90)   | (-9.13)   |           |
| $\alpha = 0$   |           |           |           | ref       |
| $\alpha = .1$  |           |           |           | -0.209*** |
|                |           |           |           | (-5.76)   |
| $\alpha = .5$  |           |           |           | -0.392*** |
|                |           |           |           | (-8.17)   |
| received gross |           | -0.0178*  | -0.0161   | -0.00551  |
| income         |           | (-2.57)   | (-1.37)   | (-1.23)   |

Table 18 (continued)

|                             | (1)                  | (2)                  | (3)                  | (4)                 |
|-----------------------------|----------------------|----------------------|----------------------|---------------------|
| $q * \alpha$                |                      | 0.0101<br>(0.04)     | 0.141<br>(0.36)      | 0.0305<br>(0.20)    |
| last round<br>relative fine |                      |                      | 4.666***<br>(13.76)  | 1.557***<br>(17.81) |
| Constant                    |                      |                      |                      | 0.121<br>(0.91)     |
| <hr/>                       |                      |                      |                      |                     |
| cut1                        |                      |                      |                      |                     |
| Constant                    | -0.847***<br>(-8.08) | -1.294***<br>(-6.33) | -1.283***<br>(-3.46) |                     |
| <hr/>                       |                      |                      |                      |                     |
| cut2                        |                      |                      |                      |                     |
| Constant                    | 0.713***<br>(6.82)   | 0.267<br>(1.31)      | 0.517<br>(1.40)      |                     |
| <hr/>                       |                      |                      |                      |                     |
| sigma2_u                    |                      |                      |                      |                     |
| Constant                    | 6.68e-37<br>(0.00)   | 3.04e-34<br>(0.00)   | 0.412***<br>(4.49)   |                     |
| Demographics                | YES                  | YES                  | YES                  | YES                 |
| Observations                | 8517                 | 8517                 | 3469                 | 3469                |

t statistics in parentheses.

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

B.6. Hurdle model

Table 19

The effect of the probability and magnitude of overestimation on tax compliance – twopm.

|                    | (1)                   | (2)                   | (3)                 |
|--------------------|-----------------------|-----------------------|---------------------|
| <hr/>              |                       |                       |                     |
| logit              |                       |                       |                     |
| $q * \alpha = 0$   | ref                   |                       |                     |
| $q * \alpha = .01$ | 0.187**<br>(2.71)     |                       |                     |
| $q * \alpha = .05$ | 0.170**<br>(3.08)     |                       |                     |
| $q * \alpha = .25$ | 0.0593<br>(0.86)      |                       |                     |
| $q = 0$            |                       | ref                   |                     |
| $q = .1$           |                       | 0.223***<br>(3.83)    | ref                 |
| $q = .5$           |                       | 0.0951<br>(1.72)      | -0.128**<br>(-2.60) |
| $\alpha = .1$      |                       |                       | ref                 |
| $\alpha = .5$      |                       |                       | 0.0000491<br>(0.00) |
| Constant           | -0.344<br>(-1.56)     | -0.346<br>(-1.57)     | -0.0763<br>(-0.31)  |
| <hr/>              |                       |                       |                     |
| regress            |                       |                       |                     |
| $q * \alpha = 0$   | ref                   |                       |                     |
| $q * \alpha = .01$ | -0.0974***<br>(-6.38) |                       |                     |
| $q * \alpha = .05$ | -0.107***<br>(-8.66)  |                       |                     |
| $q * \alpha = .25$ | -0.0943***<br>(-6.08) |                       |                     |
| $q = 0$            |                       | ref                   |                     |
| $q = .1$           |                       | -0.0986***<br>(-7.62) | ref                 |
| $q = .5$           |                       | -0.105***<br>(-8.47)  | -0.00560<br>(-0.53) |
| $\alpha = .1$      |                       |                       | ref                 |
| $\alpha = .5$      |                       |                       | 0.00810<br>(0.76)   |
| Constant           | 0.454***<br>(9.27)    | 0.456***<br>(9.30)    | 0.334***<br>(6.24)  |
| Demographics       | YES                   | YES                   | YES                 |
| Observations       | 9018                  | 9018                  | 7014                |

t statistics in parentheses.

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

B.7. Exploratory results

**Table 20**  
Behavioral motivations.

| Motivation                     | Percent |
|--------------------------------|---------|
| Honesty                        | 38.92%  |
| Contributing to the collective | 6.79%   |
| Avoiding fines                 | 32.93%  |
| Compensating                   | 15.17%  |
| Revenge                        | 1.20%   |
| Other                          | 4.9%    |
| Total                          | 100%    |

**Table 21**  
Behavioral motivations merged.

| Motivation merged | Percent |
|-------------------|---------|
| Honesty           | 45.71%  |
| Avoiding fines    | 32.93%  |
| Compensating      | 16.37%  |
| Other             | 4.99%   |
| Total             | 100%    |

**Table 22**  
Composition of tertiles per motivation.

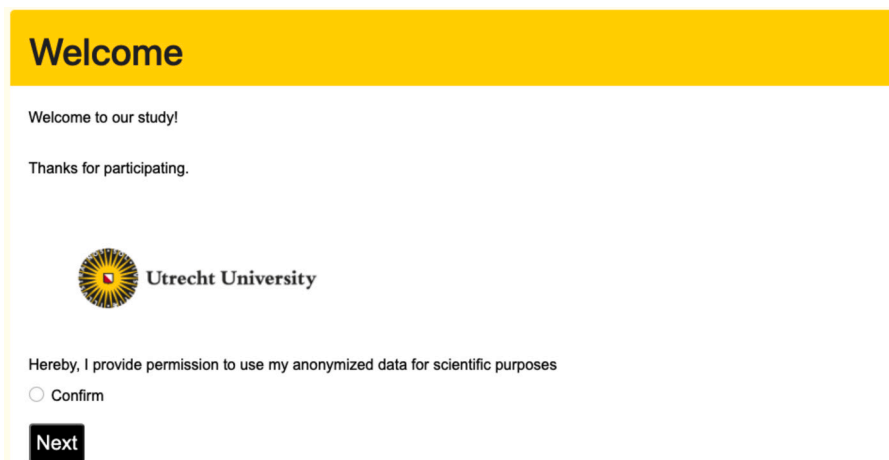
|                | pct top tertile | pct medium tertile | pct bottom tertile |
|----------------|-----------------|--------------------|--------------------|
| Honesty        | 57.20524        | 21.21212           | 6.097561           |
| Fine avoidance | 17.46725        | 44.84848           | 42.68293           |
| Compensating   | 25.32751        | 33.93939           | 51.21951           |
| Total          | 100             | 100                | 100                |

**Appendix C. Online experiment**

The following appendix contains the instructions of the experiment written out, the flow of the experiment and screenshots of how it looked for the participants.

*C.1. Welcome*

The experiment starts once participants have pressed the link through the Prolific website, then they are redirected to a welcome slide in order to provide their informed consent. (See Fig. 4.)



**Fig. 4.** Welcome to the study.

## C.2. Instructions

The instructions were separated and displayed in two screens, the first screen focused on the facts of the study that remained constant (see Fig. 5), the second on those that change in every round (see Fig. 6). At the end we invite participants to practice in three trial rounds.

**Instructions**

This study looks at tax reporting behavior and consists of several rounds of tax declarations. Before you start declaring your taxes, please go over the following instructions carefully. After reading the instructions you will play 3 practice rounds that do not count towards your payoff. First we will explain the conditions that stay the same over the entire study (in all tax declarations):

- In every round you receive a gross income of on average 25000 ECU (Experimental Currency Units), only you know your gross income.
- For your final reward the first 300000 ECU equal **£1,80 (guaranteed reward)**. All ECU's earned above 300000 will be converted into pounds with a rate of **65134,3 ECU = 1£ (bonus reward)**.
- In each round you must file a tax declaration in which you declare your income to a virtual tax authority. You can declare any share of your gross income between **0 ECU and the actual amount you received**.
- The income you declare is taxed at a rate of 25% (This means that for every **1000 ECU you declare, you pay 250 ECU in tax**). The tax will be deducted from your income. Thus, if you declare 1000 ECU, you are left with 750 ECU.
- The virtual tax authority will **randomly** audit 40% (40 out of 100) of the tax declarations of taxpayers, to inspect their tax declarations.

**Next**

Fig. 5. Instructions 1.

This study looks at tax reporting behavior and consists of several rounds of tax declarations. Before you start declaring your taxes, please go over the following instructions carefully. After reading the instructions you will play 3 practice rounds that do not count towards your payoff. First we will explain the conditions that stay the same over the entire study (in all tax declarations):

- In every round you receive a gross income of on average 25000 ECU (Experimental Currency Units), only you know your gross income.
- For your final reward the first 300000 ECU equal £1,80 (guaranteed reward). All ECU's earned above 300000 will be converted into pounds with a rate of 65134,3 ECU = 1£ (bonus reward).
- In each round you must file a tax declaration in which you declare your income to a virtual tax authority. You can declare any share of your gross income between 0 ECU and the actual amount you received.
- The income you declare is taxed at a rate of 25% (This means that for every 1000 ECU you declare, you pay 250 ECU in tax). The tax will be deducted from your income. Thus, if you declare 1000 ECU, you are left with 750 ECU.
- The virtual tax authority will randomly audit 40% (40 out of 100) of the tax declarations of taxpayers, to inspect their tax declarations.

Below we explain the conditions that change in every round of tax declarations.

- If you are audited, the virtual tax authority independently estimates your income and compares it with the amount in your declaration. If your reported income does not match the estimation of the tax authority, you will pay a fine.
- However, the tax authority sometimes makes a mistake and overestimates your true gross-income by a certain percentage. For example, if your true gross-income is 20000 ECU and the tax authority overestimates your income by 10%, then your estimated income is 22000 ECU.
- You will always be informed of the probability of the tax authority overestimating your income.
- The tax authority will make you pay the taxes on your unreported income. Plus a fine of 1 ECU for each ECU of underpaid tax. If you did not report 1000 ECU, you will have to pay 250 ECU in tax for the 1000 you did not report, plus (+) a fine of the same (250 ECU) amount.
- If your income is overestimated, the additional tax payment and fine will be based on the income that the tax authority estimates.
- If you are not audited, your earnings will be equal to the amount of income minus the tax on the income you declared (25% of declared income).
- What you earn in each round will be added to your final reward. Your final payment is the sum of the income earned in each round plus (+) the guaranteed reward.

To start the 3 practice rounds, click “next”. These rounds do not count towards your final payoff!

## Instructions II

Below we explain the conditions that change in every round of tax declarations.

- If you are audited, the virtual tax authority independently estimates your income and compares it with the amount in your declaration. If your reported income does not match the estimation of the tax authority, you will pay a fine.
- **However**, the tax authority sometimes makes a mistake and **overestimates your true gross-income by a certain percentage**. For example, if your true gross-income is 20000 ECU and the tax authority overestimates your income by 10%, then your estimated income is 22000 ECU.
- You will always be informed of the probability of the tax authority overestimating your income.
- The tax authority will make you pay the taxes on your unreported income. Plus a **fine** of 1 ECU for each ECU of underpaid tax. If you did not report 1000 ECU, you will have to pay 250 ECU in tax for the 1000 you did not report, plus (+) a fine of the **same** (250 ECU) amount.
- If your income is overestimated, the additional tax payment and fine will be based on the income that the tax authority estimates.
- If you are not audited, your earnings will be equal to the amount of income minus the tax on the income you declared (25% of declared income).
- What you earn in each round will be added to your final reward. Your final payment is **the sum of the income earned in each round plus (+) the guaranteed reward**.

To start the 3 practice rounds, click "next". These rounds **do not** count towards your final payoff!

Next

Fig. 6. Instructions 2.

### C.3. Tax declarations

The tax declarations and their results were identical in form through out the study. Participants first encountered them in the practice rounds. The tax declaration starts by explaining the elements that are specific to the round followed by those that are constant in lighter gray. The slider and the calculator table below it are dynamic and allow the participant to see the changes in ECU for all the different scenarios (*audit, audit and over-estimation, no audit*) depending on how many ECU she declares. (See Fig. 7.)

### Sample Tax Declaration

In **this** tax declaration:

- Your gross-income is **20500** ECU.
- **Probability** that tax authority will overestimate income: **10%**
- The **size** of the overestimation: **50%**

Move the slider below to choose the amount of income (ECU) you want to report to the virtual tax authority. **The income you declare makes a difference for your bonus payment**. The calculation table below tells you the possible outcomes of your decision and how likely they are to happen. When you're done, click "Next".

Recall that in **every** tax declaration:

- Tax rate: 25%
- Probability you are audited: 40%
- Fine if audited: taxes owed + 1 ECU fine per undeclared ECU

|                           |  |  |
|---------------------------|--|--|
|                           | Your taxable income would be:  |  |
|                           | You would pay in taxes:  |  |
| <b>This situation is:</b> | If mistaken, the overestimated income would be:  |  |
| 60% likely                | In case of no audit, your after-tax income is:   |  |
| 36% likely                | In case of an audit, your after-tax income is:   |  |
| 4% likely                 | In case of an audit where the tax authority overestimates your income, your after-tax income is: |  |

Next

Fig. 7. Sample Tax Declaration.

In this tax declaration:

- Your gross-income is 20500 ECU.
- Probability that tax authority will overestimate income: 10%
- The size of the overestimation: 50%

Move the slider below to choose the amount of income (ECU) you want to report to the virtual tax authority. The income you declare makes a difference for your bonus payment. The calculation table below tells you the possible outcomes of your decision and how likely they are to happen. When you're done, click "Next". Recall that in every tax declaration:

- Tax rate: 25%
- Probability you are audited: 40%
- Fine if audited: taxes owed + 1 ECU fine per undeclared ECU

#### C.4. Audit wait

After filling a tax declaration a participant must wait 5 seconds in the trial rounds and 3 seconds in the eighteen incentivized rounds before they get the results of the audit. The wait screen shows the time of filling in a similar language to that of HMRC and mentions the virtual tax authority explicitly. (See Fig. 8.)

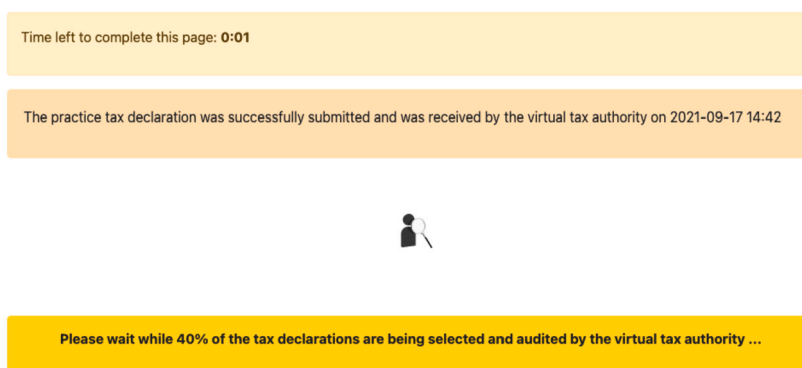


Fig. 8. Waiting screen.

Time left to complete this page mm:ss The (practice) tax declaration was successfully submitted and was received by the virtual tax authority on yyyy-mm-dd hh:mm

#### C.5. Audit results

After the participants fill their tax declarations and have waited 3-5 seconds they get the results of their audit. In these results participants get informed if they were audited, audited and overestimated, or audited and not overestimated. They also get a detailed chart with their gross income, the income estimated by the tax authority, the overestimation if it applies, the taxes paid and their reason, the fines paid and their reason, and finally the end of round income. Below we show the three possible results. (See Figs. 9–11.)

You were audited in this round.

- The tax authority did not overestimated your income.
- Income you declared: 10800 ECU
- Income in this round after filed taxes: 12950.00 ECU

#### C.6. Checking understanding

After the trial rounds, we checked if participants understood the game setup by asking them two questions. (See Fig. 12.) If participants failed to answer correctly they were pointed to a fourth practice round. (See Fig. 13.) All participants had a “fresh-up” of the instructions before starting the official rounds. (See Fig. 14.)

Please answer the questions below to proceed to the paid rounds of tax declarations in the study.

1. If the audit probability is 40%.... [pick number in dropdown menu] in 100 declarations are expected to be audited.

**Correct Answer:** 40



- You were **not** audited in this round.
- Income you declared: **6900 ECU** .
- Income in this round after filed taxes: 25275.00 ECU.

Below you can find how your tax declaration has been handled by the virtual tax authority.

|   |                                 |
|---|---------------------------------|
| Selected by tax authority for audit?                                      | no                              |
| Gross-income  | 27000                           |
| Income overestimated by tax authority?                                    | no                              |
| <b>Overestimation</b> by tax authority                                    | not applicable when not audited |
| <b>Estimated</b> income by tax authority                                  | not applicable when not audited |
|   |                                 |
| Taxes paid on declared income   | - 1725                          |
| Additional <b>tax</b> and <b>fine</b> due to underreporting               | not applicable when not audited |
| Additional <b>tax</b> and <b>fine</b> due to overestimation               | not applicable when not audited |
|   |                                 |
| <b>End of round income = gross-income -(additional) taxes &amp; fines</b> | <b>25275.00 ECU</b>             |

Next

Fig. 9. Results when not audited.

### Result tax declaration

- You were **audited** in this round.
- The tax authority **overestimated** your income by **2170.00 ECU**.
- Income you declared: **9200.00 ECU** .
- Income in this round after filed taxes: 12065.00 ECU.

Below you can find how your tax declaration has been handled by the virtual tax authority.

|   |                     |
|---|---------------------|
| Selected by tax authority for audit?                                      | yes                 |
| Gross-income  | 21700.00            |
| Income overestimated by tax authority?                                    | yes                 |
| <b>Overestimation</b> by tax authority                                    | + 2170.00           |
| <b>Estimated</b> income by tax authority                                  | = 23870.00          |
|   |                     |
| Taxes paid on declared income   | - 2300.00           |
| Additional <b>tax</b> and <b>fine</b> due to underreporting               | - 6250.00           |
| Additional <b>tax</b> and <b>fine</b> due to overestimation               | - 1085.00           |
|   |                     |
| <b>End of round income = gross-income -(additional) taxes &amp; fines</b> | <b>12065.00 ECU</b> |

Next

Fig. 10. Results when audited and overestimated.

2. If you earned an income of 1000 and the tax authority says you made 1050 they overestimated your income [Drpdown: true, false]

**Correct Answer: true**

Unfortunately you answered question 1 and 2 incorrect.

The correct answer to question 1) is 40. If there is a 40% chance that you will be audited, it means that 40 out of 100 tax returns are audited by the tax authority.

The correct answer to question 2) is True. To estimate means to try to accurately guess a value or quantity. When the tax authority estimates your income it is trying to accurately determine YOUR income based on their own information. Overestimation refers to the tax authority thinking you made more money than you actually did. For example, if you made 10000 ECU, the tax authority can by mistake think you made 10500.

Before you move forward we ask you to do another practice round below.

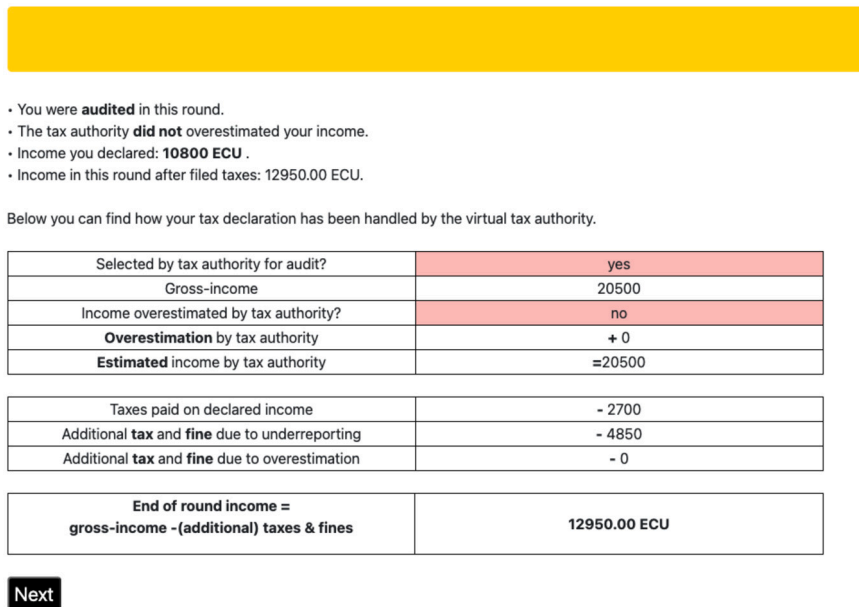


Fig. 11. Result when audited and not overestimated.

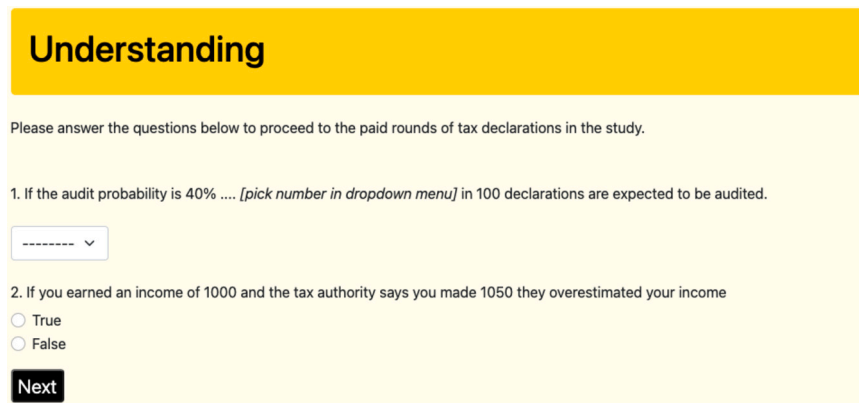


Fig. 12. Comprehension/Understanding of the experiment.

The practice rounds are now finalized. Please read the following summary of the instructions, to proceed to the paid rounds of tax declarations.

- The tax rate of 25% and the audit rate of 40% are the same in all rounds. This means that for every 1000 ECU you declare, you pay 250 ECU in tax, and that 40 out of 100 tax declarations will be audited.
- Remember: there are 3 possible outcomes for each round: (1) No audit, (2) Audit without overestimation, (3) Audit with overestimation.
- Your income, the probability of the tax authority overestimating your income and the extent to which this happens can vary every round of tax declarations and will always be communicated. After every round you will be informed whether your tax declaration has been audited and what the result of this audit is.
- If at any moment you want to reread the instructions, you can find them by clicking on a button at the bottom of each page.
- The official study will take between 15 and 21 rounds of tax declarations, followed by a short questionnaire.

C.7. End of experiment

Once participants have completed eighteen rounds of declarations they are forwarded to the demographics and final questionnaire. (See Fig. 15.)

### Extra practice tax declaration 4

Unfortunately you answered question **1 and 2 incorrect**.

The **correct** answer to question 1) is 40. If there is a 40% chance that you will be audited, it means that 40 out of 100 tax returns are audited by the tax authority

The **correct** answer to question 2) is True. To estimate means to try to accurately guess a value or quantity. When the tax authority estimates your income it is trying to accurately determine YOUR income based on their own information. Overestimation refers to the tax authority thinking you made more money than you actually did. For example, if you made 10000 ECU, the tax authority can by mistake think you made 10500.

Before you move forward we ask you to do another practice round below.

In **this** tax declaration:

- Your gross-income is **27000** ECU.
- **Probability** that tax authority will overestimate income: **0%**
- The **size** of the overestimation: **0%**

Move the slider below to choose the amount of income (ECU) you want to report to the virtual tax authority. **The income you declare makes a difference for your additional payoff**. The calculation table below tells you the possible outcomes of your decision and how likely they are to happen. When you're done, click "Next".

Recall that in **every** tax declaration:

- Tax rate: **25%**
- Probability you are audited: **40%**
- Fine if audited: taxes owed + **1 ECU** fine per undeclared ECU

Fig. 13. Additional practice round.

### Summary of practice rounds

The practice rounds are now finalized. Please read the following summary of the instructions, to proceed to the paid rounds of tax declarations.

- The tax rate of **25%** and the audit rate of **40%** are the same in all rounds. This means that for every **1000 ECU you declare, you pay 250 ECU** in tax, and that **40 out of 100** tax declarations will be audited.
- Remember: there are 3 possible outcomes for each round: **(1) No audit, (2) Audit without overestimation, (3) Audit with overestimation**.
- Your income, the probability of the tax authority overestimating your income and the extent to which this happens can vary every round of tax declarations and will always be communicated. After every round you will be informed whether your tax declaration has been audited and what the result of this audit is.
- If at any moment you want to reread the instructions, you can find them by clicking on a button at the bottom of each page.
- The official study will take between **15 and 21 rounds of tax declarations**, followed by a short questionnaire.

Next

Fig. 14. Summary of practice rounds.

#### C.8. Retrieval

The first part of the questionnaire consisted in retrieving the last round where the participant had been overestimated if this was applicable, if not we retrieved the last round (fill), we later asked participants what motivated their answer and if they followed the same strategy throughout the experiment. And we also include a Likert scale on the fairness perception of the round. (See Fig. 16.)

This is the result of your tax declaration 16 earlier in the experiment. Please answer the questions below regarding this declaration. (See Fig. 17.)

Please explain why you declared 0.00 ECU in round 16, max 500 characters.  
The procedure used in this round of the experiment was fair. (Please choose a number on a scale from 1 to 9). Where 1 is “very unfair” and 9 is “very fair”.

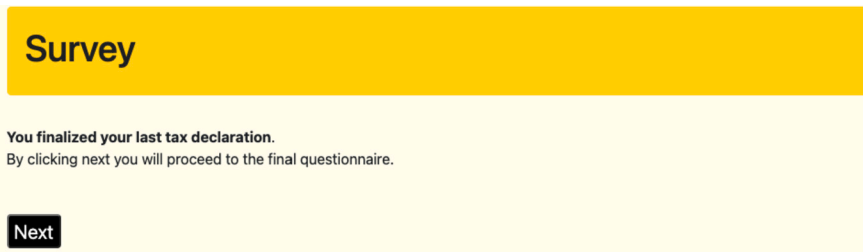


Fig. 15. Summary of practice rounds.

**This is the result of tax declaration 16 you filed earlier.**

This is the result of **your** tax declaration 16 earlier in the experiment. Please answer the questions below regarding **this declaration**.

- You were **audited** in this round.
- The tax authority **overestimated** your income by **2140**.
- Income you declared: **0.00 ECU**.
- Income in this round after filed taxes: 9630.00 ECU.

Below you can find how your tax declaration has been handled by the virtual tax authority.

|  |            |
|--|------------|
| Selected by tax authority for audit?     | yes        |
| Gross-income                             | 21400.00   |
| Income overestimated by tax authority?   | yes        |
| <b>Overestimation</b> by tax authority   | + 2140     |
| <b>Estimated</b> income by tax authority | = 23540.00 |

|   |          |
|---|----------|
| Taxes paid on declared income                               | - 0      |
| Additional <b>tax</b> and <b>fine</b> due to underreporting | - 10700  |
| Additional <b>tax</b> and <b>fine</b> due to overestimation | - 1070.0 |

|  |                    |
|--|--------------------|
| <b>End of round income =<br/>gross-income - (additional) taxes &amp; fines</b> | <b>9630.00 ECU</b> |
|--|--------------------|

Please explain why you declared 0.00 ECU in round 16, max 500 characters.

Explanation

Fig. 16. Retrieval of round.

Is the strategy you used for this round (16) different or similar to the one used in other rounds? If so, explain how, max 500 characters explanation.<sup>31</sup>

### C.9. Demographics

We asked generic demographic questions to complement the data already obtained by Prolific. (See Fig. 18.)

- Gender [Dropdown: male, female]
- Year of birth [Dropdown: year list]
- Highest completed level of education [Dropdown: Primary School, High school, Vocational training, Bachelor, Master, PhD, Other]
- Current occupation [Dropdown: Student, Employed, Self-employed, Unemployed, Other]
- My personal monthly income before taxes is [Dropdown: 0 – 1500 GBP, 1501-3000 GBP, 3001-5000 GBP, 5000, I do not know]
- Have you ever reported your income (either from employment or from self-employment) to a tax authority, either personally or through a tax advisor? [Dropdown: Yes, No, I do not know]
- Country of residence [Open field]

<sup>31</sup> These answers, similar to Bezael et al. (2021), function as a robustness check for the quality and seriousness of answers. We flagged motivations that reflected a lack of awareness or attention to the experiment. This “unaware” category represents approximately 3% of our sample, suggesting that most participants understood the task and were engaged with the process.

Please explain why you declared 0.00 ECU in round 16, max 500 characters.

Explanation

The procedure used in this round of the experiment was fair. (Please choose a number on a scale from 1 to 9). Where 1 is "very unfair" and 9 is "very fair"

1
  2
  3
  4
  5
  6
  7
  8
  9

Is the strategy you used for this round (16) different or similar to the one used in other rounds? If so, explain how, max 500 characters.

explanation

**Next**

Fig. 17. Questions on strategy.

## Demographics

Gender

----- ▾

Year of birth

----- ▾

Highest completed level of education

----- ▾

Current occupation

----- ▾

My personal monthly income before taxes is

----- ▾

Have you ever reported your income (either from employment or from self-employment) to a tax authority, either personally or through a tax advisor?

----- ▾

Country of residence

**Next**

Fig. 18. Demographics.

C.10. Tax attitude questionnaire

- We asked participants questions about their tax perceptions and attitudes. (See Fig. 19.)
- Have you participated in a study on tax compliance before? [Dropdown: yes, no]
  - Are you generally a person who is fully prepared to take risks or do you try to avoid taking risk? (Please choose a number on a scale from 1 to 9). Where 9 is "fully prepared to take risks" and 1 is "definitely avoiding to take risks"
  - How often have you yourself thought about cheating on your taxes? (Please choose a number on a scale from 1 to 9). Where 1 is "rarely" and 9 is "very often"
  - When you pay your taxes do you feel that something is taken away from you or that you contribute to society? (Please choose a number on a scale from 1 to 9). Where 1 is "definitely taken away from me to" and 9 is "definitely contributing to society":
  - In my opinion the HMRC in the UK is more concerned with collecting as much as it can, than with collecting the correct amount of tax. (Please choose a number on a scale from 1 to 9). Where 1 is "I do not agree at all" and 9 is "I agree completely" (see Fig. 20)
  - To what extent do you agree or disagree with the following statements on a scale from:(1) I do not agree at all - (9) I agree completely
  - The procedure used in this tax experiment was fair:
  - The audit outcomes of my tax declarations were appropriate:

## Post-experiment Questionnaire

Have you participated in a study on tax compliance before?

Yes  No

Are you generally a person who is fully prepared to take risks or do you try to avoid taking risk? (Please choose a number on a scale from 1 to 9). Where 9 is "fully prepared to take risks" and 1 is "definitely avoiding to take risks"

1  2  3  4  5  6  7  8  9

How often have you yourself thought about cheating on your taxes? (Please choose a number on a scale from 1 to 9). Where 1 is "rarely" and 9 is "very often"

1  2  3  4  5  6  7  8  9

When you pay your taxes do you feel that something is taken away from you or that you contribute to society? (Please choose a number on a scale from 1 to 9). Where 1 is "definitely taken away from me to" and 9 is "definitely contributing to society":

1  2  3  4  5  6  7  8  9

In my opinion the HMRC in the UK is more concerned with collecting as much as it can, than with collecting the correct amount of tax. (Please choose a number on a scale from 1 to 9). Where 1 is "I do not agree at all" and 9 is "I agree completely"

1  2  3  4  5  6  7  8  9

**Next**

Fig. 19. Demographics.

## Post-experiment Questionnaire

To what extent do you agree or disagree with the following statements on a scale from:

**(1) I do not agree at all - (9) I agree completely**

The procedure used in this tax experiment was fair:

1  2  3  4  5  6  7  8  9

The audit outcomes of my tax declarations were appropriate:

1  2  3  4  5  6  7  8  9

In my opinion the virtual tax authority of this study is trustworthy:

1  2  3  4  5  6  7  8  9

What was your main objective while participating?

'Cheating on taxes if you have a chance is always justified:

1  2  3  4  5  6  7  8  9

If you have anything else you want to let us know please fill in here (max 300 words?)

**Next**

Fig. 20. Demographics.

- In my opinion the virtual tax authority of this study is trustworthy:
- What was your main objective while participating? [Dropdown: Being honest, Avoiding fines, Compensating for earlier rounds, Revenge, Contributing to the collective, Other]
- Cheating on taxes if you have a chance is always justified:
- If you have anything else you want to let us know please fill in here (max 300 words?)

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