The Effects of Income and Consumption Tax Regimes and Future Tax Rate Uncertainty on Proportional Savings and Risk-Taking

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ABSTRACT: This paper uses an experimental design to examine how income and consumption tax regimes and future tax rate uncertainty affect proportional savings and risk-taking. For the experiment, undergraduate subjects were given certificates redeemable for goods and services at two time periods. They were then asked to determine the time at which they wished to redeem the certificates and the manner in which they wished to allocate unredeemed certificates between safe and risky investment funds. The results indicate that when future tax rates are certain, an income tax regime reduces proportional savings and increases proportional risk-taking when compared to a consumption tax regime. When future tax rates are uncertain, the effects are more complex. They generally suggest, however, that future tax rate uncertainty adversely affects the savings and risk-taking neutrality of a consumption tax regime while diminishing the risk-taking incentive of an income tax regime.

Key Words: *Income tax, Consumption tax, Savings, Risk-taking.*

Data Availability: *The data are available on request.*

I. INTRODUCTION

The manner in which institutional risk-sharing arrangements affect behavior is a fundamental policy issue with broad implications for accountants. Among the questions prompted by such arrangements are those regarding the effects of professional liability insurance on audit performance, regulatory recommendations on firm disclosures, and contractual agreements

on owner, creditor and manager actions. Within the tax domain, one such question currently under debate concerns the effects of income and consumption tax regimes on savings and risk-taking (e.g. Anderson 1994; Eisner 1995; Gray 1995; Toder 1995). Policy-makers are particularly concerned about this question because of the role savings and risk-taking play in maintaining relative living standards, business productivity, international competitiveness and economic growth.[1]

Analytical research on the effects of income and consumption tax regimes on savings and risk-taking by Ahsan (1989, 1990) indicates that, when compared to a no-tax world, an income tax regime decreases the proportion of savings undertaken by individuals, but increases the proportion of savings invested in risky assets. A consumption tax regime, in comparison, does not alter proportional savings or risk-taking from their no-tax levels so the regime is neutral with respect to savings and investment decisions. No empirical research to date, however, has directly tested these analytical conclusions. In addition, no empirical or analytical work has examined the savings and risk-taking effects of the two tax regimes when future tax rates are uncertain.

This paper reports the results of an experimental test of the proportional savings and risk-taking effects of income and consumption tax regimes under conditions of certain and uncertain future tax rates. For this test, 90 undergraduate subjects were assigned to one of two groups simulating income and consumption tax regimes. Each group was then required to make savings and risk-taking decisions for three repeated treatments, one containing a certain tax rate on both present and future transactions, another containing a certain tax rate on present transactions but an uncertain tax rate on future transactions, and a third without any tax rate.

Subjects began the experiment with certificates redeemable for goods and services at two time periods: the 30-day period immediately following the experiment or the 30-day period commencing three months later. Certificates not redeemed in the immediate 30-day period could be invested in two investment funds offering either safe or risky returns. The decision task of the experiment required the subjects to determine the time at which they wished to redeem certificates and the manner in which they wished to allocate unredeemed certificates between the two investment funds.

In general, the results of the experiment support Ahsan's analytical work regarding the savings and risk-taking effects of the two tax regimes when present and future tax rates are certain. Subjects assigned to the income tax regime group were found to save proportionally less and to allocate proportionally more of their savings to risky investment than those assigned to the consumption tax regime group. Likewise, when the future tax rate was uncertain, proportional savings and risk-taking were lower and higher, respectively, for the income tax regime group than the consumption tax regime group. The difference in the proportional savings of the two tax regime groups, however, was just significant at the .10 level for the uncertain future tax rate.

Comparing the effects of certain and uncertain tax rates within the two tax regime groups, both proportional savings and risk-taking were found to be lower for the consumption tax regime group when the future tax rate was uncertain than when it was certain. For the income tax regime group, a similar reduction in proportional risk-taking was found. The reduction in proportional savings, however, was not significant.

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[1] Relative living standards, business productivity, international competitiveness and economic growth are directly affected by capital investment, and capital investment is directly affected by savings and risk-taking. Low rates of savings and risk-taking generally are believed to have an adverse effect on an economy because of their relationship with other economic variables. Policy-makers often attempt to positively influence savings and risk-taking behavior by changing fiscal and tax incentives (for more complete discussions of the economic effects associated with savings and risk-taking, see Eisner 1994; Kosters 1992; Toder 1995).

Taken together, the results of the study imply that when both present and future tax rates are certain, a consumption tax regime is neutral with respect to proportional savings and risk-taking, while an income tax regime decreases and increases proportional savings and risk-taking, respectively. In comparison, when the future tax rate is uncertain, the savings and risk-taking neutrality of a consumption tax regime is adversely affected and the risk-taking incentive of an income tax regime is diminished.

The remainder of this paper is organized as follows. Section II explains the theoretical background and hypotheses of the paper. Section III describes the experimental method used to test the hypotheses. Section IV presents the statistical results. Section V summarizes the findings and suggests directions for future research.

II. THEORETICAL BACKGROUND AND HYPOTHESES

Income and consumption tax regimes are two major forms of broad-based taxation that create substantially different savings and risk-taking incentives.[2] According to the analytical work of Ahsan (1989, 1990), an income tax regime, by including savings in the tax base, reduces the after-tax rate of return on savings and provides an incentive for taxpayers to shift consumption from future periods to the present. The total amount of savings undertaken, as well as the proportion of after-tax income allocated to savings, are less than in a no-tax world. However, the proportion of savings invested in risky assets is greater than a no-tax world because, in addition to reducing the after-tax rate of return on savings, the regime also reduces the variability of the return. Taxpayers consequently are encouraged to allocate a larger share of their savings to risky investment since the after-tax level of risk associated with such investment is less.

In a consumption tax regime, Ahsan (1989, 1990) shows that the exclusion of savings from the tax base makes the regime neutral with respect to current and future consumption decisions. Consequently, the proportion of savings undertaken is the same as that of a no-tax world.[3] Similarly, the proportion of savings allocated to risky investment is the same as that of a no-tax world because the size of the savings portfolio and the return on savings are not directly affected by the consumption tax. Instead, they are only affected when consumed.

In deriving his conclusions, Ahsan (1989, 1990) uses a two-period model of savings and portfolio behavior which assumes that taxpayers act to maximize their utility from consumption over both periods and that they exhibit constant relative risk aversion (CRRA).[4] Additionally, the model assumes that both the income and consumption tax regimes are proportional with no limitation on the deductibility of losses.

In the first period of the model, taxpayers hold an endowment representing the sum of the current value of their net assets at the beginning of the first period and the earnings of that period.

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[2] An income tax regime includes in the tax base the sum of an individual's consumption during the taxable period and the change in his/her net worth. A consumption tax regime differs from an income tax regime in that it excludes from the tax base the net change in the individual's savings during the period. In its most basic form, a consumption tax is collected directly from the taxpayer and is based on the total amount spent on consumption during the tax period. As such, it varies from a sales tax or value-added tax which, although also based on consumption, are collected from producers and sellers (Bradford 1986).

[3] The analytical work of Hunt and Enis (1989) reaches a similar conclusion regarding the differential savings effect of income and consumption tax regimes. Their work, however, does not directly discuss the proportional savings effect. In addition, it does not examine the risk-taking effects of the two tax regimes.

[4] CRRA preferences are widely used in the economic risk-taking literature and are asserted by Sinn (1983) to be the only class of von Neumann-Morgenstern preferences that are consistent with existing psychological work. Individuals who exhibit CRRA preferences are insensitive to multiplicative transformations of a lottery with a given expected value, but sensitive to additive wealth changes.

They then allocate this endowment between consumption and savings. The portion of the endowment allocated to savings may be invested in two assets, one with a certain return and the other with a risky return. In the second period, they consume both the savings portion of the endowment and the return on those savings.

After comparing the proportional savings and risk-taking effects of income and consumption tax regimes, Ahsan (1989) examines the sensitivity of his model's conclusions over a broad range of parameter values.[5] He also contrasts the effects of the regimes with equal revenue and utility tax rates, using a no-tax world as the benchmark. In general, his results indicate that when the tax rates of the income and consumption tax regimes are set to raise equal expected revenue, both regimes lead to an equal loss of expected utility (versus a no-tax world). However, with such rates the income tax regime's savings disincentive is stronger for lower levels of relative risk aversion, while its risk-taking incentive is uniform across all levels of relative risk aversion. The savings and risk-taking neutrality of the consumption tax regime, in comparison, is unaffected by the level of relative risk aversion.

Ahsan's (1989, 1990) model assumes that the tax rate on both present and future transactions is constant and certain. This assumption, however, limits the generalizability of his conclusions because it ignores the frequency with which the tax rate schedule has explicitly changed during the past 15 years (Economic Recovery Tax Act of 1981; Tax Reform Act of 1986; Revenue Reconciliation Act of 1993), as well as the almost yearly implicit changes resulting from modifications in the tax base (e.g., Tax Equity and Fiscal Responsibility Act of 1982; Deficit Reduction Act of 1984; Revenue Reconciliation Act of 1987; Technical and Miscellaneous Revenue Act of 1988; Revenue Reconciliation Acts of 1989 and 1990; Tax Extension Act of 1991). In reality, decisions regarding future consumption are subject to an additional source of risk not included in his model—tax rate uncertainty.

When Ahsan's model is extended to include an uncertain future tax rate having the same expected value as the present tax rate, his conclusions are slightly different. The additional risk associated with the uncertain future tax rate serves as a disincentive to savings for future consumption among taxpayers who exhibit CRRA. The proportion of savings undertaken by these taxpayers, therefore, declines below that which would occur with a certain future tax rate for either income or consumption tax regimes. In other words, the savings discouragement of an income tax regime is intensified, while the savings neutrality of a consumption tax regime is negatively disturbed. The magnitude of these adverse savings effects, as well as the extent to which the two regimes differ in their proportion of savings, are dependent on the degree of uncertainty in the future tax rate and the relative rates of the regimes.

The effect of future tax rate uncertainty on proportional risk-taking is similar. The additional risk associated with the uncertain future rate causes CRRA taxpayers to reduce the proportion of their savings invested in the risky asset. This reduction occurs for both income and consumption tax regimes because CRRA taxpayers seek to hold their overall risk level constant, irrespective of the structure of the tax regime. The risk-taking incentive of an income tax regime is consequently moderated, while the risk-taking neutrality of a consumption tax regime is adversely altered. The intensity to which proportional risk-taking is affected, as well as the extent to which the two regimes differ in their proportional risk-taking, are again dependent on the degree of uncertainty in the future tax rate and the relative rates of the two regimes.

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[5] A secondary aspect of Ahsan's (1989, 1990) analysis involves the savings and risk-taking effects of a wealth tax regime. Because a wealth tax regime is equivalent to a consumption tax regime in its effect on the life-time budget constraint, it is not examined in this paper.

To compare the specific savings and risk-taking effects of future tax rate uncertainty for the two tax regimes, four qualifying conditions must be added to the analysis. These conditions require that (1) the expected revenues and utilities of the two regimes are equal, (2) the before-tax rates of return on savings for the two regimes are identical, (3) the probability assessments about the two regimes' future tax rates are equivalent, and (4) the level of relative risk aversion exhibited by CRRA taxpayers is close to unity.

The first two conditions are explicit requirements necessary to ensure that the risk attributable to the uncertain future rates is comparable. As such, they also correspond with the conditions used by Ahsan (1989) in his numerical analysis of the savings and risk-taking effects of certain future tax rates. The third condition is a supplemental requirement needed to equalize the level of risk arising from different assessments about the likelihood and distribution of the future tax rates. When combined with the earlier assumption of equal present and expected future tax rates, it establishes parallel tax rate expectations for the two regimes. The fourth condition is an analytical requirement based on the risk-taking analysis of Arrow (1974). It confines relative risk aversion to a tractable range and allows for behavioral predictions.

Given the preceding conditions, it is possible to draw general inferences regarding the differential savings and risk-taking effects of income and consumption tax regimes subject to future tax rate uncertainty. Specifically, it can be shown that an uncertain future tax rate causes the proportional savings of an income tax regime to be less than that of a consumption tax regime. Concurrently, an uncertain future tax rate causes the proportional risk-taking of an income tax regime to be greater than that of a consumption tax regime.[6] The differential effects of income and consumption tax regimes posited by Ahsan (1989, 1990) for certain future tax rates thus continue in the presence of future tax rate uncertainty.

Despite the current interest in the savings and risk-taking effects of income and consumption tax regimes among accountants, attorneys, economists and policy-makers (e.g., American Council for Capital Formation 1994, 1995; Kosters 1992, National Research Council Board on Science, Technology, and Economic Policy 1994; Nunn et al. 1992; Pollack 1995), no empirical research has yet tested the basic conclusions of Ahsan's (1989, 1990) analytical work or the disincentive effects of future tax rate uncertainty. Instead, the models and methods of previous empirical studies have been motivated by other concerns. Empirical research on savings, for example, generally has employed econometric models to examine the relationship between savings and after-tax returns. These studies' findings, however, have been inconclusive. Several investigations indicate that proportional savings would be less for an income tax regime than a consumption tax regime because a positive relation exists between the real after-tax interest rate and savings (e.g., Boskin 1978; Boskin and Lau 1988; Makin and Couch 1989; Skinner and Feenberg 1990; Summers 1981, 1984). Others suggest that proportional savings would not be affected by the structure of the tax regime because consumption patterns are unpredictable and insignificantly influenced by the after-tax interest rate (e.g., Evans 1983; Friend and Hasbrouck 1983; Gravelle 1992; Hall 1988; Howrey and Hymans 1980).

In contrast to the wealth of empirical studies on savings, the empirical research on risk-taking is more sparse. To date, only two studies have been conducted in this area, and both have utilized an experimental economics methodology (King and Wallin 1990; Swenson 1989). Despite a consistency in their findings, both studies fail to provide much insight into the differential effects of income and consumption tax regimes under conditions of certain and uncertain future tax rates

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[6] Details regarding the manner in which the differential proportional savings and risk-taking effects were derived are available upon request.

because their primary focus was the risk-taking effects of an income tax regime with a certain tax rate. The findings of these two studies do suggest, nonetheless, that a proportional income tax regime with a certain tax rate has little or no impact on investment in risky assets.

This study uses an experimental design to examine the proportional savings and risk-taking effects of income and consumption tax regimes under conditions of certain and uncertain future tax rates. The findings of the study provide general insight into the behavioral effects of institutional risk-sharing arrangements, as well as specific insight into the disincentive effects of taxation. Initially, two research hypotheses are tested based on the analytical work of Ahsan (1989, 1990):

H1a: Proportional saving is lower for an income tax regime with a certain tax rate than for either a consumption tax regime with a certain tax rate or a regime without a tax.

H1b: Proportional risk-taking is greater for an income tax regime with a certain tax rate than for either a consumption tax regime with a certain tax rate or a regime without a tax.

Six additional research hypotheses are tested based on the extension of Ahsan's (1989, 1990) work to include the effects of uncertainty in the future tax rate:

H2a: Proportional saving is lower for an income tax regime with an uncertain future tax rate than for a consumption tax regime with an uncertain future tax rate.

H2b: Proportional risk-taking is greater for an income tax regime with an uncertain future tax rate than for a consumption tax regime with an uncertain future tax rate.

H3a: Proportional saving is greater for an income tax regime with a certain future tax rate than for one with an uncertain future tax rate.

H3b: Proportional risk-taking is greater for an income tax regime with a certain future tax rate than for one with an uncertain future tax rate.

H4a: Proportional saving is greater for a consumption tax regime with a certain future tax rate than for one with an uncertain future tax rate.

H4b: Proportional risk-taking is greater for a consumption tax regime with a certain future tax rate than for one with an uncertain future tax rate.

In essence, the savings hypotheses of H1a, H2a, H3a and H4a posit that $S_o \approx S_{cc} > S_{cu}$, $S_{ic} > S_{iu}$, where S denotes proportional savings, the first subscript refers to the tax regime (income, consumption, none) and the second subscript refers to the future tax rates (certain, uncertain) where applicable. Likewise, the risk-taking hypotheses of H1b, H2b, H3b and H4b propose that $R_{ic} > R_{cc} \approx R_o > R_{cu}$ and $R_{ic} > R_{iu} > R_{cu}$, where R denotes proportional risk-taking. No hypotheses are posited for the relationship between proportional savings for a consumption tax regime with an uncertain future tax rate and an income tax regime with a certain future tax rate. The specific nature of this relationship depends on the extent of uncertainty in the future tax rates. For a similar reason, no relationship is posited between proportional risk-taking for an income tax regime with an uncertain future tax rate, that of a consumption tax regime with a certain future tax rate, and that of a no-tax regime.

II. METHOD

Experimental Design

The experiment utilized a repeated measure, between-subjects design with two groups and three treatments. The two between-subjects groups simulated income and consumption tax regimes. The three within-subject treatments varied the certainty of future tax rates and the existence of a tax. In both the income and consumption tax regime groups each subject received in random order a control treatment in which no tax was mentioned or assessed, a certain tax rate treatment in which the present and future tax rates were fixed at a single rate, and an uncertain tax rate treatment in which the present tax rate was fixed but the future tax rate was variable. In this latter treatment, the expected future tax rate was the same as the present tax rate, but was distributed with a 50 percent probability of being either higher or lower.

Subjects

Ninety undergraduate subjects from advanced accounting classes were selected to participate in the experiment from a pool of 142 volunteers. Selection was based on the results of a pre-test questionnaire which assessed the subjects' risk and savings preferences. The risk portion of the questionnaire elicited certainty equivalents for two series of lottery questions. The first series used Kachelmeier's (1990) price judgment instrument to identify risk-averse subjects. The second series examined the subjects' sensitivity to multiplicative transformations of lottery values and, thus, indicated relative risk preferences. Together, the results of these two series were used to select only those subjects who exhibited similar and constant relative risk aversion.[7]

Although not used as a selection device, the savings portion of the questionnaire was employed to classify subjects into three strata. Subjects from these strata were then randomly assigned to the two tax regime groups. A similar procedure was followed with respect to the pre-test risk measures of the subjects. The resulting tax regime groups consequently exhibited equivalent pre-test savings and risk-taking preferences.

Compensation for participation in the experiment was received in the form of certificates redeemable for goods and services at various retail establishments located near campus and catering to college students. Certificates were used rather than cash because the theoretical construct under investigation involved consumption behavior. The use of certificates, which

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[7] Subjects were excluded from the experimental sample when the pre-test questionnaire indicated that they were neither risk-averse nor constant in their risk preferences. The Berg et al. (1986) method of inducing risk preferences was not used for this study because such an induction method would have been a joint test of the risk-induction technique and the analytical effects of income and consumption tax regimes (for a more complete discussion of the limitations of the Berg et al. risk-induction technique, see Davis and Holt 1993) However, to check the reasonableness of the risk preference classification, a post-experimental analysis of the subjects' risk-taking behavior was conducted. For this analysis, the relative risk undertaken by the subjects, including tax-induced risk, was measured by computing separate coefficients of variation for each subject's investment portfolio n each of the three repeated tax treatments. The calculation of these relative risk measures involved dividing the standard deviation of the potential after-tax returns of each investment portfolio by the mean expected after-tax return When the future tax rate was certain, only the income tax regime group was subject to a tax-induced change in the risk of their after-tax returns When the future tax rate was uncertain, both the income and consumption tax regime groups were subject to tax-induced changes. Different relative risk measures consequently were possible for the various tax treatments even when the same percentages of a subject's investment portfolio were invested in the safe and risky funds. The results of this analysis suggested that the subjects exhibited similar relative risk aversion, that their behavior was consistent with the CRRA assumption, and that their risk-taking decisions were not significantly affected by differences in the magnitudes of the tax treatments' expected returns. The analysis, however, did not indicate whether the subjects' level of relative risk aversion was close to unity because no such empirical measurement was possible

could not be redeemed in part or whole for cash, avoided confounding consumption and savings behaviors among subjects having differing post-experimental investment opportunities.[8]

To control for wealth effects across the tax rate treatments, only one of the subjects' decision sets from the three treatments was used to determine the number of certificates received. The specific determination of which decision set to use was made by the subjects at the end of the experiment when they were asked to roll a single die. If they rolled a one or two, their payoff was based on their first set of decisions. If they rolled a three or four, their payoff was based on their second set of decisions. If they rolled a five or six, their payoff was based on their third set of decisions. The rationale underlying this random-selection method of compensating the subjects was that, by treating each decision set as separable and equally likely, it required those subjects who wished to maximize their expected payoff to make independent and optimal decisions for each of the three treatments. Changes in wealth during one of the treatments consequently should have had no effect on the decisions for the other treatments (Davis and Holt, 1993).

Task

The task was administered to the subjects in separate rooms of a university behavioral laboratory. Upon entering the laboratory room, the subjects were given written instructions and shown 1,400 certificates, denominated in amounts of one, ten, 24, 50 and 100. They were then told, via the instructions, that the experimental task would require them to make three sets of decisions under different conditions and their payoff from these decisions would be randomly determined at the end of the experiment when they rolled a die.

As to the form of their payoff, the subjects were told that they would receive certificates redeemable for goods and services at any or all of five different retail establishments. The five establishments consisted of a computer software dealer, a copying center, a fast-food outlet, a bookstore and university merchandiser, and a compact disc and tape store. The rate of redemption for their certificates, the subjects were informed, was 100 certificates for $1 of goods and services.[9]

In the treatment without a simulated tax, neither the income nor consumption tax regime groups received any additional information regarding the redemption rate. In the certain tax rate treatment, however, the income tax regime group was further told that an immediate redemption fee of 25 percent would be assessed on their entire 1,400 certificates and that another redemption fee of 25 percent would be levied on any gains, net of losses, resulting from subsequent investment of unredeemed certificates (discussed below). The instructions also specified that for losses in excess of gains, the redemption fee would be waived and that certificates equal to 25 percent of the excess losses would be granted.

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[8] The receipt of cash payoffs could have confounded consumption and savings behaviors because some subjects might have selected to receive the entire amount of their cash payoffs at the first available opportunity and, thus, appeared within the experimental design to be making a consumption decision when, in actuality, they intended to invest their payoffs outside the experimental setting in higher-yielding investments than those afforded by the experiment.

[9] Denominated certificates of less than 100 were printed in rolls so that they could be carried, counted and redeemed easily. To redeem certificates of less than 100, the subjects unwound the appropriate number and tore this amount off along a perforated edge. Different colors were used to aid in distinguishing the various denominated amounts. At the end of the experiment, when the subjects actually received their certificates, those subjects in the consumption tax regime group whose payoffs were based on their decisions for the certain and uncertain tax rate treatments received denominated certificates that reflected the redemption fee. For example, the denominated certificates received by the subjects in the certain tax rate treatment were in amounts of 1.4, 14, 35, 70 and 140 and were redeemable for goods and services having a cash value of 1¢, 10¢, 25¢, 50¢ and $1.00, respectively. Similar adjustments were made to the certificates received by the subjects in the uncertain tax rate treatment.

The instructions of the certain tax rate treatment for the consumption tax regime group differed from those for the income tax regime group in that the subjects were informed that each time a certificate was redeemed, a redemption fee equal to 40 percent of the value of the goods and services received would be assessed. They were told that a redemption fee would not be imposed, however, until the time of a redemption. No information was provided regarding the treatment of gains and losses since these amounts were automatically included in the total number of certificates redeemed.

Both tax regime groups received instructions for the uncertain tax rate treatment that were similar to those of their certain tax rate treatment. The distinguishing difference of the uncertain tax rate treatment was that the future redemption fee was presented as having an equal probability of being a rate either higher or lower than that of the present redemption fee. For the income tax regime group, the two future redemption rates were ten and 40 percent and were applicable to gains and losses on invested certificates. For the consumption tax regime group, the two future redemption rates were 20 and 60 percent and were applicable to both invested certificates and net earnings.

The primary decision required by the experimental task for all three tax rate treatments involved the timing of current and future consumption; a secondary decision concerned the riskiness of investment. Before making either decision, the subjects were told that they had two opportunities to redeem certificates. The first opportunity was within the 30-day period immediately following the experiment. The second opportunity was after a lapse of three months, when certificates could again be redeemed within a 30-day period. The redemption opportunities were presented in a manner that allowed the subjects to select one or both redemption times for part or all of their certificates.

As an incentive to temporarily postpone redemption, the subjects were permitted to invest unredeemed certificates for the three-month period in one or both of two investment funds. One of these funds, Fund A, promised to pay a certain before-tax return of 50 percent on invested certificates. The other fund, Fund B, offered to pay a before-tax return of either 100 or 25 percent. The probabilities of these returns were stated as 80 and 20 percent, respectively.[10]

The instructions specified that if a decision was made to invest any certificates, the accumulated value of these certificates (after payment of applicable redemption fees for the income tax regime group) would be mailed to the subjects at the end of the three-month period.[11] The only opportunity cost directly associated with an investment decision, therefore, arose from the three-month delay in redeeming certificates.

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[10] Although the expected after-tax returns and relative economic spreads across the savings alternatives differed for the three tax treatments and two tax regime groups, the differences resulted from inherent features of the tax regimes rather than inequivalencies in the selected rates of return or tax. For the certain and uncertain consumption tax rate treatments, the expected after-tax rates of return were identical to the rates of return for the treatments without a tax. These rates corresponded because a consumption tax regime, by design, has no effect on return. In comparison, the expected after-tax rates of return for the certain and uncertain income tax rate treatments were lower than the rates of return for the certain and uncertain consumption tax rate treatments and no-tax treatments because the design of an income tax inherently lowers the return on savings. Equalization of the expected after-tax returns would have required the use of either disparate before-tax returns or a zero-rate income tax. Neither of these two alternatives was viable in the context of the study because the first would have confounded the results with an exogenous market rate adjustment while the second would have negated the significance of the research questions under investigation.

[11] Each subject who invested in the funds was mailed the appropriate number of certificates at the end of the 12th week following the experiment. Allowing time for mail delivery, the certificates should have been received within one or two days of the three-month investment period. No subjects reported not receiving their certificates and only three percent of the mailed certificates were not redeemed within the 30-day redemption period.

After the subjects finished making their decisions for each of the three tax rate treatments, they were asked to roll a die to determine which of their decision sets would be the basis of their payoff. Subjects who selected the decision set for the uncertain tax rate treatment were asked to roll a second die to determine the appropriate rate of their future redemption fee. Following this determination, all subjects were given the number of certificates they wished to redeem in the immediate 30-day period and asked to complete a short post-test questionnaire.

The intent of the post-test questionnaire was to assess the effectiveness of the manipulated variables and experimental procedures. Responses to this questionnaire indicated that all of the subjects understood the relevance of the redemption fee to their payoffs and the key difference between the two investment funds. In addition, the post-test data showed that 83 subjects considered their payoffs (and expected future payoffs) to be adequate, 85 understood the factors that determined their payoffs, and 88 had no knowledge of either the parameter values of the other tax regime group or the payoffs to other subjects. The final value of the subjects' payoffs, after inclusion of future investment returns and reduction for assessed redemption fees, was between $6.56 and $28.00, with an average of $15.23. For most subjects, the experimental task lasted approximately 50 minutes; an additional three to ten minutes was required to redeem the certificates at the retail establishments.

Parameter Values

In selecting the tax rates and investment rates of return for the experiment, three criteria were employed. First, the tax rates of the income and consumption tax regime groups were required to generate analytically equivalent expected revenue and utility.[12] Second, the expected before-tax rates of return on savings for the two tax regime groups were required to be identical.[13] Third, the future tax rates of each regime group were required to follow a dichotomous probability distribution with an expected value equal to that group's present tax rate.

The first two selection criteria were based on the equivalency conditions used by Ahsan (1989) in his numerical analysis of certain future tax rates. In his analysis, Ahsan demonstrated that when income and consumption tax regimes provide expected before-tax returns on safe and risky assets of 50 and 75 percent, respectively, an income tax rate of 25 percent and a consumption tax rate between 38 and 41 percent (depending on the degree of relative risk aversion) are equivalent in terms of both expected revenue and utility. For the experiment, a consumption tax rate of 40 percent was selected over the alternative rates of 38, 39 or 41 percent for computational ease.

The third criterion was based on the third condition of the uncertainty analysis presented earlier. When combined with the first two selection criteria, it ensured that the selected tax rates and investment rates of return satisfied the primary conditions underlying the hypothesized relationships in an experimentally efficient manner. Neither it nor the other two selection criteria,

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[12] Without knowledge of the subjects' utility functions, it was not possible to determine *a priori* the tax rates at which the income and consumption tax regime groups would generate equivalent revenue and utility. The selection criteria consequently were based on analytical rather than experimental equivalency. *Ex post* calculations based on the subjects' behavior during the experiment indicated that the two tax regime groups generated approximately the same amount of revenue. No *ex post* calculation of the subjects' utility was possible.

[13] Because of inherent differences in the design of income and consumption tax regimes, it was not possible for the two simulated tax regimes to have the same expected before- and after-tax rates of return. To have equalized the expected after-tax rates of return for the two tax regime groups would have required the use of either dissimilar before-tax rates of return or a zero-rate income tax. As discussed in footnote 10, however, neither of these two alternatives was viable in the context of the study.

however, provided any assurance that the level of relative risk aversion exhibited by the subjects during the experiment would be close to unity. Instead, this condition was assumed to be satisfied by the pre-screening progress.

The three-month time requirement for invested certificates was adopted for two reasons. First, this time requirement proved acceptable to the participating establishments when soliciting their cooperation in redeeming certificates. Second, it avoided potential problems with graduating or transferring subjects whose decisions, under a longer time requirement, might have been affected by post-experimental factors, such as future career plans or travel.[14]

Savings and Risk-Taking Measures

Two dependent measures were calculated for each subject in the three tax rate treatments. The first measure, representing proportional savings, was computed as the ratio of the number of certificates invested in both Funds A and B to the total number of certificates available for investment. For the consumption tax regime group, the denominator of this ratio was 1,400, or the total number of certificates given to each subject. For the income tax regime group, however, the denominator was 1,400 only when the treatment did not include a simulated tax; in the certain and uncertain tax rate treatments the denominator was 1,050. Use of this lower denominator was required for these two treatments because the simulated income tax reduced the number of available certificates by 25 percent.

The second measure, representing proportional risk-taking, also was calculated as a ratio. It differed from the savings measure, however, in the numerator was the number of certificates invested in the riskier Fund B, while the denominator was the total number of certificates invested in both Funds A and B. When no certificates were invested by a subject for a particular tax rate treatment, a risk-taking measure was not calculated and the observation was treated as missing. Irrespective of the subjects' savings behavior, the calculation of the risk-taking measure was the same for all tax regime groups and rate treatments. Both the measures of proportional savings and risk-taking corresponded with those used in the analytical work of Ahsan (1989, 1990).

III. RESULTS

Tests of the effects of the tax regime groups and rate treatments on proportional savings and risk-taking were conducted using repeated-measures ANOVAs with univariate and multivariate procedures. Univariate procedures were employed to test the between-subjects effects of the tax regime groups, while multivariate procedures were utilized to test the within-subject effects of the tax rate treatments. Multivariate procedures were employed for the within-subject tests because the circularity assumption was not tenable for either repeated measure, proportional savings or risk-taking.[15] Tests of the assumptions required for the between-subjects univariate approach and the within-subject multivariate approach showed no significant violations.[16]

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[14] By using a three-month time requirement, the entire experiment, from pre-test questionnaire to final payoff, was completed within one semester. A longer time requirement would have spanned more than a single semester and possibly introduced uncontrollable confounding effects.

[15] Tests of within-subject effects using a univariate repeated-measures ANOVA are unbiased only when the variances and covariances of the repeated-measures display a particular patterned relationship known as circularity. Circularity requires that for all pairs of repeated measures the sum of their variances minus twice their covariance equals a constant. When the data do not satisfy the circularity assumption, multivariate procedures are appropriate

[16] In addition to testing for violations of the assumptions underlying the univariate and multivariate models, the Box-Cox procedure was employed to determine if a power transformation or angular transformation could better minimize the error sum of squares The results of this procedure indicated that the untransformed data produced the minimum error sum of squares The results consequently are reported using the untransformed data.

The results of the repeated-measures ANOVAs are reported in table 1. For both the measures of proportional savings and risk-taking, the main effects of the tax rate treatment and the interactions of the rate treatments and regime groups are significant (p = .000). In comparison, the main effects of the tax regime groups are not significant (p = .148 and .075); but this finding is not interpretable in light of the significant interaction and requires further examination. Graphical illustrations of the interactions are presented in figures 1 and 2.

Figures 1 and 2 reveal that, in the absence of a tax, the income and consumption tax regime groups undertook approximately equal proportions of savings and risk-taking. When a certain tax rate was considered, however, the income tax regime group decreased and increased its levels of

TABLE 1

Repeated Measure ANOVA Tests of Differences for the Tax Regime Groups and Tax Rate Treatments

Source of Variation	df	Sum of Squares	Mean Square	Wilks' Lambda	F-statistic	p-value
Panel A. Proportional Savings:						
Between-subjects:						
Tax regime group	1	4,796.80	4,796.80		2.13	.148
Error	88	198,602.68	2,256.85			
Within-Subject:						
Tax rate treatment	2	7,042.09	3,521.04	.532	38.29*	.000
Interaction of tax rate treatment with regime group	2	3,340.94	1,670.47	.742	15.11*	.000
Error	176	16,659.29	94.66			
*Panel B. Proportional Risk-taking:***						
Between-subjects:						
Tax regime group	1	7,788.61	7,788.61		3.27	.075
Error	69	164,172.55	2,379.31			
Within-Subject:						
Tax rate treatment	2	3,773.06	1,886.53	.603	22.42*	.000
Interaction of tax rate treatment with regime group	2	2,366.81	1,183.41	.702	14.43*	.000
Error	138	10,801.84	78.27			

* The F-statistic is based on Wilks' lambda criterion.
** The general linear model is used to adjust for unequal sample sizes.

FIGURE 1
## Tax Regime Group by Tax Rate Treatment Interaction Effect on Proportional Savings
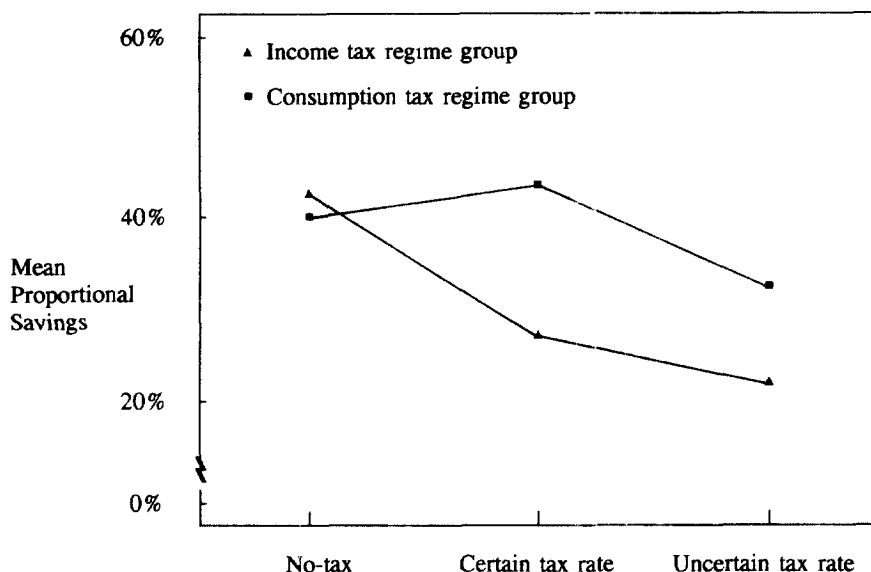
Cell Means

	n	Mean	Standard Deviation
Income Tax Regime Group:			
No-tax	45	42.49	32.83
Certain tax rate	45	28.47	25.84
Uncertain tax rate	45	23.60	22.76
Consumption Tax Regime Group:			
No-tax	45	41.19	29.30
Certain tax rate	45	43.57	31.95
Uncertain tax rate	45	35.08	27.37

proportional savings and risk-taking, respectively; the consumption tax regime group responded with little change. When asked to consider the uncertain tax rate, both groups responded by reducing their savings and risk-taking proportions. However, the magnitude of their responses differed. For the measure of proportional savings, the decline was almost twice as great for the consumption tax regime group as for the income tax regime group. For the measure of proportional risk-taking, the decline was approximately equal for both groups.

Statistical analyses of the simple effects associated with the interactions were performed using Tukey's HSD multiple comparison test. This test allowed the main effects of the tax regime groups and rate treatments to be examined separately. However, because the test, in its general

FIGURE 2
Tax Regime Group by Tax Rate Treatment Interaction Effect on Proportional Risk-Taking
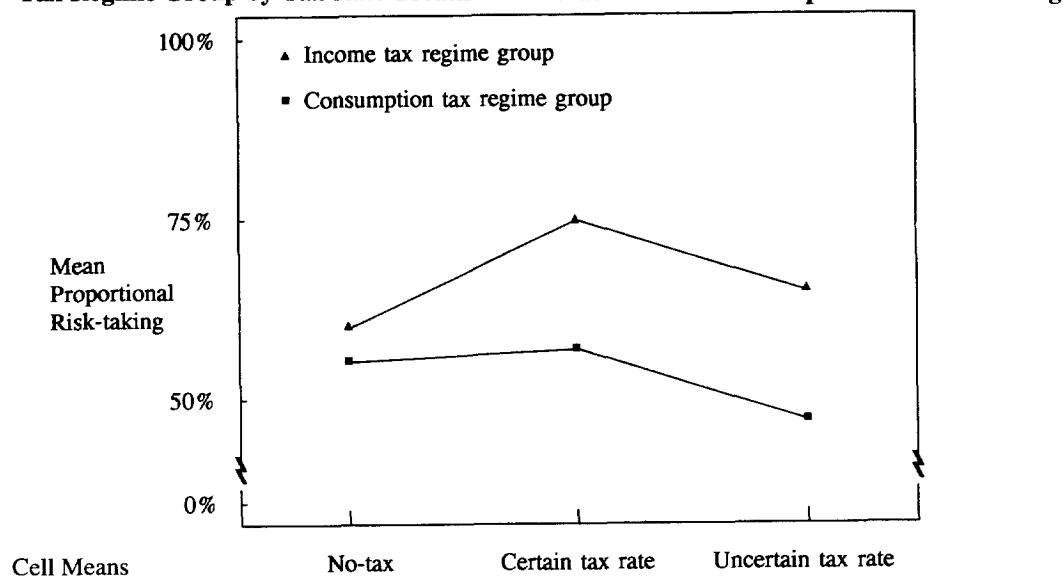
Cell Means	n	Mean	Standard Deviation
Income Tax Regime Group:			
No-tax	34	59.02	33.27
Certain tax rate	34	74.46	29.01
Uncertain tax rate	34	64.95	30.15
Consumption Tax Regime Group:			
No-tax	37	56.35	28.18
Certain tax rate	37	57.57	27.63
Uncertain tax rate	37	48.20	26.15

form, is not robust to violations of the circularity assumption, the residual mean squares of the specific contrasts of interest were used instead of the pooled residual mean squares (Boik 1981; Kirk 1982). In addition, because the sample sizes of the proportional risk-taking measure for the two tax regime groups differed, a modified version of the test proposed by Spjøtvoll and Stoline (1973) was used to test the between-subjects effect on this measure.

Table 2 presents the results of the multiple comparisons between the two tax regime groups. As expected, no significant differences were detected between the proportional savings and risk-taking means of the income and consumption tax regime groups when they were not subject to a tax ($p > .15$). However, when the two groups were subject to a certain tax rate, their proportional savings and risk-taking behavior differed, with the income tax regime group saving proportionally less and risking proportionally more than the consumption tax regime group ($p < .05$). These findings support hypotheses H1a and H1b and lend credibility to Ahsan's (1989, 1990) analytical conclusions.

TABLE 2
Tukey's HSD Multiple Comparison Test of Simple Between-Subjects Effects for the Tax Rate Treatments

Tukey's HSD test: Critical value $q_{\alpha_t, w, dt} \sqrt{\dfrac{MS_{error}}{n}}$

Comparisons of Tax Regime Means	df	n	Mean Square Error	Computed Value	p-value
Panel A. Proportional Savings:					
No-tax	88	45	968.27	1.30	>.15
Certain tax rate	88	45	844.20	15.10	<.05
Uncertain tax rate	88	45	633.69	11.48	<.10
Panel B. Proportional Risk-taking:					
No-tax	69	34*	943.65	2.67	>.15
Certain tax rate	69	34*	800.67	16.89	<.05
Uncertain tax rate	69	34*	791.54	16.75	<.05

α_{ew} denotes the experiment-wise error rate and is the basis for the reported p-values.

* Adjusted for unequal sample sizes using the Spjøtvoll-Stoline T' test, a generalization of Tukey's HSD test. This test replaces n in the HSD denominator with n_{min}, the minimum of the compared sample sizes

With respect to the effects of the uncertain tax rate treatment, similar differences between the two groups' proportional savings and risk-taking behavior were detected. The difference between the two groups' mean proportional savings, however, was just significant at the .10 level. Three possible explanations for this lack of strong support for hypothesis H2a are possible. First, the income tax regime group may not have viewed the uncertainty of the future tax rate as prominently as the consumption tax regime group because it affected only their earnings from invested amounts and these amounts were already low from the simulated tax. Second, the income tax regime group may have exhibited a floor effect whereby their level of proportional savings could not be reduced by the same amount as that of the consumption tax regime group. Third, the uncertainty in the manipulation of the future tax rate may not have been perceived as equivalent by the two groups, despite the analytical equivalence.[17]

The proportional risk-taking means of the income and consumption tax regime groups for the uncertain tax rate treatment were significantly different at conventional levels (p < .05). This finding supports hypothesis H2b and corroborates the effect observed in figure 2, where the differences between the means of the tax regime groups' proportional risk-taking measures

[17] The analytical equivalence of the uncertainty in the two tax regime groups' future tax rate was based on Arrow's (1974, 111) analytical work on risk-taking which suggests a value for relative risk aversion close to unity. When relative risk aversion is substantially greater than one (i.e., four or more), this analytical equivalence can be maintained only if the consumption tax regime group saves proportionally less than that of the income tax regime group. The lack of support for hypothesis H2a consequently may be due to high levels of relative risk aversion among the subjects. However, neither the pre-test questionnaire responses regarding risk nor the risk-taking behavior exhibited by the subjects during the no-tax treatment provide evidence of high levels of relative risk aversion. Any inequivalence in the savings behavior, therefore, would appear more likely to be attributable to perceptual or cognizant differences regarding the future tax rate manipulation.

appeared to be similar for both the certain and uncertain tax rate treatments. It also implies that the uncertain future tax rate manipulation was perceptually equivalent in terms of its effect on risk-taking behavior.[18]

The results of the multiple comparisons among the three tax rate treatments for the two regime groups are presented in table 3. As shown in panel A, the mean proportional savings measures of the income tax regime group were significantly less for the certain and uncertain tax rate treatments than for the no-tax treatment (p < .01). The difference between the group's proportional savings means for the certain and uncertain tax rates, however, was not significant (p > .15). This latter finding does not support the posited effect of hypothesis H3a and may be attributable to the same factors as discussed earlier for hypothesis H2a.

The proportional savings behavior of the consumption tax regime group was consistent with both the analytical conclusions of Ahsan (1989, 1990) and hypothesis H4a. Specifically, the group's proportional savings means for the no-tax and certain tax rate treatments were found not to differ significantly (p > .15). This lack of a significant difference agrees with Ahsan's (1989, 1990) analytical work. It does not, however, provide interpretable evidence as to the savings neutrality of a consumption tax regime since many other factors also could account for such a result. More interpretable, therefore, are the findings of significantly greater mean proportional savings measures for the no-tax and certain tax rate treatments than for the uncertain tax rate treatment (p < .05). In particular, the significance of the comparison between the certain and uncertain tax rate treatments supports hypothesis H4a and indicates that future tax rate uncertainty can impair a consumption tax regime's neutrality toward savings.

With respect to proportional risk-taking, panel B of table 3 shows that the proportion of risk undertaken by the income tax regime group was significantly greater for the certain tax rate treatment than for the no-tax and uncertain tax rate treatments (p < .05). The difference in the mean proportional risk-taking measures of the group for the no-tax and uncertain tax rate treatments, however, was not significant (p > .15). The finding of significantly greater proportional risk-taking behavior for the certain tax rate treatment than for the uncertain tax rate treatment supports hypothesis H3b. Together with the finding of no significant difference between the uncertain and no-tax treatments, it also suggests that perceived uncertainty about future tax rates can counteract and reduce much the risk-seeking effect of an income tax regime.

The proportional risk-taking behavior of the consumption tax regime group differed from that of the income tax regime group in two respects. First, the group did not exhibit a significantly different risk-taking response for the no-tax and certain tax rate treatments (p > .15), supporting Ahsan's (1989, 1990) analytical conclusion regarding the risk-taking neutrality of a consumption tax regime. Second, the group took significantly more risk with its savings during the uncertain tax rate treatment than during the no-tax treatment (p < .05). But like the income tax regime group, the consumption tax regime group did invest significantly more of its savings in the risky asset during the certain tax rate treatment than during the uncertain tax rate treatment (p < .05). The latter finding supports hypothesis H4b. It and the earlier finding of support for hypothesis H3b jointly imply that uncertainty in the future tax rate can create an aversion to risk, irrespective of a tax regime's structure.

The preceding results have several implications for the broader savings and risk-taking relationships proposed earlier. The findings regarding proportional savings between the two tax

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[18] The apparent perceptual equivalence in the risk-taking behavior of the two tax regime groups is based on the proportional risk-taking measure. This measure does not capture the total amount of risk undertaken by the groups or the difference in the groups' return on and variability of savings.

TABLE 3
Tukey's HSD Multiple Comparison Test of Simple Within-Subject Effects for the Tax Regime Groups

Tukey's HSD test: Critical value $q_{\alpha_{ew}, df} \sqrt{\dfrac{MS_{error}}{n}}$

Comparisons of Tax Rate Means	df	n	Mean Square Error	Computed Value	p-value
Panel A. Proportional Savings:					
Income tax regime group:					
No-tax vs. certain tax rate	44	45	270.36	14.02	<.01
No-tax vs. uncertain tax rate	44	45	276.06	18.89	<.01
Certain tax vs. uncertain tax rate	44	45	140.69	4.87	>.15
Consumption tax regime group:					
No-tax vs. certain tax rate	44	45	160.05	2.38	>.15
No-tax vs. uncertain tax rate	44	45	101.26	6.11	<.05
Certain tax vs. uncertain tax rate	44	45	187.44	8.49	<.05
Panel B. Proportional Risk-taking:					
Income tax regime group:					
No-tax vs. certain tax rate	33	34	338.45	15.44	<.05
No-tax vs. uncertain tax rate	33	34	152.06	5.93	>.15
Certain tax vs. uncertain tax rate	33	34	151.11	9.51	<.05
Consumption tax regime group:					
No-tax vs. certain tax rate	36	37	59.98	1.22	>.15
No-tax vs. uncertain tax rate	36	37	115.09	8.15	<.05
Certain tax vs. uncertain tax rate	36	37	136.94	9.37	<.05

α_{ew} denotes the experiment-wise error rate and is the basis for the reported p-values.

regime groups and among the three tax rate treatments suggest an overall savings effect of $S_o \approx S_{cc} > S_{cu}, S_{ic}$. The findings regarding proportional risk-taking suggest an overall effect of $R_{ic} > R_o \approx R_{cc} > R_{cu}$ and $R_{ic} > R_{iu} > R_{cu}$. Unsupported by the empirical tests is the proposed relationship of $S_{cu}, S_{ic} > S_{iu}$. However, as mentioned earlier, three plausible explanations exist for this lack of support.

IV. CONCLUSION

The experimental findings of this study suggest that institutional risk-sharing arrangements, such as the structure of a tax regime, can have significant and multidimensional effects on behavior. Specifically, this study found that an income tax regime discourages proportional savings and encourages proportional risk-taking when the tax rate is certain. In comparison, a consumption tax regime with a certain tax rate was found to be neutral with respect to proportional savings and risk-taking.

When the future tax rates of the two regimes are uncertain, the study's findings show that both proportional savings and risk-taking decline to levels below those which occur with certain future

tax rates. The magnitudes of the declines, however, are dissimilar for the two regimes. For an income tax regime, the decline in proportional savings is not significantly different from that which occurs with a certain tax rate; the decline in proportional risk-taking, however, is significant. For a consumption tax regime, the declines in both proportional savings and risk-taking are significantly different from their levels with a certain future tax rate. These findings jointly suggest that although institutional risk-sharing arrangements can simultaneously create incentive and disincentive effects, the introduction of uncertainty about the future operation of such arrangements can counteract or exacerbate such effects.

Because the study was conducted using a laboratory experiment, several limitations restrict the generalizability of the findings (for a discussion of the advantages and disadvantages of experimental tax research, see Bonner et al. 1991). In particular, the use of exogenous rates of return and tax rather than rates determined in a market or political environment limits the applicability of the findings. The selection of subjects based on savings and risk preferences and the suppression of noneconomic factors such as societal norms, demographic-related preferences and infinite consumption-savings options also restricts the extent to which inferences can be drawn. Most important, however, the contextual nature of the study and its emphasis on tax-related effects limits generalizations to other, non-tax risk-sharing arrangements. Future research might assess the effects of other types of risk-sharing arrangements and investigate noneconomic factors and endogenous tax and savings rates.

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