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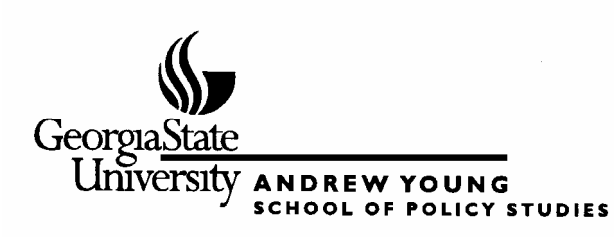

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Abstract

This paper reports the results of experiments designed to examine whether a taste for fairness affects people's preferred tax structure. Building on the Fehr and Schmidt (1999) model we devise a simple test for the presence of social preferences in voting for alternative tax structures. The experimental results show that individuals demonstrate concern for their own payoff and inequality aversion in choosing between alternative tax structures. However, concern for redistribution decreases when it leads to increasing deadweight losses. Our findings have important implications for the design of optimal tax theory.

JEL Classification: *JEL* C92, D63, H21, H23
Keywords: tax policy, social preferences, fairness.)

1. Introduction

There is a belief among some public finance economists – especially among its practitioners – that, if enacted, optimal tax policy prescriptions would be widely unpopular with the public. Therefore such policies are often regarded as politically infeasible though theoretically optimal.[1] Such conclusions are puzzling. After all optimal tax policy prescriptions are derived from the maximization of a social welfare function of individual utilities subject to a tax revenue constraint [see, for example, Ramsey (1927), Mirrlees (1971), Diamond and Mirrlees (1971), and McCaffery and Slemrod (2004)]. If individual utility is correctly specified and the social welfare function properly accounts for distributional concerns then optimal tax policy prescriptions should be popular with the public rather than unpopular.[2]

One possible explanation for this paradox may be that individual utility is not correctly specified as depending exclusively on one's own payoff. Rather people may care about their own payoff as well as the payoffs of others, i.e., people have social preferences. Outside the context of optimal tax theory, the existence of social preferences is well established [see, for example, Frohlich and Oppenheimer (1992), Ledyard (1995), Camerer (1997), Bolton and Ockenfels (2000), and Charness and Rabin (2002)]. Clearly the policy prescriptions of optimal tax theory may be quite different if people care not only about their own payoff but also the payoffs of others.[3] More specifically, if people

[1] See Hettich and Winer (1988) for an interesting study of the political economy of tax reform. In their approach, tax structures are determined by government officials that attempt to maximize support from selfish voters. Their approach is an alternative explanation of why optimal tax theory has not been that relevant in the real world. Another possible explanation is provided by high information requirements associated with optimal tax theory. See, for example, Martinez-Vazquez and Rider (1996), who describe some of the practical difficulties of implementing optimal tax policy prescriptions and offer a revelation approach to overcome the information requirements.

[2] Several authors have used survey data to uncover public preferences for tax structures, in particular, for redistribution through progressive taxation [e.g. Lewis (1978), Gemmell, Morrissey, and Pinar (2004), and the review in Sheffrin (1994)]. Other studies have used experiments to investigate preferences for different degrees of tax progressivity [e.g., Hite and Roberts (1991)]. McCaffery and Baron (2004) report experimental evidence that the nature of the tax system and the way it is framed or presented to participants affect views on progressive taxation.

[3] There is substantial evidence suggesting that social preferences influence behavior in a variety of environments: Kahneman, Knetsch and Thaler (1986) in firm pricing policies; Bagnoli and McKee (1991) in public good experiments; and Göth, Schmittenberger and Tietz (1990) in ultimatum bargaining games. Yet, some evidence also suggests that fairness considerations may not be important in other environments [e.g., Roth, Parsnikar, Okuno-Fujiwara and Zamir (1991) and Fehr and Schmidt (1999)].

care about the distributional consequences of taxation, then tax structures that are perceived to result in an unfair distribution of after-tax incomes will reduce individual utility relative to tax structures that better satisfy individual concerns for distributional equity.[4] That is, the loss in utility associated with an unfair distribution of incomes may be just as keenly felt as the conventional excess burdens of distortionary taxation.[5]

The most direct evidence bearing on this issue comes from the path breaking work of Frohlich and Oppenheimer (1992) and Engelmann and Strobel (2004). Frohlich and Oppenheimer (F&O) use laboratory experiments to investigate which principle of distributive justice people choose absent knowledge of their position in the income distribution.[6] In other words, they ask subjects to express a preference for a principle of distributive justice among several stylized principles, such as the familiar maximin principle [Rawls (1971)], efficiency principle [Harsanyi (1953, 1955)], among others.[7] F&O find that most groups choose a mixed principle: they prefer to maximize average income as in Harsanyi constrained by an income floor for the worst-off individual as in Rawls. Although F&O do not directly address the choice of tax structure, their results can be interpreted to imply that people care about both the efficiency and distributional consequences of tax policy and not, as in conventional optimal tax theory, simply the size of their own after-tax payoff. Though very instructive, their experiments do not provide quantitative evidence on the nature of the trade offs among the potentially conflicting goals of maximizing one's own payoff, maximizing the sum of individual payoffs, and maximizing the payoff of the worst off individual. In other words, people may express support for the principles of efficiency and equity in the abstract. However, they may

[4] Economic models can describe rational behavior *and* incorporate documented individual preferences and emotions. For example, Hermalin and Isen (2000) include regret and guilt as utility reducing emotions. See also Ackert, Church, and Deaves (2003) who argue that emotion can enhance individual decision-making in financial settings.

[5] Payment resistance (tax evasion) may also increase if tax systems are perceived to be unfair [Andreoni, Erard and Feinstein (1998) and Alm (1998)].

[6] Several other later papers have studied the choice in societies with different income distribution systems behind the "veil of ignorance" [e.g. Johansson-Stenman, Carlsson, and Daruvula (2002), and Carlsson, Gautam Gupta, and Johansson-Stenman (2002)].

[7] By efficiency, we mean maximizing the sum of individual payoffs. We are not referring here to Pareto efficiency.

have only a very limited willingness to pursue such goals if they come at the expense of a reduced own payoff.

In a related paper, Engelmann and Strobel (E&S) shed light on the nature of the trade off between these potentially conflicting goals. They use one-shot, distribution experiments to compare the performance of several behavioral models, including theories reflecting social preferences. Consistent with F&O, E&S conclude that theories of inequality aversion have no additional explanatory power in their data beyond what can be explained by the mixed rule of efficiency and maximin. They also conclude that theories of inequality aversion perform poorly in cases where a distribution with less inequality is Pareto dominated by another distribution.

In this paper we examine fairness motives as a possible explanation of the paradox of optimal tax theory. We build on Fehr and Schmidt's (1999) model of inequality aversion to test whether people are willing to choose a distribution with a smaller own payoff in order to achieve a more equitable distribution of after-tax payoffs. In the experiments reported in this paper, we present participants with a simple task. We randomly assign nine participants in each experimental session with a payoff uniformly distributed between $10 and $50, in increments of $5. Then, the participants are asked to vote for either a uniform head tax or a progressive tax. The vote of the majority determines the tax structure and consequently the distribution of after-tax payoffs to the subjects. Our laboratory experiments, conducted with student subjects, elicit individually held social preferences for redistributive taxation. Our central finding is that some people are prepared to sacrifice their own income in order to reduce inequality in the distribution of after-tax payoffs, but this apparent demand for fairness decreases as the cost of reducing inequality increases.

Our experiments differ from those of F&O and E&S in three critical aspects. First, in their canonical experiments participants do not know their ranking in the income

distribution.[8] Although we also examine behavior with role uncertainty, in our canonical experiments participants know their position in the pre-tax distribution. This allows us to gauge whether and how much participants are willing to sacrifice in terms of a smaller after-tax payoff in order to reduce payoff inequality.

Second, in E&S's setting the median income subject is a dictator and only the payoffs to others are changed by the dictator's preferred distribution; in particular the dictator's own payoff is unaffected. In our view, a decision reflects a taste for fairness when the preferred outcome requires a sacrifice to the decision maker in the form of a reduced after-tax payoff in order to achieve a more equitable distribution of payoffs. Experimentally, a taste for fairness is exhibited when one tax structure is preferred to another even though the individual's payoff is reduced under the preferred tax structure. Third, we use majority rule as the social choice mechanism rather than a dictator as in E&S. Since majority rule is frequently used in democracies to make collective choices -- such as the redistribution of income -- we believe that it is important to examine individual preferences for distributional equity in an environment using this collective choice mechanism.

This paper proceeds as follows. In the next section, we describe a model that formalizes our notion of fairness. Section Three presents a summary of voting behavior, and Section Four discusses the statistical model and the results. Section Five offers some concluding comments.

2. A Model of Social Preferences

As reviewed in the previous section, there is growing empirical evidence in support of social preferences, or more precisely, people are concerned with their own payoffs as well as the payoffs of others. Although theoretical work continues on the form

[8] Engelman and Strobel provide some evidence based on sessions in which the subjects know their position in the income distribution and are required to sacrifice in order to achieve greater equity and/or efficiency. However, these experiments are mentioned only in passing to test the robustness of results obtained from their canonical experiments with role uncertainty and the decision maker's own payoff is unaffected by the choice of distribution.

of such social preferences, from our perspective, three recent models are particularly relevant in framing how people may vote for different tax structures. First, Charness and Rabin (2002) develop a model that combines social preferences, efficiency concerns, and reciprocity to predict behavior in economic experiments. In their two-person formulation, a player's utility is the weighted average of one's own payoff and the other player's payoff where the weight for the other player depends on payoff inequality and whether the other player has behaved unfairly. From their model, E&S abstract two principles, namely efficiency and maximin. Second, Bolton and Ockenfels' (2000) argue that own payoff and relative standing can explain observed behavior in many economic games. In their formulation, however, players do not care about inequality among other players or efficiency. Finally, Fehr and Schmidt (1999) develop a model where own payoff and inequality aversion play key roles, however, their model does not incorporate a concern for efficiency. Consequently, as E&S discuss, the Fehr-Schmidt model may perform poorly in predicting choice when a more equal distribution is Pareto dominated by a less equal distribution.

Several considerations are pertinent in choosing a theoretical framework to explain individual preferences among alternative tax structures. First, we are not concerned here with reciprocity because voting processes are often anonymous, which prevents participants from observing one another's voting behavior and rules out the ability to punish unfair play. Second, the choice of tax structure may be affected not only by the presence of social preferences but also concerns about efficiency. Third, the possible existence of social preferences may take varied and complex forms. An approach that allows some people to be concerned with their own payoff, averse to income inequality, and concerned with efficiency is, we believe, sufficiently flexible to account for different possible voting behaviors. Fourth, people may be more apt to show social preferences in "low cost" voting environments when their decisions tend to matter less, as compared to "high cost" private choice environments, with the latter being the context of the three models summarized above.[9]

[9] Eichenberger and Oberholzer-Gee (1998) provide experimental evidence that is consistent with the argument that behavior is fairer in a political sphere because the observation of social norms is costless.

Fehr and Schmidt's model provides a basis for our examination of social preferences. In their model, a player's utility is a linear sum of one's own payoff and the losses from disadvantageous and advantageous inequality.[10] Our statistical model, described later in this paper, is an adaptation of the Fehr and Schmidt model that incorporates efficiency concerns.

In Fehr and Schmidt's model with n players, an individual's utility depends on one's own payoff and inequity aversion as follows:

$$U_i(\pi_1, \pi_2, ...\pi_n) = \pi_i - \delta_1\left(\frac{1}{n-1}\right)\sum_{i \neq j} \max\{\pi_j - \pi_i, 0\} - \delta_2\left(\frac{1}{n-1}\right)\sum_{i \neq j} \max\{\pi_i - \pi_j, 0\}.$$

In this model π_i is the monetary payoff to player i; δ_1 is a parameter measuring the degree of disadvantageous inequality aversion; and δ_2 is a parameter measuring the degree of advantageous inequality aversion. The first term on the right-hand-side reflects player i's concern for his own payoff. The next two terms reflect the loss in utility that i suffers from disadvantageous and advantageous inequality, respectively. We assume that $\delta_1 > \delta_2$; or, in words, i suffers more from disadvantageous than advantageous inequality. Following Fehr and Schmidt, we assume that a player's inequity aversion is self-centered, so that he does not care about inequities among other players. Finally, we normalize the disutility from inequity aversion by n -1 in order to ensure that the effect of inequity aversion is independent of the number of players. As discussed below, this model of individual utility can be adapted to predict an individual's vote between two tax structures and our experimental design allows us to test for social motives.[11]

3. Experimental Design and Method

The choice of tax structure in any country is a complex process, but ultimately it can be reduced to voters supporting different political platforms with tax proposals

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People are fairer in the political sphere where social norms can be observed through voting behavior, which is nearly costless to observe.

[10] Inequality is disadvantageous when a reference individual earns more than the person evaluating the outcome. Advantageous inequality arises when the reference individual makes less than the evaluator.

[11] One feature of this model is the potentially high correlation among three terms, which are all functions of own payoff. We discuss the empirical implications of this correlation and possible remedies below.

implying different degrees of redistribution and efficiency losses through various economic incentives. In our experimental setting individuals express a preference for distributional equity when voting for alternative tax structures, some of which involve efficiency losses to achieve a reduction in inequality.

We began by conducting six experimental sessions, each consisting of a series of five trials.[12] Nine university students participated in each session, which were completed in approximately 30 minutes.[13] The average age of participants was 22.0 years, and no participant took part in more than one session.[14] After they arrived for the experiment, participants received a set of instructions and followed along as an experimenter read aloud. The instructions are included in the Appendix. The experimental design is summarized in Table I and described below.

In all sessions, participants are endowed with an income or pre-tax payoff that is theirs to keep for participating in the study except that they pay a tax. Each participant's income is determined by drawing a card from a set of nine cards. The following incomes are recorded on the cards: $10, $15, $20, $25, $30, $35, $40, $45 and $50. They are also reminded that because each income is equally likely, the average pre-tax payoff across participants is $30.[15]

[12] Since there may be learning in this repetition, our analysis below controls for session fixed effects. However, note that repeated game effects, such as "cooperative" choices, are not of concern because the nine participants in each of our experimental sessions vote anonymously.

[13] In order to establish a consistent pre-tax payoff distribution across the nine sessions, it was necessary to choose a fixed number of participants for each session. We eliminate the possibility of a split majority or 50-50 vote by requiring an odd number of subjects. We settled on nine participants in order to provide anonymity among the participants on the one hand and to limit the total cost of the experiments on the other.

[14] Some critics question the relevance of insight provided by experiments with student subject pools. If the average person behaves differently from university students, we should be cautious in drawing inferences about the general population. However, the evidence suggests that the behavior of subjects draw from other populations is not markedly different from the behavior of student subjects [Davis and Holt (1993, page 17)].

[15] Of course, people may behave differently when their income is earned rather than endowed. In particular, people may be more predisposed to fairness when endowed. Hoffman, McCabe, Shachat, and Smith (1994) provide experimental evidence that first movers in dictator and ultimatum games offer less when the first mover is decided by the higher score on a general knowledge test.

In all treatments the tax is one of two types. As Table 2 reports, Tax 1 is a lump-sum head tax of $7.50 and Tax 2 is a progressive income tax. Notice from Panel A of Table 2 that the tax regimes are revenue neutral in Treatments 1 and 2.[16] The sum of after-tax payoffs is $202.50 for both the head and progressive taxes. For Treatments 1 and 2, four of the nine participants receive a higher after-tax payoff under the head tax, as noted in Table 1. Four (4) low-income participants receive a higher after-tax payoff under the progressive tax; whereas, the median participant with a pre-tax payoff of $30 receives the same after-tax payoff under both tax structures.[17] If the participants care only about their after-tax payoff, high-income participants (i.e., pre-tax payoff > $30) prefer the head tax; low-income participants (i.e., pre-tax payoff < $30) prefer the progressive tax; and the median income participant (i.e., pre-tax payoff = $30) is indifferent.

The after-tax payoff of the subjects is determined by majority vote in the choice between the head tax (Tax 1) and the progressive tax (Tax 2).[18] Participants are given 5 minutes to indicate the preferred tax. After the votes are tallied, the chosen tax structure is publicly announced and participants are reminded that their after-tax payoff is private information that should not be disclosed at any time.

These procedures are repeated five times in each session. As the instructions indicate, participants are told at the outset that they would be paid based on the results of only one of the trials, and this trial would be chosen by a card draw at random by one of the participants from a set of cards labeled 1-5. Since *ex ante* the students have no way of knowing which trial is the payout trial, it is in their interest to treat all trials with equal seriousness.[19]

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[16] In Treatments 3 and 4, we simulate the excess burden of progressive taxation by using two tax regimes that are not revenue neutral, as discussed below.

[17] During the experiments, we used the more neutral terms Tax 1 and Tax 2 rather than lump-sum tax and progressive tax to refer to the two tax regimes in order to avoid unintentionally biasing the responses.

[18] Clearly, we are concerned in this paper with outcome fairness. There is a related literature that examines process fairness. By using majority voting to decide the outcome, we have invoked a process, which we believe to be widely accepted as process fair. However, it would be interesting in future research to examine the sensitivity of the results reported here to alternative decision rules such as super majority or weighted voting schemes.

[19] As discussed in greater detail, we estimate a variant of our model in which we control for round effects. We do not find any evidence of a round effect.

Treatments 1 and 2 differ in that participants in Treatment 1 vote for a tax structure *before* they drew an income card. In other words, participants in Treatment 1 vote before they know their pre-tax payoff. Since they do not know their place in the income distribution when they vote, they have no way of knowing whether the chosen tax regime increases or decreases their after-tax payoff, and, in that sense, they vote 'as if behind a veil of ignorance,' to use a phrase coined by Rawls (1971). In Treatment 2 participants vote after drawing an income card; so they know their standing in the income distribution when they vote. These two treatments allow us to see if knowledge of one's position in the income distribution, and thus the effect of the vote on their own after-tax payoff, changes the outcome of the vote.

At the conclusion of each session, participants complete a post-experiment questionnaire, designed to collect demographic information. Consideration of demographic information does not indicate any notable differences between participants across all sessions (1-10), as expected given that all subjects are recruited from the same pool. In addition, their responses on the questionnaire indicate that they found the experiment interesting and the monetary incentives motivating. Participants respond on an eleven-point scale as to how interesting they found the experiment, where 1 = not very interesting and 11 = very interesting. The mean response for Treatments 1 and 2 is 9.22. Participants also respond on an 11-point scale as to how they would characterize the amount of money earned for taking part in the experiment, where 1 = nominal amount and 11 = considerable amount. The mean response across Treatments 1 and 2 is 9.0.

4. Summary of Voting Behavior

A. *Revenue Neutral Treatments*

Table 3 summarizes the preferences of participants as revealed by their voting behavior. In Treatment 1, the majority vote for Tax 2 (the progressive tax) in 11 of 15 trials. In these sessions, participants do not know their income level when they cast their votes, and the majority chose the progressive tax. This result supports the view that

people care about the distributional consequences of taxation and not simply their own payoff. Since the participants do not know their pre-tax payoff, however, a majority voting for the progressive tax may reflect risk aversion. In fact, the Rawls maximin criterion is often criticized on the grounds that it assumes a greater degree of individual risk aversion than indeed may be the case.

In order to control for this source of risk, we allow participants to observe their pre-tax payoff before voting.[20] This experimental design also allows us to observe whether participants are willing to sacrifice income in order to satisfy a taste for fairness, if in fact a taste for fairness drove the previous finding. In Treatment 2, the majority votes for the progressive tax (Tax 2) in 10 of 15 trials. As we will see, it is not necessarily the median participant with a pre-tax payoff of $30 who is decisive. Thus, some participants vote for the progressive tax even though they suffer in terms of their own after-tax payoff. Alternatively, some median income participants vote against the progressive tax even though their after-tax payoff is unaffected by their choice of distribution. In other words, it appears that some participants are prepared to pay or sacrifice income in order to satisfy a taste for fairness. This evidence of heterogeneity in the population may play an important role in distribution experiments and may help explain the conclusion of E&S that theories of inequality aversion do not provide additional explanatory power not provided by the efficiency and maximin principles.

Table 4 provides additional insight into the behavior of our experimental participants. As one might expect, in Treatment 1 where the participants vote 'behind a veil of ignorance,' voting for either Tax 1 or Tax 2 shows no pattern across payoffs. Interestingly, however, we observe approximately the same proportion of total votes for the progressive tax (Tax 2) in Treatment 2 (59/135 = 0.44), in which pre-tax payoffs are known before voting as when they are not, as in Treatment 1 (54/135 = 0.40). In Treatment 2, we observe a clear pattern in voting behavior with low (high) payoff

[20] In a strict sense, removing the "veil of ignorance" only removes the uncertainty regarding one's income. Uncertainty remains as to how others will vote, and we cannot rule out rule an effect of this type of uncertainty on voting. But, note that uncertainty regarding how others will vote is equally present behind the "veil of ignorance."

individuals showing a strong preference for the progressive tax (head tax). It is impossible to infer whether low payoff individuals are voting for the progressive tax out of concern for their own payoff and/or due to disadvantageous inequality aversion because the two motives are congruent. However, we also see that the median-income participant whose pre-tax payoff is $30 votes only slightly more often for Tax 2 (8/15 = 0.53).

Significantly in terms of our hypothesis, some individuals vote for the progressive tax (Tax 2) even when it is clearly not in their monetary self-interest to do so. In fact, we observe more votes for Tax 2 by high-income participants (15.0% or 9/60 votes) as compared to votes for Tax 1 (head tax) by low-income participants (1.6% or 1/60 votes).

To provide further insight into voting behavior, we report voting by income in Table 4. In Treatment 2 (pre-tax income is known before voting), nine out of a possible 60 votes cast were for the progressive tax, even though the participants know before casting a vote that their pre-tax payoff is greater than the median, and therefore they would be sacrificing income by voting for the progressive tax (Tax 2). Four (4) participants cast these nine votes. Two of these subjects participated in session 4, and one each in sessions 5 and 6. We refer to these subjects as fairness preferring. Three of the four always voted for the progressive tax (Tax 2), regardless of their income level.

Demographic information for Treatment 2 indicates the following. Our median participants are in their third year of university study. Two fairness-preferring participants are in their first year at the university, and the other two are in their third year. Two fairness-preferring participants are men, and two are women. Three of the four report that their household income is less than $25,000, and one reports income in the range of $25,001-$50,000. The median participant in sessions 4-6 reports income in the $25,001 to $50,000 range. Because three of four fairness-preferring participants report income less than the median, there is some evidence that our fairness-preferring subjects are, on average, lower income.

Overall the results support the hypothesis that some subjects exhibit social preferences and are prepared to pay for more equitable outcomes, even if it is personally costly to do so.

B. *Treatments with a Distortionary Progressive Tax*

Because previous experimental evidence suggests that some people care about efficiency or maximizing the sum of payoffs, we conduct two additional treatments.[21] In Treatments 3 and 4, we require participants to choose between two tax regimes that are not revenue neutral. In other words, the sum of the after-tax payoffs from the "distortionary" progressive tax is less than that of the lump-sum head tax. Notice from Panel B of Table 2 that in Treatment 3, the sum of the after-tax payoffs with the head tax is $247.50; whereas the sum of the after-tax payoff with the progressive tax is $202.50. With the exception of the two lowest pre-tax payoff participants ($10 and $15), all the subjects have an economic incentive – absent inequality aversion - to vote for the head tax (Tax 1). Turning to Treatment 4, the after-tax payoffs are summarized in Panel C of Table 2. Again, the tax regimes are not revenue neutral. The sum of after-tax payoffs with the lump-sum head tax is $225.00; whereas the sum of after-tax payoffs with the distortionary progressive tax is $202.50. Now, five of nine participants have an economic incentive – again absent inequality aversion – to vote for the head tax (Tax 1). In short, the tax regimes in Treatments 3 and 4 are not revenue neutral; otherwise the procedures are identical to those described above for Treatment 2. As before, nine university students participated in each session; the participants knew their pre-tax payoff before they voted; and the majority vote determined the after-tax payoffs. Finally, these procedures were repeated five times in each session.

Table 3 reports the voting behavior of the majority in Treatments 3 and 4. In contrast to the behavior observed in Treatment 2, the majority of participants vote against

[21] As in Treatments 1 and 2, participants completed a post-experiment questionnaire at the conclusion of each session. Participants responded on an eleven-point scale as to how interesting they found the experiment, where 1 = not very interesting and 11 = very interesting and the mean response for Treatments 3 and 4 is 8.94. Participants also responded on an 11-point scale as to how they would characterize the amount of money earned for taking part in the experiment, where 1 = nominal amount and 11 = considerable amount and the mean response across Treatments 3 and 4 is 9.08.

the progressive tax. In Treatment 3, the majority votes for the lump-sum head tax in every trial. In Treatment 4, the majority votes for the lump-sum head tax in eight of ten trials. In other words, when the tax is not revenue neutral, fewer people are willing to sacrifice to reduce the dispersion in after-tax payoffs. This result is suggestive: Individuals care about distributional equity, but they also care about the total size of the pie being divided.[22]

Votes by income level, reported in Table 4, also support this interpretation. Few people with high incomes (i.e., pre-tax payoff > \$30) vote for the progressive tax. In Treatment 3, all participants with incomes greater than or equal to \$20 have an economic incentive – absent distributional considerations - to vote for the head tax (Tax 1). We observe only 2.9% (2/70 votes) of high-income votes for the progressive tax (Tax 2) in Treatment 3. Similarly, in Treatment 4 only 4% (2/50) of high-income voters (pre-tax payoff ≥ \$30) choose the progressive tax (Tax 2).

5. Statistical Model and Results

The foregoing discussion provides a number of interesting insights into the observed voting patterns. Generally speaking, the results are consistent with the predictions of the Fehr-Schmidt model of inequality aversion. In order to submit the model to a more rigorous test, we use the data generated by our experiments to estimate an empirical analog of the Fehr-Schmidt model, which predicts voting behavior in our experimental environment.

The empirical model is given as follows:

$$\mathsf{y}_i^* = \left(B_0 + \alpha_i^*\right) + B_1 D + B_2 \Delta\pi_i + B_3 \Delta\left(\frac{1}{n-1}\right)\sum_{i \neq j} \max\left\{\pi_j - \pi_i, 0\right\} +$$

$$B_4 \Delta\left(\frac{1}{n-1}\right)\sum_{i \neq j} \max\left\{\pi_i - \pi_j, 0\right\} + \varepsilon_i .$$

[22] We observe that as the excess burden of the distortionary progressive tax increases, the number of people voting for the progressive tax (Tax 2) decreases. This suggests that there may be a downward sloping demand for fairness. This is an interesting issue for further study.

In this model, y_i^* is a latent-continuous-random-variable representing the change in utility due to the progressive tax (Tax 2) versus the head tax (Tax 1). The change in utility of a particular choice cannot be observed, but we can observe the individual's vote. In a binary choice, voting is incentive compatible. We assume that the individual votes in favor of the tax structure that maximizes own utility, and

$$Vote_i = \begin{cases} 1 \; if \;\; y_i^* > 0. \\ 0 \; if \;\; y_i^* \leq 0. \end{cases}$$

In other words, y_i^* takes the value of 1 when a subject prefers the progressive tax; and 0 otherwise.

Since E&S report evidence that the Fehr-Schmidt model of inequality aversion performs poorly when distributions are Pareto dominated, we include a dummy variable D, which takes the value of 1 for Treatments 3 and 4, which are not revenue neutral. This allows us to account for efficiency concerns. We also assume that i's utility depends on the difference in one's own payoff and differences in the indices of disadvantageous and advantageous inequality, as defined in Section I above. In order to control for unobserved heterogeneity among the subjects, we include α_i^*, which is a latent random variable that reflects unobserved idiosyncratic tastes for fairness. Finally, the random error of the structural model is given by ε_i.

Since the value of the regressors for each observation depends on pre-tax income, which was randomly assigned by drawing a card, we feel confident that α_i^* is statistically independent of the other regressors in the model. We also include a constant in the regression; therefore, α_i^* is the deviation from a common mean. Lacking any information about the distribution of α_i^*, it seems reasonable to assume that deviations from a common mean are normally distributed in the student population from which we drew our sample. Accordingly, we assume $\alpha_i^* \sim N(0,\sigma_\alpha^2)$ and $E[\alpha_i^*|D_t,x_i,di_i,ai_i,\varepsilon_i] = E[\alpha_i^*]$, where di_i and ai_i are the indices of disadvantageous and advantageous inequality, respectively. By further assuming ε_i has a standard normal distribution, it follows that our

specification is a multivariate probit model.[23] Therefore, we estimate our empirical model using random effects probit. Our results are very similar to those reported subsequently when we estimate random-effects or fixed-effects, linear probability or logit models. In contrast to E&S's one shot design, our experimental design allows us to control for individual effects. Charness and Rabin (2002) report evidence that individual effects may be important in experiments designed to elicit tastes for distributional equity.

Our experimental design elicits repeated binary choices by 63 subjects. The resulting data include 315 votes for treatments 2, 3, and 4.[24] The regression results are reported in Table 5 for two specifications of the model.[25] The table reports estimated coefficients with t-statistics in parentheses and the corresponding marginal effects in brackets. The first specification (column 1) is a model of purely selfish preferences, in which voting behavior is determined only by the difference in one's own payoff. The second specification (column 2) includes measures of the difference in disadvantageous and advantageous inequality.[26] Recall that the estimated coefficients of a probit equation indicate the direction of change due to a vote for the head tax (Tax 1); whereas the marginal effects show the change in the probability of a vote for the head tax for each independent variable. Finally, the table reports goodness of fit measures, including Wald's χ^2 test statistic for the significance of the regression, the estimated value of the log-likelihood function, and McFadden's Adjusted Pseudo-R^2.[27]

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[23] The assumption of unit variance is an innocent normalization [see, for example, Greene (2002)]. Also, Hsiao (2003) provides an excellent discussion of discrete choice as well as fixed and random effects models.

[24] We exclude treatment 1 because pre-tax payoffs are unknown before voting and we need a reference payoff in order calculate the regressors. Furthermore, the regressors would be identical for any choice of reference income. For example, the expected payoff is an obvious candidate to serve as the reference income; but, in this case the regressors would be identical for every observation.

[25] For the random-effects model, the likelihood (for an independent unit i) is expressed as an integral, which is computed in STATA using Gauss-Hermite quadrature. STATA recommends that the fitted model be evaluated for sensitivity to the chosen number of quadrature points. As a rule of thumb, if the coefficients do not change by more than a relative difference of 0.01 percent, then the choice of quadrature points does not significantly affect the outcome and the results may be confidently interpreted. When we change the number of quadrature points by ± 4 points, our estimates do not change by more than the indicated 0.01 percent.

[26] In order to test for learning or order effects, we constructed a variable that ranged from 1 to 5 depending on the round of the experiment. This variable was statistically insignificant at conventional levels. More importantly, including this variable in the regression does not change the results reported below.

[27] Like a conventional R^2 in the context of ordinary least squares, McFaden's Pseudo-R^2 increases as the number of regressors in the model increases. Accordingly, we adjust the likelihood ratio index by

The estimated coefficients of both models have the expected signs and are statistically significant at conventional levels, except for the dummy variable for a distortionary progressive tax, which is statistically insignificant.[28] In the purely selfish model, a subject with greater change in own payoff is more likely to vote for the head tax and subjects in the treatments in which the progressive tax is distortionary are also more likely to vote for the head tax. As predicted by Fehr and Schmidt's model of social preferences, however, subjects dislike inequality as evidenced by the negative and statistically significant estimates of the coefficients of the change in the indices of disadvantageous and advantageous inequality in the social preferences model. We also perform a likelihood ratio test of the linear restriction that social preferences do not belong in the model (H_O: $B_3 = B_4 = 0$). This test rejects the null hypothesis ($\chi^2 = 13.24$, $p < 0.01$) at conventional levels of significance. Interestingly, the estimated coefficients in the social preferences specification are consistent with earlier experimental evidence suggesting that individuals are more concerned with disadvantageous inequality (coefficient = -0.6915) than advantageous inequality (coefficient = -0.5031).

One drawback of the Fehr-Schmidt model is that the regressors are potentially collinear. In fact, the covariances are substantial, ranging from -0.831 in the case of the covariance between the differences in own payoff and the indices of disadvantageous inequality and -0.931 for the covariance of the differences in the indices of advantageous and disadvantageous inequality. The case of high correlation among the variables is not one of identification as in the case of perfect collinearity. In fact, estimates are consistent in the presence of near multicollinearity [Greene (2002)]. Rather the problem is precision; the higher the correlation between the regressors becomes, the less precise our

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subtracting K, the number of regressors in the model, from the numerator of the index. Therefore, McFadden's likelihood ratio index must increase by more than 1 for each added regressor in order for the adjusted measure reported here to increase in value. See McFadden (1984) and note no. 4 of Table 5 for further details.

[28] Since others have argued that whether and how social preferences are exhibited depends importantly on the economic environment, we report the results including the dummy variable to control for differences in the economic environment among treatments. We also estimated both specifications of the model without the dummy variable. We obtain the same qualitative results. Specifically, the estimated coefficient on the change in one's own payoff is positive and statistically significant in both models, and the estimates on the changes in the two indices of inequality aversion are negative and statistically significant in the social preferences specification.

estimates will be. In other words, our reported t-statistics are biased downward, and we are more likely to accept the null hypothesis though it is false. Since we reject the null hypothesis that the slope coefficients are equal to zero, the high collinearity among the regressors does not appear to be problematic. However, we experimented with alternative specifications of the model, by squaring the terms of the indices of inequality before summing them, in order to reduce the high degree of collinearity among the regressors. This transformation of the data substantially reduces the covariances and, as expected, the estimates are more precise. In summary, our evidence supports the model of social preferences.

6. Conclusion

This paper reports the results of simple experiments designed to examine individual preferences regarding tax structures. The literature suggests that an optimal tax minimizes the excess burden of taxation subject to a revenue constraint. For example, lump-sum taxes are thought by some to be an ideal form of taxation because they do not change relative prices and, therefore, do not induce excess burdens. Historically, however, lump-sum taxes are infrequently used in practice and are often greeted with strong public opposition when they are employed. We believe that for a given tax revenue yield, a lump-sum tax may not be optimal because people care about the fairness of tax structures as well as their total burden.

The results of our experiments are consistent with this conjecture. When given the choice between a lump-sum head tax and a lump-sum progressive tax, the majority of participants choose a progressive tax, even when participants know their pre-tax payoff before voting. Informal conversations with participants subsequent to the experimental sessions suggest that fairness was a consideration. However, when the tax is not revenue neutral through the internalization of sizable excess burdens, the majority voted for a lump-sum head tax. Thus, when the group's total after-tax payoff had to be sacrificed to reduce inequality among payoffs, fewer were willing to pay for fairness.

Standard economic models, including those of optimal taxation, must be consistent with the full range of human motives if they are to provide reasonable guides to policy design. Our evidence suggests that at least some people value fairness and that models that exclude this concern may not adequately characterize preferred outcomes. Further investigation of the impact of social preferences on decision making in groups will provide important insight for economic policy, including, but not limited to, the optimal tax structure.

TABLE 1—EXPERIMENTAL DESIGN

Treatment	Sessions	Vote before or after income revealed?	Amount of head tax	Number with higher after-tax payoff with Head tax
1	1-3	Before	$7.50	4 out of 9
2	4-6	After	$7.50	4 out of 9
3	7-8	After	$2.50	7 out of 9
4	9-10	After	$5.00	5 out of 9

TABLE 2—TAX STRUCTURES

Panel A: Treatments 1 and 2 (Sessions 1-6)

Pre-Tax Income	Tax 1: Head tax		Tax 2: Progressive tax	
	Tax	After-tax payoff	Tax	After-tax payoff
$10.00	$7.50	$2.50	$0	$10.00
$15.00	$7.50	$7.50	$2.00	$13.00
$20.00	$7.50	$12.50	$3.00	$17.00
$25.00	$7.50	$17.50	$4.00	$21.00
$30.00	$7.50	$22.50	$7.50	$22.50
$35.00	$7.50	$27.50	$11.00	$24.00
$40.00	$7.50	$32.50	$12.00	$28.00
$45.00	$7.50	$37.50	$13.00	$32.00
$50.00	$7.50	$42.50	$15.00	$35.00
Total	$67.50	$202.50	$67.50	$202.50

Panel B: Treatment 3 (Sessions 7-8)

Pre-Tax Income	Tax 1:Head tax		Tax 2: Progressive tax	
	Tax	After-tax payoff	Tax	After-tax payoff
$10.00	$2.50	$7.50	$0	$10.00
$15.00	$2.50	$12.50	$2.00	$13.00
$20.00	$2.50	$17.50	$3.00	$17.00
$25.00	$2.50	$22.50	$4.00	$21.00
$30.00	$2.50	$27.50	$7.50	$22.50
$35.00	$2.50	$32.50	$11.00	$24.00
$40.00	$2.50	$37.50	$12.00	$28.00
$45.00	$2.50	$42.50	$13.00	$32.00
$50.00	$2.50	$47.50	$15.00	$35.00
Total	$22.50	$247.50	$67.50	$202.50

Panel C: Treatment 4 (Sessions 9-10)

Pre-Tax Income	Tax 1: Head tax		Tax 2: Progressive tax	
	Tax	After-tax payoff	Tax	After-tax payoff
$10.00	$5.00	$5.00	$0	$10.00
$15.00	$5.00	$10.00	$2.00	$13.00
$20.00	$5.00	$15.00	$3.00	$17.00
$25.00	$5.00	$20.00	$4.00	$21.00
$30.00	$5.00	$25.00	$7.50	$22.50
$35.00	$5.00	$30.00	$11.00	$24.00
$40.00	$5.00	$35.00	$12.00	$28.00
$45.00	$5.00	$40.00	$13.00	$32.00
$50.00	$5.00	$45.00	$15.00	$35.00
Total	$45.00	$225.00	$67.50	$202.50

TABLE 3 — MAJORITY VOTING

Treatment	Sessions	Number of sessions with majority vote for		Percentage of majority vote	Percentage of votes for Tax 1
		Tax 1 (head tax)	Tax 2 (Progressive tax)		
1	1-3	4	11	0.64	0.36
2	4-6	5	10	0.56	0.44
3	7-8	10	0	0.81	0.81
4	9-10	8	2	0.54	0.54

TABLE 4—VOTING BY INCOME

Income	Treatment 1 Sessions 1-3		Treatment 2 Sessions 4-6		Treatment 3 Sessions 7-8		Treatment 4 Sessions 9-10	
	Tax 1	Tax 2	Tax 1	Tax 2	Tax 1	Tax 2	Tax 1	Tax 2
10	9	6	1	14	2	8	0	10
15	4	11	0	15	3	7	0	10
20	6	9	0	15	9	1	0	10
25	7	8	0	15	10	0	2	8
30	4	11	7	8	10	0	9	1
35	7	8	13	2	10	0	10	0
40	2	13	13	2	10	0	10	0
45	7	8	11	4	9	1	9	1
50	8	7	14	1	10	0	10	0
Total	54	81	59	76	73	17	50	40

Note: Tax 1 is a head tax; Tax 2 is a progressive tax.

TABLE 5— PROBIT REGRESSIONS OF VOTING

Independent Variable	Purely Selfish Model	Social Preferences Model
Constant	-0.5711 (-1.81)*	3.0908 (2.24)**
Change in own payoff	0.3780 (6.42)*** [0.0949]	0.2814 (2.25)** [0.0890]
Dummy for distortionary progressive tax (Dummy=1 for Treatments 3 and 4, else 0)	0.5307 (1.30) [0.1379]	1.0352 (1.60) [0.3338]
Change in disadvantageous inequality	-	-0.6915 (-3.14)*** [-0.2186]
Change in advantageous inequality	-	-0.5031 (-1.76)* [-0.1590]
χ^2 test of the significance of the regression	41.33***	36.26***
Estimated value of the log-likelihood function	-93.42	-86.75
McFadden's Adjusted Pseudo-R^2	0.5426	0.5602

Notes:
1. In the upper panel, estimated coefficients are reported at the top of each cell; below which t-statistics for the estimated coefficients are reported in parentheses ( ); and below that the corresponding marginal effects are reported in brackets [ ].
2. Although we do not report t-statistics for the marginal effects, there is no change in significance for any of the variables.
3. A single asterisk (*) indicates that the estimate is significant at the 10-percent level, a double asterisk (**) indicates significance at the 5-percent level, and a triple asterisk (***) indicates significance at the 1-percent level.
4. McFadden's Adjusted Pseudo-$R^2 = 1 - \left(\frac{\ln \hat{L} - K}{\ln L_0} \right)$; where $\ln[L_0]$ is the maximized value of the log-likelihood function computed with only a constant term; $\ln\left[\hat{L}\right]$ is the maximized value of the log-likelihood function for the model, and K is the number of regressors. We subtract K from the numerator of the likelihood ratio index (LRI) to account for changes in the LRI due to the changes in the number of regressors in the models (see footnote 26 for further details).

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Appendix: Experimental Instructions

The experimental instructions for Treatment 2 follow. Changes in the instructions for other treatments are noted in brackets.

General Instructions

This experiment is concerned with the economics of decision-making. The instructions are simple, and if you follow them carefully and make good decisions, you might earn a considerable amount of money that will be paid to you in cash.

In this experiment you will be given an endowment of cash. This endowment is your income for participating in the experiment today except that you must pay a tax.

A Record Sheet is included with these instructions. You will keep track of your decisions on this sheet.

Specific Instructions

Your income, before taxes, is determined by drawing a card from a set of nine cards. The incomes recorded on the nine cards are as follows: $10, $15, $20, $25, $30, $35, $40, $45, and $50. Notice that because each income level is equally likely, the average income is $30 *before taxes are paid*.

The tax you pay on income will be one of two types. With Tax 1, all participants in this room will pay a tax of $7.50. With Tax 2, the tax paid varies across income levels. The following table summarizes the tax that is paid for each income level.

Pre-Tax Income	Tax 1		Tax 2	
	Tax	After-tax payoff	Tax	After-tax payoff
$10.00	$7.50	$2.50	$0	$10.00
$15.00	$7.50	$7.50	$2.00	$13.00
$20.00	$7.50	$12.50	$3.00	$17.00
$25.00	$7.50	$17.50	$4.00	$21.00
$30.00	$7.50	$22.50	$7.50	$22.50
$35.00	$7.50	$27.50	$11.00	$24.00
$40.00	$7.50	$32.50	$12.00	$28.00
$45.00	$7.50	$37.50	$13.00	$32.00
$50.00	$7.50	$42.50	$15.00	$35.00

[Note: The amount paid with Tax 2 varies in Treatments 3 and 4. The tax structures are reported in Table 2 of the paper.]

Whether the tax you pay is Tax 1 or Tax 2 will be determined by majority vote. After the experimenter distributes the income cards, you will be given 5 minutes to

indicate which tax you prefer. When all participants have recorded their votes on their Record Sheets, the experimenter will tally the votes and report on the outcome. Please record the tax paid and your after-tax payoff on your Record Sheet. Your income is your private information and should not be disclosed to other participants at any time.

[Note: In Treatment 1 income cards are distributed after votes are recorded.]

We will repeat these steps 5 times. At the end of each trial, the tax chosen by the majority vote is announced. However, only one of the five trials will be binding. A number from one to five will be randomly selected to determine the binding trial. Your after-tax payoff from the binding trial is yours to keep and will be paid to you in cash.

Please do not confer with other participants in making your decisions at any time. Please remember that once you record your vote in each trial, you cannot change it.

Record Sheet

Trial	Your vote (Tax 1 or Tax 2)	Majority vote (Tax 1 or Tax 2)	Your pre-tax payoff (from your income card)	Your after-tax payoff
1				
2				
3				
4				
5				