Social Preferences, Perceived Fairness of Local Tax Regimes and the Demand for Redistribution: An Experimental Study

Master's Thesis by James Phillips

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Abstract

This research seeks to understand the extent to which social preferences - which include perceptions of fairness as well as equality and efficiency concerns - drive demand for redistribution. Three key sources of demand for redistribution were identified as (i) income maximisation, (ii) risk aversion and (iii) social preferences. A modified Charness and Rabin (2002) utility function was implemented to model these. Hypotheses were derived from a combination of literature evidence and predictions from the model. An experiment was then designed to test hypotheses and results were used to estimate utility weights of each determinant of demand for redistribution. Subjects were split into groups and chose their preferred rate of taxation under a variety of scenarios including their level of involvement, the certainty of their pre-tax income, the source of inequality and the level of dead-weight loss. To extend understanding on the influence of perceptions of fairness on demand for redistribution, the influence of perceptions of procedural and distributive fairness of local tax regimes was also assessed to address a gap in the literature.

It was found that social preferences play a key role in driving demand for redistribution. Subjects opted for lower taxation under efficiency losses and when inequality was determined due to luck (random draw) as opposed to level of productivity (performance in a quiz). Additionally, subjects who opted for high redistribution when unaffected by their tax decision also opted for high redistribution when their income was known, when their tax decision affected them and when they were awarded the highest possible level of pre-tax income. This indicated that concerns for equality were present in the sample. However, an attempt to observe the role of perceived procedural and distributive fairness of local tax regimes on demand for redistribution yielded inconclusive results. A gap in the literature therefore remains surrounding the influence of perceptions of procedural fairness and its influence on demand for redistribution. Finally, an attempt to model the relative importance of determinants of demand for redistribution and therefore the extent of social preferences, was unsuccessful. However, results indicated that subjects cared positively about incomes of the poorest member of their group and therefore also possessed genuine social concerns.

Keywords: *social preferences, perceived fairness, demand for redistribution, political economy, censored regression.*

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1 Introduction

"The test of our progress is not whether we add more to the abundance of those who have much; it is whether we provide enough for those who have too little."

— Franklin D. Roosevelt

According to Oxfam (2018), the wealthiest 42 individuals in the world now possess the same amount of wealth as the 3.7 billion poorest. 82% of global wealth produced in 2017 went to the top 1% of earners. The disparity in earnings between the richest and poorest continues to grow rapidly, as indicated in Figure 1.1.

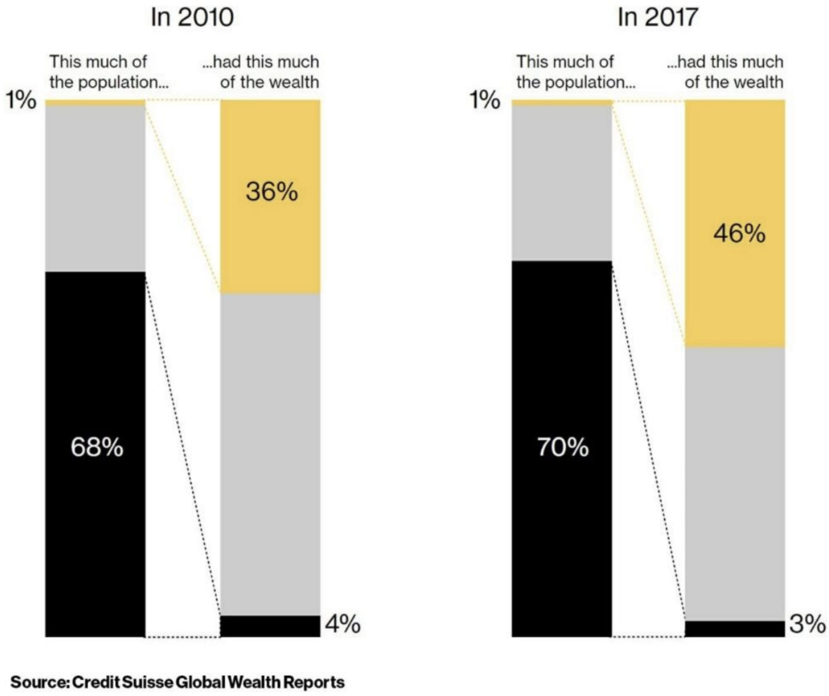


Figure 1.1 - Inequality Continues to Expand (2010-2017)

High and rising inequality can have ramifications for society along a number of vectors. While there is ongoing dispute over the direction of the causal effect of inequality on economic growth (Alesina and Rodrik, 1994; Forbes, 2000; Chen and Guo, 2002), there is evidence to suggest that inequality results in social unrest, poorer opportunities for those less fortunate and weaker trust in institutions (Gould and Hijzen, 2016). As the top earners accumulate wealth at a rate disproportionately greater than those in the lower half of the income distribution, a new "Gilded Age" has emerged - although this time it is worldwide and is deepening. This emergence highlights the importance of understanding drivers of demand for redistribution so that policymakers can implement informed fiscal policy based on empirical evidence.

Understanding the determinants of demand for redistribution by simply observing aggregate data is difficult. Consequently, incentivised experiments have been used to analyse behaviour. Economic experimentation can help to positively describe attitudes towards redistribution and enable researchers to analyse behaviour in a controlled setting. Durante *et al.* (2014) made a notable attempt to use experiments to test for, and to estimate, the relative importance of sources of demand for redistribution. They identified income maximisation, social insurance (or risk aversion) and social preferences as important determinants and tested their influence as well as relative importance to the decision maker using experiments. In their concluding remarks, they noted that conducting similar experiments but using different country subject pools would provide a valuable next step in bolstering the literature on demand for redistribution. Following a review of recent literature, it appeared that this step had not yet been conducted on a similar scale. Also, despite wide ranging evidence for the role of self-interest and risk aversion, the role of social preferences - particularly perceptions of fairness - in driving demand for redistribution were less clear. Hence, *the motivation of this research is to understand the extent to which social preferences - which includes equality and efficiency concerns as well as perceptions of fairness - drive demand for redistribution*.

An experiment similar to Durante *et al.*'s (2014) was conducted on a sample of 135 subjects. The experiment was extended to improve understanding on the role of perceptions of fairness further by including more information on the impact of perceived fairness of local tax systems on demand for redistribution. Particular ambiguity in the literature surrounds the role of perceptions of procedural fairness on demand for redistribution and this was addressed. Subjects were split into groups and asked to display their preferred tax choice under a variety of choice environments. These were framed in a real-world context by allocating each individual within their respective group a pre-tax payoff that followed the UK income distribution. Treatments included a variation on the source of inequality (i.e. whether pre-tax income was assigned by chance or whether it was earned), the level of efficiency loss, the level of uncertainty about their pre-tax income allocation as well as whether the decision maker was affected by their decision. This enabled each source of demand for redistribution to be tested and parameters of a modified Charness and Rabin (2002) multiplayer model to be estimated. This would enable an understanding of the relative importance that an individual places on each determinant of demand for redistribution to be achieved.

Hypotheses were derived by combining testable predictions made by the Charness and Rabin model with evidence from the academic literature. It was found that income maximisation played a role in driving demand for redistribution. Subjects reduced demand for redistribution with increasing certain absolute individual income. However, when income was uncertain, demand for redistribution did not decrease with increasing expected individual income as predicted. Also, surprisingly risk aversion appeared to have no influence on demand for redistribution in the sample. Contrastingly, on average, subjects opted for higher levels of redistribution when income was known than when it was uncertain. Trends in the data revealed that many subjects were overconfident about their future income prospects under uncertainty, which may have influenced this result.

The evidence shows that social preferences importantly drive demand for redistribution. Deadweight loss universally resulted in systematic preferences for lower redistribution. Subjects opted for tax rates between 6 and 10 percentage points lower on average when 25% efficiency losses were incurred. Additionally, subjects showed a concern for equality. On average, those who opted for high levels of redistribution when their decision did not influence them also tended to opt for high redistribution when their decision did influence them. This result held even for those who were awarded the highest level of pre-tax income and when income was known, indicating true concerns for equality at the expense of private benefit. Perceptions of distributive fairness also played an important role in the demand for redistribution. Subjects under a veil of ignorance opted for approximately 20 percentage points higher levels of redistribution when inequality occurred at random versus when it occurred as a result of higher productivity, indicating that perceptions of distributive fairness matter in the demand for redistribution. However, the extension of Durante *et al.*'s experiment - which analysed the role of perceptions of fairness of local tax systems on demand for redistribution - provided statistically insignificant results and therefore no causal inferences could be drawn on this matter. An attempt to understand the relative importance of social preferences on demand for redistribution - by modelling utility weights of each determinant of demand - was unsuccessful. This resulted from the fact that subjects appeared to care negatively about aggregate group income, distorting the parameter estimate measuring the relative importance an individual places on equality versus efficiency concerns. Consequently, parameter estimates lost their interpretation as relative utility weights. This analysis did prove, however, that subjects cared positively about the incomes of the poorest member of their group.

This study makes a useful contribution to the literature by improving understanding of the role of social preferences in the demand for redistribution. It does so by replicating the experimental approach of DPV on different country subject pools and by extending this to assess the influence of perceptions of fairness of local tax systems on demand for redistribution. Similar experiments should be run in future to enable a better understanding of utility and social welfare functions, which may ultimately enable policymakers to deliver socially optimal policy in order to help address important politico-economic problems of today and in the future.

2 Literature Review

2.1 Why Seek Redistribution?

The literature on the demand for redistribution highlights several key factors that influence an individual's preference for redistributive policy. These include: (i) income maximisation, (ii) risk aversion and (iii) social preferences - comprised mainly of a concern for equality, a dislike for efficiency loss, perceptions of fairness and reciprocity.

2.1.1 Income Maximisation

According to the literature on preferences for income redistribution, when deciding on a preferred level of redistribution, individuals place highest importance on their own expected income relative to other motives (Beck, 1994; Schildberg-Hörisch, 2010; Durante, Putterman and van der Weele, 2014). Traditional politico-economic models of redistribution show that if the income distribution is right-skewed[1], defined as when the mean wage is greater than the median, then a self-interested median voter should theoretically prefer a higher marginal rate of taxation the more unevenly distributed income is (Romer, 1975; Meltzer & Richard, 1981). This supports the theory that demand for redistribution is inversely related to one's level of income. In a similar vein, Roberts (1977) developed theory showing that an economic agent's preferences towards redistribution are more likely to be positive the lower is his income generating ability, when compared with average income. This is supported widely in the literature (Fong, 2001; Alesina and Giuliano, 2010).

Not all lower earners prefer higher redistribution; a comparison of U.S. and European fiscal systems presents a case whereby more equal societies[2] opt for higher redistribution than less equal societies (Alesina and Glaeser, 2004) - often referred to as the Robin Hood paradox (Lindert, 2004). Roland Bénabou and Efe Ok (2001) considered the fact that 'poorer' individuals may prefer lower levels of redistribution based on their prospects of future upward social mobility. From an income maximisation perspective, despite predictions of traditional models revealing that a rational median voter tends to prefer greater redistribution when the income distribution is right-skewed, Bénabou and Ok showed that there are also selfish forces

[1] Income distributions are invariably right-skewed in the data (with heavy upper tails). This is documented widely across the academic literature (Atkinson, 2002; Piketty, 2003; Wolff, 2004; Benhabib *et al.*, 2011).

[2] USA has a Gini coefficient of 47. The higher the Gini coefficient, the greater reported inequality. When compared with other major European countries this figure is high. France for example has a Gini of 30.1 and the Netherlands 25.1 (CIA World Factbook, 2016).

that drive incentives for a median voter to prefer low levels of redistribution, especially when potential future expected earnings are taken into account.

2.1.2 Risk Aversion

A risk averse economic agent may anticipate that the likelihood of large upward social mobility in the future is low. As income is uncertain, redistribution of economic resources can act as insurance against future negative shocks in an uncertain economic climate (Alesina and La Ferrara, 2005). John Rawls (1971) showed that behind a 'veil of ignorance', where subjects are unaware of both their income as well as their future authority in society, individuals had a positive willingness to pay for an income transfer from higher to lower payoffs. Beck (1994) reinforced this finding with experimental tests observing the impact of risk aversion on demand for redistribution. He showed that individuals opt for a level of redistribution that provides them with an income floor that they are satisfied with were they to receive the lowest income. In another experimental setting, Durante *et al.* (2014) showed that the risker the method of determining one's pre-tax income, for example a difference between whether pre-tax income was assigned by chance or through a mechanism of earning it, the higher the average preferred rate of taxation by subjects. More risk averse individuals should therefore prefer higher redistribution and when income is uncertain one would expect to observe the same effect (Meltzer and Richard, 1981; Bénabou and Ok, 2001). The robustness of this prediction has been confirmed more recently (Alesina and La Ferrara, 2005; Alesina and Giuliano, 2010 and Gärtner *et al.*, 2017).

2.1.3 Social Preferences

Income maximisation and risk aversion form two key drivers of demand for redistribution. However, traditional politico-economic models of redistribution under the assumption of "*homo economicus*", along with many other traditional economic models, do not account for the fact that some economic agents are also concerned with outcomes of others when considering a utility maximisation problem. A series of influential laboratory experiments proved the existence of such behaviour, referred to in the literature as social preferences (Camerer & Weigelt, 1988; Frohlich & Oppenheimer, 1992; Fehr & Schmidt, 1999; Charness & Rabin, 2002; Charness, 2004; Engelmann & Strobel, 2004). Many of these models measure social preferences using 'two-player' games including, for example, the dictator (Kahneman, Knetsch, and Thaler, 1986) and ultimatum (Guth, Schmittberger, and Schwarze, 1982) games.

A broad definition of social preferences has typically included a combination of altruism, reciprocity, fairness, inequality aversion and considerations of aggregate payoffs.

Bowles and Gintis (2002) showed that reciprocity plays a role in an individual's demand for redistribution, for example they showed that an individual may withdraw their support for redistribution if recipients are reckoned to be deliberately capitalizing on the generosity of those paying taxes. However, the role of reciprocity in decision making will not be evaluated here, as this research is concerned more with the influence of a dislike for inequality and efficiency loss as well as perceptions of fairness on the demand for redistribution. When referring to social preferences in future therefore, this paper refers more specifically to concerns for equality, perceptions of fairness and dislike of efficiency losses.

Concerns for Equality

In the literature on social preferences, individuals display a positive concern for the income of the worst-off individual (Charness and Rabin, 2002; Durante *et al.,* 2014). The extent of this concern however is ambiguous. In a two-player Charness and Rabin (2002) model, C&R henceforth, C&R derived an estimate for the utility weight that the richest individual places on the income of the poorest individual. When Durante *et al.* (2014) ran similar experiments with more people, their equivalent estimate[3] was still positive but ten times smaller and individuals were less willing to give up their final payoff to increase income of the lowest earner. Hence, when the decision involves more people, it would appear that the concern for the worst-off individual is reduced significantly. Well documented in Durante *et al.* (2014) is the fact that the concern for the payoff of the worst-off individual varies based on the means by which that individual ended up being the worst-off individual. Perceptions of fairness in terms of how pre-tax income was distributed played a key role.

Perceptions of Fairness

Studies on the role of perceived fairness of the distribution of wealth in driving demand for redistribution are traceable back to the works of historian and political philosopher Alexis de Tocqueville. Its role has also subsequently been documented widely more recently (Piketty 1995, 1998; Ravallion and Lokshin, 2000; Fong, 2002; Alesina and Angeletos, 2004; Bénabou and Tirole, 2006; Krawczyk, 2010). Individuals care significantly about the method by which income is assigned. Alesina and Angeletos (2004) for example showed that if society believes that variation in levels of productivity are the result of inequality in society, then individuals

[3] Durante *et al.* (2014) used a method of converting their estimates from their multiplayer version of the Charness and Rabin (2002) model into estimates that could be compared to two-player Charness and Rabin estimates. The calculation for this transformation is provided on Table IV of page 840 in Charness and Rabin (2002).

tend to prefer less redistribution. If favourable endowments were awarded fortuitously however, then more redistribution was preferred. This finding is acknowledged widely across the literature (Fong, 2002; Corneo and Gruner, 2002; Alesina and LaFerrara, 2003; Krawczyk, 2010; Fong and Lutterman, 2011; Durante *et al., 2014*). Alesina and Glaeser (2004) applied this to a comparison of demand for redistribution in Europe and the USA. They explained that in the USA, many believe that poverty arises due to a lack of effort while conversely in Europe, society tends to believe that poverty results more as a result of misfortune.

While the role of perceptions of distributive fairness and its impact on demand for redistribution is clear, there are other measures of fairness that may influence the demand for redistribution. Krawczyk (2010) divided perceived fairness and its impact on the demand for redistribution into two key areas. In the first, he reviewed the role of perceived distributive fairness and corroborated previously discussed findings. He found that transfers were 20% lower when determinants of success came as a result of luck versus relative performance in a task. Krawczyk also focused on the role of perceived procedural fairness. Procedural fairness of a tax system would be reflected in equal opportunity for all with regards to upward social mobility for example (Verboon and Goslinga, 2009). Krawczyk (2010) hypothesised that a greater dispersion of chances would lead to more support for redistribution and the welfare state, i.e. the lower the perceived procedural fairness of a system, the higher the demand for redistribution. Interestingly, Krawczyk (2010) found no evidence to support this conjecture in his results, leaving a gap in the literature to be addressed.

Dislike of Efficiency Loss

Redistribution tends to result in efficiency losses. A common example of the efficiency loss resulting from redistribution is provided by Daron Acemoglu and James Robinson (2001), "...one form of income redistribution inefficiency is farmers' receiving price supports or input subsidies. Such policies distort relative prices and discourage the reallocation of productive resources away from agriculture and into other sectors, such as manufacturing, where they could be better used". Policies that attempt to redistribute income typically come at the cost of a shrinkage of the social pie (Browning, 1993) and economic agents are resultantly left with a conundrum when deciding on their preferred redistributive policy. Browning and Johnson (1984) analysed the trade-off between equality and efficiency, by estimating the marginal cost of depressing income inequality and found that it was surprisingly high. They found that under fixed wage elasticities, the disposable money income of upper-income quintiles of households is reduced by \$9.51 for each dollar unit increase for lower income quintiles.

2.1.4 Understanding the Relative Importance of Each Determinant of Demand for Redistribution

The different drivers of demand for redistribution compete with one another: an individual who begins to earn more income should favour a lower level of redistribution based on its impact on his or her expected income. However, if an individual places high importance on social insurance, a policy that imposes greater redistribution may be more desirable. Most would claim to care about equality in society to some extent, yet, if one cares for efficiency in the sense of maximising economic resources available to all, this individual would have to sacrifice the income of those worst off in society by opting for less redistribution. Understanding the relative importance that the average individual places on each of driver of demand for redistribution would be highly informative for those concerned with modelling in macroeconomics and political economy or policy making. Consequently, there has been an attempt in the literature on demand for redistribution to model the relative importance an individual places on each factor influencing preferences for redistribution. Recognising the difficulty to undertake this using field data, a number of incentivised experiments have been used. These have enabled analysis of the demand for redistribution in a controlled setting and have allowed researchers to estimate relative utility weights of each determinant of demand for redistribution referring to models of social preferences theory.

The experimental literature on demand for redistribution has sought to confirm and measure the effect of the three previously identified determinants of public demand to redistribute income from more to less wealthy citizens. These were: income maximisation, risk aversion and social preferences. The role of income maximisation is universally recognised as being an important driver of demand for redistribution (Beck, 1994; Ackert, Martinez-Vazquez and Rider, 2007; Schildberg-Hörisch, 2010; Durante *et al.*, 2014). Durante *et al* (2014) estimated that individuals place by far the greatest importance on maximising their own expected income when entering a redistribution decision. Risk aversion is also found to be an important driver of demand for redistribution in the experimental literature (Beck, 1994; Schildberg-Hörisch, 2010). Greater ambiguity, however, exists over the role of social preferences. Ackert, Martinez-Vazquez and Rider (2007) and Schildberg-Hörisch (2010) found evidence to support the notion that preferences for a more even distribution of wealth importantly drive preferences for redistribution. Beck (1994), however, found no evidence to suggest that subjects in his experiments cared for a more equal income distribution beyond individual risk aversion. Similarly, Krawczyk (2010) found no evidence to support his hypothesis that a greater dispersion of chances would result in greater demand for redistribution. With regards to efficiency concerns, Beckman, Formby and Smith (2004) and

Krawczyk (2010) and Durante *et al.* (2014) revealed evidence for concerns over efficiency losses.

2.2 Modelling and Testing Social Preferences in the Demand for Redistribution

Durante, Putterman and van der Weele (2014), henceforth DPV, made a notable attempt to identify the relative importance that an individual places on each identified driver of demand for redistribution in their paper entitled, "*Preferences for Redistribution and Perception of Fairness: An Experimental Study*". They identified (i) the self-interest of those less well endowed, (ii) the insurance motive and (iii) social preferences - where social preferences could be divided into efficiency concerns, equality concerns and fairness concerns - as being notable determinants of demand for redistribution. They subsequently developed an experiment that enabled them to combine the social preferences literature (Fehr & Schmidt, 1999; Charness & Rabin, 2002) with the literature on political economy (see for example, Meltzer and Richard, 1981). In this sense, it reflected experimental settings previously designed by Ackert *et al.* (2007) and Krawczyk (2010).

DPV's Model

DPV applied a modified version of a C&R[4] (2002) multiplayer model to their experiment in order to bridge the political economy literature on redistribution and the literature on social preferences. The original C&R model however does not incorporate risk preferences and as DPV were concerned with the effect of risk aversion on demand for redistribution, they modified the original model to account for this. The resultant mean-variance utility function was written formally as:

$$U_i(y_1, \ldots, y_N) = (1 - \lambda)\,[(1-\gamma)Ey_i + \gamma(-\sigma_{y_i})] + \lambda\,[\delta y^{min} + (1-\delta)\textstyle\sum_j y_j] \quad (1)$$

where U_i denotes the utility function of a given individual, i and y_i denotes the post-tax income or payoff of individual i. Ey_i and σ_{y_i} represent the expectation and standard deviation of post-

[4] Charness and Rabin (2002) developed a series of experimental games to test theories of social preferences, showing that individuals do in fact care about the payoffs of other players and not just their own outcomes. They showed that individuals are particularly concerned with improving outcomes of lowest payoff players and that individuals are also motivated by reciprocity. In doing so, they outlined simple conceptual models with testable empirical predictions.

tax income for individual i respectively. The influence of expected income on utility is designed to enable measurement of the importance that an individual places on maximising their own income. The standard deviation of income is included in the model to capture risk preferences. These two components of the utility function therefore permit measurement of the weights that an individual places on their own personal outcomes and they possess a joint relative weight of $(1-\lambda)$. The remaining two variables in the utility function are y^{min} and $\sum_j y_j$. y^{min} represents the post-tax income of the individual who receives the lowest payoff in a group. This permits measurement of the extent that a subject cares for equality of payoffs in their group. The $\sum_j y_j$ term represents total group income and permits measurement of preferences for aggregate group income (and the extent to which efficiency loss alters demand for redistribution). The $\lambda \in [0,1]$ parameter measures the extent that subject i cares about social welfare versus their own self-interest (taking into account both their expected income as well as the standard deviation of their own income). If one were to set $\lambda = 0$ for example, this means that they care solely about their own outcomes. The $\gamma \in [0,1]$ parameter captures the extent an individual cares about reducing risk σ_{y_i} versus augmenting expected income Ey_i. If for example, one was to set $\gamma = 0$, then an individual places complete importance in maximising their income and does not worry about the risk this may entail. The $\delta \in [0,1]$ parameter measures the importance an individual places on supporting the worst-off player in their respective group. When $\delta = 1$, an individual follows pure maximin preferences (Rawls, 1971) whereby they care solely about the outcome of the worst off. If $\delta = 0$, their social concern is solely focused on aggregate payoffs.

DPV's Findings

DPV found that subjects preferred a lower rate of taxation when there was a positive efficiency loss associated with redistribution and also when pre-tax income was awarded through "earned" means versus when income was assigned through means of good fortune. They found that when an individual became involved by their decision, that they preferred a higher tax rate and they also found evidence of risk aversion through the fact that subjects' payoffs influenced their tax choices more under the resolution of uncertainty. Also, subjects who opted for high redistribution when unaffected by their decision continued to opt for high redistribution when income was known - even when endowed with a high level of known individual income, indicating concerns for equality. Estimation of the λ, γ and δ parameters provided in Equation (1) enabled DPV to measure the relative importance a subject placed on each motive of demand for redistribution in their experiment. DPV found on average that individuals place 81% weight on the level of their own income, 15% on the standard deviation of their own income, 3% on the income of the lowest earner and 1% weight on efficiency. Interestingly, DPV found that when decisions on redistributive policy were made when pre-tax income was allocated as a result of luck, the utility weight on own income was reduced to 73% and the weight on the income of the lowest earner increased to 10%. The authors therefore found evidence for the role of social preferences in driving demand for redistribution. They found that individuals care about those worst-off and are willing to give up personal income in order to increase efficiency, which corroborates predictions of social preferences models outlined by C&R (2002) and Engelmann and Strobel (2004).

Conclusions and Implications

In their concluding remarks, DPV noted that conducting experiments similar to theirs but using different country subject pools would provide a valuable next step in furthering current understanding on the role of social preferences in the demand for redistribution. A review of the recent literature indicated that this step had not yet been conducted on a similar scale. Across the literature on demand for redistribution, the roles of income maximisation and risk aversion are clear. Whilst DPV provide evidence of social preferences and the extent of its importance in determining demand for redistribution, further evidence to support this in the literature is thin. In addition, there exists particular ambiguity over the role of perceptions of procedural fairness in driving demand for redistribution (Krawczyk, 2010). Consequently, the central research question of this paper is:

To what extent do social preferences drive the demand for redistribution?

This paper therefore seeks to test DPV's findings by running similar experiments with a pool of subjects from different countries. In doing so, it aims to improve understanding on the role of social preferences and particularly the influence of perceptions of fairness on demand for redistribution, concurrently addressing a gap in the literature on the role of perceptions of procedural fairness.

3 Predictions and Hypotheses

Hypotheses were derived, all things remaining equal, by combining the testable empirical predictions of the modified C&R (2002) multiplayer model referred to in Equation (1) with evidence from the academic literature discussed in Section 2. A diagrammatic overview of testable hypotheses is provided in Figure 3.1, these are developed in Sections 3 and 4.

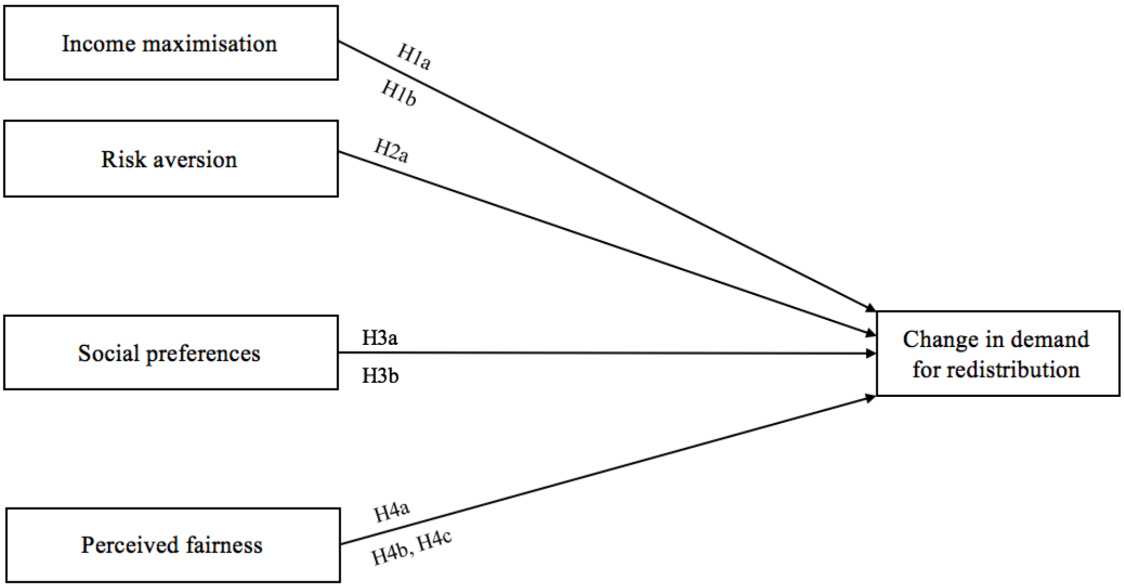


Figure 3.1 - Proposed Hypotheses of Factors Influencing Demand for Redistribution

3.1 Income Maximisation

Equation (1) predicts that for subjects who care positively about their expected post-tax income, i.e. when λ and γ are less than one, utility from opting for a higher tax rate decreases with either expected or obtained income. This, in combination with arguments in Section 2.1.1, leads to the first hypothesis:

H1 – as the absolute level of individual income increases, lower average tax rates will be chosen

As subjects are to be placed in a situation where they may be either certain or uncertain of their own incomes, subsequently, H1 may be split into the following two hypotheses:

H1a – as uncertain absolute individual income increases, lower average tax rates will be chosen

H1b – as certain absolute individual income increases, lower average tax rates will be chosen

3.2 Risk Aversion

The literature identifies the fact that risk averse individuals should prefer higher redistribution as greater redistribution reduces the standard deviation of post-tax income (discussed in Section 2.1.2). For example, if one were to choose zero redistribution, the gap between the lowest and highest post-tax income would be at a maximum. However, if one were to choose complete redistribution, every member of society would receive the same income and the variance of post-tax income would be reduced to zero. Additionally, for a risk averse individual in Equation (1), reflected by $\gamma > 1$, higher taxation should be preferred. Hence:

H2 – under uncertainty, a higher perceived standard deviation of own income results in higher demand for redistribution

A proxy for testing this hypothesis with the experimental evidence is discussed in Section 4.3.1 where details of the experiment are revealed and will be referred to as Hypothesis H2a.

3.3 Social Preferences

Efficiency concerns

For an individual who has concerns over equality and efficiency losses (when λ is greater than zero in model (1)), efficiency losses will reduce utility from taxation and resulting redistribution. According to model (1) this is due the fact that with an efficiency loss, redistribution is less effective at delivering for the poorest subjects. A combination of this prediction as well as evidence in the literature discussed in Section 2.1.3 leads to the following Hypothesis:

H3a – efficiency loss will always result in lower demand for redistribution

Equality concerns

For an individual with social concerns, Equation (1) predicts that the payoff of the least well-off individual enters positively into their utility function. The literature on demand for redistribution also indicates that individuals care about the payoff of the worst-off (DPV). Those with a concern for equality when a decision does not influence them should therefore also possess a concern for equality when it does influence them. If subjects who voted for high redistribution when unaffected by their tax decision subsequently changed their tune as a result of being awarded a high-income rank ex-post resolution of certainty, this indicates that there does not exist a true concern for equality. Thus:

H3b – those with a concern for equality when the redistribution decision does not involve them will also possess this concern when it does

3.4 Perceived Fairness

As Equation (1) does not include a process-based theory of fairness, it cannot make any testable predictions with regards to fairness. However, DPV noted that if one were to conjecture the fact that inequality concerns, captured by the δ variable, were stronger under "lucky" means of pre-tax income assignment than under "earned", then a higher tax would be preferred. The literature on perceived distributive fairness also strongly indicates that people indeed care about how income is determined. Hence:

H4a – demand for redistribution is stronger when pre-tax income is allocated at random rather than when earned

To extend the work of DPV, this paper seeks to understand further the role of perceived fairness in determining demand for redistribution by considering perceptions of fairness of local tax systems both in terms of distributive and procedural fairness (as defined in Section 2.1.3).

H4b – lower perceptions of distributive fairness of domestic tax systems result in higher demand for redistribution

H4c – lower perceptions of procedural fairness of domestic tax systems result in higher demand for redistribution

Statistical evidence for H4c would importantly address a gap in the literature (Krawczyk, 2010).

4 Experimental Approach

The experiment was designed to test all hypotheses. Subjects undertook the experiment online and over two sessions in the English language using the Qualtrics software platform[5]. It was decided upon to run the experiment online due to the possibility of reaching a wider range of subjects and not only students at Erasmus University. Subjects could also be reached quickly and affordably via online experimentation. External validity of the experiment, including limitations and rigour, are discussed in Section 6.2. The experiment was designed such that the politico-economic literature on demand for redistribution could be combined with models of social preferences. Subjects were typically either recruited online via social media and forums or via the Erasmus University network.

4.1 Background

The concept of the experimental design centrally builds upon the design proposed by DPV. DPV's experiment was structured chronologically according to Figure 4.1, where Part I observed tax choices made by a "disinterested" decision maker, Part II observed tax choices when a subject was affected by their tax decision and under a veil of ignorance and Part III observed tax choices when an individual was interested and had full information of their group ranks and corresponding pre-tax income allocation.

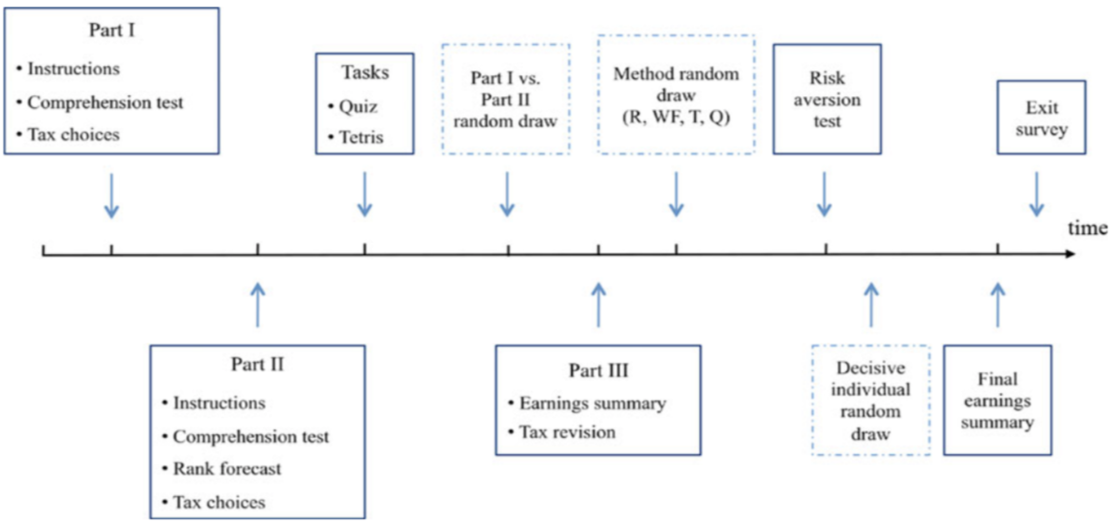


Figure 4.1 - Chronological Sequence of Events in DPV's Experiment

[5] Both parts of the experiment were undertaken using the Qualtrics online survey software licensed by the Erasmus University Rotterdam at https://erasmusuniversity.eu.qualtrics.com/.

4.2 Extending DPV

DPV noted that conducting experiments similar to theirs would provide a deeper understanding of preferences for redistribution due to the scarcity of similar studies in the literature. DPV analysed subjects who attended Brown University; individuals typically exposed to a U.S. political and economic system. The U.S. system differs somewhat compared to a typical European political-economic system, so for those participating in this experiment one might expect to observe interesting differences in the data. Any similarities may help to generalise DPV's findings on the other hand.

This research extends DPV's study by furthering understanding on the role of perceived fairness on the demand for redistribution. Krawczyk (2010) divided the impact of the perceived fairness of the division of wealth on redistribution into two key areas: (i) perceived distributive fairness and (ii) perceived procedural fairness. DPV's paper solely observed the influence of distributive fairness on demand for redistribution in analysing the impact of varying the method of income determination. This experiment extends DPV's work by incorporating tests to determine the impact of an individual's perceptions of distributive and procedural fairness of their local tax systems on demand for redistribution. Evidence for the impact of perceived distributive fairness on demand for redistribution is well documented (Fong, 2002; Corneo and Gruner, 2002; Alesina and LaFerrara, 2003; Alesina and Angeletos, 2005), however Krawczyk (2010) was unable to find evidence for the impact of perceived procedural fairness on demand for redistribution. This experiment therefore seeks to reinforce existing knowledge of perceptions of distributive fairness on demand for redistribution as well as to learn more about the impact of perceptions of procedural fairness. The ultimate goal is to understand the extent to which social preferences drive demand for redistribution.

4.3 Experimental Design

The experiment followed a within-subject design where subjects remained in the same groups throughout. Each subject was therefore exposed to the same content over both sessions. The entire experiment is provided in detail in Appendix A. Prior to the experiment, subjects were informed that they would be taking part in an experiment designed to understand social preferences. Subjects were informed that the process would be conducted over two sessions, hereby referred to as Session 1 and Session 2. An overview of the chronological sequence of events that occurred during the experiment is detailed in Figure 4.2.

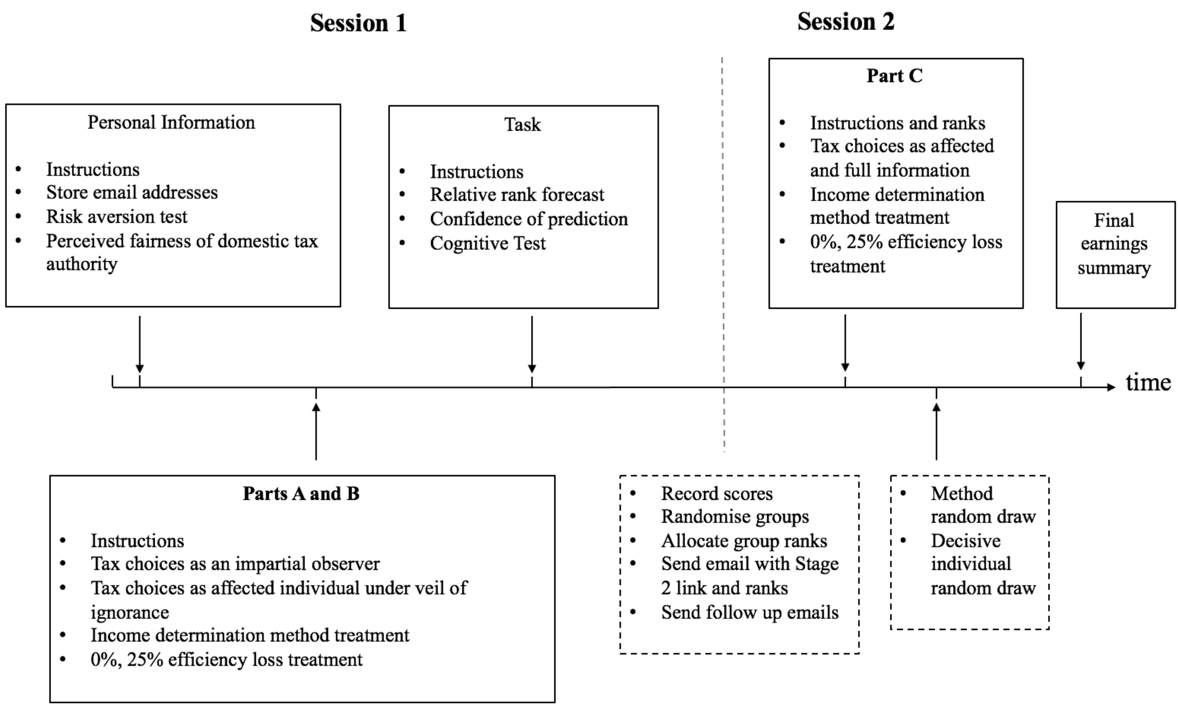


Figure 4.2 - Chronological Sequence of Events in the Experiment

Session 1 took approximately 10 minutes for a respondent to complete and Session 2, sent to subjects via email at a later date, typically took the subject no longer than one minute to complete. Session 2 of the experiment was designed to be as short as possible in order to maximise the aggregate sample size and mitigate loss of subjects and possible related nonresponse bias. Upon receiving the email to complete Session 2, subjects were informed that the task would take only one minute of their time. Subjects were informed that they would be split into groups of five, by randomisation, at the end of Session 1. Throughout the experiment, subjects were asked to display their tax preferences under a number of different scenarios (or treatments), which would affect the payoff distribution of their group of five, each of whom remained anonymous to the respondent at all times. Subjects were informed that they must complete Session 2 in order to have a chance of winning money. They were also informed that the second survey would depend on their responses and performance in a quiz included at the end of Session 1.

4.3.1 Session 1

1. Personal Information

First, subjects' emails were recorded and verified using piped text to ensure the correct email was stored, these emails would be essential in order to deliver information for Session 2 of the experiment and also to inform respondents of whether or not they had won the prize ex post completion of the experiment. Subjects were also informed that their private data would be destroyed ex post in order to protect their privacy. Other personal information recorded in this section included age, gender, nationality, number of economics courses taken, as well as 7-point Likert scales for political-economic stance (Bakker *et al.,* 2012) and risk attitudes (Falk *et al.*, 2016). A more comprehensive assessment of risk attitudes would have been obtained using the multiple price list method (Harrison and Rutström, 2008), however, it was judged that due to the fact that the content of the first survey would take subjects considerable time, the shorter risk preference elicitation method was preferred. This decision was taken to reduce the potential drop-out rate between sessions. The final part of the Personal Information section determined a subject's perception of procedural and distributive fairness of the tax system in their domestic country. A 7-point Likert scale was used, and subjects were asked two questions, taken from Verboon and Goslinga (2009), to determine perceptions of distributive and procedural fairness of their domestic tax systems. For distributive fairness, these were:

"The level of taxation in your country of domicile is high"
"From the taxes you have to pay, you get enough in return in the form of public services".

For procedural fairness, these were:

"The tax office treats everyone equally"
"The tax office cares about equality for all".

2. Parts A and B

Subjects were then asked a series of questions regarding their demand for redistribution. These questions made up the core of the experiment in eliciting demand for redistribution. The experiment was split into three parts over the two sessions, defined as Parts A, B and C and these would correspond respectively to Parts I, II and III of DPV's experiment. In the first session, only Parts A and B were included.

Following their assignment, subjects were allocated a rank within their group and this determined their pre-tax payoff. At this stage, they were not made aware of their relative group ranks and corresponding pre-tax incomes. They would find this information out posterior to completing Session 1. They were informed that they would have the chance of winning money in the experiment and that their responses would directly influence their potential earnings as well as the earnings of the other participants in their group were they to be selected as the decisive decision maker (DDM_i henceforth). Subjects were told that they would be allocated one of five provisional pre-tax payoffs in the range of £5.53-62.53 with aggregate group income initially totalling £100. This is presented in Table 4.1. The distribution was designed to proportionally represent the United Kingdom income distribution[6] (Office for National Statistics, 2018) and subjects were informed of this in order to liken the experiment to a real scenario. As a sizeable number of subjects were from Europe or studied in the Netherlands, the Euro/Sterling exchange rate was provided for clarity.

Table 4.1 - Group Ranks and Corresponding Pre-Tax Payoffs

Quintile/Rank	UK Income Distribution (£)	Payoff (£)
1	170,000	62.53
2	39,700	14.61
3	27,100	9.96
4	20,000	7.37
5	15,000	5.53

Subjects were then informed that they would have the opportunity to redistribute income. Subjects had the opportunity to choose a tax rate increasing in intervals of 10% ranging from 0%, which would result in a post-tax payoff distribution identical to the pre-tax distribution and 100% which would result in perfect payoff equality after tax if selected. By observing Table 4.2, one can see that implementing a tax rate of 0% would result in the same post-tax income distribution as the pre-tax income allocation. If one were to tax 100% however, each participant would receive £20 and hence income would be distributed perfectly evenly. This linear tax system[7] reflects a similar tax system to the one used by DPV in their experimental design.

[6] The purpose of distributing payoffs according to the United Kingdom income distribution was to frame the decision-making process as if it were a real macroeconomic problem for subjects.

[7] The tax effect was calculated by taking the difference between payoffs at 0% and 100% taxation, subtracting the amount of tax from that difference and then subtracting this total from the pre-tax income for each respective rank. Referring to Table 4.2 for example, for an individual who was ranked number 1, the difference between their payoff at 0% and 100% is (£62.53-£20) £42.53. If we then take 10% (if we want to know the payoff at 10% tax) of this figure (£4.253) and then subtract this from the payoff at 0% tax (£62.53-£4.253) this equates to £58.28 which is the payoff for Rank 1 at 10% tax. The same calculation is conducted for each tax rate and each rank to produce the post-tax distribution presented in Table 4.2.

Table 4.2 - Group Ranks and Post-Tax (0-100%) Corresponding Post-Tax Payoffs

		Tax Effect										
Rank	**Payoff (£)**	**0%**	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	**100%**
1	62.53	62.53	58.28	54.03	49.77	45.52	41.27	37.01	32.76	28.51	24.25	20.00
2	14.61	14.61	15.14	15.68	16.22	16.76	17.30	17.84	18.38	18.92	19.46	20.00
3	9.96	9.96	10.97	11.97	12.97	13.98	14.98	15.99	16.99	17.99	19.00	20.00
4	7.37	7.37	8.63	9.89	11.16	12.42	13.68	14.95	16.21	17.47	18.74	20.00
5	5.53	5.53	6.98	8.42	9.87	11.32	12.77	14.21	15.66	17.11	18.55	20.00

Treatments

Four treatments were implemented in order to observe demand for redistribution under a variety of criterion. A summary of the treatments and their key findings are presented in Table 4.3

Table 4.3 - Treatment Variable Descriptions and Main Findings

Treatment	Description	Values	Main findings
Involvement	Whether an individual was affected by their tax choice	Part A (unaffected), Parts B (affected, veil of ignorance) and C (affected, full information)	Lower tax rate when affected but under a veil of ignorance. Higher tax rate when affected and under full information *(directional, not statistically significant)*
Uncertainty	Awareness of respective pre-tax income allocations	Part 2: uncertain, Part 3: certain	Higher tax rate with certainty *(directional, not statistically significant)*
Efficiency Loss	Proportion of tax revenue lost	0%, 25%	Tax rate decreases with efficiency loss *(statistically significant)*
Income Determination Method	Method used to allocate group ranks and corresponding pre-tax income	Random, Quiz	Tax rate decreases when income was determined by being earned versus when it was determined at random *(statistically significant)*

Recall that the experiment was split into three parts. In Part A, subjects made tax choices for another random group and were therefore not affected by their tax decisions. Part A was hence referred to as the "disinterested decision maker" scenario. In Part B, subjects' tax choices affected their own group and consequently themselves, however as subjects were unaware of their ranks and corresponding pre-tax payoff, there was an element of risk in the decision-making process. Part C would be conducted in Session 2 when group ranks were revealed to subjects and this treatment would measure demand for redistribution under the resolution of certainty and when the subject was involved by their decision. Splitting tax decisions into these three scenarios enabled the impact of both involvement as well as uncertainty to be tested. Additionally, a treatment which varied the level of efficiency loss as well as a treatment that varied the method by which subjects were allocated their respective group ranks (and therefore pre-tax incomes) were also implemented in each of Parts A, B and C. These will now be discussed in more detail.

Involvement

Varying levels of involvement were implemented by separating decision making into three parts as discussed. In Part A, the individual was disinterested. In Parts B and C however, they became affected by their tax decisions. Adam Smith (1759) referred to the 'detached spectator' as the true guardian of correct behaviour in his *Theory of Moral Sentiments*. A comparison of decision making between when an individual was involved and when they were not would provide a means of understanding further the extent of the influence of social preferences on demand for redistribution. If demand for redistribution were to change drastically when an individual became involved for example, their social concern may not have been genuine. In Part A, post-tax earnings for a given, non-decisive individual can be written formally as:

$$y_i = (1 - t)y_i^0 + t(1 - e)\,\frac{1}{5}\sum_{j=1}^{5} y_j^0 \qquad (2)$$

where y_i denotes post-tax earnings of non-decisive individual i, t represents the tax rate, y_i^0 the pre-tax earnings of non-decisive individual i and e the efficiency loss parameter. At the end of the experiment, a DDM_i and their chosen tax rate was selected as the final post-tax payoff for a randomly drawn Part of the experiment, as well as randomly drawn treatments. If Part A - where the decision maker was not involved and made tax choices on behalf of another group of five individuals - were chosen as the method used to determine the final payoffs, subjects were informed that the DDM_i would receive a fixed income in the range of £20-21[8], again to be determined randomly. They were reminded again that they would not be affected

[8] A random number would be paid to the DDM_i so that they never knew whether or not they were the decisive individual when final payoffs were allocated. This was undertaken so that they did feel a sense of discomfort at knowing they were the decisive individual. The range £20-21 was chosen as it lay just above the expected value of lottery winnings in the case of 0% efficiency loss (£20).

by the redistributive process. The group whom the final payoff allocation went to would also be randomly drawn. The payoff of the DDM_i would result formally as:

$$y_{DDM_i} = y^0_{DDM_i} \qquad (3)$$

where y_{DDM_i} is the post-tax income of DDM_i, $y^0_{DDM_i} \sim U(20{,}21)$ is the randomly drawn fixed payoff for DDM_i. The Involvement treatment would enable Hypothesis 3b to be tested.

Uncertainty

John Harsanyi (1953) observed decision making behind a "thin veil of ignorance" - defined as whereby an individual is unaware of their talents, abilities and relative standing in society (or rank within the group in the context of this experiment), but they know they have an equal chance of being allocated a given position as anyone else. The use of a thin veil of ignorance would permit analysis of decision making under risk, one of the hypothesised key drivers of demand for redistribution, and therefore Hypothesis 2a. This would form Part B. In this Part, subjects were "interested" decision makers but uncertain about their group ranks and corresponding pre-tax payoff. They were therefore forced to take into account variability of their future income under this treatment. Formally, the post-tax payoff of DDM_i in Part B is:

$$y_{DDM_i} = (1-t)y^0_{DDM_i} + t(1-e)\,\frac{1}{5}\sum_{j=1}^{5} y^0_j \qquad (4)$$

Efficiency loss

"The money must be carried from the rich to the poor in a leaky bucket. Some of it will simply disappear in transit, so the poor will not receive all the money that is taken from the rich" - Arthur Okun's (1975) "leaky bucket" argument.

Efficiency loss in the context of this experiment is defined as the percentage of total tax revenue lost for each incremental 10% increase in taxation. The efficiency loss treatment compared tax choices between scenarios with 0% efficiency loss compared to those with a 25% efficiency loss. In the 0% efficiency loss scenario, represented by the original post-tax payoff distribution in Table 4.2, aggregate group income from 0% tax through 100% tax was £100. In the 25% efficiency loss scenario however, reported in Table 4.4, increasing taxation gradually reduced aggregate group income. For example, at 0%, aggregate group income remained at £100. At 50% this was reduced to £92.50 and at 100%, aggregate group income was £75 which represents an overall efficiency loss of 25% if chosen, compared to the situation with no efficiency loss. The Efficiency Loss treatment was implemented in order to test Hypothesis 3a.

Table 4.4 - Group Ranks and Post-Tax (0-100%) Corresponding Payoffs with Efficiency Loss

		Tax Effect with 25% Efficiency Loss										
Rank	**Income (£)**	**0%**	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	**100%**
1	62.53	62.53	57.87	53.06	48.13	43.15	38.17	33.24	28.40	23.72	19.23	15.00
2	14.61	14.61	15.04	15.40	15.69	15.89	16.00	16.02	15.94	15.74	15.43	15.00
3	9.96	9.96	10.89	11.76	12.55	13.25	13.86	14.36	14.73	14.97	15.06	15.00
4	7.37	7.37	8.57	9.71	10.79	11.77	12.66	13.42	14.05	14.54	14.86	15.00
5	5.53	5.53	6.93	8.27	9.55	10.73	11.81	12.76	13.58	14.23	14.71	15.00

Income Determination Method

Subjects were informed that relative ranks and corresponding pre-tax payoffs could be assigned to them either at random or based on their relative performance in a quiz to be performed at the end of Session 1. This was designed to mirror real-life methods of determining financial success. Success based on a random draw for example could be compared to being born into a family of high social status or born into a wealthier region. Success based on relative performance in a quiz could be likened to being rewarded for higher productivity, either through employing greater effort or possessing higher innate ability. This treatment importantly enabled the impact of perceptions of distributive fairness to be tested. For example, if being allocated a high rank due to luck was perceived to be unfair, one may have expected to find higher tax rates under the "random" method of pre-tax income determination versus the "earned" method. The Income Determination Method treatment would enable Hypothesis 4a to be tested.

3. Quiz

After completing Parts A and B, subjects were told that they would then be required to fill out a timed quiz in the final section of Session 1. Initially, subjects were asked to predict their expected ranks in the quiz and then state their confidence in that prediction. This measure would be used to proxy confidence in predicting future income, key in testing Hypothesis 2. Individuals who were less confident in predicting their rankings (and therefore expected income) would possess a higher perceived income risk and would be expected to subsequently opt for higher taxation as a form of social insurance. From this, the following testable hypothesis was derived:

H2a – lower confidence in predicting income will result in higher demand for redistribution

This data would also be used to calculate an individual's perceived standard deviation of own income which would be used in modelling relative utility weights.

Subjects were given three minutes to complete a quiz that was designed to test a mixture of cognitive ability and general knowledge. Questions started at a reasonable level of difficulty and became increasingly more challenging. The quiz therefore tested a combination of ability and the effort put in to complete the task. Performance in the quiz was scored out of 15, a higher score translated to a higher relative group rank (and corresponding payoff) which was calculated after Session 1 by the experimenter. Groups were drawn randomly after Session 1. As a given subject regularly recorded the same score as another in their group, higher ranks were awarded to those who achieved a higher percentage of questions answered correctly. In the case that these were the same, time taken to complete the test was used to differentiate subjects.

One possible limitation of the quiz was the fact that the content might have been more weighted towards those with strengths in the field of mathematics as opposed to the arts. In order to address this, a pilot version of the quiz was sent to a selection of acquaintances of ranging educational and academic backgrounds beforehand and none reported back any significant issues, but minor changes were made to aid understanding. After completion of Session 1, survey results were recorded, and individuals were randomly assigned into groups of five[9]. This meant that there were initially 35 groups as there were 175 subjects after Session 1. Subjects were allocated two group ranks based on a random draw and also based on their relative performance in the quiz.

4.3.2 Session 2

Subjects were individually sent emails thanking them for completing the first session and subsequently were asked to complete the second stage of the experiment. They were sent a link to the experiment in an email along with their respective ranks for "random" and "earned" pre-tax income determinations. Subjects were again informed that Session 2 would only require

[9] Random teams of five were generated at https://www.randomlists.com/team-generator using emails. The random generator generated teams that were also in a random order and therefore ranks based on random assignment could also be determined from this random generation.

one minute of their time. As many subjects did not respond to the initial email, follow up emails were sent to some individuals on a number of occasions, with subjects being reminded that if they were unable to complete the second part, they would not be eligible for the final payoff. Despite these efforts, 40 subjects were lost between Sessions 1 and 2.

Upon opening the link for the second survey, subjects were required re- enter their email and this was verified using piped text. Subjects were then asked to re-enter their respective group ranks for random and earned methods of pre-tax income allocations. This was subsequently checked after the experiment was finished to ensure that subjects were not misled with regards to their ranks. Of the individuals who responded, all entered the correct ranks for each income determination method.

Part C

Subjects were then offered the opportunity to revise their tax choices given their known rankings for each respective method of designating pre-tax income as well as under both 0% and 25% efficiency loss treatments. This would form the four tax choices under certainty for Part C of the experiment. After completing these tax choices, the experiment completed and subjects were informed that one individual, DDM_i (along with a corresponding Part, efficiency loss and income determination method), would be randomly chosen and their tax decision for that particular scenario and treatment combination would be used to deliver post-tax winnings to each member of their group. The incentive structure therefore followed a Random Lottery Incentive. As mentioned in the 'Involvement' treatment part of this section, in the special case that Part A was selected as the decisive Part, where the DDM_i was "disinterested", the DDM_i would receive a fixed payoff, to be chosen randomly between £20 and £21. Their tax choice for the correct level of efficiency loss and income determination method (also randomly drawn) would then be allocated to another group. This group would be randomly drawn.

5 Results and Data Analysis

This Section is structured as follows. Summary statistics, key tables, figures and variable descriptions are provided in Section 5.1. In Section 5.2, data analysis is split into the three Parts of the experiment (Parts A, B and C) where treatment effects are analysed, and statistical tests performed. Hypotheses from Section 3 are addressed in Section 5.2. A summary of results is provided in Section 5.2.5. In order to understand the extent of social preferences on demand for redistribution, the central research question of this paper, parameters of Equation (1) were estimated in Section 5.3. This information also supplements findings in the previous section.

5.1 Summary Statistics, Variables and Regression Table

In total there were 135 independent observations at the subject level and 2 independent observations at the session level. At the end of Session 1 there were 35 independent observations at the group level, but some individuals did not complete Session 2. Initially, the total number of respondents who completed the first session was 175. There was therefore a total of 40 individuals who did not complete Stage 2 and the corresponding observations from Stage 1 were dropped. There were therefore a number of incomplete groups after Session 2, but this did not impact the functionality of the experiment. However, there exists the possibility of some non-response bias associated with losing subjects between the two sessions.

The remainder of Section 5.1 displays figures and tables to be referred to in the data analysis in Section 5.2. Figure 5.1 presents a distribution of Tax Rate Frequencies for Part A (disinterested), Part B (interested and uncertain) and Part C (interested and certain) of the experiment (over both Efficiency Loss and Income Determination Method treatments). Figures 5.2 and 5.3 provide a breakdown of average tax rates over the three Parts of the experiment for both the Efficiency Loss treatment (Figure 5.2) and the Income Determination Method treatment (Figure 5.3). Table 5.1 gives an overview of the distribution of tax choices by each Part of the experiment for all treatments, along with the associated distribution of tax choices for each Efficiency Loss and Income Determination Method treatment. Table 5.2 gives an overview and description of treatments used in regression analyses in Section 5.2. Finally, Table 5.3 reports results of Tobit regressions that provides the base for much of the core data analysis used throughout Section 5. The figures and tables referred to in this Section are consistently referenced throughout the remainder of Section 5. Detail on all remaining sample statistics for each variable can be found in Appendix B.

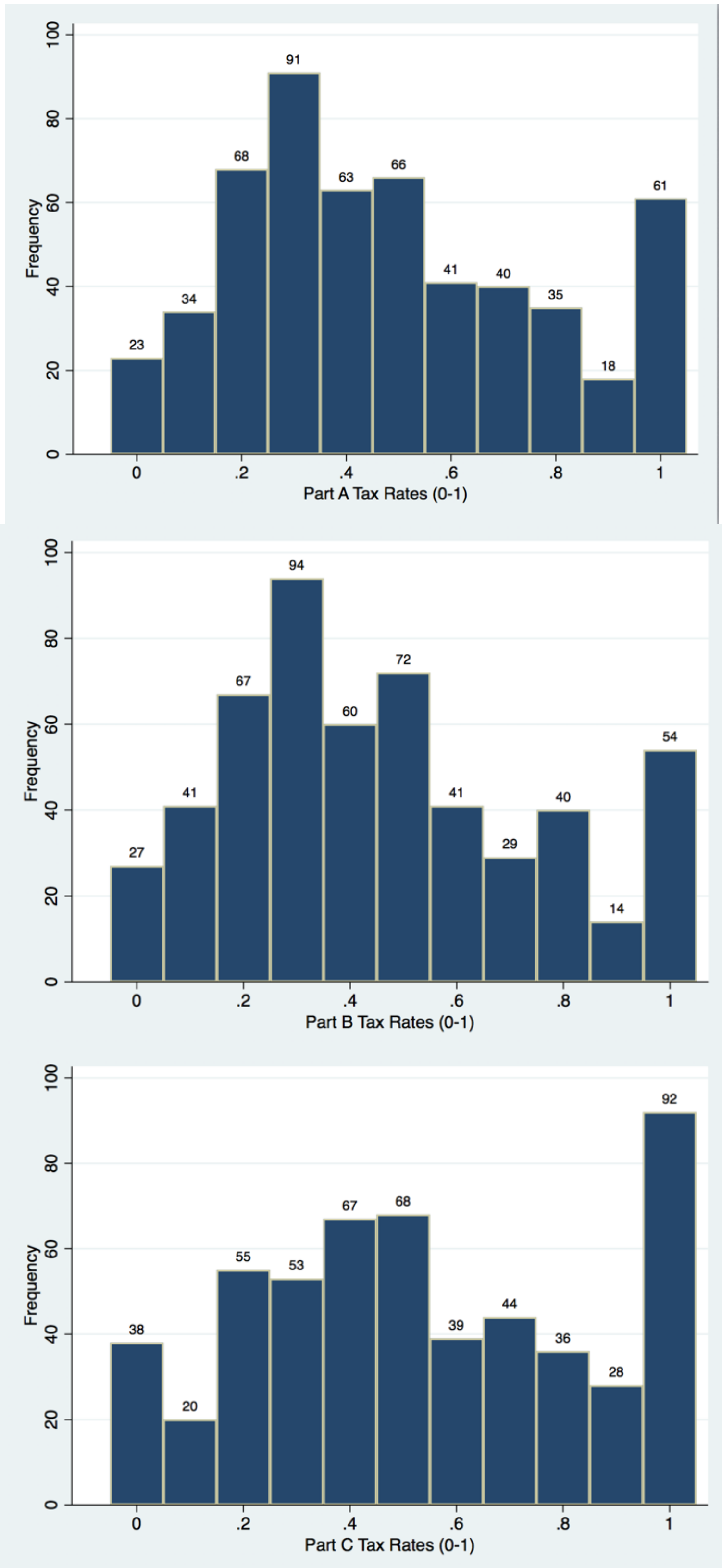


Figure 5.1 - Tax Rate Frequencies for Part A (Disinterested and Uncertain), Part B (Interested and Uncertain) and Part C (Interested and Certain) of the Experiment (Over Both Efficiency Loss and Income Determination Method Treatments)

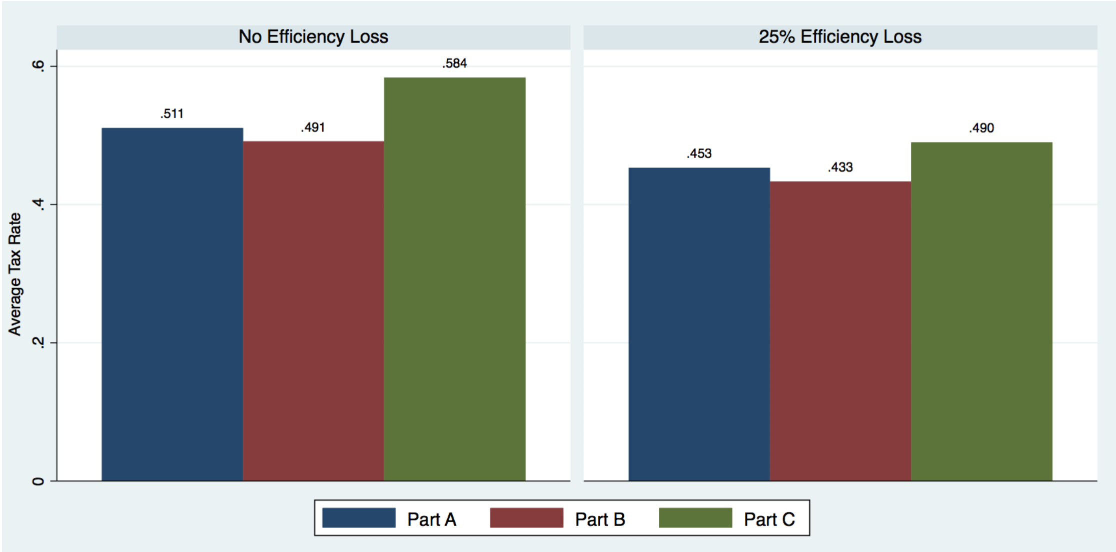


Figure 5.2 - Average Tax Rates by Part and Level of Efficiency Loss

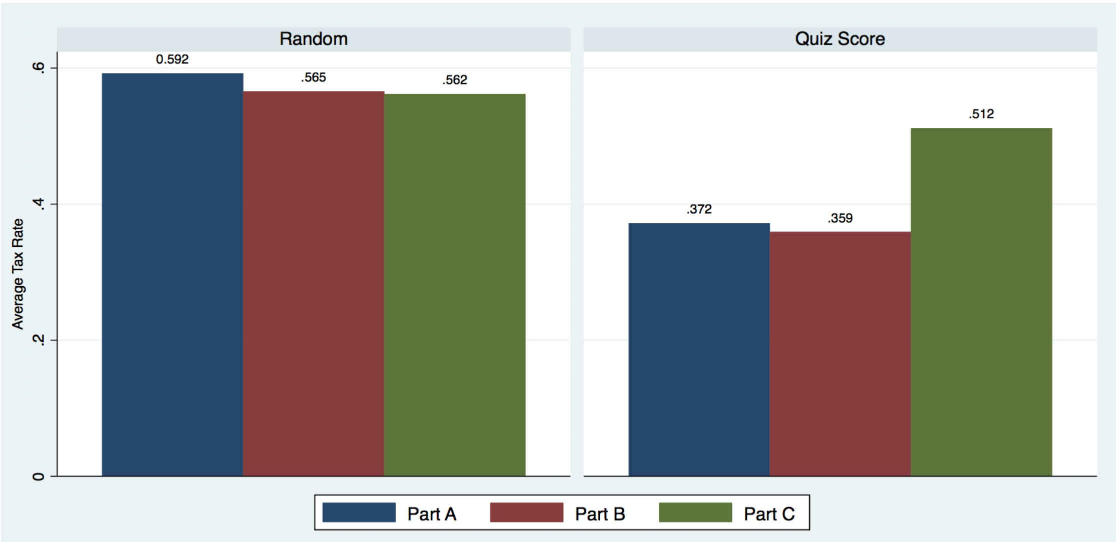


Figure 5.3 - Average Tax Rates by Part and Pre-Tax Income Determination Method

Table 5.1 - Distribution of Tax Choices Overall, by Part, Income Det. Method and Efficiency Loss

Part A (135 subjects, 540 choices)					
	All	Random	Quiz Score	No Efficiency Loss	25% Efficiency Loss
t=0%	4.3%	3.0%	5.2%	3.0%	5.6%
t=10%	6.3%	4.8%	7.8%	4.4%	8.1%
t=20%	12.6%	7.0%	18.1%	13.0%	12.2%
t=30%	16.9%	11.1%	22.6%	18.1%	15.6%
t=40%	11.7%	9.3%	14.1%	12.2%	11.1%
t=50%	12.2%	13.0%	11.5%	9.6%	14.8%
t=60%	7.6%	6.7%	8.5%	8.1%	7.0%
t=70%	7.4%	9.3%	5.6%	6.7%	8.1%
t=80%	6.5%	8.5%	4.4%	5.6%	7.4%
t=90%	3.3%	5.5%	1.5%	3.7%	3.0%
t=100%	11.3%	21.9%	0.7%	15.6%	7.0%
Part B (135 subjects, 540 choices)					
	All	Random	Quiz Score	No Efficiency Loss	25% Efficiency Loss
t=0%	5.0%	4.1%	5.9%	4.1%	5.9%
t=10%	7.6%	3.7%	11.5%	6.7%	8.5%
t=20%	12.4%	8.1%	16.7%	11.5%	13.3%
t=30%	17.4%	14.8%	20.0%	17.8%	17.0%
t=40%	11.1%	7.8%	14.4%	11.1%	11.1%
t=50%	13.4%	13.3%	13.3%	11.1%	15.6%
t=60%	7.6%	7.8%	7.4%	8.1%	7.0%
t=70%	5.4%	6.7%	4.1%	5.9%	4.8%
t=80%	7.4%	10.4%	4.4%	7.0%	7.8%
t=90%	2.6%	4.4%	0.7%	3.0%	2.2%
t=100%	10.0%	18.5%	1.5%	13.3%	6.7%
Part C (135 subjects, 540 choices)					
	All	Random	Quiz Score	No Efficiency Loss	25% Efficiency Loss
t=0%	14.1%	6.7%	7.4%	6.3%	7.8%
t=10%	7.4%	4.1%	3.3%	1.9%	5.6%
t=20%	20.4%	9.6%	10.7%	9.6%	10.7%
t=30%	19.6%	9.6%	10.0%	8.1%	11.5%
t=40%	24.8%	11.1%	13.7%	13.7%	11.1%
t=50%	25.2%	10.0%	15.2%	11.9%	13.3%
t=60%	14.4%	6.7%	7.8%	6.7%	7.8%
t=70%	16.3%	9.3%	7.0%	5.2%	11.1%
t=80%	13.3%	7.4%	5.9%	6.3%	7.0%
t=90%	10.4%	4.4%	5.9%	6.3%	4.1%
t=100%	34.1%	21.1%	13.0%	24.1%	10.0%

Table 5.2 - Name, Type and Description of Variables

Variable	Type	Dependent Variable	Description
Part A Tax Rate	Limited	Yes	Linear tax choice for Part A - between 0-100% - increasing in increments of 10%
Part B Tax Rate	Limited	Yes	Linear tax choice for Part B - between 0-100% - increasing in increments of 10%
Part C Tax Rate	Limited	Yes	Linear tax choice for Part C - between 0-100% - increasing in increments of 10%
Male	Categorical	No	Subject gender. Female=0, Male=1.
European	Categorical	No	Background dummy. European=1, Otherwise=0.
Asian	Categorical	No	Background dummy. Asian=1, Otherwise=0.
Other	Categorical	No	Background dummy. Other=1, Otherwise=0.
Over 35	Categorical	No	Subject aged over 35. Over 35=1, Otherwise=0.
Number Econ. Courses Taken	Categorical	No	Number of Economics courses taken. Less than 2=0, 2 or more=1.
Politically Conservative	Continuous	No	Political-Economic stance of a subject. (1-7) where 1=Extreme Left, 4=Centre, 7=Extreme Right.
Risk Propensity	Continuous	No	Propensity to take risk. (1-7) where 1=extremely risk averse and 7=extremely risk seeking.
Perceived PF (High/Low)	Categorical	No	PF=1 if PF score higher than 8. Combined score of two questions (each 1-7) to derive perceived procedural fairness of local tax systems. 1=minimum score, 14=maximum PF score
Perceived DF (High/Low)	Categorical	No	DF=1 if DF score higher than 8, 0 otherwise. Combined score of two questions (each 1-7) to derive perceived distributive fairness of local tax systems1=minimum score, 14=max score
Income Determination Method	Categorical	No	Pre-tax income determination method. Random=0, Quiz score=1.
Efficiency Loss	Categorical	No	25% Efficiency loss treatment. Efficiency loss=1, No efficiency loss=0.
Expected Rank	Categorical	No	Expected relative group rank in the quiz (1-5).
Confidence Level	Categorical	No	Confidence of correctly predicting relative group rank. 1=High confidence, 0=Low confidence. Measured on a scale of 1 (low)-5 (high). 4 and above was high confidence.
Confidence*Expected Rank	Continuous	No	Interaction of expected group rank in the quiz and the confidence of the individual in predicting their relative group rank.

Table 5.3 - Tobit Regressions for Parts A (Disinterested Decision Maker), B (Interested and Uncertain) and C (Interested and Certain)

	Dependent Variable - Tax Rate (0-1)							
	Part A	Part A	Part B	Part B	Part B	Part C	Part C	Part C
	All	All	All	All	Earned	All	All	All
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Efficiency Loss	-0.0676***	-0.0690***	-0.0649***	-0.0653***	-0.0308**	-0.1027***	-0.1037***	-0.0920***
	(0.0239)	(0.0170)	(0.0238)	(0.0164)	(0.0124)	(0.0189)	(0.019)	(-0.0203)
Income Determination Method	-0.2275***	-0.2331***	-0.2097***	-0.2137***	*(omitted)*	-0.0560*	-0.0571*	-0.0114*
	(0.0232)	(0.0247)	(0.0232)	(0.0228)		(0.0290)	(0.0295)	(0.0330)
Expected Rank (1-5)					0.0103			
					(0.0352)			
Confidence Level (Low/High)					0.0587			
					(0.1294)			
Confidence*Expected Rank					-0.0298			
					(0.0448)			
Part A Tax Choice								0.2160***
								(0.0809)
Male		0.0525		0.0720*	0.0458		0.0498	0.0407
		(0.0342)		(0.0375)	(0.0403)		(0.0394)	(0.0385)
European		0.1656***		0.1240**	0.0237		0.0843	0.0523
		(0.0464)		(0.0485)	(0.0480)		(0.0535)	(0.0522)
Other		0.2710***		0.2778***	0.1171**		0.2652***	0.2274**
		(0.0884)		(0.0847)	(0.0533)		(0.1023)	(0.1121)
Over 35		-0.0474		-0.0324	-0.0201		-0.0834	-0.0768
		(0.0432)		(0.0447)	(0.0443)		(0.0549)	(0.0522)
Risk Propensity (1-7)		0.0138		-0.1724	-0.0041		-0.0096	-0.0146
		(0.0187)		(0.0196)	(0.0194)		(0.0233)	(0.0231)
Politically Conservative (1-7)		-0.0450***		-0.0431**	-0.0416**		-0.0304	-0.0223
		(0.0199)		(0.0198)	(0.0200)		(0.0246)	(0.0241)
Number Econ. Courses Taken		-0.0562***		-0.0605	-0.0627		-0.0402	-0.0293
		(0.0351)		(0.0395)	(0.0394)		(0.0434)	(0.0436)
Perceived PF (Low/High)		-0.0701		-0.0110	-0.0132		-0.0334	-0.0184
		(0.0536)		(0.0564)	(0.0568)		(0.0642)	(0.0773)
Perceived DF (Low/High)		0.0436		0.0368	0.0339		0.0548	0.0558
		(0.0350)		0.04001	(0.0390)		(0.0409)	(0.0773)
Observations	540	540	539	539	270	540	540	540
Uncensored Observations	456	456	458	458	250	410	410	410
Left-Censored	23	23	27	27	16	38	38	38
Right-Censored	61	61	54	54	4	92	92	92
Log-Likelihood	-217.2388	-179.2881	-213.9900	-186.5824	-185.9060	-369.0230	-351.7787	-344.3043
Pseudo-R^2	0.1842	0.3373	0.1649	0.2796	0.7216	0.0257	0.0755	0.0974

*Notes: Coefficients shown are marginal effects. Standard errors are in parentheses. Coefficients and standard errors are reported to 4 decimal places. *** represents significance at the 1% level (p<0.01), ** represents significance at the 5% level (p<0.05), * represents significance at the 10% level (p<0.1). For the Efficiency Loss variable, the base category is no efficiency loss; for the Income Determination Method variable, the reference category is random assignment; the base category for the Male dummy is being female; the base category for European and Asian background dummies is the 'Other' background category. Table 5.2 gives a detailed account of each variable for further information. Robust standard errors (clustered per individual) are reported in parentheses. Evidence for STATA output of Column I is in Appendix G.*

5.2 Data Analysis

This section is divided by analysing data according to each Part of the experiment and addressing the Hypotheses – detailed in Section 3 - through statistical testing and regression analyses. Each Part of the experiment enabled different Hypotheses to be tested and therefore the Hypothesis testing is undertaken according to the Part of the experiment instead of in numerical order. *A summary of results of the data analysis and their support (or lack thereof) for the Hypotheses is provided in Section 5.2.5.*

5.2.1 Statistical Tests

Various statistical tests and regression analyses were conducted throughout Section 5. Technical details of these are provided in Appendices C, D and F and are referenced in the relevant text.

5.2.2 Part A (Disinterested Decision Maker)

Part A observed tax choices when the subject's payoff was not personally affected by their decision. Drawing reference from Table 5.1, an initially interesting observation for tax choices in Part A is the fact that a positive tax rate was chosen in 95.7% of instances across each treatment. To add to this, when observing tax choices under the Efficiency Loss treatment of 25% in isolation, the proportion of positive tax choices fell only slightly to 94.4%. Subjects opted for perfect post-tax income equality in 11.3% of cases and when income was determined at random, the disinterested decision maker opted for perfect equality on 21.9% of occasions. There were striking differences between treatments at the 100% tax level in Part A. Only 0.7% of subjects opted for perfect payoff equality when pre-tax income was assigned due to performance in the quiz, however this increased to 21.9% when pre-tax income was allocated at random. Introducing 25% efficiency losses reduced the proportion of individuals opting for perfect equality by over half going from 15.9% under no efficiency loss to 7% under the 25% deadweight loss. Average tax rates fell from 51.1% to 45.3% under the 25% Efficiency Loss treatment and on average individuals opted for a 59.2% tax rate when income was allocated at random, versus a 37.2% average tax rate when higher pre-tax income was earned via superior performance in the quiz.

Social Preferences - Efficiency Concerns

The -*signrank*- command was used in STATA to perform Wilcoxon Signed-Rank (WSR) tests. See Appendix C for detail on the test including intuition as well as null and alternative hypotheses. For the Efficiency Loss treatment in Part A, a test statistic of 4.251 was recorded, with a p-value of 0.00 indicating a rejection of the null hypothesis. The population median differences are significantly different from zero at the 1% significance level, *ceteris paribus*. To reinforce these findings, a series of regression analyses were conducted. As observations at the limits (0 and 1) were observed, the chosen model was one of a censored dependent variable, as opposed to a truncated model where observations at the limits would not be observed. James Tobin (1958) developed a censored regression model named the Tobit model that could deliver consistent estimates for a model including a dependent variable with partially continuous and partially discrete probability masses at one or more points. Hence, a two-limit Tobit regression censored at 0 and 1 (or 0% and 100%) tax rates was chosen in conducting regression analyses to cater for the fact that certain subjects may have preferred to opt for a tax level higher than 100% or indeed lower than 0%. See Appendix D for technical detail on the two-limit Tobit model including the likelihood function and expected values of the dependent variable.

The following code was implemented in STATA to conduct the two-limit Tobit regression: *-tobit [varlist], ll(0) ul(1) vce (cluster id)-*. This set upper and lower limits to zero and one respectively and implemented cluster-robust standard errors at the subject level. In order to directly interpret coefficients, marginal effects were calculated post-estimation. The following command was implemented to perform this: *-mfx, predict(ys(0, 1))-*. Reported in Table 5.3 are the marginal effects of each regressor on the dependent variable. Ordinary Least Squares (OLS) estimates are also presented in Appendix E giving very similar estimates to those of the Tobit model. The Tobit model assumes that the limit-numbers might be higher or lower than the boundaries given i.e. zero and one. With large numbers of subjects opting for the 100% rate of taxation, particularly in Part C as shown in Figure 5.1, it is possible that subjects may have preferred a higher rate of redistribution even than the upper limit. This would have resulted in significant differences between OLS and Tobit results. The fact that OLS estimates were comparable to Tobit estimates indicates that this was not the case. Columns I and II of Table 5.3 show tax choices for Part A of the experiment.

Column I displays results of the regression of average tax rates in Part A on the Efficiency Loss variable explained in Table 5.2. The coefficient is negative and t-tests on the null hypothesis that the coefficient equates to zero are rejected at the 1% significance level (p=0.00), *ceteris paribus*. This supports initial observations from Figure 5.2. As the coefficients in Table 5.3 are marginal effects, the magnitude of their coefficients can be interpreted directly. Referring to Column I, “disinterested” decision makers opted for an average tax rate that was 6.76 percentage points lower under a 25% level of efficiency loss compared to at the 0% level of efficiency loss, *ceteris paribus*. This effect was significant at the 1% significance level. Column II of Table 5.3 includes a series of individual control variables, which ultimately altered estimates from the specification in Column I only very minimally. For example, the Efficiency Loss treatment results in a 6.90 percentage point lower average tax rate with control variables and a 6.76 percentage points lower average tax rate without. This provides initial support for part of Hypothesis 3a - *efficiency loss will always result in lower demand for redistribution*. Column II also displays the effect of personal characteristics on the demand for redistribution[10].

Social Preferences - Perceptions of Fairness

The Income Determination Method treatment was then tested to observe the impact of perceptions of distributive fairness on demand for redistribution. A WSR test was performed and generated a statistic of 10.216, with a p-value of 0.00, indicating a rejection of the null hypothesis at the 1% significance level, *ceteris paribus*. The population median differences between "random" and "earned" income determination method samples are therefore significantly different from zero. Referring to Figure 5.3, it is clear to see that the disinterested decision maker in Part A opted for a far higher average tax rate when pre-tax income was determined at random (59.2%) versus when it was determined when the subject earned their higher group rank (37.2%). Additionally, Column I shows that on average, subjects preferred 22.75 percentage points lower tax rates when income was assigned based on performance in the quiz at the end of the first session of the experiment, compared to when income was allocated at random, *ceteris paribus*. This was also significant at the 1% level.

The fact that subjects opted for tax rates 22.75 percentage points lower on average when income was earned versus when it was allocated randomly indicates that subjects cared about fairness in terms of the method by which income was distributed. A combination of this, along with evidence from the WSR test, provides initial evidence to support Hypothesis 4a – *demand for redistribution is stronger when pre-tax income is allocated at random rather than when earned*.

[10] Interestingly, males appeared to prefer more redistribution with a 5.3 percentage point marginal effect, *ceteris paribus* (significant at the 5% level, *ceteris paribus*), which contradicts for example DPV's (2014) finding that women prefer more redistribution under the scenario of a disinterested decision maker. They found an 11.3 percentage point marginal effect in the opposite direction. Unsurprisingly, individuals who were politically more conservative - derived from answers given to the question regarding political-economic stance provided in Appendix A - opted for lower tax rates on average and this was significant at the 1% level, *ceteris paribus*.

"Perceived PF" and "Perceived DF" variables in Column II provide marginal effects for the variables observing the influence of perceptions of fairness of domestic tax systems on demand for redistribution. An individual who had high perceptions of procedural fairness preferred a lower level of redistribution and the opposite was found for perceptions of distributive fairness. Both of these coefficients were insignificant however, therefore no conclusions could be drawn on causal inference. There was therefore no support for Hypotheses 4b and 4c in Part A.

5.2.3 Part B (Interested and Uncertain Decision Maker)

Part B observed decision making where subjects were informed that their tax decisions would potentially affect their final payoff. However, they were unaware of their group ranks for both "random" and "earned" income determination methods and the corresponding payoffs for each. Hence, there was an element of risk in their decision making process. Drawing reference from Figure 5.2 and Figure 5.3, the pattern of Part B tax rates followed a similar trend to that of Part A. Average tax rates in Part B were, however, almost systematically slightly lower than in Part A for each of the Efficiency Loss and Income Determination Method treatments. This starkly contrasts the result found in DPV, whereby tax rates in their equivalent Part B were higher than Part A.

Income Maximisation

In order to test Hypothesis 1a - *as uncertain absolute individual income increases, lower average tax rates will be chosen* - the following analysis was undertaken. A Mann-Whitney U (MWU) test was performed - details of the test intuition along with null and alternative hypotheses are provided in Appendix C. The -*ranksum*- command was implemented in STATA in order to perform the test. The MWU test is useful to test whether two independent samples came from the same population and therefore useful to compare between-subject variation. It is therefore useful in comparing average tax rates chosen by those with high certain or uncertain individual absolute income with those of low incomes – hence will be used in testing income maximisation hypotheses. Average tax choices of those who predicted a high level of income (predicted ranks 1 and 2 before taking the Quiz) in the "earned" Income Determination Method treatment of Part B, were compared with those who predicted they would obtain a low level of income (predicted ranks 3, 4 and 5 after performance in the quiz). Results of the MWU test would provide statistical evidence for whether distributions of the two populations were equal - i.e. if there was a statistically significant difference in average tax choice between those who had high levels of expected income and those who had low levels of expected income under the "earned" Income Determination Method. Analysis was undertaken solely for the "earned" Income Determination Method as subjects gave information on their expected rank based on their performance in the quiz but did not have the chance to predict their income under the "random" method. A p-value of 0.106 indicated no rejection of the null hypothesis that the distributions of both populations are equal at the 10% level of significance, *ceteris paribus,* although the failure to reject is extremely narrow.

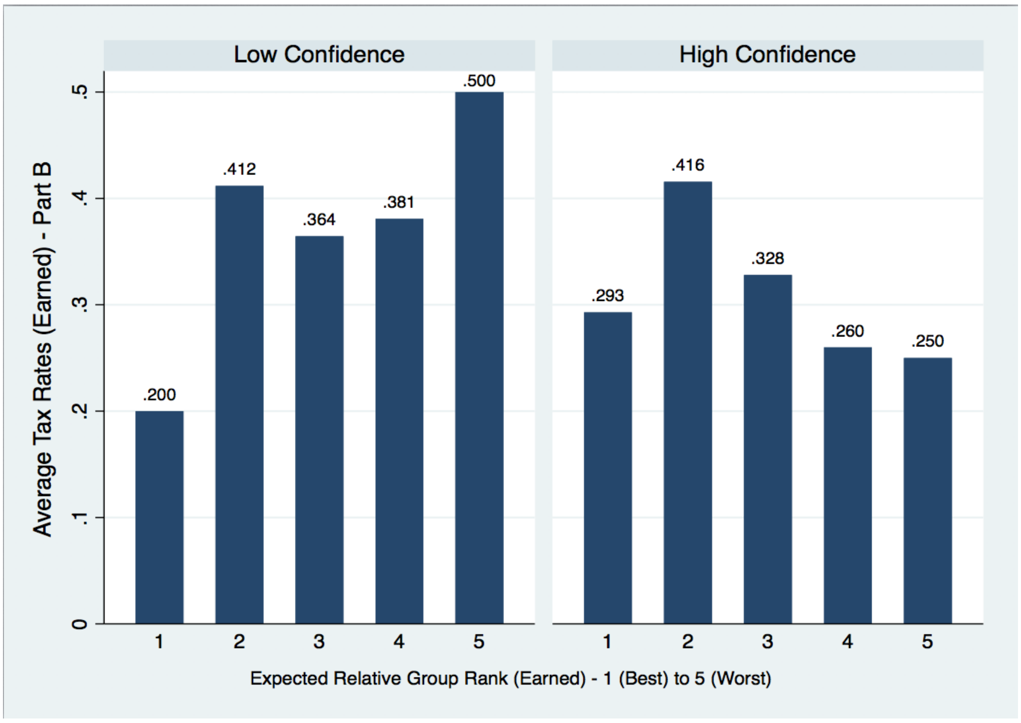


Figure 5.1 - The Impact of Expected Income on Demand for Redistribution for Individuals who Possessed Low and High Confidence in Their Expected Income Prediction

A further look at the data provides an explanation for this. Subjects' expected group ranks (and therefore expected income) before taking the quiz, as well as their confidence in this prediction were compared with their demand for redistribution for the "earned" Income Determination Method treatment. Tax choices for both Efficiency Loss treatments were used. Figure 5.4 reports average "earned" tax rates in Part B for each expected rank (1 being the best, up to 5 being the worst). Analysis is split by individuals who had a high and low level of confidence in their prediction (see Table 5.2 for a definition of the dummy variable reporting level of confidence in predicting expected income). For individuals who had low confidence in predicting their expected income, those expecting to be ranked better and therefore those who expected to earn more income opted for a lower rate of taxation. This conjecture would support Hypothesis 1a. The story is less clear for those with high confidence in predicting their expected income however. Referring again to Figure 5.4, an individual who was confident of being ranked first in their group in Part B of the experiment opted for a tax rate of 29.3% whereas an individual who was confident of being ranked last in their group opted for a lower rate (25.0%). This is counter-intuitive, as provided subjects were largely driven by income maximisation, as is suggested in the literature, one would expect those who are confident of earning high income to opt for less redistribution than those who were confident of being ranked last in their group. The distribution of those with 'high' confidence of predicting their income should therefore be more polarised than the distribution for those with 'low' confidence - and in an upward trajectory (from 1-5). Somewhat the opposite effect is observed. Hence, for subjects who had high confidence in predicting their income, there is no support for Hypothesis 1a and this would play a key role in determining why the null hypothesis of the MWU test was not rejected. Overall, H1a is therefore not supported in the data.

To further this analysis, Tobit regressions were observed. Column V of Table 5.3 shows Part B tax rates solely for decisions concerning the "earned" Income Determination Method (performance in the quiz). This was performed so that an analysis of expected income (predicted group rank based on performance in the quiz) and corresponding confidence of this prediction on preferred tax rates when income was earned could be undertaken. This specification therefore includes expected rank, confidence in predicting this rank and the interaction between the two variables. Results indicate that an individual with a low expected rank preferred more redistribution, but the coefficient on Expected Rank was insignificant, *ceteris paribus*, and no statistical inference could be drawn. Individuals with a high level of confidence in predicting their ranks, indicated by the Confidence Level (High/Low) variable, opted for more redistribution but this was also insignificant. The coefficients on the interaction of these two variables were also statistically insignificant, all else remaining the same. From these findings, there therefore existed no support for H1a.

Risk Aversion

Results from Part B also enabled Hypothesis 2a - *lower confidence in predicting income will result in a higher average tax rate when pre-tax income is determined by performance in the quiz,* to be tested. Referring to Column V of Table 5.3, the effect of confidence on average tax rates would theoretically be calculated by taking the sum of the coefficients on the Confidence Level variable and the Confidence*Expected Rank interaction term. None of these coefficients were significant however and thus, no significant causal inference could be drawn with regards to Hypothesis 2b, *ceteris paribus*. There was therefore no support in the data to suggest that under uncertainty, those with a higher perceived standard deviation of own income opted for higher redistribution as a form of social insurance. A result that contrasts evidence in the literature on the role of risk aversion in the demand for redistribution.

In DPV's paper, they found that when income was determined at random, subjects chose average tax rates 5 percentage points higher under Part II (where income involves the decision maker but is uncertain) than under Part I where the decision maker was "disinterested". They indicated that this finding was consistent with risk aversion and the social insurance motive. When a decision impacts the future payoff of a subject, the random income determination method results in a larger variability of future expected earnings than under "earned" methods where an individual is more under control of what they earn. Hence, one would expect an individual, assuming they are risk averse, to opt for a higher taxation when the decision affects their payoff under these criteria. In contrast to findings of DPV, the results of this experiment found the opposite. In this experiment, subjects opted for an average of roughly 3 percentage points higher (p=0.0312[11]) tax rates when income was determined at random in Part A than in Part B, suggesting that subjects took on more risk when the decision involved themselves.

Social Preferences - Efficiency Concerns

A pair of WSR tests were used to statistically show whether the Efficiency Loss (0 and 25%) treatment groups came from the same population. The results followed the same trend as in Part A whereby higher levels of efficiency loss resulted in lower demand for redistribution. For the Efficiency Loss treatment in Part B, a WSR test statistic of 4.312 was recorded with a p-value of 0.00, indicating a rejection of the null hypothesis. The population median differences between the 0% and 25% efficiency loss samples are significantly different from zero at the 1% significance level, *ceteris paribus*. In Part B subjects opted for average tax rates of 49.1% under no efficiency loss and this fell to 43.3% under 25% efficiency losses.

Similarities with results in Part A are further evidenced in Columns III, IV and V of Table 5.3. The coefficient on the Efficiency Loss variable is very similar to that in Part A and this is robust when individual controls are added in Columns IV and V indicating that the treatment had a similar effect on subjects' tax decisions when their decision

[11] This p-value refers to the results of the WSR test. This finding means one can reject the null hypothesis that population median differences equate to zero at the 5% significance level, *ceteris paribus*.

impacted their final payoff to when it did not. In Part B, the marginal effect of the Efficiency Loss treatment was very slightly smaller. For example, in Part B (Part A), subjects opted for an average tax rate that was 6.49 (6.76) percentage points lower under 25% efficiency losses compared to at 0% efficiency losses, *ceteris paribus.* This was statistically significant at the 1% significance level (p=0.00) and provides support for H3a

Social Preferences - Perceptions of Fairness

As in Part A, Figure 5.3 clearly shows that the interested yet uncertain decision maker in Part B opted for a largely higher average tax rate when pre-tax income was determined at random (56.5%) versus when it was determined when the subject earned their higher group rank (35.9%). The WSR test statistically confirms this difference. A test statistic of 10.473, with a p-value of 0.00, indicates a rejection of the null hypothesis at the 1% significance level, *ceteris paribus.* The population median differences between the "random" and "earned income determination method samples are significantly different from zero in this sample. Tobit regression analyses confirmed this finding further. On average, in Part B subjects preferred 20.97 percentage points lower tax rates when income was assigned based on performance in the quiz, compared to when income was allocated at random, *ceteris paribus*. This was also statistically significant at the 1% significance level (p=0.00). This means that for Part B, a situation where individuals were affected by their decision but were uncertain of future income, Hypothesis 4a – *demand for redistribution is stronger when pre-tax income is allocated at random rather than when earned* - is supported in the data.

The influence of perceived fairness of domestic tax systems on demand for redistribution was then tested - addressing Hypotheses 4b and 4c for Part B. In order to do so, the "Perceived PF" and "Perceived DF" variables in Column IV of Table 5.3 were observed. In Column IV, marginal effects for each were provided. An individual who had a high perception of procedural fairness of their local tax system preferred a lower level of redistribution and the opposite was found for perceptions of distributive fairness. Both of these coefficients were insignificant however, therefore no conclusions could be drawn, as was the case in Part A. Therefore, Hypotheses 4b and 4c could also not be addressed in Part B.

5.2.4 Part C (Interested and Certain Decision Maker)

In the final part of the experiment, subjects were aware of their ranks (and therefore pre-tax income) and were involved in their tax decision for all treatments. As in DPV, Figure 5.2 shows that on average, individuals opted for higher taxes in Part C than in the other

Parts. Considering Figure 5.3, it can be seen that the difference in tax rates occurred largely as a consequence of the "earned" income determination method.

Income Maximisation

To test Hypothesis 1b - *as certain absolute individual income increases, lower average tax rates will be chosen* - Part C tax choices for the "earned" and random income determination method were compared with a subject's group rank. As insurance concerns no longer played a role due to the fact that ranks were now certain, it was expected that demand for redistribution would be lower for those who were allocated a high rank and higher for those who received a low rank (in line with income maximisation). A MWU Test was undertaken to compare tax choices in Part C for those who had high certain absolute individual income (ranks 1 and 2) with those who had low certain income (ranks 3, 4 and 5). A p-value of 0.00 was recorded, indicating a rejection of the null hypothesis that the distributions of both populations are equal at the 1% level of significance, *ceteris paribus*.

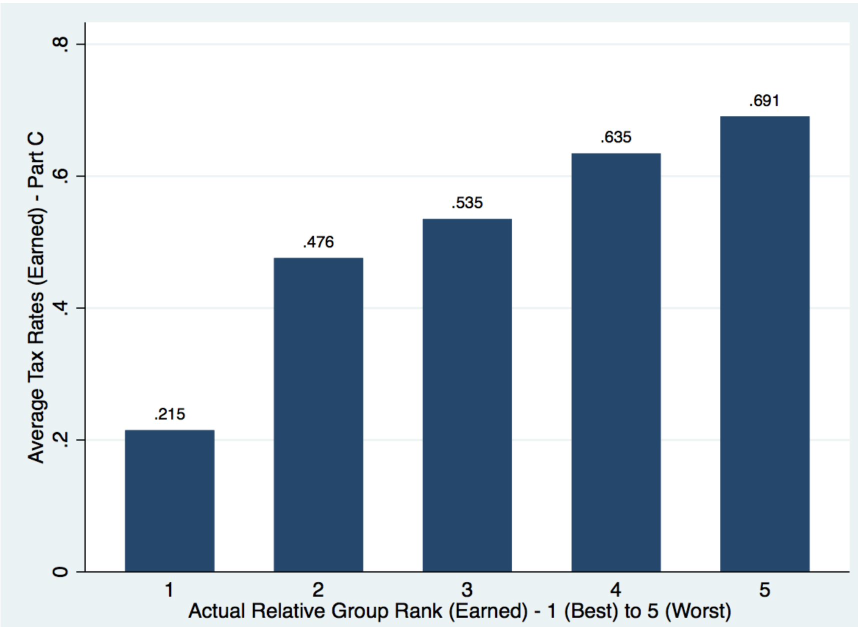


Figure 5.2 - The Impact of Certain Income on Demand for Redistribution Over Both Efficiency Loss and Income Determination Methods

Figure 5.5 depicts this difference and supports the conjecture that with a higher rank in Part C, subjects tended to opt for a lower tax on average. On average, a subject who was ranked number one in their group of five over both Efficiency Loss and Income Determination Method treatments chose a tax rate of 21.5%. This increased significantly to 47.6% for an individual who received the second highest rank in their group and an individual who received the lowest pre-tax income allocation opted for a tax rate of 69.1% on average. This supplements evidence from the MWU test providing support for H1b.

Risk Aversion

Risk aversion would be implicit if average tax preferences in Part B were greater than those in Part C (due to the fact that income goes from being unknown to certain). The opposite effect was observed in the data (see Figure 5.2 and Figure 5.3) however. An explanation for this can be found. Upon comparing an individual's predicted group rank based on their quiz score with their actual rank, it was found that subjects overestimated their rank on 57 occasions (42.22%), underestimated their rank on 41 occasions (30.37%) and were correct about their rank on 37 occasions (27.41%). This is indicative of the fact that subjects tended to overestimate their ability to perform well in many cases. Such over-optimism is widely discussed in the literature (see for example Smith, 1776, Book I, Chapter X; DeBondt and Thaler, 1995) and may provide some explanation for why the average subject had an appetite for risk taking.

Social Preferences – Efficiency Concerns

Efficiency losses had a sizeable impact on average tax rates in Part C. Figure 5.2 shows that subjects opted for an average tax level of 58.4% under 0% efficiency loss and 49.0% under 25%. A WSR test revealed a p-value of 0.00 with a test statistic of 7.757 indicating a rejection of the null hypothesis that the population median differences are zero, *ceteris paribus*. Rejection is at the 1% level of significance. This is evidenced even further by observing the Tobit regressions in Table 5.3. (Columns VI-VIII), which show that on average subjects opted for tax rates 10.3 percentage points lower when income was certain under a 25% Efficiency Loss treatment compared with a 0% Efficiency Loss treatment. This was statistically significant at the 1% level (p=0.00). There was therefore evidence in all Parts of the experiment to support Hypothesis 3a.

Social Preferences – Equality Concerns

In order to measure equality concerns and address Hypothesis 3b - *those with a concern for equality when the redistribution decision does not involve them will also when possess this concern when it does* - a comparison of tax decisions in Part A with those in Part C was undertaken. If individuals who opted for a high tax rate in Part A also opted for a high tax rate in Part C, this is an indication that subjects care about the incomes of others. If subjects change their preferences, for example, when allocated a high certain pre-tax income rank, they may not possess true concerns for equality. Column VIII of Table 5.3

presents the results of Part C tax rates on the coefficient of Part A Tax Choice, Efficiency Loss and Income Determination Method treatments as well as some individual control variables. The coefficient on Part A tax choice is positive and statistically significant at the 1% level, *ceteris paribus*. This implies that a higher Part A tax choice corresponds with a higher Part C tax choice on average, indicating that a 'detached spectator' who preferred a more equitable distribution when the decision did not affect them carried these preferences with them regardless of the effect it may have had on their personal income. This provides support for H3b.

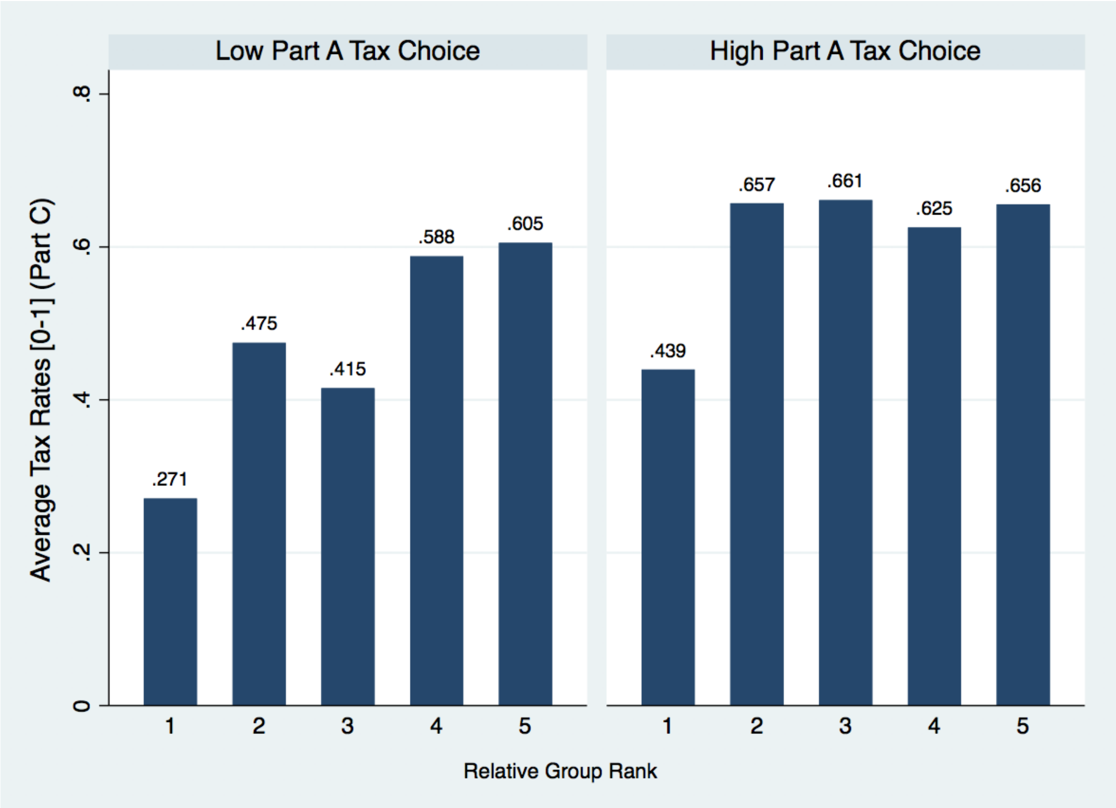


Figure 5.3 - A Comparison of the Influence of Part A Tax Choices (Split Into Both Those who Opted for a Low and High Tax Rate in Part A), on Part C Tax Choices by Relative Group Rank

To further this, Figure 5.6 compares Part C tax choices for each respective group rank for the "earned" income determination method of those who opted for a higher-than-median[12] - henceforth referred to as "High" - tax rate in Part A, with those who opted for a lower-than-median i.e. "Low" tax rate in Part A. Figure 5.6 shows that on average for each relative group rank, those who opted for a "High" Part A tax rate also opted for higher

[12] The median tax rate for Part A was 40%. As a result, those who opted for 40% and under were regarded as having opted for a "Low" Part A tax rate and those over 40% opted for a "High" Part A tax rate. Hence, these were split into the two panels shown in Figure 5.6 for a comparison.

tax choices in Part C than their counterparts who voted for "Low" Part A tax rates. This is particularly obvious for those who were awarded the highest group rank and corresponding pre-tax income in Part C. While those who opted for a "Low" Part A tax rate and who were awarded the highest payoff based on their performance in the quiz opted for an average Part C tax rate of 27.1%, their "High" Part A tax counterparts opted for a 43.9% tax rate on average. This difference is indicative of the fact that subjects who had concerns for the payoffs of others tended to maintain concerns for equality even when this resulted in a large reduction in their actual payoff. While this does not provide further statistical evidence for Hypothesis 3b, it supports evidence from the regression analyses.

Social Preferences - Perceptions of Fairness

Figure 5.3 reveals that on average in Part C, subjects opted for an average tax of 56.2% when income was allocated at random versus 51.2% when it was earned. This was by far the closest difference in average tax rates throughout each Part between "random" and "earned" income determination methods. Nonetheless, a WSR test confirmed systematic differences between average tax rates when income was earned via higher productivity versus when it was allocated at random. A p-value of 0.0097 and a test statistic 2.585 indicate a rejection of the null hypothesis that the population median differences are zero at the 1% level, *ceteris paribus.* A glance at Tobit regressions in Columns VI, VII and VIII of Table 5.3 supports these findings, although the level of statistical significance of the effect was lower than in Parts A and B. Subjects opted for 5.3 percentage points lower average tax rates when income was certain and was determined at random versus when it was determined due to performance in the quiz. This result was significant at the 10% level (p=0.06), all else remaining the same. This provides further support for Hypothesis 4a - *demand for redistribution is stronger when pre-tax income is allocated at random rather than when earned*.

The influence of perceptions of fairness of domestic tax systems on demand for redistribution was then tested for Part C - to address Hypotheses 4b and 4c. In order to do so, the "Perceived PF" and "Perceived DF" variables in Column VII of Table 5.3 were observed. As in Parts A and B, an individual who had a high perception of procedural fairness of their local tax regime preferred a lower level of redistribution and the opposite was found for perceptions of distributive fairness. Both of these coefficients were once again insignificant however, *ceteris paribus,* therefore no conclusions could be drawn with regards to causal inference. Therefore, Hypotheses 4b and 4c could also not be addressed in any of Parts A, B or C.

5.2.5 Summary of Hypothesis Tests and Results

Hypotheses	Testing Method	Result
H1a – *as uncertain absolute individual income increases, lower average tax rates will be chosen*	1. Mann-Whitney U test comparing Part B "earned" tax choices of those with "High" (1 and 2) expected "earned" ranks versus "Low" (3, 4 and 5) expected "earned" ranks. 2. Tobit regression, (Column V of Table 5.3) - Expected Rank on average "earned" tax rates.	Null hypothesis not rejected in both tests; no support for H1b.
H1b – *as certain absolute individual income increases, lower average tax rates will be chosen*	Mann-Whitney U test comparing "High" (1 and 2) versus "Low" (4 and 5) Part C ranks and average tax rates.	Null hypothesis rejected; support for H1b.
H2a – *lower confidence in predicting income will result in higher demand for redistribution*	Tobit regression (Column V of Table 5.3) - effect of Confidence Level on Part B "earned" average tax rates.	Null hypothesis not rejected; no support for H2a.
H3a – *efficiency loss will always result in lower demand for redistribution*	Wilcoxon test and Tobit regression	Rejection of null hypothesis in both tests; support for H3a.
H3b – *those with a concern for equality when the redistribution decision does not involve them will also possess this concern when it does*	Tobit regression (Column VIII of Table 5.3) – influence of Part A tax choices on Part C tax choices.	Rejection of null hypothesis; support for H3b.
H4a – *demand for redistribution is stronger when pre-tax income is allocated at random rather than when earned*	Wilcoxon test and Tobit regression	Rejection of null hypothesis in both tests; support for H4a.
H4b – *lower perceptions of distributive fairness of domestic tax systems result in higher demand for redistribution*	Tobit regressions (Columns II, IV, VII of Table 5.3) Perceived DF variable	Null hypothesis not rejected; no support for H4b.
H4c – *lower perceptions of procedural fairness of domestic tax systems result in higher demand for redistribution*	Tobit regressions (Columns II, IV, VII of Table 5.3) Perceived PF variable	Null hypothesis not rejected; no support for H4c.

This concludes statistical testing of the Hypotheses detailed in Sections 3 and 4.

5.3 Structural Estimations and the Extent of Motives for Redistribution

In Section 5.2 it was determined that social preferences play an important role in driving demand for redistribution. Now, to understand the relative utility weight the average subject placed on social preferences in the demand for redistribution, parameters of

Equation (1) were estimated. As the model does not include a process-based theory of fairness, modelling the influence of perceptions of fairness on demand for redistribution was not achievable. The Conditional Logit Model (CLM) was used to generate structural estimates for the parameters of Equation (1). It was chosen as the CLM is appropriate to model a situation where a choice among alternatives is a function of characteristics of the alternatives as opposed to, or as well as, the characteristics of the individual who is making the choice, as is the case with individual preferences with regards to choosing rates of taxation. The CLM is particularly useful for observing problems where individual choices are based at least partly on observable characteristics of each alternative, which in the case of this experiment, are different tax rates. The utility received from each choice is a linear function in choice attributes. In the case of this study, the utility function u_{it}, as in Equation (1), is estimated as:

$$u_{it} = \beta_1 Ey_{it} + \beta_2 \sigma_{y_{it}} + \beta_3 y_t^{min} + \beta_4 \sum_j y_{jt} \quad (5)$$

where regressors are the variables discussed in Equation (1). This model was used to forge a likelihood function whereby estimates for β_1 through β_4 were constructed via maximum likelihood estimation. Subsequently, in order to then derive utility weights for the parameters in Equation (1), non-linear transformations were conducted on $\widehat{\beta_1}$ through $\widehat{\beta_4}$. These transformations were provided in DPV and are reported in Equation (6).

$$\lambda = \frac{\widehat{\beta_3} + \widehat{\beta_4}}{\widehat{\beta_1} + \widehat{\beta_2} + \widehat{\beta_3} + \widehat{\beta_4}}, \gamma = \frac{\widehat{\beta_2}}{\widehat{\beta_1} + \widehat{\beta_2}}, \delta = \frac{\widehat{\beta_3}}{\widehat{\beta_3} + \widehat{\beta_4}} \quad (6)$$

For detail on CLM background, theory and model limitations, please refer to Appendix F.

5.3.1 CLM - Method

Data was pooled for Parts A, B and C such that a post-tax value for each variable in Equation (5) was calculated for each alternative $\tau \in \{0, 0.1, \ldots, 1\}$, for each subject, each income determination method and each level of efficiency loss. This meant that for one subject, there existed the product of eleven observations for each alternative {0, 0.1, ...1}, by three Parts of the experiment, by two Efficiency Loss treatments (0 vs. 25%) and by two Income Determination Methods (random vs. earned). Hence, there were 132 observations per subject and a total of 17,820 observations in the structural estimation dataset.

In order to generate the independent variables in Equation (5), a unique value for each of the 17,820 independent observations had to be created for the following variables. Given each alternative tax rate $\tau \in \{0, 0.1, \ldots, 1\}$, an individual's own income Ey_{it} was calculated for each Part, Income Determination Method and Efficiency Loss level. The same was conducted for the standard deviation and perceived standard deviation of own income $\sigma_{y_{it}}$, the minimum post-tax income in a group y_t^{min} and the aggregate after-tax income of the group $\sum_j y_{jt}$.

As well as observing the effect of standard deviation of own income, as in DPV, this study also observes the impact of the perceived standard deviation of own income on the demand for redistribution. Subjects may have different perceptions of risk regarding their future income and thus have affected their choices. The perceived standard deviation of own income was related to the standard deviation of own income in the following way. For Part A, income for a given subject was fixed at £20.23. For Part B, where individuals were unsure of their own income, an uncertainty index was calculated. If an individual recorded a level of confidence of their predicted income of 1 or 2 (very unconfident or somewhat unconfident) they were allocated an index score of 1. If they reported a confidence of 3 (neither unconfident nor confident), they were allocated an index score of 2. If they scored a 4 or a 5 (somewhat confident or very confident), they were allocated an index score of 3. The following calculation was then performed for each subject: *uncertainty=(4-index_score)/4.* This resulted in an individual who scored a higher index score (3) receiving an uncertainty index of 0.25. Low confidence individuals would score 0.75 and medium confidence would score 0.5. After generating an index for uncertainty, this number was multiplied by actual standard deviation of own income for each tax rate to give a perceived standard deviation of own income variable. This means that for an individual with low confidence in predicting their future income, they would have a higher perceived standard deviation of own income than someone who was confident.

The calculations for each variable were conducted in Excel using *-IF-* and *-HLOOKUP-* functions, which drew reference from post-tax allocations under 0% and 25% Efficiency Loss treatments provided in Tables 4.2 and 4.4. An overview of the method of calculating independent variables is presented in Table 5.4. After calculating each of the variables and repeating for each independent observation, the data was checked repeatedly and also by a third party to ensure that it was correctly calculated. As part of ensuring rigour in analysis, DPV's dataset was compared with this dataset in order to check to see if calculations for each of the variables as well as the code used to run regressions matched theirs; this was confirmed.

Table 5.4 - Method of Calculating Independent Variables

	Expected Income	**Standard Deviation of own Income**	**Minimum Income**	**Aggregate Income**
	Ey_{it}	$\sigma_{y_{it}}$	y_t^{min}	$\sum_j y_{jt}$
Part A	• Fixed at random draw in the interval £20-21 - the random draw was £20.23.	• Fixed standard deviation of 0.23. (£20.23 - the average £20.00)	• Minimum possible group income for each alternative tax rate, given efficiency loss of 0% or 25%.	• Total group income for each alternative tax rate given efficiency loss of 0% or 25%.
Part B	• For the "random" income determination method, own income for each alternative was determined by a subject's rank for "random" for both efficiency loss groups • For "earned", subjects were allocated the rank they predicted they would be with regards to how well they thought they would do in the quiz - this was applied to both efficiency loss treatments.	• The standard deviation of all incomes at each alternative was calculated for both efficiency loss levels.	• Minimum possible group income for each alternative tax rate, given efficiency loss of 0% or 25%.	• Total group income for each alternative tax rate given efficiency loss of 0% or 25%.
Part C	• For the "random" income determination method, a subject's rank for 'random' income determination was applied to each alternative tax rate for both efficiency loss treatments • For "earned", subjects were allocated their rank based on their quiz score and this was applied to both efficiency loss treatments.	• Standard deviation of own income was zero for all treatments due to the fact that income was certain.	• Minimum possible group income for each alternative tax rate, given efficiency loss of 0% or 25%.	• Total group income for each alternative tax rate given efficiency loss of 0% or 25%.

5.3.2 CLM - Results

The CLM was run in STATA using the *-asclogit-* command. Results are reported in Table 5.4. The dependent variable was a subject's tax choice which was a binary variable that equated to one for the tax rate they chose $\tau \in \{0, 0.1, \ldots, 1\}$ and zero for each of the ten alternative tax choices for each given Part, income determination method and efficiency loss level. Independent variables were as discussed: own income, standard deviation of own income, minimum income and aggregate income for regressions I, II and III and standard deviation of own income was replaced with perceived standard deviation of own income for regressions IV, V and VI. Cluster-robust standard errors were applied at the individual level. Estimates were presented based on all data (in Columns I and IV) and they were also split between the two income determination methods. Additionally, estimates from DPV are reported in Column VII.

When estimations for "all" data as well as for the "random" income determination methods were considered, the coefficient on Expected Income Ey_{it} was positive and significant at the 1% significance level in each case, *ceteris paribus.* Under the "earned" income determination method it remained positive but became much smaller and lost any level of significance however (see Columns III and VI). All coefficients on Standard Deviation of Own Income and Perceived Standard Deviation of Own Income $\sigma_{y_{it}}$ were positive, which is indicative of the fact that subjects were indeed risk seeking, but none were significant at any level of significance, *ceteris paribus.* No conclusions could therefore be drawn on causation. Coefficients on Minimum Income y_t^{min} were all positive and significant at the 1% level and all coefficients on Aggregate Income $\sum_j y_j$ were negative and significant at the 1% level, *ceteris paribus.*

Estimates for the λ parameter were positive and statistically significant at the 1% level of significance under every specification. This provides yet further evidence that the social preferences defined in Equation (1) – efficiency and equality concerns – played an important role in the demand for redistribution. This supports Hypotheses 3a and 3b. The remaining parameter estimates for γ revealed positive estimates and in Column VI where income was determined by performance in the quiz, the coefficient was statistically significant at the 5% significance level, *ceteris paribus*. This implies that under the 'earned' income determination method, individuals placed a sizeable importance on lowering the perceived standard deviation of own income relative to maximising their expected income. The δ parameter is positive and statistically significant at the 1% significance level for all regressions other than Column III, *ceteris paribus*. Importantly however, the estimate for δ fell out of the [0,1] range in every specification due to the fact that estimates for $\beta 4$ were all negative. Reasons behind this are discussed in Section 6.1. Relative utility weights therefore could not be interpreted for any specification.

Table 5.4 - Equation (1) Utility Function Parameter Estimates

	Coefficient	All (I)	Random (II)	Earned (III)	All (IV)	Random (V)	Earned (VI)	All (DPV) (VII)
Expected Income	$\beta 1$	0.0282***	0.0396***	0.0125	0.0283***	0.0395***	0.0131	0.0223***
		(0.0074)	(0.0092)	(0.01154)	(0.0075)	(0.0092)	(0.0115)	(0.018)
St. Deviation of Income	$\beta 2a$	0.0080	0.0024	0.0087				-0.006
		(0.0100)	(0.0111)	(0.0096)				(0.005)
Perceived St. Dev. Of Income	$\beta 2b$				0.0229	0.0088	0.0254	
					(0.0250)	(0.0274)	(0.0242)	
Minimum Income	$\beta 3$	0.0800***	0.0807***	0.0796***	0.0810***	0.0814***	0.0807***	0.019*
		(0.0156)	(0.0146)	(0.0158)	(0.0160)	(0.0158)	(0.0162)	(0.011)
Aggregate Income	$\beta 4$	-0.0273***	-0.0285***	-0.0254***	-0.0275***	-0.0287***	-0.0257***	0.0025
		(0.0056)	(0.0057)	(0.0057)	(0.0057)	(0.0057)	(0.0057)	(0.003)
λ		0.5925***	0.5541***	0.7194***	0.5106***	0.5221***	0.5885***	0.084*
		(0.1357)	(0.0885)	(0.1557)	(0.1216)	(0.1430)	(0.1729)	(0.047)
γ		0.2212	0.0577	0.4098	0.4474	0.1826	0.6598**	0.027
		(0.5971)	(0.2511)	(0.3294)	(0.2802)	(0.4681)	(0.2723)	(0.023)
δ		1.5187***	1.5468***	1.4690	1.5149***	1.5433***	1.4674***	0.881***
		(0.1167)	(0.1223)	(0.1115)	(0.1156)	(0.1218)	(0.1104)	(0.106)
Observations		17,820	8,910	8,910	17,820	8,910	8,910	35,948
Cases		1620	810	810	1620	810	810	3268
Log PseudoL		-3752.1003	-1865.1445	-1883.0892	-3751.6416	-1865.0981	-1882.8038	-7275.5019

Notes: Cluster-robust standard errors are reported in parentheses under coefficients. Coefficients and standard errors are reported to 4 decimal places. *** represents significance at the 1% level (p<0.01), ** represents significance at the 5% level (p<0.05), * represents significance at the 10% level (p<0.1). Standard errors for λ, γ and δ were computed using the delta method which is built into the *-nlcom-* command in STATA. Evidence for STATA output of Column I is in Appendix H.

It is possible to transform utility parameter estimates of the modified C&R (2002) multiplayer model - Equation (1) - into estimates of their original two-player C&R model in order to garner a like-for-like comparison between the results presented in this Section, with DPV's results and the original results from C&R. In order to directly compare results, the λ, γ and δ parameters must be converted into the σ and ρ parameters of the two-player model. In the two-player model, ρ captured the weight that the individual with the most wealth placed on the income of the individual with the least. σ measured the utility weight the least wealthy individual places on the income of the most wealthy. C&R (2002, p.852) detailed a method of transforming coefficients of the multiplayer model into that of the two-player model, suggesting:

$$\rho = \frac{\lambda}{(1+\lambda(1-\delta))} \text{ and } \sigma = \frac{\lambda(1-\delta)}{1+\lambda(1-\delta)} \qquad (7)$$ [13]

These transformations may be interpreted as follows. When an individual places more weight on social good versus their own, i.e. when λ increases, both ρ and σ also increase. When δ increases, i.e. when an individual places an increasing importance on the income of the least wealthy versus aggregate income, ρ increases and conversely, σ falls. As λ and δ are statistically significant in the base regression where both income determination methods were considered, given in Column I of Table 5.4, estimates from this specification were used. The λ coefficient was therefore 0.7145 and the δ coefficient 1.5187. Due to the fact that the δ coefficient falls out of the limits $[0,1]$, transformations for ρ and σ were unfortunately not interpretable, hence a direct comparison of estimates from C&R and DPV with those in this paper could not be made.

[13] Note, the γ parameter is not included due to the fact that it was added to Equation (1) by DPV in order to capture the influence of risk preferences, but it was not present in the original C&R models.

6 Discussion

The aim of this paper was to examine the extent to which social preferences play a role in driving demand for redistribution. In the literature on demand for redistribution, income maximisation, risk aversion and social preferences are highlighted as important drivers of demand for redistribution. These were subsequently modelled using a modified C&R utility function, Equation (1). Using experimental evidence, a combination of empirical predictions of Equation (1) and established evidence from the literature were tested on a sample of 135 subjects. The parameters of Equation (1) were estimated to derive relative utility weights of each determinant of demand for redistribution and to develop an understanding of the extent to which social preferences drive demand for redistribution. This section consists of a comparison of the results with established findings in literature, followed by a discussion regarding external validity of the experiment and suggestions for future research.

6.1 Comparison of Findings with the Existing Literature

Income Maximisation

This experiment revealed that an increase in certain absolute individual income resulted in lower demand for redistribution, which is in line with predictions of traditional politico-economic models of redistribution - see Meltzer and Richard (1981), for example. However, there was no evidence to suggest that subjects who *expected* to earn higher absolute individual income preferred a lower level of redistribution when income was uncertain, as hypothesised. A comparison of individuals with high and low confidence in predicting their future income showed that individuals with low confidence preferred lower rates of taxation with increasing expected income. This fell in line with hypotheses. Surprisingly however, those with high confidence in earning the highest level of income (29.3% average tax choice) opted for more redistribution than those who had high confidence of earning the lowest level of group income (25.0% average tax choice), as illustrated in Figure 5.4. This finding was surprising as one would normally expect those who were very confident of earning the highest bracket of income to opt for lower tax rates than those who were very confident in expecting the lowest, particularly if income maximisation plays an important role in driving demand for redistribution as is documented widely in the literature (see DPV as one example). This indicates that subjects in this sample were potentially concerned with factors other than those influencing solely their own outcomes. A purely rational "*homo economicus*" agent would likely not act in this manner.

Risk Aversion

The impact of risk aversion on demand for redistribution was tested by comparing subjects with low confidence in predicting future income with those who had high confidence in their ability to predict their future income. The intuitive expectation being that an individual who was very confident of predicting their income would have a lower perceived standard deviation of own absolute income than an individual with low confidence in their ability to predict future income. This test revealed no evidence to suggest that individuals with a higher perceived standard deviation of own income preferred higher tax rates, as was hypothesised. Contrary to much of the literature on the role of risk aversion in the demand for redistribution (Beck, 1994; Alesina and La Ferrara, 2005; Alesina and Giuliano, 2010 and Gärtner *et al.*, 2017), there was no evidence to support the role of risk aversion in the demand for redistribution. Furthermore, an attempt to run structural estimations of Equation (1) - provided in Section 5.3 - indicated that all coefficients on Standard Deviation of Own Income and Perceived Standard Deviation of Own Income $\sigma_{y_{it}}$ were positive, indicative of the fact that subjects were actually risk seeking, but none were significant at any level of significance, *ceteris paribus.* This reinforced the lack of evidence in this paper for the role of risk aversion in determining demand for redistribution. A glance at the data showed that subjects actually opted for higher rates of taxation on average when income was certain (in Part C) than when income was uncertain (Part B), further supporting the notion that risk aversion had a negligible role in driving demand for redistribution in this experiment.

A potential explanation for this can be found by observing evidence that subjects tended to overestimate their future level of income. Of the 135 total subjects, 57 overestimated their future income before taking the quiz at the end of Session 1. This suggests that subjects may have been overconfident of their chances or ability to perform well in the task and thus may have opted for lower tax rates than a rational economic agent might. There is ample evidence of overconfidence in the literature - Werner DeBondt and Richard H. Thaler (1995) notably remarked: *"Perhaps the most robust finding in the psychology of judgment is that people are overconfident".* DPV similarly documented a tendency for subjects in their experiment to display such overconfidence, yet they found evidence for the role of risk aversion in driving demand for redistribution. There are a few possible reasons for this result: subjects in DPV's experiment were required to display their risk preferences via a multiple price list where real money was at stake. This represents an improved method of eliciting risk preferences than the one in this research for two reasons. Firstly, a more precise measurement of risk preferences can be made using a multiple price list versus the 7-point scale used in the design of this experiment (see Appendix A). Many individuals opted for moderate risk preferences (40.74% of subjects opted for "Somewhat Willing" to take risks, for example) meaning that variation in the Risk Propensity variable, defined in Table 4.3, was not high and this could have affected results substantially. Secondly, as the risk preference elicitation method was an incentivised task in DPV, subjects likely opted for choices more aligned with their true preferences as a result of superior control through satisfaction of the five precepts for sufficient microeconomic experimentation (Smith, 1982).

Social Preferences

Tests on the influence of social preferences in driving demand for redistribution included analysing the roles of efficiency and equality concerns as well as the role of perceived fairness. Consistent with the literature on demand for redistribution, in every scenario, introducing efficiency losses resulted in lower demand for redistribution. This corroborates findings in the experimental literature on demand for redistribution (Beckman, Formby and Smith, 2004; Krawczyk, 2010 and DPV).

Additionally, those who preferred greater redistribution in Part A (when the decision on how much income to redistribute did not affect them) also preferred greater redistribution in Part C (when they were involved, and their income was known). This was firstly shown statistically through the fact that Part A tax rates had a positive and significant effect on Part C tax rates. This finding was consistent with DPV. This was then illustrated further by the following example. An individual who opted for a lower-than-median tax rate in Part A and was ranked in the highest income bracket for either income determination method (ranked number one in the group) in Part C opted for an average Part C tax rate of 27.1%. On the other hand, Part C highest income bracket earners for either income determination method who voted for a higher-than-median Part A tax rate chose a tax rate of 43.9% on average. This was illustrated in Figure 5.6 and reflects a large difference in preferences between the two sets of individuals. This result implies that those who cared about equality in Part A when their tax decision did not affect them continued to do so even when it meant they would lose a significant portion of their known post-tax payoff. Analysis from Section 5.2 was therefore consistent with DPV's findings indicating that subjects were indeed concerned with equality considerations.

Perceptions of Fairness

To further understand the role of perceptions of fairness in driving demand for redistribution, testing found that subjects consistently showed an increased appetite for redistribution when income was determined through means of good fortune than when income was earned by a proxy for productivity - performance in a quiz. This is indicative of individuals caring about the means by which income is distributed, corroborating a large body of literature on the role of perceptions of distributive fairness in the demand for redistribution (for example, Alesina and Angeletos, 2005). However, when another means of testing the influence of distributive fairness was used - which analysed subjects' perceptions of the distributive fairness of local tax systems by asking questions to subjects designed by Verboon and Goslinga (2009) - no significant result was reported. As a consequence, this study was unable to reinforce existing evidence showing that individuals with low perceptions of distributive fairness consequently prefer higher redistribution.

An attempt was then made to address the gap in the literature regarding the role of perceptions of procedural fairness of domestic tax systems in driving demand for redistribution - left as a result of inconclusive results from Krawczyk (2010). Tests, which again used questions designed by Verboon and Goslinga (2009) to elicit perceptions of procedural fairness of local tax regimes, again found no significant effect on demand for redistribution. Table 5.3 indicated that subjects who had high perceptions of procedural fairness tended to opt for lower rates of redistribution on average, as hypothesised. However, none of these results were statistically significant, no causal inference could therefore be made. As both "Perceived PF and DF" variables measuring fairness rendered insignificant results, a more comprehensive means of addressing distributive and procedural fairness would provide a useful contribution to existing research. In this study, only two questions were asked for each measure in order to shorten time subjects spent undertaking the quiz. Verboon and Goslinga (2009) on the other hand incorporated six items to measure distributive fairness and seven items to measure procedural fairness. This suggests a more in-depth measurement of perceptions of fairness may indeed have been preferable.

Structural Estimations and the Extent of Motives for Redistribution

After testing the hypotheses, parameters of Equation (1) were estimated in order to support findings from Section 5.2 and importantly also to address the central research question in understanding the extent of social preferences on the demand for redistribution. To estimate the parameters of Equation (1), the coefficients of Equation

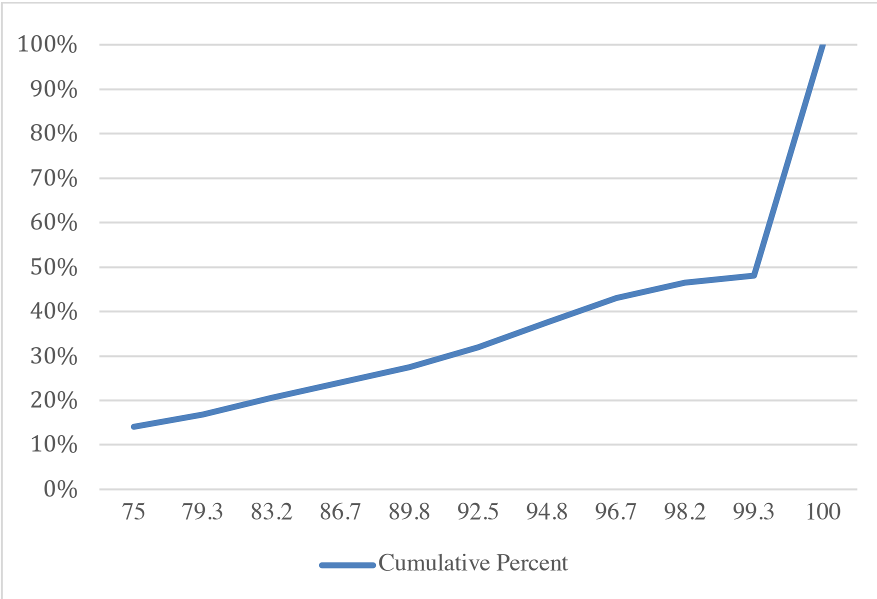
(5) were estimated and then transformed according to Equation (6). Coefficients of Equation (5) were estimated using conditional logit estimation and they showed that in this study, individuals care positively about maximising expected income. This was particularly salient when inequality was determined at random. When inequality was determined when income was "earned", however, this result became insignificant.

This likely occurred as a result of a combination of reasons. As a result of the experimental design, 80% of subjects in a given group benefitted from opting for levels of redistribution tending towards 100% (see Tables 4.2 and 4.4). Only the top ranked player in each group benefitted from extremely low levels of redistribution. Under the "random" income assignment method, subjects may have been inclined to question why anyone else is more entitled than them to earn high levels of income, subsequently shifting their reference point for this income assignment method and opting for higher levels of redistribution. Under the "earned" income determination method, subjects may have accepted lower personal incomes and opted for a lower tax rate (as they believed those who earned high levels of income should not be punished based on higher levels of productivity). If this conjecture is true, it points to another example in the data of the influence of perceptions of fairness and social preferences on the demand for redistribution.

The Standard Deviation of Own Income as well as Perceived Standard Deviation of Own Income had positive coefficients which was surprising, although these results were not significant. This followed from evidence in Section 5.2.3. Nonetheless, the direction of the effects contradicted findings of DPV. A possible reason for this may have been due to overconfidence, either through over-optimism or miscalibration. As discussed, an analysis of expected group ranks versus actual group ranks indicated that subjects showed signs of underestimating their income risk and overestimating their prospects of earning a high income via being awarded a high group rank. This may go some way to explaining why subjects did not show a dislike for income risk, which would have been expected (Beck, 1994; DPV).

Subjects expressed a concern for the income of poorest member of their group, and this was statistically significant in all specifications, which supported the fact that subjects in the sample do indeed care about equality. Finally, the coefficients on Aggregate Income ($\beta 4$) in Table 5.4 were negative and statistically significant across all specifications which contradicts much of the literature on the role of efficiency concerns in the demand for redistribution (Browning, 1993 and DPV for example). In an attempt to explain this, a comparison of data on aggregate income preferences for this paper (Panel A) and DPV (Panel B) was made and is depicted in Figure 6.1. This considers the total group income after each tax choice for all subjects over both income determination methods. The total group income is displayed on the ‘x’ axis and the ‘y’ axis represents the corresponding cumulative percent of choices. A comparison of Panel A and B shows that subjects in DPV’s experiment (Panel B) opted for the highest group income allocation (396 USD) in around 63% of instances.

Panel A



Panel B

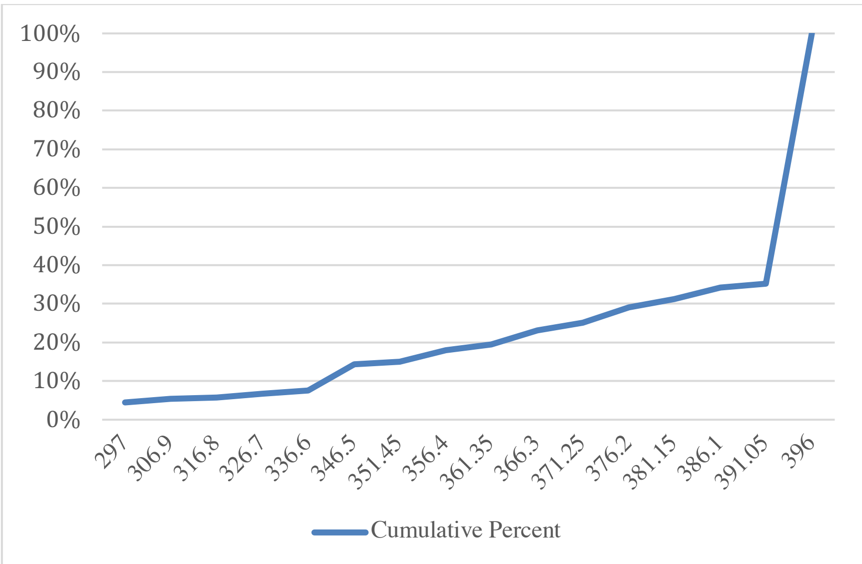


Figure 6.1 - A Comparison of Cumulative Aggregate Incomes Between This Paper (Panel A) and DPV (Panel B)

Whilst Panel A indicates that subjects in this study opted for the highest level of group income (100 GBP) on just over 50% of occasions. This suggests that subjects in this study were far less sensitive to the efficiency losses related to redistribution. This may have occurred for a few reasons. Firstly, subjects in this study may simply have had more of a concern for an equitable distribution than those in DPV's study. Another possible explanation for this result can be derived by comparing pre-tax payoff distributions of the two surveys. In this survey, groups were split into five. Only the highest ranked subject benefitted from opting for a tax rate of 0% in this instance. On the other hand, groups in DPV's study were sized at 20 subjects, with more beneficiaries from opting for lower levels of redistribution. In this study, as only the highest ranked individual received a large pre-tax payoff and the rest received similarly low payoffs, subjects may have decided to punish the good fortune of this individual due to jealousy, despite the efficiency losses incurred. In DPV's study, as higher redistribution would have negatively impacted a number of subjects, there may have been less incentive to opt for this punishment in the face of efficiency losses.

After estimating coefficients of Equation (15), these estimates were then transformed to derive parameters of the C&R utility function - Equation (1). Consistently, the social concern (λ) coefficient was positive and statistically significant, providing further evidence that social preferences play an important role in demand for redistribution and corroborating findings in DPV. The γ variable, which measures the extent to which an individual prefers to reduce risk versus increasing expected income, was only significant in Column V of Table 5.4 when income was earned and the perceived standard deviation of own income was used instead of actual standard deviation of own income. This is a surprise considering one would expect a subject to place more importance on mitigating risk for the "random" income determination methods. Finally, the δ variable, which captures the extent to which subjects are concerned with the payoff of the poorest in the group versus aggregate efficiency concerns, was observed. None of the specifications delivered an estimate that could be interpreted as a relative utility weight as all estimates for the δ variable were greater than one. This occurred mainly due to the fact that the coefficient on Aggregate Income was negative over all specifications, as discussed above. This drove the δ variable to be greater than one in every instance. It was therefore not possible to derive relative utility weights for any specification and no direct comparison could be drawn to DPV or C&R. The extent of social preferences on demand for redistribution relative to the other noted sources of demand for redistribution therefore could not be determined.

6.2 External Validity

A key question in experimental economics is whether or not results from experimentation can make reliable inferences about real-world behaviours (Levitt and List, 2007). A discussion of the external validity of this experiment including its limitations as well as methods of ensuring experimental rigour is considered below.

6.2.1 Experiment Limitations

One limitation of the within-subject design was the possibility of order effects (Charness, Gneezy and Kuhn, 2011). Order effects may occur if individuals tend to use their decision from the first scenario as a base for later scenarios. The order of scenarios was the same for each subject which may have biased results. For example, those who opted for perfect payoff equality in Part A may have felt compelled to opt for perfect payoff equality in the case where it affected them as well, but this may not have truly reflected how the subject would have acted in reality. If the order was switched, it is quite possible that different choices would have been made. Another potential issue with the experiment design was that the subjects had to fill out a second-stage survey. 40 subjects out of an initial 175 did not complete the second stage of the experiment. If the individuals who did not respond to the second stage differed systematically from those who completed the experiment, non-response bias may have distorted results. Also, the experiment was a single blind experiment in the sense that individuals did not reveal their identities, only their email addresses. For some, emails included subjects' names and therefore these subjects were aware that the experimenter would be able to see their responses and, therefore, perfect anonymity was not upheld in all cases. This gives rise to the possibility of the experimenter demand effect in which subjects' behaviours change as a result of hints about what may constitute appropriate behaviour (Zizzo, 2010). Ideally, perfect anonymity would have been upheld via a double-blind experiment.

Another potential limitation of the experimental set up were the stakes of the game. The chosen incentive structure was a random lottery incentive paid at the end of the experiment to a random DDM_i and their respective group. The expected value of winning the lottery was on average around 20 pounds sterling, and only five of the total 135 subjects would have had the opportunity to receive this based on the incentive structure. Due to the fact that the chances and stakes of winning were fairly low, this may have reduced incentives for subjects to select true preferences. For example, this may have particularly impacted subjects' risk preferences.

Online experiments are subject to a number of confounding factors that may skew results. There is no way of observing how seriously a subject read instructions of the experiment or whether they could have been distracted. In contrast, this would have been easier to control in a laboratory setting. Subjects may also not have believed that they were going to be paid at the end of the experiment and this may have influenced their preferences further. In addition, using a multiple price list would have resulted in a more precise understanding of risk preferences as mentioned. If the experiment were conducted in a laboratory setting, this could have been conducted. However, in order to save time and reduce potential drop-out rates, it was decided on to opt for a quicker method of eliciting risk preferences. Also, 45% of the subject pool were aged 23 or 24. While analysing this age group enabled a direct comparison to DPV, a more evenly distributed age representation may have delivered results more representative of the wider population.

Finally, a handful of individuals reported difficulty in understanding some technical terms, such as the concept of tax effects and efficiency loss. Ideally, these effects would have been explained verbally and diagrammatically as well as in table format. This could have been achieved more reliably in a laboratory setting. As well as having the capacity to explain tax effects in more detail, DPV noted that 85% of their subjects had undertaken two or more courses in Economics. 53% had studied two or more economics courses in this study. Economics students may have found it easier to interpret the tables used in the experiment as well as understand the concept of the method of taxation.

6.2.2 Experiment Rigour

A number of methods were applied to enhance the validity of the experiment. Subjects were randomised into groups in order to control for selection bias. Also, Parts A, B and C were ordered specifically from “disinterested” to “interested yet uncertain” and then finally to “interested and certain” as it was felt that the impartial decision should importantly not be anchored by any decision where self-interest was a motivation. In order to address issues relating to difficulty understanding technical terms, a clear explanation of the effects of each level of taxation and a clear explanation of efficiency loss was provided, referring to values in Tables 4.1 and 4.2. Additionally, a pilot survey was sent to a number of individuals prior to running the experiment, none of whom had worked in economics or finance. Minor amendments were made after reviewing the comments made by these individuals, for example, some of the wording of certain questions were changed to include less technical jargon. Steps were therefore taken to ensure that the experiment was understandable for as many people as possible.

In order to mitigate nonresponse bias and retain as many subjects as possible between Sessions 1 and 2, a series of personalised emails were sent to individuals with regular reminders for those who had not completed Session 2. Session 2 was also designed to be very short to incentivise individuals to complete it. To reduce possible subject error filling out the survey, subjects were asked to re-input their group ranks for both income determination methods at the start of Session 2 to confirm that they had correctly understood them. They were also asked to confirm their email in both sessions in order to reduce the possibility of Session 2 being sent to the wrong address. Furthermore, the fact that the experiment was conducted online and that results were all recorded electronically in a single database reduced chances of potential error. If data were recorded manually, there would have been more potential for mistakes in the data.

A monetary incentive was implemented in order to control for bias that could have occurred as a result of intrinsic motivations. The chosen incentive structure was a random lottery incentive paid at the end of the experiment to a random DDM_i and their respective group. This method was chosen for several reasons. It reduced costs of the experiment and also controlled for issues regarding wealth effects or the "house money effect". The reward was small, as mentioned in Section 4.3, however rewards were considered to be large enough to offset subjective costs incurred by participating in the experiment. Alm and Jacobson (2007)'s Reward Dominance criteria was therefore deemed to have been verified. In addition, to make the experiment more life-like, the 0% efficiency loss pre-tax income distribution was made proportional to that of the UK income distribution.

6.3 Suggestions for Future Research

The experimental literature on the demand for redistribution is relatively young and therefore more work attempting to model preferences for redistribution would make a useful contribution for both policymakers and economists alike. As no conclusions were drawn with regards to the relative weighting of each driver of demand for redistribution in this paper, further experiments attempting to replicate DPV's research on individuals from countries other than USA would provide a useful contribution to the literature on demand for redistribution. In addition, the role of perceptions of procedural fairness in driving demand for redistribution still remains ambiguous. Further analysis of the role of perceptions of fairness would therefore make a useful contribution to the literature. On reflection, larger group sizes would be preferred for future experiments. As mentioned, small group sizes and in this experiment may have distorted results versus those in DPV. In addition, DPV conducted their experiments with 336 subjects versus 135 in this experiment. It is possible that this may have influenced results. A sample size more similar to DPV might therefore also be suggested for future research. Additionally, future research may seek to use a more rigorous method of measuring risk preferences, such as a multiple price list, and simultaneously increase the stakes of the game.

7 Conclusions

High and rising inequality in many countries across the world has highlighted the importance of understanding what drives preferences for redistribution. Experimental evidence can help policymakers better understand what drives demand for redistribution so that more informed policy decisions can be made.

Three key sources of demand for redistribution were identified: income maximisation, risk aversion and social preferences. In the literature, the role of income maximisation and risk aversion in driving demand for redistribution is clear. However, the role of social preferences is less established which led to the central research question: *what is the extent of social preferences in the demand for redistribution?* To address this, sources of demand for redistribution were modelled using a modified Charness and Rabin (2002) utility function. Empirical predictions of this model as well as evidence in the literature enabled hypotheses to be developed and these were tested using experimentation. Demand for redistribution was analysed in a real-world context by allocating subjects into groups and observing tax choices under various treatments. Treatments included a variation on the source of inequality (i.e. whether pre-tax income was assigned by good fortune or whether it was earned), the level of efficiency loss, the level of uncertainty about their pre-tax income allocation as well as whether the decision maker was affected by their decision. This enabled each source of demand for redistribution to be tested and relative utility weights of the Charness and Rabin (2002) model to be derived. Importantly, the experiment also addressed a gap in the literature on the influence of perceptions of procedural fairness on the demand for redistribution.

It was found that with increasing actual income, subjects preferred lower levels of redistribution, supporting the theory that self-interest plays a role in influencing demand for redistribution. Surprisingly however, when income was uncertain, those who had high confidence in predicting their future income did not opt for lower levels of redistribution on average. Those with low confidence did opt for lower redistribution with increasing expected income however. There was insufficient evidence in the sample to suggest that social insurance motives played a role in driving demand for redistribution. Contrastingly, subjects tended to opt for higher levels of redistribution when income was known than when it was uncertain. An analysis of expected group ranks versus actual group ranks indicated that subjects tended to underestimate their income risk and overestimate their prospects of earning high income. This can partially explain why the social insurance motive was not found to have had an effect. Had the stakes of the game been higher, it is possible that income risk would have been more salient and subjects may have expressed more risk averse preferences. Future experiments should therefore seek to increase stakes so that subjects face a more realistic problem.

There was evidence that social preferences play a significant role in driving demand for redistribution. Firstly, dead-weight loss resulted in systematic preferences for lower redistribution. Introducing a 25% Efficiency Loss treatment resulted in 6-10 percentage points lower preferred tax rates on average. As well as having efficiency concerns, subjects also appeared to care about equality. Those who opted for high levels of redistribution when their decision did not influence them also tended to opt for high redistribution when their decision did influence them. The data showed that many held these preferences even when they were endowed with the highest bracket of pre-tax income. Also, subjects cared positively about how income was determined, opting for tax rates roughly 20 percentage points lower on average when income was earned versus when it was determined at random. The role of perceptions of procedural and distributive fairness of domestic tax systems on demand for redistribution provided inconclusive results. A question mark therefore remains particularly over the role of perceptions of procedural fairness on demand for redistribution. This presents an opportunity for future research.

Ultimately, an attempt to model utility weights was unsuccessful as subjects appeared to care negatively about aggregate group income, distorting utility parameter estimates thus losing their interpretation as relative utility weights. This outcome may have been a result of small group sizes and the fact that only one individual gained from low levels of redistribution. Consequently, the remaining four members of the group had a strong incentive to 'punish' this individual for their own benefit by opting for high levels of redistribution even in the face of efficiency losses. Higher stakes in the experiment may also have altered this result. However, statistically significant estimates for the λ variable of Equation (1) - a measure of social preferences - across all specifications indicated that subjects possessed concerns for outcomes other than those of their own. Additionally, subjects cared positively about payoffs of the worst-off members of their group.

This study enhances the literature by furthering understanding on the role of social preferences in the demand for redistribution. It does so by replicating DPV's experiment on a different country subject pool and by extending their work to analyse the influence of perceptions of fairness in more detail. Looking forward, similar experiments should be conducted to enable a better understanding of utility and social welfare functions, which may ultimately enable key decision makers to tackle global politico-economic challenges.

Appendices

Appendix A - Experiment

Session 1

Personal Information

Thank you for participating in this experiment which will contribute to my academic research.

You will be asked to undertake two surveys, this being the first. This section of the experiment should take **no longer than 10 minutes** to complete and the subsequent survey will take **no longer than one minute (two questions)** but is essential!

There will be a chance to win money in this experiment and your responses will directly influence your potential earnings as well as those of other participants in your group within the experiment.

Your responses will be anonymous and your email is only required so that I can contact you regarding the second part of this experiment and to let you know if you have won! This is the only use of your email and upon completion such records will be destroyed.

You must complete the second survey which will be sent to you in the following weeks in order to complete this experiment and have a chance of winning money. The second survey will depend on your responses and performance in a quiz at the end of this first section!

This part of the survey will include three parts. Part 1 will record basic personal information, Part 2 will ask questions regarding your preferences towards redistribution of income and Part 3 will involve a Quiz.

Once again, thank you and good luck!

James Phillips
Erasmus University Rotterdam

Part 1 - Basic Information
Please enter your main email address *(please note this is only used to contact you for the required second survey):*

Please re-enter your main email address *(please note this is only to confirm the above address is correct):*

Age (years):

Gender:

Male	Female	Other
○	○	○

What is your nationality?

Afghanistan

Please indicate the number of Economics courses taken in education:

Less than 2	2 or more
○	○

Which economic stance most accurately reflects your views?

Note:
- Left involves more taxation and a higher government involvement in economic affairs including nationalisation of business.
- Right involves less taxation and redistribution of income, cuts to welfare spending and more privatisation of business.

Extreme Left (Collectivist)	Left	Centre-Left	Centre	Centre-Right	Right	Extreme Right (Libertarian)
○	○	○	○	○	○	○

In general, how willing or unwilling are you to take risks?

Very unwilling	Unwilling	Somewhat unwilling	Neither unwilling nor willing	Somewhat willing	Willing	Very willing
○	○	○	○	○	○	○

Please indicate your perceptions of the tax system where you live:

	Completely disagree	Generally disagree	Disagree a little	Neither agree nor disagree	Agree a little	Generally agree	Completely agree
The tax office treats everyone equally	○	○	○	○	○	○	○
The tax office cares about equality for all	○	○	○	○	○	○	○
The level of taxation in your country of domicile is high	○	○	○	○	○	○	○
From the taxes you have to pay do you get enough in return in the form of public services	○	○	○	○	○	○	○

Parts A and B

Part 2a - Redistribution Game

This part of the survey considers your views on how taxation is used to redistribute income (i.e. the gap between top and bottom earners is reduced). You will be asked a series of questions about what level of redistribution you would set, and then you are asked to consider this in when a cost to such a system is imposed. You will be asked to answer these in two scenarios.

You will be asked to make choices that will affect your potential experimental earnings and earnings of other players. Your responses will be entirely anonymous.

You will be assigned to a group with five others and these groups will be defined randomly after Part 1 of the survey, you will not be identified or learn of the other group members.

Within your group, you will be assigned a relative rank (1 to 5) and corresponding pretax income. These ranks will be obtained either by **luck** (drawn randomly) or based upon **ability** (relative performance in the quiz at the end of this survey).

Group ranks and corresponding pretax earnings, or 'Experimental Incomes' are provided in Table 1 below.

Incomes in Table 1 are split into five ranks for each group member and these are proportional to the income distribution of the United Kingdom.

Please note: £1 equates to €1.13 as of 05/07/18.

Table 1 - Group Rank and Corresponding 'Pretax' Experimental Income

Rank	Pretax Experimental Income (£)
1	62.53
2	14.61
3	9.96
4	7.37
5	5.53

Income Redistribution based on Tax

	Tax Effect										
Rank	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
1	62.53	58.28	54.03	49.77	45.52	41.27	37.01	32.76	28.51	24.25	20.00
2	14.61	15.14	15.68	16.22	16.76	17.30	17.84	18.38	18.92	19.46	20.00
3	9.96	10.97	11.97	12.97	13.98	14.98	15.99	16.99	17.99	19.00	20.00
4	7.37	8.63	9.89	11.16	12.42	13.68	14.95	16.21	17.47	18.74	20.00
5	5.53	6.98	8.42	9.87	11.32	12.77	14.21	15.66	17.11	18.55	20.00

Scenario 1: You are an impartial observer (your choice does not affect you)

In this instance, your choice **will not affect your own experimental income** but will affect the incomes of a group of five others in this experiment, if your decision is chosen to be decisive.

As the decisive individual (if chosen) you will receive a fixed income in the range of £15-£17 regardless of your tax choices for the group. They will receive their winnings based on their rank and corresponding income based on **your tax choice.**

Referring to Table 2 above, please choose your preferred tax rate if ranking and therefore pretax income of the group are allocated **randomly** - i.e. income is earned purely by **luck.**

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
○	○	○	○	○	○	○	○	○	○	○

Now please indicate your preferred tax rate for the group if ranking and therefore pretax income are allocated based upon **ability** (i.e. performance in a quiz taken later in this experiment) and are therefore **earned.**

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
○	○	○	○	○	○	○	○	○	○	○

Scenario 2: You are now involved (your tax decision affects you)

You are now part of the group and your income will be affected by your choice of tax if you are selected as the decisive individual.

If your pretax income is drawn at **random** and therefore achieved by **luck**, again referring to Table 2, what is your preferred tax rate?

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
○	○	○	○	○	○	○	○	○	○	○

You are again part of the group and your income will be affected by your choice of tax.

Referring to Table 2, if your pretax income is assigned based on **ability** (performance in a quiz to be taken later in this experiment) and is therefore **earned**, what is your preferred tax rate?

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
○	○	○	○	○	○	○	○	○	○	○

Part 2b - Redistribution Game with a Cost of Taxation

You must now make similar decisions to those in part 2a above, however taxation now results in a cost to the overall income of the group. So, higher taxes increase costs and result in a reduction in overall group income. See Table 3.

For example 0% tax results in a group income of £100, (e.g. same as before). But a 50% tax effect results in a total group income of £92.50, and a 100% tax reduces the total group income to £75 (or £15 each).

Table 3 - Group Rank and Corresponding 'Post-Tax' Incomes with Tax Cost

		Cost Adjusted Tax Effect									
Rank	Pretax Experimental Income (£)	0%	10%	20%	30%	40%	50%	60%	70%	80%	90
1	62.53	62.53	57.87	53.06	48.13	43.15	38.17	33.24	28.40	23.72	19.
2	14.61	14.61	15.04	15.40	15.69	15.89	16.00	16.02	15.94	15.74	15.
3	9.96	9.96	10.89	11.76	12.55	13.25	13.86	14.36	14.73	14.97	15.
4	7.37	7.37	8.57	9.71	10.79	11.77	12.66	13.42	14.05	14.54	14.
5	5.53	5.53	6.93	8.27	9.55	10.73	11.81	12.76	13.58	14.23	14.

Scenario 1 - You are an impartial observer (your choice does not affect you)

Again, this choice will affect another group of individuals and not your own experimental income. If you are randomly selected as the decisive individual you will receive a fixed income in the range of £15-£17 regardless of your tax choices for the other group.

They will receive their winnings based on their rank and corresponding income based on your tax choice.

Given pretax income is allocated **randomly** and therefore by **luck**, referring to Table 3 what is your preferred tax rate for a group of five others, given the introduction of tax costs?

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
○	○	○	○	○	○	○	○	○	○	○

Referring to Table 3, please indicate your preferred tax rate for the group if ranks and therefore pretax income are allocated based on **ability** (performance in a quiz to be taken later in this experiment) and are therefore **earned**, given the introduction of tax costs to overall group income.

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
○	○	○	○	○	○	○	○	○	○	○

Scenario 2: You are now involved (your tax decision affects you)

You are now part of the group and your potential experimental income will be affected by your choice of tax.

Referring to Table 3, if your pretax income is drawn at **random** and therefore achieved by **luck**, what is your preferred tax rate given the new tax cost to overall group income?

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
○	○	○	○	○	○	○	○	○	○	○

You are now part of the group and your income will be affected by your choice of tax.

Referring to Table 3, if your pretax income is assigned based on **ability** (performance in a quiz to be taken later in this experiment) and is therefore **earned**, what is your preferred tax rate given the new tax cost to overall group income?

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
○	○	○	○	○	○	○	○	○	○	○

Task - Quiz

Part 3 - Quiz

You are now required to undertake a short quiz where you must answer as many correct questions as possible in **under three minutes**.

Performance will directly influence your income from this experiment in the second survey, where you will state your final tax choices knowing your relative rank in the group.

The quiz will involve some IQ and general knowledge related questions. They will roughly increase in difficulty as you get further.

Your score will depend on the number of correct answers in this quiz, i.e. the better you perform, the higher your relative rank and therefore the more you are likely to receive in winnings.

Beforehand, please predict how you think you will rank in this quiz relative to a random group of four other individuals in this survey (1 being the best, 5 being the worst).

1	2	3	4	5
○	○	○	○	○

How confident are you of this prediction?

Very Unconfident	Somewhat Unconfident	Neither Unconfident nor Confident	Somewhat Confident	Very Confident
○	○	○	○	○

This question lets you record and manage how long a participant spends on this page. This question will not be displayed to the participant.

0300

What is the next number in the series: 1, 2, 4, 7, _?

12	11	10	9	8

How many legs does a spider have?

4	6	8	10	12

What is 25% of 360?

30	60	75	90	105

What is 2*(17-3+9)?

*(note: * denotes multiplication)*

26	52	40	46	48

How many sides in a nonagon?

0	9	8	7	6

What approximately is the global population? (billion)

5.8	6.4	7.2	8.3	9.1

What is the next letter in the series: A, B, D, G, _?

H	I	J	K	L

How many planets out from the sun is Earth?

2	3	4	5	6
◯	◯	◯	◯	◯

What is 2/3rds of one quarter of 36

6	8	9	12	18
◯	◯	◯	◯	◯

Which number is next in the series: 12, 6, 24, 4, _?

18	32	48	64	80
◯	◯	◯	◯	◯

What is 32 squared, divided by 2?

32	264	428	256	512
◯	◯	◯	◯	◯

Which of these is NOT a capital city

LNDN	PRS	MDRD	MLN	LSBN
◯	◯	◯	◯	◯

If a bacteria doubles in population every 20 minutes, how many hours does it take for one million bacteria to grow to a population of over 4 billion ?

4	6	8	10	12
◯	◯	◯	◯	◯

What is the square root of 484?

22	16	24	18	26
◯	◯	◯	◯	◯

Which of these is the ODD one out?

Croatian	Finnish	Slovak	Irish	Russian
◯	◯	◯	◯	◯

End of Session 1.

Session 2

Thank you for completing the first part of the survey. This second part will take about **one minute** to finish.

In the email for this survey you were given two group ranks. The first is a group rank based on **luck**. The second is your group rank based on your **quiz score** from the previous survey.

Using your ranks, please indicate your tax choices. This will affect how much money you (and the others in your group) may receive if you are chosen to be a winner.

Please provide the email used to send you this survey link (this is for research data checking only) :

Please confirm this email:

Please confirm your group rank provided in the email based on **luck** (randomly drawn):

Please confirm your group rank provided in the email based on the **quiz score**:

Tax choices with no cost - Please refer to Table 1 when making your choices.

How to read the table:
As an example - if you were given a rank of **1** for luck or for your quiz score in the email, and you chose a tax effect of **0%**, you would receive **62.53** pounds. However, if you chose **50%** tax effect, you would receive **41.27** pounds and so on.

Note: 1 pound is equal to 1.13 euros.

Table 1 - Tax System with no cost

Income Redistribution based on Tax

	Tax Effect										
Rank	**0%**	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	**100%**
1	62.53	58.28	54.03	49.77	45.52	41.27	37.01	32.76	28.51	24.25	20.00
2	14.61	15.14	15.68	16.22	16.76	17.30	17.84	18.38	18.92	19.46	20.00
3	9.96	10.97	11.97	12.97	13.98	14.98	15.99	16.99	17.99	19.00	20.00
4	7.37	8.63	9.89	11.16	12.42	13.68	14.95	16.21	17.47	18.74	20.00
5	5.53	6.98	8.42	9.87	11.32	12.77	14.21	15.66	17.11	18.55	20.00

Using Table 1, what is your preferred tax rate given the rank provided to you by **luck** in the email sent?

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Using Table 1, what is your preferred tax rate given the rank provided to you by **quiz score** in the email sent?

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Tax Choice with a cost - Now make similar two decisions referring to Table 2, but note that there is now a cost to taxation.

For example: If you tax 0% in this instance, overall group income is equal to (62.53+14.61+9.96+7.37+5.53) = **100 pounds.**
But, if you tax 50%, as another example, overall group income is reduced to (38.17+16+13.86+12.66+11.81) = **92.50 pounds.**
And, if you tax 100%, as another example, overall group income is reduced yet again to (15+15+15+15+15) = **75 pounds.**
Therefore taxing more results in larger overall losses to total group income.

Table 2 - Tax System with a cost

		Cost Adjusted Tax Effect									
Rank	**Pretax Experimental Income (£)**	**0%**	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90**
1	62.53	62.53	57.87	53.06	48.13	43.15	38.17	33.24	28.40	23.72	19.
2	14.61	14.61	15.04	15.40	15.69	15.89	16.00	16.02	15.94	15.74	15.
3	9.96	9.96	10.89	11.76	12.55	13.25	13.86	14.36	14.73	14.97	15.
4	7.37	7.37	8.57	9.71	10.79	11.77	12.66	13.42	14.05	14.54	14.
5	5.53	5.53	6.93	8.27	9.55	10.73	11.81	12.76	13.58	14.23	14.

Using the Table 2, what is your preferred tax rate given the rank provided to you by **luck** in the email sent?

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Using the Table 2 provided, what is your preferred tax rate given the rank provided to you by **quiz score** in the email sent?

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
○	○	○	○	○	○	○	○	○	○	○

Thank you. Finally, one survey participant will be randomly chosen as the winner and their tax decision will be paid out to themselves and their group. Good luck!!

Please press the **Finish** arrow to complete the survey.

End of Session 2 and experiment.

Appendix B – Summary Statistics

	Type	Percent Subjects
Political-Economic Stance	Extreme Left	0.74
	Left	9.63
	Centre-Left	31.85
	Centre	20.74
	Centre-Right	33.33
	Right	2.96
	Extreme Right	0.74
Propensity To Take Risk	Very Unwilling	0.00
	Unwilling	5.19
	Somewhat Unwilling	22.96
	Neither Unwilling nor Willing	8.89
	Somewhat Willing	40.74
	Willing	17.78
	Very Willing	4.44
Gender	Male	55.56
	Female	44.44
Number of Economics Courses Taken	Less than two	47.41
	Two or more	52.59
Region From	Europe	82.22
	Asia	14.81
	Other	2.96
Age	Under 35	85.19
	35 and over	14.81
Confidence in ability to predict income	Low	57.04
	High	42.96
Perception of Procedural Fairness	Low	53.33
	High	46.67
Perception of Distributive Fairness	Low	54.91
	High	45.09
Rank Predictions	Optimistic	30.37
	Correct	27.41
	Pessimistic	42.22

Appendix C - Statistical Tests

The Wilcoxon Signed-Rank Test

As the dependent variable - Tax Rate for a given Part (0-1) - is in the form of a ratio scale, a broad class of statistical tests (both parametric and non-parametric) could be performed on the data. In order to test whether two paired samples came from the same population, which is the case with the treatments in the within-design of this experiment, Wilcoxon matched pairs tests were performed throughout analyses. The null and alternative hypotheses are as follows:

$$H^{WSR}{}_0\text{: population median differences equate to zero, i.e. } \theta = 0$$
$$H^{WSR}{}_1\text{: population median differences do not equate to zero, i.e. } \theta \neq 0$$

In the context of this experiment, the Wilcoxon Signed-Rank test was performed according to the following procedure. The difference in tax rates between a control group (0% efficiency loss for example) and treatment group (25% efficiency loss) was taken for a given Part of the experiment. A modulus was then applied to each difference to ensure negative differences became positive. These differences were then ranked from smallest to largest. After calculating ranks, ranks were then split back up into positive and negative based on whether the difference in tax rates was positive or negative for each observation and the total of both positive and negative ranks was calculated. The smallest of these two rank totals was taken as the test statistic which in turn delivered a p-value that enabled the null hypothesis to be rejected or not rejected.

Intuitively, if both samples are similar, the sum of the ranks of both samples should also be similar. Hence, the null hypothesis will not be rejected. If samples are not from the same population however, the sum of the ranks should differ to a greater extent and one may expect to reject the null hypothesis.

The Mann-Whitney U Test

The Mann-Whitney U test is a non-parametric test that is useful to test whether two independent samples came from the same population. In doing so, the test observes differences in distribution. The test is used for between-subject analysis. The null and alternative hypotheses are as follows:

$H^{MWU}{}_0$*: distributions of the two populations are equal, i.e.* $\mu_1 = \mu_2$

$H^{MWU}{}_1$*: distributions of the two populations are not equal, i.e.* $\mu_1 \neq \mu_2$

The test is performed by pooling all data and ranking observations in increasing order. Ultimately, similarities in rank totals of the two samples should mean the samples are similar. If there are large differences, it is likely that one has systematically different outcomes to the other.

Appendix D - Two-Limit Tobit Model

The Two-Limit Tobit Model

Amemiya (1985, p. 384) highlighted five variants of the Tobit model (Types I-V). A Type I model was chosen including one observable dependent variable and one latent variable. The model follows the form:

$$t_i^* = x_i{}'\beta_x + \varepsilon_i$$

where the latent dependent variable takes the form:

$$t_i = t_i^* \text{ if } 0 < t_i^* < 1$$

$$t_i = 0 \text{ if } t_i^* \leq 0$$

$$t_i = 1 \text{ if } t_i^* \geq 1 \tag{D.1}$$

Here, t_i is the dependent variable, the tax rate chosen by subject i, t_i^* is the latent dependent variable representing tax rates without censoring, β_x is a parameter measuring the influence of a given independent variable on the dependent variable and $x_i{}'$ denotes a vector of independent variables. 0 and 1 are the lower and upper limits of the dependent variable respectively. ε_i is the unobserved random error term.

Censored regression models are usually estimated via the maximum likelihood (ML) method. Under the assumption of normality and homoscedasticity, i.e. $\varepsilon_i \sim i.i.d.\ N(0, \sigma^2)$, the log-likelihood function of the two-limit Tobit model is (Henningsen, 2012):

$$log\ L = \sum_{i=1}^{N} [\ I_i^0\ log\ \Phi\ (\frac{-x_i'\beta}{\sigma}) + I_i^1\ log\ \Phi\ (\frac{x_i'\beta-1}{\sigma}) + (1 - I_i^0 - I_i^1)\ (\ log\ \phi\ (\frac{t_i - x_i'\beta}{\sigma}) - log\ \sigma)] \tag{D.2}$$

Here, $\phi(.)$ denotes the probability density function and $\Phi(.)$ represents the cumulative distribution function of the standard normal distribution. I_i^0 and I_i^1 are indicator functions whereby:

$$I_i^0 = 1 \text{ if } t_i = 0 \quad \text{and} \quad I_i^1 = 1 \text{ if } t_i = 1$$

$$I_i^0 = 0 \text{ if } t_i > 0 \qquad\qquad I_i^1 = 0 \text{ if } t_i < 1 \tag{D.3}$$

The log-likelihood function is subsequently maximised with respect to the parameter vector $(\beta', \sigma)'$ using optimisation algorithms. Maddala (1983, p. 161) shows that the expected value of t_i is:

$$Et_i = \beta x_i[G_{2i} - G_{1i}] + \sigma[g_{1i} - g_{2i}] + [1 + G_{2i}] \qquad \text{(D.4)}$$

where G_{2i} is the value of the unit normal distribution at $\frac{(1-\beta x_i)}{\sigma}$ and simultaneously, G_{1i} the value of the unit normal distribution at $\frac{-\beta x_i}{\sigma}$. Furthermore, g_{2i} and g_{1i} represent the values of unit densities at the respective points. Maddala (1983) continues to mention that the first two parts of Equation (D.4) equate to the probability of the dependent variable t_i being between the limits multiplied by the expected value of t_i given t_i is between zero and one. The third part of the Equation, $[1 + G_{2i}]$, equates to the probability that the dependent variable equates to the upper limit, multiplied by the upper limit itself (which equates to 1).

Appendix E – OLS Sensitivity Analysis

Table E.1 – OLS Regressions

	Dependent Variable - Tax Rate (0-1)		
	Part A	Part B	Part C
	All	All	All
	(I)	(II)	(III)
Efficiency Loss	-0.0574**	-0.0585**	- 0.0937***
	(0.0228)	(0.0228)	(0.0265)
Income Determination Method	-0.2204***	-0.2066***	-0.0560*
	(0.0228)	(0.0228)	(0.0290)
Constant	0.6209***	0.5952***	0.6087***
	(0.0225)	(0.0223)	(0.0241)
Observations	540	540	540

Appendix F – Conditional Logit Model - Background, Theory, Method and Limitations

Background and Theory

The Conditional Logit Model (CLM) is a probabilistic choice model that McFadden (1973) argued can be obtained from a comparison of underlying utility. Regressors typically include characteristics of choice alternatives, for example cost or aggregate value, as well as individual characteristics. Applied to this experiment, suppose an individual has a range of τ alternatives to choose from such that t_i is a discrete choice with τ alternatives. Here, τ is the range of available tax rates (from 0 to 1 in increments of 0.1) i.e. τ = {0, 0.1, ..., 1}. Subsequently, let $U_{i\tau}$be the utility of choosing alternative τ to individual i. Utility is divided into two independent random variables with both a systematic component $x_{i\tau}$ and a random component $\varepsilon_{i\tau}$. It follows therefore that:

$$U_{i\tau}= x_{i\tau}\beta+ \varepsilon_{i\tau} \quad \text{(F.1)}$$

On the assumption that an individual maximises utility, then individual i will always opt for alternative τ that maximises their utility. If U_i is the choice of individual i that maximises utility then:

$$U_i= \text{argmax}(U^*_{i0}, U^*_{i0.1}, \ldots, U^*_{i1}). \quad \text{(F.2)}$$

As the choice contains a random error, it follows that the probability of individual i opting for tax rate τ is:

$$\pi_{i\tau}= \Pr\{\max(U_{i0,\ldots,}U_{i1}) = U_{i\tau}\} \quad \text{(F.3)}$$

provided that the errors $\varepsilon_{i\tau}$ are independently distributed satisfying the Type I extreme value distribution with cumulative density function:

$$\text{F}(\varepsilon)= \exp\{-\varepsilon- \exp(-\varepsilon)\} \quad \text{(F.4)}$$

If this assumption is satisfied, it can be shown formally (Maddala, 1983) that the probability of choosing tax rate $\tau \in \{0, 0.1, \ldots, 1\}$ is:

$$\pi_{i\tau}= \Pr(t_i = \tau)= \frac{exp\{u_{i\tau}\}}{\sum_{k=0}^{1} exp\{u_{ik}\}} \quad \text{(F.5)}$$

and the response probabilities generated by Equation (F.5) form the conditional logit model.

CLM - Limitations

The CLM strictly assumes independence from irrelevant alternatives (IIA). This assumption states that either including or excluding another alternative from the choice should not affect the relative risks between choosing alternatives t_0 and t_1 in the existing choice set. This can be breached if an alternative that is excluded for example is very similar to one of the alternatives already present in the choice set and therefore creates a systematic change in coefficients when included. A classic example of when the IIA assumption may not be satisfied was made by McFadden (1974). He showed that having the choice between taking a red bus or a taxi, and then introducing the option to take a blue bus home, may break the IIA assumption as it affects the relative risks of the remaining options. Under these circumstances, the conditional logit model is no longer applicable. In the case of this research, the issue is mitigated as each tax alternative presents a dissimilar option from one another. Each incremental tax increase {0, …, 1} are different in terms of the impact they have on the individual as well as group outcomes. There is no option to choose a tax rate of 20% in red versus a tax rate of 20% in blue for example.

Appendix G – Tobit Output Example

Below displays an example of the Tobit output for Column I of Table 5.3.

```
. tobit p1_tax efficiency_loss quiz_score, ll(0) ul(1)

Refining starting values:

Grid node 0:   log likelihood = -217.23885

Fitting full model:

Iteration 0:   log likelihood = -217.23885
Iteration 1:   log likelihood = -206.36984
Iteration 2:   log likelihood = -206.08963
Iteration 3:   log likelihood = -206.08949
Iteration 4:   log likelihood = -206.08949

Tobit regression                                Number of obs     =        540
                                                   Uncensored     =        456
Limits: lower = 0                                  Left-censored  =         23
        upper = 1                                  Right-censored =         61

                                                LR chi2(2)        =      93.09
                                                Prob > chi2       =     0.0000
Log likelihood = -206.08949                     Pseudo R2         =     0.1842

----------------------------------------------------------------------------------
          p1_tax |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-----------------+----------------------------------------------------------------
 efficiency_loss |  -.0753936    .026713    -2.82   0.005    -.1278681    -.022919
      quiz_score |   -.256356   .0267634    -9.58   0.000    -.3089295   -.2037825
           _cons |   .6588617   .0234596    28.08   0.000      .612778    .7049455
-----------------+----------------------------------------------------------------
  var(e.p1_tax)  |   .0936518   .0064937                      .0817263    .1073175
----------------------------------------------------------------------------------
```

Appendix H – Conditional Logit Output Example

The following is output for Column I of Table 5.4.

```
.  asclogit taxchoice own sd min sum, case(ID8) alternatives(taxrate) cluster(id) noconstant
note: variable own has 540 cases that are not alternative-specific: there is no within-case variability
note: variable sd has 1080 cases that are not alternative-specific: there is no within-case variability
note: variable sum has 810 cases that are not alternative-specific: there is no within-case variability

Iteration 0:   log pseudolikelihood = -3760.0456
Iteration 1:   log pseudolikelihood = -3752.1122
Iteration 2:   log pseudolikelihood = -3752.1003
Iteration 3:   log pseudolikelihood = -3752.1003

Alternative-specific conditional logit         Number of obs      =     17,820
Case variable: ID8                             Number of cases    =       1620

Alternative variable: taxrate                  Alts per case: min =         11
                                                              avg =       11.0
                                                              max =         11

                                                  Wald chi2(4)    =      36.34
Log pseudolikelihood = -3752.1003                 Prob > chi2     =     0.0000

                                   (Std. Err. adjusted for 135 clusters in id)
------------------------------------------------------------------------------
             |               Robust
   taxchoice |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
taxrate      |
         own |   .0282157   .0074362     3.79   0.000      .013641    .0427904
          sd |   .0080152   .0099857     0.80   0.422    -.0115565    .0275869
         min |   .0800039   .0156487     5.11   0.000     .0493329    .1106748
         sum |  -.0273242   .0056397    -4.85   0.000    -.0383777   -.0162707
------------------------------------------------------------------------------
```

```
. * lambda
. nlcom (_b[min]+_b[sum])/(_b[own]+_b[sd]+_b[min]+_b[sum])

       _nl_1:  (_b[min]+_b[sum])/(_b[own]+_b[sd]+_b[min]+_b[sum])

------------------------------------------------------------------------------
   taxchoice |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   .5925016   .0865655     6.84   0.000     .4228364    .7621668
------------------------------------------------------------------------------

. * gamma
. nlcom _b[sd]/(_b[own]+_b[sd])

       _nl_1:  _b[sd]/(_b[own]+_b[sd])

------------------------------------------------------------------------------
   taxchoice |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   .2212266   .2252593     0.98   0.326    -.2202734    .6627266
------------------------------------------------------------------------------

. * delta
. nlcom  _b[min]/(_b[min]+_b[sum])

       _nl_1:  _b[min]/(_b[min]+_b[sum])

------------------------------------------------------------------------------
   taxchoice |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   1.518686   .1167055    13.01   0.000     1.289947    1.747425
------------------------------------------------------------------------------
```

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