Chapter 2

A BEHAVIORAL ACCOUNTING STUDY OF STRATEGIC INTERACTION IN A TAX COMPLIANCE GAME

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Abstract

This paper reports an experiment on a tax compliance game based on the model of Graetz, Reinganum, and Wilde (1986). A model implication is that the audit rate, β, is insensitive to the proportion of strategic versus ethical taxpayers, ρ. Our hypotheses contrarily predict that auditors with limited rationality use ρ as a cue for adjusting β. The hypotheses assume a simple additive process: $\beta = \beta' + \beta''$, where β' depends on ρ, and β'' depends on a belief about the taxpayer's strategy. The results show positive associations between ρ and β', and between auditors' uncertainty about ρ and β'. The auditors formed incorrect beliefs about the taxpayers' responses, which affected β''. The auditors incorrectly believed that the taxpayers increased the rate of under-reporting income as ρ increased, and that the taxpayers expected a higher audit rate when the auditors faced uncertainty about ρ. The taxpayers correctly believed that β increased as ρ increased, and responded by decreasing the rate of under-reporting income.

1. INTRODUCTION

Behavioral accounting research tests hypotheses regarding the implications of realistic assumptions about human rationality for economic decisions in accounting settings (Waller, 2002). One such assumption is that decision-makers face cognitive limitations which prevent them from acting as if they maximize expected utility (Simon, 1982). As thoroughly documented in the psychology literature, cognitive limitations can lead to systematic decision biases (Connolly, Arkes, and Hammond, 2000). Drawing from psychology, behavioral accounting researchers normally test

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their hypotheses with experimental methods that emphasize internal validity, sometimes at the expense of external validity. As in psychology, most behavioral accounting experiments examine the behavior of isolated subjects who respond to an exogenous choice or information set. This approach has the advantage of screening out many sources of noise, especially the responses of other subjects, which sharpens the focus on an individual's decision process.

Critics of behavioral accounting experiments raise two related questions. The first question concerns rationality: how should subjects without cognitive limitations act in the experimental setting? Formal theories of accounting establish stylized settings of competitive or strategic interaction, and derive the equilibrium consequences for the role of information. To maintain tractability, the formal theories assume that decision-makers maximize expected utility. This theoretical perspective prompts the question about rational behavior in a specific experimental setting, in order to evaluate if not predict the subjects' behavior. Although some behavioral accounting experiments employ a normative model or principle, most fail to relate the experimental design or evidence to any formal theory of accounting. The second question concerns external validity: do conclusions about the subjects' behavior in individual settings generalize to the aggregate economic settings that are relevant to accounting? An important mechanism in these economic settings is the competitive or strategic interaction of players with conflicting preferences, which would discipline and potentially eliminate the decision biases found in individual settings. Arbitrage traders in equity markets would take advantage of unsophisticated traders who systematically over-react to accounting disclosures. Auditees reporting income would take advantage of auditors who systematically under-react to cues indicating income manipulation.

Behavioral accounting research can address both questions by incorporating three steps into the experimental design. First, accounting experimenters can assign subjects to opposing roles, e.g., auditors and auditees, and observe their strategic interaction in game settings (Camerer, 2003). Besides addressing the question about external validity, this step allows experimenters to expand their research agenda. How does an auditor with limited rationality form a belief about the strategy choice of an auditee also with limited rationality? Second, in the tradition of experimental economics (Smith, 2000), accounting experimenters can operationalize a game-theoretic model based on the assumption that decision-makers maximize expected utility. This step addresses the question about rationality, by providing a basis for determining the strategy choices of ideal players with unlimited rationality and for evaluating the strategy choices of real players with limited rationality. Third, in the tradition of behavioral decision research (Kahneman and Tversky, 2000), accounting experimenters can manipulate a variable that, although normatively irrelevant in the game-theoretic model, is hypothesized to affect the behavior of players with limited rationality.

This study reports an experiment that used the three-step approach to examine behavior in a tax compliance game. The experiment operationalized the game-theoretic model of Graetz, Reinganum, and Wilde (1986), who provided a seminal analysis of the tax compliance problem (for literature reviews, see Andreoni, Erard, and Feinstein, 1998; Cuccia, 1994).[1] In the model, the taxpayer chooses a strategy $\{\alpha, 1 - \alpha\}$ when true income is high, whereby he under-reports income with probability α and honestly reports income with probability $1 - \alpha$. The auditor chooses a strategy $\{\beta, 1 - \beta\}$ when reported income is low, whereby she conducts a costly audit with probability β and does not audit with probability $1 - \beta$. The model assumes two taxpayer types: proportion ρ are strategic taxpayers who maximize expected wealth, and proportion $1 - \rho$ are ethical taxpayers who adhere to an internalized norm for honesty. The auditor maximizes expected net revenue, i.e., tax plus fine minus audit cost. Before conducting an audit, the auditor cannot distinguish the taxpayer types. When the auditor conducts an audit and detects under-reporting, the taxpayer must pay a fine plus the tax for high true income. An implication of the model is that the optimal audit rate β^* is insensitive to an exogenous change in ρ, as long as ρ exceeds a threshold. The strategic taxpayer fully absorbs the change in ρ by adjusting the optimal rate of under-reporting income α^*.

Contrary to the model-based implication, our hypotheses predict that the auditor with limited rationality is sensitive to both the level of ρ and uncertainty about ρ. To represent limited rationality, we propose that the auditor chooses the audit rate through a simple additive process:

$$\beta = \beta' + \beta'', \tag{1}$$

where β' is a function of the factors that directly affect the auditor's choice, e.g., audit cost, and β'' is a function of the auditor's belief about the taxpayer's strategy, $E_a(\alpha)$.[2] To measure β' and β'', we performed a regression for each auditor:

$$\beta = \mathrm{A} + \mathrm{B} \cdot E_a(\alpha) + \varepsilon. \tag{2}$$

B indicates the sensitivity of the auditor's strategy choice to a change in belief about the taxpayer's strategy. For each round, we used $\{\mathrm{A} + \varepsilon\}$ as a measure of β', and $\{\mathrm{B} \cdot E_a(\alpha)\}$ as a measure of β''. We hypothesize that β' increases with increases in the level of ρ and in the auditor's uncertainty about ρ, and that β'' changes with changes in the level of ρ and in the auditor's uncertainty about ρ.[3]

The experimental procedure assigned subjects to the role of strategic taxpayer or auditor. A computer automated the role of ethical taxpayer. At the start of each round, the strategic taxpayers chose a rate for under-reporting income when true income was high, and the auditors chose an audit rate when reported income was low. Before stating their strategy choice, all subjects provided an estimate of their opponent's strategy. Over 20 rounds, the procedure randomly varied ρ among three levels (0.25, 0.50, 0.75). The procedure also manipulated the auditors' uncertainty about ρ on a between-group basis. In one group, the auditors knew the level of ρ before stating their audit rate for the round. In the other group, the auditors knew that the three levels of ρ were equally likely, but did not know the level of ρ until the end of the round. In all cases, the strategic taxpayers knew ρ, and they knew whether the auditors knew ρ. Because each level of ρ exceeded a threshold, the optimal audit rate was a constant, regardless of round-by-round variation in the level of ρ and regardless of the auditors' uncertainty about ρ.

As hypothesized, the results showed a significantly positive relationship between the level of ρ and β'. The auditors who knew the level of ρ increased β' as the proportion of potential tax cheaters increased. In addition, β' was significantly higher for the auditors with uncertainty about ρ. The results for β'' were less straightforward. The relationship between the level of ρ and β'' was positive but insignificant, indicating that the auditors' belief about how the taxpayers reacted to changes in ρ had a modest effect on the audit rate. However, β'' was significantly lower for the auditors who faced uncertainty about ρ, indicating that the auditors incorrectly believed that the taxpayers raised their estimate of the audit rate when the auditors faced uncertainty about ρ. For their part, the taxpayers were sensitive to the auditors' use of ρ as a cue for adjusting the audit rate. The taxpayers correctly believed that the audit rate increased as the level of ρ increased, and responded by decreasing the rate of under-reporting income.

2. GAME SETTING

The setting involves the interaction of a taxpayer and an auditor (Graetz et al., 1986). The population of taxpayers includes a proportion ρ of strategic taxpayers who under-report income given the right incentive, and a proportion $1 - \rho$ of ethical taxpayers who always report honestly. True income is either low or high, and reported income is either low or high. All players know the probability of high rather than low true income. Given low true income, all taxpayers report low income, because there is never an incentive to over-report income. Given high true income, ethical taxpayers report high income, but strategic taxpayers report low income with probability α, and report high income with probability $1 - \alpha$. The amount of tax is higher when reported income is high rather than low.

Given low reported income, the auditor decides whether to conduct a costly audit that reveals true income. Before conducting an audit, the auditor cannot distinguish among an honest report from an ethical taxpayer with low true income, an honest report from a strategic taxpayer with low true income, and under-reporting by a strategic taxpayer with high true income. When the auditor detects under-reporting, the taxpayer must pay a fine in addition to the tax on high income. The auditor's cost to conduct an audit is positive but less than the sum of the fine plus the tax difference for high versus low income. Given low reported income, the auditor conducts an audit with probability β, and no audit with probability $1 - \beta$. Given high reported income, there is never an audit.

Figure 1 shows the players' best-response functions, which intersect at α^* and β^*. α^* is the rate of under-reporting income at which the auditor's return from conducting an audit is zero:

$$\alpha^* = C(1 - P)/[\rho \cdot P(F + T - C)], \tag{3}$$

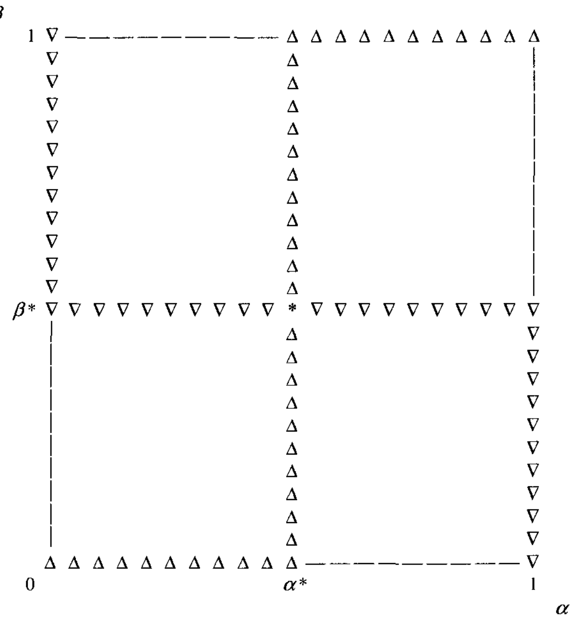

Figure 1. Best-response functions and optimal strategies.
The figure shows the best-response functions of the strategic taxpayer (∇) and auditor (Δ). The players' best-response functions intersect at α^* and β^*.

where C is the audit cost, P is the probability of high true income, F is the fine for detected under-reporting, and T is the tax difference for high versus low income. If α is less than α^*, then the auditor never conducts an audit when reported income is low. If α is more than α^*, and α^* is less than one, then the auditor always conducts an audit when reported income is low.[4] β^* is the audit rate at which the strategic taxpayer's return from under-reporting is zero:

$$\beta^* = T/[F + T]. \tag{4}$$

If β is less than β^*, then the strategic taxpayer always under-reports when true income is high. If β is more than β^*, then the strategic taxpayer never under-reports when true income is high. Equation 3 implies an inverse relationship between the level of ρ and the optimal rate of under-reporting income. Equation 4 implies that the optimal audit rate is not sensitive to the level of ρ.

The experiment fixed most of the model's parameters for each of 20 rounds. In each round, there was a 0.50 probability that true income was high (100 francs), and a 0.50 probability that true income was low (0 franc). The tax was 50 francs for reported income of 100 francs, and the tax was 0 franc for reported income of 0 franc. The audit cost was 10 francs. The fine for detected under-reporting was

50 francs. The level of ρ randomly varied round-by-round among three levels (0.25, 0.50, 0.75). The optimal audit rate was a constant, because each level of ρ exceeded a threshold (0.11).[5] Given the above parameter values, the optimal strategies in the experiment were:

$\beta^* = 0.50$, regardless of ρ,

$\alpha^* = 0.44$, when ρ was 0.25,

$\alpha^* = 0.22$, when ρ was 0.50, and

$\alpha^* = 0.15$, when ρ was 0.75.

These optimal strategies assume unlimited rationality, and provide a benchmark for evaluating the subjects' behavior. To predict the subjects' behavior, the following hypotheses assume limited rationality.[6]

3. HYPOTHESES

Our hypotheses assume that the auditor with limited rationality chooses the audit rate through an additive process:

$$\beta = \beta' + \beta''. \tag{5}$$

β' is a function of the factors that directly affect the auditor's choice:

$$\beta' = f(C, F, T, \rho). \tag{6}$$

For example, a decrease in the audit cost implies an increase in β', other things held constant. β'' is a function of the auditor's belief about the taxpayer's strategy, $E_a(\alpha)$:

$$\beta'' = g(E_a(\alpha)). \tag{7}$$

To assess $E_a(\alpha)$, the auditor assumes that the taxpayer also employs an additive process:

$$E_a(\alpha) = E_a(\alpha') + E_a(\alpha''), \tag{8}$$

where α' is based on the factors that directly affect the taxpayer's choice, and α'' is based on the taxpayer's estimate of the audit rate. $E_a(\alpha')$ reflects the auditor's belief about how the taxpayer responds to factors such as the fine for detected underreporting. $E_a(\alpha'')$ reflects the auditor's belief about the taxpayer's estimate of the audit rate. Incorporating such beliefs into the choice of β is the upper limit for strategic reasoning by the auditor with limited rationality.

Effects of ρ. The first set of hypotheses (H1-H3) predicts that the auditor with limited rationality responds to round-by-round variation in the level of ρ by adjusting the audit rate, even though ρ is normatively irrelevant to the optimal audit rate. H1 assumes that the auditor perceives ρ as a factor that directly affects her choice, so that changes in the level of ρ affect β'. When the taxpayer population includes a higher proportion of potential cheaters, the auditor increases the audit rate, even if no taxpayer changes the rate of under-reporting income. A higher audit rate is necessary, simply because there are more potential tax cheaters.

H1. When the auditor knows the level of ρ, there is a positive association between the level of ρ and β'.

H2 and H3 assume that the auditor also perceives ρ as a factor that directly affects the taxpayer's choice, so that changes in the level of ρ affect $E_a(\alpha)$ and β''. Any factor that directly affects both the auditor and taxpayer is likely to produce countervailing effects on $E_a(\alpha')$ and $E_a(\alpha'')$. Regarding $E_a(\alpha')$, the level of ρ evokes a social norm for the taxpayer to "look at what others are doing and follow the majority" (Elster, 1989, p. 56). As the proportion of potential cheaters increases, the norm dictates that the taxpayer should cheat more. This consideration implies a positive association between the level of ρ and $E_a(\alpha)$. Regarding $E_a(\alpha'')$, the taxpayer expects a higher audit rate as the level of ρ increases, consistent with H1, and responds by decreasing the rate of under-reporting. This consideration implies a negative association between the level of ρ and $E_a(\alpha)$. Because the net effect of these considerations could be either positive or negative, H2 and H3 are non-directional. H2 predicts that changes in the level of ρ induce the auditor to revise $E_a(\alpha)$, and H3 predicts that changes in the level of ρ induce the auditor to revise β''.

H2. When the auditor knows the level of ρ, changes in the level of ρ induce the auditor to revise $E_a(\alpha)$.

H3. When the auditor knows the level of ρ, changes in the level of ρ induce the auditor to revise β''.

Effects of Auditors' Uncertainty about ρ. The second set of hypotheses (H4-H6) predicts that the auditor with limited rationality responds to uncertainty about ρ by adjusting the audit rate, even though ρ is normatively irrelevant to the optimal audit rate. Beginning with Ellsberg (1961), there have been many demonstrations that individuals react to missing information about probability parameters as if they were ambiguity-averse: they prefer choices with known parameters, and desire more information about choices with unknown parameters, other things held constant (Camerer and Weber, 1992; Frisch and Baron, 1986).[7] In an experimental audit setting where auditees had an incentive to over-state their asset value, Zimbelman and Waller (1999) found that auditors increased their costly sampling to compensate for uncertainty about the asset valuation process. Similarly, H4 predicts that the auditor who faces uncertainty about ρ increases β', relative to the auditor who knows the level of ρ.

H4. An auditor's uncertainty about the level of ρ induces the auditor to increase β'.

H5 and H6 assume that the auditor also perceives her uncertainty about ρ as a factor that affects the taxpayer's choice, because of an information asymmetry. When the auditor faces uncertainty about ρ, the taxpayer has an information advantage in that the taxpayer can adjust his strategy based on the level of ρ, whereas the auditor cannot. Accordingly, the auditor's uncertainty about ρ affects $E_a(\alpha)$ and β''. These effects depend on the auditor's belief about the taxpayer's belief about the effect of the auditor's uncertainty on the audit rate. A possible taxpayer belief is that the auditor facing uncertainty always sets the audit rate as if $\rho = 0.50$, i.e., the mean of the uniform distribution for ρ. Given this belief, the taxpayer exploits the information advantage when ρ is 0.75 by increasing the rate of under-reporting, relative to the case where the auditor knows ρ. This consideration implies a positive association between the auditor's uncertainty about ρ and $E_a(\alpha)$. Another possible taxpayer belief is that the auditor facing uncertainty compensates by increasing the audit rate, consistent with H4. This consideration implies a negative association between the auditor's uncertainty about ρ and $E_a(\alpha)$. Because the net effect of these considerations could be either positive or negative, H5 and H6 are non-directional. H5 predicts that the auditor's uncertainty about ρ induces the auditor to revise $E_a(\alpha)$, and H6 predicts that the auditor's uncertainty about ρ induces the auditor to revise β''.

H5. An auditor's uncertainty about the level of ρ induces the auditor to revise $E_a(\alpha)$.

H6. An auditor's uncertainty about the level of ρ induces the auditor to revise β''.

4. METHOD

The experiment operationalized the tax game described earlier, using 80 business, science, and technology students at a major university. The data analyzed in the next section are from four experimental sessions, each with 12 strategic taxpayers and 8 auditors. Throughout the experiment, the instructions referred to strategic taxpayers as reporters and auditors as verifiers. Each session consisted of 20 rounds. The design included a within-subjects variable, i.e., round-by-round variation in ρ among three levels (0.25, 0.50, 0.75), and a between-subjects variable, i.e., the auditors' uncertainty about ρ (present, absent). In two sessions, the auditors knew the level of ρ when stating the audit rate. In the other two sessions, the auditors knew that the three levels of ρ were equally likely, but did not know the realized level of ρ until the end of the round. The procedure randomly and anonymously re-paired the auditors and taxpayers round-by-round, in order to minimize reputation formation.

We conducted the experiment with a computer network.[8] At the start of the experiment, the procedure randomly assigned subjects to the role of auditor or strategic taxpayer. The instructions told all subjects about the incentives, information, and task for each role. Each subject received US$15 for completing the experiment plus the outcome of a lottery with a prize of US$15. Each subject's chance of winning the prize was a linear function of the amount of francs earned in the 20 rounds. A different function was used for auditors and strategic taxpayers, such that expected pay was the same for each role, based on the optimal strategies stated earlier. For any subject who maximized the expected chance of winning the prize, the incentives were consistent with the assumptions of Graetz et al. (1986).

The procedure consisted of eight steps in each round. The subjects provided their responses in steps 3 and 4. The computer executed all remaining steps. In the first two rounds, the subjects had a maximum of four minutes to enter their responses. In subsequent rounds, the subjects had a maximum of 1.5 minutes to enter their responses.

Step 1. The computer determined the proportion of strategic taxpayers, ρ, for the round.[9] To vary the level of ρ without changing the number of active subjects, the procedure used *automatic reports* as a proxy for ethical taxpayers. The instructions stated that there were a number of automatic reports in addition to the reports from the 12 strategic taxpayers. The number of automatic reports varied among three equally likely values (4, 12, 36). Reported income always matched actual income in an automatic report. In contrast, reported income in a report from a strategic taxpayer could be lower than actual income, depending on the taxpayer's decision. The instructions included a schedule detailing the three possibilities (Table 1). In the no uncertainty condition, all subjects knew that all subjects received this information in Step 1. In the uncertainty condition, all subjects knew that only the taxpayers received this information in Step 1.

Step 2. The computer randomly pre-assigned all reports to the eight auditors, without disclosing the assignment to any subject. The computer assigned 6 reports to each auditor when the number of automatic reports was 36, 3 reports to each auditor when the number of automatic reports was 12, and 2 reports to each auditor when the number of automatic reports was 4. The instructions stated that the auditors would

Table 1. Schedule for Proportion of Strategic Taxpayers

	Number of reports from strategic taxpayers	*Number of automatic reports*	*Proportion of reports from strategic taxpayers*	*Chance of occurrence*
(1)	12	36	25%	1/3
(2)	12	12	50%	1/3
(3)	12	4	75%	1/3

not know whether the reports assigned to them were automatic reports or reports from the strategic taxpayers, without conducting a costly audit for each report, and that the taxpayers would not know which of the auditors had their report.

Step 3. The auditors provided responses to two questions. One question asked the auditors to assume that a taxpayer's actual income was 100 francs and to estimate the probability that the taxpayer would report income of 0 franc. This response measured $E_a(\alpha)$. The other question asked the auditors to assume that reported income was 0 franc and to state the probability of conducting an audit for this report. The latter response measured β.

Step 4. The taxpayers provided responses to two questions. One question asked the taxpayers to assume that an auditor received a report of 0 franc and to estimate the probability that the auditor would audit the report. This response measured $E_t(\beta)$. The other question asked the taxpayers to assume that their actual income was 100 francs and to state the probability that they would report income of 0 franc. The latter response measured α. Steps 3 and 4 took place concurrently.

Step 5. The computer determined whether actual income was 0 or 100 francs, separately for each taxpayer and automatic report. There was a 50% chance for each level of income.

Step 6. The computer determined the amount of reported income, separately for each taxpayer. If a taxpayer's actual income was 0 franc, the computer always produced a report of 0 franc. If a taxpayer's income was 100 francs, the computer applied the taxpayer's α response from step 4. Suppose that a taxpayer's α response was 80%. The computer implemented a chance device with a probability of 0.80 of reporting income of 0 franc and a probability of 0.20 of reporting income of 100 francs.

Step 7. The computer determined whether the auditors conducted an audit, separately for each report assigned to them. If reported income was 100 francs, the computer always produced the decision not to audit. If reported income was 0 franc, the computer applied the auditor's β response from step 3. Suppose that an auditor's β response was 25%. For each report assigned to the auditor, the computer implemented a chance device with a probability of 0.25 of conducting an audit and a probability of 0.75 of no audit.

Step 8. The computer tallied the results for the period and provided feedback to the subjects. The instructions included a schedule detailing each player's payoff under all possible scenarios (Table 2).

Each subject's computer screen displayed an information window, a history window, and a message window. The information window showed the conditions that were in effect for the round, e.g., the audit cost was 10 francs. For the auditors

Table 2. Schedule for Players' Payoffs

	Strategic taxpayer's actual income	*Strategic taxpayer's reported income*	*Does auditor audit?*	*Strategic taxpayer's payoff*	*Auditor's payoff*
(1)	0	0	no	0	0
(2)	0	0	yes	0	–10
(3)	100	100	no	50	50
(4)	100	0	no	100	0
(5)	100	0	yes	0	90

in the uncertainty condition, however, the information window did not show the proportion of strategic taxpayers. The history window showed the results for prior rounds. For each auditor, the history window showed each round's number of automatic reports, number of assigned reports, the auditor's responses, number of audited reports, total audit cost in francs, total payoff in francs, current payoff in francs per report, and cumulative average payoff in francs through the current round. For each taxpayer, the history window showed each round's number of automatic reports, the taxpayer's responses, actual and reported income, whether an audit occurred, current payoff in francs, and cumulative average payoff in francs through the current round. The message window included the two questions described earlier (step 3 for auditors, or step 4 for taxpayers) and spaces for providing responses.

5. RESULTS

A statistical problem with using multiple replications of a one-period game is serial dependence. We took several steps to reduce this problem. The experimental procedure randomly re-paired auditors and taxpayers each round, and used two random sequences of ρ over the 20 rounds. The data analysis computed each subject's mean response over multiple rounds with the same level of ρ. Using repeated-measures analysis of variance, hypothesis testing involved only three values of each auditor's responses for β and $E_a(\alpha)$. Finally, we performed additional analyses to determine whether the results were similar in the earlier rounds (i.e., the first three observations at each level of ρ) and later rounds (i.e., the last three observations at each level of ρ).

Panel A of Table 3 presents descriptive statistics for the audit rate and rate of under-reporting income. The mean audit rate was 0.48. For the no uncertainty condition, the audit rate increased from 0.34 to 0.45 to 0.51, as the level of ρ increased from 0.25 to 0.50 to 0.75. The audit rate was higher when the auditors faced uncertainty about ρ (0.53) than when the auditors knew the level of ρ (0.43). The mean

Table 3. Strategy Choice and Estimate of Opponents' Strategy – Mean (Standard Deviation)

	Auditors			*Strategic Taxpayers*		
	Uncertainty about ρ			*Uncertainty about* ρ		
	Absent	*Present*	*Over groups*	*Absent*	*Present*	*Over groups*
[A] Strategy Choice.						
$\rho = 0.25$	0.34 (0.20)	0.54 (0.26)	0.44 (0.25)	0.67 (0.24)	0.62 (0.25)	0.64 (0.25)
$\rho = 0.50$	0.45 (0.22)	0.50 (0.21)	0.47 (0.21)	0.46 (0.25)	0.50 (0.23)	0.48 (0.24)
$\rho = 0.75$	0.51 (0.21)	0.53 (0.23)	0.52 (0.22)	0.33 (0.27)	0.45 (0.24)	0.39 (0.26)
Over ρ	0.43 (0.17)	0.53 (0.23)	0.48 (0.21)	0.49 (0.20)	0.52 (0.20)	0.51 (0.20)
[B] Estimate of Opponents' Strategy.						
$\rho = 0.25$	0.63 (0.19)	0.57 (0.17)	0.60 (0.18)	0.34 (0.17)	0.41 (0.23)	0.37 (0.20)
$\rho = 0.50$	0.66 (0.11)	0.56 (0.14)	0.61 (0.13)	0.54 (0.12)	0.44 (0.21)	0.49 (0.18)
$\rho = 0.75$	0.74 (0.09)	0.58 (0.15)	0.66 (0.15)	0.68 (0.17)	0.49 (0.20)	0.59 (0.21)
Over ρ	0.68 (0.10)	0.57 (0.15)	0.63 (0.14)	0.52 (0.10)	0.45 (0.19)	0.48 (0.16)

Panel A shows means, with standard deviations in parentheses, for the auditors' audit rate and strategic taxpayers' rate of under-reporting income. Panel B shows means, and standard deviations in parentheses, for the auditors' estimate of the rate of under-reporting income and the strategic taxpayers' estimate of the audit rate. There were three levels for the proportion of strategic taxpayers, ρ (i.e., 0.25, 0.50, and 0.75), and two levels for the auditors' uncertainty about ρ (i.e., present and absent).

rate of under-reporting income was 0.51. The taxpayers' rate of under-reporting income was slightly higher when the auditors faced uncertainty about ρ (0.52) than when the auditors knew the level of ρ (0.49). For the no uncertainty condition, the rate of under-reporting decreased from 0.67 to 0.46 to 0.33, as the level of ρ increased from 0.25 to 0.50 to 0.75. For the uncertainty condition, the rate of under-reporting decreased from 0.62 to 0.50 to 0.45, as the level of ρ increased from 0.25 to 0.50 to 0.75.

Panel B of Table 3 presents descriptive statistics for the subjects' estimates of their opponent's strategy. The auditors' mean estimate of the rate of under-reporting was 0.63. For the no uncertainty condition, the auditors' estimate increased from 0.63 to 0.66 to 0.74, as the level of ρ increased from 0.25 to 0.50 to 0.75. The auditors' estimate was lower when the auditors faced uncertainty about ρ (0.57) than when the auditors knew the level of ρ (0.68). The taxpayers' mean estimate of the audit rate was 0.48. The taxpayers' estimate was lower when the auditors faced uncertainty about ρ (0.45) than when the auditors knew the level of ρ (0.52). For the no uncertainty condition, the taxpayers' estimate increased from 0.34 to 0.54 to 0.68, as the level of ρ increased from 0.25 to 0.50 to 0.75.

As a preliminary to hypothesis testing, we performed a regression for each auditor over 20 rounds:

$$\beta = A + B \cdot E_a(\alpha) + \varepsilon. \tag{9}$$

To measure β' in the tests of H1 and H4, we computed $\{A + \varepsilon\}$ for each round, and then computed the mean value for each level of ρ. To measure $E_a(\alpha)$ in the tests of H2 and H5, we used the mean estimate of the rate of under-reporting for each level of ρ. To measure β'' in the tests of H3 and H6, we computed $\{B \cdot E_a(\alpha)\}$ for each round, and then computed the mean value for each level of ρ. Although not part of hypothesis testing, we used the same approach to compute α' and α'' for the taxpayers.

Panel A of Table 4 shows the results from a series of repeated-measures analyses of variance. In each analysis, the within-subjects factor was the level of ρ (i.e., 0.25, 0.50, or 0.75), and the between-subjects factor was the auditors' uncertainty about ρ (i.e., present or absent). The dependent variables were β', $E_a(\alpha)$, β'', and β. Panel B of Table 4 shows the results from repeated-measures analyses of variance with the same dependent variables, but with a reduced data set that included the no uncertainty group. Panel C of Table 4 shows the results from one-way analyses of variance with the same dependent variables, but with a reduced data set that included cases with ρ of 0.50. The entries are F statistics. The F statistics without brackets are based on observations from all 20 rounds. The F statistics within brackets are based on observations from the earlier and later rounds, respectively.

Effects of ρ. H1 predicts that, when the auditor knows the level of ρ, there is a positive association between the level of ρ and β'. Focusing on the no uncertainty group (Panel B of Table 4), there was a significantly positive association between the level of ρ and β' ($F = 5.04$, $p = 0.013$). The results were similar for the earlier and later rounds. Taking all 20 rounds into account, the auditors in the no uncertainty

Table 4. Effects of Proportion of Strategic Taxpayers and Uncertainty on Auditors' Responses

	Independent Variable	Dependent Variable			
		β'	$E_a(\alpha)$	β''	β
[A]	ρ	1.96 {5.52**, 1.08}	4.31* {4.14*, 3.59*}	2.25 {0.94, 1.29}	3.74* {4.91**, 1.36}
	Uncertainty	9.71** {8.04**, 6.76**}	5.75* {2.45, 8.48**}	5.60* {4.55*, 5.05*}	1.82 {2.87, 0.60}
	ρ × Uncertainty	4.91** {2.19, 5.75**}	3.04 {2.10, 2.49}	1.86 {1.73, 0.87}	6.06** {3.81*, 5.42**}
[B]	ρ	5.04** {4.89**, 5.97**}	4.61* {3.95*, 3.77*}	2.17 {0.98, 1.22}	6.08** {5.69**, 4.81*}
[C]	Uncertainty	7.73** {5.77*, 6.64**}	5.00* {0.87, 8.44**}	5.97* {4.89*, 5.27*}	0.64 {0.37, 0.70}

*Significant at $p = 0.05$, two-tailed.
**Significant at $p = 0.01$, two-tailed.

Panel A shows the results from repeated-measures analyses of variance with a within-subjects factor (i.e., the proportion of strategic taxpayers was 0.25, 0.50, or 0.75), and a between-subjects factor (i.e., auditors' uncertainty about ρ was present or absent). Panel B shows the results from repeated-measures analyses of variance for the no uncertainty group only. Panel C shows the results from one-way analyses of variance for cases with ρ of 0.50. In all panels, the dependent variables are β' in the first column, $E_a(\alpha)$ in the second column, β'' in the third column, and β in the last column. The entries are F statistics including observations for all 20 rounds and, in brackets, for the first three rounds at each level of ρ and for the last three rounds at each level of ρ.

group increased β' from 0.08 to 0.15 to 0.18, as the level of ρ increased from 0.25 to 0.50 to 0.75.[10] These results support H1.

H2 predicts that, when the auditor knows the level of ρ, changes in the level of ρ induce the auditor to revise $E_a(\alpha)$. Focusing on the no uncertainty group (Panel B of Table 4), there was a significantly positive association between the level of ρ and $E_a(\alpha)$ ($F = 4.61$, $p = 0.018$). The results were similar for the earlier and later rounds. Taking all 20 rounds into account, the auditors in the no uncertainty group increased $E_a(\alpha)$ from 0.63 to 0.66 to 0.74, as the level of ρ increased from 0.25 to 0.50 to 0.75.[11] These results support H2.

H3 predicts that, when the auditor knows the level of ρ, changes in the level of ρ induce the auditor to revise β''. Focusing on the no uncertainty group (Panel B of Table 4), there was an insignificant association between the level of ρ and β'' ($F = 2.17$, $p = 0.132$). The results were similar for the earlier and later rounds.

Taking all 20 rounds into account, the auditors in the no uncertainty group increased β'' from only 0.26 to 0.29 to 0.33, as the level of ρ increased from 0.25 to 0.50 to 0.75.[12] Although the auditors in the no uncertainty group revised $E_a(\alpha)$ in response to changes in the level of ρ, consistent with H2, such belief revision did not lead to a significant change in β'', contrary to H3.

Effects of Auditors' Uncertainty about ρ. H4 predicts that an auditor's uncertainty about ρ induces the auditor to increase β'. Table 4 includes two tests of H4. Based on the entire sample, the first column in Panel A of Table 4 shows a significant effect for uncertainty ($F = 9.71$, $p = 0.004$). Based on the subsample with ρ of 0.50, the first column in Panel C of Table 4 also shows a significant effect for uncertainty ($F = 7.73$, $p = 0.009$). The results were similar for the earlier and later rounds. An advantage of the latter test is its direct comparison between auditors who faced uncertainty, i.e., a uniform distribution for ρ with a mean of 0.50, and auditors who knew that the level of ρ was 0.50. Both tests indicate that the auditors' uncertainty about ρ affected β'. For the entire sample, β' was 0.56 when the auditors faced uncertainty and 0.13 when they did not. For the subsample with ρ of 0.50, β' was 0.55 when the auditors faced uncertainty and 0.15 when they did not. These results support H4.

H5 predicts that an auditor's uncertainty about ρ induces the auditor to revise $E_a(\alpha)$. Based on the entire sample, the second column in Panel A of Table 4 shows a significant effect for uncertainty ($F = 5.75$, $p = 0.023$). Based on the subsample with ρ of 0.50, the second column in Panel C of Table 4 also shows a significant effect for uncertainty ($F = 5.00$, $p = 0.033$). These effects were stronger in the later rounds than in the earlier rounds. Both tests indicate that uncertainty about ρ induced the auditors to revise $E_a(\alpha)$. For the entire sample, $E_a(\alpha)$ was 0.57 when the auditors faced uncertainty and 0.68 when they did not. For the subsample with ρ of 0.50, $E_a(\alpha)$ was 0.56 when the auditors faced uncertainty and 0.66 when they did not. These results support H5.

H6 predicts that the auditor's uncertainty about ρ induces the auditor to revise β''. Based on the entire sample, the third column in Panel A of Table 4 shows a significant effect for uncertainty ($F = 5.60$, $p = 0.025$). Based on the subsample with ρ of 0.50, the third column of Panel C in Table 4 also shows a significant effect for uncertainty ($F = 5.97$, $p = 0.021$). The results were similar in the earlier and later rounds. Both tests indicate that uncertainty about ρ induced the auditors to revise β''. For the entire sample, β'' was –0.04 when the auditors faced uncertainty and 0.30 when they did not. For the subsample with ρ of 0.50, β'' was −0.05 when the auditors faced uncertainty and 0.29 when they did not. These results support H6.

The last column of Table 4 shows the analyses that used β as the dependent variable. Panel A shows a significant effect for the level of ρ ($F = 3.74$, $p = 0.03$), a significant interaction effect for the level of ρ and auditors' uncertainty about ρ ($F = 6.06$, $p = 0.004$), but an insignificant effect for auditors' uncertainty about ρ ($F = 1.82$, $p = 0.187$). For the no uncertainty group, Panel B shows a significant effect for the level of ρ ($F = 6.08$, $p = 0.006$). For the subsample with ρ of 0.50, Panel C shows an insignificant effect for uncertainty ($F = 0.64$, $p = 0.431$).

Taken together, the above tests indicate that the auditors responded to changes in the level of ρ, and to their uncertainty about ρ. Increases in the level of ρ, and in their uncertainty about ρ, induced a significant increase in β'. A higher level of ρ meant that there were more potential cheaters in the taxpayer population, justifying a higher audit rate. Also, the auditors increased β' to compensate for their uncertainty about ρ (cf. Zimbelman and Waller, 1999). Increases in the level of ρ induced a modest increase in β''. Although variation in the level of ρ induced the auditors to revise $E_a(\alpha)$, the impact was not strong enough to cause a significant change in β''. The auditors' uncertainty about ρ induced significant decreases in $E_a(\alpha)$ and β''. The decrease in $E_a(\alpha)$ indicated the auditors' belief that the taxpayers believed that the auditors compensated for uncertainty about ρ by increasing the audit rate. The auditors' uncertainty about ρ had countervailing effects on β' and β'', such that uncertainty had a modest effect on β.

6. STRATEGIC TAXPAYERS

Table 5 shows the results from a series of repeated-measures analyses of variance. In each analysis, the within-subjects factor was the level of ρ (i.e., 0.25, 0.50, or 0.75), and the between-subjects factor was the auditors' uncertainty about ρ (i.e., present or absent). The dependent variables were α', $E_t(\beta)$, α'', and α. The taxpayers significantly decreased their rate of under-reporting as the level of ρ increased ($F = 25.67$, $p = 0.001$, last column of Table 5). This effect depended on revisions in $E_t(\beta)$ and α''. Increases in the level of ρ induced the taxpayers to revise upward their estimates

Table 5. Effects of Proportion of Strategic Taxpayers and Uncertainty on Taxpayers' Response

Independent Variable	*Dependent Variable*			
	α'	$E_t(\beta)$	α''	α
ρ	4.88** {3.41*, 1.51}	31.15** {24.39**, 23.68**}	23.59** {17.14**, 16.36**}	25.67** {18.75**, 13.00**}
Uncertainty	0.58 {0.38, 0.83}	2.61 {1.69, 2.34}	1.45 {1.13, 1.53}	0.38 {0.66, 0.08}
$\rho \times$ Uncertainty	2.26 {0.84, 1.49}	13.00** {7.38**, 10.52**}	11.34** {5.32**, 11.88**}	2.83 {1.30, 2.20}

*Significant at $p = 0.05$, two-tailed.
**Significant at $p = 0.01$, two-tailed.

The table shows the results from repeated-measures analyses of variance with a within-subjects factor (i.e., the proportion of strategic taxpayers was 0.25, 0.50, or 0.75), and a between-subjects factor (i.e., auditors' uncertainty about ρ was present or absent). The dependent variables are α' in the first column, $E_t(\beta)$ in the second column, α'' in the third column, and α in the last column. The entries are F statistics including observations for all 20 rounds and, in brackets, for the first three rounds at each level of ρ and for the last three rounds at each level of ρ.

of the audit rate ($F = 31.15$, $p = 0.001$, second column of Table 5) and revise downward their rate of under-reporting ($F = 23.59$, $p = 0.001$, third column of Table 5). The significant interaction effects in the second and third columns of Table 5 indicate that the level of ρ had larger effects on $E_t(\beta)$ and α'' when the auditors knew the level of ρ. These results were similar for the earlier and later rounds. To a lesser extent, the level of ρ also affected α' ($F = 4.88$, $p = 0.01$, first column of Table 5). In sum, the taxpayers' beliefs were sensitive to the auditors' use of ρ as a cue for adjusting the audit rate, and the taxpayers responded by adjusting the rate of under-reporting.

7. ERRORS IN STRATEGY CHOICE

The optimal strategies from Graetz et al. (1986) provided a benchmark for evaluating the subjects' strategy choice. Panel A of Table 6 shows the mean signed error, i.e., the difference between the subjects' strategy choice and the optimal strategies stated earlier, with the standard deviation in parentheses. Panel B of Table 6 shows the mean absolute error with the standard deviation in parentheses. For the auditors, the largest mean errors occurred when the auditors knew that ρ was 0.25. The auditors decreased the audit rate with decreases in the level of ρ, and consequently under-audited when ρ was 0.25. The mean absolute error was about 0.15 to 0.20, regardless of the level of ρ or the auditors' uncertainty about ρ. For their part, the taxpayers cheated too much. The mean signed and absolute errors were about 0.20 to 0.30, regardless of the level of ρ or auditors' uncertainty about ρ.

8. ERRORS IN ESTIMATES OF OPPONENT'S STRATEGY

Panel A of Table 7 shows the mean signed error, i.e., the difference between the subjects' estimate of their opponent's strategy and their opponent's actual strategy, with the standard deviation in parentheses. Panel B of Table 7 shows the mean absolute error with the standard deviation in parentheses. For the auditors, the largest mean errors occurred when the auditors knew that ρ was 0.75. The auditors incorrectly believed that the taxpayers increased α as the level of ρ increased. On the contrary, the taxpayers decreased α as the level of ρ increased. For their part, the taxpayers correctly believed that the audit rate increased with increases in the level of ρ.

9. CONCLUSION

This paper reported a behavioral accounting experiment on strategic interaction in a tax compliance game. The experiment employed a three-step approach. First, the experiment assigned subjects to the opposing roles of auditor and strategic taxpayer. This step addressed a past criticism of behavioral accounting research: economic mechanisms such as the interaction of players with conflicting preferences discipline and potentially eliminate the decision biases found in individual settings. Second, the experiment operationalized a game-theoretic model of the tax compliance

Table 6. Errors in Strategy Choice – Mean (Standard Deviation)

	Auditors			*Strategic Taxpayers*		
	Uncertainty about ρ			*Uncertainty about ρ*		
	Absent	*Present*	*Over groups*	*Absent*	*Present Present*	*Over groups*
[A] Signed Errors.						
$\rho = 0.25$	–0.16 (0.20)	0.04 (0.26)	–0.06 (0.25)	0.23 (0.24)	0.18 (0.25)	0.20 (0.25)
$\rho = 0.50$	–0.05 (0.21)	0.01 (0.22)	–0.02) (0.21)	0.24 (0.25)	0.28 (0.23)	0.26 (0.24)
$\rho = 0.75$	0.01 (0.21)	0.03 (0.23)	0.02 (0.22)	0.18 (0.27)	0.30 (0.24)	0.24 (0.26)
Over ρ	–0.07 (0.18)	0.03 (0.23)	–0.02 (0.21)	0.22 (0.20)	0.25 (0.20)	0.23 (0.20)
[B] Absolute Errors.						
$\rho = 0.25$	0.23 (0.12)	0.20 (0.16)	0.22 (0.14)	0.29 (0.15)	0.27 (0.15)	0.28 (0.15)
$\rho = 0.50$	0.18 (0.13)	0.17 (0.13)	0.17 (0.12)	0.31 (0.15)	0.30 (0.19)	0.31 (0.17)
$\rho = 0.75$	0.16 (0.13)	0.19 (0.13)	0.18 (0.13)	0.24 (0.22)	0.32 (0.22)	0.28 (0.22)
Over ρ	0.19 (0.12)	0.19 (0.13)	0.19 (0.12)	0.25 (0.15)	0.27 (0.17)	0.26 (0.16)

Panel A (B) shows the mean and standard deviation in parentheses for the signed (absolute) error in the auditors' audit rate and strategic taxpayers' rate of under-reporting income, compared to the optimal strategies based on Graetz et al. (1986). There were three levels for the proportion of strategic taxpayers, ρ (i.e., 0.25, 0.50, and 0.75), and two levels for the auditors' uncertainty about ρ (i.e., present and absent).

problem (Graetz et al., 1986). This step addressed another past criticism of behavioral accounting research: without a formal model of strategic interaction, it is problematic to define rational behavior in the experimental setting. Third, the experiment manipulated two variables that were normatively irrelevant in the game-theoretic

Table 7. Errors in Estimate of Opponents' Strategy – Mean (Standard Deviation)

	Auditors			*Strategic Taxpayers*		
	Uncertainty about ρ			*Uncertainty about ρ*		
	Absent	*Present*	*Over groups*	*Absent*	*Present*	*Over groups*
[A] Signed Errors.						
$\rho = 0.25$	–0.04) (0.19)	–0.05) (0.17)	–0.04) (0.17)	0.00 (0.18)	–0.13) (0.22)	–0.07) (0.21)
$\rho = 0.50$	0.20 (0.11)	0.06 (0.14)	0.13 (0.14)	0.10 (0.18)	–0.06 (0.20)	0.02 (0.20)
$\rho = 0.75$	0.41 (0.09)	0.13 (0.15)	0.27 (0.19)	0.17 (0.19)	–0.04 (0.21)	0.07 (0.23)
Over ρ	0.19 (0.23)	0.05 (0.17)	0.12 (0.21)	0.09 (0.14)	–0.08 (0.19)	0.01 (0.18)
[B] Absolute Errors.						
$\rho = 0.25$	0.15 (0.12)	0.12 (0.12)	0.14 (0.12)	0.15 (0.09)	0.22 (0.14)	0.18 (0.12)
$\rho = 0.50$	0.20 (0.10)	0.11 (0.10)	0.16 (0.11)	0.17 (0.10)	0.16 (0.13)	0.17 (0.11)
$\rho = 0.75$	0.41 (0.09)	0.17 (0.10)	0.29 (0.16)	0.21 (0.15)	0.17 (0.11)	0.19 (0.13)
Over ρ	0.25 (0.16)	0.14 (0.11)	0.20 (0.15)	0.18 (0.08)	0.19 (0.11)	0.18 (0.10)

Panel A (B) shows the mean and standard deviation in parentheses for the signed (absolute) error in the auditors' estimate of the rate of under-reporting income and the strategic taxpayers' estimate of the audit rate, compared to the actual mean strategies of the opponent. There were three levels for the proportion of strategic taxpayers, ρ (i.e., 0.25, 0.50, and 0.75), and two levels for the auditors' uncertainty about ρ (i.e., present and absent).

model, i.e., the level of ρ and uncertainty about ρ, to test hypotheses about auditors' choice of the audit rate, β.

The hypotheses assumed that the auditor with limited rationality makes a strategy choice through a simple additive process: $\beta = \beta' + \beta''$, where β' depends on ρ, among other factors, and β'' depends on the auditor's belief about the taxpayer's strategy, $E_a(\alpha)$. The results showed that the auditors used ρ as a cue for adjusting the audit rate. There were significantly positive associations between the level of ρ and β', and between the auditors' uncertainty about ρ and β'. Regarding $E_a(\alpha)$ and β'', the auditors formed incorrect beliefs about the taxpayers' responses. The auditors incorrectly believed that the taxpayers increased the rate of under-reporting as the level of ρ increased, although this belief had only a modest effect on β''. Also, the auditors incorrectly believed that the taxpayers expected a higher audit rate when the auditors faced uncertainty about ρ. For their part, the taxpayers were sensitive to the auditors' use of ρ as a cue for setting the audit rate. The taxpayers correctly believed that the audit rate increased as the level of ρ increased, and responded by decreasing the rate of under-reporting income.

A key element in the experiment was the players' formation of a belief about their opponent's strategy and incorporation of this belief into their own strategy choice. Future research might further examine belief formation and its impact on strategy choice, in two ways. One way is to elaborate the subjects' task. Our experiment collected the subjects' estimates of their opponent's strategy. A future experiment additionally might collect the subjects' estimates of their opponent's estimate of their own strategy. For example, the auditors might estimate $E_a(E_t(\beta))$ as well as $E_a(\alpha)$. The extra data would clarify how the subjects make belief-based adjustments in their strategy choice. The other way is to simplify the subjects' task. Our experiment required the taxpayers to estimate the audit rate and incorporate the estimate into their strategy choice. A future experiment might use a sequence that (1) requires the auditors state the audit rate, (2) informs the taxpayers about the audit rate, and (3) requires the taxpayers to state the rate of under-reporting income. This sequence simplifies the taxpayers' reasoning process by replacing $E_t(\beta)$ with β, and simplifies the auditors' reasoning process by eliminating the need to estimate $E_a(E_t(\beta))$. Consequences of this sequence might be less cheating by the taxpayers and more accurate estimates of α by the auditors, relative to the levels in our experiment. Such evidence could inform tax policy makers who decide whether to pre-announce the audit rate.

NOTES

1 Other experiments on tax compliance include Alm, Jackson, and McKee (1992), Beck, Davis, and Jung (1991, 1992), Boylan and Sprinkle (2001), Collins and Plumlee (1991), Friedland, Maital, and Rutenberg (1978), Kim (2002), and Moser, Evans, and Kim (1995). These experiments examined the effects on taxpayer compliance of independent variables such as the tax rate, audit rate, penalty for under-reporting, and public good "payback" to the taxpayer. None of these experiments adopted the three-step approach of our experiment, none operationalized the Graetz et al. (1986) model, and none examined the effects of the proportion of strategic versus ethical taxpayers.

2 Equation 1 is comparable to an anchoring-and-adjustment process, where β' is an anchor that is based on the auditor's payoffs and other parameters of the setting, before considering the taxpayer's strategy, and β'' is an adjustment that is based on the auditor's belief about the taxpayer's strategy.

3 As elaborated below, the hypotheses for β'' are non-directional, because of countervailing considerations. The net effect depends on how the auditor weighs these considerations.

[4] When α^* is greater than one, it never pays to conduct an audit.

[5] To compute the threshold, enter all parameter values except ρ into Equation 3, set the equation equal to one, and solve for ρ.

[6] Our hypotheses focus on the auditor. However, we also collected and analyzed observations of the taxpayers' choice of α and belief about the audit rate, $E_t(\beta)$.

[7] There are many theoretical and operational definitions of ambiguity in the decision literature. Ellsberg (1961, p. 657) defined ambiguity as the "quality depending on the amount, type, reliability, and 'unanimity' of information, giving rise to one's degree of 'confidence' in an estimate of relative likelihoods." Camerer (1995, p. 645) more simply defined ambiguity as "not knowing relevant information that could be known." Our experiment manipulated whether the auditors knew the level of ρ or not. In the latter case, the auditors knew the uniform distribution for ρ. This manipulation is consistent with the above definitions, but not with other operational definitions in the literature that left unstated the distribution for the probability parameter. To avoid ambiguity on this point, we refer the auditor's uncertainty about ρ, rather than ambiguity about ρ.

[8] Contact the first author (acckim@ewha.ac.kr) for a copy of the instructions.

[9] When designing the experiment, we pre-determined two random sequences with 20 values of ρ drawn from a uniform distribution over 0.25, 0.50, and 0.75. We used each random sequence in two of the four sessions. When implementing step 1, the computer used one of the pre-determined random sequences.

[10] Panel A of Table 4 shows that, taking all 20 rounds into account, there was a significant interaction between ρ and uncertainty ($F = 4.91, p = 0.011$). The interaction effect was stronger in the later rounds. The auditors used ρ as a cue for adjusting β' when they knew ρ.

[11] Panel A of Table 4 shows that, taking all 20 rounds into account, there was a significant main effect for ρ ($F = 4.31$, $p = 0.018$), and a marginally significant interaction between ρ and uncertainty ($F = 3.04$, $p = 0.055$). The level of ρ affected $E_a(\alpha)$.

[12] Panel A of Table 4 shows that, taking all 20 rounds into account, there was an insignificant main effect for ρ ($F = 2.25$, $p = 0.114$) and an insignificant interaction between ρ and uncertainty ($F = 1.86$, $p = 0.164$).

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