An Experimental Analysis of Tax Avoidance Policies*†

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Abstract

Policies to reduce aggressive tax avoidance are increasingly being implemented or discussed in many countries around the world. Tax authorities hope that such policies will generate new tax revenue by increasing overall tax compliance. We present an experimental design to investigate the effect of a stylized anti-avoidance tax policy on tax compliance behavior. We highlight that anti-avoidance tax policies that reduce tax avoidance can also induce an increase in tax evasion ("substitution effect"), which limits the additional tax revenue these policies will generate. We show that the degree of substitution depends crucially on behavioral factors such as tax morale. Policymakers therefore also need to consider behavioral features while designing such policies and estimating their potential effects.

Keywords: Anti-Avoidance Tax Rules (AAR), Aggressive Tax Avoidance, Tax Evasion, Compliance

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*This paper involves the collection of data on human subjects and the author(s) disclose that they have obtained Institutional Review Board (IRB) approval.

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1. Introduction

Faced with the dual problem of budget deficits and public debt limits, policymakers in many countries are actively pursuing a variety of avenues to raise tax revenues. One potential avenue is to reduce the tax gap: tax payments not collected due to the evasion and avoidance activity by taxpayers. While evasion (a fraudulent way of hiding one's true tax position) has traditionally been the primary target, policymakers are also increasingly turning their attention towards mitigating aggressive forms of tax avoidance that exploit tax code loopholes to reduce tax payments. Although such activities are in line with the letter of the law, policymakers do not consider them in accordance with "the spirit" of the tax code, and are discussing various policies to combat aggressive tax avoidance strategies (OECD, 2011).

Relative to other available fiscal tools, policies aiming to reduce aggressive tax avoidance to raise tax revenues are more appealing to policymakers for a combination of reasons. First, the issue of aggressive tax avoidance is economically significant. The tax justice network documents that the tax avoidance costs the government of the European Union Member States approximately €150 billion a year which exceeds the total expenditure spent on education (€133 billion) by the European Union in 2009 (Murphy, 2012). Second, policies aimed at reducing tax avoidance also provide policymakers with an alternative fiscal tool which is more feasible and politically acceptable than directly altering the tax rates which could very well be distortionary. Last, such policies in addition to discouraging the aggressive avoidance behavior may also effectively discredit such behavior, hence signaling that the state is forcing other citizens to pay their fair share of taxes. Such a signal can potentially improve the perception of the overall fairness of the tax system and behaviorally encourage all citizens to be more compliant towards their tax payments (Kahan, 1997; Roth et al., 1989). As a result, tackling aggressive avoidance is currently a highly debated issue around the world.

The UK's Chancellor of the Exchequer, George Osborne, for example, announced his plan to introduce an anti-avoidance rule in the UK in his 2013 Budget speech. Anti-Avoidance Rules (AARs) are a set of principle-based rules giving tax authorities discretion to differentiate between responsible tax planning and aggressive tax avoidance.[1] The AAR aims to provide a mechanism to deny the tax benefits of avoidance deemed not to be in the spirit of the tax code. In general, policymakers hope that AARs will reduce aggressive tax avoid-

[1] Aggressive tax avoidance often involves sophisticated schemes that are built upon complex mechanisms (see, for example, Icebreaker schemes, Liberty one schemes). As such, these schemes are not intended to generate economic activity but instead exploit shortcomings, weaknesses, or ambiguities in tax laws to reduce tax payments. For example moving funds or using financial instruments that are treated differently in different jurisdictions or construction of fictitious or shell companies can be regarded as aggressive tax avoidance.

ance behavior and increase tax revenue.[2] Many other countries (such as the USA, Hong Kong, India, China) are also either considering or have already incorporated AARs in their tax code. Although these policies have generated a lot of discussion in policy circles, there has so far been limited systematic evaluation of the efficacy of these policies. Moreover, much of the media attention surrounds the impact of such policies on corporations, however, the effect is perhaps more pronounced for a common taxpayer. Murphy (2003) shows that during the 1990s, an estimated $4 billion in tax revenue was lost as a result of 42,000 Australians becoming involved in aggressive mass marketed tax schemes. Moreover, Braithwaite (2003) relates that a multitude of strategies that seek to exploit deficiencies in the law are continuously being devised each year which leaves the common taxpayer vulnerable.

In this paper, we present an experimental study to assess the effect of these policies on tax compliance behavior and overall tax gap, measured as the sum of tax evasion and aggressive tax avoidance.[3] As the effect of fiscal policy on overall compliance and the tax gap depends on the interaction between governments and citizens, perception about legal system to promote justice, past fiscal policies and other institutional features, a field experiment or analysis based on observational data would likely be most informative. However, the debate surrounding AAR is relatively new and the lack of data limits undertaking such systematic studies. Moreover, challenges such as measurement (of variable of interest such as self-reported income, confidential penalties etc.) and identification (of tax rates, compliance rates due to endogeneity) pose some serious limitations in drawing a credible causal evidence from observational studies (see, e.g., Slemrod and Weber, 2012). A laboratory experiment provides a controlled and a stylized environment as a potential approach to study tax issues in a causal manner. While the stylized nature may raise concerns about external validity, Alm et al. (2015) show that insights from tax based experiments can generalize beyond the laboratory.

In our paper, we conduct a laboratory experiment to evaluate the causal effect of ARR on the overall tax compliance. Specifically, we extend traditional laboratory experiments on tax evasion (such as Alm and McKee (1998); Torgler (2002) which are primarily based on the Allingham and Sandmo's (1972) theoretical framework) by including an explicit tax avoidance mechanism. In our design, the tax evasion problem is captured by subject's

[2]These expectations of policymakers about the effect of AARs are clearly evident in the transcript of the recent budget speech by George Osborne who states: "The Office of Budget Responsibility confirms that this (AAR) will bring forward £4 billion of tax receipts. And it will fundamentally reduce the incentive to engage in tax avoidance in the future." HM Treasury, Budget 2014

[3]Countries of the European Union treat aggressive tax avoidance as a part of the tax gap, while the USA does not (see Gemmell and Hasseldine (2012) for a broader discussion). Since we are interested in the overall fiscal budget, we refer to the European definition.

willingness to truthfully report income in the presence of an exogenous audit probability and potential penalties for underreporting. The tax avoidance problem is introduced via an effort based task, where subjects can reduce their tax base by exerting costly effort. The avoidance problem in our design reflects that in real life tax avoidance activity is associated with some form of cost such as filling extra tax forms, finding appropriate deductions, finding loopholes in the tax code or finding an accountant etc. (See e.g., Alm, 1988, 2014; Cowell, 1990; Slemrod, 2001). Introducing tax avoidance and evasion problems jointly is a novel feature of our design, and allows us to study our main question of interest: how AARs affect tax compliance and the tax gap?

Whether a given aggressive tax avoidance strategy will be successful in reducing tax payments is uncertain under AAR. This uncertainty stems from the fact that the distinction between responsible tax planning and aggressive tax avoidance depends on ethical and societal perspective rather than an interpretation in a legal sense (Braithwaite, 2003). This gives substantial discretion to courts and tax offices in deciding whether a strategy violates an ethical perspective, making the outcome of an avoidance strategy difficult to predict for taxpayers.[4] We capture this uncertainty generated by AAR in our experimental setting by drawing an unknown value of a threshold variable which is only revealed ex-post, and determines whether a certain degree of avoidance undertaken turns out to be successful or not.

A priori it is not clear the extent to which the implementation of AAR will affect a taxpayer's overall compliance behavior. On the one hand, since AAR introduces uncertainty about whether the benefits of avoidance will be realized, it should reduce the degree of aggressiveness of a taxpayer's avoidance strategy. On the other hand, for the same taxpayer the lower incentive to avoid may be offset by evading higher amounts. However, the extent to which AAR should be expected to affect a taxpayer's choice between evasion and compliance potentially depends on both standard economic and behavioral reasoning.

Some of the economic and behavioral reasons that can play a role in evaluating the ultimate effect of policies like AAR on tax compliance and consequently the tax gap include income effect (Cross and Shaw, 1982), bracketing choice (Read et al., 1999), or aversion to lying and tax morale (Luttmer and Singhal, 2014). Intuitively, income effect plays a role because evasion depends on the degree of taxpayers' risk aversion, which in turn depends on their wealth. Since wealth depends on the amount of avoidance there is an effect from changes in avoidance to evasion through this income channel. Hadar and Seo (1990), among others, have a similar discussion in the context of portfolio choice problems. Taxpayers'

[4]For a detailed discussion of the discretion given to tax authorities, see Prebble and Prebble (2010).

decisions may also be subject to the choice of bracketing which influences whether the tax-payer makes the choice about each avoidance, evasion, and compliance in isolation (referred as narrow bracketing) or assess the consequences of all of the choices together (referred as broad bracketing). Under narrow bracketing, AAR may reduce tax avoidance without increasing evasion and, as a result, overall tax compliance will increase. In contrast, under broad bracketing reduction in avoidance due to AAR may go hand in hand with an increase in evasion and the effect of AAR on the overall compliance would, therefore, be less clear. Taxpayer's behavior can also potentially be driven by aversion to immoral or lying behavior (referred as tax morale), where taxpayers pay taxes for non-pecuniary reasons. In the presence of such behavioral reasoning, the potential effect of AAR may very well deviate from theoretical predictions. Therefore a systematic analysis can advance our understanding of how AAR may potentially affect tax compliance, which is the analysis we undertake in this paper.

Our experimental results show that the AAR has two effects on individual's tax behavior. On the one hand, as expected the AAR reduces tax avoidance, in line with the stated intent of such tax policies and, on the other hand, increases tax evasion. While the overall tax gap is lower in our AAR condition, the potential increase in tax revenue from a successful reduction in tax avoidance is at least partially offset by higher tax losses from evasion. When comparing the extent to which evasion increases in our data with what an expected utility model would predict, we find significant differences: the expected utility model predicts a much greater switch to evasion and a resulting increase in the tax gap due to the ARR. We find evidence that narrow bracketing and tax morale cost of evasion may all play a role in the deviations observed between our empirical results from the theoretical predictions. However, a model with constant relative risk aversion and a tax morale cost of evasion matches our data reasonably well.

These findings are significant for a number of reasons. First, they indicate that a proper evaluation of AARs should account not only for the policy's effect on avoidance but also its possible implications for tax evasion. Moreover, ignoring the behavioral factors such as morale cost while evaluating the potential effect of ARR on evasion is likely to bias estimates of the policy's impact on closing the tax gap. Second, from a policymaker's point of view, tax avoidance and evasion are not necessarily perfect substitutes. In particular, tax evasion is defined to be illegal and distorts the accounting of economic activity. Hence, even if an AAR reduces the overall tax gap, assessing the welfare implications of the policy may need to address difficult trade-offs between the desire to increase tax revenue, and the overall fairness, and transparency of the tax system.

The remainder of the paper is organized as follows. In Section 2, we provide the review of the existing literature and in Section 3 we provide our experimental design. Section 4 presents our main results of how the AAR affects behavioral and policy based variables. Section 5 provides a detailed discussion of potential behavioral explanations within the standard theoretical framework to match the empirical data. Section 6 concludes. Appendix A provides a step by step guide to the simulation procedure used in Section 5 and Appendix B provides instructions and screen shots for our experimental design. An online Appendix provides additional analyses.

2. Literature Review

The theoretical literature on tax compliance has mostly focused on the problem of tax evasion. For example, in the seminal work of Allingham and Sandmo (1972), taxpayers have the choice between truthfully declaring or underreporting their income, and face potential penalties if an audit – which occurs with a fixed probability – discovers hidden income. This economics of crime approach is well suited to studying illegal tax evasion, and has been extended along many dimensions (Yitzhaki, 1974, 1987; Kaplow, 1990; Cremer and Gahvari, 1994; Alm, 2012). However, the approach is less appropriate for considering tax avoidance, which is a legal activity that does not involve hiding income. The theoretical literature studying tax avoidance has therefore used a cost of avoidance approach, in which taxpayers can reduce their taxable income at the cost of finding suitable avoidance opportunities (see e.g., Alm, 1988; Slemrod, 2001; Mayshar, 1991). Few papers have considered the problem of evasion and avoidance jointly in a theoretical framework (such as Cowell, 1990; Cross and Shaw, 1982).

As with the theoretical literature, most empirical studies on tax compliance have also focused on the problem of tax evasion. In particular, a large literature has studied the link between tax evasion and tax rates, penalties, audit probabilities, prior audit experiences, and socio-economic characteristics of taxpayers (see e.g., Friedland et al., 1978; Beron et al., 1990; Dubin et al., 1990; Andreoni et al., 1998). Most of this literature relies on observational and non-experimental data, which suffers from both measurement and identification problems. Measurement problems arise because evasion, which is the outcome variable of interest, is very difficult to observe accurately and the independent variables – audits, the threat of audits, penalties – are also difficult to capture at the individual level because of confidentiality of enforcement strategies. Identification issues arise primarily with studies that aggregate tax data at the district or state level, because of endogeneity in the variation of tax rates, enforcement efforts, and compliance rate, which are treated as exogenous in numerous studies. A number of studies have proposed instruments to mitigate these identification problems (see, e.g., Dubin and Wilde, 1988; Dubin et al., 1990; Pommerehne and Frey, 1992). However, Andreoni et al. (1998) and Slemrod and Yitzhaki (2002) provide critical reviews of this literature and argue that none of the available instruments are likely to satisfy the assumptions for IV-estimation to be consistent.

The numerous difficulties with reliable empirical research on tax behavior have motivated researchers to utilize experimental approaches. One important source of experimental data is laboratory experiments, which benefit from a controlled environment that can counter measurement and identification issues. Most of such studies (for example, Friedland et al., 1978; Becker et al., 1987; Alm et al., 1992b,a, 2009) concentrate on multi-period reporting game based on the theoretical framework of Allingham and Sandmo (1972), where subjects receive and report income, pay taxes and then face the uncertainty of being audited with a pre-specified penalty. Our experimental design builds on this literature. In particular, we incorporate two features from the theoretical tax literature: (1) a choice over how much income to report – "evasion" – with an exogenous audit probability and resulting penalties for underreported income, and (2) a costly effort task that allows the participant to reduce their tax base – "avoidance" – and is not subject to penalties. While the evasion problem is standard, the avoidance problem is novel.

3. Experimental Design

We recruited 133 students from the University of Magdeburg as subjects to participate in the experiment. All payments were in euro, with one lab dollar equaling one euro cent, and made at the end of the sessions where all sessions were conducted in German. The experiment was programmed and conducted with z-Tree (Fischbacher, 2007) and recruitment took place via hroot (Bock et al., 2012). We provide the experimental instructions and screen shots of each stage of the experiment in Appendix B.

The experiment consists of four parts. Subjects know that they will participate in four parts of the single experiment where the final pay-off will be made at the end of part 4 and will be based on either part 1,2 and 3 or part 1,2 and 4 (i.e., only one of the last two parts will be randomly selected to determine the final payoffs). No other information regarding the details of what each part entails is provided to the subjects at the start of the experiment. Subjects are randomly assigned to participate in either a control (treatment) condition in part 3 or a treatment (control) condition in part 4.[5]

In part 1, subjects' risk tolerance is elicited by using Holt and Laury (2002), for which the payment is also made at the end of the experiment in order to avoid income effect. Next subjects are given information about part 2 of the experiment which is an income generating task (itself a modification of Erkal et al., 2011) that sets their earned endowments for the rest of the experiment. The instructions for part 3 are then given to the subjects which ask them to report their earned endowment which is subject to 50% tax rate along with the 0.3 probability of audit, which if takes place results in confiscation of any underreported income as a penalty. In the same part, subjects are also asked to make a binary decision of whether they want to further reduce their taxable income by undertaking an additional task. If the subjects' response is affirmative, they proceed to the additional task which is a slider task (following Gill and Prowse, 2012, 2013). After this subjects receive the instruction for part 4 of the experiment which is a repetition of part 3 except with one modification in terms of how tax liability reduction is determined from the slider based task. This concludes the experiment and subjects then receive the final payoff.

Part 3 and 4 are either a main control condition or a treatment condition. As a result part 3 provides us with a sub-sample of observations from the control condition and the rest from the treatment condition, which is used for the between analysis provided in the Section 4. Together part 3 and part 4 provide us with observations which are used for our within analysis provided in online Appendix. Prior to our formal analysis of the data, we describe each of the main steps of our design in detail and present the illustration for the design from a subject's point of view in Figure 1. Having discussed the steps in detail we then describe the biases and confounds that our design avoids and how our implementation allows us to test the effects of the AAR on reported income and the tax revenue.

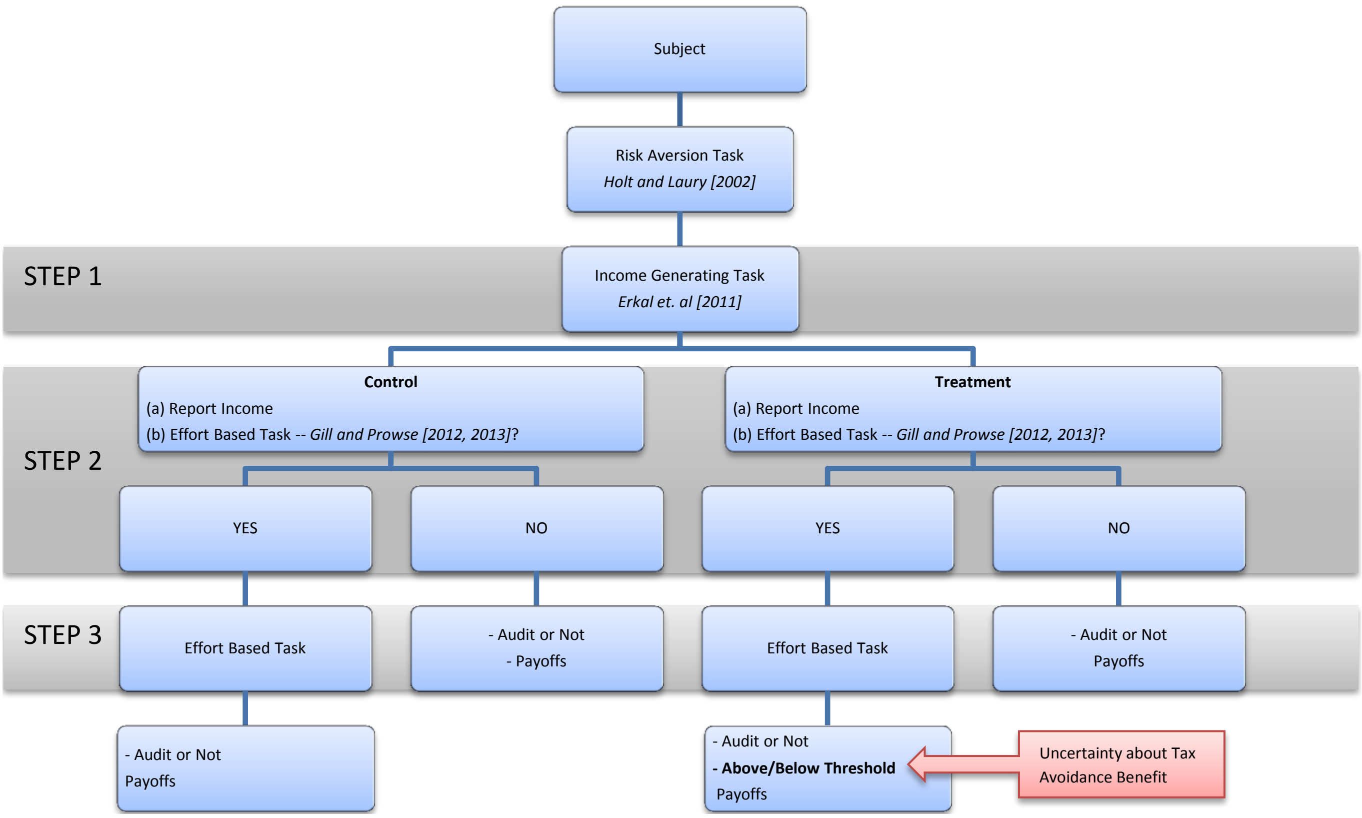
3.1. Design Details

Step 1: Income Generating Task

The income generating task is common for both treatments and is based on a real effort task which lasts for 5 minutes (adapted from Erkal et al., 2011). This effort task is an encryption task, where subjects see a table on the screen which assigns a number to each letter of the alphabet in a random order. For a given word, the task is to substitute the letters of the alphabet with numbers using the table and per encryption of the word, subjects earn 70 lab

[5] A subject can encounter a control condition in part 3 and then a treatment condition in part 4 (or) a treatment condition in part 3 first and then a control condition in part 4.

Figure 1: Illustration of Experimental Design – Round 1



Note: Subject i is randomly assigned to either control or AAR treatment at the start of the experiment.

dollars equivalent to 0.7 €.[6] There is some variation across subjects' income levels, however since only 5 minutes are allowed for generating income, variation in income is minimal. On average, subjects earn around 12.86 € in the allotted 5 minute window. This step provides us data on income of subject i which we denote by W_i.

Step 2: Reporting of Income and the Binary Decision to Undertake Avoidance At the start of step 2, subjects receive instructions about step 2 and step 3 as a function of whether a subject is participating in the control or AAR treatment. In step 2, subjects report their income from step 1. The underreporting in this step provides data on the evasion behavior of subject i which is denoted by E_i and is measured as $W_i - X_i$ where W_i is income from step 1 and X_i is the reported income from step 2. However, whether the amount of evasion intended by the subject is actually realized depends on the random audit which is revealed at the end of each round. The exogenous parameters are the tax rate denoted by $t = 50\%$, the audit probability denoted by $p = 0.3$, and the penalty rate denoted by

[6]For example, the word JURY is encrypted as 5-25-2-20. In the laboratory settings, this task induces real effort and is easy to understand for subjects.

$F = 100\%$. If audited, the cost of evasion is the loss of all evaded income whereas if not audited, the benefit is that no tax is paid on the evaded income.

On the same screen, subjects decide if they want to avail further deductions that will reduce their taxable income with additional effort. If subjects choose to take further deductions, they proceed to step 3 which is described below otherwise they proceed directly to the payoff screen.

Step 3–Control: The Avoidance Task

If subjects in step 2 decide to avail further deductions they proceed to step 3, which contains a maximum of 10 effort based tasks, which appear on 10 separate screens. Subjects can choose to preform as many of these tasks as they wish but the benefit of exerting extra effort reduces with each additional task. In particular, a subject is able to reduce their taxable income by 10% after the first effort task, but can only reduce 10% of the remaining reported income after the second effort task and so on. Therefore, there is a decreasing benefit of avoidance.

The effort task is a modified version of the task proposed by Gill and Prowse (2012, 2013) in which subjects use sliders to match numbers on a screen. In our design, subjects are asked to move the slider to exactly the middle of the slider bar such that the matched number via the slider is 50. Each task is presented on one screen and we denote the task undertaken by subject i as T_i where $T_i \in [1, ..10]$. For each T_i there are $S_{T_i} = 30 + 2 * (T_i - 1)$ sliders to be moved to avail 10% reduction in the taxable income (X_i).[7] On the same screen, subjects are asked if they would like to proceed to the next effort task to reduce the tax base by another 10% of their remaining reported income ($0.9^{T_i-1}X_i$) or finish undertaking further tasks.[8] If the subject clicks no further deduction or reaches the maximum task the subject then proceeds to the payoff screen.

Step 3–AAR: The Avoidance Task

The anti-avoidance rule is introduced via a threshold which is implemented through a randomly generated number from 0 to 10 (both inclusive). The number drawn for the threshold determines whether avoidance is successful or not. If the number of slider tasks undertaken is less than or equal to the threshold then the taxpayer successfully reduces the taxbase via avoidance, otherwise taxpayer is unsuccessful.[9] However, the threshold is unknown to

[7] Task 1 contains $S_{1_i} = 30$ sliders, task 2 contains $S_{2_i} = 32$ sliders and so on.

[8] Remaining reported income can be calculated as $0.9^{T_i-1}X_i$: For the 1st task, it is X, for the 2nd task it is $0.9 * X_i$ and for the third task it is $0.9^2 * X_i$ and so on.

[9] For example if the subject undertakes 8 tasks and the threshold is 2 then the subject only incurs a cost and obtains no benefit. However, if the subject performs 2 tasks and the threshold is 8, then the subject reaps the benefits.

the subject throughout the experiment and therefore ex-ante, it is not clear a priori if a particular number of tasks will be successful or not.

All other features of step 3–AAR are same as described for step 3–Control.[10] Step 3–Control and Step 3–AAR provide us with a discrete number of avoidance tasks (T_i) undertaken by the subject i. However, we convert T_i into a continuous, monetary amount of savings (intended) by the subject and denote it by A_i. We explain the construction of A_i in detail in the next section.

Information about audit, thresholds, payable round revealed
At the end of step 3 of each round, information about whether the subject is audited or not, the number of the randomly drawn threshold and the final payoff from that round is revealed. After round 1, subjects receive information about the round 2 and proceed to step 2 and step 3 of the remaining condition.[11] After round 2 concludes, subjects receive the final pay-off from one of the two rounds which is randomly chosen. This concludes the experiment. The experiment takes about 45 – 60 minutes per subject and the subject on average earns about 11.21 €.

3.2. Design Discussion

In this section, we discuss some important features of our experimental design. In order to provide a robust analysis of how the implementation of the AAR affects subjects' behavior towards the reporting of income, exerting effort for tax avoidance, and subsequently AAR's implication for policymakers, we also discuss several precautions we take.

The income generating task in step 1 is based on a real effort task to earn income. This step introduces a certain degree of variation in income between subjects which is important to ensure that subjects' decision to evade taxes does not automatically reveal subjects' untruthful behavior. Subjects should, therefore, be less likely to maneuver their behavior regarding tax evasion for concerns over the experimenter knowing their actual income. This step also minimizes the "house-money effect" whereby subjects may take different decisions if income is endowed rather than earned. In addition, to ensure that subjects' effort in the income generating task is not influenced by the rest of the experiment, information is disseminated sequentially in the experiment: first at the start of step 1 where information about step 1 is given and second at the end of step 1 where information about steps 2 and

[10] There are again a maximum 10 avoidance tasks and each screen allows the subject to stop further avoidance tasks. Moreover, the number of sliders per task also increases while the potential benefit decreases with each subsequent task as has been explained in Step3–Control.

[11] More details and rationale behind round 2 are discussed in Section 3.2.

3 is given together.[12] The sequencing of information ensures that subjects' performance in step 1 is not confounded with anticipatory effects based on information about step 2 and step 3.

We take two precautions to minimize concerns that subjects who are very committed to earning income in step 1, are also the same subjects, on average, who are committed to avoidance in step 3. First, the effort task in step 1 and step 3 are kept simple and are therefore less likely to be ability driven. Second, we use different tasks in step 1 and 3 so if ability is at all important then performance in these tasks would require different skills. However, to confirm that this concern is limited in our design, we compute the correlation between our subjects' income from step 1 and number of avoidance task in step 3. Both for the control and the treatment condition the correlation is small, which indicates that the ability of subjects in step 1 is not an important determinant in subjects' decision of undertaking certain number of tasks in step 3.[13] Therefore, the likelihood that our data on the number of avoidance task is driven by subjects' ability instead of tax minimization incentives, is very low.

An important challenge for the experimental design is to create a meaningful distinction between evasion and avoidance in the laboratory setting. While evasion in our setup follows the standard expected utility framework of Allingham and Sandmo (1972), avoidance is based around the effort task in step 3 which is set up to proxy the real life costs of avoidance such as, the effort required to get appropriate information about avoidance strategies, find specific deductions, rearrange activity so specific deduction becomes available, fill in additional information on tax forms, find an accountant etc. Using a cost of avoidance approach is standard in joint evasion and avoidance models (see, e.g., Cowell, 1990; Cross and Shaw, 1982) and using real effort has two key advantages over other potential methods for introducing such costs. First, the cost associated with avoidance is more tangible to subjects and there is a greater distinction between the non-compliance cost in terms of evasion and avoidance than if everything was based only on monetary payoffs. While we lose some control in quantifying the cost of avoidance, the distinct effort cost effectively induces subjects to carefully consider the trade-offs between evasion and avoidance choices.[14] Second, we do not rely on framing to induce a distinction between evasion and avoidance. While Blaufus et al. (2016) show that simple framing of tax avoidance strategies as illegal or legal can have

[12]Information at the end of step 1 differs depending on the condition the subject is assigned to.

[13]The correlation between the income generated in step 1 and the number of avoidance tasks undertaken in step 3 in the control and the AAR treatment are 0.043 and 0.188, respectively.

[14]See, Gächter et al. (2015) for discussion of the trade-offs involved in using real effort tasks. Importantly, since our quantitative analysis in the next section concentrates on evasion we do not lose much in terms of insights by being unable to exactly quantify the cost of avoidance from our experimental data.

some effect, ex-ante it is unclear how strong these effects will be.

A further challenge for the design is to allow subjects to make a joint decision about their evasion and avoidance strategies while basing avoidance around a sequential effort task. Several features are integrated into the design to make a joint decision possible. First, the information about step 2 and step 3 is provided together at the end of step 1, which ensures that subjects are aware of the joint dependence of their evasion and avoidance decision on their payoffs before starting step 2 and step 3. Subjects also participate in a practice round of step 2 and 3 after the information is communicated to allow them to familiarize themselves with what the evasion and avoidance decisions entail. Second, in step 2 subjects are asked to make two decisions: report their income and decide whether to undertake the effort based task to avoid taxes. Step 2 is shown in one shot, and on the same screen subjects are provided with an on-screen calculator which is pre-coded to calculate the final payoff when the subjects insert reported income (from step 2), the number of avoidance tasks (intended in step 3) and a potential threshold associated with the AAR condition.[15] The calculator ensures that subjects are fully aware of the interdependence of the payoffs for their avoidance and evasion decisions. Third, to ensure subjects understand the payoff structure, the numerical values for the audit probability, tax rate, and avoidance payoffs are kept as simple as possible.[16] Finally, whether an audit took place or not, the value of the threshold for the avoidance, and the corresponding final pay-offs are only revealed to the subjects upon conclusion of step 3.

In our experiment, the maximum number of avoidance tasks that a subject can undertake is bounded above by 10. We are aware that we have a finite number of avoidance tasks in our design which may lead to a maximum number of tasks by some subjects as a potential solution in terms of avoidance availed (especially in the control condition where there is no uncertainty for the avoidance strategy). However, the decreasing marginal benefit of avoidance reduces the incentive to choose a corner solution to the avoidance problem. In addition, following Gill and Prowse (2012, 2013) our task is skill free and extremely monotonous.

The idea behind implementing AAR in the experimental environment using a threshold is to capture two features of a taxpayer's avoidance problem when facing AARs. First, in general, the power and discretion given to tax authorities to rule against an avoidance strategy, makes the benefit of the avoidance strategy uncertain. Second, this uncertainty

[15]Pre-coded calculator is a function of whether a subject is participating in the control or AAR condition, i.e., the calculator allows the option to insert a threshold only for the subjects in the AAR condition.

[16]In real life, the absolute benefit of evasion and avoidance of tax payments can be potentially large even with a smaller tax rate since incomes are much higher. However, in a laboratory setting the parameters need to be rescaled and therefore apart from the ease of calculation of the tax payment, another rationale behind a higher tax rate of 50% is to ensure that the benefit of evasion in terms of unpaid taxes and the reduction in taxable income by 10% for the case of avoidance are worthwhile for the subjects in the laboratory.

decreases with the aggressiveness of avoidance (which is measured by the number of tasks): less aggressive avoidance is more likely to be successful while more aggressive avoidance is less likely to be successful (Braithwaite, 2003). A uniformly distributed threshold allows us to match that a subject who does more task is more likely to be above the threshold. A zero avoidance task is then equivalent to non-aggressive avoidance behavior.[17] Of course, there are additional features of real life AARs which are not captured in the design, however the above features reflect two aspects of AAR which are particularly prominent.

To allow additional analysis, we also augment our experiment such that subjects repeat step 2 and step 3 for another round. We refer to the augmented round as round 2. Round 2's instructions are provided to the subjects once round 1 is concluded. As a result, subjects are aware of the existence of round 2 even while performing round 1 but they are not aware of what they will be required to do in round 2. In round 2 subjects repeat the experiment (subjects who were randomly assigned to a control treatment in round 1, perform the AAR treatment in round 2 and vice versa). Collecting data from round 2 is innocuous to our main between dataset from round 1; however, having a second round provides us with additional observations to conduct a with-in analysis (which is provided in the online Appendix). The usual limitation in the with-in dataset (artificial consistency, artificial inconsistency, mental fatigues) is minimized by making the final payment contingent on either of the two rounds which is determined by a random draw only at the end of the entire experiment.

3.3. Expected Utility

In this section, we present the expected utility framework. Note, for convenience we drop the subscript i from subject-specific variables in the expressions below.

Given the probability of audit $p = 0.3$, tax rate $\tau = 0.5$ and income W, the expected utility under our experimental design of the control can be written as:

$$EU^C = 0.7u(Y) + 0.3u(Z) - c(T),$$

where $c(T)$ denotes the effort cost associated with T number of avoidance tasks, Y is the income if there is no audit, Z is the income if there is an audit, and E is the amount of

[17] Note, setting the distinction between aggressive avoidance and non-aggressive avoidance at zero is simply a normalization. Alternatively, the subject could be allowed to do some number of tasks before potentially becoming an aggressive avoider.

evasion:

$$\begin{aligned} Y &= W - 0.5 * 0.9^T (W - E) \\ Z &= W - E - 0.5 * 0.9^T (W - E). \end{aligned}$$

Unlike the control, under our experimental design of AAR the benefit from avoidance is uncertain and therefore the expected utility under AAR condition can be written as:

$$EU^A = 0.7 \left[\left(\frac{11-T}{11} \right) u(Y) + \left(\frac{T}{11} \right) u(Y') \right] + 0.3 \left[\left(\frac{11-T}{11} \right) u(Z) + \left(\frac{T}{11} \right) u(Z') \right] - c(T),$$

where $\frac{T}{11}$ $(\frac{11-T}{11})$ is the probability that the taxpayer's avoidance is unsuccessful (successful), Y and Z are defined as above, Y' is the income if there is no audit but the number of tasks is above the threshold, and Z' is the income if there is an audit and number of tasks is above the threshold:

$$\begin{aligned} Y' &= W - 0.5(W - E) \\ Z' &= W - E - 0.5(W - E). \end{aligned}$$

Non-linearity due to risk aversion in the above problem makes it difficult to formulate predictions based on the expected utility model. However, by abstracting away from risk aversion and effort cost we can consider the effect of introducing AAR on evasion and avoidance separately and gain an insight as to how our variables of interest are affected across the two conditions. In terms of avoidance, introducing AAR means that if the number of tasks T is above the threshold then the payoff from avoidance is 0, whereas the payoff when T is below or equal to the threshold (which occurs with probability $\frac{11-T}{11}$) is $0.5 * (1 - 0.9^T)(W - E)$. In the control the payoff from avoidance is certain and is $0.5 * (1 - 0.9^T)(W - E)$. The optimal number of tasks in the AAR condition maximizes $\frac{11-T}{11} * 0.5 * (1 - 0.9^T)(W - E)$ and leads to 5 tasks. In the control maximizing $0.5 * (1 - 0.9^T)(W - E)$ leads to the corner solution of 10 tasks, so that a higher amount of avoidance is optimal in the control relative to AAR condition. This incentive to reduce the level of avoidance is exactly the mechanism policymakers have in mind to tackle aggressive avoidance by including AAR in the tax code.

Expected value calculations also allow us to consider the potential effect of AAR (relative to control) on evasion. Specifically, the expected marginal benefit of evading under AAR can be written as $0.5 * \frac{11-T}{11} * 0.9^T + 0.5 * \frac{T}{11}$, with the marginal cost simply being the probability of being caught evading which is 0.3. For the control the marginal benefit is $0.5 * 0.9^T$, which is certain but lower than the marginal benefit under AAR while the marginal cost is the same across the two conditions. As a result, the two optimum in the control are as follows: (1) only engage in avoidance such that number of avoidance tasks are high ($T \geq 5$) since then $0.5 * 0.9^T < 0.3$; or (2) only engage in evasion when ($T < 5$) since full evasion ($E = W$) is then optimal, i.e., $0.5 * 0.9^T > 0.3$. In the AAR condition, however, the optimal strategy is to engage only in full evasion ($E = W$) since $0.5 * \frac{11-T}{11} * 0.9^T + 0.5 * \frac{T}{11} > 0.3$ for all possible T. These expected value calculations lead us to conjecture that in aggregate, the behavior of risk neutral taxpayers should reveal more evasion and less avoidance under AAR than under our control condition.

In this framework, it is clear that there is a "substitution" from avoidance to evasion under AAR relative to our control. Intuitively, when AAR is implemented taxpayers choose to engage in other available means to reduce tax payments. However, the above discussion abstracts away from risk aversion and effort costs, although in theory these features should affect avoidance, evasion, and the overall tax gap. We explore the importance of these missing features and other behavioral aspects (such as tax morale, narrow bracketing behavior etc.) as well as quantify the extent of substitution between avoidance and evasion and the ultimate effect on the tax gap in Section 4 and Section 5.

4. Results

The objective of our design is to evaluate the extent to which our AAR condition affects the avoidance to evasion substitution and the tax gap. While the first measure which is based on two variables (avoidance and evasion) reflects behavioral variation across the control and the AAR conditions, the second measure (tax gap) can point towards direct policy implications.

4.1. Variables of Behavioral and Policy Interest

We define absolute evasion as the difference between income earned, denoted by W_i (data collected in step 1) and reported income, denoted by X_i (data collected in step 2) for subject i. However, the same absolute evasion of two subjects with different earnings can capture different evasion behaviors, we therefore normalize evasion by income. This evasion measure, denoted by E_i/W_i, is the proportion of income evaded by the subject i, and is given by:

$$E_i = W_i - X_i \tag{1}$$
$$\frac{E_i}{W_i} = \frac{W_i - X_i}{W_i}. \tag{2}$$

Our experiment also generates data on the number of avoidance tasks (T_i) performed by each subject i. We convert this discrete measure of avoidance into a continuous avoidance measure to facilitate the interpretation of the variable as the proportion of income avoided by a subject. The continuous avoidance measure, denoted by A_i, is constructed as follows:

$$A_{T_i} = 0.1 * \overbrace{(0.9^{T_i - 1} * X_i)}^{\text{Remaining Reported Income}} \tag{3}$$
$$A_i = \sum_{T_i=1}^{T_i=T} A_{T_i} \equiv (1 - 0.9^{T_i}) * X_i, \tag{4}$$

where A_{T_i} is the saving from the T-th avoidance task and A_i is the total savings from all T tasks.[18] Finally, our avoidance to earning ratio is simply $\frac{A_i}{W_i}$, which is the proportion of income avoided by subject i. Since absolute avoided tax can reflect different avoidance behavior, we use the avoided tax normalized by subject's earning.

In our context the tax gap is defined as the difference between the full tax revenue and the actual amount of taxes collected. In our experiment, a subject can evade, avoid or comply with statutory taxes. Assuming that all subjects do not engage in evasion or avoidance (that is, comply fully) provides us with a measure of the full tax revenue. However, when subjects engage in avoidance or/and evasion we measure the actual tax revenue collected.

Given that income is taxed at a rate t we can measure the full tax revenue per subject, denoted by FT_i, which is just

$$FT_i = \tau * W_i \tag{5}$$

To calculate the actual tax gap we look at how much income was evaded and avoided in the control and in the AAR condition by each subject. Therefore, the actual tax per subject,

[18] In the event that a subject chooses no avoidance tasks, $A_{T_i=0} = 0$ and $A_i = 0$.

denoted by AT_i and the tax gap per subject, denoted by TG_i are defined as follows:

$$AT_i = \tau * (W_i - E_i - A_i) \quad (6)$$

$$TG_i = FT_i - AT_i \quad (7)$$

where E_i and A_i are measured by equation 1 and 4, respectively. The tax gap (TG_i) is therefore the difference between Equation 5 and 6. However, to facilitate interpretation of the tax gap measure that is inline with the evasion and avoidance measure constructed above, we use the tax gap per income TG_i/W_i which can be written in the reduced form as the sum of normalized evasion and avoidance measures multiplied by the tax rate ($TG_i/W_i = \tau * (E_i + A_i)/W_i$). The interpretation of the tax gap per earning measure is simply the proportion of income of subject i contributing to the tax gap via evasion and avoidance.

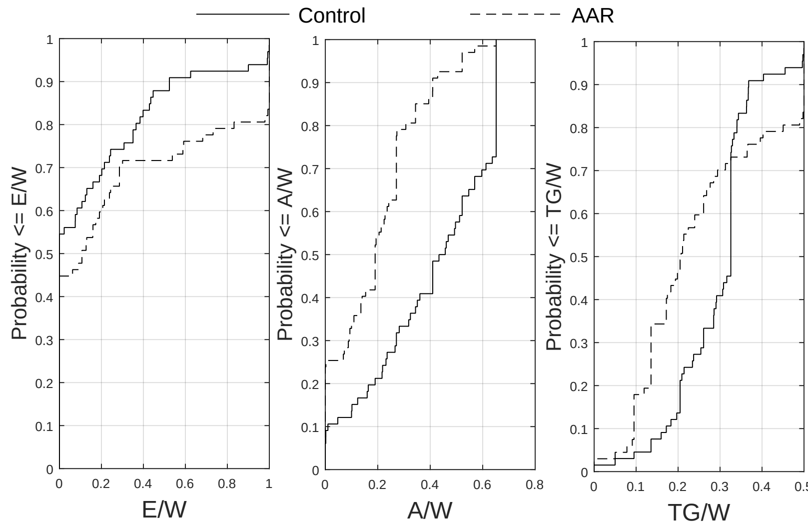
4.2. Main Results

We discuss first the plots of the overall distribution of evasion, avoidance and tax gap measures in the control and the AAR condition. Figure 2 depicts the control condition with a bold line and the AAR treatment with a dashed line. We see that the evasion measure in the AAR treatment is everywhere below the evasion measure in the control, which shows that the overall distribution has shifted to the right. Specifically, for any point in the distribution, say x, the proportion of the sample evading (as a proportion of income) more than x is higher in the AAR condition than in the control: evasion increases uniformly from control to the AAR condition. Put another way, the evasion measure in the AAR condition first order stochastically dominates the evasion measure in the control. As expected under our design, the opposite is true when we look at the avoidance measure in the two conditions.

The distributional plots for the tax gap measures show that unlike the evasion and avoidance measures, the effect of AAR condition is not uniform. Therefore, there is only second order stochastic dominance evident for the tax gap measure in the control. This weaker result is driven by the opposing effects of evasion and avoidance inherent in the AAR.[19] The distributional analysis suggests caution in interpreting the average effect of AAR on the tax gap since the distributional plots show that the effect is not uniform.

[19]The tax gap CDF for the control has a large increase when it crosses the tax gap CDF of the AAR condition, reflecting that there is a maximum of 10 tasks allowed in our setting. While the large increase effects the point at which the CDFs cross it is important to note that the CDFs will always cross as long as the taxpayer cannot avoid all income and the avoidance CDF for the control has a lot of mass to the left

Figure 2: Cumulative Distributions of Evasion, Avoidance and Tax Gap



Note: In the three panels we illustrate the CDF for avoidance, evasion and the tax gap in the control (bold line) and AAR (dashed line) condition, respectively in our data. Kolmogorov-Smirnov test further confirms that the null hypothesis that the CDFs for avoidance and evasion across control and AAR condition are drawn from the same distribution is rejected at 5% significance level.

To complement our analysis from the distributional plots, we also provide the descriptive statistics for evasion, avoidance and the tax gap measures in the control and the AAR conditions for our between sample in Table 1 and Figure 3.

Table 1: Between Summary Table

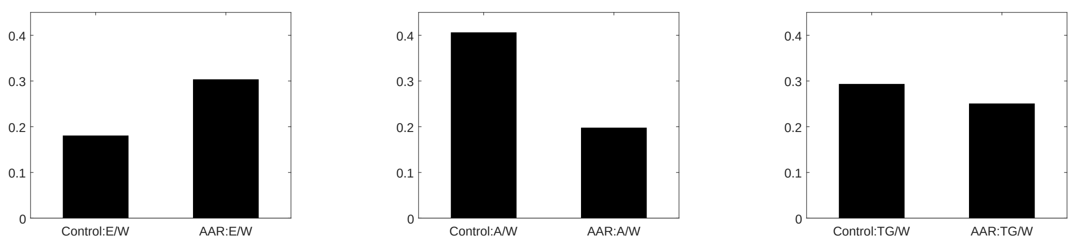
				P Values		
Measure	Treatment	Mean	SD	T Test	Fisher Exact	N
$\frac{Avoidance}{Earning}$	Control	0.4057	0.2251	0.0000	0.0000	66
	AAR	0.1973	0.1645			67
$\frac{Evasion}{Earning}$	Control	0.1801	0.2843	0.0410	0.0221	66
	AAR	0.3030	0.3930			67
$\frac{TaxGap}{Earning}$	Control	0.2929	0.0974	0.0220	0.0204	66
	AAR	0.2445	0.1673			67

Three observations stand out. First, our average evasion measure significantly increases (from 0.18 to 0.30) while our average avoidance measure reduces significantly (from 0.40 to 0.20) from control to treatment. To test for randomness and a meaningful difference across our control and AAR condition variables, we use two statistical tests: Fisher exact test (which tests the null hypothesis of non-random association between our 2 categorical

and the evasion CDF for the AAR condition has a lot of mass to the right.

variables – being in the control or AAR conditions), and unpaired t-test (which tests the null hypothesis that the means for the control and AAR are equal). Based on these tests, we reject the null hypothesis at 5% significance level and therefore it is clear that significant and meaningful differences across the control and the ARR treatment exist. Third, the aforementioned statistical tests show that the tax gap measure has significantly reduced in the AAR condition. We also illustrate these conclusions in Figure 3 and in the online Appendix we also provide formal regression analysis which controls for subject specific characteristics, and confirms our aforementioned results.

Figure 3: Bar Graph: $\frac{Evasion}{Earning}(\frac{E}{W})$, $\frac{Avoidance}{Earning}(\frac{A}{W})$ & $\frac{TaxGap}{Earning}(\frac{TG}{W})$



(a) $\frac{Evasion}{Income}$ (b) $\frac{Avoidance}{Income}$ (c) $\frac{TaxGap}{Income}$

Note: The average difference between the control and AAR condition for all variables is statistically significant at less than 5% level.

5. Interpretation of Results

The empirical evidence from the previous section showed that a reduction in tax avoidance goes hand in hand with an increase in fraudulent tax evasion activity in response to the AAR (substitution effect of AAR). This result is qualitatively but not quantitatively inline with the expected value calculations based on linear utility (risk neutrality) which predicts only corner solutions for evasion, which is not consistent with our empirical findings. We therefore study the predictions of a model with risk aversion (EU model) and explore the extent of the substitution under this framework (relative to our empirical findings).

5.1. Evasion Behavior

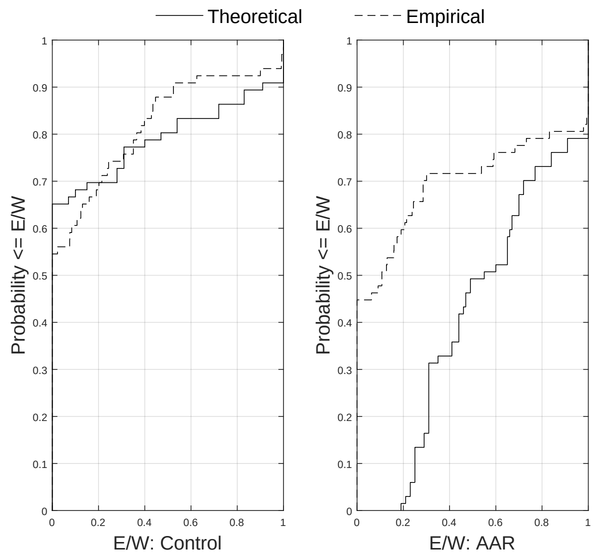
To analyze how well our evasion result is explained by the EU framework we perform a simulation exercise in which we simulate the data for evasion and compare the simulated data with our empirical data. For the simulated data we use the exogenous parameters from the experimental design such as the probability of audit and the tax rate, as well as using additional exogenous information (collected as part of our experiment) on taxpayer's income and risk aversion. The evasion data is then simulated using the experimental data for tax avoidance from the control and AAR conditions under the assumption that the underlying data generating process comes from an EU model with constant relative risk aversion (CRRA). Although the amount of avoidance in our experiment is chosen endogenously, exploiting this data for our simulation exercise allows us to theoretically study the quantitative effect of AAR on evasion and subsequently the extent of the substitution effect.[20]

We depict the simulated data as a cumulative density function (henceforth "theoretical CDF") in panel 1 of Figure 4 for the control condition and panel 2 of Figure 4 for the AAR condition. To facilitate comparison we also plot the cumulative density function for our experimental data (henceforth "empirical CDF") in each of the sub figures. We quantify the distance between the empirical CDF and theoretical CDF using the Kolmogorov-Smirnov test (henceforth "KS statistics"). This statistical test allows us to test the null hypothesis that the empirical sample is drawn from the same distribution as the theoretical sample. Based on the test statistics we are unable to reject our null hypothesis for the control but we reject the null hypothesis for the AAR condition at 5% significance level. This means that the control matches the theoretical predictions well whereas the AAR condition does not. Specifically, in the AAR condition there is a systematic and a significant deviation in the evasion behavior in our data compared to the theoretical prediction such that there is always lower evasion in our empirical data than what the EU theory predicts. Hence, in response to AAR the degree of substitution between evasion and avoidance in our data is weaker than predicted by the EU model.

What can explain the relative weak substitution between evasion and avoidance in our experimental data relative to the EU based predictions? One extension of the model that can bring the theoretical data closer to the empirical data is by introducing a tax morale cost. Experimental evidence based on the classic evasion problem of Allingham and Sandmo (1972) – such as Andreoni et al. (1998) and Slemrod and Yitzhaki (2002) – has previously shown that only 30% of taxpayers evade taxes despite positive expected return from evasion. Extended EU models (see for e.g., Benjamini and Maital, 1985; Gordon, 1989; Dhami and Al-Nowaihi, 2007) which include a morale cost of evasion can accommodate such behavior as they rationalize corner solutions in which some taxpayers do not evade any amount of income. Panel 2 shows a key difference between the theoretical and the empirical data in the AAR condition: we observe significant amount of subjects who evade nothing which cannot

[20] See Appendix A for details on the simulation procedure.

Figure 4: EU: Cumulative Distributions of Evasion



Note: In the two panels we illustrate the theoretical CDF (bold line) based on the EU framework and the empirical CDF (dashed line) for the control and AAR condition, respectively. Kolmogorov-Smirnov test further confirms that the null hypothesis, i.e., the theoretical and empirical data are drawn from the same continuous distribution, cannot be rejected for the control condition but rejected for the AAR condition, at 5% significance level.

be accommodated even using a simple EU framework.

To show that adding a tax morale cost can provide additional behavioral structure to the EU framework which facilitates matching our data better, we extend the the framework (henceforth "EU morale cost") as follows:

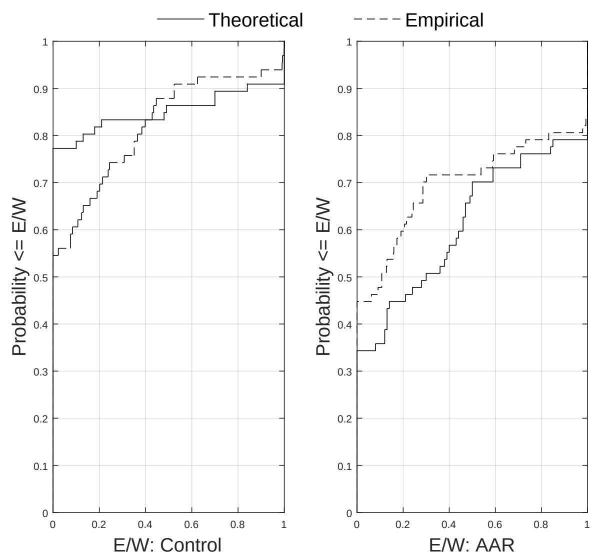
$$\begin{aligned} EU^C &= 0.7u(Y) + 0.3u(Z) - c(\bar{T}) - V(E), \\ EU^A &= 0.7\left[\left(\frac{11-\bar{T}}{11}\right)u(Y) + \left(\frac{\bar{T}}{11}\right)u(Y')\right] + 0.3\left[\left(\frac{11-\bar{T}}{11}\right)u(Z) + \left(\frac{\bar{T}}{11}\right)u(Z')\right] \\ &- c(\bar{T}) - V(E) \end{aligned}$$

where $\bar{T}$ is the number of tasks pinned down from the data, $u(x) = \frac{1}{1-\theta}x^{1-\theta}$ is the CRRA utility function where θ denotes the measure of relative risk aversion, and $V(E)$ is a tax morale cost that is a positive function of the quantity of evaded income. The theoretical and empirical CDFs where the EU morale cost model has a linear cost, $V(E) = 0.027E$, are shown in Figure 5.[21] The CDFs illustrate that such a cost can match the simulated

[21] The cost function $V(E) = 0.027E$ is one of many that can match the data better than the EU model without a cost and is used here simply to illustrate the potential of such cost to better match theory and data. However, there are two features of the function that are appealing more generally: (1) it is increasing

data with our empirical data for the AAR condition. In particular, the KS statistics reveal that the theoretical and empirical CDFs are now indistinguishable from each other at 5% significance level. However, we do observe some deviation in the lower values of evasion in the control and AAR condition (left tail of the distribution).

Figure 5: EU morale cost: Cumulative Distributions of Evasion



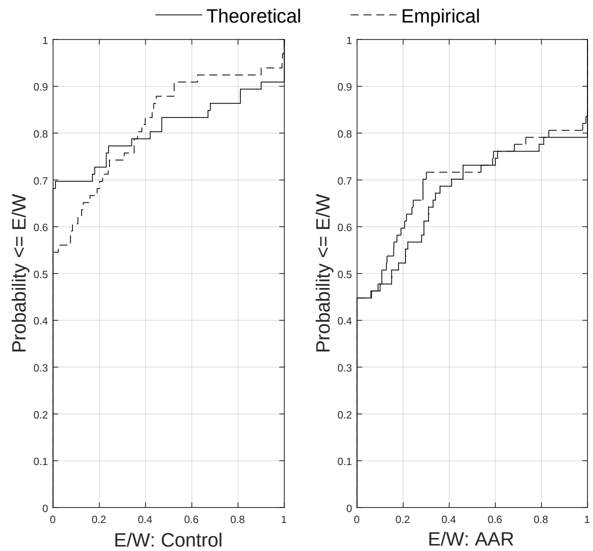
Note: In the two panels we illustrate the theoretical CDF (bold line) based on the EU Morale cost framework and the empirical CDF (dashed line) for the control and AAR condition, respectively. Kolmogorov-Smirnov test further confirms that the null hypothesis, i.e., the theoretical and empirical data are drawn from the same continuous distribution, cannot be rejected for the control and AAR conditions, at 5% significance level.

In the simulated data (based on the EU morale cost model) the frequency of non-evaders in the control is 78%, while in the empirical data the frequency of non-evaders is about 55%. Therefore, while overall the model with a morale cost matches our data better, the morale cost alone is unsuccessful in perfectly matching the control data for the left tail of the distribution. One way to improve the fit between theory and data in this regard is to allow for a lower morale cost in the control than in AAR condition, reducing the amount of non-evaders in the simulated control data. A possible behavioral rationale for a lower costs in the control may be, for example, that without ARR reducing tax payments through avoidance is not punished so that taxpayers also see other means of reducing taxes as more justified and they thus have a lower morale cost of evasion. On the other hand, the fact that the AAR punishes avoidance reinforces a norm that reducing taxes by other means is also not justified, leading to a higher morale cost of evasion. We present the theoretical and

in evasion, such that for every dollar evaded, there is 27 cents cost due to tax morale, and (2) when there is no evasion there is no cost.

empirical CDFs with different morale cost in the EU framework in Figure 6.[22] KS statistics also deliver the test results which confirm that the null hypothesis of similar distributions in the control and AAR cannot be rejected at 5% significance level.

Figure 6: EU morale cost: Cumulative Distributions of Evasion



Note: In the two panels we illustrate the theoretical CDF (bold line) based on the EU different Morale cost framework and the empirical CDF (dashed line) for the control and AAR condition, respectively. Kolmogorov-Smirnov test further confirms that the null hypothesis, i.e., the theoretical and empirical data are drawn from the same continuous distribution, cannot be rejected for the control and AAR conditions, at 5% significance level.

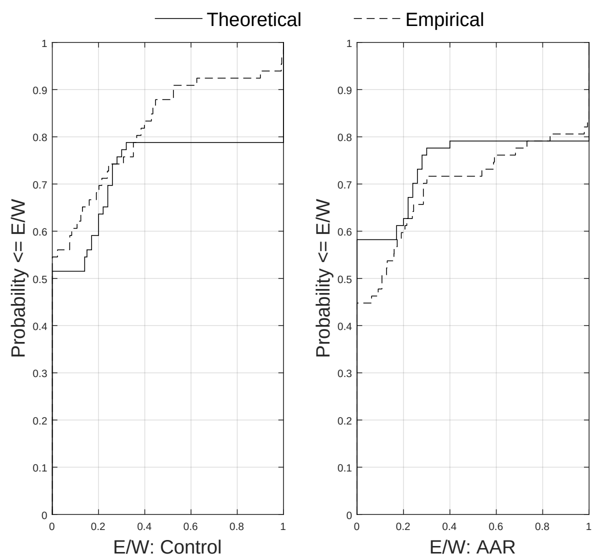
Another potential explanation for the weak evasion in our empirical data relative to the simulated theoretical data based on EU model, is that a proportion of our subjects may have made the decisions about evasion and avoidance in isolation (narrow bracketing) instead of making the decisions jointly (broad bracketing) and did not take the interaction between evasion and avoidance fully into account. Rabin and Weizsäcker (2009) provide experimental evidence that subjects who face multiple decisions tend to choose an option in each case without fully accounting for other decisions and circumstances (referred as exhibiting narrow bracketing). As a result, there is a violation from the predictions under the traditional expected utility model such that a decision maker makes choices that are first order stochastically dominated.

To explore the effect of narrow bracketing, we simulate the data based on EU morale cost framework when taxpayers ignore avoidance decision while making the evasion decision. Note that under this framework there should be no treatment effect since the decision maker ignores the avoidance decision while making the evasion decision, however comparing the

[22] In particular the cost function for the control is 0.006E while for the AAR is 0.04E.

simulated data on evasion with the empirical data in Figure 7 we find an interesting effect. The narrow bracket model seems to perform well for the lower evasion amounts (left tail of the distribution) in the control and for higher evasion amounts (right tail of the distribution) for the AAR. This result is consistent with the fact that we observe a treatment effect in the aggregate data and suggests that if a proportion of subjects did narrow bracket it occurred at different extremes of evasion behavior across the control and the treatment.[23]

Figure 7: Narrow Bracket: Cumulative Distributions of Evasion



Note: In the two panels we illustrate the theoretical CDF (bold line) based on the EU morale cost & narrow bracket framework and the empirical CDF (dashed line) for the control and AAR condition, respectively. Kolmogorov-Smirnov test further confirms that the null hypothesis, i.e., the theoretical and empirical data are drawn from the same continuous distribution, is rejected for the control condition but cannot be rejected for the AAR condition, at 5% significance level.

5.2. Tax Gap

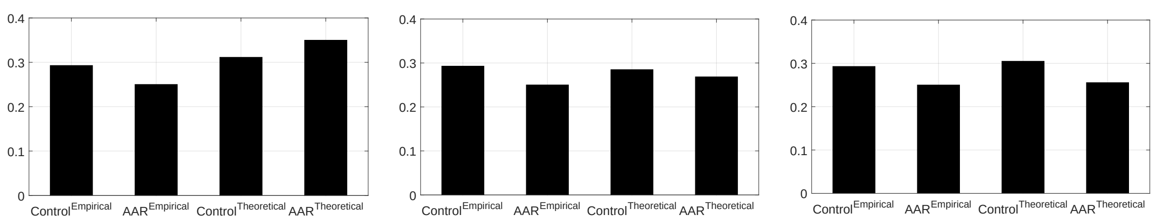
In this section we now study how our theoretical analysis translates to the tax gap measure and how well it matches our empirical findings. Since the morale cost based theoretical frameworks were most successful in explaining our empirical data for evasion and for reasons of brevity, we focus our analysis for the tax gap on the morale cost framework only.

[23]The income effect is muted under the assumption of a CRRA functional form of utility in the EU tax morale framework, therefore to explore if income effect plays an important role, we replace the functional form of utility with an exponential function. Like CRRA based EU tax morale framework, we observe that the mentioned framework matches the AAR condition relatively well and not as well for the control condition for lower amounts of evasion. In particular, in the control condition empirical data show less frequency of zero evasion than that from the theoretical data based on the exponential EU tax morale framework. We suppress the CDFs from this exercise to save space.

Figure 8(a) shows the average tax gap in the control and the AAR condition for the EU model, Figure 8(b) for the EU morale cost model and Figure 8(c) for the EU different morale cost model. In each of the figures, we also provide the average tax gap in the control and AAR condition in our empirical data to facilitate comparison. From Figure 8(a) we see that, contrary to the empirical findings, the tax gap increases from the control to the AAR condition for our EU model as the increase in evasion dominates the reduction in avoidance leading to an increase in the tax gap. In contrast, Figure 8(b) and Figure 8(c) show that inline with our experimental data the tax gap instead decreases for the morale cost models as the reduction in avoidance dominates the increase in evasion. Moreover, EU different morale cost framework appears to perform the best amongst the other alternatives.[24]

The implication of this result is that policymakers using the EU based model for theoretical predictions may mistakenly conclude that AAR will be ineffective in reducing the tax gap. However, behavioral reasons, such as tax morale, which inhibit taxpayers' substitution to evasion under AAR translates into significantly decreasing tax gap. Adding tax morale cost to a standard model can accurately predict this outcome.

Figure 8: Bar Graph: $\frac{TaxGap}{Earning}$



(a) EU

(b) EU morale cost

(c) EU different-morale cost

Note: First and second bar in Figure 8(a) – 8(c) are the average tax gap in the control and the AAR condition in our empirical data. Third and fourth bar in the same graphs are the average tax gap in the control and the AAR treatment based on EU, EU morale cost and EU different-morale cost framework, respectively.

Finally, since policymakers are likely to be interested in the welfare implications of AAR and not only its effect on the size of the tax gap, it is important to note that in our design avoidance and evasion have very different effects on deadweight loss. Since avoidance involves a resource cost and evasion does not, switching from avoidance to evasion due to ARR should

[24] CDFs and the corresponding KS statistics (not included in the paper to save space) also show that under the EU framework, the simulated tax gap data for the control matches well with the empirical data but this is not the case for our AAR condition. Like evasion analysis provided in the last section, the simulated data for the tax gap using the additional morale cost in the standard EU framework – the EU morale cost model – matches better for both the control and the AAR condition with our empirical data. Moreover, a model with different morale cost for the control and AAR in the standard EU framework – the EU different morale cost model – appears to perform the best. We suppress the CDF plots for brevity.

reduce these costs and deadweight loss should fall due to the policy. However, as noted by Chetty (2009) for risk averse evaders the uncertainty around potentially being audited also constitutes a resource cost so the strength of this effect on the deadweight loss will be diminished for risk averse taxpayers. Moreover, since the AAR creates uncertainty in the benefit of avoidance in our setting it may also increase deadweight loss by generating an additional resource cost in the avoidance decision. Therefore, while in our design the effect of AAR on welfare is quite stark for risk neutral taxpayers, it is less clear exactly how strong the welfare effect of ARR will end up being if one takes risk aversion into account.

6. Conclusion

Recently policymakers have been actively discussing and pursuing policies to reduce the tax gap by targeting aggressive tax avoidance. Despite these policy debates, there has so far been limited systematic studies to evaluate the efficacy of these policies on the overall tax compliance. Partly the lack of systematic study is due to the challenges of measurement and identification issues posed while conducting observational or field experiment studies. In light of these challenges, our paper uses a controlled laboratory experiment to inform policymakers of the potential behavioral effects and policy implications of anti-avoidance rules (AAR).

Our analysis points out two main implications of AARs. First, we highlight the substitution effect of AARs: reduction in avoidance goes hand in hand with an increase in evasion. Second, this inherent substitution effect hampers the effectiveness of AAR in terms of reducing the tax gap: while the overall tax gap is lower because of AAR, the potential increase in tax revenue from the successful reduction in tax avoidance is at least partially offset by higher tax losses from evasion. These results are consistent with the theoretical predictions based on an EU framework with an additional behavioral feature of tax morale cost.

Our work makes three main contributions. First, our work augments the standard evasion problem with an effort based tax avoidance problem which allows us to study the problem of evasion and avoidance jointly. Second, the experimental study provides insights about the extent of substitution between avoidance and evasion in a controlled environment that circumvents the measurement issues due to lack of available observational data. Finally, our work highlights the importance of behavioral features which play a significant role in understanding the potential economic effects of AAR on the tax gap.

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A. Appendix: Step by Step simulation procedure

Two samples of data for evasion and tax gap are used in Section 5.

1. Construction of sample 1: Sample 1 referred as the empirical/experimental data is simply our data collected under our experimental design setting.

2. Construction of sample 2: Sample 2 referred as the theoretical/simulated data is constructed using the following steps:

   (a) Exogenous parameters (the probability of audit (p), the tax rate (τ)), subject specific parameters (risk aversion (θ) and the income earned (W)) and subject specific number of avoidance tasks (T) are taken as given. We call these "inputs" in the following steps.

   (b) Given these inputs, for each subject i we construct the amount of evasion (E) based on the optimization of our theoretical framework (which is either (a) EU framework, (b) EU Morale cost framework, (c) EU different Morale cost framework, or (d) EU Morale cost & narrow bracketing framework). This step provides us with an artificial data of the same length as our dataset.

   (c) For the simulated control and AAR sample, the optimization problem for example for the EU framework is provided in Section 3.3 where the agent maximizes $E_C(u)$ in the control condition and $E_A(u)$ in the AAR condition with evasion E as the choice variable.

   (d) For each subject i we construct the tax gap TG by using the optimized evasion levels from step 2c and the other inputs in Equation 5 and 6.

   (e) Both E and TG are then normalized by subject's income W. These normalized variables compose our simulated data.

3. CDFs for the variables from step 2 are constructed and plotted along with the CDFs of the experimental data from step 1 for the same variables.

4. Using the two-sample Kolmogorov-Smirnov test we check the null hypothesis which is whether the empirical data and the theoretical data samples come from the same distribution. This test is applicable in our setting because the test does not specify what the underlying distribution of any of the two samples is, as is the case for us since the true distribution of the samples is unknown.

B. Appendix: Instructions and Experimental Design

B.1. Welcome

Welcome to the Experiment!

Within the scope of experimental economics research we want to conduct an experiment. You have the opportunity to earn money. How much money you will earn will depend on your decisions and chance. At the end of the experiment you will receive your earnings in cash.

Your decisions during this experiment are anonymous so matching a decision to a particular person is not possible.

If you have any question during the experiment you should open the door of your cabin and a member of the lab staff will come over to you. **Any form of communication between you and other participants during the experiment is prohibited and will lead to your immediate expulsion from the experiment**.

Todays experiment consists of four parts **“Red”, “Yellow”, “Blue” and “Green”** which are played in this order. You will only start a part of the experiment when you have completed the previous part. Experiment “Yellow” will serve as a basis for the experiments in “Blue” and “Green”. Please open your cabin door as soon as you have finished an experiment and remain seated.

Payoff structure:

Once you have completed the “Blue” experiment you will be individually invited to the room next door. There you will get your payoff from experiment “Red”. Additionally you will receive your payoff from the experiments “Yellow” and “Green” or “Yellow” and “Blue”. The determination of the combination will be random. Both combinations have the same probability.

In your cabin you will find a two sided “consent form”. This document is a requirement of the New York University Abu Dhabi, which is the funding source of this study. Please read this form care-fully and if you are in agreement, sign it.

Once you have signed this consent form or if there are any questions please open the door of your cabin and stay seated until a member of the lab staff come over to you. You may now begin with the consent form.

B.2. Red Experiment: Holt and Laury Test

Instruction for experiment part “red”’ (please write your seat number at the top right of the page)

Please choose one of the two lotteries A and B in every one of the following 10 decision situations. To do so you place a cross in the respective field in the table. Note that whether the part experiment “red” or “blue” is payoff relevant will be randomly selected later. Moreover, while you will make a choice in all 10 decision situations in this part of the experiment you will only be paid for one of the choices (as long as the part experiment “red” is payoff relevant). Which one of the 10 choices is payoff relevant will also be randomly selected.

In each decision situation the lottery A pays either 2.00 or 1.60 euro and lottery B pays either 3.85 or 0.10 euro. However, the probability of the two payoffs being realized varies from situation to situation. Specifically, the probability of the high payoff rises and the low payoff falls the further you get down the table.

After all 3 parts of the experiment are finished you will play either experiment part “red” or “blue” in the room next door. If you are randomly selected to play the “red” experiment then a computer will twice randomly draw a number between 1 and 10, first to choose one of the choices you have made in this part of the experiment to be payoff relevant and then to select your payoff from the chosen lottery. If the randomly drawn number is smaller or equal to the probability of the high payoff then you will receive the high payoff. Otherwise you will receive the low payoff.

	Lottery A	Lottery B	Your choice	
			A	B
1.	2,00 € with 10 % or 1,60 € with 90 %	3,85 € with 10 % or 0,10 € with 90 %	o	o
2.	2,00 € with 20 % or 1,60 € with 80 %	3,85 € with 20 % or 0,10 € with 80 %	o	o
3.	2,00 € with 30 % or 1,60 € with 70 %	3,85 € with 30 % or 0,10 € with 70 %	o	o
4.	2,00 € with 40 % or 1,60 € with 60 %	3,85 € with 40 % or 0,10 € with 60 %	o	o
5.	2,00 € with 50 % or 1,60 € with 50 %	3,85 € with 50 % or 0,10 € with 50 %	o	o
6.	2,00 € with 60 % or 1,60 € with 40 %	3,85 € with 60 % or 0,10 € with 40 %	o	o
7.	2,00 € with 70 % or 1,60 € with 30 %	3,85 € with70 % or 0,10 € with 30 %	o	o
8.	2,00 € with 80 % or 1,60 € with 20 %	3,85 € with 80 % or 0,10 € with 20 %	o	o
9.	2,00 € with 90 % or 1,60 € with 10 %	3,85 € with 90 % or 0,10 € with 10 %	o	o
10.	2,00 € with 100 % or 1,60 € with 0 %	3,85 € with 100 % or 0,10 € with 0 %	o	o

B.3. Yellow Instructions

Instructions Experiment "Yellow"

Please read the instructions carefully. If you have a question, please open the door of your cabin and remain seated. An experimenter will come to you. The experiment will be performed on a computer. In experiment "Yellow" you will earn income. This income is your basis for the following two experiments. Your final payoff from experiment "Yellow" can only be determined after you have finished all experiments.

If you have a question, please open the door of your cabin and the experimenter will come to you.

If you are sure that you have no more questions regarding experiment "Yellow" press "Start".

In the experiment, we will use lab dollars and the conversion of the lab dollar to euro is 100 lab dollars = 1 Euro.

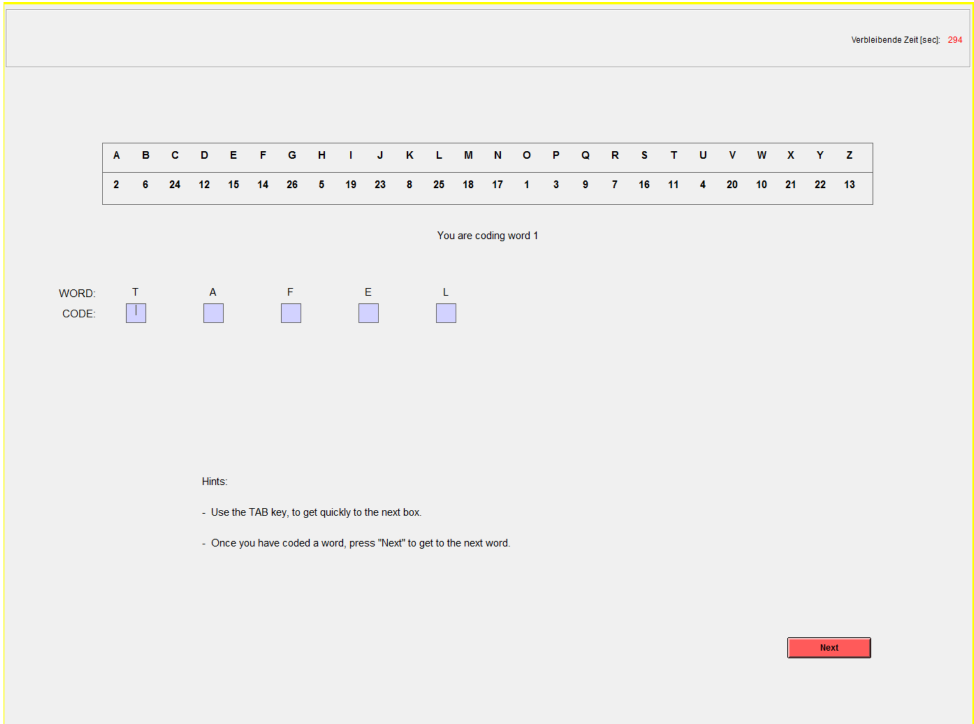
Screen 1 Experiment "Yellow":

In the experiment, you are responsible for earning an income using task 1. Task is described below:

What you see on the screen is a table which contains letters and associated numbers with each letter. You will see a word given to you on the computer. Using the table, encrypt the letters into numbers. You have to type the number in the space below the letter.

On the back page you find an example. In the experiment there will be another association of letters and numbers.

As soon as you are finished with experiment "Yellow" you will get instructions for the next Experiment. **Please open the door of your cabin, when you are done with Experiment "Yellow"'.**



1. **Fill in the numbers:**

   Then below T you insert 11, below A you insert 2, below F you insert 14, below E you insert 18 and below L you insert 25.

2. **Click OK:**

   After this, you must click OK to earn your income. Only a complete word encrypted will earn you your income.

3. **Mistake in typing:**

   If you fill something incorrectly, the computer will give you a warning that something is wrong and you will have to fix it before you can proceed to the next word to earn more income.

4. **Earning per word:**

   You will earn 70 lab dollars per word (which is equivalent to 0.70 Euros)

5. **Time for the task:**

   You will be allowed to earn as much as you can in 5 minutes. After 5 minutes the task ends.

Any Questions?

Press “Start”.

B.4. Blue Instructions

Instructions Experiment “Blue”

Please read the instructions carefully. If you have a question, please open the door of your cabin and remain seated. An experimenter will come to you. The experiment will be performed on a computer.

In experiment “Yellow” you earned income. In experiment “Blue” a tax on you income is due. Experiment “Blue” will consist of two rounds. The first round of the experiment is a practice round. The practice round of the experiment gives you the opportunity to make sure you understand the types of tasks you have to perform, the decisions you will make, and how it will affect your earnings. The total amount of money you will earn today will be given to you at the end of the experiment. The practice round does not count towards your final earnings. Remember that your payoff will come either from the “Blue” experiment or from the ”Green” experiment. The determination of the payoff relevant experiment will be selected by chance. Read the instructions carefully before you start the practice round. Again, note that the practice round will not count towards your payoff.

In the experiment, we will use lab dollars and the conversion of the lab dollar to euro is 100 lab dollars = 1 Euro.

Screen 2 DECLARATION OF INCOME

At the beginning you will find your income from experiment “Yellow”.

There is a tax of 50% due on your income. This tax is only due on the income which you report in you declaration. No matter how much income you decide to report, there is an exogenous probability of audit which is set at 30%. This means that an average of 3 people out of 10 will be audited. None of your decisions determine whether you will be audited or not. The audit probability is random.

If you get audited and you declared your true income, there will be no consequences for you. If you declared less than your true income and you get audited, the part of you income that you have not declared will be fully retained (i.e. there is a penalty of 100% on the non-declared income).

Before you declare your income you can check your potential final payoff with the help of the tax calculator. Enter the income you want to declare and the repetitions of task Alpha (task Alpha is explained on the next pages). All your statements in the tax calculator are non-binding and serve only as aid to you.

In the next box, you are asked to declare your income. This declared income is binding and is used to calculate your tax and your income after tax. You are allowed to report your true income or to underreport your income.

The possible audit only takes place at the end of the experiment. Whether you are audited or not will be randomly chosen at the end of the experiment.

At the bottom of the screen, the experiment also gives you an opportunity to exempt parts of your income from the tax. This means you have to pay less tax and your payoff increases. You therefore need to make a decision whether to undertake task alpha (explanation follows) or to end the experiment. Note that task Alpha will require you to exert effort.

Please make sure you understand task Alpha before you make this decision.

1. textbfDecision Do you want to avail reduction in taxes by exerting an effort in task

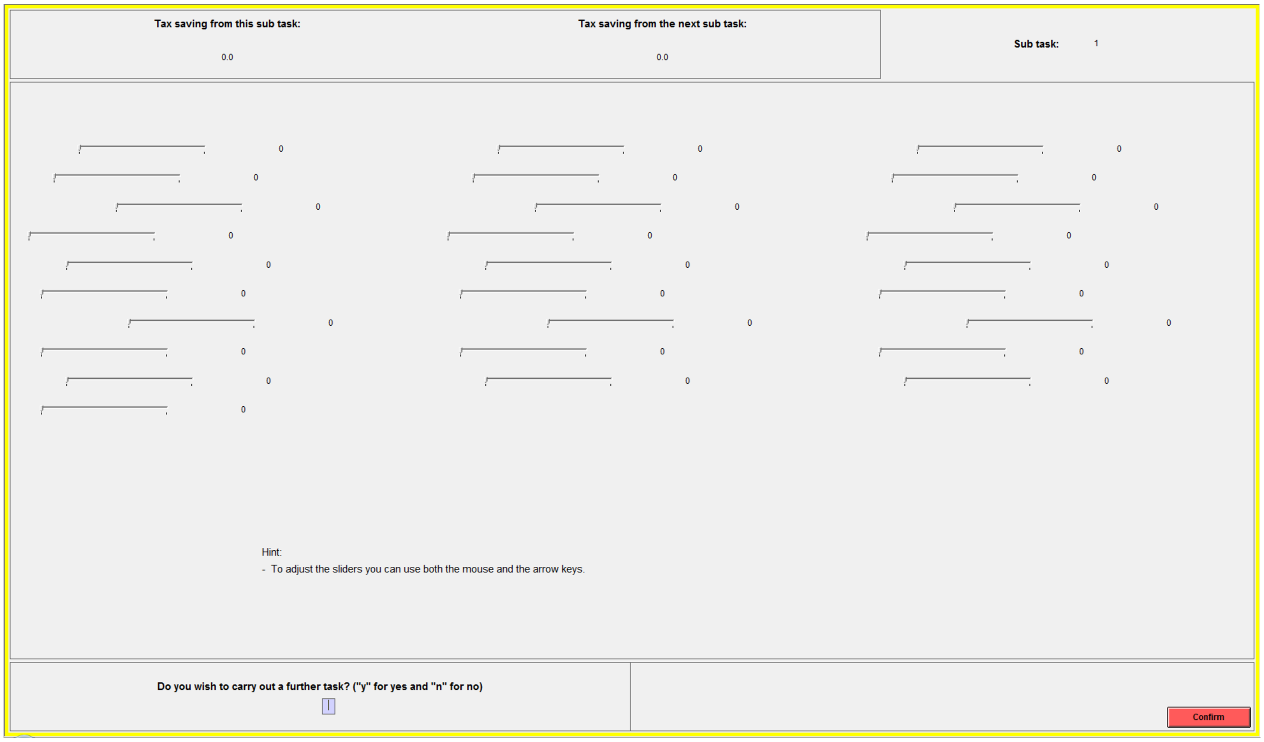
Alpha?

- If you say No (enter ”N”), screen 4 will appear.
- If you say Yes (enter ”Y”), screen 3 will appear.

Screen 3 TASK Alpha:

If you say yes, you will see screen 3. This screen asks you to exert effort.

1. **Task Alpha:**
    - Your task is to move the slider to the middle such that the number next to each slider signifies that you are exactly at 50. You can do this by either using the mouse and/or by clicking on the slider and moving the slider forward or backward with a forward arrow and back arrow on your keyboard. You must do all the sliders to be qualified for a reduction in taxes paid.
    - The reduction of you tax burden ensues by a reduction of your taxable income by 10%. This means 10% of your income is tax-free.
2. **Decision:**
    - After you have successfully fulfilled the task, you make a decision whether you want reduce your tax burden further by undertaking another task Alpha. By doing this you will reduce your taxable income by another 10%. Please note, your taxable income is already reduced, therefore the 10
    - See the screen below:



3. **Confirm:**

   You are then asked to confirm the following information that is provided on the screen:

   - Tax reduction for this task: This task will decrease your tax by this amount (and your income will increase by this amount). Equal to: (declared income)*0.1*0.5.
   - Tax reduction for the next task: The next task will decrease your tax by this amount. If want to avail another task enter "Y" and click on "confirm". If you do not want to avail another task enter "N" and click on "confirm".

4. **Mistake**

   In case you did not put the slider exactly on 50, you will see a warning and you can correct the mistake.

5. **Repetitions**

   You can avail task Alpha a maximum of 10 times. In the exercise round you are only allowed to avail this task once.

Screen 4: Possible Audit

Once you decide you do not want to reduce your tax payment further from task Alpha, you will be audited with the probability of 30%. Following this your payoff from experiment "Blue" is shown.

Are there any questions?

Please click on the screen "Start Practice round".

B.5. Green Instructions

Instructions Experiment “Green”

Please read the instructions carefully. If you have a question, please open the door of your cabin and remain seated. An experimenter will come to you. The experiment will be performed on a computer.

In experiment “Yellow” you earned income. In experiment “Green” a tax on you income is due.

Experiment “Blue” will consist of two rounds. The first round of the experiment is a practice round. The practice round of the experiment gives you the opportunity to make sure you understand the types of tasks you have to perform, the decisions you will make, and how it will affect your earnings. The total amount of money you will earn today will be given to you at the end of the experiment. The practice round does not count towards your final earnings. Remember that your payoff will come either from the “Green” experiment or from the “Blue” experiment. The determination of the payoff relevant experiment will be selected by chance. Read the instructions carefully before you start the practice round. Again, note that the practice round will not count towards your payoff.

In the experiment, we will use lab dollars and the conversion of the lab dollar to euro is 100 lab dollars = 1 Euro.

Screen 2 DECLARATION OF INCOME

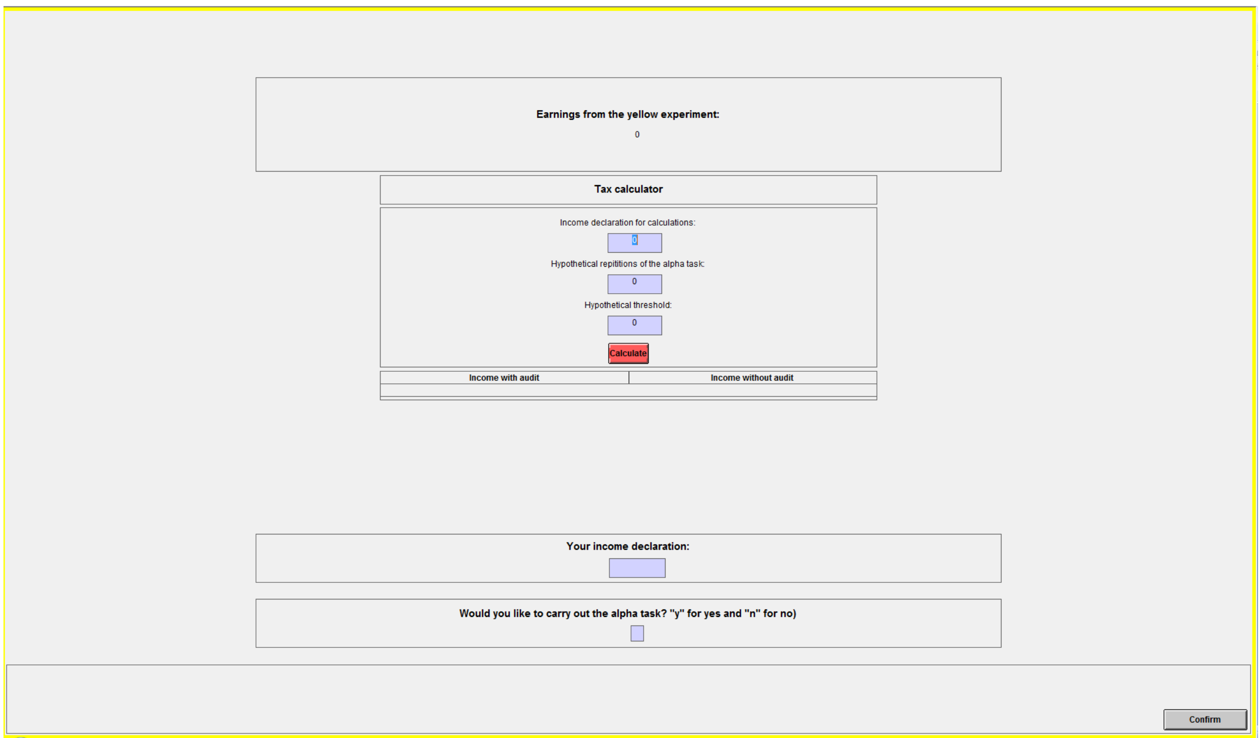
At the beginning you will find your income from experiment “Yellow”. There is a tax of 50% due on your income. This tax is only due on the income which you report in you declaration. No matter how much income you decide to report, there is an exogenous probability of audit which is set at 30%. This means that an average of 3 people out of 10 will be audited. None of your decisions determine whether you will be audited or not. The audit probability is random.

If you get audited and you declared your true income, there will be no consequences for you. If you declared less than your true income and you get audited, the part of you income that you have not declared will be fully retained (i.e. there is a penalty of 100% on the non-declared income).

Before you declare your income you can check your potential final payoff with the help of the tax calculator. Enter the income you want to declare and the repetitions of task Alpha and a threshold (task Alpha and threshold are explained on the next pages). All your statements in the tax calculator are non-binding and serve only as aid to you.

In the next box, you are asked to declare your income. This declared income is binding and is used to calculate your tax and your income after tax. You are allowed to report your true income or to underreport your income.

The possible audit only takes place at the end of the experiment. Whether you are audited or not will be randomly chosen at the end of the experiment.



At the bottom of the screen, the experiment also gives you an opportunity to exempt parts of your income from the tax. This means you have to pay less tax and your payoff increases. You therefore need to make a decision whether to undertake task alpha (explanation follows) or to end the experiment. Note that task Alpha will require you to exert effort.

Please make sure you understand task Alpha before you make this decision.

1. **Decision**

   Do you want to avail reduction in taxes by exerting an effort in task Alpha?

   - If you say No (enter "N"), screen 4 will appear.

- If you say Yes (enter "Y"), screen 3 will appear.

Screen 3 TASK Alpha:

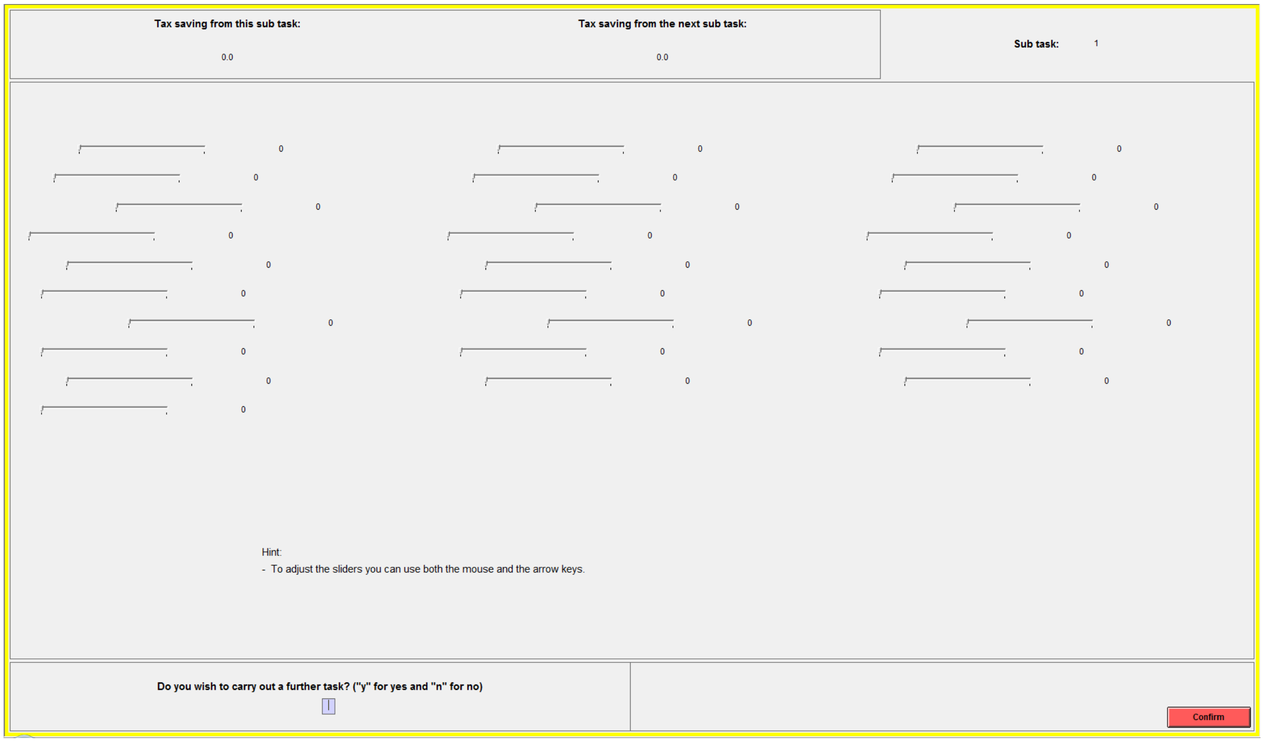
If you say yes, you will see screen 3. This screen asks you to exert effort.

1. **Task Alpha:**

   - Your task is to move the slider to the middle such that the number next to each slider signifies that you are exactly at 50. You can do this by either using the mouse and/or by clicking on the slider and moving the slider forward or backward with a forward arrow and back arrow on your keyboard. You must do all the sliders to be qualified for a reduction in taxes paid.
   - The reduction of you tax burden ensues by a reduction of your taxable income by 10%. This means 10% of your income is tax-free.

2. **Decision:**

   - After you have successfully fulfilled the task, you make a decision whether you want reduce your tax burden further by undertaking another task Alpha. By doing this you will reduce your taxable income by another 10%. Please note, your taxable income is already reduced, therefore the 10% will be based on your current income.
   - See the screen below:



3. **Confirm:**

   You are then asked to confirm the following information that is provided on the screen:

   - Tax reduction for this task: This task will decrease your tax by this amount (and your income will increase by this amount). Equal to: (declared income)*0.1*0.5.
   - Tax reduction for the next task: The next task will decrease your tax by this amount. If want to avail another task enter "Y" and click on "confirm". If you do not want to avail another task enter "N" and click on "confirm".

4. **Mistake**

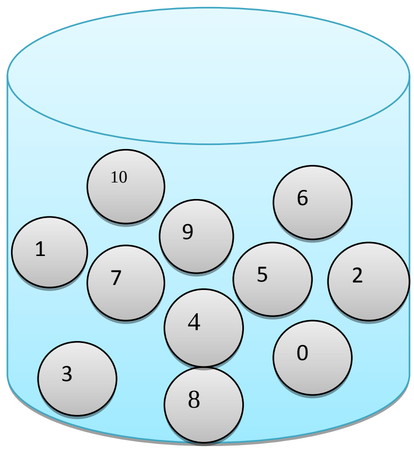
   In case you did not put the slider exactly on 50, you will see a warning and you can correct the mistake.

5. **Repetitions**

   You can avail task Alpha a maximum of 10 times. In the exercise round you are only allowed to avail this task once.

6. **Determination of the Threshold**

   Imagine the following urn with numbered balls. At the end of the experiment a computer will draw one of the balls from the urn.



Threshold for task 2 is determined using an urn shown on the right. A numbered ball is drawn from such an urn. Note that every numbered ball can be drawn with an equal probability of 1/11.

If the Threshold is **less** than the number of completed tasks Alpha, there will be no **tax exemptions.**

If the Threshold is **greater or equal** than the number of completed tasks Alpha, there will be **a tax exemption** of 10% per completed task Alpha.

The Threshold will be revealed at the end of the experiment only.

Screen 4: Possible Audit

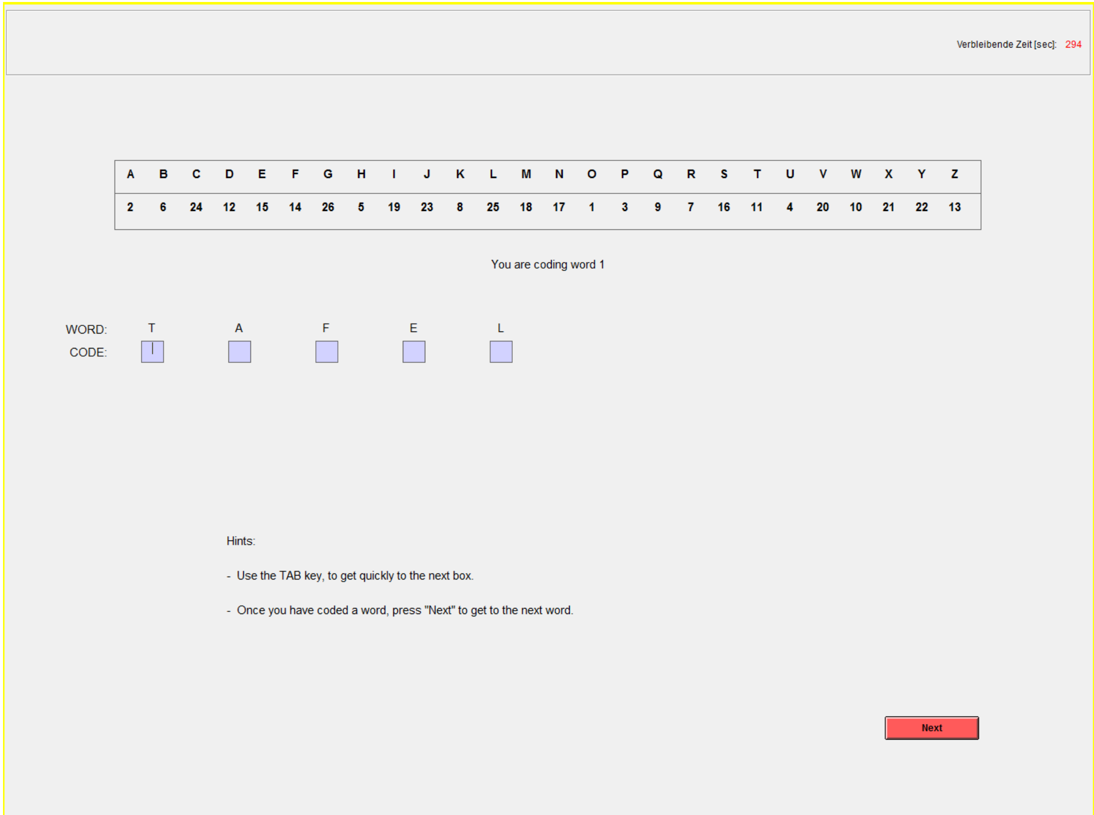
Once you decide you do not want to reduce your tax payment further from task Alpha, you will be audited with the probability of 30%. Following this your payoff from experiment "Blue" is shown.

Are there any questions?

Please click on the screen "Start Practice round"

B.6. Figures

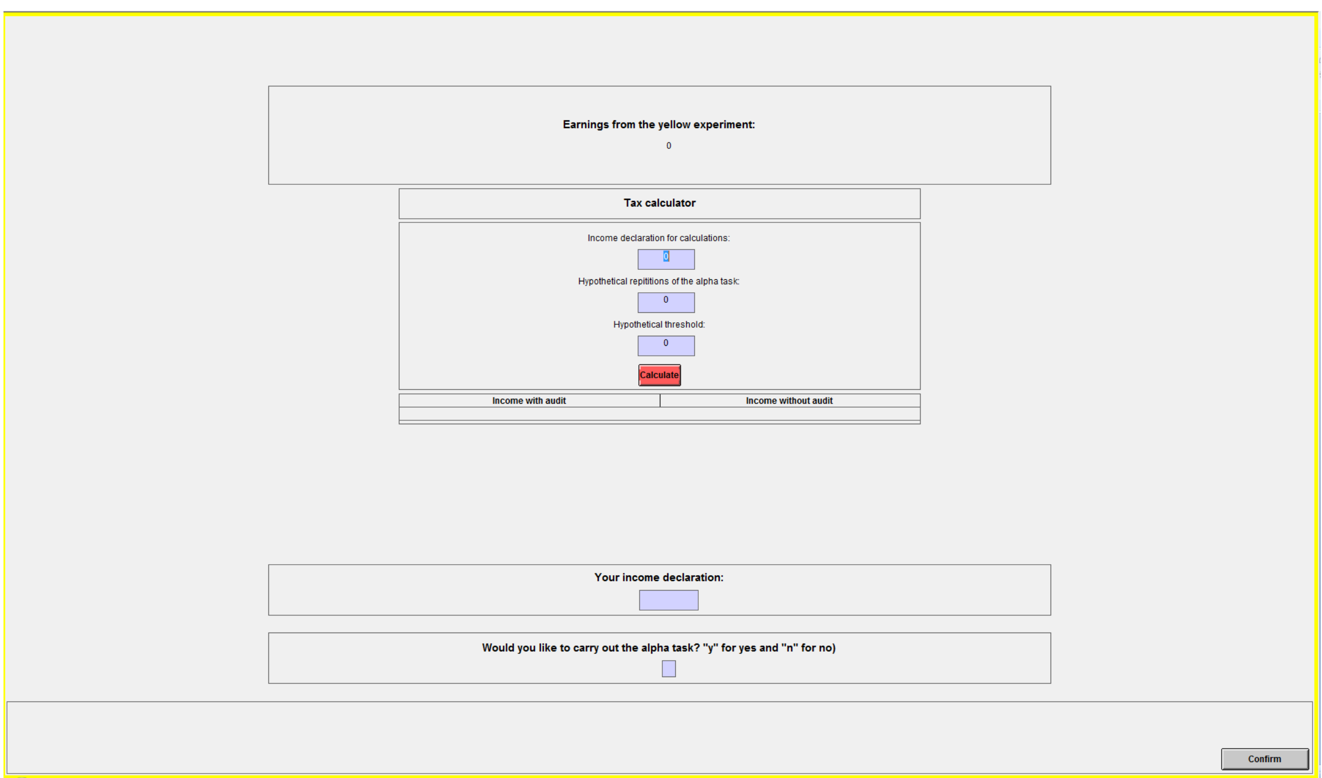
Figure 9: Step 1



Step 1 – Income generating task: requires subject to encrypt the alphabet with numbers as given in the table. Encryption of each word gives 0.7 €. There are 5 minutes to perform this task.

Figure 10: Step 2

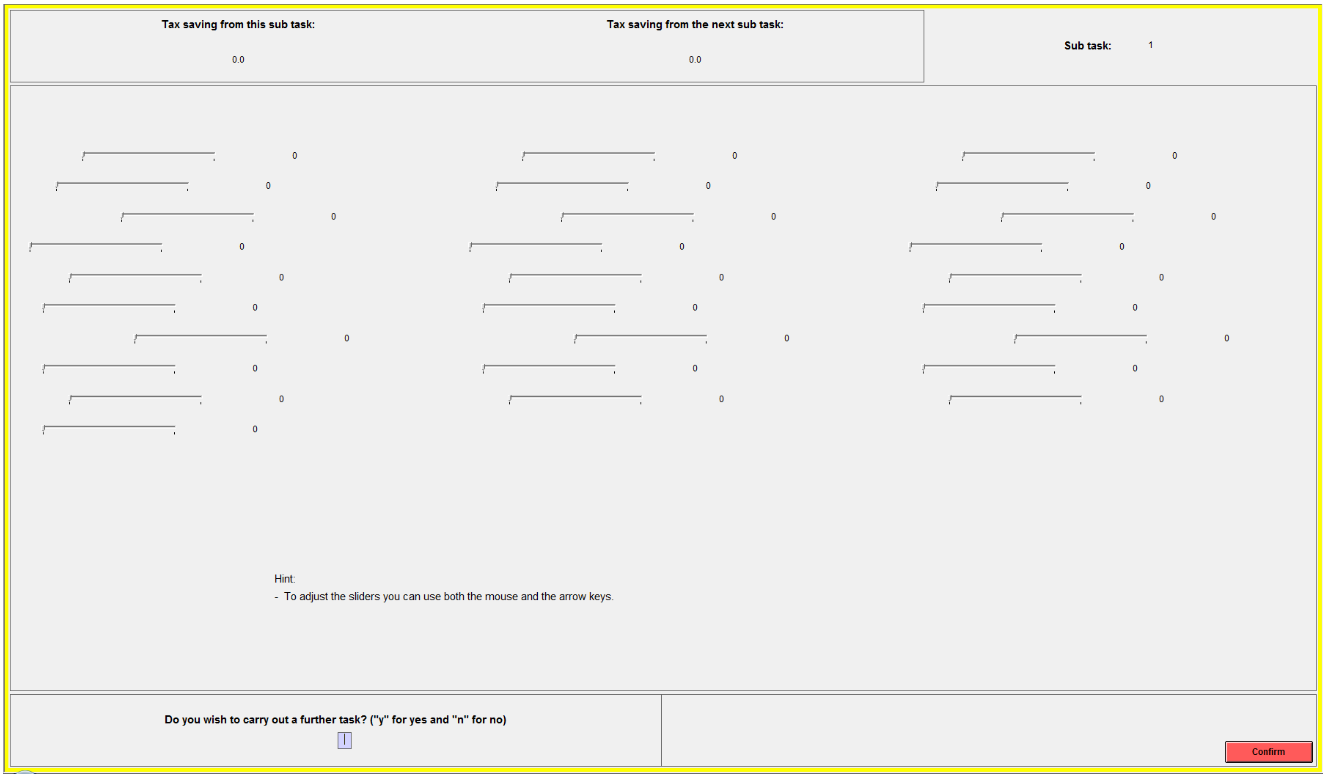
(a) Step 2: Control



(b) Step 2: AAR Treatment

Step 2 – Reporting of Income and Binary decision to undertake avoidance requires subjects to report income as well as make a decision whether to undertake avoidance task in the next step or not. Calculator is also provided in this step, which allows subjects to determine how their decisions will impact their final payment where the payment is contingent on (1) Reported income, (2) Number of avoidance task intended, (3) Audited or not, (4) in case of AAR treatment if the Threshold is X. Changing one parameter then explains how the pay-off is affected.

Figure 11: Step 3



Step 3 – Avoidance Task: requires subject to move all the sliders on the screen such that the sliders exactly match the number 50. Each avoidance task entails 10% reduction in the remaining reported income as explained in section 3