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Tax Reporting Behavior: Underreporting Opportunities and Pre-populated Tax Returns[1]

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1. Introduction

With online filing, the potential exists for the tax agency to pre-populate the individual's tax return with "known" data, such as information reported by third parties or gleaned from past returns. The set of information that can be pre-populated by the tax agency may include earnings reported by third parties such as wages, salaries and interest income; conditions required to claim exemptions or deductions (such as marriage or the birth or dependent status of a child); age; and the tenure of residency in the current location. By reducing taxpayers' costs of completing the tax form, this service may facilitate filing and accurate tax reporting, thereby enhancing tax collections.

Alternatively, pre-populating the form may lead taxpayers to devote efforts to underreporting in other ways. If these are more difficult for the agency to evaluate, the net effect may be lower overall tax collections. Taxpayers vary in terms of their opportunities for underreporting taxes and this heterogeneity will interact with the potential for the tax agency to pre-populate the tax form. Further, the information the tax agency enters may be incorrect. In this case, the taxpayer faces an interesting dilemma – to change the information or not. The behavioral response to pre-populated returns is an open question; exacerbated by the interaction

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of what we label taxpayer "type" and innate motivation or taxpayer "segment" with pre-filled forms.

While the pre-populating of the individual's tax form may be thought a beneficial service, the impacts are likely to be confounded by the taxpayer heterogeneity in underreporting *opportunities* (types). Pre-populating some of the information may result in unintended consequences that can be avoided by an understanding of the interactions of taxpayer properties and the information service.[2] We present a theoretical model of the effects on various motivations for tax reporting and suggest ways that this model can incorporate the effects of the tax agency pre-populating elements of the tax return as a taxpayer service. Theory provides some insights as to the effect but in the end, theory cannot resolve all of the competing effects described above. We test the predictions using the results from a series of laboratory experiments specifically designed to address this issue. In the theoretical development that follows we assume individuals minimize the expected costs of tax reporting and we introduce the motivations that underlie some of the taxpayer segments described above. In the experimental setting we induce taxpayer types as the opportunities for underreporting. Thus, the higher the ratio of itemized to standard deduction and the higher the fraction of total income that is not reported by third parties ("off the books" income) the greater the opportunities for underreporting. Finally, we implement the pre-filled tax form as a treatment. The design allows us to investigate the interactions across taxpayers types (objective), tax payer segments (behavioral), and pre-populated tax returns (services). We find that tax underreporting increases

[2] For example, the taxpayer may feel that if the agency is aware of the pre-populated information it may also be aware of other elements (line items on the tax form) as well, and this awareness may prompt greater compliance. Alternatively, the taxpayer may think the agency knows only what it includes on the pre-populated form and this awareness may prompt lower levels of compliance. Further, any incorrect information may be used as justification for underreporting tax liability.

when the tax forms is pre-populated and as the taxpayer's opportunities for underreporting (the less the tax agency can observe from other sources) increase. The effect of taxpayer segment is complex and not so easily summarized.

2. Theoretical Framework

a) Rational Cheater Model

The traditional model of tax compliance assumes each taxpayer is a rational cheater (Allingham and Sandmo, 1972; Yitzakhi, 1974; Scotchmer, 1989; Scotchmer and Slemrod, 1989). A taxpayer chooses, if filing, what taxes to report, x_l, on each line item, l, on the tax form.[3] Once a taxpayer has filed their tax form, it is subject to a random audit process that occurs with probability p. Audits on tax returns perfectly reveal unpaid taxes separately for each line item on the tax form. In addition to being liable for unpaid taxes, there is a constant per-unit penalty $\beta > 0$ assessed on unpaid taxes. Further, neither excessive reported income nor unclaimed deductions are revealed during an audit, and in this sense an audit is never beneficial.[4]

Let the actual tax liability on one or more line items be uncertain from the taxpayer's perspective, representing the complexity of the tax code. Let t_l^0 denote the actual tax liability associated with line item l. From the perspective of the taxpayer, tax liability is a random variable t_l with a distribution function, $F(t_l)$, which is assumed to have positive density $f(t_l)$ on the interval $[a_l, b_l]$. It is assumed that $f(t_l^0) > 0$, such that the true tax liability is considered

[3] To be clear, we use the term "line item" to denote tax owed on reported income and claimed deductions. That is, the taxpayer computes the tax liability associated with the items entered on the tax form. We assume throughout that a taxpayer chooses not to file if the optimal reporting for all line items is zero, $x_l^* = 0\ \forall l$.

[4] Tax owed is computed on taxable income thus there is a possible interaction effect. The taxpayer may report more income and more deductions while leaving tax owed unchanged. However, our audit process treats each line independently – that is, does not incorporate offsetting errors and ca not benefit the taxpayer in this way.

probable. Conditional upon filing, the taxpayer chooses the optimal tax liability to report on each line item in order to minimize her expected costs

(1) $$\min_{\boldsymbol{x}} \sum_l \left\{ x_l + p \left\{ (1+\beta) \int_{x_l}^{b_l} (t_l - x_l) f(t_l) dt_l \right\} \right\},$$

where $\boldsymbol{x} = \{x_1, \dots, x_L\}$. The optimal reporting choice, x_l*, is implicitly defined by

(2) $$F(x_l^*) = 1 - \frac{1}{p(1+\beta)} \qquad \forall l.$$

The interpretation is that the taxpayer minimizes expected cost by equating the marginal cost of reported taxes with the *expected* marginal cost of an audit.

In recent years, the tax compliance literature has augmented this traditional rational-cheater model to account for motivating factors beyond the enforcement regime. We incorporate two of these factors which we hypothesize to be relevant for interpreting data from the laboratory experiment.

b) Under-Reporting Opportunity

The rational cheater framework assumes that taxpayers may freely choose the level of taxes to report to an ignorant tax authority who can only learn a taxpayer's true liability through a random audit process. While this may be true for self-employed taxpayers, in many countries employers are legally required to report the earnings of employees to the tax authority for compliance purposes. This matching documentation severely limits a taxpayer's ability to under-report their income, since doing essentially guarantees the imposition of fines. This limits employed taxpayers that desire to evade their taxes to overstating their deductions beyond allowable amounts.

Still, taxpayers are often limited in their ability to overstate their deductions. For example, to claim exemptions for spouses and/or children their existence must be confirmed.

Moreover, there can be limits to standard deduction amounts; to claim larger deductions entails more complicated reporting requirements, such as submitting itemized claims. Thus it stands to reason that taxpayers will be more inclined to itemize in order to evade taxes when it is rational to do so (i.e., when the enforcement regime is weak such that the expected marginal penalties are relatively low, $p(1+\beta) < 1$). To summarize, limited under-reporting opportunity implies when the enforcement regime is weak, $p(1+\beta) < 1$, that the optimal reporting choice is to pay minimal taxes equal to a lower limit greater than zero, $x_l = \underline{x} > 0$.

c) Pre-Filled Information and Errors

Online filing combined with electronic record keeping introduces the possibility that the tax agency can pre-populate the individual's tax return with "known" data, such as information reported by third parties or gleaned from past returns. Let y_l denote the pre-populated value for line item l, which can either be correct, $y_l = t_l^0$, or incorrect, $y_l \neq t_l^0$. Moreover, if incorrect, pre-populated values can either exaggerate, $y_l > t_l^0$, or understate, $y_l < t_l^0$, an individual's tax liability. However, the rational cheater framework suggests these mistakes will not be viewed symmetrically from the taxpayer's point of view. Indeed, the same incentives that determine a taxpayer's optimal reporting choice, x_l*, drive their decision to correct a pre-populated value. The benefit of correcting errors that exaggerate a taxpayer's liability is the avoided excessive taxes paid. Conversely, the benefit of correcting errors that understate tax liability is the avoided expected marginal penalty, $p(1+\beta)$. Presumably, the only cost involved in correcting such errors would be the cognitive costs associated with determining the correct tax liability, which are trivial in the experiment. Hence, taxpayers should have sufficient incentive to correct either type of error. Still, as long as the expected marginal penalties are relatively low, $p(1+\beta) < 1$,

there is greater incentive to correct errors that exaggerate a taxpayer's liability relative to errors that understate tax liability. Therefore, it is possible that taxpayers respond to errors in prepopulated forms asymmetrically, correcting those that exaggerate tax liability more often than those that understate tax liability. It is an open empirical question as to the effect of pre-filled info on compliance, and hence suggests the need for empirical investigations.

3. Experimental Design[5]

a) Overview

The following section describes the experimental setting as developed for this project. Sample participant computer screens and printed instructions are included in Appendix A. Our experimental design implements the fundamental elements of a voluntary reporting system (e.g., the U.S. individual income tax). Participants earn income by performing a task and self-report their tax liability to a tax authority. Final tax liability is a function of earned income and deductions claimed. The taxpayer makes the decision of whether to file, and conditional on filing reports her tax liability.[6] If an audit occurs unreported taxes are discovered. The (random) audit process performs without error – both unpaid taxes and a penalty are collected.

We implement the use of pre-filled tax forms and investigate the effects through a set of treatments. To induce the benefits of pre-filled information the taxpayers have to make up to three entries to the tax form: Income "on the record", Income "off the record", and Tax Deductions. For the Deduction, the taxpayers have the option of claiming a Standard Deduction or an Itemized Deduction. Income "on the record" constitutes the income the tax agency has

[5] Our design follows previous work in this area such as Alm, Jackson, and McKee (2009) and Alm et al (2010). For the current research, the decision setting is expanded to emphasize the role of information services arising from tax complexity and uncertain liabilities. The details are presented below.
[6] If the individual chooses to not file, in which case the audit probability is lower but not zero.

reported to it by third parties (employers, banks, etc.) and is, thus, known to the tax agency. Income "off the record" is income not subject to third party reporting and is, thus, unknown to the tax agency absent an audit. Deductions reflect taxpayer status and can be estimated by the tax agency from past information but would not be known absent an audit.

Since the tax agency has some information it can pre-populate some of these lines of the tax return when the taxpayer accesses the return for filing. Such pre-population lowers the taxpayer's cost of completing the form. However, it also signals to the taxpayer the information the agency has and also what information the agency does not have. Further, the information available to the tax agency may be incomplete or out of date and the items pre-populated on the form may be incorrect. Thus the taxpayer has to bear the cost of changing these elements. Since the tax agency may make errors to the taxpayer's advantage there is the potential for the individual to accept the pre-filled information although it is wrong.

b) Experiment Design Protocols

The taxpayers (participants) earn income at the beginning of the session by completing a simple task. These earnings are in effect for the remainder of the session. Thus, a low income taxpayer maintains that status throughout the experiment. Participants also complete a risk attitude elicitation task modeled after Holt and Laury (2002) and a follow-up debriefing questionnaire. The sessions include 20 paid decision rounds preceded by two unpaid training rounds. The experiment length is not pre-announced. Each period the participants are presented with a tax form that requires completion and submitting to the tax agency. Depending on the treatment in effect the participant may know their true income or not and their true deduction or

not. Also, depending on the treatment, some of the lines on the tax form may be pre-populated when the form is sent to the taxpayer.

The key parameters used for the experiments are reported in Table 1 and all amounts are denominated in lab dollars.[7] The pre-populated items consist of "on the record" or matched income and the standard deduction. The "off the record" or non-matched income is never pre-populated since the tax agency would not have access to this information absent an audit. Since the participants complete the earnings task only once, the incomes reported in Table 1 are in effect for the respective taxpayer throughout the session. The standard deduction levels are set at either 400 or 600 and if this item is pre-populated there is a 25% chance that the value is incorrect.

To help identify the effect of enforcement, the audit process is as follows. Matched income, since this is known with certainty by the tax authority, is automatically audited regardless of whether a form is filed (we label this as a "partial audit"). (In the case of a non-filer, this is tantamount to reporting 0 matched income.) The remaining line items – unmatched income and deduction – are audited at a lower rate and the audit probability varies depending on whether the participant files or not. There are three audit rates in effect, and each participant sees all three rates during the course of the session. In particular, the session is divided into four five-round series and the same rate is in effect for all rounds of a series. As most of the predicted between-participant variation in tax-reporting within a particular treatment occurs at the middle audit probability, when this rate is in effect it is encountered in two consecutive series. The sequence of audit probabilities is varied across sessions to allow us to control for order effects.

[7] Lab dollars are converted to US dollars at the end of the session at the rate of 750 lab dollars to one US dollar.

We introduce taxpayer types defined by the potential for tax underreporting as depicted in Table 2. Under-reporting opportunities are defined by the level of unmatched total income and the relative size of the itemized or standard deduction. A range of values for the Itemized Deduction is implemented when this value is unknown to the taxpayer. The taxpayer is informed of the range shown in Table 2. This is implemented in the experiment by randomly drawing a number from a uniform distribution with supports equal to the range of possible itemized deduction amounts. When the standard deduction is pre-filled on the tax form there is a 25% chance that the wrong value is entered and the third column shows the values that will be entered in this case. The types represent different underreporting opportunities. In particular, Type 1 and Type 4 taxpayers have a higher allowed standard deduction; Type 2 and Type 5 taxpayers have a higher allowed itemized deduction; and Type 3 and Type 6 taxpayers have expected itemized deductions that are equal to their allowed standard deductions. We implement this typology randomly across participants. In particular, participants are randomly assigned a type prior to the beginning of each of the four five-round series.

To investigate the effects of pre-populated information we implement several "treatments" as depicted in Table 3. These treatments define design elements that vary between-subjects, i.e. each participant only faces a single treatment. Treatment 1 constitutes a baseline in which no information is pre-populated on the tax return and all elements of income are known with certainty. The baseline setting (Treatment 1) forms the basis for the investigation into the introduction of pre-populated tax returns.[8] Treatment 2 introduces pre-filled items (matched income and standard deduction) but income and deductions are known with certainty by the

[8] In a previous project we investigated the effects of taxpayer uncertainty in these line items and the service provision of information to resolve the uncertainty. The treatments investigated included the availability and reliability of the information but in all cases the taxpayer was required to enter on the tax form the claimed credit or deduction directly.

taxpayer. Treatments 3 and 4 introduce non-matched income and itemized deduction uncertainty.[9] In Treatment 3 no items are pre-populated and in Treatment 4 the matched income and standard deduction are pre-populated. Treatments 5 and 6 mimic Treatments 3 and 4 except that the middle and high income participants have a higher level of unmatched income. Since this information is not available to the tax authority the role of the partial audit is decreased.

c) Experiment Procedures

The participants begin by completing the risk elicitation task. After they have read through the on-screen instructions they complete the income earning task. This task is a simple number sorting exercise that is timed by the computer. The participants completing the task fastest earn the highest income and those completing the slowest earn the lowest income. In these sessions there are three income levels as shown in Table 1. The participants are split evenly across these levels. The participants complete two training rounds. In the first training round the timer on filing is turned off which allows the participants to become familiar with the interface. The second training round runs at normal speed. Prior to the start of the first real round the participants' initial wealth balances are reset to zero. Participant earnings are the sum of the round earnings for the 20 real rounds plus the earnings from the risk elicitation procedure. Average earnings were approximately $27 for the session which lasted 90 minutes on average.[10]

In the tax reporting rounds, participants are informed of their pre-tax income and that of the other participants in the session. The tax form is presented on the screen and the participants

[9] The true tax liability may be unknown due to, for example, the status of an organization receiving the charitable contribution, whether the contribution elicited a "gift" from the receiving organization, and so on.
[10] The range of earnings based on participant decisions was -$6 to $46. However, we paid participants a minimum of $10 as an expression of goodwill and to maintain the current favorable reputation of the respective experimental economics programs.

choose whether or not to fill out and file a tax form. The participants use the interface to enter their "on the record" income, "off the record" income, and deduction amount. Absent an audit their round earnings are equal to their actual income minus any taxes reported to the tax authority. The audit process has two stages. The language refers to a "partial audit" in which the income "on the record" reported is matched with the true value that is known to the tax authority by virtue of third party reporting. The probability of this partial audit is 100%. Any unreported taxes from underreporting the on the record income will be detected and the unpaid taxes plus penalty (300%) will be imposed. A "full audit" checks reported "off the record income" as well as the deduction claimed. These audits occur with a known probability and are one hundred percent effective. Unpaid taxes are detected and collected along with the penalty (300%). During a session the participant's type changes periodically as does the audit probability. The participants are informed that such changes will occur and that they will be informed of the tax enforcement policy changes.

The participants are informed that they will make (up to) three entries: Income "ON the record", Income "OFF the record", and a Standard or Itemized deduction. They are further informed that the first two entries increase final taxes while the third reduces final taxes. Since we cap deductions at reported income (on plus off the record) we ask that they enter these items in order. If they attempt to enter deduction exceeding income a pop-up screen informs them that this is not a valid entry and that deductions cannot exceed total income. Participants are free to alter their entries up until they file or until the tax form times out.[11]

The participants are informed they will know the exact amount of Income "ON the

[11] Since "timing out" is a dominated strategy we emphasize this by including an additional penalty if the time expires before the form is filed or the participant selects to not file.

record" and that this amount is also *known* to the tax authority and is automatically audited (in what we refer to as a Partial Audit in the instructions) every round. The participants are reminded that if they under-report Income "ON the record", they will automatically have to pay the unpaid taxes, as well as pay penalties. They are further informed that they will know their Income "OFF the record" (participant to uncertain values in those treatments in which this is in effect) but that the "OFF the record income" is *not known* by the tax authority, unless the individual is selected for a Full Audit. The participants are informed that they have the option to claim a Standard Deduction or an Itemized Deduction (an amount of their choosing). There are two possible Standard deduction amounts and the participants are informed that they will know the highest Standard deduction each can claim without chance of penalty. If they choose the Itemized deduction, they will know the highest amount you can claim without chance of penalty. The deduction amount that is allowed to be claimed without penalty is *not known* by the tax authority, unless the participant is selected for a Full Audit. Deductions are subtracted from the *total* income reported and the difference is multiplied by the tax rate of 50% to determine final taxes.

A Partial Audit is always conducted; reported on the record income is checked against the actual value for unpaid taxes. But, as the participants are informed, there is a chance a participant will undergo a Full Audit, in which case off the record income and the claimed deduction amounts are checked along with the reported on the record income for unpaid taxes. Participants always know the chance of a Full Audit prior to making their tax reporting and filing decisions. Unpaid taxes, the base for the penalty, are determined by multiplying the difference between reported taxes and actual taxes. Unpaid taxes arise if the participant reports too little income and/or claims too much in deductions. The penalty rate is set at 300% multiplied by the

unpaid taxes discovered in the audit process.[12] Participants are informed that if they report more income than earned and/or claim less in deductions than allowed, they will *not* be refunded the taxes overpaid. That is, the audit process can never increase a participant's earnings.

Not filing is an option and the participants are informed that this will be treated as if no taxes are reported and that the audit of the on the record income will, of course, discover unpaid taxes on this income. Further a full audit may occur and additional penalties be levied. For most of our parameter settings, not filing is a dominated strategy. The participants are better of reporting at least the income on the record since any under reporting here is automatically detected. Finally, allowing the form to time out without selecting "file" or "not file" results in the automatic audit of on the record income and an additional penalty (100%) imposed. We inform the participants that it is never in their interest to allow the form to time out; "not file" is a superior play.

Full audits are conducted randomly. The participants are informed that the probability they will be selected for a full audit will be shown each round and that the selection is purely random and independent of whether they select the itemized or standard deduction as well as whether they change the pre-filled amounts entered on the line items. After the participants have filed (or not filed) a bingo cage holding a mixture of blue and white balls appears on the screen. The balls bounce around in the cage for a few moments and a door at the top of the box opens. If a blue ball exits the participant experiences a full audit and if a white ball exits only the partial audit is undertaken.[13]

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[12] This rate is considerably above the rate used by the US IRS but it was set to simulate the additional costs a taxpayer incurs when being audited, including the psychological costs.

[13] The audit process used in these experiments is completely random. While much of the IRS audit selection is based on endogenous rules, a purely random process avoids some of the complications that would arise from the use of relative reports. The use of the random process allows us to focus on the issues to be investigated in this series of

d) Participant Pools

These experiments were conducted with student participants at the University of Tennessee and Appalachian State University. The experimental labs consist of 24 networked computers, a server, and software designed for this series of experiments. Recruiting at both sites was accomplished using the Online Recruiting System for Experimental Economics (ORSEE) developed by Greiner (2004). The participant databases were built using posters and announcements sent via email to students. Participants were contacted via email, and were permitted to participate in only one tax experiment (other experimental projects were ongoing at the time and participants may have participated in other types of experiments). Only participants recruited specifically for a session are allowed to participate, and no participant has prior experience in this experimental setting. Methods adhere to all guidelines concerning the ethical treatment of human participants.

The experiment session proceeds in the following fashion. Each participant sits at a computer located in a cubicle, and is not allowed to communicate with other participants. The instructions are conveyed by a series of computer screens that the participants read at their own pace (see Appendix for some example screens), with a printed summary sheet provided and read aloud by the experimenter (see Appendix for an example). Clarification questions are addressed. The participants are informed that all decisions are private; the experimenter is unable to observe the decisions, and the experimenter does not move about the room once the session starts to emphasize the fact that the experimenter is not observing the participants' compliance decisions.

experiments. Alm and McKee (2004) have examined the behavioral responses under endogenous processes and find the taxpayers attempt to coordinate reporting levels but that they have difficulty doing so.

This reduces, to the extent possible, peer and experimenter effects that could affect the decisions of the participants. All actions that participants take are made on their computer.

There are three sessions (i.e. replications) for treatments T1 through T4, and four sessions of T5 and T6. Since we utilize two participant pools and varied audit probabilities, in blocks, within session, we implemented an optimal fractional factorial design to efficiently identify average participant pool effects and control for ordering effects. Each location implemented at least one session of each treatment. There are overall 20 sessions that yielded data from 383 participants.

4. Analysis of the Data

a) Econometric model

$$y_{li} = \beta_0 + \boldsymbol{\beta_I X_I} + \boldsymbol{\beta_D X_D} + \boldsymbol{\beta_A X_A} + \beta_C X_C + \beta_L X_L + \beta_H X_H + \beta_{N10} X_{N10} + \beta_T X_T + \beta_U X_U + \boldsymbol{\beta_P X_P} + \varepsilon_i$$

To test the various hypotheses described below, we specify a linear regression model that uses a particular measure of under-reported taxes as the dependent variable. Three dependent variables are considered: under-reported taxes on unmatched income (Model 1), under-reported taxes on the deduction (Model 2), and overall under-reported taxes (Model 3).[14] For unmatched income, the variable is constructed as the tax rate (50%) multiplied by the difference between (expected) unmatched income earned and the amount reported on the tax form. For the deduction, the variable is constructed as the tax rate (50%) multiplied by the difference between

[14] We do not present a model related to matched income, since it is common knowledge in the experiment that this line item is always audited. We note that about 5% of observations correspond with under-reported matched income, and this percentage decreases in later rounds of the experiment.

the reported deduction and the (expected) deduction allowed. Finally, overall under-reported taxes are the sum of under-reported taxes on the three line items (i.e. this includes over/under-reporting on matched income).

As independent variables, we include: indicator variables corresponding with the income categories, $\boldsymbol{X_I}$, (the omitted category is the low income level, 1200); indicators for the (expected) allowed deduction categories, $\boldsymbol{X_D}$, (omitted is the low deduction level, 400); indicators for the audit rate, $\boldsymbol{X_A}$, (omitted is the low audit rate, 10%); an indicator for cases where matched income and the standard deduction were pre-populated correctly, X_C; an indicator for instances where the pre-populated standard deduction was less than the allowable amount, X_L; an indicator where the pre-populated standard deduction exceed the allowable amount, X_H; an indicator for treatments with high unmatched income when the audit rate was 10%, X_{N10}; an indicator for taxpayers that chose an itemized deduction rather than a standard deduction, X_T; an indicator for treatments with uncertain tax liabilities, X_U; and, finally, a set of personal characteristics, $\boldsymbol{X_P}$.[15] Thus, all included variables, excluding the demographic controls, are dummy variables and represent treatment conditions that are exogenous to the participant.[16] These variables are defined and descriptive statistics are provided in Table 4. To correct the usual ordinary least squares (OLS) standard errors for unspecified heteroskedasticity and within-subject autocorrelation, we use cluster-robust standard errors. Heteroskedasticity and autocorrelation robust t and F statistics are used when evaluating hypotheses.

[15] Based on the relationship between total income and deductions, situations arise where many possible decisions equate to the *same* level of under-reporting and expected penalty. For instance, if a participant had 600 in matched income, 600 in unmatched income and a standard deduction of 600, there are many ways to get to zero tax liability – which is an optimal response for a sufficiently low audit probability. To achieve this, they could report 0 in unmatched and claim the 600 deduction; report 600 in unmatched and claim 1200 in deductions; or various combinations between that have the same expected reporting costs. So the indicator variable "Limited opportunity" in the model captures the mean difference in under-reporting for this subgroup relative to others.

[16] In addition, we explored using dummy variables to control for the particular order of audit rates introduced in the session, but the coefficients on the order indicators were jointly insignificant and omitted from the presented models.

In determining the relevant sample for the regression analysis, we exclude some observations. In particular, as noted in the design section, the participant has the opportunity to file a tax return, to not file, or it is possible that the tax form can time out. The rational-cheater model suggests that it is never in the taxpayer's interest to not file in our design. Even though the "not file" option is associated with a much lower (full) audit rate, the automatic penalties associated with matched income leads to lower earnings. Only 2.6% of observations corresponded with non-filers and less than 0.1% of observations corresponded with timing out.

b) Testable hypotheses – rational cheater model

The experimental design allows us to test some fundamental hypotheses based on standard rational-cheater model, as well as hypotheses related to under-reporting opportunity and pre-populated tax forms. First, as it relates to tax enforcement, we use three audit rates: 10%, 30% and 50%. When tax liability is certain, based on the rational-cheater model, at a 10% audit rate the marginal benefits of under-reporting taxes are higher than the marginal costs of under-reporting by a factor of 1 to 0.40. At the 30% and 50% audit rates, it is rational to truthfully report: there is a 1.2-to-1 and 2-to-1 ratio, respectively, of marginal costs to marginal benefits of under-reporting.[17] With uncertainty, and assuming risk neutrality, predictions of complete non-compliance and full compliance are maintained for the 10% and 50% audit rates. At 30%, there is an incentive to partially under-report.[18] Thus, under uncertainty, we span the spectrum of possible tax under-reporting predictions with our choice of audit rates. The overall prediction is

[17] Based on the theoretical model given in (1), in the special case of certain tax liability, we have a corner solution of full compliance when $1 \leq p(\beta + 1)$, and full noncompliance when $1 > p(\beta + 1)$.

[18] Under uncertainty, and the uniform distributions we employ, the interior solution given by equation (2) becomes $x_l^* = \frac{a-b}{p(\beta+1)} + b$, where a and b represent the lower and upper bounds on the tax liability range associated with the particular line item.

for higher under-reporting (at 30% audit rate) with uncertainty. However, based on earlier research (Vossler and McKee, 2012), we expect this hypothesis not to hold (i.e. no effects of uncertainty were uncovered previously).

In addition, we hypothesize that certain features of the tax system limit taxpayers' ability to engage in tax evasion. There are three income levels in the experiment – 1200, 1600 and 2000 lab dollars – which are determined prior to the experiment via a simple income task. There is no practice with the income task and no expected correlation between an individual's intrinsic tax compliance behavior and her performance on this task. For treatments T1-T4, the (expected) amount of unmatched income is equal to 600. As such, for these treatments the rational-cheater model predicts there to be no effects of earned income on under-reporting. For treatments T5-T6, the amount of unmatched income is increased to 1000 and 1400 for the 1600 and 2000 income groups, respectively. For these treatments, there theoretically should be additional under-reporting with the 10% audit rate.

The expected allowed tax deduction varies by taxpayer "type" as defined previously, and equal 400, 600 or 800 lab dollars. When the audit rate dictates full noncompliance, the rational-cheater model predicts that the taxpayer simply should take the maximum deduction possible in order to render overall tax liability to be zero. Under full compliance, the taxpayer should take her allowed standard deduction if it is higher than the expected value of the itemized deduction, or otherwise claim the expected value of the itemized deduction. Given that taxpayer type is assigned randomly, the rational-cheater model predicts no effects of taxpayer type on the amount of under-reporting. We expect the level of under-reporting will be affected by the mere *opportunity* to under-report. In our design, taxpayers with a higher income and/or a lower

allowed tax deduction have a relatively higher tax bill and this yields opportunity space for tax underreporting.

Finally, we explore whether pre-populating the amount of the standard deduction on the tax return (treatments T2, T4 and T6) has any effects on compliance. If the information is correct, this should have no influence on tax compliance. Alternatively, if the information is incorrect and exaggerates tax liability, the incentive to correct the error is the avoided excessive taxes, whereas if the information is incorrect and understates tax liability, the incentive to correct the error is the avoided expected penalty. In either case, the taxpayer has an incentive to correct the error. Hence, there should be no effect of pre-populated returns.

We summarize our hypotheses below. Note that predictions regarding under-reporting relate to overall under-reporting resulting from both the unmatched income and deduction decisions.

H1: $\beta_{2000} > \beta_{1600} > 0$: Increasing matched income increases the opportunity of tax under-reporting on deductions.

H2: $\beta_{800} < \beta_{600} < 0$: Increasing the allowable deduction decreases the opportunity of tax under-reporting on deductions.

H3: $\beta_{50} < \beta_{30} < 0$: Increasing the audit rate decreases the level of tax under-reporting.

H4: $\beta_C = \beta_L = \beta_H = 0$: Pre-populating the tax form has no effect on tax under-reporting.

H5: $\beta_{N10} > 0$: Increasing the level of unmatched income increases the opportunity for tax under-reporting on unmatched income.

H6: $\beta_T > 0$: Taxpayers that should choose an itemized rather than standard deduction have an increased opportunity for tax under-reporting on the deduction.

H7: $\beta_U > 0$: Uncertainty increases the level of tax under-reporting.

5. Results

Tables 5 and 6 report compliance rates for each line item based on the main treatment parameters, namely, whether the tax form was pre-populated or not (Table 5) and whether the proportion of income that was non-matched was high or low (Table 6). As expected based on the rational-cheater framework, compliance is extremely high for matched income, which was audited with certainty, with an overall compliance rate of 104 percent. Most noncompliance was the result of under-reporting non-matched income (81 percent of unmatched income was reported) and/or overstating deductions (112 percent of the allowable amount was deducted). Although the rational-cheater framework predicts pre-populating the tax form should have no effect on compliance, doing so appears to reduce compliance, particularly on unmatched income. This may be the result of subjects focusing their evasion effort on the line item that was not pre-populated, although this is strictly speculation. Table 6 does not reveal any obvious trends associated with under-reporting opportunity from unmatched income, however, this is not surprising since this treatment parameter should only matter when the audit rate is 10%. We investigate this further in the regression results below.

The three tax under-reporting models are presented in Table 7. The basic results are supportive of the broad implications drawn from an underlying model that considers the cost-minimization motives of the rational-cheater model that accounts for under-reporting opportunity. From Model 1, as predicted by the rational-cheater model, under-reporting is decreasing in the audit probability (H3) and the level of unmatched income when the audit rate is low (H5). There are two unanticipated effects with respect to the rational-cheater. First, there is a positive and significant effect on under-reporting unmatched income from providing pre-populated information, which is most pronounced when the pre-populated deduction exceeds the

allowable amount. Second, there is negative and significant effect associated with uncertainty regarding tax liability. Recall, the rational-cheater model predicts uncertainty should increase under-reporting at an audit rate of 30% under risk-neutrality.

From Model 2, there are very strong effects of under-reporting opportunities. Indeed, both income coefficients are positive and statistically significant (H1) and both deduction coefficients are negative and significant (H2). All four of these coefficients are large in magnitude. As with the unmatched income reporting decision, the audit rate effects are consistent with theory (H3) and well-pronounced. The hypothesis regarding the pre-populated information (H4) is supported for the deduction decision, despite the unanticipated effect on the unmatched income reporting decisions. There is a positive and significant effect for being an "itemized" taxpayer type on under-reporting (H6). Note that this simply reflects that their allowed itemized deduction is higher than their allowed standard deduction, and not whether the participant actually itemized.

From Model 3, we see the "combined" effects of the three taxpayer decisions. This includes significant effects of audit rate (H3), under-reporting opportunity (H1 and H2), and itemized taxpayer type (H6). Overall, the effect of being of an itemized taxpayer type is positive and statistically significant, although the effect of having high unmatched income is insignificant. The positive and significant effects of high unmatched income on the unmatched income reporting decision appear to have been offset by the negative effects of this variable in the deduction decision. The same is true for most of the pre-populated information, the exception being when the pre-populated deduction exceed the allowable amount, which significantly increases under-reporting.

Evidence from the three models suggests that it may be important to refine the behavioral model to consider the aggregate effects from the separate line items on the tax form. To be clear, the rational-cheater model suggests that line items should be treated in isolation as they are treated independently in the audit process. But, it is certainly rational for taxpayers to look at the "bottom line" of total taxes owed and then make adjustments to the deduction and/or unmatched income decisions in order to achieve the desired level of taxes paid. Such adjustment behavior necessarily creates some interdependencies of the line item decisions.

a) Effects of individual characteristics on under-reporting

We collected some very basic demographic information in the debriefing questionnaire. To explore the effects of observable participant characteristics, we estimated each model while including the following variables: an indicator for females; age; an indicator for participants with a college degree; an indicator for participants who are employed; and the number of safe choices made in the risk preference elicitation exercise.[19] Not surprisingly, since participant characteristics are uncorrelated with experimental design conditions, inclusion of these demographics does not noticeably alter the magnitudes, signs or significance of estimated treatment effects. Only two demographic variables have significant coefficients. In particular, female participants under-report approximately 80 lab dollars less in tax liability (i.e. they report more) and participants who exhibited risk aversion under-report about 70 lab dollars less on average. The direction of the gender effect is consistent with previous tax compliance experiments. The estimated effect of risk aversion is inconsistent with expected utility theory.

[19] We did collect other information, such as education, occupation, and income. Given we are using student participants, there is little variation in education and occupation and self-reported income is unreliable (e.g. participants are inconsistent in their interpretation of income, with variation in whether parental income, and scholarship and fellowship income is included).

While only speculation, this may be the result of a portfolio effect; taking less risk in the risk preference elicitation exercise may afford subjects the opportunity to take more risk in the tax compliance experiment, even though the former uncertainty is resolved after the latter.

6. Conclusions and Directions for Further Research

An enhanced service role for a tax agency may include pre-populating tax returns with information provided to the agency by third parties. This has the potential to reduce the tax reporting effort and, thus, improve the accuracy and completeness of tax reporting by individuals. However, the final effect is complicated by taxpayer heterogeneity in under-reporting opportunities. We report here on the results of a set of experiments designed to investigate the effects of pre-populated tax return information. By interacting this with whether the information is correct and with under-reporting opportunities (defined as taxpayer types) we are able to investigate the effects of pre-populated tax information with segments of the taxpayer population.

An analysis of the "combined" effects of the taxpayer decisions on reporting matched income, non-matched income, and the deduction (that is reporting the taxes owed), we find significant effects of the audit rate, under-reporting opportunity, pre-populated information, and itemized taxpayer type. Overall, the effect of being of an itemized taxpayer type was significant in the deduction decision as well as the combined model. The positive and significant effects of high unmatched income are offset by the negative effects of this treatment variable in the deduction decision. Evidence from the three models suggests that it may be important to refine the behavioral model to consider the aggregate effects from the separate line items on the tax

form. Although audits in the experiment are conducted on a line-by-line basis the participants behave as if there are composition effects in the tax compliance decision.

Of particular interest from the policy maker's perspective is the effect of incorrect pre-filled information. As we report in the results of our analyses of the data, pre-filled information that incorrectly understates tax liability increases tax under-reporting. Hence, if the tax agency were to offer such a taxpayer service, they should error on the side of exaggerating tax liability so as to not induce additional evasion.

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Table 1: Experiment Parameters

Parameter / variable	Value(s)
Total Income	Low: 1200 Medium: 1600 High: 2000
Non-Matched Income	Low scenario: Expected value: 600 (all Total Income categories) Uncertainty range: +/- 400 High scenario: Low Income: 600 +/- 200 Medium Income: 1000 +/- 400 High Income: 1400 +/- 600
Matched Income	Total Income – Expected value of Non-Matched Income
Standard Deduction	400 or 600
Probability of Error	25% for Pre-populated standard deduction
Itemized Deduction	Expected value: 200, 400, 600, or 800 Uncertainty Range: +/- 200
Partial Audit Probability	100% audit rate for matched income
Full Audit Probability – File	10%, 30%, or 50%
Full Audit Probability – Not File	Full Audit Probability – File × 10%
Penalty Rate	300% on unpaid taxes
Penalty Rate if Time Expires	Penalty Rate plus 100% of unpaid taxes
Tax Rate	50% on taxable income
Tax Filing Time	120 seconds

Table 2: Taxpayer Types

Type	Standard Deduction (Correct)	Standard Deduction (Incorrect)	Itemized Deduction	Itemized Deduction Range
1	400	600	200	0 – 400
2	400	600	600	400 – 800
3	400	600	400	200 – 600
4	600	400	400	200 – 600
5	600	400	800	600 – 1000
6	600	400	600	400 – 800

Table 3: Treatment Conditions

Experiment Element	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Pre-populate Matched Income & Standard Deduction	No	Yes	No	Yes	No	Yes
Uncertain Non-matched Income & Itemized Deduction	No	No	Yes	Yes	Yes	Yes
Non-matched Income Scenario	Low	Low	Low	Low	High	High

Table 4: Data Description

Variable	Description	Mean (Std. dev.)
Income_earned = 2000	= 1 if high income of 2000; = 0 otherwise	0.34 (0.47)
Income_earned = 1600	= 1 if middle income of 1600; = 0 otherwise	0.33 (0.47)
Income_earned = 1200	= 1 if low income of 1200; =0 otherwise	0.33 (0.47)
Deduction = 400	= 1 if (expected) deduction of 400; =0 otherwise	0.34 (0.47)
Deduction = 600	= 1 if (expected) deduction of 400; =0 otherwise	0.50 (0.50)
Deduction = 800	= 1 if (expected) deduction of 400; =0 otherwise	0.16 (0.37)
Audit = 10%	= 1 if 10% audit probability; = 0 otherwise	0.25 (0.43)
Audit = 30%	= 1 if 30% audit probability; = 0 otherwise	0.50 (0.50)
Audit = 50%	= 1 if 50% audit probability; = 0 otherwise	0.25 (0.43)
Prepopulated w/ Correct Deduction	= 1 if form pre-populated and correct deduction entered	0.39 (0.49)
Prepopulated w/ Overstated Deduction	= 1 if form pre-populated and deduction entered is greater than the allowable deduction	0.06 (0.25)
Prepopulated w/ Understated Deduction	= 1 if form pre-populated and deduction entered is less than the allowable deduction	0.06 (0.24)
High_unmatched	= 1 if high level of unmatched income; = 0 otherwise	0.28 (0.45)
Itemized	= 1 if itemized deduction was chosen; = 0 otherwise	0.42 (0.49)
Uncertainty	= 1 If uncertain tax liability; = 0 otherwise	0.71 (0.45)
Female	= 1 if subject was female; = 0 otherwise	0.42 (0.49)
Age	= age of the subject	21.61 (3.60)
College	= 1 if the subject has a college degree; = 0 otherwise	0.12 (0.33)
Employed	= 1 if subject is employed full- or part-time; = 0 otherwise	0.36 (0.48)
Averse	= 1 if subject made 4 or more safe choices in risk elicitation task; = 0 otherwise	0.79 (0.41)
Taxes under-reported (Unmatched income)	Taxes under-reported based on unmatched income filed	71.13 (245.12)
Taxes under-reported (Deduction)	Taxes under-reported based on deduction decision	22.49 (193.50)
Taxes under-reported (Overall)	Taxes under-reported based on matched, unmatched and deduction filed	80.28 (328.03)

Table 5 Proportion of Line Item Reported By Prepopulated Tax Form

Line Item	Unpopulated	Prepopulated Correct	Prepopulated Understated	Prepopulated Overstated	Overall
Matched Income	102.5	105.7	105.2	105.2	104.1
Unmatched Income	86.1	77.2	77.1	73.0	81.3
Deduction	111.2	112.5	96.4	137.9	112.5
Overall	90.4	85.6	94.3	72.6	87.6
No. of Obs.	3606	2914	458	479	7457

Table 6 Proportion of Line Item Reported By Treatment

	Low Unmatched Income					High Unmatched Income				
Line Item	Unpopulated	Correct	Understated	Overstated	Overall	Unpopulated	Correct	Understated	Overstated	Overall
Matched Income	100.6	104.1	103.8	102.5	102.3	107.1	110.1	109.6	112.5	108.7
Unmatched Income	83.6	78.2	76.1	78.0	80.6	92.5	74.6	79.9	59.3	82.8
Deduction	108.5	116.5	98.0	145.2	113.4	118.0	101.6	91.4	117.8	110.2
Overall	89.6	87.3	95.1	75.7	88.1	92.3	81.1	92.1	64.0	86.2
No. of Obs.	2574	2115	345	351	5385	1032	799	113	128	2072

Table 7.1. Tax under-reporting models

Dependent Variable: Taxes under-reported (in lab dollars)			
Variable	Model 1: Unmatched income	Model 2: Deduction	Model 3: Overall
Income_earned = 1600	-3.753 (20.100)	39.774*** (14.932)	44.116* (25.790)
Income_earned = 2000	13.125 (20.481)	69.667*** (17.535)	82.453*** (31.426)
Deduction = 600	13.868 (14.955)	-56.092*** (12.151)	-39.433* (20.618)
Deduction = 800	-2.455 (17.472)	-90.808*** (14.416)	-92.977*** (24.170)
Audit = 30%	-58.640*** (10.195)	-22.672*** (7.065)	-85.119*** (12.737)
Audit = 50%	-116.998*** (12.186)	-46.600*** (7.427)	-165.364*** (14.938)
Prepopulated w/ Correct Deduction	41.275** (17.174)	-0.862 (13.218)	30.950 (22.375)
Prepopulated w/ Overstated Deduction	62.932*** (21.218)	27.926 (17.691)	81.207*** (26.742)
Prepopulated w/ Understated Deduction	33.824* (19.987)	-24.043 (16.008)	2.106 (25.881)
High unmatched w/ Audit = 10%	64.761** (26.771)	-14.140 (18.939)	33.258 (32.711)
Itemized	-22.965 (14.797)	93.664*** (14.892)	58.389*** (19.650)
Uncertainty	-40.924** (16.951)	-24.891* (14.988)	-73.778*** (25.463)
Female	-48.887*** (17.707)	-18.218 (12.780)	-78.953*** (23.059)
Age	1.385 (2.270)	1.926 (1.446)	2.549 (2.878)
College	-7.606 (24.435)	-8.398 (18.363)	-18.737 (39.629)
Employed	8.125 (17.286)	-21.936 (13.428)	-0.644 (23.183)

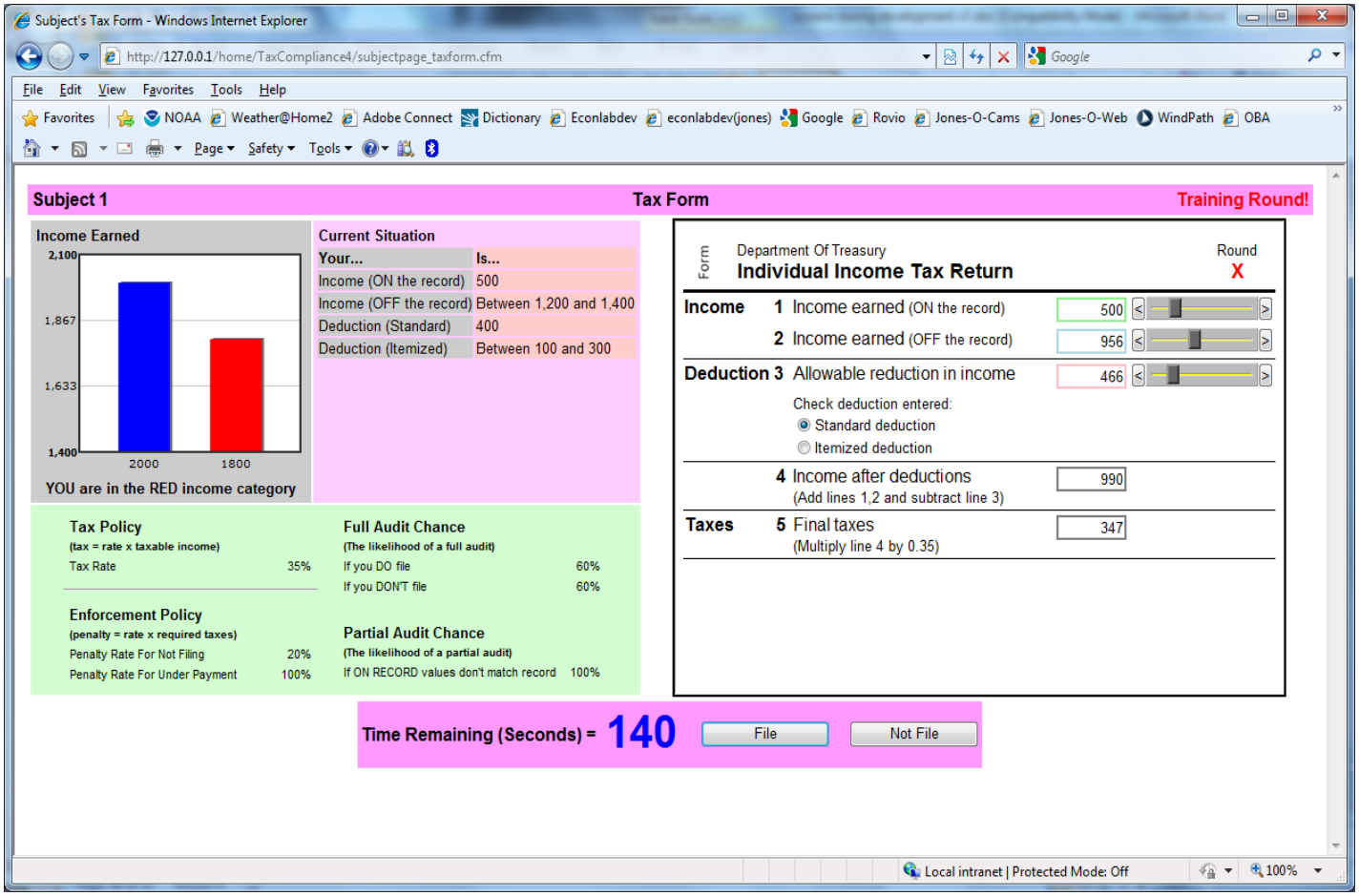
Risk Averse	58.397** (22.689)	-3.964 (21.053)	67.809** (32.611)
Intercept	60.692 (61.779)	30.853 (44.825)	103.381 (80.478)
N	7457	7457	7457
R^2	0.069	0.143	0.109
F	8.63***	8.22***	12.77***

*, **, and *** denotes estimates that are statistically different from zero at the 10%, 5%, and 1% significance levels, respectively. Cluster-robust standard errors are in parentheses.

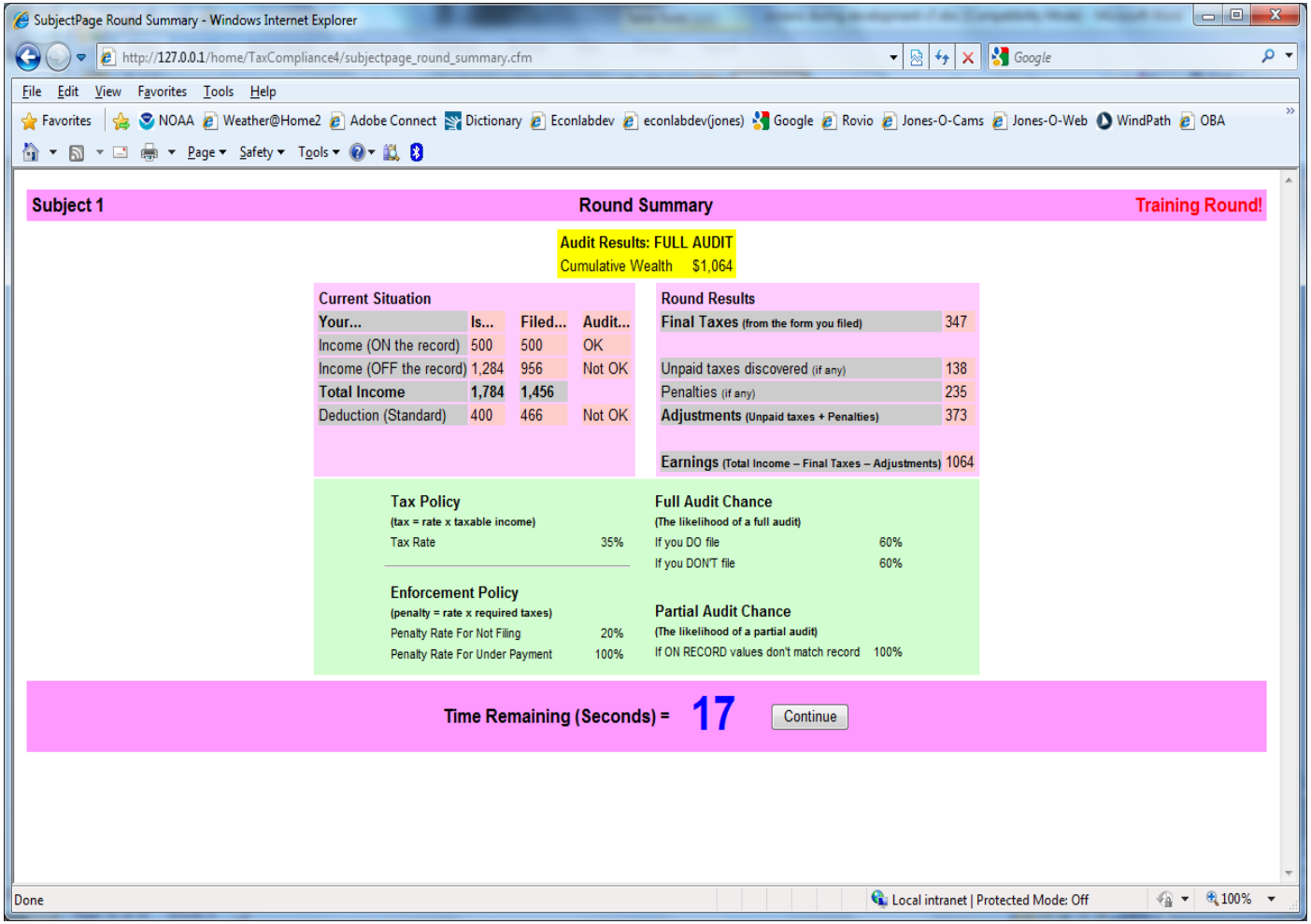
Appendix A

This section presents the materials describing the experimental setting. Several of the computer images that form the experiment interface are presented as well as a sample of the printed instructions provided the subjects.

A.1 Subject screen for tax filing – training round



A.2 Subject screen for end of round summary



A.3 Representative Instructions (Treatments 4 & 6)

Experiment Overview

You will be participating in an economics experiment that lasts several decision "rounds". In each round you will be making a tax reporting decision. You will not know the number of rounds until the end of the experiment.

The currency used in the experiment is lab dollars, and will be exchanged for real (US$) dollars at a rate of 750 lab dollars to $1(US) at the end of the experiment. With the exception of any "training" rounds, you will have the ability to earn money in every round.

Prior to the first round, you face an Income task. In this task, you will sort a scrambled arrangement of the numbers 1 through 9. The participant in your group with the fastest (slowest) time receives the highest (lowest) Income. This Income will be in effect for *ALL* of the tax reporting rounds.

In the tax reporting rounds, you choose whether or not to fill out and file a tax form. The amount of money you earn in the round is equal to your Income minus any taxes you report to the tax authority (Final taxes). However, there is an audit process, and if the tax authority discovers you have under-reported the amount of taxes you owe, you will pay the additional taxes owed (unpaid taxes) plus penalties.

Overall, your earnings for a decision round are determined as follows:
If unpaid taxes *are not* found: Round earnings = Income – Final taxes
If unpaid taxes *are* found: Round earnings = Income – Final taxes – unpaid taxes - penalties

The settings you face will vary during the experiment. The experiment software will notify you of any changes, before the new settings take effect.

If you file the tax form…

On the tax form, you will make three entries, your: Income "ON the record"; Income "OFF the record"; and a Standard or Itemized deduction. The first two entries increase your Final Taxes, while the third entry reduces your Final Taxes.

Please make the decisions in order: Income "ON the record" first, Income "OFF the record" second, and your deduction third. You are free to alter the amounts prior to filing.

You will know the exact amount of your Income "ON the record". This amount is also *known* to the tax authority and is automatically audited (a Partial Audit) every round. So if you under-report your Income "On the record", you will automatically have to pay the unpaid taxes, as well as pay penalties.

You will only be given a range of possible amounts for your Income "OFF the record". Each amount within this range has an *equal chance* of being your actual amount, which represents the lowest amount you can claim without penalty. This actual amount is *not known* by the tax authority, unless you are selected for a Full Audit.

You have the option to claim a Standard deduction OR an Itemized deduction (an amount of your choosing). There are two possible Standard deduction amounts. You will know the highest Standard deduction you can claim without chance of penalty.

You will only be given a range of possible amounts for your Itemized deduction. Each amount within this range has an *equal chance* of being your actual amount, which represents the highest amount you can claim without penalty. This actual amount is *not known* by the tax authority, unless you are selected for a Full Audit.

Deductions are subtracted from the *total* income you report ("ON" and "OFF" the record income). The difference is then multiplied by the tax rate of 50% to determine your Final taxes.

Prior to making any entries, you will notice that the tax authority has already entered on your form an amount for Income "ON the record" and a Standard deduction. You are free to change these amounts. Whether you change these or not does not affect your probability of a Full Audit. That is, the audit process does not give any special attention to whether you report the pre-selected amounts or change these amounts.

The tax audit process…

As mentioned above, you will always undergo a Partial Audit under which the reported Income "ON the record" is checked against the actual value for unpaid taxes.

There is a chance you will undergo a Full Audit, in which case Income "OFF the record" and your claimed deduction amounts are checked along with your Income "ON the record" for unpaid taxes. You will know the chance of a Full Audit prior to making your decisions.

Unpaid taxes are determined by multiplying the difference between what you report and your actual value by the tax rate of 50%. There are unpaid taxes only if you claimed too little income and/or claimed too much in deductions.

You must pay penalties equal to 300% multiplied by the unpaid taxes discovered in the audit.

If you claim more income than you earned or less in deductions than you are allowed, you will *not* be refunded the overpaid taxes. In this sense, the audit process cannot increase your earnings.

If you do *not* file the tax form…

If you do not file, your Taxes reported will be 0. In the audit process, this is treated the same as if you reported no income and claimed no deductions. This means that, since a Partial Audit is always conducted, you will be found to have unpaid taxes for Income "ON the record".