Appalachian State University

Department of Economics Working Paper

Number 13-24 | October 2013

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Efficient tax reporting:
The effects of taxpayer information services[1]

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September 2013

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ABSTRACT

As policy makers recognize the complexity of the tax system can result in some "evasion" being due to errors, there has been increasing focus on the role of taxpayer services as a tool in the enforcement regime. Such programs can improve the image of the tax agency but the critical issue is the effect on tax reporting. While the earlier focus has been on tax evasion, tax over-reporting is also an issue since it leads to inefficient resource allocation. Thus, the present paper focusses on the effectiveness of taxpayer service programs in enhancing tax reporting. Data are collected on tax reporting decisions via laboratory experiments designed to implement the tax reporting task. To investigate the effects of taxpayer services, we "complicate" these compliance decisions of subjects, and then provide "services" from the "tax administration" that allow subjects to compute more easily their tax liabilities. Briefly, we find that our subjects are less likely to file when tax liability is uncertain but the provision of information offsets this effect; it appears that simply providing the service, even an imperfect service, increases the propensity to file and the accuracy of the filing.

JEL Classifications: H2, H26, C91.

Keywords: tax information services; tax reporting; behavioral economics; experimental economics

1. Introduction

Almost everyone agrees that the personal income tax system in the US is complex and, as a result, individuals face considerable uncertainty when computing their true tax liabilities.[2] The effect of this uncertainty can be manifest as the individual simply choosing to not file a tax return. This imposes budget costs (lost revenue) and social cost (individuals not "in the system" so unable to benefit from social programs). Even when individuals do file, uncertainty regarding tax liability can lead to errors and these can result in too little or too much tax being reported to the tax authority. Both errors are costly to society. There is a considerable literature discussing tax underreporting.[3] While much of the observed underreporting can be regarded as deliberate (evasion), much can also be the result of confusion (reporting error). The U.S. Internal Revenue Service (IRS) applies discretion in imposing penalties; those for underreporting due to taxpayer error are typically lowest. However, since not all errors are detected, there is an inevitable loss to the budget. Perhaps, the more important impact is the potential moral hazard problem. If taxpayers perceive the price of public services to be lower than in actuality, they will vote for larger output of public programs and the result is an efficiency loss.

Uncertain tax liabilities can also cause taxpayers to err in the direction of over-paying taxes leading also to efficiency losses; if these taxpayers perceive that the price of public services is high (based on their tax bill) they will vote for smaller than optimal levels of provision.

These effects may, of course, be offsetting and the aggregate welfare loss could be small. However, relying on offsetting errors requires the effects meet certain aggregation requirements

[2] Deductions, exemptions, and credits are subject to rules that are often not well specified since there is considerable heterogeneity across taxpayers.
[3] Excellent surveys are provided in Cowell (1990), and Andreoni, Erard, and Feinstein (1998). More recent literature is summarized in Slemrod (2007).

and ignores the social capital effect of a loss of trust in the fiscal exchange.[4] It is more productive to address the problem directly. In this regard many tax agencies are exploring the use of complementary enforcement instruments one of which is the provision of information and assistance services.[5] While taxpayer service programs may improve the image of the tax authority, the actual effect on tax reporting accuracy is an open empirical question.[6]

In this paper we focus on the effects of having the tax agency provide information to (partially or completely) resolve the tax liability uncertainty for the taxpayer. Our research utilizes laboratory experiments with student and non-student participants as a means of testing the role of information services in terms of their effectiveness in enhancing tax filing and reporting. The lab is a powerful research tool for such questions. Within the laboratory setting, we compare the filing and tax reporting effects of complexity and information services of varying degrees of accessibility and accuracy while controlling for extraneous factors. Our experimental setting mimics the naturally occurring environment. Participants earn income, report their income to a tax authority, and face an audit process. To investigate the existence of taxpayer services, we complicate the compliance decision of participants by making their true tax liability uncertain, and as treatments we provide services from the "tax administration" that permit participants to form a more accurate assessment of their tax liabilities.[7] By analyzing the tax reporting response of participants to these services with an underlying random audit

[4] See Alm, Jackson and McKee (1993) for a demonstration of the effect of the fiscal exchange on tax compliance for a given level of enforcement effort.

[5] For FY 2011 the IRS budget allocated $5.5 billion to "enforcement" and $2.3 billion to "taxpayer services" to provide taxpayer assistance and education regarding tax liability and filing questions. Thus the service component continues to be a significant element of the IRS's interaction with taxpayers. Implicit in this argument is the notion that enforcement will be less costly per unit of revenue (more efficient) if the tax administrators facilitate accurate reporting as well as penalize inaccurate reporting.

[6] Taxpayers can respond to complexity by reporting tax liabilities greater than actual due to fear of misunderstanding the rules and being audited for making errors. Or, taxpayers may view tax rule complexity as an opportunity for evasion since they will attempt to argue error rather than malfeasance if audited. See Krause (2000) for a discussion.

[7] Such information reduces the cognitive burden of computing individual tax liabilities. The issue of tax liability uncertainty differs from enforcement uncertainty. As Alm, Jackson, and McKee (1992b) show, enforcement uncertainty can increase tax reporting among risk averse individuals.

framework, we are able to determine the relative effectiveness of these alternative paradigms in generating more accurate tax reporting behavior.

The lab offers several advantages over the field for such research. First, since we induce participants with tax liabilities we know the exact levels of compliance of all the taxpayer participants in the experiment – whether audited or not. This is not the case with field data. Second, lab investigations allow us to alter policy parameters in an orthogonal fashion, which minimizes the possible confounds from unobservable factors affecting compliance. Third, since we induce the level of uncertainty concerning the tax regulations we can reliably correlate the costs of uncertainty (the losses from errors) with the availability of information. Of course, the lab offers a cost-effective approach to test-bed policy changes.

Previous experimental work investigating the effects of information services provides a basic understanding of overall compliance behavior on the part of individual taxpayers (Alm et al., 2010; Beck, Davis, and Jung, 1996). The experiments reported in the current paper allow us to focus on individual components of the tax reporting decision (deductions and credits claimed), the effects of service quality (i.e. availability and accuracy), and efficiency. In particular, we use an efficiency measure based on the deviation of reported taxes from the true tax liabilities. This metric recognizes that all errors lead to an efficiency loss. New data allow tests of predictions of the expanded theoretical models presented in the next section. Briefly, we find that our subjects are less likely to file when tax liability is uncertain; but, the provision of information offsets this effect. It appears that simply providing the service, even an imperfect service, increases the propensity to file and can improve tax revenue efficiency. Further, the provision of the information service leads to more efficient reporting behavior – lower errors in reporting – and the taxpayers face the true cost of public services.

2. Theoretical Model

The basic economic model of tax compliance (Allingham and Sandmo, 1972; Yitzhaki, 1974) characterizes a situation where a taxpayer faces a tax reporting "gamble" where she assesses the tradeoffs between the risks of penalty with the benefits of a lower tax payment. As we are interested in tax reporting for individuals who do not know their actual tax liability and are thus prone to errors, our framework closely follows the small subset of theoretical papers that model such a setting (e.g. Alm, 1988; Beck and Jung, 1989; Jung, 1991; Scotchmer and Slemrod, 1989). Our framework extends the discussion by modeling the tax *filing* decision when liability is uncertain and by incorporating the effects of information services on the tax reporting and filing decisions.

Our decision setting is characterized as follows. A risk-neutral taxpayer chooses whether to file, and if filing is her choice what to report on one or more "line items" on the tax form.[8] We assume that the taxpayer considers directly the tax liability associated with her line item reports which allows us to generally characterize the optimal decision regardless of whether the line item is associated with a credit, deduction, reported income, or otherwise. Non-filers face a lower probability of audit, r, relative to audit probability for filers, p, such that not filing is potentially an optimal choice. Audits are completely random and independent of whether other persons are audited or the reported tax liability. 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 upon audit, there is a constant per-unit penalty $\beta > 0$ assessed on unpaid taxes.[9] Audited non-filers are simply treated as if they filed a blank return (i.e. reported tax liability is 0 for all line items), and then the audit

[8] To be clear, we use the term "line item" to denote any tax form entry that the taxpayer has discretion over what to report. For simplicity, we rule out simple mathematical errors that, to a large extent, are automatically discovered by the tax authority and not subject to penalty.
[9] Largely consistent with the literature, upon audit there is no refund or bonus associated with over-paid taxes.

process is the same as for filers.

The actual tax liability on one or more line items is uncertain, and there may be an information service available to partially or fully resolve the uncertainty. Let x_l^0 denote the actual tax liability associated with line item l.[10] From the perspective of the taxpayer, tax liability is a random variable x_l with distribution function $F(x_l)$, which is assumed to have positive density $f(x_l)$ on the interval $[a_l, b_l]$. It is assumed that x_l^0 lies within the interval, i.e. the true tax liability is considered probable. Further, assume that there are institutional or other constraints on the range of amounts the taxpayer is allowed to enter, such that reports lie in the interval $[\underline{a}_l, \overline{b}_l]$, with $\underline{a}_l \leq a_l \leq b_l \leq \overline{b}_l$.

As the decision of whether to file depends upon the expected costs of filing, we consider the optimal reporting decision first. Conditional upon filing, for each line item on the tax form the taxpayer chooses a tax liability to report, denoted R_l. The optimal reporting problem is then one of choosing a vector of tax liabilities $\boldsymbol{R} = \{R_1, \ldots, R_L\}$ in order to minimize expected costs:

(1) $$\min_{\boldsymbol{R}} \sum_l \left\{ R_l + p\left\{ (\beta + 1) \int_{R_l}^{b_l} (x_l - R_l) f(x_l) dx_l \right\} \right\}.$$

The optimal reporting choice for a particular line item, R_l^*, is implicitly defined by

(2) $$1 = p(\beta + 1) \int_{R_l^*}^{b_l} f(x_l) dx_l \qquad \forall l.$$

The interpretation is that the taxpayer minimizes cost by equating the marginal cost of taxes reported with the expected marginal cost of the audit. The first-order necessary conditions can instead be written as

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

[10] Note that the liability may be negative, such that taxpayers receive a refund.

An interior solution exists for R_l^* on the interval$[a_l, b_l]$ if $\frac{1}{p(\beta+1)} < 1$. Otherwise, there is a corner solution $R_l^* = \underline{a}_l$, i.e. the taxpayer engages in maximum tax evasion.[11] It is possible in general for the optimal reported liability to be under, over or equal to the true liability. For instance, even if $E[x_l] = x_l^0$ (i.e. beliefs are unbiased) there is the potential value to over-report in expectation as it decreases the probability (and expected cost) of being found to have underreported.

When liability is certain, it is not possible to have over-reporting as optimal, as paying too much tax provides no benefit regardless of whether an audit occurs. Instead, under certainty, the solution is to fully comply when $\frac{1}{p(\beta+1)} < 1$, and to engage in maximum evasion when $\frac{1}{p(\beta+1)} > 1$. Thus, uncertainty in the former case – if anything – leads the taxpayer *away* from the truth.[12] In the latter case, uncertainty has no effect as the taxpayer will be at the corner solution of maximum evasion regardless.

Turning to the decision of whether to file a return, the taxpayer compares the expected costs of reporting the vector $\boldsymbol{R} = \boldsymbol{R}^*$, as implicitly defined by (2), with the expected costs of not filing. Given an audited non-filer is treated as if they reported zero on all line items, her expected cost is determined by setting $\boldsymbol{R} = \boldsymbol{0}$ in equation (1), and replacing *p* for *r* to reflect the difference in filer versus non-filer audit rates. Let D denote the difference in expected costs, which is given by

(3) $$D = \sum_l \left\{ R_l^* + p\left\{(\beta+1)\int_{R_l^*}^{b_l}(x_l - R_l^*)f(x_l)dx_l\right\}\right\} - \sum_l \left\{ r\left\{(\beta+1)\int_0^{b_l} x_l f(x_l)dx_l\right\}\right\}.$$

[11] If the line item is associated with a liability, for example, then this means reporting zero liability. However, if the line item is associated with a deduction or a credit, then this implies taking the maximum deduction or credit possible in which case x_l^* is as large and negative as possible.
[12] This result is similar to that obtained by Beck and Jung (1989).

Then, the taxpayer files a return with the vector of reported liabilities$\boldsymbol{R} = \boldsymbol{R}^*$ if $D \leq 0$, and otherwise chooses not to file (i.e. "reports" $\boldsymbol{R} = \boldsymbol{0}$).

2.1 The effect of information services on tax reporting

In general, an information service may provide truthful or untruthful signals regarding tax liability. For instance, a taxpayer may incorrectly interpret a discussion with a tax agent as suggesting she can claim a deduction she is not legally entitled to. Further, there is randomness in the process. That is, for example, different tax agents may provide different information or the taxpayer may perceive some tax agents to be more credible or convincing than others. Let $G(x_l)$ represent the perceived distribution of the tax liability with the information service, with associated density function $g(x_l)$. To be clear, the distribution $G(x_l)$ reflects the taxpayer's *expectation* about the liability distribution upon receipt of the service, rather than her beliefs after receipt of the service. This thus acknowledges that information services are a random process and do not necessarily lead to the taxpayer receiving perfect and/or valuable information in an ex post sense.

Two desirable properties of an information service are that: (i) it is unbiased, i.e. $E[x_l|G] = x_l^0$; and (ii) it reduces the uncertainty over x_l through, for example, reducing the variance [i.e. $Var(x_l|G) < Var(x_l|F)$]. Congruent with these properties, but slightly more general, we consider a *helpful information service*, which we define as one with $G(x_l) \leq F(x_l)$ for $x_l \leq x_l^0$ and $G(x_l) \geq F(x_l)$ for $x_l \geq x_l^0$, with strict inequality between distribution functions holding at least for some x_l.

An information service that is expected to reveal the truth with certainty fits the above characterization. More generally, conditional on initial beliefs being unbiased, then the above single-crossing condition will hold for any information service that meets properties (i) and (ii). Specially, in this case the single-crossing condition implies that $F(x_l)$ is a mean-preserving spread of $G(x_l)$, and hence the information service is best characterized as decreasing the riskiness associated with the tax-reporting gamble. When both distributions are from the same family, common families of distributions (e.g. uniform, normal, exponential) satisfy this single-crossing condition. However, the definition does not mandate that beliefs are unbiased nor follow specific distributions.

For clarity, let $R_{l,I}^*$ and $R_{l,N}^*$ denote the optimal choice with and without information, respectively. This type of information service leads to a more truthful report, thus increasing the efficiency of the tax collection system.[13] This result is stated formally in the following proposition.

Proposition 1: Conditional on filing being an optimal choice, a *helpful information service* leads to an optimal tax liability report that is closer to the truth. Specifically, either $x_l^0 \geq R_{l,I}^* \geq R_{l,N}^*$ or $x_l^0 \leq R_{l,I}^* \leq R_{l,N}^*$ characterizes the optimal solution, with $R_{l,I}^* \neq R_{l,N}^*$ whenever $G\left(R_{l,I}^*\right) \neq F\left(R_{l,N}^*\right)$ and $\frac{1}{p(\beta+1)} < 1$.

Proof: see Appendix A.

2.2 The effect of information services on tax filing

A taxpayer decides whether to file based on the relative expected costs of filing her optimal report and the expected costs of not filing. In general, the change in the relative costs induced by the information service is ambiguous. However, there are several interesting cases for

[13] To be clear, given that information services have a random outcome, this result is true "on average" rather than specifically for each taxpayer in each instance.

which we can characterize the effect of information on the filing decision. For clarity, let D_I and D_N denote the relative costs of filing, as defined by equation (3), for the information and no information cases, respectively.

Proposition 2. Assume $E[x_l|F] = E[x_l|G]\ \forall l$. If for all l (i) $b_l \leq 0$, and/or (ii) $a_l \geq 0$ holds, or (iii) $r = 0$, then a *helpful information service* increases tax filing, i.e. $D_I \leq D_N$.

Proof: See Appendix A.

The main assumption stated in Proposition 2 is that the information service is not predicted to alter the expected value of the tax liability. This holds, for instance, when both initial beliefs and the information service are unbiased. The remaining conditions require that every line item is clearly associated with a refund or tax (but not both), or alternatively the perceived non-filing probability is zero. It is plausible that at least some taxpayers (i.e. those who have been "off the grid" in the past) perceive the latter condition to be true. The conditions identified in Proposition 2 do not encompass all possible cases under which information services encourage filing. For example, it may be that the conditions only hold for *some* line items but the cost savings afforded by reporting optimally on these (relative to not filing) could outweigh the additional costs of optimally reporting on line items that do not meet the sufficiency conditions.

The above theoretical results suggest that an information service increases overall efficiency. That is, information services increase the proportion of filers which necessarily leads to more truthful reporting relative to the non-filing case. In addition, for those who would have filed regardless, the information service leads to reports that are likewise closer to the truth. In the experiments described next, we test whether these basic theoretical results are supported empirically.

3. **Experimental Design and Treatments**[14]

Our experimental design implements the fundamental elements of a voluntary reporting system such as applied in the U.S. individual income tax. Participants earn income by performing a task and self-report their tax liability to a tax authority.[15] In the present setting final tax liability is a function of earned income, deductions claimed, and credits applied. The participant makes the decision of whether to file and, conditional on filing, reports her tax liability. If an audit occurs unreported taxes are discovered; there is no error in the audit as in the theory. If the individual has evaded taxes both the unpaid taxes and a penalty are collected. If the individual chooses to not file the audit probability is lower but not zero.

To complicate this basic setting, and thus introduce potential value in tax ruling information, we introduce some institutional details. Earned income varies between participants, and within participants across decision rounds. In particular, earned income ranges from 1000 to 2000 lab dollars, in 100 increments. Earned income is subject to both allowed deductions (reducing taxable income) and to a potential tax credit (reduces the taxes owed directly). The levels of these items are not serving as experimental treatments; thus, in all sessions we set the deduction at 50% of income and the expected tax credit starts at 825 for an income of zero and declines at a rate of 0.3 for each additional dollar of earned income. These amounts are sufficiently high that the participants in the experiment perceive the tax treatment of the deductions and credit as salient. Further, the tax rate is set at 50%. Finally, the audit probability

[14] 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.

[15] Our experimental setting is very contextual and the presence of the income earning task provides, we argue, for the necessary degree of "parallelism" to the naturally occurring world that is crucial to the applicability of experimental results (Smith, 1982; Plott, 1987). The experimental setting need not – and should not – attempt to capture all of the variation in the naturally occurring environment, but it should sufficiently recreate the fundamental elements of the naturally occurring world for the results to be relevant in policy debates. In this regard, our experimental design uses tax language (which is presented via the subject interface) and also requires that the participants disclose tax liabilities in the same manner as in the typical tax form.

is set at 30% and 6% for filers and non-filers, respectively, and the penalty rate is set at 300% (of unpaid taxes). Enforcement effort (audit probability and penalty level) is held constant. The effects of enforcement efforts have been widely investigated (see Alm, Jackson, and McKee, 1992a) and we only need that this effort be salient in the current setting. Information regarding all tax and enforcement parameters (and procedures) is common knowledge.

When an individual is selected for audit, both the deduction and credit line items are checked for errors. Our audit rate for filers is much higher than actual *full* audit rates in the United States. However, the IRS conducts a range of audits, and for many types of audits the actual rates are quite high.[16] The lower audit rate for non-filers reflects the greater difficulty the IRS faces in detecting those who do not file (Erard and Ho, 2001). The fine rate is somewhat higher than the penalties imposed by the IRS for evasion but these higher monetary penalties simulate the full costs of undergoing an audit. Table 1 summarizes the key parameters of the experiment design.

Since the tax filing/reporting decision is repeated in our laboratory setting, the amount of the deduction and credit are not fixed based on income alone. In the naturally occurring world the tax code changes from year to year, individual contributions to charities can change over time, or medical expenses for a year can rise to the threshold for tax deductibility, etc. These changes all affect deductions and credits. Thus, even if a subject receives the same earned

[16] While overall audit rates are quite low, among certain income and occupation classes they are more frequent. The oft-reported IRS audit rate (currently less than one percent) is somewhat of an understatement. This reported rate usually refers to full audits. In fact, the IRS conducts a wide range of audit-type activities, including line matching and requests for information, and these activities are much more frequent. For example, in 2005 only 1.2 million individual returns (or less than one percent of the 131 million individual returns filed) were actually audited. However, in that year the IRS sent 3.1 million "math error notices" and received from third parties nearly 1.5 billion "information returns", which are used to verify items reported on individual income tax returns.

income in two decision rounds her credit and/or deduction level will change.[17] We implement uncertain levels of deduction and credit by placing uniform distributions around the expected deduction and credit amounts, and then randomly drawing from the distribution to determine the true deduction and credit amounts. For both the credit and deduction, the supports of the uniform distributions are +/- 50% of expected value.

3.1 Experimental treatments

We employ a between-subjects design, where the treatment variables across sessions are whether tax liability is uncertain, the availability of an information service, the quality of the service if provided (i.e. the value of the information), and whether or not the information is always provided upon request. There are six treatments overall. In the Certainty Baseline treatment, there is no notion of uncertainty in the sense that participants are automatically given information on their true deduction and credit, i.e. they see the random draws from the underlying uniform distribution. In the Uncertainty Baseline treatment, the credit and deduction are uncertain and there is no information service. The remaining four treatments are determined by crossing whether perfect or imperfect information is available, with whether the service is delivered when requested or not (simulating a tax agency resource constraint).

The perfect information service, when requested and delivered, reveals the true deduction and credit. For the imperfect service, the participant is shown the supports of a new uniform distribution around the true deduction (credit), and the support of the distribution is 50% smaller than the original. As the true deduction or credit is in fact a draw from the original, wider distribution displayed, the midpoint of the new distribution is not necessarily the same as the

[17] These periodic adjustments reflect possible changes in status due to unexpected changes in allowed deductions (through unusual medical expenses for example) or credits (say through short lived programs such as energy credits for improving efficiency of heating or cooling systems).

original. With certain delivery, the information request is always fulfilled, and in the uncertain delivery it has a 50% chance of being fulfilled. This is analogous to calling up an IRS representative or looking at online FAQs and not receiving useful information. [18]

3.2 Theoretical implications

The experimental design lends itself to testing the main implications of the theory, as well as other possible behavioral patterns. Focusing first on the optimal reporting decision, with the experiment parameters ($p = 0.3$; $\beta = 3$) we have that $\frac{1}{p(\beta+1)} < 1$. Thus, when liability is uncertain, the optimal reporting decision is defined by equation (2). With certainty or receipt of the perfect information service, it is optimal to report the truth. For both the deduction and credit decision, based on the experiment parameters it is optimal to underreport relative to the true tax liability (i.e. over-claim deductions and credits). To see this, with uncertainty and the uniform distribution employed, based on equation (2), the solution to the cost minimization problem is $R_l^* = \frac{a_l - b_l}{p(\beta+1)} + b_l$. Consider the case of the tax credit, which in the context of the model reflects a negative liability. For the highest earned income level of 2000, the expected credit liability is −225 with an uncertainty range of b_l=−112.5 and a_l=−337.5. This yields $R_l^* = -300$ (a credit of 300), such that underreporting relative to the expected tax liability is optimal. Since the expected tax credit is a decreasing function of income, and the width of the uniform distribution is held constant, this leads to a lower degree of underreporting as income increases. In contrast, since the

[18] These are, admittedly, highly stylized information services but the design meets the conditions for parallelism as discussed in footnote 15. The information services implemented capture the essential ingredients as faced in the naturally occurring setting. The services may (but not always) resolve uncertainty and may (but not always) be delivered in a timely fashion to meet the filing deadline. As implemented, the task is simpler than in the naturally occurring setting but the effort is commensurate with the decision costs and rewards in the lab.

expected tax deduction is an increasing function of income, the opposite is true: those with higher incomes optimally underreport liability relatively more than those with lower incomes.

Following from Proposition 1, and noting that the information service is unbiased, providing perfect or imperfect information decreases the amount of tax underreporting, i.e. information leads to more truthful reporting. The basic theory does not include arguments for possible behavioral considerations such as spite or gratitude, and the prediction is that the taxpayer would simply respond in a case where the requested information service was unavailable as she would if no service existed or otherwise did not make the request.

In terms of the filing decision, following Proposition 2, reducing uncertainty increases the propensity to file. For our particular parameters, the net benefits of filing are decreasing with income. In particular, those with higher incomes have an overall higher tax liability. Under certainty, the expected filing rate is approximately 90%. With partial information acquisition, this rate decreases to approximately 80% and is 70% in uncertainty settings when the uncertainty remains unresolved. As the information service leads to more truthful reporting as well as encourages filing, the overall efficiency of the tax system is improved.

3.3 Participant pool and procedures

The experiments were conducted at two universities utilizing the same software and lab setup. The participant pools included students and non-students (university staff, mostly), who participated in separate sessions. The experimental labs consist of two dozen 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 announcements sent via email to students and staff. Participants were contacted via email, and permitted to participate in only one session (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 had prior experience in this setting. Methods adhere to all guidelines concerning the ethical treatment of human participants. Overall, there are 486 participants: 114 students and 119 non-students at university 1; 164 students and 89 non-students at university 2.

An 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, and a printed summary sheet (see Appendices B and C for illustrative materials). Next, the summary sheet is read aloud by the experimenter and any clarification questions are addressed. Participants then go through two unpaid training rounds and are given an additional opportunity to ask questions. The participants are informed that all decisions will be 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. This reduces, to the extent possible, peer and experimenter effects. All actions that participants take are made on their computer and individual responses cannot be tied to a particular subject.

In each round of the experiment, participants earn income based upon their performance in a simple computerized task, in which they are required to sort numbers into the correct order. The participant who finishes in the shortest time receives the highest income of 2000 lab dollars, the next receives 1900, and so on. Participants are informed of their earnings and those of the others in their group to ensure that they believe the relative nature of the earnings. The reported earnings represent the only information participants have of other participants, and the earnings task is the only source of payoff interdependence.

After earning income, participants are presented with a screen that tells them their income in that round as well as the tax policy parameters. Participants are informed they may claim a deduction (reducing tax liability) and a tax credit (reducing tax owed or increasing refund due). The deduction reduces the amount of earned income for which taxes must be paid. Given the tax rate of 50%, each additional dollar of deduction claimed reduces reported tax liability by 50 cents. Each dollar of claimed credit reduces liability by a dollar. The maximum credit participants are allowed to report is 825, and they are allowed to deduct their entire income. Other than these bounds, participants are informed that they may enter any amounts for their deduction and their tax credit.

Participants are able to experiment with different reports during the time allowed for filing. Thus, they can observe the potential changes in their reported take-home income (absent an audit) for each potential reporting strategy they investigate. A timer at the bottom of the tax form counts down the remaining time. The participants are allowed 120 seconds to file and the counter begins to flash when there are fifteen seconds remaining.[19] Thus, the process in the lab mimics that by which a taxpayer may well conduct different calculations in the time prior to actually filing her taxes (whether he or she uses one of the available tax software programs or simply does the tax return by hand). The participant can choose to instead not file the form at any time. If an information service is available, this can be requested at any time prior to the filing date.

The random audit selection process is implemented by the use of a virtual bingo cage that

[19] Failure to file on time results in additional penalties as in the naturally occurring setting.

appears on each participant's computer screen. A box with blue and white bingo balls appears on the screen following the tax filing. The ratio of blue to white balls determines the audit probability. The balls begin to bounce around in the box, and after a brief interval a door opens at the top of the box. If a blue ball exits, the participant is audited; a white ball signifies no audit. The audit applies only to the current round declarations, not to past (or future) rounds.

When an audit occurs, the true values of the uncertain components (deductions and tax credit) are displayed. If the individual has underreported her tax liability for one or both line items, she must pay the additional taxes as well as pay a penalty. If an individual has over-reported her tax liability no over payments are returned to the individual.[20] Since the audits work the same for non-filers and filers, a non-filer is not allowed to receive any credit or deduction and thus is liable for taxes on their full earned income and pays a penalty based on this amount of unpaid taxes. Participants are presented with a final screen that summarizes everything that happened during the round, including net earnings. This process is repeated for a total of 20 paid rounds, but to minimize end-of-game effects the total rounds is unannounced.

Lab dollars are converted at the end of the experiment at the rate of 1500 lab dollars to 1 U.S. dollar in student sessions and 600 to 1 for non-student sessions. After the paid rounds, participants fill out a brief questionnaire recording basic demographics and some information on tax reporting experience. The session concludes with each participant being paid privately, in cash. Earnings averaged $20 for student participants and for non-students were $50.

These experiments are designed to inform a policy debate and, as such, must meet two conditions to be useful in this regard. First, the design must meet the conditions for *parallelism* as discussed above in footnote 15. Second, the experiment must satisfy *external validity*, that is,

[20] Certain errors on the part of the taxpayer may not be easily verified in the event of an audit. For example, failure to claim a deduction for a charitable contribution because the taxpayer was uncertain of the status (e.g., 501c(3) status) of the organization may not be observed by the tax agency even in the event of an audit.

do the results observed in the laboratory apply to the "naturally occurring" world? Parallelism relates to the internal validity of the design as we addressed earlier. External validity is, by its nature, more difficult to assess since the reason for doing lab experiments is often that naturally occurring data are insufficient or incomplete. While one cannot "prove" external validity it is possible to muster a weight of evidence argument. First, our present experiment utilizes data from non-student (adult) and student subjects thus addressing a common concern in the external validity debate. Second, using a similar design Alm, Bloomquist, and McKee (2013) show that the behavior of the subjects in the lab setting closely reflects the behavior of taxpayers in the field. Finally, using a slightly different design from the one employed here and with all adult subjects, Cummings et al (2009) find tax reporting behavior across countries exhibits differences arising, as predicted, solely from stark differences in each country's political history. Thus, there is considerable evidence to suggest that the basic design of the present experiment satisfies external validity.[21]

4. Analysis

We analyze three outcomes from the experiment. The first is the decision to file or not. The second is underreported taxes for those who filed.[22,23] In particular, we convert credit and deduction amounts into a reported liability (a one-dollar credit decreases liability by one dollar whereas a one-dollar deduction decreases liability by 50 cents) and take the difference between this and expected liability. Expected liability is calculated based on the participant's information

[21] Of course, someone could assert that he or she is not convinced by these arguments. But, the same standard of skepticism should be applied to research utilizing recall survey data. This would apply to research utilizing data from the Current Population Survey, among other sources.

[22] Alternatively, we can construct *ex post* measures based on the realized, true liabilities. Not surprisingly, given the large number of participants and decision rounds (i.e. the large number of random draws), the alternative measures lead to the same basic conclusions.

[23] We also estimated models for the credit and deduction reporting decisions separately (available upon request), which gives rise to similar conclusions.

set at the time of filing and thus depends on the information setting (certain or uncertain) and any information obtained from an information service.

The third outcome is a measure of tax reporting efficiency. As noted previously, both positive and negative deviations from truthful reporting can decrease the efficiency of the tax system. Thus, a simple measure such as the percentage of taxes collected is not appropriate as positive and negative deviations would simply cancel out. Instead, we utilize a measure that takes on values between 0 and 100 percent (inclusive), and treats positive and negative deviations of equal magnitude as leading to the same efficiency loss. In particular, we define efficiency as:

(4) $$Efficiency = \left(1 - \frac{|report - truth|}{|min\ liability - truth|}\right) \times 100\%,$$

where *report* is the total taxes reported, *truth* is the actual (expected) tax liability, and *min liability* is the lowest (or highest) possible amount that can be reported. An efficiency of 0% arises for a reported liability that is the furthest possible from the truth, e.g. the participant deducts all her earned income and claims the largest possible credit of 825. 100% efficiency equates to (*ex ante*) truthful reporting. This efficiency measure accommodates both filers and non-filers, i.e. non-filers are simply treated as "reporting" zero tax liability.

We analyze the three outcome variables separately with linear regressions. Included explanatory variables are indicators and interaction variables that capture expected differences due to tax liability information, and Earned Income. Specifically, we include an indicator for Certainty Baseline observations (n = 1640). Three interaction variables correspond with the perfect information service setting: the interaction Perfect Info × Not Requested equals 1 for those in the two perfect information treatments who did not request information (n = 1706); the interaction Perfect Info × Requested × Not Received equals 1 for those in the perfect information treatment where delivery is imperfect (n = 436); and Perfect Info × Requested × Received equals 1 for those in the two perfect information service treatments who successfully obtained the service (n = 1255). A parallel set of interactions are included for the imperfect information treatments (sample sizes for the three subsamples are 1665, 336 and 1101). No indicator is included for Uncertainty Baseline observations (n = 1480), such that estimated coefficients measure differences relative to this treatment.

Estimation of the models is through ordinary least squares. To control for possible heteroskedasticity, within-subject serial correlation and between-subject contemporaneous error correlation, we compute robust standard errors with clustering at both the participant and decision-round level. Further, robust t and F statistics are used when evaluating hypotheses. The estimated models are presented as Model 1 in Tables 3 through 5. Table 2 describes the data.

Model 1 in Table 3 confirms the two theoretical implications of the theory with regard to the tax filing decision. First, the filing rate is decreasing in income. As the allowable credit is higher for those with lower incomes, this is an expected result. The estimate from the model suggests that the difference in the filing rate between those with 1000 lab dollar income and those with a 2000 lab dollar income is 36 percentage points. Second, successful acquisition of the information service increases tax filing. Those who successfully obtained the perfect or imperfect information service are 28% and 25% more likely to file, respectively. Of note is that these effects are about 50% larger than in the Certainty Baseline. Also, the effect on filing for those who requested but did not obtain the service (perfect or imperfect) is of similar magnitude to those who were successful.

Overall 62% of subject decisions involved filing a tax form. This is substantially less than predicted by the theory but not inconsistent with other observations.[24] One possible explanation is that not filing minimizes cognitive burden as the subsequent liability reporting is avoided. Observed differences in filing rates across the range of earned income are also larger than predicted. This could also be tied to cognitive burden as those with high incomes interested in evading much of their liability can simply chose the not file strategy as a reasonable approximation of their desired level of evasion.

Result 1: Information services increase the propensity to file a tax return.

It is possible that service information effects could be due to self-selection, i.e. those with an unobserved taste for truthful reporting are more likely to request the information service. The filing rates for those who do not request the information service are statistically identical to those in the Uncertainty Baseline treatment. Hence, this is inconsistent with the self-selection story as we do not see those opting out of the service filing less frequently. We more formally explore the possibility that information requests should be treated as endogenous later in the analysis, and find evidence to the contrary.

Turning to the model of tax underreporting (Model 1, Table 4), there is strong evidence that receiving an information service significantly decreases underreporting. The direction of the effect is consistent with theory. The magnitude of the effect is similar across the perfect and imperfect settings, with estimates of 101.14 and 102.28 in underreporting reductions, respectively. Interestingly, there is evidence of an unintended consequence when the perfect

[24] The behavior observed in these sessions is similar to the baseline results reported by Alm et al (2012) using a similar experimental setting and is also consistent with estimates of non-filing by taxpayers for whom all income not reported by third parties (Erard and Ho, 2001).

information service is requested but not delivered. On average, this increases underreporting relative to the Uncertainty Baseline by 116.53, which is nearly equal in magnitude to the effect of successfully delivering the service. Those not selecting the service engage in statistically similar levels of evasion as those in the uncertainty baseline.

There is no mean statistical difference in underreporting across the Certainty and Uncertain Baselines.[25] Based solely on this, information services would be expected to have no aggregate effect, which of course is not the case. An unexpected result is that there is a strong and positive income effect, with an increase in underreporting 168.02 lab dollars higher for the 2000 income level relative to the 1000 level. With perfect information, the optimal strategy is to report truthfully regardless of income. With uncertainty, based on our parameters, expected underreporting is essentially invariant to income. For a participant with an earned income of 1000, expected underreporting is 262. This same figure is 267 for those with an income of 2000.[26] In the Uncertainty Baseline, estimated underreporting is similar to that predicted by theory at high income levels (e.g. underreporting of 239.51 for income of 2000) but is less than theory predicts for lower income levels (71.49 for income of 1000).

<u>Result 2</u>: (a) Successfully provided information services leads to less tax underreporting. (b) An unsuccessfully provided perfect information service motivates an increase in tax underreporting.

As indicated by the estimation results in Table 5 (Model 1), successfully providing information services when requested leads to positive and significant efficiency gains. For the

[25] This result is less surprising when we consider that complexity (uncertain tax liabilities) can lead to errors in both under- and over-reporting as we noted in the introduction.
[26] Theoretically, optimal evasion is increasing in income for the deduction and decreasing in income for the credit. Based on our experiment parameters, these effects almost exactly offset.

perfect service, the average gain is 14.69 percentage points. For the imperfect service, the gain is cut by over half of this at 6.21 percentage points. These results are consistent with findings that those who obtain services are more likely to file (given that not filing leads to inefficient reports) and report more truthfully. When either the (perfect or imperfect) service is not requested or requested by not delivered, this has a null effect on efficiency. Efficiency is increasing in income, with an estimated 9.92 percentage point increase in comparing income levels of 1000 and 2000. The direction of the effect is consistent with theory.

Theoretically, with perfect tax liability information, efficiency in the experiment should be 100%. This is not borne empirically, with efficiencies for the Certainty Baseline estimated to be in the range of 76 to 86%, and efficiencies when the perfect service is obtained in the 80 to 90% range. Efficiencies for the Uncertainty Baseline are estimated to be in the 65 to 75% range.

Result 3: Information services when successfully provided increase the efficiency of the tax reporting system.

4.1 Supplemental analysis

By experimental economics standards we have data from a diverse set of participants, with wide variation in key demographics such as age, tax filing experience, and educational attainment. To explore the effects of participant characteristics, we re-estimated the three models while including the participant-based covariates identified in Table 2 as well as a time trend (i.e. decision round number). The demographic information was voluntarily provided by participants, and we unfortunately lose about 85% of the observations when including demographics. The expanded specification is presented as Model 2 in in Tables 3 – 5.

Compared to the more parsimonious models presented above, the treatment effects are largely unchanged in terms of coefficient signs, magnitudes and statistical significance. This is of course expected given that our identification is based on random treatment assignment and we have a large number of participants. Turning to the partial effects of the control variables, unobserved factors associated with gender differences are most prominent, with females estimated to underreport 126.61 lab dollars less than males. Females report more truthfully on average, to the extent of a 6.40 percentage point increase over males. This is consistent with gender specific behavior in other tax reporting settings (see Alm, Cherry, Jones and McKee, 2010) and in other settings involving risky outcomes (see Powell and Ansic, 1997; Dwyer, Gilkeson, and List, 2002). Underreporting is modestly decreasing in age (3.92 lab dollars for a 1-year increase) and increases across decision rounds (8.93 lab dollar increase each round). There is minimal evidence of differences across our four subject pools defined by lab location and student status, with the only significant pairwise difference occurring between the two non-student pools in the filing decision model. There is no apparent carryover of this subject-pool effect in terms of underreporting and efficiency.

To further examine the possible impacts of learning and other motives that may give rise to trending behavior over time (i.e. decision rounds), we estimated two additional sets of models (with and without the participant-based controls) that: (1) included time fixed-effects instead of a time trend; (2) restricted the data to include only the last five decision rounds.[27] The signs and magnitudes of the treatment effects are robust to these specifications.

Lastly, given that our design has participants request or not the information service, it is possible that this aspect of the design may lead to specification issues if the decision to request the service is correlated with unobservables related to truthful reporting. Intuitively, one might

[27] It is not possible to include subject fixed-effects due to perfect collinearity by virtue of the experimental design.

expect that those less likely to report truthfully would also be those less likely to request the service. To explore this, we estimated instrumental variables regressions that parallel Model 1 for the three dependent variables. Specifically, following an approach proposed by Wooldridge (2010, procedure 21.1, pg. 939), we fit a probit model using *Requested* as the dependent variable and use the estimated probabilities from the model as an IV for *Requested* in the outcome equation.[28] Included as additional instruments in the probit model are: *Experience*, *College* and *Employment* (which were never jointly significant in the outcome equations); indicators of student status and whether the participant can be claimed as a dependent on another's tax return; an identification variable unique to a particular session; the number of participants in the session.

In the "first-stage" regressions, the estimated probability is significantly (partially) correlated with the potential endogenous variable.[29] Using Wooldridge's (1995) score test, we fail to reject the null hypothesis that *Requested* is in fact exogenous.[30] This evidence supports our earlier findings as it suggests that an IV approach is not needed for this application. As additional anecdotal evidence that self-selection is not significantly distorting our conclusions, we note that in all regressions presented in Tables 3 – 5, coefficients on the two *Not Requested* interactions are not statistically different from zero. If selection was driving the results we would have instead expected that those not requesting information would have lower filing rates, more underreporting, and lower efficiencies than those in the Uncertainty baseline where no information service was available.

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[28] Technically, the models presented in Tables 3 – 5 include six potentially endogenous covariates given that the request decision is embedded in six interactions involving the perfect and imperfect information treatments. To help strengthen identification, in our IV exercise we consider a slightly different specification where the included covariates are *Certainty*, *Perfect*, *Imperfect*, *Earned Income*, and *Requested*. This specification thus reduced the number of potentially endogenous variables to one.

[29] Test statistics for the filing, underreporting and efficiency models are, respectively: $F(1, 434) = 18.97$, $p < 0.01$; $F(1, 396) = 5.23$, $p = 0.02$; and $F(1, 434) = 18.97$, $p < 0.01$.

[30] Test statistics for the filing, underreporting and efficiency models are, respectively: $F(1, 434) = 2.53$, $p = 0.11$; $F(1, 396) = 0.03$, $p = 0.86$; and $F(1, 434) = 0.20$, $p = 0.65$.

5. Discussion

Tax complexity lowers tax reporting efficiency. Our subjects are less likely to file when tax liability is uncertain and, conditional on filing, to commit more reporting errors. The provision of information potentially offsets these effects. This main result holds for those who request the service as well as those who do not. That is, it appears that simply *providing* the service, even an imperfect service, increases the propensity to file and the accuracy of reporting. In fact, the filing rate exceeds the rate observed in our baseline (no tax liability uncertainty) setting when the taxpayers face uncertain liabilities and information services are provided. This result holds for both perfect and imperfect information services. For both the deduction and credit reporting decision, information services enhance reporting accuracy but the observed effect is greatest for participants at the higher earned income levels.

Since not filing is an option for the taxpayer, we would expect it to be counterproductive to make tax information services unreliable since this will not address the uncertainty regarding tax liability.[31] Our results demonstrate that information services that fail to provide information that is requested can have a negative impact on tax reporting efficiency relative to a no-service setting. On the whole, the experimental and theoretical evidence suggests that the tax authority can increase compliance through the availability of information services. This works through an increase in filing rates and, conditional upon filing, greater incentives to truthfully reveal tax liability. Tax reporting efficiency is enhanced when taxpayer services are provided but this result holds only when the information is available, requested and delivered. When the information is requested but not delivered, the effect is a significant increase in overstating deductions and credits relative to when the information is delivered. In fact, when the information is not

[31] Of course, the value of the taxpayer service derives from the costs (monetary and not) imposed on the taxpayer for non-compliance. Absent enforcement effort, services that enhance compliance would have less value to the taxpayer.

delivered tax reporting efficiency is not different from the setting in which the information was not available. Thus, if such services are provided, the capacity must be sufficient to meet requests. Failure to deliver on information requests leads to lower compliance, perhaps even more so than if no information service is available in the first place.

While we demonstrate the provision of information services can reduce tax reporting errors, information programs are costly and we must consider the impact on the overall efficiency of the tax reporting system. As errors are reduced the collections from audits will fall. While one option is to reduce the number of audits as the error rates fall, maintaining the historical audit probability would still imply that the information services are beneficial. Since the audits will imply lower penalties being assessed, it is reasonable to expect that taxpayers will be more favorably disposed toward the tax authority and such trust will enhance reporting. It remains for future research to investigate the tradeoffs between enforcement effort and information programs in reducing tax reporting errors, and further the effectiveness of information programs across various taxpayer segments.

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Table 1. Experiment Parameters

Parameter / variable	**Value(s)**
Earned Income	1000 to 2000, in 100 increments
Audit Probability, Filer (ρ)	30%
Audit Probability, Non-filer (r)	6%
Penalty Rate (β)	300% on unpaid taxes
Tax rate	50% on taxable income
Tax Deduction	Expected value: 50% × Income Range: +/− 50% of expected value
Tax Credit	Expected value: 825 – (0.3 × Income) Range: +/− 50% of expected value

Table 2. Descriptive Statistics

Variable	Description	Mean (std. dev.)
Experiment-related measures		
Earned Income	Income from the experiment earnings task. Takes on values of 1000 to 2000, in 100 increments.	1558.62 (278.19)
Filed	=1 if tax form filed; =0 otherwise	0.62 (0.49)
Taxes Underreported	A measure of underreported taxes for filers. Calculated as the difference between reported liability and (expected) actual liability	121.32 (349.79)
Tax Efficiency	*see formula in text*	74.35 (26.91)
Certainty Baseline	=1 if participant is in baseline certainty treatment; =0 otherwise	0.17 (0.38)
Uncertainty Baseline	=1 if participant is in baseline uncertainty treatment; =0 otherwise	0.15 (0.36)
Perfect Info Available	=1 if perfect information service available; =0 otherwise	0.35 (0.48)
Imperfect Info Available	=1 if imperfect information service available; =0 otherwise	0.32 (0.47)
Requested	=1 if requested information service; =0 otherwise	0.31 (0.46)
Received	=1 if received information service; =0 otherwise	0.23 (0.42)
Round	Decision round of experiment	10.43 (5.75)
Participant characteristics		
Female	=1 if participant is female; =0 otherwise	0.57 (0.50)
Tax Experience	=1 if participant indicates she files a tax return without the aid of a tax preparation service; =0 otherwise	0.51 (0.50)
Age	Participant's age, in years	30.25 (13.56)
College	=1 if participant has a college degree; =0 otherwise	0.38 (0.49)
Employment	=1 if participant employed full time; =0 otherwise	0.39 (0.49)
Sub Pool 2	=1 if student participant at lab site 1; =0 otherwise	0.24 (0.43)
Sub Pool 3	=1 if non-student participant at lab site 2; =0 otherwise	0.19 (0.39)
Sub Pool 4	=1 if student participant at lab site 2; =0 otherwise	0.34 (0.47)

Table 3. Tax Form Filing Models: Estimation Results

Dependent Variable: Filed (=1 if tax form filed; =0 otherwise)		
	Model 1	Model 2
Intercept (Uncertainty Baseline)	1.09^{**} (0.07)	1.02^{**} (0.13)
Certainty Baseline	0.16^{**} (0.06)	0.19^{**} (0.06)
Perfect Info Available × Not Requested	−0.07 (0.06)	−0.03 (0.06)
Perfect Info Available × Requested × Not Received	0.23^{**} (0.06)	0.25^{**} (0.07)
Perfect Info Available × Requested × Received	0.28^{**} (0.05)	0.25^{**} (0.06)
Imperfect Info Available × Not Requested	−0.03 (0.06)	−0.00 (0.06)
Imperfect Info Available × Requested × Not Received	0.25^{**} (0.06)	0.28^{**} (0.07)
Imperfect Info Available × Requested × Received	0.25^{**} (0.05)	0.28^{**} (0.06)
Earned Income (in 1000s)	-0.36^{**} (0.04)	-0.30^{**} (0.04)
Round		0.00 (0.00)
Female		−0.04 (0.03)
Tax Experience		0.01 (0.03)
Age		0.00 (0.00)
College		0.01 (0.04)
Employment		0.00 (0.06)
Sub Pool 2		−0.06 (0.08)
Sub Pool 3		-0.22^{**} (0.05)
Sub Pool 4		−0.10 (0.08)
Number of Observations	9619	8365
R^2	0.109	0.133

Notes: * and ** denote estimates that are statistically different from zero at the 10% and 5% significance levels, respectively. Standard errors are adjusted for clustering at both the participant and decision-round levels.

Table 4. Tax Underreporting Models: Estimation Results

Dependent Variable: Taxes Underreported		
	Model 1	Model 2
Intercept (Uncertainty Baseline)	−96.53 (68.80)	75.53 (123.48)
Certainty Baseline	−31.22 (53.15)	−23.88 (48.46)
Perfect Info Available × Not Requested	2.55 (59.59)	16.30 (58.98)
Perfect Info Available × Requested × Not Received	116.53** (59.14)	108.70* (57.59)
Perfect Info Available × Requested × Received	−101.14** (48.72)	−105.84** (46.92)
Imperfect Info Available × Not Requested	−51.14 (61.74)	−74.08 (53.44)
Imperfect Info Available × Requested × Not Received	−27.99 (58.83)	−17.08 (54.48)
Imperfect Info Available × Requested × Received	−102.28** (50.03)	−96.06** (48.96)
Earned Income (in 1000s)	168.02** (34.17)	128.78** (33.42)
Round		8.98** (1.31)
Female		−126.61** (31.52)
Tax Experience		13.57 (27.35)
Age		−3.92** (1.45)
College		40.11 (31.58)
Employment		−57.58 (53.86)
Sub Pool 2		52.25 (73.71)
Sub Pool 3		−12.57 (43.44)
Sub Pool 4		−57.15 (69.82)
Number of Observations	5956	5166
R^2	0.039	0.179

Notes: * and ** denote estimates that are statistically different from zero at the 10% and 5% significance levels, respectively. Standard errors are adjusted for clustering at both the participant and decision-round levels.

Table 5. Tax Efficiency Models: Estimation Results

Dependent Variable: Tax Efficiency		
	Model 1	Model 2
Intercept (Uncertainty Baseline)	55.57** (4.00)	45.51** (7.09)
Certainty Baseline	10.31** (3.12)	8.35** (3.00)
Perfect Info Available × Not Requested	−1.36 (2.66)	−2.24 (2.88)
Perfect Info Available × Requested × Not Received	−6.86** (3.45)	−8.42** (3.60)
Perfect Info Available × Requested × Received	14.69** (2.55)	13.81** (2.67)
Imperfect Info Available × Not Requested	−1.88 (2.83)	−2.36 (2.83)
Imperfect Info Available × Requested × Not Received	−0.65 (2.99)	−1.92 (3.24)
Imperfect Info Available × Requested × Received	6.21** (2.47)	4.45* (2.64)
Earned Income (in 1000s)	9.92** (1.86)	11.06** (2.07)
Round		−0.03 (0.06)
Female		6.40** (1.90)
Tax Experience		−0.14 (1.70)
Age		0.10 (0.09)
College		−68.05 (2.25)
Employment		2.70 (3.13)
Sub Pool 2		0.41 (4.25)
Sub Pool 3		3.66 (2.40)
Sub Pool 4		5.71 (4.15)
Number of Observations	9619	8365
R^2	0.069	0.092

Notes: * and ** denote estimates that are statistically different from zero at the 10% and 5% significance levels, respectively. Standard errors are adjusted for clustering at both the participant and decision-round levels.

Appendix A. Proofs of Propositions 1 and 2

Proof of Propostion 1. First, note that if $\frac{1}{p(\beta+1)} \geq 1$ there is a corner solution at $R_l^* = \underline{a}_l$ and the service has no effect and therefore Proposition 1 holds. Otherwise, $\frac{1}{p(\beta+1)} < 1$ and in which case equation (2') implicitly defines the solution. It follows that

(A1) $\quad G\left(R_{l,I}^*\right) = F\left(R_{l,N}^*\right) \quad \forall l.$

When it is optimal to over-report in the absence of information, i.e. $R_{l,N}^* > x_l^0$, by assumption we have that $G\left(R_{l,N}^*\right) \geq F\left(R_{l,N}^*\right)$. From (A1), this assumption implies $G\left(R_{l,N}^*\right) \geq G\left(R_{l,I}^*\right)$, and it follows that $R_{l,I}^* \leq R_{l,N}^*$. Otherwise, when it is optimal to underreport in the absence of information, i.e. $R_{l,N}^* < x_l^0$, by assumption $G\left(R_{l,N}^*\right) \leq F\left(R_{l,N}^*\right)$. It follows that $G\left(R_{l,N}^*\right) \leq G\left(R_{l,I}^*\right)$ and $R_{l,I}^* \geq R_{l,N}^*$. Whenever $G\left(R_{l,N}^*\right) \neq F\left(R_{l,N}^*\right)$ we have that $R_{l,I}^* \neq R_{l,N}^*$, i.e. the information service leads to a reporting choice that is strictly closer to the truth.

Proof of Proposition 2. The proof proceeds by first showing that the costs of filing decrease with the information service and then showing that the costs of filing (at worst) do not increase with the service. Together, these conditions insure that information service decreases the relative costs of filing versus not filing.

Assuming an interior solution, the following expression is the difference in expected filing costs without and with the information service (for a specific line item):

(A2) $\quad \left[R_{l,N}^* + p(\beta+1)\int_{R_{l,N}^*}^{b_l}\left(x_l - R_{l,N}^*\right)f(x_l)dx_l\right] - \left[R_{l,I}^* + p(\beta+1)\int_{R_{l,I}^*}^{b_l}\left(x_l - R_{l,I}^*\right)g(x_l)dx_l\right].$

Integrating by parts the two integrals, and rearranging, we have that

(A3) $\quad \left(R_{l,N}^* - R_{l,I}^*\right)\left(\frac{1}{p(\beta+1)} - 1\right) + \int_{R_{l,I}^*}^{b_l} G(x_l)dx_l - \int_{R_{l,N}^*}^{b_l} F(x_l)dx_l.$

First consider the case where $R_{l,N}^* < R_{l,I}^*$. Note that $\int_{R_{l,N}^*}^{b_l} F(x_l)dx_l = \int_{R_{l,I}^*}^{b_l} F(x_l)dx_l +$

$\int_{R_{l,N}^*}^{R_{l,I}^*} F(x_l)dx_l$. The last term in this sum can be written as $F(R_{l,I}^*)(R_{l,I}^* - R_{l,N}^*) - \varepsilon$, with $\varepsilon > 0$.

Substituting these expressions into (A3), and rearranging, yields:

(A3') $\left[(R_{l,N}^* - R_{l,I}^*)\left(\frac{1}{p(\beta+1)} - 1 + F(R_{l,I}^*)\right)\right] + \int_{R_{l,I}^*}^{b_l} [G(x_l) - F(x_l)]dx_l + \varepsilon.$

Since $F(R_{l,I}^*) > G(R_{l,I}^*) = 1 - \frac{1}{p(\beta+1)}$, the first term is positive. The second term is positive as when $E[x_l|F] = E[x_l|G]$ (as assumed) as this insures that the area between the two CDFs to the right of x_l^0 is at least as large as the area between the CDFs to the left of x_l^0. Since $\varepsilon > 0$ it follows that the overall cost difference is > 0.

In a similar vein, for the case $R_{l,N}^* > R_{l,I}^*$, we can write expression (A3) as:

(A3'') $\left[(R_{l,N}^* - R_{l,I}^*)\left(\frac{1}{p(\beta+1)} - 1 + F(R_{l,N}^*)\right)\right] + \int_{R_{l,N}^*}^{b_l} [G(x_l) - F(x_l)]dx_l + \varepsilon\ .$

As $F(R_{l,N}^*) = 1 - \frac{1}{p(\beta+1)}$, the first term is equal to 0. The second term and third terms are strictly positive such that the overall cost difference is > 0. If we instead assume a corner solution, then the expected cost difference is zero under the assumption that $E[x_l|F] = E[x_l|G]$, given that this implies equivalent expected penalties.

We turn now to the expected costs of not filing. Condition (i) of Proposition 2 simply states that the probable liability amounts are all non-positive (i.e. a refund is probable). As with case (iii), the expected penalty associated with non-filing is simply zero with and without the service. Condition (ii) states that the range of probable liabilities is non-negative. With this, an audit will always reveal the taxpayer to have underreported with or without the service. As such, if the expected liability is equal with and without the service (as assumed), it follows that the expected penalty is likewise equal.

Appendix B. Experiment Summary Sheet for Perfect Information Service Treatment

Experiment Overview

- You will be participating in a market simulation that lasts several decision “rounds”.

- In each round, you first play an earnings game and then face a tax reporting decision.

- Each round is completely independent from the others, which means your decisions in one round in no way affects the outcome of any other round.

- In the tax reporting decision, you choose whether or not to fill out and file a tax form.

If you file a tax form…

- On the tax form, you decide how much to claim in deductions and how much to claim in tax credits. These two amounts determine your Final taxes paid. If Final taxes paid is a negative number, then this reflects a tax refund.

- You will not know the exact amount of your actual deduction and credit. Instead you will just be shown a range for each (this is displayed on the left side of the tax reporting screen). Each amount within the range has an equal chance of being your actual deduction (credit). You can choose to claim any amount between 0 and 825 for the credit and any amount between 0 and your Income earned for the deduction.

- There is an information service available to you at no cost. If you request the service, you will be shown the exact amount of your actual deduction and credit.

- You request the service by clicking on the “get better information” button.

- You have a 30% chance of being audited. Audits are determined completely at random and do not depend on your decisions or the decisions of others.

- If you are not audited, or if you are audited but do not owe additional taxes, your earnings for the round are your Income earned minus the Final taxes paid.

- If you are audited, your earnings for the round are adjusted as follows…
    - If the amount of deductions you claimed was *more* than what you were allowed, then you must pay taxes on the difference (unpaid taxes);
    - If the amount of credits you claimed was *more* than what you were allowed, then you must pay back the difference (unpaid taxes);
    - In addition, you pay a penalty equal to 300% multiplied by the amount of unpaid taxes (from deductions and credits).
    - If you claimed *less* in deductions and/or credits than you were allowed, you will not be refunded the difference. In this sense, the audit can never help you.

If you do <u>not</u> file a tax form…

- You have a 6% chance of being audited. Audits are determined completely at random.

- If you are not audited, your earnings for the round equal your <u>Income earned</u>.

- If you are audited, your earnings for the round are adjusted as follows…
    - You are not eligible for any deductions or any credit. In this sense, the audit can never help you.
    - You must pay taxes based on your Income earned (unpaid taxes).
    - In addition, you pay a <u>penalty</u> equal to 300% multiplied by the amount of unpaid taxes.

Appendix C. Selected Instruction Screenshots (can be omitted for publication)

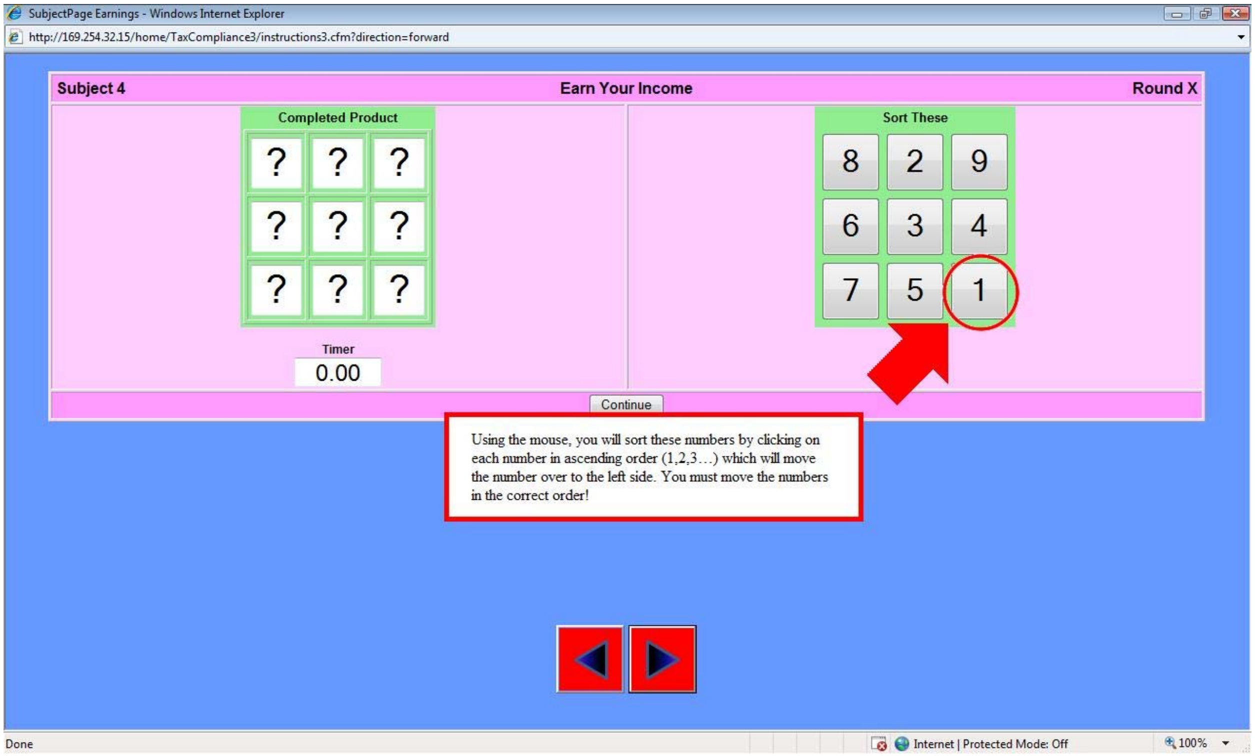

Figure C1. Income earnings task (from onscreen instructions)

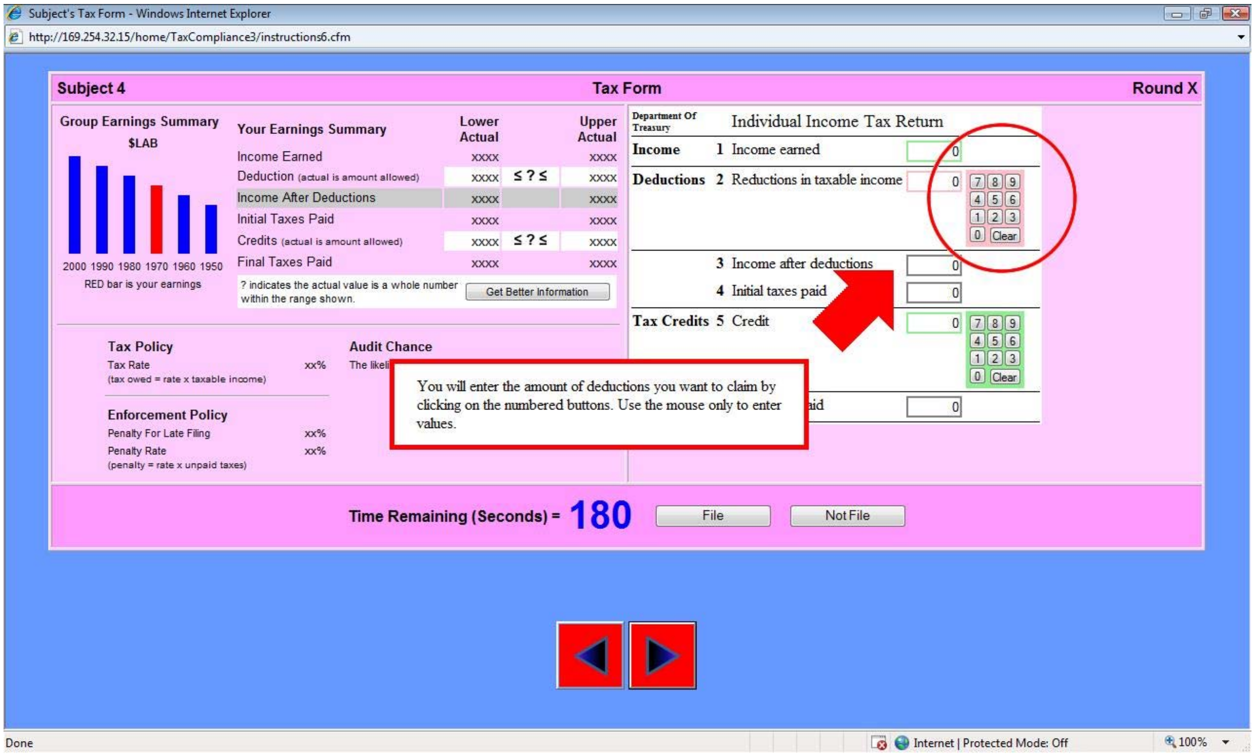

Figure C2. Tax decision screen (from onscreen instructions)

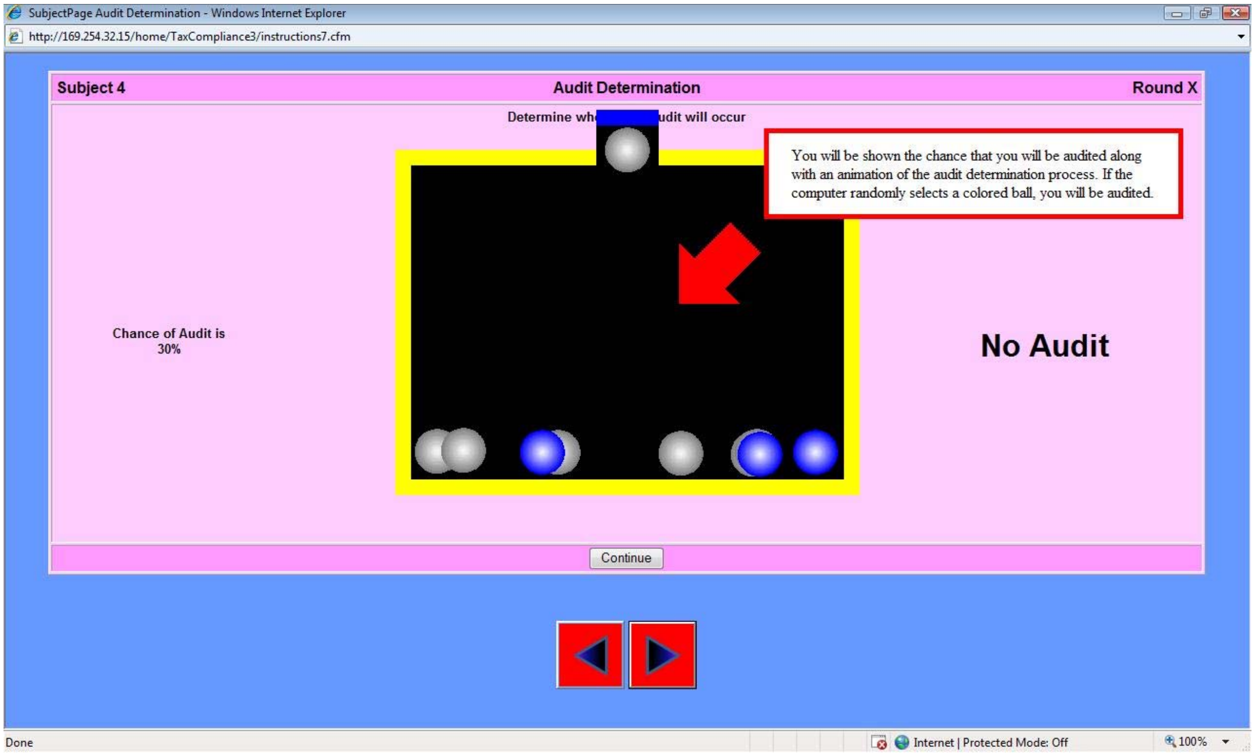

Figure C3. Audit selection process

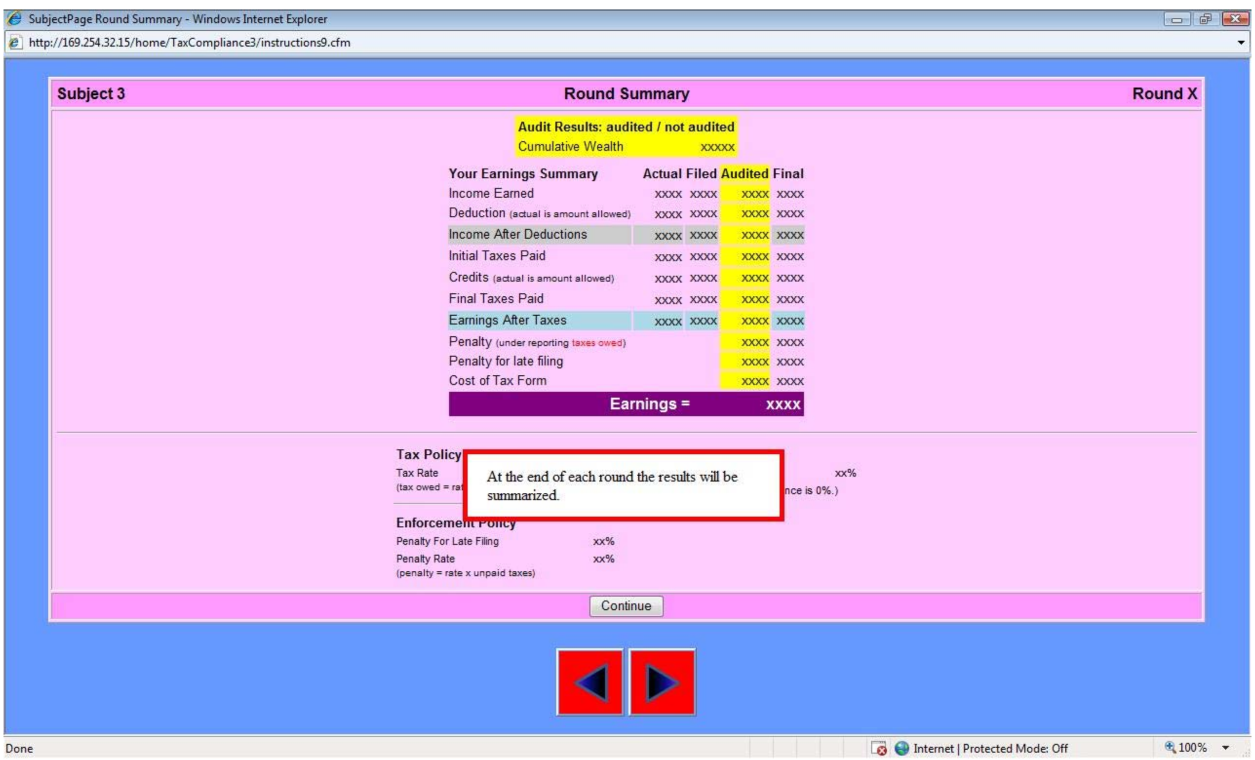

Figure C4. Results screen