Preferences for Taxation and Redistribution: An Experimental Study*

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Summary

Economists debate the reasons why we find progressive taxation and government expenditures, which cause real income to be distributed somewhat more equally after versus before taxes and transfers, in all industrialized countries. Contending possibilities include a shared desire that income be distributed less unequally than market forces alone would dictate, or successful political coalitions to redistribute away from those with higher incomes. We study the relative importance of fairness preferences versus self-interest in determining tax choices in a laboratory decision-making experiment. When choosing as "disinterested observers," most of our subjects prefer that there be less inequality among others, and they're willing to pay something to bring that about. When sure of the effect on their own earnings, subjects' experimental tax choices are primarily governed by self-interest, but fairness preferences continue to play a role. The external validity of the experiment is supported by its replication in a non-student subject pool and by the high correlation between tax decisions and political preferences reported in a survey. Results include a correlation between fairness preference and risk-aversion, and a finding that males' but not females' preferred levels of redistribution are highly responsive to whether differences in pre-tax incomes are due to differences in task performance. Judging by decisions in the "disinterested observer" condition, subjects' aggregate welfare would be highest if post-tax and transfer inequality were less than actual current levels in the United States.

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0. Introduction

Redistribution of income through government taxes and expenditures has long been normal practice in industrial democracies. Using data from the Luxembourg income surveys, Branko Milanovic (2000) estimated that the income share of the bottom two quintiles of households in 14 OECD countries in the early 1990s was on average 14.7% higher when measured on a post-tax-and-transfer than on a pre-tax-and-transfer basis. Even in the U.S., the least redistributive of the wealthy industrialized countries, Milanovic found a difference of almost 8% between the income share of the bottom 40% of households after versus before taxes and transfers.

The ever-contentious issue of how much redistribution there *ought* to be is one that in the end must cross the boundary between positive and normative discussion. Yet there are many points on which positive economic analysis can be helpful. Studies that attempt to estimate the magnitude of the trade-off between equality and efficiency are one example. An understanding of *why* income is redistributed can also be pursued as a matter of positive analysis. Among the possible explanations of redistributive taxation is that there is a social consensus behind it, that is, a large majority of citizens feel better off living in a society with less inequality. In the limit, redistribution could be Pareto improving, i.e. even those with high incomes could prefer that redistribution occur despite the material cost to them.[1] If redistribution were universally preferred, then an efficient amount of redistribution could in principal be found whether using the Pareto criterion itself or by a Benthamite social welfare function.

At the other end of the spectrum of explanations is the idea that redistribution results from majority rule and self-interest, as emphasized in traditional political-economic models of redistribution.[2] The distribution of incomes in all observed societies is right skewed, with the income of the median individual or household being far below the arithmetic average income. Thus, assuming that a given amount of revenue has to be raised by either a head tax (taking a fixed amount per person), a flat tax (taking an equal proportion of income from each person), or a progressive tax (taking a proportion of income that is higher the greater the individual's income), a self-interested median voter will always prefer the flat over the head tax and the progressive over the flat tax, assuming absence of incentive considerations. If government expenditures benefits all

[1] The idea of a universal preference for redistribution raises the question of why the government tax system would have to be involved, rather than a set of decentralized private transfers. One answer is that people might prefer to participate in redistribution but only if they are assured that others are doing the same; see Sen, 1967.

[2] This has also been the view of philosophically conservative opponents of redistribution. As the American social Darwinist William Sumner wrote in a famous essay, "The Forgotten Man," "The type and formula of most schemes of philanthropy or humanitarianism is this: A and B put their heads together to decide what C shall be made to do for D."

more or less equally, political-economic models that restrict taxation to a well-defined spectrum from the regressive to the progressive and assume equal participation in elections thus always predict that progressive taxes will be adopted in market democracies. In the absence of incentive and other dynamic considerations, such models predict the complete confiscation and redistribution of incomes. With the addition of such considerations, interior equilibria resembling those actually observed are logical outcomes.[3]

Experimental economists have found considerable evidence that many people do not behave as if possessing strictly self-interested utility functions, but rather evince social preferences including preferences for fairness (Fehr and Schmidt, 2003). Not only do most subjects in the ultimatum game assign 40 or 50% of an experimental endowment to an anonymous partner, an action that might be explained by concern over rejection of "unfair" offers; most subjects also voluntarily share some part of their endowment with a partner who has no veto over the division in the dictator game, and when "entrusted" with money in a trust game, most "return the trust." When dictator games are modified to give an observing third player the right to monetarily punish the dictator, such observers frequently sacrifice some of their earnings to punish dictators perceived as unfair, even though the punisher is only a spectator to the initial division. The willingness to pay for a fair outcome, which is observed in these experiments, is in principle consistent with the idea of a citizenry willing to pay an efficiency cost (and, for those with higher incomes, direct costs due to the lowering of their income shares) to redistribute income through the fiscal system. However, it may be misleading to make inferences from small group interactions, because the social and political contexts and cues that are operative in the political sphere in a large society may be qualitatively quite different.[4]

We conducted a series of experiments to shed light on the presence and strength of preferences for reducing inequality of incomes in society, including the willingness to pay for greater equality. A focus of our experiments is the possible divergence between self-interest and general social preferences regarding (re-)distribution. We hope to shed light on the degree to which observed redistributive outcomes in democracies should be explained by political economic forces rooted in self-interest versus by social preferences for equality as a good in its own right. Toward this end, each subject in our experiments expressed a preference for redistribution both under the condition of being an outside observer of a distribution of income among others, and in the situation of being an affected party with a specific interest stemming from the expectation or knowledge of having a higher or lower pre-tax income.

[3] Redistribution could also be less than total because (a) voters perceive some inequalities as "earned" and thus fair, (b) higher-income voters are more politically active, (c) lower-income voters have less understanding of their interests and their perceptions are influenced by the political activity of higher-income voters, or (d) the relevant decision space is not limited to a continuum along a single dimension, hence there is no clear equilibrium.

[4] There have been a few experiments with monetary incentives to study preferences regarding redistribution with reference to the macro political economy sphere; see for example Ackert, Martinez-Vazquez and Rider, 2004.

The paper proceeds as follows. Section 1 describes the design and rationale of our experiments, while Section 2 prepares the ground for interpreting the results. Section 3 lays out the basic results, and Section 4 investigates consistency between subjects' choices in the experiment and their expressed views on matters of inequality and redistribution. In Section 5, we present an econometric analysis of subjects' decisions, including exploration of the predictive power of background variables. Section 6 summarizes the findings and discusses their implications and directions for further research.

1. Design

Most of the burgeoning experimental literature studying social preferences involves experimental interactions between pairs or small numbers of individuals. The tasks involved are presented to the subjects with exchange, sharing or other framings. These experiments exhibit the usual feature distinguishing economic from other social and psychological experiments, namely that choices are costly in the sense that subjects are paid not (mainly) for their participation, but as a function of the decisions made. Some of the smaller number of experiments conducted by researchers interested in the distribution of income in society break with this pattern by paying subjects a fixed amount and asking them to reveal their preferences among distributions without specific monetary inducements (see Amiel, 1998). We wanted to maintain the feature of costly choices, and to strike a balance between a more neutral and a more contextual framing of our experiment. We framed the task facing our subjects with a reference to the societal distribution of income, but we did not announce a purpose of eliciting their views on distribution, unlike for example Frohlich and Oppenheimer (1992). In our experiment we had a relatively large number of subjects engage in and be affected by choices on distribution, in the belief that interacting with a considerable number of individuals—21 in each of our sessions, lacking and prior contact and communication—would put them in the mind-set of choice on a societal level.

We began each session by introducing Table 1. We explained that the left column of the table shows the average pre-tax incomes of the lowest to highest earning twentieths of the adult population of the United States, and that the right column consists of numbers proportionate to those in the left one, each being an amount to be earned in the experiment, unless modified by taxes, by one of twenty subjects. (A $5.00 participation fee was also given to each person completing the session, a minimum deemed necessary for purposes of recruiting participants.) It was mentioned that the pretax earnings might be altered by a tax and transfer process, but before that process was introduced, we described four ways in which subjects might be assigned to pre-tax earnings levels: (1) randomly, (2) in accordance with the average income of the place they grew up in (hereafter, the "where from" method),[5] (3) according to performance on a general knowledge Quiz, and (4) according to performance in a computer game, Tetris. We

[5] Subjects either entered the zip code, if in the United States, or the country name, if not, of the place their family lived when they went to high school. The computer then looked up average incomes in a table based on data from the U.S. Bureau of the Census and the World Bank, and ranked the subjects accordingly.

explained that one of the four methods would be selected at random toward the end of the experiment, to be the basis for payment. Finally, we announced that in the first of two main experimental conditions that would ultimately be selected from at random to be the basis for payments, dubbed Experiment I, each subject had an equal chance of being selected as the "decisive individual" (DI), a twenty-first participant directly affected neither by the Table 1 income profile nor by the impact on that profile of any tax and transfer program that might be enacted. That individual would dictate the tax rate to apply to the incomes of the other twenty participants. By requiring all twenty-one subjects to indicate their tax preferences at the outset, "impartial observer" preferences were elicited from the entire subject pool. We used a dictator rather than median voter design so that subjects would have no reason to vote strategically.[6]

Tax and transfer options in our experiment are simple. In Experiment I, the decisive individual could select a tax rate $t \in [0, 0.1, 0.2, \ldots, 0.9, 1]$ to apply uniformly to each of the other twenty subjects' pre-tax earnings, with the proceeds—in some sessions after deduction of an "administrative cost," reflecting the possible efficiency loss associated with taxes and transfers—being distributed equally among those subjects. Thus, after-tax earnings of subjects other than the DI were given by:

$$y_i = (1 - t)x_i + t(1 - a)(1/20)(\Sigma x_j) \qquad (1)$$

where x_i is i's pre-tax earnings (one of the numbers in the right column of Table 1), $i \in [1,2,\ldots,20]$ indexes one of the 20 affected subjects, t is the tax rate, $a \in [0,0.125,0.25]$ is the "cost of administering the tax" (not mentioned in the instructions of sessions in which $a = 0$), and the summation is taken over all twenty individuals affected by the tax. The effects of taxation and redistribution of the proceeds were explained to subjects verbally, graphically, in a table (Table 2), and by means of an equation resembling (1), so that both more and less mathematically inclined subjects could understand them. The parameter a was fixed and constant during a given session, allowing its effects to be measured only by between subject comparisons.

The income of the decisive individual was either entirely unaffected by taxes and transfers (our pure disinterested observer benchmark), or else was affected only by way of a cost per 10% of tax that he or she choose to impose (modified "disinterested observer" scenarios allowing measurement of willingness to pay). Specifically, the DI earned a base amount randomly chosen within the interval from \$19.80—the average of the twenty x_i values in Table 1—to \$21.80. From this was deducted a charge $c*10t$, with c taking the value 0 in some sessions and in other sessions 0.25, 0.5, or 1.0 (for example, if $c = 0.25$, the decisive individual is charged 25 cents for imposing a tax of 10%, 50 cents for a tax of 20%, up to \$2.50 for a tax of 100%, which fully equalizes earnings among the other twenty subjects). Although it was impossible to totally eliminate comparisons between his or her own income and that of the other twenty subjects, we

[6] *Ex post* random selection of the dictator has the potential drawback that if subjects derive utility from expressing a preference that makes them feel good about themselves, they might be more likely to do this because their choice will have real effect with probability $1/21 \approx .047$ only. To discourage such thinking, we asked subjects to select taxes as if they were the decisive individual.

chose a base income at least equal to the group average for the decisive individual with the aim of moderating the salience of such concerns.[7] Subjects were told that the identity of the DI would never be revealed, an approach we adopted in order to eliminate worry over any direct social tension he or she might experience from anyone unhappy with the chosen *t*, as well as largely eliminating desire for social approval as a factor in decisions The DI's base income had a random element to make it difficult even for that individual to be sure s/he had been chosen—again to reduce worries about feelings of tension at the end of the session. We wanted each subject to focus as much as possible, when choosing tax rates, on the consequences for the others' earnings, and not on any consequences for their own social interactions with the others at the close of the experiment.[8] The tax cost *c*, like the efficiency loss α, was fixed for the session and its effects are thus studied by between-subject comparison.

Each subject chose one tax rate that would apply if individuals were assigned to pre-tax incomes randomly, a possibly different tax rate that would apply if pre-tax incomes were assigned according to the "where from" method, etc. We made the cost of taxing and redistributing income differs across sessions to permit analysis of the demand for redistribution as a costly good.

The other condition under which the decision on the tax rate might be made, called Experiment II, was designed to elicit potentially *self-interested* choices that can be contrasted with the disinterested choices of Experiment I. In this part of the experiment, each subject was again asked to select a tax rate to apply to each of the four methods of assigning individuals to pre-tax earnings levels, but this time on the understanding that if he or she was eventually selected as the DI and if Experiment II were randomly chosen as the one to be paid off on, his/her base income would be one of the twenty earnings levels shown in Table 1 and would be modified according to equation (1). Thus, a strictly self-interested subject, while choosing $t = 0$ in Experiment I, should choose $t = 1$ in Experiment II's choice for, say, the Tetris condition if she knows herself to be a very poor Tetris player. As in Experiment I, there was also a possible cost to the decisive individual per 10% of tax (0, 0.25, 0.50, 1.0), and potential administrative costs (0, 0.125, 0.25) of redistribution, which varied across sessions.[9] In a given session, these costs did not vary between Experiments I and II.

As part of the on screen instructions for Experiment I, which were read aloud so that all subjects were aware that they faced the same rules and procedures, subjects were told that there would also be an Experiment II and that which experiment payments would be based upon would be determined by a coin toss toward the end of the session.

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[7] A higher base income would reduce the likelihood of invidious comparisons with higher earners, but increase the likelihood of guilty comparisons with low earners. The impact of the choice of base income can be explored in future experiments.

[8] This also resembles the situation of a voter in an election, where ballots are cast in secret. Furthermore, we emphasized that choices would not be recorded under individuals' names, so that subjects' should not have felt constrained by concern over "how it would look to the experimenter."

[9] Since there are only twenty pre-tax incomes to which to assign subjects, one subject other than the PI was randomly chosen in Experiment II to be given an income in the \$19.80 to \$21.80 range, the range in which the PI's base income lies if Experiment I obtains.

At the end of the instructions, the subjects were invited to ask questions and then answered five multiple choice questions to test their comprehension of the procedures, making new choices if necessary until they answered all questions correctly. Each subject then chose four preferred tax rates for Experiment I, after which the nature of Experiment II was explained, questions were again invited, and subjects again took a comprehension test. Before choosing their four Experiment II tax rates, subjects also responded to questions about where they expected their pre-tax earnings to fall under each of the four earnings determination methods, and how confident they were about their guesses. They then chose the tax rates, took the 20 question Quiz, practiced the Tetris game (which used some unfamiliar pieces devised for the experiment) for two minutes, and played the Tetris game for five minutes.

After this, a coin was tossed to determine whether payments would be based on Experiment I or Experiment II. If Experiment II was chosen, each subject was shown how he or she actually ranked under each of the four earnings-determination methods, and all were given a chance to select new tax rates, which would substitute for their initial Experiment II choices. We label this set of choices Experiment II-Revised. There was no reconsideration stage if Experiment I was chosen.[10] Then two dice were rolled one after the other to determine the earnings-determination method, and a number was drawn from a hat or basket by one of the subjects to select the decisive individual.[11]

Finally, subjects were asked to make a series of choices between earning a dollar with certainty and participating in a lottery with a 50% probability of earning nothing and a 50% probability of earning a positive amount that increased from one question to the next - the amounts being $1.80 in the first choice, $2.00 in the second, $2.33 in the third, $2.67 in the fourth, and $3.00 in the fifth and last. This portion, dubbed Experiment III and not pre-announced to the subjects, contributed on average an extra $1.50 or about 6% to total earnings, and was included in order to generate an indicator of risk aversion. After completing it, subjects learned their earnings and the operative tax level, and answered a series of questions about their gender, area of study, socioeconomic background, political views, and views on inequality and taxation, while cash payments were counted out and handed to each at their seats. The instructions including the graphic interfaces seen by the subjects can be viewed at http://www.brown.edu/Research/IDE/walkthrough.[12] Chart 1 summarizes the sequence of the experiment.

[10] This is due to the likelihood that knowing her ranks would let the person chosen know he or she had been PI, when only the PI's income is uninfluenced by the tax

[11] Each of the four methods was assigned to one of the four possible outcomes {even, even}, {even, odd}, {odd, even} and {odd, odd}, where order as a possible differentiating factor. Twenty-one slips of paper were placed in the hat or basket, each containing a two digit ID number that the computer assigned randomly to each subject. Because the ID numbers bore no particular relation to seating, the number could be read aloud without revealing who the decisive individual was. The number drawing, coin toss, and dice rolling were used to make the randomness of the choices fully evident to the participants.

[12] This version of the instructions can be viewed by clicking the "Proceed" buttons at the bottom of each screen; no data need be entered to proceed.

In all, 336 undergraduates drawn from the full spectrum of subject areas at Brown University took part in 16 sessions, of which 4 used each possible tax cost, half with no administrative cost and a quarter with each of the two administrative costs (.125 and .25).[13] Table 3 summarizes the number of sessions and subjects as distinguished by the exogenous parameters c and α. All sessions took place in a computer lab capable of seating 24 students seated in four rows with some space between each pair of subjects. Because subjects were not drawn from particular classes, they were not likely to know one another before the sessions. Total earnings averaged about $26.30 in sessions without administrative cost and slightly less in sessions with such costs. To check the sensitivity of the results to the subject pool, additional sessions were conducted using a total of 55 adult subjects recruited from the surrounding community; details will be reported later.

2. Expectations and Interpretation

Before turning to the results, we prepare the ground with some observations on what we should expect based on standard economic theory and more general social and behavioral science, and remarks about potential interpretations of subjects' behaviors.

Experiment I investigates whether individual subjects prefer that earnings from a 90 minute session be distributed more equally than is pre-tax income in the United States. When there is no tax cost, taxing and redistributing the incomes of the other twenty subjects has no effect on the earnings of the decisive individual, so if the arguments in subjects' utility functions are limited to their own earnings and effort only, their choice of tax rates should be random. Under this condition, subjects' abilities to select a different tax rate for each of four alternative ways of determining pre-tax earnings is helpful, because statistically significant differences between the rates preferred for one method versus those preferred for another can be taken as evidence that subjects are not indifferent to how income is distributed among others. Subjects who care only about their own earnings should also be indifferent to the presence or absence of efficiency losses associated with taxation, since these affect the other twenty subjects only. If subjects in fact chose significantly lower tax rates in Experiment I when administrative charges were higher than they did when they are lower, this suggests that subjects are not indifferent to the earnings of others, and that they weigh both equality and efficiency when negotiating a trade off between those objectives (Charness and Rabin, 2002).

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[13] Subjects, among whom were 184 male and 151 female students (and one who failed to respond regarding gender), were recruited using an on campus job listing in an on-line magazine, the Brown Daily Jolt, and flyers placed in students' campus mailboxes. 13.7%, slightly more than their representation in the Brown student body, were studying economics as (one of) their concentration(s) (major(s)). Subjects could participate in one session only. The advertisements described the experiment as being conducted by experimenters in the Economics Department and aimed at "understanding aspects of decision-making." Prospective subjects were told that they would earn at least $5.11 and possibly as much as $106.00, with the average amount earned being about $25 and depending on own and others' choices and on luck. Care was taken to properly inform prospective subjects of the uncertainty of earnings without emphasizing the uncertainty so much that we would attract only risk takers or make those who chose to participate feel that their fellow participants "clearly knew the risks" and thus were "not entitled to earn more than the minimum."

Anticipating that a considerable number of subjects might show a preference for greater equality among others when this could be achieved at no cost, we introduced tax costs to investigate their willingness to pay for greater equality. If we ignore the possible concern of the decision-maker with the relationship between his own earnings and those of the other twenty participants, we can think of our data as potentially tracing out curves indicating the degree of equality (among others) demanded as a function of its price to the decision-maker. Among subjects for whom equality is a good, quantity demanded can be expected to increase as price falls.[14]

We introduced four methods of determining pre-tax earnings to test whether preferences for redistribution are sensitive to perceptions of whether differences are "earned" and hence "deserved". We conjectured that distributing earnings with approximately the same ordering as incomes of students' families would be perceived as least deserved and least fair, since it reinforces inequalities not due to efforts made by the recipients themselves. We expected inequalities generated randomly to be somewhat less objectionable, since each subject had an equal chance *ex ante* of winding up in each position. Nonetheless, subjects might consider it unfair that individuals who invested the same amount of time and effort in the experiment should earn quite different amounts of money (e.g. $5.11 versus $105.00, plus the $0 to $3 from lottery decisions). Finally, we thought that paying out earnings according to performance on a quiz or a computer game might be perceived as relatively fair, because outcomes could be perceived as reflecting each individual's efforts or skills. We included both a knowledge-based quiz and a game (arguably) of skill because we were unsure, and curious, which was more likely to be perceived as a reflection of merit.[15]

Unlike Experiment I, under the Experiment II condition for determining the tax rate, subjects have clear private interests provided that they can anticipate their ranks according to some of the criteria. When there is no tax cost or administrative charge, a strictly self-interested individual will choose a tax rate of 0 if she is sure of being among the seven highest earners (with pre-tax earnings above $19.80) and a tax of 100% if she is sure of being among the thirteen lowest earners (earnings below $19.80). If the subject has a hunch about her rank but is uncertain, risk aversion can be expected to be a factor in

[14] The decision-maker's comparison of his or her own expected earnings with those of the others introduces a complicating factor. It has been hypothesized, e.g. by Fehr and Schmidt (1999), that people tend to dislike more those inequalities that are disadvantageous to themselves (i.e., seeing others earn more than they do) than those that are advantageous (seeing others earn less than themselves). This raises the possibility that subjects in our experiment would favor high taxes because they bring their session's highest earners down toward parity with their own expected earnings, perhaps with little or no concern for bringing up the earnings of the lowest pre-tax earners. In sessions with a high enough tax cost, however, the price of bringing the earnings of the other twenty to parity at $19.80 is that the decisive individual herself must expect to earn considerably less—a base amount of $19.80 to $21.80 minus $10 for a tax of 100%. In these sessions, then, dislike of disadvantageous inequality is unlikely to explain large purchases of redistribution.

[15] Many rewards including admission to competitive colleges accrue to intellectual ability and its application, and the quiz score can be viewed as proxy for those traits. The computer game, on the other hand, can be likened to a task seen as calling for expenditure of effort, similar to the hash-mark game used by Hoffman and Spitzer (1985), or the proof-reading task used by Frohlich and Oppenheimer (1992). The impact of "deservingness" on distributive preferences is studied by Hoffman and Spitzer as well as Hoffman, McCabe, Shachat and Smith (1994).

her decision, whereas decisions in Experiment II-Revised provide a clean indication of the role of self-interest, independent of risk-aversion. Adjustments for tax and administrative charges are in principal straightforward. The tax decision with respect to the random method of determining earnings in Experiment II is of special interest, because while the decision-maker is directly affected by the outcome even when there is no tax cost or administrative charge, she has no basis for expecting to receive any particular ranking, so the decision is very much like that behind a Rawlsian "veil of ignorance," with both attitudes towards risk and beliefs about fairness possibly playing a role. More generally, any fairness concerns held with more than trivial strength can influence choices in Experiment II as in Experiment I, and we can in principal impute the weights given to fairness versus self-interest by contrasting each individual's choices in the two conditions.

Our way of generating a measure of risk aversion is a straightforward application of the von Neumann-Morgenstern expected utility model. According to that model, individuals may prefer either the certain option or the lottery depending on their degree of risk aversion (or love of risk), but looking at the choices in ascending order of the expected value of the lottery, the certain option should never be chosen once a lottery of lower expected value has been chosen. Among those whose decisions in Experiment 3 were consistent with this principle, the point at which they switched from certain to risky option offers a natural way of ranking the degree of risk aversion - the later the switch point, the more risk averse the individual.[16] We expect to see a positive correlation between the tax rate chosen under the random method in Experiment II and this risk aversion measure. There should likewise be a correlation between risk aversion and the tax rate for those lacking confidence in their estimates of their rank for the other methods of determining pre-tax earnings, in Experiment II. There is no reason why risk aversion should be related to tax choices in Experiment I, unless it happens to be the case that a taste for greater equality in society goes hand in hand with risk aversion, as has sometimes been suggested.

3. Results

Our main analysis is of the 16 experimental sessions in which all participants were undergraduates. These subjects appeared to have no difficulty understanding the instructions, and accordingly tax choices for each of the four earnings determination methods for both Experiments I and II were given by all subjects, as were revised choices for Experiment II in cases where the coin toss chose it (7 of 16 sessions). All but one subject also completed the debriefing questions which provide us with information about gender, ethnicity, socioeconomic background, political and philosophical views, and the Experiment III questions which help us to measure risk aversion. Of the 335 subjects completing these parts, 308 answered the risk-aversion questions consistently and 27 in an inconsistent fashion, that is they rejected a gamble with high expected value but accepted one with lower expected value. To keep the sample as large as possible, we

[16] Unfortunately, the experimental literature suggests that different ways of measuring risk aversion can produce measures that are inconsistent with one another, and there is no consensus on which measure is most reliable, or even on whether reliable measures of risk aversion can be obtained.

define a risk aversion measure, *riskav2*, which can be calculated for both consistent and inconsistent responders, carrying out each piece of analysis also for the 308 subject sample who replied consistently to check robustness.[17] Since the results turn out to be quite similar, we show below the analysis that uses *riskav2*, thereby preserving our ability to use the larger sample.

3.a. "Disinterested" tax choice: Experiment I

What, if any, demand is there for equalizing the distribution of earnings among 20 other subjects while leaving one's own earnings unchanged with the possible exception of a demand-indicating fee? Figures 1a and 1b are histograms showing the frequency of choices of taxes from 0 to 100% under each of the four methods for assigning individuals to earnings positions. In these figures, only treatments in which the effect of the tax is strictly redistributive (i.e., where there is no efficiency loss) are considered. To give an impression of sensitivity to cost, Figure 1 shows preferred taxes when it costs the chooser nothing (tax cost = 0) and Figure 2 shows choices when the chooser pays \$1 per 10% of tax.

According to Figure 1, the large majority of subjects are egalitarians, in the sense that all else being equal, they prefer that earnings are distributed more equally than the status quo, whichever rule determines income rank. When redistribution costs nothing to the DI, the percentage favoring some equalization of earnings ranges from 84% for the random method, to 76.2% if they're determined by performance in the Tetris game. Figure 2 shows that two-third to three-quarters of the subjects prefer some redistribution under each method of pre-tax income determination when it costs them \$1 per 10% of tax. (40.5% for random method, 50.0% for "where from" method, 33.3% for Tetris, 35.7% for Quiz) chose to pay \$5 or more for partial equalization, and 76.79% (80.9% for random method, 80.9% for where from method, 71.4% with Tetris, 73.8% with Quiz) chose to pay at least \$1 to at least slightly clip the highest earnings and bring up the lowest ones.

A check of average preferred tax (including now also sessions with positive efficiency losses) shows that subjects exhibit a greater desire to redistribute if the earnings of fellow subjects are determined randomly (average Experiment I preferred tax over all subjects: 49.3%) or based on where they are from (average tax: 45.1%) than if they are determined by performance on a quiz (37.3%) or Tetris game (37.6%). Wilcoxon matched pair tests for within-subject comparisons show that subjects were somewhat

[17] For the consistent answers, we define riskav1 as 0 if the subject always chose the lottery, 1 if they chose the lottery for the last 4 questions (where the expected value of the lottery is \$1 or more), 2 if they did so for the last 3 questions, 3 if for the last 2 questions, 4 if for the last question only, and 5 if they always chose the sure \$1. To define *riskav2* for both consistent and inconsistent responders, we consider that rejection of a lottery implies a greater degree of risk aversion the larger is the high outcome. Accordingly, we assign one point for rejection of a (0,\$1.80) lottery, 2 for rejection a (0,\$2.00) lottery, etc., up to 5 for rejection of a (0,\$3.00) lottery. We sum the points to get *riskav2*, which runs from 0 to a maximum of 15 for the consistent preference cases. An example of an inconsistent case is an individual who chooses the lotteries between 0 and \$2.00 and between 0 and \$2.67, but who otherwise takes the certain \$1. For such an individual, *riskav2* equals 1+0+3+0+5 = 9.

more likely to choose a higher tax for the random than for the "where from" method (two-tailed test *p*-value: .021), much more likely to choose a higher tax for the random or where from method than for the quiz or Tetris methods (*p*-values below .001 in all four comparisons), but there's no difference in tax choice between the Tetris and quiz methods (*p*-value: .276).

Figures 3 and 4 show comparisons of tax preferences under varying tax costs (Figure 3) and efficiency losses (Figure 4). The figures seem broadly consistent with the ideas that (a) redistribution is a conventional good, with quantity demanded being downward sloping in price, and that (b) subjects demand less redistribution the less is gained by the beneficiaries, due to increasing efficiency cost. Mann-Whitney tests, used for between-subject comparison, do not find significant differences in preferred tax as between subjects facing 0, 25, or 50 cent costs per 10% of tax, but they do find the preferred tax to be lower when the cost is $1 per 10% of tax than at 0, at 25 cents, or at 50 cents, significant at the 5% level or better in two-tailed tests. Mann-Whitney tests find no difference in preferred tax among those facing a 12.5% efficiency loss and those facing no efficiency loss, but a lower tax is preferred at a 25% than at a 12.5% efficiency loss, significant at the 10% level, and at a 25% versus a 0% efficiency loss, significant at the 5% level, both in two-tailed tests.

Further analysis of the effects of factors like the tax cost on subjects' preferred degree of redistribution when in the disinterested observer position is conducted by estimating a set of multiple regression equations using data from all sessions (see Table 4). A separate regression is run for the tax choice pertaining to each method of determining income ranks (random, tetris, etc.). Tax rate chosen by the individual is the dependent variable, and explanatory variables include tax cost (0,.25,.5, or 1), efficiency loss (0,.125,or .25), *riskav2* (our measure of risk aversion from Experiment III), a gender dummy (1 for female, 0 for male), ethnic/racial dummy variables,[18] the log of home area income (based on the average income of the participants' area or country of origin), self-assessed socioeconomic status (based on the respondent's answer to the question: "When you were growing up, were your parents …?" the possible answers being: poor, working class, middle class, upper middle class, rich), self-assessed *relative* socioeconomic status ("How does your family's level of affluence compare to others in the area you grew up in?", possible answers ranging from "below average" to "above average" on a 7-point scale), number of economics courses taken, and three self-reported indicators of political beliefs: political philosophy (ranging from "very liberal to "conservative" on a 7-point scale), attitude toward equality (ranging from "less equality" to "more equality" on a 7-point scale) and toward current redistribution (ranging from "too much redistribution" to "too little redistribution" on a 7-point scale). Both socioeconomic status and relative socioeconomic status are included to test the conjecture that views of inequality are influenced by status relative to those with whom one interacted most frequently.

For three of the four methods, tax cost turns out to be a negative determinant of the chosen tax rate, significant at the 5% level or better, with coefficients suggesting that

[18] Categories reported, and numbers in the subject pool, are white (213), Asian (58), black (25), Hispanic (21), other (18).

as the cost rises from 0 to $1 per 10% of tax, the preferred tax falls by between 6% (under the Quiz method) and 17% (under the random method). This is in line with the average preferred tax falling (for all methods) from 45.3% with a tax cost of 0, to 33.7% with a tax cost of $1. The coefficient on the efficiency loss variable is negative as expected but statistically significant only in the regression for the "where from" method. According to the point estimates, the preferred tax falls from 44.7% with no efficiency loss to 36.3% for an efficiency loss of 25%.

An interesting result is that the risk aversion measure is positively and significantly correlated with tax preference when income ranks are determined by the random and Tetris methods. When only those responding to Experiment III with consistent risk preferences are included and the alternative measure, *riskav1*, is used, the regression results are substantially the same. This result suggests a correlation between the preference for equality and the personal characteristic of risk-aversion.

After other factors are controlled for, gender does not have a significant effect on tax choice under the random and "where from" methods; however, females prefer higher taxes than males under the Quiz and Tetris methods, significant at the 1% level. When interpreting this result, it's important to note that males prefer substantially higher taxes under random and "where from" than under Quiz and Tetris, suggesting that they find inequalities resulting from task performance to be more acceptable. In contrast, the tax rates preferred by females are about the same in both cases. Thus, male and female subjects appear to have different attitudes about the degree to which relative performance confers rights to different earnings, a result that might help to explain the gender gap in U.S. politics.

The ethnic indicators have statistically insignificant coefficients in most of the estimates. There is a somewhat unexpected pattern of tax preferences under the random method, where the coefficients on black and Asian are significantly negative and positive, respectively.[19] But given the relatively small numbers in these minority groups, not much weight should be placed on this.

The number of economics courses taken is significantly negatively related to tax preference when earnings ranks are determined randomly or according to the "where from" method, which might be interpreted as evidence that egalitarians are less drawn than are others to the study of economics and/or that studying economics reduces ardor for taxation or equality.[20] However, no significant relationship appears in the other two cases.

Turning to socioeconomic status, while political-economy models that assume self-interest predict that those of higher socioeconomic status will want lower taxes,

[19] Asians tend to choose higher level of taxation than African-Americans (55.2% vs. 36% in the random method, 38% vs. 34% in the tetris method, 43.1% vs. 41.2% in the "wherefrom" method). This tendency holds for all methods but Quiz in which Asians tend to choose significantly lower tax rate than African-Americans (33.2% vs. 48.8%).

[20] Compare Frank, Gilovitch and Regan, 1993.

insofar as these affect them directly, there is no clear-cut prediction of a relationship between socioeconomic status and redistributive preference for the disinterested observer in Experiment I. On the one hand, those in higher social classes may carry a self-interested aversion to redistribution over into this quite different context; on the other hand, egalitarianism could be a taste that the rich can afford to indulge more ("*noblesse oblige*"). In the event, the regressions show no relationship between socioeconomic status and tax preference under the random and Tetris methods, but a significant negative relationship under "where from" and Quiz conditions, supporting the "carry over" idea. *Relative* socioeconomic status has a positive coefficient in the one case where it is mildly significant (under "where from," at exactly the 10% level); perhaps those used to being better off within their community came away with a distaste for inequality, at least when it is inherited.

The coefficients on the measures of political and ideological views potentially validate the view of egalitarianism as a preference and, at least as importantly, they provide welcome reassurance that the laboratory environment of our experiment succeeded in eliciting social preference information from which valid inferences at the more macro-social level might be made. A more liberal political philosophy is associated with a preference for higher taxes under three of the four methods, though it's statistically significant only under the random method when all three measures in this category are included. "Favor equality" likewise has positive coefficients in three of the four cases, significant in the cases of "where from" and Quiz. "Little redistribution" has positive coefficients in every case and is significant in two cases and just shy of significant at the 10% level in a third. Due to high correlations among the three measures, we also estimated variants of Table 4's regressions that contain only one of the three at a time, and in these cases (not shown), the coefficients on all three are always of the predicted sign and significant at the 5% level or better.

3.b Tax choice with personal interest and uncertainty: Experiment II initial decision

In their initial Experiment II choices, subjects selected a tax rate to apply to themselves and nineteen others under each of four earnings assignment methods, without exact knowledge of what their income ranks would be. Subjects could guess where they would rank in terms of the income of the place they grew up, performance on a general knowledge test (similar to the SAT II), and performance in a game of Tetris. Those confident of ranking relatively high (low) thus had a clear personal interest in having the tax be low (high), as do voters in general elections who have relatively high or relatively low incomes. If most subjects were confident of their rank estimates and voted self-interestedly, most choices should have been for either 0 or 100% tax rates. As in both Experiment I and real elections, subjects might also let their judgments about what is right or good for others or for society as a whole influence their decisions. And unlike the revised tax choices, which we look at in the next section, uncertainty could lead risk-averse subjects to prefer some redistribution. This should certainly have been the case under the random method of determining rank, where only those with strong beliefs about their luck would have an interest apart from risk and inequality preferences. Indeed, as mentioned earlier, Experiment II decisions under random distribution correspond to the philosophical idea of choice behind a veil of ignorance (Rawls, 1973; Harsanyi, 1977).

Figure 5 is a histogram of Experiment II tax choices that provides another visual comparison of preferences across the four methods of pre-tax income determination. (For brevity, we pool decisions under all tax costs and efficiency loss levels.) Because there are now selfish reasons for large numbers of subjects to favor some redistribution, it is no surprise that the preferred tax rate is somewhat higher than in Experiment I. However, the difference between Experiment II and Experiment I tax choices is modest. This time 14.25% of subjects selected tax rates of 100%, compared with an overall 13.96% in Experiment I. 46.42% of subjects, versus 44.18% in Experiment I, choose taxes of 50% or more. 79.03% of subjects, versus 76.42% in Experiment I, choose a tax of at least 10%.[21]

Looking only at cases where the tax cost is $1 per 10% (84 observations), as we did before, the numbers are 8.63% (versus 7.74% in Experiment I) for a tax of 100%, 38.69% (versus 34.82% in Experiment I) for a tax of 50% or more, and 72.02% (versus 69.94 % in experiment I) for a tax of 10% or more.

Table 5 presents regressions analyzing the choice of tax in Experiment II as a function of preferences for equality measured by one's Experiment I tax choice (*tax I*), tax cost, efficiency loss, a self-interest measure termed 'costliness,' and three measures related to risk aversion and confidence in one's guess of one's own rank. *Costliness* refers to the expected personal cost of a higher tax, and is measured in such a way that it increases linearly with the earnings category the subject predicts he or she will be in for the earnings assignment method in question (the higher one's expected earnings rank, the less one benefits from redistribution; see the appendix for details). *Lack confidence* takes the value 0 if the subject reported being 'quite confident' of his/her guess about rank, 1 if he/she answered 'somewhat confident', and 2 if 'not at all confident.' Logically, more risk-averse individuals should prefer more redistribution the less confident they are about their position on the income scale, so we also include an interaction term between *riskav2* of *lack confidence*, as well as entering *riskav2* as a variable in its own right. Because subjects had no basis for guessing their ranks under the random method, we did not ask

[21] In Experiment II the percentage of individuals choosing a tax rate of 100% is 19.40 for the "where from" method (compared to 19.10% in Experiment I), 22.09% for the random method (compared to 19.10% in Experiment I), 8.95% for the quiz method (compared to 9.25% in Experiment I) and 6.57% for the Tetris method (compared to 8.36% in Experiment I). The percentage of individuals choosing a tax rate of 50% or more is 48.06% for the "where from" method (compared to 47.46% in Experiment I), 61.19% for the random method (compared to 54.93% in Experiment I), 40.30% for the quiz method (compared to 36.72% in Experiment I) and 36.12% for the Tetris method (compared to 37.61% in Experiment I). The percentage of individuals choosing a tax of at least 10% is 74.03% for the "where from" method (compared to 75.52% in Experiment I), 86.87% for the random method (compared to 80.00% in Experiment I), 80.30% for the quiz method (compared to 75.82% in Experiment I) and 74.93% for the Tetris method (compared to 74.33% in Experiment I).

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them to guess their ranks under that method so it is not analyzed in Table 5. Instead, we show a regression for decisions under all three methods, pooled.

With respect to the issues motivating our research, the core variables in the regressions are *costliness*, an indicator of self-interest, and *tax I*, an indicator of preference for equality as a social good. Both variables have the expected sign and are highly significant in all regressions, supporting the supposition that both self-interest and social preferences receive some weight. We use two methods to get a sense of how important each is relative to the other. First, we compare the magnitudes of the effects of one standard deviation changes in each variable. Based on the all methods regression, a one standard deviation increase in *costliness* decreases the preferred tax by 9.9% while a one standard deviation change in *tax I* changes it by 21.2%.[22] Our second way of assessing the relative importance of the two factors is to estimate the regression without one, the other, or both variables, and compare R-squared, which can be viewed as measuring the explained portion of the variation in the dependent variable—sometimes called a "leverage analysis" (see Table 6). In the all methods regressions, R-squared is 0.042 with neither variable, 0.279 adding *costliness* but not *tax I*, 0.536 adding *tax I* but not *costliness*, and 0.609 (as in Table 5) when both are included. Both methods lead to the same conclusion: a one standard deviation change in *tax I* has about twice as much impact on *tax II*, and adding *tax I* alone explains about twice as much of the still unexplained variance in *tax II* as does adding *costliness* alone, so it seems that the disinterested preferences for redistribution, measured by *tax I*, is more important than the personal costliness of redistribution in the Experiment II environment where own interest is given a role to play. (Leverage analysis for the individual methods are similar and are shown in table 6.) Of course, there is the possibility that our experimental design influenced the result: each subject submitted her four Experiment I choices less than ten minutes before submitting her four Experiment II decisions, and subjects might have experienced cognitive dissonance when changing their tax preferences. So the result must be treated with caution.

Turning to the other variables, the direct cost of the tax to the decisive individual (*Tax Cost*) has inconsistent signs and is not significant in any of Table 5's regressions, but the Efficiency Loss has its expected negative sign in all regressions and is significant at the 5% level in the combined regression and at the 10% level in the regression for the preferred tax under Tetris. Risk aversion (measured by *Riskav2*) has the predicted positive sign and is significant at the 5% level in the combined regression and in the "where from" only regression. Lack of Confidence is associated with a preference for more redistribution according to three of the four regressions, significant at the 5% level in the "where from" regression and at a little short of the 10% level in the combined regression. The coefficient on the interaction between *riskav2* and Lack of Confidence is not significant in any of the regressions. But on the whole the results are consistent with the desire not to sacrifice earnings when redistribution entails a large efficiency cost, and

[22] Method by method, the corresponding results are 15.9 % for *costliness* versus 20.8% for *tax rate I* under the "where from" method; 7.4% for *costliness* versus 19.8% for *tax rate I* under Tetris; and 4.6% for *costliness* versus 22.7% for *tax rate I* under the Quiz method.

to reduce the risk of a low outcome by redistributing earnings when one is risk averse or has a less clear sense of where one will fall within the pre-tax earnings distribution.

3.c. Tax choice with fully known interests: Experiment II-Revised

The revised decision on the Experiment II tax presents the purest opportunity for the expression of self-interest, since it is made after learning of one's precise rank according to each of the four methods of earnings assignment. Risk aversion has no direct relevance, and a strictly self-interested subject should choose either a 100% tax or a 0% tax, depending on his or her rank under the particular earnings method. Deviation towards redistribution by those whose earnings would be maximized by a 0% tax must reflect concern for lower earners or a preference for equality, while downward deviation by one whose self-interest favors a 100% tax suggests a belief that the higher incomes are rightfully earned or deserved (most plausible in the Quiz and Tetris conditions) or some other source of reluctance to alter the unequal earnings pattern.

Figure 4's histogram of revised tax preferences indeed shows a considerable shift toward 0 and 100% outcomes, consistent with a predominance of self-interest. Calculating the earnings-maximizing tax choice for each subject under each assignment method, taking into account the effects of tax and administration costs on own earnings, we find that a little under a third of subjects (31.6% overall, 27.9% under the random method, 32.7% under "where from," 33.3% under Tetris and 32.7% under Quiz) chose a tax rate that did not maximize his or her own earnings.

The regressions in Table 7 nevertheless show statistically significant influence on tax choices of the other-regarding or social preferences driving *tax I* choices. The three risk- and confidence-related terms included in Table 5's regressions are excluded from these regressions, given the resolution of uncertainty. *Costliness*, which captures most of the own-earnings concern, continues to do so in a nuanced way, since it measures not simply whether 0% or 100% is most favorable to the subject (abstracting from tax and administrative cost, which are represented in the regression by their own controls), but how costly (rewarding) it is to move to a higher (lower) tax (that is, while an individual in the 7^{th} highest earning position is better off with 0% than with 100% tax - earning \$20.62 instead of \$19.80 - the earnings difference for such a subject is very small compared to that for an individual in the highest earning position, who earns \$100.00 with no tax versus \$19.80 with 100% tax; see Table 2).

As in Table 5, the coefficient on *Tax I* is positive and significant at the 1% level for the combined regression and in the regression for the choice under each individual method except Tetris where, interestingly, it is quite insignificant, suggesting that this game conferred considerable entitlement to earnings in the minds of our subjects. Using again the two approaches applied in the previous section to assess the relative weights given to self-interest and to social preferences, we find that based on the combined regression, a one standard deviation decrease in *costliness* decreases the preferred tax by

31.3% while a one standard deviation change in *Tax I* changes it by 6.4%.[23] Using the leverage method, in the combined regressions, R-squared is 0.004 with neither variable, 0.519 adding *costliness* but not *tax I*, 0.064 adding *tax I* but not *costliness*, and 0.538 when both are included. Since adding *costliness* alone explains about eight times as much of the still unexplained variance as does adding *tax 1* alone, it seems that in the revised Experiment II tax choices, interest in one's own payoff is a far more important factor than interest in a fair distribution. Results for the tax preferences for each individual earnings-determination method are similar and are shown in table 8. The reversal of the relative importance accorded to social preferences versus individual interest, when moving from the original to the revised Experiment II choices, suggests that the importance of social preferences to the original decisions was greatly influenced by uncertainty about earnings positions.

3.d. Experiments with non-student subjects

We conducted experiment sessions with adult residents of the Providence area to obtain indications of whether the results reported above may be peculiar to our student subject pool. Because it proved difficult to recruit sufficient numbers of subjects, three of the four sessions with non-student subjects had fewer than 21 subjects.[24] To make the sessions as similar as possible to those with student subjects, those present were therefore randomly assigned to ranks between 1 and 21 so that the spectrum of pre-tax incomes and the basic shape of the pre-tax income distribution would remain roughly the same. The non-student sessions were otherwise the same as those using student subjects except that a) a simpler game, Pacman, was substituted for Tetris, b) subjects were asked for their incomes (without knowing how the information would be used), and the rank-order of these was used instead of the "Where From" method, c) we substituted simpler reading comprehension questions for the general knowledge quiz, and d) to the four pre-tax income determination methods or their counterparts we added a fifth method in which pre-tax incomes were inversely rather than directly related to the rank order of own income. Also, in two of the four sessions, average payout for the main portion of the

[23] Looking at the decisions method-by-method, the corresponding results are 29.10 % for *costliness* versus 7.71% for *tax I* under the "where from" method; 33.42% for *costliness* versus 0.96% for *tax I* under Tetris; and 29.83% for *costliness* versus 7.21% for *tax I* under the Quiz method; 34.08% for *costliness* versus 10.04 % for *tax I* under the Random method.

[24] The first session, N1, attracted 15 non-student subjects. For our second attempt, session N2, we attracted only 10 non-student subjects but added 11 student subjects to fill the session. Subjects did not know one another's backgrounds (who were and who were not students). The discussion in this section considers the choices of the 10 non-students in the N2 session, only; the 11 student observations are not analyzed either here or elsewhere in the paper. For sessions N3 and N4, we attempted to boost recruiting by raising expected earnings by 100%, but we still obtained only 17 and 13 subjects, respectively. Parameters for these sessions were: N1, tax cost = $0.50 per 10% of tax; N2, tax cost = $0.25 per 10% of tax; N3, tax cost = $1 per 10%; N4, tax cost = $0.50 per 10%. All of the sessions had zero efficiency loss. Subjects were recruited by placing classified advertisements under general employment opportunity in a print and on-line newspaper, the *Providence Phoenix*, and inviting interested individual to sign up on line for a one-time opportunity to participate in an experiment and earn $5 to $103 (or $10 to $206), with earnings averaging $25 ($50) and exact earnings depending on own and others' choices and luck. A few subjects turned out to be students at other local institutions but the large majority were not students and were beyond university age.

experiment was increased from $25 to $50 in a (largely unsuccessful) effort to attract more participants.

Given the small samples involved, we will not report detailed analysis of these sessions. The main thing we want to report is that Mann-Whitney tests fail to find significant differences between the tax choices of student and non-student subjects for most pre-tax income determination methods and most tax costs. Just as many adult subjects as students, although attracted to the experiment by the prospect of earning some money and having been informed in advance that earnings could vary sharply from participant to participant, were willing to reduce their own earnings to cause earnings to be distributed more equally among the others in their session. For example, four of fifteen subjects in one session were willing to pay $5 in Experiment I to equalize the earnings of the other 14 subjects if earnings would otherwise be determined by subjects' incomes outside of the experiment; in another of the sessions, in which taxes cost $1 per 10%, three of seventeen subjects were willing to pay up to $10 for full equalization in the same condition, while another five subjects were willing to pay $5 to $7 to tax and redistribute 50 to 70% of the pre-tax earnings of their fellow subjects. Like the student subjects, the non-students tended to choose lower taxes in the event that pre-tax earnings were based on quiz or computer-game performance than when they were determined randomly or by income. Curiously, there is no systematic difference in the average preferred tax under inverse income determination versus under direct income determination, although there's some tendency for those individuals preferring high taxes under one condition to prefer low taxes under the other. Non-student subjects' tax choices responded to differences in tax cost in the same way as did those of students. Finally, subjects tended to prefer higher taxes in the sessions with higher stakes—evidence consistent (in view of the still larger stakes involved in real world tax choices) with the idea that our results may have external validity.[25]

4. Can Redistribution Increase Social Welfare?

The question that our experiment was intended to help us answer is to what extent fiscal redistribution in a politically democratic industrialized market economy can be understood as increasing welfare quite generally, due to a social preference for greater equality, versus representing the self-interested expropriation of a richer minority by the poor and middle income majority. Not too surprisingly, the experiment supports the view that self-interested expropriation and disinterested preferences for equality *both* play some part in explaining why redistribution occurs. When redistributing income is without cost to them, about 80% of our subjects choose to reduce the inequality of earnings among 20 fellow subjects relative to the kind of pre-tax income inequality that exists among U.S. citizens. And subjects' pro-egalitarian preferences appear to be unrelated to their socioeconomic statuses outside of the lab. This portion of the experiment thus suggests fairly broad support for greater equality.

[25] We don't wish to base strong claims on this subject pool. Not only is it small, but fewer of the subjects appear to have well-paying full time jobs than might a general cross section of the adult population. Also, Replications with larger, more representative subject pools in multiple locations would therefore be desirable.

When subjects' immediate private interests conflict with their disinterested preferences regarding inequality, in our experiment, they place more weight on their own interest the more certain they are of it, but concern about others' incomes or about the pattern of inequality continues to influence their choices to some extent, especially when the method of determining earnings is not viewed as conferring entitlement.

If there is unanimous agreement (even among those with higher pre-tax incomes) that income should be distributed more equally, then taxing and redistributing income can be Pareto-improving.[26] But what if a majority favors some redistribution and a minority prefers that there be none? To say whether "society" is better off redistributing, and how much redistribution is best, then requires some way of aggregating the well-being of different individuals. To illustrate, we conduct an exercise assuming a specific cardinal form of utility function that can be calibrated from our data to determine what level of redistribution maximizes additive welfare.

Suppose that each individual's utility is a function of his/her post-tax-and-transfer income and of the degree of equality of the earnings distribution within a society that includes him/her.

$$U_i = f(y_1,y_2,\ldots,y_i,\ldots,y_n).$$

More specifically, let i's utility be additive in her income and in some function h_i of the equality of the distribution of incomes:

$$U_i = y_i + h_i((y_1,y_2,\ldots,y_i,\ldots,y_n)$$

Because the pattern of earnings in our experiment is completely determined by the chosen level of the tax parameter t, we can conveniently write:

$$U_i = y_i + h_i(t)$$

where the function h_i and thus U_i is assumed to be increasing in the degree of equality, and thus in t. Note that function h_i can vary, so that for some individuals $t = 0$ might maximize utility. In Experiment I, expected income $E(y_i) = \$20.80 - ct$, with c being the tax cost parameter 0, 0.25, 0.5 or 1.0. Hence,

$$U_i = \$20.80 - ct + h_i(t),$$

so i's utility is maximized where $d\,U_i/dt = 0$, i.e. where

$$c = h'(t) = \partial h_i/\partial t$$

[26] While it might appear that redistribution could be implemented by voluntary transfers, there is still scope for collective choice and action in this case, because individuals may prefer that transfers be made as long as others participate, but not otherwise. Leaving it to each high income individual to transfer money to some low income individual might not suffice, in this case. See Sen, 1967.

Suppose, for simplicity, that $h_i(t)$ is concave in t and has the form $h_i(t) = a + \beta_i t + \delta_i t^2$ where $\beta > 0$ and $\delta < 0$ are individual-specific constants. Then, the value of t at which an individual's utility is at its maximum is that at which

$$t = (c/2\delta_i) - (\beta/2\delta_i)$$

While we cannot recover the precise utility functions of our subjects, values of β and δ can be imputed to each individual *i* if we assume that these parameters are a continuous function of the characteristics or preferences that they reported in the experiment. As an example, assume that both β_i and δ_i can be predicted by responses to the exit survey question about favoring equality (for convenience F_i). Assume further that $\beta_i = bF_i$ and $\delta_i = dF_i$., where b and d are scalars.

Then each utility-maximizing individual should choose t so that

$$t = c/2dF_i - b/2d$$

and we can identify the best-fitting values of b and d by estimating the regression equation

$$t = \alpha_0 + \alpha_1(c/2F_i) + \varepsilon_i$$

where $\alpha_1 = 1/d$, $\alpha_0 = -b/2d$, and ε_i an i.i.d. error. There is no difficulty solving for b and d given that c is a known parameter.

With estimates of b and d in hand, we can compute estimates of β_i and δ_i for each individual using the sample-wide estimates of the b and d and each individual's response F_i. To find the tax rate which maximizes additive social welfare $\sum U_i = \sum\{y_i + h_i(t)\} = \sum\{y_i + a + \beta_i t + \delta_i t^2\} = \sum\{y_i + a + bF_i t + dF_i t^2\}$, we carry out a computer search over all values of t for the one at which this sum is at its maximum.

Using all four Experiment I tax choices of all 335 subjects for whom the data are complete, we obtain the regression estimate

$$t = 0.504 - 0.1325\ (c/2F_i)$$

which implies that $b \approx 7.6075$ and $d \approx -7.54717$. The estimates of α_0, α_1 and hence of b and d based on tax preferences for each earnings determination method taken individually are presented in table 9. The aggregate utility maximizing tax under the conditions of Experiment I turns out to be approximately 0.43 (a 43% tax rate) under Tetris and Quiz determination of pre-tax incomes and 0.56 under Random and "Where From" determination.

Actual redistribution of income through the U.S. fiscal system doesn't conform exactly to potential outcomes in the experiment, since tax rates vary by income bracket (rather than being a constant proportion for all), only a fraction of taxation is redistributed in the form of benefits to individuals or households, and government expenditures are somewhat progressive, rather than going equally to all. Nonetheless, we can get a sense of the degree of redistribution by using one of various inequality measures on a pre- and post-tax basis. Using for an initial exercise the Gini coefficient, which ranges from 0 for complete equality to 1 for maximum inequality, the inequality of the pre-tax distribution of income among U.S. adults based on the data in Table 1 is 0.512, although at the household level, the Census Bureau reported a Gini coefficient of 0.456 for 1998. If 43% of pre-tax incomes were taxed and then distributed equally, in our experiment, the Gini coefficient would fall from 0.512 to 0.292. If 56% were taxed, as seems to be additive social welfare maximizing when pre-tax inequalities are not seen as "earned," based on our subjects' choices in the Random and "Where From" conditions, the Gini coefficient of the resulting distribution would be 0.225. The Census Bureau says the Gini coefficient for post-tax income distribution among households was 0.430 in 1998. This rough exercise is thus sufficient to permit us to conclude that maximizing the additive social welfare of our subject population, based primarily on their pure or social preferences for greater equality, would require more, and not less, progressive taxation and governmental redistribution than characterizes the United States today, but perhaps a similar level to that of Sweden, which had a Gini coefficient of 0.250 around 2002, according to the World Bank.

Reduction of extreme differences in income may be a way of improving the sense of well-being of the large majority of a country's population, because of widespread preferences for equality, possibly based on moral beliefs, possibly on beliefs that it is good for social cohesion, peace, and stability. But policy conclusions can't be drawn directly from our research in its current state. Larger and more representative samples of individuals need to be studied. Alternative techniques of assessing the data, using other representations of individual utility functions and other measures of income distribution, are also needed. Calculations must also be made based on decisions in Experiment II, where subjects' selfish and social interests may clash. More care is required in going from data on inequality among individuals to conclusions regarding inequality among households. And most importantly, more complete assessments need to take into account the incentive impact of higher taxation, something that this particular project was not meant to evaluate.

We close with three principal conclusions. First, laboratory decision-making experiments hold promise of helping economists to assess the sources and strength of preferences for altering the market distribution of income through the fiscal system. Second, our experiment provides evidence that "social preferences" for "fairness" in small-group interactions carry over into large-group settings. Third, at least part of the demand for redistributive taxation derives from widely shared preferences for greater post-tax equality. Thus, the efficiency cost that taxes and public-assistance programs impose on society by distorting incentives appears to be partly offset by increased welfare owing to a more equitable and perhaps socially stable distribution of income. This means that eliminating public redistribution would not necessarily increase efficiency, understood in its full sense. The best way that economists can assist in increasing society's well-being may be to identify less wasteful and less incentive-dampening ways to reduce income disparities, rather than automatically calling for less redistribution on grounds that it hurts the economy.

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Table 1.
Incomes of U.S. Individuals,
and Possible Experiment Earnings.

$166	$0.11
$2,383	$1.51
$4,878	$3.10
$6,792	$4.31
$8,699	$5.53
$10,715	$6.81
$12,818	$8.14
$15,052	$9.56
$17,525	$11.13
$20,028	$12.72
$22,795	$14.48
$25,637	$16.29
$28,991	$18.42
$32,458	$20.62
$36,697	$23.31
$41,776	$26.54
$48,516	$30.82
$57,538	$36.55
$72,488	$46.05
$157,423	$100.00

Note: left column numbers are U.S. Bureau of the Census data for pre-tax income by ranked twentieths of population. Right column numbers are subjects' pre-tax and transfer-earnings from Experiment I or 2. Subjects also earned $5 for participation and $0 to $3 from Experiment 3.

Table 2. Subject earning levels in Experiment I under different values of tax *t*.

T = 0	*t* = .1	*t* = .2	*t* = .3	*t* = .4	*T* = .5	*t* = .6	*t* = .7	*t* = .8	*t* = .9	*t* = 1
0.11	2.07	4.04	6.01	7.98	9.95	11.92	13.89	15.86	17.83	19.80
1.51	3.34	5.17	7.00	8.83	10.66	12.49	14.31	16.14	17.97	19.80
3.10	4.77	6.44	8.11	9.78	11.45	13.12	14.79	16.46	18.13	19.80
4.31	5.86	7.41	8.96	10.51	12.06	13.61	15.15	16.70	18.25	19.80
5.53	6.95	8.38	9.81	11.24	12.66	14.09	15.52	16.95	18.37	19.80
6.81	8.11	9.41	10.70	12.00	13.30	14.60	15.90	17.20	18.50	19.80
8.14	9.31	10.47	11.64	12.81	13.97	15.14	16.30	17.47	18.63	19.80
9.56	10.59	11.61	12.63	13.66	14.68	15.70	16.73	17.75	18.78	19.80
11.13	12.00	12.87	13.73	14.60	15.47	16.33	17.20	18.07	18.93	19.80
12.72	13.43	14.14	14.85	15.55	16.26	16.97	17.68	18.38	19.09	19.80
14.48	15.01	15.54	16.08	16.61	17.14	17.67	18.20	18.74	19.27	19.80
16.29	16.64	16.99	17.34	17.69	18.04	18.39	18.75	19.10	19.45	19.80
18.42	18.55	18.69	18.83	18.97	19.11	19.25	19.38	19.52	19.66	19.80
20.62	20.54	20.45	20.37	20.29	20.21	20.13	20.05	19.96	19.88	19.80
23.31	22.96	22.61	22.26	21.91	21.56	21.20	20.85	20.50	20.15	19.80
26.54	25.86	25.19	24.52	23.84	23.17	22.49	21.82	21.15	20.47	19.80
30.82	29.72	28.61	27.51	26.41	25.31	24.21	23.11	22.00	20.90	19.80
36.55	34.87	33.20	31.52	29.85	28.17	26.50	24.82	23.15	21.47	19.80
46.05	43.42	40.80	38.17	35.55	32.92	30.30	27.67	25.05	22.42	19.80
100.00	91.98	83.96	75.94	67.92	59.90	51.88	43.86	35.84	27.82	19.80

Table 3. Number of sessions and subjects (in parentheses) by tax cost and administrative charge.

		Administrative Charge (Efficiency Loss)		
		None	1/8	¼
Cost per 10% of Tax to Decisive Individual	0	2 (42)	1 (21)	1 (21)
	0.25	2 (42)	1 (21)	1 (21)
	0.50	2 (42)	1 (21)	1 (21)
	1.00	2 (42)	1 (21)	1 (21)

TABLE 4. EXPERIMENT I - DETERMINANTS OF TAX RATE

Dependent Variable: tax rate

Independent variables	Where From (1)	Random (2)	Quiz (3)	Tetris (4)
Constant	0.2430 (0.1544) *p* = 0.117	0.1622 (0.1477) *p* = 0.273	0.1340 (0.1286) *P* = 0.298	0.0119 (0.1343) *p* = 0.929
Tax Cost	-0.1398*** (0.0531) *p* = 0.009	-0.17001*** (.05083) *p* = 0.001	-0.0681 (0.0442) *P* = 0.125	-0.1132** (0.0462) *p* = 0.015
Efficiency Loss	-0.4187** (0.1915) *p* = 0.030	-0.1947 (0.1833) *p* = 0.289	-0.2182 (0.1595) *p* = 0.172	-0.1173 (0.1665) *p* = 0.482
Risk Aversion (riskav2)	0.0051 (0.0049) *p* = 0.293	.0082* (.0047) *p* = 0.081	0.0030 (0.0041) *P* = 0.457	0.0079* (0.0042) *p* = 0.066
Gender	0.0595 (0.0412) *p* = 0.150	0.0030 (0.3947) *p* = 0.939	0.1534*** (0.0343) *P* = 0.000	0.1513*** (0.0358) *p* = 0.000
Asian	0.0188 (0.0540) *p* = 0.728	0.0975* (0.0517) *p* = 0.060	-0.0191 (0.0450) *P* = 0.670	0.03413 (0.0469) *p* = 0.468
Black	-0.1292 (0.0803) *p* = 0.109	-0.1663** (0.0769) *p* = 0.031	0.0450 (0.0669) *P* = 0.501	-0.0549 (0.0698) *p* = 0.433
Hispanic	0.0660 (0.0839) *p* = 0.432	-0.0166 (0.0803) *p* = 0.836	-0.0816 (0.0699) *p* = 0.244	-0.0514 (0.0730) *p* = 0.482
Socioeconomic Status	-0.0871*** (0.0285) *p* = 0.002	0.0005 (0.0273) *p* = 0.983	-0.0559** (0.0237) *p* = 0.019	|0.0188 (0.0248) *p* = 0.448
Relative Socioeconomic Status	0.0307* (0.0186) *p* = 0.100	-0.0051 (0.0178) *p* = 0.775	0.0138 (0.0155) *p* = 0.373	0.0021 (0.0162) *p* = 0.897
# of Economics Courses Taken	-0.0074 (0.0093) *p* = 0.423	-0.0155* (0.0089) *p* = 0.083	0.0072 (0.0077) *p* = 0.350	0.0012 (0.0081) *p* = 0.875

Political Philosophy (Cons. to Lib.)	0.0007 (0.0177) p = 0.967	0.02970* (0.0170) p = 0.082	-0.001 (0.0148) p = 0.916	0.0159 (0.0154) p = 0.303
Favor Equality (Less to More)	0.0388* (0.0227) p = 0.089	0.03058 (0.0218) p = 0.162	0.0383** (0.0189) p = 0.044	-0.0068 (0.0198) p = 0.729
Too Little Redistribution (Too Much to Too Little)	0.0429** (0.0196) p = 0.029	0.0210 (0.0187) p = 0.264	0.0265 (0.0163) p = 0.105	0.0403** (0.0170) p = 0.019
R-squared	0.159	0.138	0.174	0.137
Observations	335	335	335	335

Note: OLS regressions. Dependent variable is the individual's tax choice under the income determination method indicated by the column heading. Numbers in parentheses are random errors; p's are levels of significance of t-tests of each coefficient.

TABLE 5. DETERMINANTS OF EXPERIMENT 2 TAX RATE

Independent variables	Dependent Variable: Exp. 2 Tax rate			
	All Methods (1)	Where From (2)	Quiz (3)	Tetris (4)
Constant	0.3687 (0.0332) *p* = 0.000	0.4472 (0.0543) *p* = 0.000	0.2664 (0.0596) *p* = 0.000	0.3165 (0.0628) *p* = 0.000
Tax I	0.6109 (0.0213) *p* = 0.000	0.5449 (0.0365) *p* = 0.000	0.7050 (0.0361) *p* = 0.000	0.6044 (0.0384) *p* = 0.000
Tax Cost	-0.0041 (0.0183) *p* = 0.823	0.0027 (0.0344) *p* = 0.938	0.0079 (0.029) *p* = 0.788	- 0.0060 (0.0307) *p* = 0.846
Efficiency Loss	- 0.1562 (0.0657) *p* = 0.018	- 0.1033 (0.1245) *p* = 0.407	-0.1322 (0.1055) *p* = 0.211	- 0.1814 (0.1091) *p* = 0.097
Costliness	- 0.0219 (0.0016) *p* = 0.000	- 0.0293 (0.0025) *p* = 0.000	- 0.0122 (0.0029) *p* = 0.000	- 0.0182 (0.0031) *p* = 0.000
Risk Aversion	0.0069 (0.0033) *p* = 0.037	0.0129 (0.0055) *p* = 0.020	-0.0005 (0.0061) *p* = 0.932	0.0062 (0.0056) *p* = 0.271
Lack of Confidence	0.0324 (0.0202) *p* = 0.109	0.0701 (0.0351) *p* = 0.047	- 0.0072 (0.0367) *p* = 0.845	0.0384 (0.0345) *p* = 0.266
Risk Av.* Lack of Confidence	- 0.0047 (0.0031) *p* = 0.138	- 0.0117 (0.0056) *p* = 0.273	0.0039 (0.0055) *P* = 0.474	- 0.0043 (0.0053) *p* = 0.424
R-squared	0.610	0.645	0.611	0.589
Observations	1005	335	335	335

TABLE 6. EXPERIMENT 2 - LEVERAGE ANALYSIS

	Dependent Variable: Experiment 2 tax rate			
	All methods	Where From	Quiz	Tetris
R^2 without *Tax rate I* and *Costliness*	0.0424	0.0229	0.0479	0.084
R^2 with *Tax rate I* but without *Costliness*	0.5358	0.4876	0.5895	0.543
R^2 with *Costliness* but without *Tax rate I*	0.2787	0.3949	0.1422	0.2709
R^2 with both *Tax rate I* and *Costliness*	0.6081	0.6397	0.6094	0.586
Observations	1005	335	335	335

Note: Based on OLS regressions all of which include the other variables included in the regressions of Table 5.

TABLE 7. DETERMINANTS OF EXPERIMENT 2 REVISED TAX RATE

Independent variables	Dependent Variable: Exp. 2 Revised Tax rate				
	All Methods (1)	Random (2)	Where From (3)	Quiz (4)	Tetris (5)
Constant	1.0450 (0.0376) *p* = 0.000	1.0293 (0.0653) *p* = .000	0.9873 (0.0860) *p* = 0.000	0.9670 (0.0760) *p* = 0.000	1.1891 (0.0753) *p* = 0.000
Tax I	0.1848 (0.0375) *p* = 0.000	0.2893 (0.0644) *p* =0.000	0.2051 (0.0773) *p* = 0.009	0.2270 (0.0856) *p* = 0.009	0.0298 (0.0805) *p* = 0.712
Tax Cost	-0.0056 (0.0305) *p* = 0.853	0.0343 (0.0532) *P*= 0.521	- 0.0529 (0.0665) *p* = 0.428	0.0223 (0.0643) *p* = 0.729	- 0.0317 (0.0603) *p* = 0.600
Efficiency Loss	- 0.2022 (0.1164) *p* = 0.083	- 0.4314 (0.2027) *p*= 0.035	- 0.0633 (0.2531) *p* = 0.803	- 0.0090 (0.2470) *p* = 0.971	-0.2868 (0.2279) *p* = 0.210
Costliness	- 0.0517 (0.0021) *p* = 0.000	- 0.0561 (0.0036) *p*= 0.000	- 0.0479 (0.0046) *p* = 0.000	- 0.0491 (0.0044) *p* = 0.000	- 0.0550 (0.0042) *p* = 0.000
R-squared	0.5383	0.654	0.492	0.4879	0.565
Observations	588	147	147	147	147

TABLE 8. EXPERIMENT 2 REVISED - LEVERAGE ANALYSIS

	Dependent Variable: Experiment 2 Revised tax rate				
	All methods	Random	Where From	Quiz	Tetris
R^2 without *Tax rate I* and *Costliness*	0.0044	0.0156	0.0076	0.0010	0.0057
R^2 with *Tax rate I* but without *Costliness*	0.0644	0.0791	0.1126	0.0469	0.0438
R^2 with *Costliness* but without *Tax rate I*	0.5191	0.6044	0.4669	0.4626	0.5642
R^2 with both *Tax rate I* and *Costliness*	0.5383	0.6536	0.4921	0.4879	0.5647
Observations	588	147	147	147	147

Note: Based on OLS regressions all of which include the other variables included in the regressions of Table 5.

TABLE 9. ESTIMATES OF PARAMETERS b and d

	α_0	α_1	b	d
All methods	0.504	- 0.1325	7.6075	- 7.54717
Random	0.596	- 0.226	5.275	- 4.425
Where From	0.550	- 0.112	9.821	- 8.929
Tetris	0.443	- 0.128	6.922	- 7.813
Quiz	0.427	- 0.064	13.344	- 15.625

● Tax cost and efficiency loss for the session are set by the experimenter
● Subjects log in, providing their zip code or country of origin
● Instructions and Comprehension Quiz, Experiment I
● Subjects select tax rates for each income-determination method, Experiment I
● Instructions and Comprehension Quiz, Experiment II
● Subjects guess their relative rank for each income-determination method
● Subjects select tax rates for each income-determination method, Experiment II
● Subjects take general-knowledge quiz
● Subjects undergo Tetris training and practice, then play Tetris
● Public coin toss selects Experiment I or II
  ● If Experiment II selected, subjects are shown their earnings rank for each income-determining method, then revise (or reconfirm) their four tax choices.
● Public throw of dice to determine method of income-determination
● Subjects make five choices between lottery and $1 (as risk-aversion measure)
● Randomly selected subject draws paper slip from hat and reads ID code to computer-operator, designating the "decisive individual" (DI)
● Computer shows subjects their earnings and reports the DI's tax choice
● Subjects complete exit survey questions on general background, political inclination, socio-economic status, and attitudes towards equality and redistribution

Chart 1. Sequence of an experiment session.

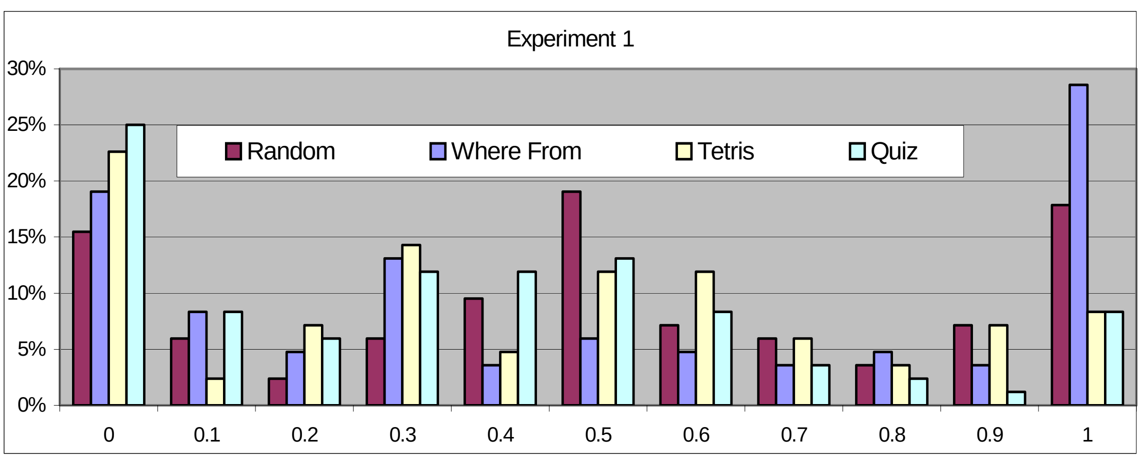

Figure 1. Histogram of preferred tax rates under varying income determination methods when there is no effect on efficiency and no effect on the chooser's earnings (Experiment I, tax cost = 0, efficiency loss = 0).

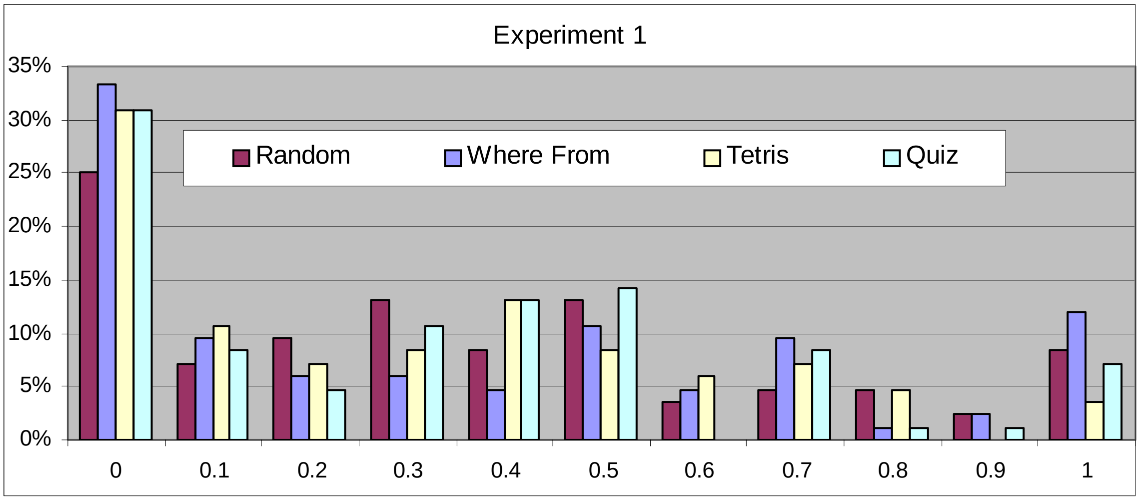

Figure 2. Histogram of preferred tax rates under varying income determination methods when there is no effect on efficiency and each 10% of tax costs the chooser $1 (Experiment I, tax cost = $1, efficiency loss = 0).

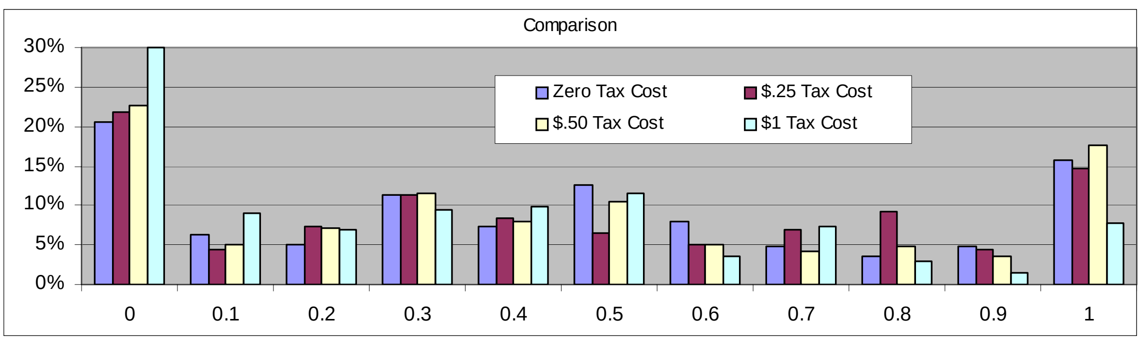

Figure 3. Histogram of preferred tax rates in Experiment I under all methods and efficiency losses, by tax cost.

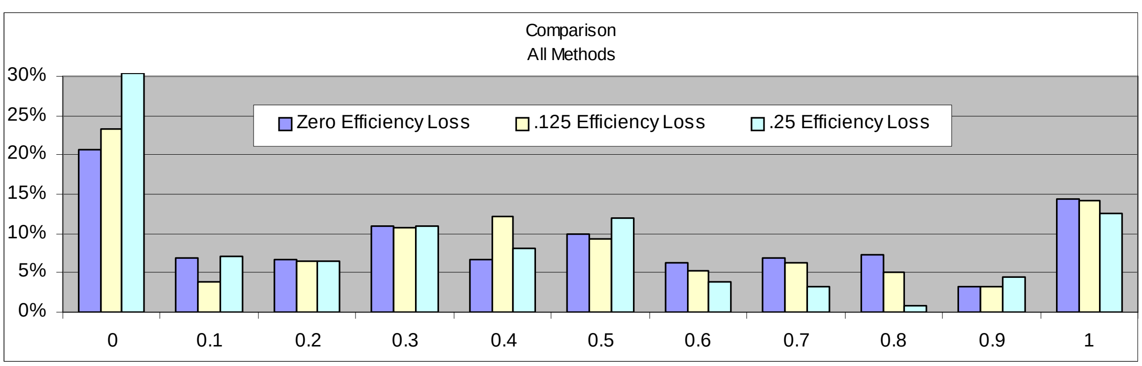

Figure 4. Histogram of preferred tax rates in Experiment I under all methods and tax costs, by efficiency loss.

Figure 5. Histogram of preferred tax rates in Experiment II under all tax costs and efficiency losses, by income determination method.

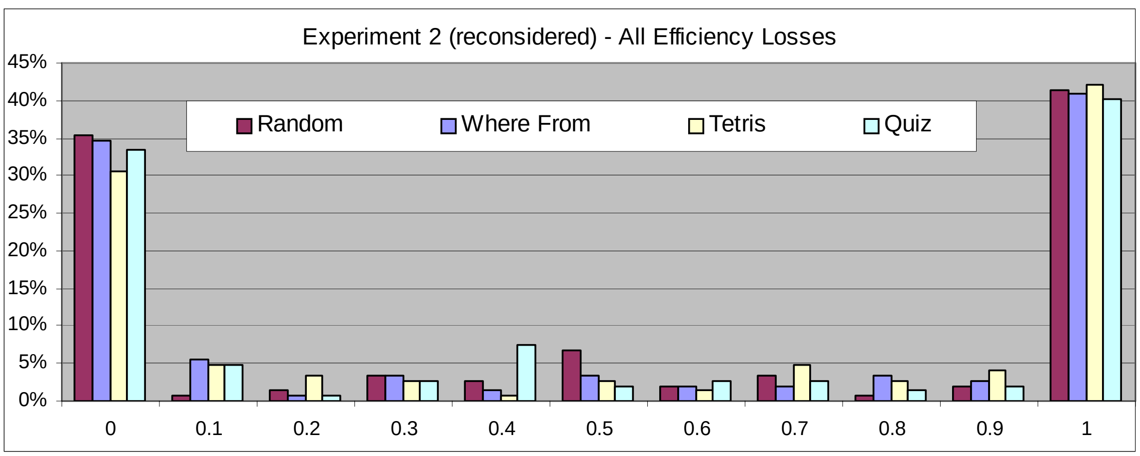

Figure 6. Histogram of preferred tax rates in Experiment II (Reconsidered) under all tax costs and efficiency losses, by method of rank assignment.