

Exploring the Heterogeneity of Other-regarding Preferences

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DEDICATION

I dedicate my dissertation to my family and friends. I am especially grateful to my parents, Jiming Peng and Lirong Gan who have been encouraging and pushing me for the past five years. Although they are back in China, they have never left my side.

I also dedicate this dissertation to my many friends who have supported me throughout this whole project. I am very appreciative for Guanbo Chen, who discussed my project with me and often shared his insights as a graduate student from another major. I also would like to thank everyone in the department who attended my presentations and helped me with this work.

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ABSTRACT

This project studies the impact of heterogeneous other-regarding preferences on many issues, such as taxation, government revenue and income inequality. The first two chapters build upon the literature of relative income effects pioneered by Duesenberry (1949). This hypothesis says that the utility of an individual depends on not only his absolute income level, but also his relative income position. An individual gains utility if his income exceeds the income of most members in his comparison group and loses utility if his income falls below the income of most members in the group. Most previous studies consider either a symmetric or a simple version of asymmetric case. In contrast, chapter 1 uses the British Household Panel Survey (BHPS) to depict a broader heterogeneity: income-dependent relative income effects. Results suggest that one's relative income effect indeed depends on one's income level.

In chapter 2, we investigate the effect of these income-dependent relative income effects on an optimal income tax model. Simulation results show that the optimal tax system becomes more progressive to the extent that the relatively wealthy have stronger concerns regarding others' income than the relatively poor. This is an important result because it may provide theoretical evidence that increasing progressivity can be efficiency-enhancing.

In chapter 3, we consider the effects of other-regarding preferences on equilibrium labor supply, tax revenue, and income inequality in a society where agents have heterogeneous skill levels and thus heterogeneous wage rates. Different from the previous two chapters, the model in this chapter is sufficiently flexible to allow the externality from agents who are "ahead" to differ in both magnitude and direction from those who are "behind." Our findings have important implications for tax policy.

TABLE OF CONTENTS

INTRODUCTION	1
CHAPTER I Estimating Income-dependent Relative Income Effects in Britain	3
1. Introduction	4
2. The Econometric Framework.....	8
3. Data and Descriptive Statistics.....	10
3.1 The Life Satisfaction Variable	10
3.2 Own Income and Relative Income	11
3.3 Control Variables.....	13
3.4 Descriptive Statistics	14
4. Estimation Results.....	16
4.1 Robustness Check	19
5. Conclusions	20
List of References	23
Appendix	26
CHAPTER II Optimal Taxation in the Presence of	
Income-dependent Relative Income Effects	34
1. Introduction	35
2. Motivation.....	38
3. The Model	42
4. Numerical Results	49
4.1 Main Results	49
4.2 Robustness Check	54
5. Discussion	56
List of References	59
Appendix	64
CHAPTER III OTHER REGARDING PREFERENCES AND INEQUALITY	71
1. Introduction	72
2. The Model	75
3. Results	76
3.1 Labor Supply Effects.....	76
3.2 Revenue Effects.....	79
3.3 Degree of Inequality Effects.....	84
4. Conclusion	90
List of References	93
Appendix	95
CONCLUSION.....	100
VITA	102

LIST OF TABLES

Table 1.1 Dependent variable: descriptive statistics and percentage of responses by year	26
Table 1.2 BHPS descriptive statistics: income variables.....	27
Table 1.3 BHPS descriptive statistics: control variables	28
Table 1.4 Life satisfaction estimation results: the benchmark case.....	29
Table 1.5 Life satisfaction estimation results: alternative income definition and reference group construction method	32
Table 1.6 Life satisfaction ordered probit estimation results: by wave	33
Table 2.1 Summary of cases evaluated.....	64
Table 2.2 Numerical results of lognormal-Pareto distribution	65
Table 3.1 The optimal labor supply	95
Table 3.2 The average consumption	96
Table 3.3 The average tax revenue	97
Table 3.4 The Gini coefficient.....	98
Table 3.5 Other-regarding preferences as a redistributive tool.....	99

LIST OF FIGURES

Figure 1.1 Relative income effects as a function of own income	30
Figure 1.2 Own income effects as a function of relative income	31
Figure 2.1 Tax structure for lognormal-Pareto distribution (benchmark)	66
Figure 2.2 Tax structure for lognormal distribution	67
Figure 2.3 Tax structure for lognormal-Pareto distribution, relative income effects dominate	68
Figure 2.4 Tax structure for lognormal-Pareto distribution, the poor have larger concerns	69
Figure 2.5 Tax structure for lognormal-Pareto distribution, evidence from BHPS.....	70

INTRODUCTION

Unlike neoclassical economics where humans are mainly described as self-interested, more and more social studies (i.e., Hopkins, 2008; Ferrer-i-Carbonell, 2005; McBride, 2001; Distante, 2013) have supported the notion that individuals' welfare depends not only on their material circumstances but also on their relative position in society.

Data supporting these views come from at least two directions. First, Duesenberry (1949) proposed the relative income hypothesis, stating that agents are competitive or status-seeking, meaning that the increase of others' income has a negative effect on your well-being. This hypothesis can explain the "Easterlin Paradox": survey data on subjective well-being shows that average happiness scores has not increased correspondingly with the rapid growth of real GDP per capita in many countries during the past several decades.

Chapter 1 explores the possibility of heterogeneous relative income effects, which can indicate whether the wealthy or the poor have higher relative income effects. Studying the true form of relative income effects can help in constructing a more efficient income taxation system.

Chapter 2 applies the chapter 1's estimation results to an optimal non-linear income taxation framework. Specifically, the consequence of incorporating these heterogeneous relative income effects into a traditional optimal income tax system is explored. If these relative income effects are as significant as presented in chapter 1, failing to control for them will cause misspecification of the optimal income tax schedule.

Data supporting other-regarding preferences also comes from another direction: choice experiments. Based Fehr and Schmidt's (1999) explicit model, a list of experiments investigate the inequality averse preferences among participants. Individuals with inequality averse preferences pursue not only own income or consumption, but also fairness. Any change to income that increases the distance of their income and others' decreases their well-being. Chapter 3 embraces this assumption. Constructing a framework in which agents can be either competitive or inequality averse, we are interested in the consequence of labor supply behavior, tax revenue, and income inequality after including these two distinct types of other-regarding preferences.

CHAPTER I
ESTIMATING INCOME-DEPENDENT RELATIVE INCOME
EFFECTS IN BRITAIN

1. Introduction

Contrary to the claims of neoclassical economists who describe humans as self-interested individuals, researchers in the social sciences have recently shown that individuals care about both their own well-being and the well-being of others (for example, Ferrer-i-Carbonell, 2005; McBride, 2001; Distant, 2013). They question the traditional view of a utility function that only considers one's own consumption or income levels. These relative effects assume that people derive utility not only from their own status, but also from comparing their status with others.

Duesenberry (1949) first proposed the relative income hypothesis, which clearly explains the "Easterlin Paradox" (Easterlin, 1974). The paradox is that despite substantial real income growth in Western countries during the past 50 years, no corresponding rise in reported happiness levels can be observed. This paradox undoubtedly points to relative income's impact, rather than absolute income's, on reported well-being.

The present study fits within the large body of literature Duesenberry pioneered. It investigates how others' income levels can affect us. These relative income effects create negative externalities because an increase in one's income level reduces another's well-being. Some scholars (i.e., Kanbur & Tuomala, 2013) have considered a policy for correcting these relative income effects through government intervention, such as taxation.

Many studies in this area have focused on symmetric relative income effects (for example, Clark and Oswald, 1996; Luttmer, 2005; Liu and Shang, 2012). They have argued that the magnitude of relative income effects is homogenous within the population. Generally, they have concluded that others' income has a substantial and negative impact

on one's own well-being. Holding everything else constant, increased income of one person's reference group makes that person worse off.

Duesenberry's relative income hypothesis is not symmetric. Instead, it states that relatively poor people derive disutility from comparisons with more wealthy individuals while the wealthy do not derive utility from comparisons with poorer individuals. These relative income effects are referred to as being upwards-asymmetric. Many studies have tested this idea, and the results have generally been mixed. Some studies have agreed with Duesenberry. For example, Ferrer-i-Carbonell (2005) found that West Germans have upwards-asymmetric relative income effects. The well-being of the poor is negatively influenced by comparing with the income level of their reference group; however, the rich do not feel happier from knowing their income is higher. Boyce et al. (2010) reported similar results using the British Household Panel Survey (BHPS), except they found rich agents feel happier from having higher income, but the magnitude of this utility from being ahead is smaller than that of the disutility from being behind.

In contrast, McBride (2001), using the (US) General Social Survey (GSS) data, revealed that the relative income concerns are in fact asymmetric downwards, meaning the impact is higher for the rich than for the poor. In addition, Mayraz et al. (2009) evaluated German Socio-Economic Panel (GSOEP) and found that relative income effects are

symmetric, implying there is a homogenous relative income effect within the population. The utility of being ahead is no different than the disutility of being behind.¹

Also, some studies investigate comparisons across countries. Corazzini et al. (2012) conducted a cross-country experiment using students and found that well-being is perceived more in relative terms for students in high-income countries than in low-income countries. This finding implies that relative income effects are stronger when one's own income level is higher. However, they also found that personal characteristics, such as gender and discipline of study, contribute much in determining well-being. A similar example is Friehe and Mechtel (2014). Taking the division of Germany into the communist GDR and the democratic FRG and its reunification in 1990 as a natural experiment, these researchers found relative income effects much higher for East Germans than West Germans.

A reasonable assumption is that a high-income earner cares differently about his reference group than a low-income earner. In the literature involving relative income effects, some studies have supported the idea that the wealthy should have stronger relative income effects than the poor because the poor devote a large portion of their income to satisfy their basic needs, thus not much income is left to make luxury purchases and comparisons with others (Corazzini et al., 2012). However, other scholars have emphasized the importance of “aspirations,” suggesting that the poor have stronger relative income

¹ Mayraz et al. (2009) and Ferrer-i-Carbonell (2005) found different results using the same dataset (GSOEP). The former let subjects choose the reference group themselves while the latter defined the reference group as all agents at the similar education level, inside the same age bracket, and living in the same region.

effects because they have aspirations that tend to be far above their socioeconomic level (Stutzer, 2004). These upward aspirations are less prevalent for the wealthy, causing them to have weaker effects. These often opposing results motivate the current study that explores the relative income effects' potential heterogeneity.

The current study has two main contributions. First, an interaction term is used to explore the possibility of income-dependent relative income effects. Most of the studies cited above explored homogenous relative income effects. Some investigated uniformly asymmetric relative income effects by categorizing the population into two groups, based on, for example, whether income level of a person is higher or lower than his reference group. The current study builds upon the consideration of asymmetric relative income effects. The assumption of uniform asymmetry is relaxed by allowing the relative income effect to be a function of one's position on the income scale. This is a more general form of heterogeneity: income-dependent relative income effects. We estimate these effects by regressing a measure of utility on one's own income, others' income, and an interaction term between the two. The interaction term is widely used in economic studies (e.g., Spilimbergo, 2009). In the current study, it measure whether relative income effect depends on the subject's income level.

Second, Layard (1980) showed that the definition of *reference group* matters considerably in this area. Most previous analyses divided the whole population into different cohorts based on one or two demographic variables, such as age (e.g., aged 20 and under, 21-25, 26-30, etc) and region. However, one disadvantage of constructing reference groups using that method is that two agents with similar ages living in the same

region may not be compared with each other only because their ages are separated by one of the age thresholds. As a result, in the current study, a cohort is derived for every individual in the sample. We believe that in the real world, it should be the case that every person chooses a reference group, probably consisting of individuals with similar demographic variables, instead of being assigned one. Therefore, instead of assigning individuals to any age group, the subject's age group is considered to include all others of the same age group plus or minus five years.

The estimation results show significant heterogeneity of relative income effects. Specifically, the poor's relative income effects (in absolute value) are larger than those of the wealthy. Exploring the form of relative income effects is important. The literature already shows the impact of homogenous relative income effects on optimal income taxation. The present study shows that allowing heterogeneous relative income effects can help in better understanding the force behind well-being and build a more efficient income tax system to better account for people's actions.

2. The Econometric Framework

To estimate income-dependent relative income effects, a utility proxy is regressed on own income, the average income of the individual's reference group, and the interaction of the two.

Following Layard et al. (2008), individual i has a level of experienced utility u_i , cardinal and comparable across individuals. All respondents reported their level of happiness, h_i , based on their experienced utility. Reported happiness for individual i , h_i , is given by

$$h_i = u_i + v_i \quad (1)$$

Equation (1) shows that in order to generate an answer to a happiness question, individual i applies an idiosyncratic, strictly increasing, and linear transformation v_i to u_i .

Following Clark and Oswald (1996), the estimation function is the following:

$$h_i = \beta_o + \beta_1 \log y_i + \beta_2 \log \mu_i + \beta_3 \log y_i * \log \mu_i + \rho X_i + \epsilon_i \quad (2)$$

$$\epsilon_i = \varepsilon_i + v_i \quad (3)$$

where y_i is individual-level reported annual income, and μ_i is the average level of annual income of the reference group for individual i . X_i is a set of control variables for individual i . ϵ_i is the usual error term, which is assumed not to be correlated with explanatory variables.

Deriving the income effects (4) is straightforward.

$$MUR_i = \frac{\partial h_i}{\partial \log \mu_i} = \beta_2 + \beta_3 \log y_i \quad (4)$$

Equation (2) is estimated using fixed effects to control for unobserved heterogeneity. Ferrer-i-Carbonell and Frijters (2004) showed that estimation results using OLS or ordered probit were not significantly different from each other. To give a more comprehensive result, ordered probit estimations are also provided as one robustness check. To interpret the results, when the average of others' income increases by 10 percent, individual i 's own utility level will fall by $-(\beta_2 + \beta_3 \log y_i)/10$ point(s).²

² For an individual experiencing a 10% percent increase of the average income of his reference group (from Y_1 to Y_2), his utility level will decrease (in absolute value) by $(\beta_2 + \beta_3 \log y_i) \times (\log(Y_2) - \log(Y_1)) = (\beta_2 + \beta_3 \log y_i) \times \log \frac{Y_2}{Y_1} = (\beta_2 + \beta_3 \log y_i) \times \log(1.1) \approx (\beta_2 + \beta_3 \log y_i)/10$.

The coefficient of interest is β_3 , which is the coefficient of the interaction term of own income and reference income. If the relative income effects depend on one's own income, then β_3 is statistically significantly different from zero. Otherwise, it concludes that the relative income effects are homogeneous. Further, if β_3 is negative, the relative income effects are downwards asymmetric, implying high-income earners have higher relative income effects than low-income earners. If β_3 is positive, the effects are upwards asymmetric, implying the poor have stronger relative income effects.

3. Data and Descriptive Statistics

3.1 The Life Satisfaction Variable

We estimate relative income effects from the British Household Panel Survey (BHPS), a longitudinal panel survey of households in Great Britain. The first wave of data, including 10,000 people living in 5,500 households in 250 areas, was collected in 1991. A panel dataset's most important advantage is that it can mitigate the bias of the unobserved individual-specific factors. For example, "very satisfied" for person A may be equal to "fairly satisfied" for person B. Using a panel dataset and fixed effects estimation model, we can rule out that bias.

Starting in 1996, a general question was included, “How satisfied are you with life overall?” The answer serves as a proxy for individual utility level, u . Respondents choose from 1 to 7, where 1 means “not satisfied at all” and 7 “completely satisfied.”³

The current study uses wave 12 to wave 18, a sub-sample across 7 years.⁴ Since wave 7, there is oversampling of low-income people. Following Distant (2013), observations belonging to the original sample are kept to maintain random sampling. The panel provides 51,194 individual-year observations.

The self-reported subjective well-being (SWB) level is treated as a legitimate and qualifying proxy of utility. Clark et al. (2008) argued that self-rated happiness and satisfaction scores are reasonable measures of the economic notion of utility.⁵ Although economists tend to be skeptical about using the SWB level, it seems unlikely that human happiness can be interpreted without considering what humans say.

3.2 Own Income and Relative Income

Because we are interested in how others’ income affects own satisfaction and how that magnitude depends on own income, own income and relative income are the two most important regressors in this analysis.

³ Respondents chose this answer based on their perceived quality of life. To help them better perceive, before this key question, the survey included a couple of questions concerning different areas of life.

⁴ The life satisfaction question appeared since wave 6 but paused on wave 11. To have a series of continuing years, all waves after 11 are chosen.

⁵ Lepper (1998) and Sandvik et al. (1993) also adopted this view.

BHPS provides annual pre-tax income for each household.⁶ In the current study, all income variables take the form of natural log and are deflated with 2005 as the base year to adjust for inflation.

In the large body of literature exploring the relative income hypothesis, there is no agreement on the definition of *own income*. Generally, studies have used adjusted average household income (i.e., Layard et al., 2008). In the current study, we use weighted average household income as the benchmark scenario. The weighted average household income is constructed using the total household annual income divided by the household's OECD-modified equivalence scale.⁷ Within each household, the weighted average household income is equally distributed on each member. Another robustness check is run using the household income instead of weighted average household income.

According to Layard (1980), people can have different reference groups. They can choose individuals with whom they are locally close or people with similar demographic characteristics; or they may just compare with everyone else at a similar income level. How to define reference *income* is a contentious issue, and several approaches exist in the literature. Specifically, there is no consensus on the definition of *reference group*. Some simply select residents based on their primary residence's geographical area (Easterlin, 1995); some at first select residents based on geographical area, then refine by interacting geographical proximity with other dimensions (Ferrer-i-Carbonell, 2005). Most previous

⁶ In BHPS, annual total household pre-tax income is the sum of annual labor and non-labor pre-tax income.

⁷ Weinzierl (2006) also adopted this equivalence scale. This scale “assigns a value of 1 to the household head, of 0.5 to each additional adult member and of 0.3 to each child” (<http://www.oecd.org/eco/growth/OECD-Note-EquivalenceScales.pdf>).

studies have divided the population into a number of different cohorts based on, age, region, and some other demographic variables. Once the cohorts are established, each person's relative income is the cohort's average income. In the current analysis, we choose a reference group for each individual in the sample that is the group of individuals within the same region⁸ and of similar ages, resulting in thousands of reference groups across the sample. Finally, consistent with previous studies, the reference group was assumed to be exogenous.

3.3 Control Variables

Dolan et al. (2008) provided a summary of factors associated with subjective well-being. Based on their results and recent literature, we choose a number of variables as the current study's regressors.

Age is found to be consistently related to SWB. Some studies show quadratic age may matter (for example, Blanchflower and Oswald, 2004). In the current analysis, however, we consider only linear age.⁹

Health status is also confirmed to substantially affect SWB (Distante, 2013). In BHPS, respondents are asked about their health status through the following question: "How would you define your health status over the last 12 months?" The answer varies from 1 to 5 where 1 means excellent and 5 means very poor. Following Distante (2013), to

⁸In the BHPS survey, respondents are classified into 19 demographic areas, such as Inner London, Outer London, East Anglia, East midlands, Greater Manchester, and Wales.

⁹We test an alternative estimation function, which includes age-squared, and find that the coefficients on other variables don't vary much and the coefficient on age-squared is not significantly different from zero.

construct a binary variable, we create a health status indicator equal to 1 when respondents choose 1 or 2, and 0 otherwise.

Marriage is another control variable in this analysis. Studies show that being alone appears to negatively affect SWB; therefore, we create a dummy to separate those who live by themselves from others. Specifically, this binary variable equals one if the respondent chooses “married” or “living as couple” and equals zero if he chooses “widowed,” “divorced,” “separated,” or “never married.”¹⁰

Employment status is another control variable that affects life satisfaction. The binary variable equals one if the respondent has a job with payment when interviewed and equals zero otherwise.

Education levels are also important determinants of satisfaction, but the dataset limits our ability to control for them due to a high rate of missing data.¹¹ Finally, we also include year and region dummies.

3.4 Descriptive Statistics

Table 1.1 provides descriptive statistics and the distribution of responses for the dependent variable. This table shows that among the respondents, few choose extreme values when asked about their life satisfaction level overall. During the 7 years from wave 12 to wave 18, the distribution of seven levels of life satisfaction is fairly stable. For each

¹⁰ From now on, “married” means this marriage status indicator is equal to one; “not married” means this indicator is equal to zero.

¹¹ Gender and race are not included because they are constant over time.

year, at least 64 percent chose 5 and 6 combined, and between 75-79 percent of the people surveyed define themselves as very satisfied.¹² Consistent with the Easterlin Paradox, there is little change in the reported life satisfaction as the average income level increases.

Table 1.2 provides descriptive statistics for different income definitions used in the regressions. The primary focus is on two types of income definitions: household income and weighted average household income with OECD-modified equivalence scale. As for the reference group, we use two different construction methods. First, we construct individual-specific cohorts for every person observed in this sample, thus allowing every person observed in the dataset to have his own reference group. To be selected in one person's reference group, the candidate has to satisfy three conditions: 1) the data came from the same year; 2) they came from the same region; and 3) the age difference between them is less than or equal to five years. The reference group's income level is the average income of all qualified candidates. Second, we follow most previous studies which defined reference groups by dividing the whole population into a number of cohorts based on region and age.¹³ This method's disadvantage is that two agents who have similar ages that are close to any age threshold will not necessarily compare with each other. However, in real life, they probably should. For that reason, building a reference group for everyone is preferable. This approach is a process simulation in which every individual compares their income to all qualified individuals.

¹²Very satisfied is defined as answering 5, 6 or 7.

¹³ Several studies are exceptions. They regress the actual income on a list of determinants and use the predicted income level to represent a person's reference income level. (see, for example, Luttmer, 2005)

Table 1.2 shows that those standing at a relatively more advantageous position in society have moderately higher life satisfaction, regardless of how the reference group is constructed and how the income variable is defined. T-tests are also performed under different settings; and for all situations, we can reject the null hypothesis that the conditional means of life satisfaction are equal without regard to how the individual's income compares to the reference group's average income.

Table 1.3 provides descriptive statistics for the control variables used in the regression. More importantly, it also provides the conditional mean life satisfaction level based on each binary control variable and the results of t-tests, which accesses whether the life satisfaction's mean for the two groups is significantly different separately for each binary variable. Table 1.3 shows that all three control variables (health status, employment status, and marriage status) have positive and significant correlations with life satisfaction, as expected. The mean life satisfaction is significantly higher when the individuals are healthy, employed, and/or married.

4. Estimation Results

The benchmark scenario adopts the weighted average household income using the OECD-modified scale. The benchmark scenario's result is shown in Table 1.4. Column 1 is the estimation results when only the absolute income level is included. In column 2, the reference income is added as an additional explanatory variable. In column 3, interaction between own income and reference income is added. The first column clearly illustrates that the own income level has no effect on satisfaction. This finding is consistent with some previous studies (i.e., Easterlin, 1974; Boyce et al., 2010). Column 2 shows that after

reference income is included, absolute income's effect is still zero. However, reference income has a significant and negative effect on life satisfaction, suggesting that others' income is a much more important factor in determining one's own happiness level than own income. The results can be interpreted as follows: whenever the average income level of one person's reference group increases by 10 percent, that person's life satisfaction level goes down by 0.021 point on the 7-point scale.

Next, in column 3, the coefficient of the interaction term is significant and positive. As own income rises, reference income's effect on satisfaction decreases (in absolute value). This finding implies that the relative income effect is heterogeneous within the population; generally, the wealthy have smaller relative income effects than the poor.¹⁴

Figure 1.1 depicts the relative income effects at various levels of own income. It demonstrates the heterogeneity of relative income effects across the population, varying significantly depending on an individual's own income level. The individual at the 5th percentile of the income distribution has a relative income effect roughly three times as large as that of the individual at the 95th percentile. Formally, $MUR = -1.141 + \log(y) \times 0.097$. If a person is at the 25th percentile of the income distribution (10976.1), when the income level of his reference group decreases by 10 percent, his life satisfaction level rises by 0.02386 point on the 7-point scale. However, if he is at the 75th percentile of the income distribution (24656.1), that rise shrinks by one-third to only 0.01601 point on the 7-point

¹⁴ Because relative income effects are jointly determined by the coefficients of reference income and interaction term, we run the joint significance test on own income with interaction term and reference income with interaction term. The results of the joint significance test rejects the null hypothesis that the coefficients are jointly equal to zero.

scale. Recall that the relative income effect is 0.0211 when no interaction term is included. In conclusion, with the interaction term, the relative income effect ranges from 0.00637 to 0.04014. It clearly shows that without the interaction term, we cannot capture relative income effects' true form, but only an average level.

This study is also interested in the coefficient of own income. Column 3 shows that after adding the interaction term, the coefficient on own income becomes significant. However, own income has a negative effect on satisfaction, and that effect is lower (in absolute value) as reference income rises, suggesting that the lower the income people have, the lower satisfaction they report. As income of the reference group surrounding that person increases, the more likely he is to report higher satisfaction. Figure 1.2 depicts the own income effects at various levels of relative income. Specifically, own income's effect on satisfaction becomes zero when reference income equals 17556.86. For two-thirds of the people studied in the present analysis, their reference income is above that threshold and an additional dollar of income translates to more happiness for them.

Finally, across three columns, the control variables show consistent findings. As age rises, people become less happy. The coefficients on health status, marriage status, and employment status are as expected. Respondents tend to be happier if they are healthy, married, or employed.¹⁵

¹⁵ Recall that the health indicator is from a question asking the survey respondents to evaluate his or her health status. To avoid any potential bias caused by the endogeneity issue from subjective evaluation, this study follows Distant (2013) and uses an alternative control variable "Limits in Activities of Daily Life (ADL)." This alternative is a binary indicating whether the respondents think their health conditions limit a certain list of daily activities. The estimation results show that replacing the subjective health status indicator with an objective one affects neither the coefficient nor significance level.

4.1 Robustness Check

In this section, the estimation results' robustness is evaluated in several ways.

The first column of Table 1.5 is benchmark scenario's estimation results. First, the weighted average household income is replaced with household income and show the estimation results in column 2 of Table 1.5. Given the highly intensive correlation between household members, we believe that the whole family income possibly matters, instead of individually weighted average household income. All control variables remain constant for comparison. Correspondingly, the reference group is constructed the same as above, except that we use household income instead. The results reported in column 2 of Table 1.5 are consistent with those discussed above. The reference income has a significant and negative effect on satisfaction. More importantly, the interaction term is significant and positive, again illustrating that relative income effects are heterogeneous within the population.

Second, the benchmark scenario's result is also tested for validity when using the traditional method to construct the reference group. Compared with the benchmark case, the current scenario still uses the weighted average household income with OECD modified scale. However, the whole population is divided into several dozen cohorts. Specifically, we divide the population into different cohorts based on region $\times$ age. This dataset contains 19 different regions, and agents within each region are divided into the following age groups: 15-25, 26-35, 36-45, 46-55, and above 55 years old. This generates $19 \times 5 = 95$ different cohorts. Each person takes the average income level of the cohort he belongs to as the reference income level. Column 3 of Table 1.5 reports the estimation findings, which are mostly consistent. The coefficient of reference income alone is slightly

less significant than previous scenarios. This finding can be explained by the reference groups' poor construction: some reference groups leave out some individuals who should belong there, such as those whose ages are near any age threshold. Finally, after adding the interaction term, the reference income has a significant and negative influence. Meanwhile, the interaction term is positive and significant, indicating that the relative income effects are heterogeneous and decreasing as own income increases.

Third, one year's data is used to perform a cross-section analysis to test whether using an ordered probit model yields similar findings. Table 1.6 shows the results. Consistent with the benchmark case, the income variable was the weighted average household income with OECD-modified scale, and the individual-specific cohorts constructed using the same criteria as before are used. The interaction term between own income and reference income is not significant in some waves although the coefficient's sign is usually consistent with the benchmark results (except for wave 14). This finding shows that by regressing the whole sample with all the years, an average effect of relative income effects across seven years is obtained, significantly dependent on the own income level. Treating the utility proxy as ordinal or cardinal does not significantly affect the results.

5. Conclusions

Since the "Easterlin Paradox" was discovered, many studies interested in the relationship between income and happiness have found that it is not, at least primarily, our own income that determines our reported well-being. Our study contributes to this growing body of literature, this study has found that after controlling for a series of control

variables, the absolute income's effect has a negligible effect on happiness. Just as the Easterlin Paradox suggests, this finding may explain why many countries' subjective well-being levels did not increase as GDP levels increased during recent decades.

Furthermore, we explore the role of relative income. Previous studies in this area have focused on either homogenous or uniformly asymmetric relative income effects. This study takes a different approach and assumes relative income effects are heterogeneous within the population. The interaction term is used to explore the dependence between own income and reference income. Consistent with previous work, reference income has a negative effect on life satisfaction. In addition, our results show the absolute income level not only influences the well-being level directly, but also affects reported life satisfaction indirectly through reference income; it changes the relative income effect's magnitude. As the absolute income level increases, the magnitude of relative income effect decreases (in absolute value). This result is consistent with some studies which support Duesenberry's claim that relative income effects are upwards-asymmetric, meaning the wealthy are not as competitive as the poor. However, this income-dependent relative income effect is more general.

The field of relative income hypothesis is a young and growing field. Relative income effects are gradually accepted in many areas and generate non-negligible impact, such as the optimal income taxation literature. Relative income effects create negative externalities since each individual suffers from growth in others' income. As a result, exploring the true correlation between income and happiness can help in deriving a more efficient optimal income tax system to adjust for the negative externalities. Our next step

is to incorporate income-dependent relative income effects revealed in the current analysis into an optimal nonlinear income tax model.

In the current study, we make a first step and find that own income affects the relative income effect's magnitude. Future research can explore nonlinearity's potential, such as quadratic-income-dependent relative income effects. Also, this study adopts the income variable as the aggregation of labor and non-labor income. It is, however, reasonable to expect agents may have different responses between relative labor income and non-labor income. Exploring this potential heterogeneity could be intriguing. Further, relative income effects' heterogeneity may depend on not only own income level, but also other variables, such as marriage or health status. That suggests two individuals with the same income level may still have distinct relative income effects. A myriad of avenues are available for pursuing heterogeneity's true form.

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Appendix

Table 1.1 Dependent variable: descriptive statistics and percentage of responses by year

Life satisfaction	<i>Proportion (%)</i>						
	<i>Wave 12</i>	<i>Wave 13</i>	<i>Wave 14</i>	<i>Wave 15</i>	<i>Wave 16</i>	<i>Wave 17</i>	<i>Wave 18</i>
Not satisfied at all (1)	1.27	1.30	0.39	1.07	0.96	1.13	1.03
2	1.89	1.92	1.46	2.36	2.11	1.86	1.83
3	5.77	5.39	5.36	6.30	6.53	6.00	5.73
4	13.71	13.29	13.26	15.28	14.17	13.83	13.80
5	31.50	29.75	34.63	32.14	31.12	31.11	32.72
6	33.11	35.22	36.74	32.16	34.28	35.06	34.22
Completely satisfied (7)	12.75	13.13	8.16	10.69	10.84	11.01	10.67

Table 1.2 BHPS descriptive statistics: income variables

Variable	Obs.	Mean	S.D.
Household income	51194	35626.17	25689.55
Weighted average household income	51194	19631.93	13844.89
Life satisfaction	51194	5.21	1.21
Life satisfaction if household income > average of the dataset*	21345	5.28	1.07
Life satisfaction if household income > average in the reference group: cohort defined by region and age	21464	5.32	1.09
Life satisfaction if household income > average in the reference group: individual-specific cohort	21467	5.33	1.09
Life satisfaction if weighted average household income > average of the dataset	20455	5.29	1.06
Life satisfaction if weighted average household income > average in the reference group: cohort defined by region and age	21238	5.32	1.08
Life satisfaction if weighted average household income > average in the reference group: individual-specific cohort	21349	5.33	1.09

* We also test that there exists a significant difference between the mean of life satisfaction between ahead of others and behind others. We test this hypothesis under different setting by varying the definition of own income and reference group.

Table 1.3 BHPS descriptive statistics: control variables

Variable	Observations	Mean	S.D.
Age	51194	45.17	18.04
Health status	51194	0.71	0.45
Employ status	51194	0.67	0.47
Marriage status	51194	0.68	0.47
Life satisfaction if healthy	36351	5.43*	1.05
Life satisfaction if not healthy	14843	4.67	1.40
Life satisfaction if employed	34447	5.23	1.09
Life satisfaction if not employed	16747	5.16	1.43
Life satisfaction if married	34588	5.30	1.14
Life satisfaction if not married	16606	5.01	1.32

* We also test that there exists a significant difference between the mean of life satisfaction between healthy and unhealthy; employed and unemployed; married and unmarried separately.

Table 1.4 Life satisfaction estimation results: the benchmark case

	Life Satisfaction	Life Satisfaction	Life Satisfaction
Own income(weighted average)	0.002 (0.010)	0.006 (0.010)	-0.948 (0.351)***
Reference income (average; individual-specific cohort)		-0.211 (0.057)***	-1.141 (0.347)***
Interaction term (own income × reference income)			0.097 (0.036)***
Age	-0.043 (0.019)**	-0.042 (0.019)**	-0.043 (0.019)**
Healthy	0.286 (0.012)***	0.286 (0.012)***	0.285 (0.012)***
Married	0.251 (0.021)***	0.253 (0.021)***	0.251 (0.021)***
Employed	0.078 (0.017)***	0.082 (0.017)***	0.083 (0.017)***
_cons	6.659 (0.801)***	8.694 (0.974)***	17.873 (3.513)***
Time dummies	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes
R^2	0.02	0.02	0.02
N	51,194	51,194	51,194
Joint significance of own income and interaction term			F= 3.89
Joint significance of reference income and interaction term			F= 10.46

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

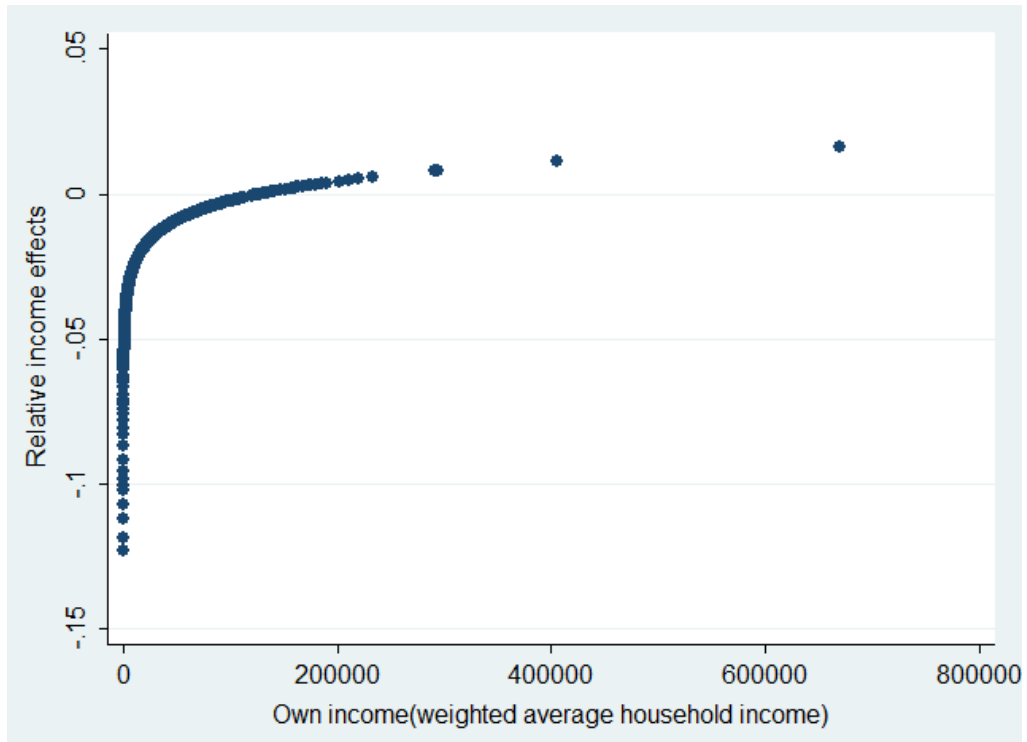


Figure 1.1 Relative income effects as a function of own income*

* Relative income effects are interpreted as the numerical decrease (increase) of utility on the 1-7 scale when one's reference income increases (decreases) by 10%.

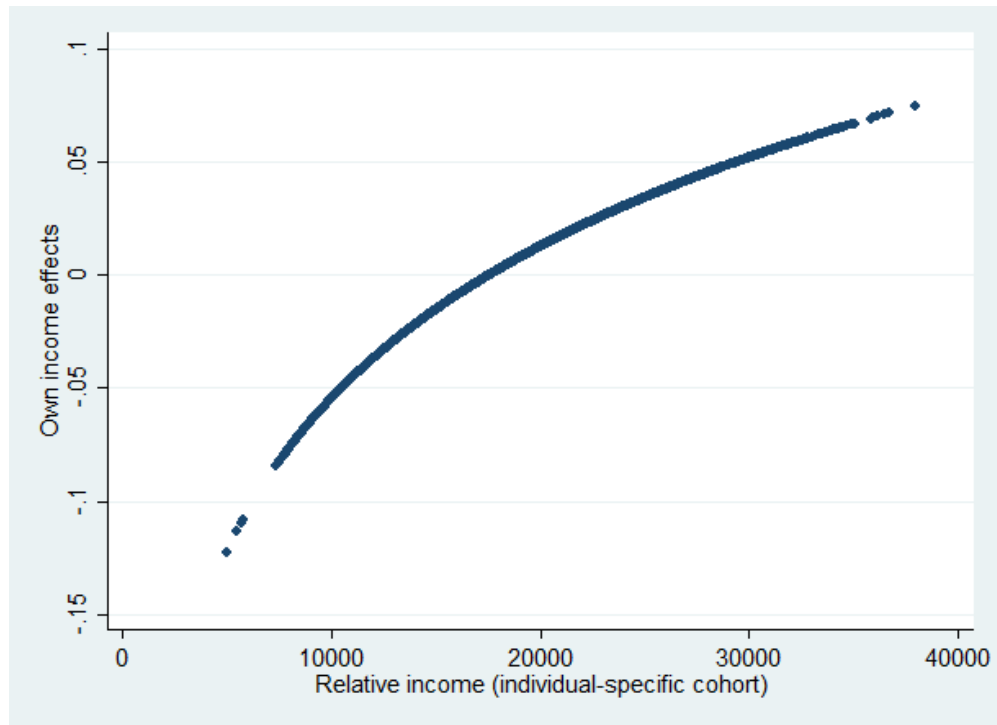


Figure 1.2 Own income effects as a function of relative income

Table 1.5 Life satisfaction estimation results: alternative income definition and reference group construction method

	Benchmark	Household income	Age × region cohorts
Own income	-0.948 (0.351)***	-0.669 (0.307)**	-0.794 (0.361)**
Reference income	-1.141 (0.347)***	-0.853 (0.302)***	-0.826 (0.359)**
Interaction term (own income × reference income)	0.097 (0.036)***	0.064 (0.029)**	0.081 (0.037)**
Age	-0.043 (0.019)**	-0.044 (0.019)**	-0.043 (0.019)**
Healthy	0.285 (0.012)***	0.285 (0.012)***	0.285 (0.012)***
Married	0.251 (0.021)***	0.251 (0.022)***	0.248 (0.021)***
Employed	0.083 (0.017)***	0.083 (0.017)***	0.080 (0.017)***
_cons	17.873 (3.513)***	15.639 (3.262)***	14.792 (3.620)***
Time dummies	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes
R^2	0.02	0.02	0.02
N	51,194	51,194	51,194
Joint significance of own income and interaction term		F= 3.89	
Joint significance of reference income and interaction term		F= 10.46	

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 1.6 Life satisfaction ordered probit estimation results: by wave

	Life satisfaction						
	Wave 12	Wave 13	Wave 14	Wave 15	Wave 16	Wave 17	Wave 18
Own income(weighted average)	-1.496 (0.772) *	-1.143 (0.683) *	0.885 (1.389)	-0.827 (0.766)	-0.237 (0.792)	-0.722 (0.823)	-1.513 (0.803) ***
Reference income (average; individual- specific cohort)	-2.512 (0.745) ***	-2.168 (0.659) ***	-0.276 (1.365)	-1.911 (0.776) ***	-1.358 (0.766) *	-1.669 (0.796) **	-2.466 (0.778) ***
Interaction term (own income × reference income)	0.157 (0.079) **	0.125 (0.070) *	-0.079 (0.140)	0.090 (0.078)	0.032 (0.080)	0.079 (0.083)	0.155 (0.081) *
Age	0.001 (0.001) *	0.002 (0.001) ***	-0.001 (0.001)	0.000 (0.001)	0.002 (0.001) ***	0.001 (0.001) *	0.003 (0.001) ***
Healthy	0.666 (0.027) ***	0.684 (0.027) ***	0.663 (0.037) ***	0.620 (0.028) ***	0.711 (0.028) ***	0.703 (0.028) ***	0.706 (0.028) ***
Married	0.332 (0.027) ***	0.304 (0.028) ***	0.364 (0.037) ***	0.331 (0.028) ***	0.317 (0.028) ***	0.299 (0.028) ***	0.314 (0.029) ***
Employed	0.003 (0.032)	0.020 (0.032)	(omitted)	0.069 (0.032) **	0.056 (0.032) *	0.068 (0.032) **	0.101 (0.033) ***
N	8,053	7,900	4,924	7,756	7,733	7,547	7,280
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

CHAPTER II
OPTIMAL TAXATION IN THE PRESENCE OF
INCOME-DEPENDENT RELATIVE INCOME EFFECTS

1. Introduction

Duesenberry's (1949) relative income hypothesis says that an individual's utility depends not only on his absolute income level, but also on his relative income position in society. An individual gains utility if his income exceeds the income of most members in his comparison group and loses utility if his income falls below the income of most members in the group.

This relative income hypothesis brings non-negligible consequences. Each rational individual initially faces a work-leisure choice. With relative income effects, the additional benefit of income leads to the over-supply of labor and under-consumption of leisure. People work hard to stay ahead. Agents expect the utility loss caused by the deviation from the work-leisure equilibrium to be compensated in the form of a utility gain from the income comparison. Nevertheless, as all agents spend more time working, the income gap will not shrink as much as they expect. The opportunity to exchange leisure for higher income seems more attractive to individuals than to society as a whole. According to Frank (2008), public policy should react to these consequences by using such tools as taxation. Income tax can serve as a critical tool to affect labor-supply choices.

This paper discusses the impact of relative income effects within a standard optimal income tax structure. The personal income tax is acknowledged to generate labor-market distortions. The tax increases work's relative price and can make individuals choose either more or less leisure. While this ambiguity has traditionally been driven by the familiar income and substitution effects, we interject another consideration: the possibility that individuals might react positively or negatively to income growth within their reference

groups. While prior studies (i.e., Clark & Oswald, 1996) have explored the impact of symmetric relative income effects on individual labor supply and the optimal income tax schedule, we extend the literature by investigating how agents respond under heterogeneous relative income concerns and how those responses affect the optimal tax schedule. Specifically, we allow for the possibility that relative income effects depend critically on one's own position in income distribution.

Asymmetric relative income effects, which have been supported by many empirical studies (i.e., Ferrer-i-Carbonell, 2005), allow for the possibility that the disutility from being behind is different from the utility from being ahead. Our approach allows the asymmetry to vary with income, in that lower-income individuals are permitted to react differently than higher-income individuals to relative income. Peng's (2015) empirical results support the notion that relative income effects vary with own income.

Using a standard utilitarian social welfare function, the present analysis offers strong evidence regarding the optimal degree of marginal tax rates' (MTRs) progressivity in the presence of asymmetric relative income effects. With the relatively wealthy agents having stronger relative concerns, the tax system becomes more progressive; otherwise it becomes more regressive. Furthermore, compared to the scenario without any relative concerns, allowing for homogeneous relative concerns results in a marginal tax rate increase for all agents, while allowing for heterogeneous relative concerns raises marginal tax rates for some and lowers marginal tax rates for the rest.

To illustrate this study's general finding, consider a society that consists of two individuals, A and B. A is a high-ability type and wealthy, while B is low-ability type and

poor. Introducing relative income effects brings extra marginal utility returns from labor (due to the comparison of incomes) and results in a more inelastic taxable income with respect to marginal tax rates.¹⁶ With symmetric relative income effects, A and B have the same (or similar) marginal return from income competition; and both types experience a similar tax increase. However, if the wealthy agent A has a larger marginal return from income comparison than B, his taxable income is much more inelastic. The government then can apply a higher rate of tax increase on A than B without a sizeable loss of efficiency, thus increasing the progressivity of the tax system. However, if the poor agent B has a larger marginal return from income comparison than A, under the utilitarian social welfare function, the government can apply a higher relative tax rate increase to B without occurring a sizeable efficiency loss. This implies a lower degree of progressivity, or possibly a regressive tax depending on the relative sizes of the marginal returns from income comparison.

The remainder of the paper proceeds as follows. Section 2 displays the motivation and some background details. Section 3 presents the optimal income tax model with asymmetric relative income effects. Section 4 discusses numerical results. Section 5 concludes.

¹⁶ A simple proof is provided later in the model section.

2. Motivation

McCormick (1983) proposes that Duesenberry's theory of income comparison depends on some notion of conspicuous consumption, expressed by Veblen (1899). Veblen argues that some products are purchased not only because of their intrinsic values, but also their function as a signal for social status. Agents are motivated to achieve a higher level of conspicuous consumption than others. Individual utility is thus influenced by a desire for social status as well as the consumption *per se*. Both Veblen and Duesenberry question the traditional utility function, which only consists of absolute amounts of goods, services, and leisure. A growing body of both empirical and experimental studies favors Veblen's and Duesenberry's arguments that the relative component in the utility function has important effects on individual's well-being.¹⁷

There are obvious difficulties with applying Veblen's theory in the design of optimal tax policy, both in theory and in practice. Not all commodities are "conspicuous." The ideal correcting tax system that considers relative concerns should only involve conspicuous consumption, such as luxury cars. Nevertheless, assigning marginal tax rates for each good based on how well they confer status is difficult.¹⁸ Even if possible, the tax structures could be extraordinarily complex with enormous administrative costs. Further, the same product

¹⁷ See Easterlin (1995, 2001), Clark and Oswald (1996), Solnick and Hemenway (1998, 2005), Tversky and Griffin (1991), Johansson-Stenman et al. (2002), Alpizar et al. (2005), Ferrer-i-Carbonell (2005), Luttmer (2005), McBride (2001), and Tran and Zeckhauser (2012).

¹⁸ Corlett and Hague (1953) argued that the goods that are relatively more complementary to the untaxed good (leisure) should be applied to higher tax rates. A similar conclusion arises here in that the goods that are more complementary to the untaxed good (social status) should also have higher tax rates.

may be valued heterogeneously across the population. The idea of individual-specific commodity tax rates is not attractive from a practical policy perspective.

In contrast, Duesenberry considered that by *income* comparison individuals receive extra utility or disutility. This theory is therefore more suitable for consideration within an optimal income taxation framework. The government would only need consider the incentives based on income comparison through income-varying tax rates. The concept of variable marginal income tax rates has enjoyed broader public support in many countries than item- or person-specific commodity tax rates.

Some papers have incorporated relative concerns into the modern optimal tax design founded by Mirrlees (1971) (Boskin and Sheshinski, 1978; Oswald, 1983; Tuomala, 1990; and Aronsson and Johansson-Stenman, 2008). All considered the case in which the relative income effects are symmetric among the population (i.e., cases in which the utility from being ahead by some amount is equal in absolute value terms to the disutility of being behind by the same amount). These studies have suggested generally higher marginal tax rates in the presence of symmetric relative income effects, but the impact on progressivity is not substantial. Some studies also have used numerical simulations to explore the effect of constant relative income effects on progressivity. Tuomala (1990) summarized his findings as follows: “Other things being equal, marginal income tax rates are higher than in the standard model when utility interdependence is assumed ... we have to admit that it does not reveal anything about the shape of the tax schedule” (p. 130). The present analysis considers heterogeneous relative income effects and establishes a stronger prediction regarding the optimal degree of progressivity.

If relative income effects are symmetric, income competing is a zero-sum game. The disutility created by owning \$100 less for one person is compensated by the utility created by owning \$100 more for another. This statement, however, does not apply under heterogeneity. If individual A has larger concerns about relative income than individual B, A's owning more income generates a positive outcome from the income competition game.

Duesenberry (1949) stated that relative income effects can be asymmetric upwards. In other words, the disutility from being behind by a certain amount exceeds the utility from being ahead by the same amount. This statement is consistent with the idea that lower-income individuals are aware of (and covet) higher social standing's benefits (Solnick and Hemenway, 1998). On the other hand, the relative income effects can also be asymmetric downwards, consistent with the notion that those with higher standing are more eager to maintain their relative position.

Many studies have employed econometric methods to look for evidence of asymmetry. They have used a proxy for utility as the dependent variable and estimated the marginal utility of some measure of a reference income level. Results from these studies have lacked a general consensus. Some studies agree with Duesenberry, showing the effects are indeed upwards asymmetric. For example, Ferrer-i-Carbonell (2005) analyzed the German Socio-Economic Panel (GSOEP) and found that West Germans have upwards asymmetric relative income effects. Specifically, poor agents were negatively influenced compared with their reference group, while rich agents did not feel happier from knowing

their income was higher. Boyce et al. (2010) found similar results using the British Household Panel Survey (BHPS).¹⁹

In contrast, McBride (2001), using the U.S. General Social Survey (GSS) data, revealed that the relative income concerns are in fact asymmetric downwards. In addition, Mayraz et al. (2009) evaluated the GSOEP data and found the relative income effects are symmetric, implying there is no difference between high- and low- income earners.²⁰ Given this lack of consensus, the current study evaluates the optimal tax schedules from a more general form of heterogeneity in order to provide a general sense of the relationship between relative income effects and tax schedule progressivity. Based on Peng's (2015) empirical work, we construct individual-specific relative income effects that either positively or negatively depend on individuals' own income levels.

Akerlof (1978) introduced some exogenous determinants into the optimal income tax mechanism, improving the tax system's reliability. He referred to these exogenous characteristics as "tagging." Several studies have shown the power of "tags." Alesina et al. (2011) considered gender-dependent taxation; Mankiw and Weinzierl (2010) argued taxation should depend on height; and Weinzierl (2011) discussed the impact of introducing age as an extra determinant. Although asymmetric relative concerns are not really exogenous and should depend on each taxpayer's relative income position in society,

¹⁹ A difference is that Ferrer-i-Carbonell (2005) found the relative income effect to be zero for high income earners; Boyce et al. (2010) only found it smaller than that of low-income earners.

²⁰ Mayraz et al. (2009) and Ferrer-i-Carbonell (2005) found different results using the same dataset (GSOEP). The former let subjects choose the reference group themselves while the latter defined the reference group as all agents at a similar education level, in the same age bracket, and living in the same region.

in the current analysis, we introduce them to correlate with exogenous wage levels under a static model and to construct a series of individual-specific relative income effects functioning in a similar fashion to Akerlof's (1978) tagging. Moreover, tagging the population based on their income is a more socially acceptable idea than other exogenous pre-determined tags, such as gender or height.

3. The Model

This section presents the model used for numerical simulations. The modern optimal income taxation framework was inspired by Mirrlees (1971). His model is a problem of maximizing a social welfare function, subject to an aggregate budget constraint and an incentive compatibility constraint. The only difference across agents is the ability level, which is assumed to be equal to their hourly wage level.

Kanbur and Tuomala (2013) incorporated relative income concerns into Mirrlees' (1971) framework. The current model is an extension of their work. For simplification purposes, let us assume there is only one reference group that is the whole population; each agent compares his own income level with the group's average income level, which is the population's average income level. All individuals have the same reference income, which is the whole population's average income.

Kanbur and Tuomala allow for symmetric relative income effects. The current study explores the optimal tax schedule under income-dependent relative income effects. A critical question is how to represent income-dependency. Studies (e.g., Ferrer-i-Carbonell 2005) empirically testing asymmetric relative concerns have usually divided the population into two categories: one whose income is higher than his comparison group's and another

whose income is lower than his comparison group's. These studies assigned two different φ for these two categories. Upwards asymmetric relative concerns are confirmed if φ of the category whose income is lower than the reference group's is larger than φ of the other. Upward asymmetry means that income comparison is mainly about comparing with people who are wealthier than you. Downward asymmetry means mainly comparing with people who are poorer than you. If each individual is comparing with the whole society, then the richer he is, the larger chance he has that his income is higher than his reference group's; the poorer he is, the larger chance he has that his income is lower than his reference group's. Based on this spirit and Peng's (2015) finding, we construct income-dependent relative income effects that are broader than in prior work and that are also monotonically correlated with agents' own income levels.

In the current study, we assign each agent a unique φ as his/her relative income effect to generate a continuous tax rate schedule. Denote agent ability (proxied by hourly wage) as w ; y is labor supply (in percentage terms); wy is pre-tax income; and x is disposable income. The goal is to construct a series of individual-specific φ that is monotonically correlated with individual's disposable income x . Due to incentive compatibility conditions, for any two individuals i and j , if $w_i > w_j$, we can have $w_i y_i > w_j y_j$ and $x_i > x_j$. As a result, w is monotonically positively related with x . Thus, we generate qualified relative concerns based on the exogenous w ; agents' relative concerns are associated with their hourly wages. Intuitively, the relative income effect is more likely to be determined by gross income, or productivity, which are more stable over time. The hourly wage rate

is a good indicator of gross income and productivity, however, and the model therefore has legitimate and exogenous relative income effects.

This relative income concern is positively or negatively correlated with an individual's own income. Let

$$\mu = \int x(w)f(w)dw \quad (1)$$

denote the average income of the reference group (here it is the whole population's average income). The ability w has a density function $f(w)$; w is on the interval $(0, +\infty)$.

The individual i will maximize his utility subject to a budget constraint:

$$x_i = w_i y_i - T(w_i y_i) + \text{transfer} \quad (2)$$

where $T(wy)$ is the amount of tax paid based on the pre-tax income $w_i y_i$; *transfer* is a lump-sum transfer that is equal for everyone. The government cannot observe individuals' abilities and thus is restricted to specifying taxes as a function only of earnings, $T(wy)$.

Following the traditional utility function evaluated in the optimal taxation literature, labor is the only income source. The agent i maximizes his additive and separable utility function as follows:

$$u_i = \log(x_i) + \varphi_i \log\left(\frac{x_i}{\mu}\right) + \log(1 - y_i) \quad (3)$$

where x_i is i 's income, x_i/μ is the ratio of own income and reference income, and $(1 - y_i)$ is leisure. Standard first order conditions are held: $u_x > 0, u_\mu < 0, u_y < 0$. The second inequality indicates that reference group's increase of income level always hurts the agents' utility.

The second term of eq. (3) is the difference between the present model and the model specified by Kanbur and Tuomala. They assume that for any two agents i and j , $\varphi_i = \varphi_j = \varphi$. The same relative concern applies to the whole population. In the current model, the relative concern is a function of the individual i 's hourly wage, w_i .

The last term of eq. (3) restricts the labor supply between 0 and 1. This restriction potentially can bring some issues of locality to numerical results. Nevertheless, the question of interest is how asymmetry affects the tax schedule. Thus, the results are still valid as long as the above restriction exists for all cases evaluated, with and without asymmetry.

To maximize own utility, each agent's behavior satisfies the following:

$$\left(\frac{1 + \varphi_i}{x_i}\right) w_i(1 - t_i) - \frac{1}{1 - y_i} \frac{\partial y_i}{\partial x_i} = 0 \quad (4)$$

where t_i is the marginal tax rate faced by individual i .

Eq. (4) implies that the marginal benefit of earning one more dollar for agent i is $w_i(1 - t_i)(1 + \varphi_i)/x_i$. Compared to the marginal benefit without relative income effects $w_i(1 - t_i)/x_i$, it is higher by $w_i\varphi_i(1 - t_i)/x_i$. This increment represents income's extra marginal benefit brought by income comparison. Meanwhile, in eq. (4) income's marginal cost (benefit of leisure) remains the same as in a traditional framework. Agents thus engage more in work and less in leisure. With symmetric relative income effects (e.g., Kanbur and Tuomala, 2013), φ is homogenous across individuals. Income's marginal benefit across individuals at various income levels only differs by x_i and t_i , the absolute income amount

and the marginal tax rate. With asymmetric relative income effects, the unique relative concern φ_i also determines i 's income's marginal benefit.²¹

Consistent with Kanbur and Tuomala (2013), the government maximizes the utilitarian social welfare function,

$$S = \int_0^{\infty} u(w)f(w)dw \quad (5)$$

Meanwhile, the social planner has revenue constraint,

$$\int_0^{\infty} T(wy)f(w)dw = R \quad (6)$$

where R is the total tax revenue. The tax revenue is distributed evenly to individuals in the form of a lump-sum transfer. As a result, this is not a traditional revenue constraint in the sense that no pre-determined revenue requirement exists. Tax revenue is purely for redistribution purposes. This is equivalent to the notion that the government needs revenue to fulfill its goal of providing a basket of public goods and services, which are assumed to be equally valued by everyone.

For any individual i , totally differentiating utility with respect to w_i , and making use of (2), (3), and (4), the incentive compatibility constraint is as follows,

²¹ This footnote serves to explore the correlation between relative income effects and the elasticity of taxable income with respect to marginal tax rates. We consider an individual i with no income effects who maximizes his/her utility: $u_i = x_i + \varphi_i(x_i - \mu) + \log(1 - \frac{z_i}{w_i})$, where z_i is pre-tax income. It is easy to deduce that the elasticity of taxable income with respect to marginal tax rates $|\varepsilon_i| = \frac{\tau_i}{[w_i(1+\varphi_i)(1-\tau_i)-1](1+\tau_i)}$. As the relative concern parameter increases, he/she becomes less elastic with respect to marginal tax rates.

$$\frac{du_i}{dw_i} = -\frac{y_i V_{y_i}}{w_i} \quad (7)$$

Eq. (7) ensures that agents will reveal true information about their ability levels. The higher their ability, the larger the utility they will get.

Under the incentive-compatibility constraint, a marginal increase in public expenditure is optimally distributed such that each agent's utility rises by the same amount. This is carried out by the lump-sum transfer and thus does not distort the labor supply decision. The cost in consumption terms of raising utility marginally for agent θ is the inverse of his disposable income's marginal utility, $1/\left(\frac{1+\varphi(w_\theta)}{x_\theta}\right)$. The cost of an incentive-compatible marginal increase in average utility for the whole population is $\int_0^\infty 1/\left(\frac{1+\varphi(w_\theta)}{x_\theta}\right) f(\theta) d\theta$. λ , the Lagrangian multiplier for the budget constraint (6), is the public funds' marginal value. It satisfies the condition below:.

$$\lambda = \frac{1}{\int_0^\infty 1/\left(\frac{1+\varphi(w_\theta)}{x_\theta}\right) f(\theta) d\theta} \quad (8)$$

Following Kanbur and Tuomala (2013), the optimal marginal tax rates for agents at each ability level are derived from the government's maximization of (5) subject to conditions (1), (6), and (7). After substituting using (8), the formula below is obtained:²²

²² Kanbur and Tuomala (2013) provide details of the algebra behind this result.

$$\frac{t_i}{1-t_i} = \frac{\gamma}{\lambda} + \left[\frac{1+E_i^u}{E_i^c} \right] \left[\frac{\left(\frac{1+\varphi(w_i)}{x_i} \right)}{w_i f(w_i)} \right] \left[\int_{w_i}^{\infty} \frac{\left(1+\frac{\gamma}{\lambda} \right)}{\left(\frac{1+\varphi(w_i)}{x_i} \right)} f(\theta) d\theta \right. \\ \left. - (1-F(w_i)) \int_0^{\infty} \frac{1}{\left(\frac{1+\varphi(w_i)}{x_i} \right)} f(\theta) d\theta \right] \quad (9)$$

where E^u is the uncompensated elasticity of labor supply, E^c is the compensated elasticity of labor supply, and γ is the Lagrange multiplier for constraint (1).

From the first order conditions, γ/λ is a constant term satisfying the following equation,

$$\frac{\gamma}{\lambda} = \frac{\int_0^{\infty} \left(\frac{\varphi}{\mu} \right) f(w) dw}{1 - \int_0^{\infty} \left(\frac{\varphi}{\mu} \right) f(w) dw} \quad (10)$$

The benchmark scenario in this study is one in which the wealthy have higher relative income effects (φ) than the poor. A concave utility of income means that income effects are smaller for high-income earners, pushing marginal tax rates down at higher-income levels. On the other hand, since the wealthy have larger relative income effects, they have less elastic taxable income than the poor in response to a marginal tax rate increase to maintain their relative position. Thus, a greater increase of marginal tax rates should apply to the wealthy to take advantage of their relatively inelastic taxable income regarding marginal rates, and a less intensive increase should apply to the poor because of their relatively elastic taxable income. This suggests a higher degree of progressivity. Collectively, these two forces determine the optimal tax rate schedule. Through numerical simulations, the next section reveals these two opposing effects' net impact on progressivity's optimal degree.

4. Numerical Results

Due to the optimal tax formula's complexity and a lack of data to inform the appropriate choice of functional form for utility, scholars (e.g., Mirrlees 1971; Kanbur & Tuomala, 2013) performed simulations to generate the optimal tax structure. In the current study, Kanbur and Tuomala's general numerical approach (2013) is used and the MTRs are calculated using the above model. Heterogeneous relative concerns' impact on the optimal tax schedule is tested by replacing and comparing different relative income effect components.

One major assumption concerns how to parameterize the wage distribution. Two different distributions are widely used to describe the exogenous wage distribution (which proxies for ability). Some (e.g., Mirrlees, 1971) assume a lognormal distribution, while others (e.g., Diamond, 1998) consider a Pareto distribution. Saez (2001) found that the lognormal distribution fits quite well for most income levels, but has an unrealistically thin top tail. In contrast, the Pareto distribution fits well at the high end. Thus, in this study the wage distribution is examined that has a lognormal distribution for most levels and a Pareto distribution for the top tail (Mankiw et al., 2009).

4.1 Main Results

Based on eq. (7), individual i 's marginal utility of absolute income is $(1 - \tau_i)/x_i$ and marginal utility of relative income is $(1 - \tau_i)\varphi_i/x_i$. Some studies considering symmetric relative income effects have found that the estimated coefficients on absolute income and relative income have almost equal absolute values and opposite signs (e.g., Clark & Oswald, 1996; Luttmer, 2005). Thus, in the benchmark scenario, the population

is assumed to span from an agent who has no relative concern to an agent who weights relative income the same as absolute income.

In this scenario, the optimal marginal tax rates are calculated in three different cases, which differ only in relative income effects, φ . Case A is the traditional setting where relative income effects do not play a role in the utility function and φ is zero for everyone. Case B has a symmetric relative income effect and φ equals one for everyone.²³ Case C, which is our primary interest, contains heterogeneous relative income effects that positively correlate with individuals' wages. In Case C we assume that φ is increasingly associated with the wage and has a uniform distribution, ranging from zero to one.²⁴ Specifically, the lowest-wage individual has φ of zero and the highest-wage individual has φ of one, with all other values of φ assigned along the uniform distribution from 0 to 1. This is the simplest version of an income-dependent relative income effect. Case A and B function as the lower and upper bounds for C, respectively. A summary of these three cases is shown in Table 2.1.

Following Mankiw et al. (2009), the wage distribution is parameterized from CPS data from March, 2007. The distribution is a modification of the lognormal approximation in which a Pareto tail is included above the 95th percentile wage. Agents' wage levels have a range of [0.01, 500.51].²⁵ Adopting the algorithm discussed in Mankiw et al. (2009),²⁶

²³ This is the same φ that Kanbur and Tuomala (2013) evaluated.

²⁴ To generate a range of [0,1] for the relative concern φ from the wage distribution [0.01, 500.51], the relative concern for agent i is $\varphi_i = 0.001998w_i - 0.00001998$.

²⁵ Some examples of the hourly wage levels accompanied by cumulative density functions are in the first two columns of Table 2.

²⁶ Details are available online: http://www.aeaweb.org/jep/app/2304_Mankiw_Weinzierl_Yagan_appendix.pdf

Table 2.2 presents the results for the lognormal-Pareto distribution. There are several features of these results. First, at every wage level, the marginal tax rates (MTR) in case B are higher than those in A. Consistent with previous studies (Kanbur and Tuomala, 2013; Tuomala, 1990), we find that symmetric relative concerns are associated with higher MTRs.

Second, Sadka (1976) and Seade's (1977) famous end-point conclusion that the marginal rate at the top income level is zero when the income distribution is bounded, which we see in case A, no longer holds in the presence of relative income effects. This result is also consistent with previous studies (Kanbur & Tuomala, 2013; Aronsson & Johansson-Stenman, 2008). While providing a lower top marginal tax rate in order to elicit effort from the highest earner remains desirable, the presence of relative income effects allows the tax rate to be non-zero.

Third, marginal tax rates are extremely high at the bottom of the income distribution. This feature (which is consistent with Mankiw et al., 2009) results mostly from efficiency concerns and thus may be quite impractical. However, the U.S. earned income tax credit (EITC) is a real-world example. Specifically, marginal tax rates become much higher as the EITC phases out due to income growth.

Note that under heterogeneous relative concerns, the marginal tax rate t_i will depend on others' relative concerns φ_{-i} as well. For example, the top-income earners in cases B and C share the same hourly wage and relative concern ($\varphi = 1$), but their MTRs are different. The reason is that while all agents' relative concerns are 1 in case B; in case C, concerns of all except the top-income earner are less than 1. Thus, keeping his current

status is harder for the top-income earner in case B than in case C. He has much stronger motivations to keep working hard and will engage in more labor. The government can thus apply a higher MTR to him without suffering a loss of efficiency.

Graphs are powerful to illustrate how progressive the tax structure is in each case. Figure 2.1 depicts the tax schedules under all three cases. The bottom line is the curve for case A ($\varphi = 0$). The top line is the curve for case B ($\varphi = 1$). The curve of case C ($\varphi \sim [0,1]$) lies mostly in between. At the bottom of the wage distribution, case C's curve converges with case A's; meanwhile at the top of the distribution, it converges with case B's. This reflects the fact that in case C, agents at the low-skill level have relative effects converging with case A's effects; agents at the high-skill level have relative effects converging with case B's effects.

A very important feature shown in Figure 2.1 is that when transitioning from case A to case C, the heterogeneous relative income effects actually raise marginal tax rates only for the extremely wealthy (for whom the hourly wage is larger than around \$175/hour while lowering marginal tax rates for the remaining majority. This consequence collectively comes from two opposing effects. First, in case C, extremely high-income earners are less distorted by high MTRs than in case A since they value their social status. This causes them to engage more in labor supply; thus, they can face higher MTRs and pay more taxes than in case A without an efficiency loss. Meanwhile, in case C the majority have smaller relative concerns, but they still have more inelastic taxable income than in case A; thus, the government should apply higher MTRs on them. Second, in case C the government intends to apply lower MTRs on the majority because of the increment of tax revenue

coming from the top-income earners. Taxing extremely high-income earners and then distributing evenly as a lump-sum transfer would be more efficient, especially when their taxable income is relatively more inelastic with respect to MTRs than low-income earners'. The simulation results show that collectively, the majority's MTRs slightly decrease, confirming that in this heterogeneity environment, φ_{-i} plays an important role in deciding MTRs. In case C, the majority enjoy lower MTRs only because of their more competitive "neighbors." This feature does not happen in case B because the majority do not differ from the top-income earners on relative concerns. Thus, the second effect above is much smaller and does not dominate the first effect. The government will try to use higher MTRs to restrain the majority as well as the high-income earners.

In the literature, relative concerns are associated with MTRs' universal increases. However, Figure 2.1 shows that taking income-dependent relative income effects that are positively related to own income into account – instead of symmetric relative concerns – decreases MTRs for most agents and increases MTRs for extremely high-income earners. This implies that if the rich do have larger relative concerns than the rest, efficiency considerations dictate higher MTRs on them and then compensate the majority by lowering their MTRs. Finally, under heterogeneity, the tax schedule's progressive segment (where MTRs increase as the wage level increases) is relatively longer, and the regressive segment (where MTRs decrease as the wage level increases) is shorter. Evidently, the optimal income tax structure is characterized by a greater degree of progressivity.

4.2 Robustness Check

The benchmark scenario consists of three important assumptions: i) the wage distribution is a combination of a lognormal distribution and a Pareto distribution; ii) the utility increase mostly comes from increased absolute income rather than increased relative income; and iii) the wealthy have larger concerns than the poor. Therefore, to reach a comprehensive conclusion of how heterogeneous relative concerns affect the optimal income tax structure, we conduct a series of robustness checks and separately replace these assumptions.

Figure 2.2 shows the optimal tax structure involving a lognormal wage distribution throughout the entire distribution.²⁷ In all three cases, consistent with Mankiw et al. (2009), MTRs are decreasing as the wage increases. After taking into account heterogeneous relative concerns, only high-income earners suffer from increased MTRs, compared to the traditional case. This again confirms the result above that if the relative income effects are positively related to own income levels, MTRs only increase for the rich. Overall, this alternate wage distribution removes the progressive segments, but the tax structure still has a lower degree of regressivity of MTRs after introducing heterogeneous relative concerns.

In the benchmark scenario, φ is uniformly distributed between 0 and 1; thus, most individuals derive more utility from absolute than from relative income. Anytime an individual's income is increased, up to half of the utility gain comes from income

²⁷ This lognormal distribution is fitted from the same dataset – March 2007, CPS.

comparison. Figure 2.3 illustrates tax curves under the alternative assumption. In this scenario, φ is uniformly distributed between 0 and 4. Thus, 75% of agents benefit more from relative rather than absolute income when facing income increases. All of the benchmark scenario's features are inherited. As φ increases for most agents, those features become more dramatic. As opposed to the traditional case, most agents have lower MTRs except the extremely wealthy group with heterogeneous relative concerns. The tax curve representing heterogeneous relative concerns becomes more progressive again.

Next, evaluating the alternative assumption regarding relative income effects is worthwhile. Figure 2.4 presents tax curves under the lognormal-Pareto distribution when relative income effects are negatively related to own income. In this scenario, low-income agents have large φ , and high income agents have small φ . As before, the curve that mostly lies between represents relative income effects of upward asymmetry (φ has a uniform distribution among the agents, ranging from zero to one). This curve appears more regressive instead. The other two curves represent the structures with symmetric relative concerns and no relative concern from top to bottom, respectively. In this situation, low-income earners have higher relative concerns and more inelastic taxable income with respect to tax increases. On purely efficiency grounds, the low-income individuals need to be taxed more heavily because of their relatively inelastic taxable income. However, high-income earners contribute much larger tax revenue than the rest. As a result, compared to the tax curve under the traditional scenario, everyone suffers from a higher MTR in this upward asymmetry scenario. The government cannot afford lower MTRs for the wealthy

while raising MTRs for the poor. Taxing the rich to compensate the poor is easier than the other way around.

Finally, we also incorporate Peng (2015)'s empirical evidence and deduct the optimal MTRs. Figure 2.5 shows the result. Peng (2015) evaluates British Household Panel Survey (BHPS) and finds the poor have larger concerns regarding others' income. For simplicity, in figure 2.5, we assume the poorest person's relative income effect is 0.85, the wealthiest person's relative income effect is 0, and the relative income effect still fits in a uniform distribution among the population.²⁸ The tax curve under this situation is close to the one in figure 2.4, and it also becomes less progressive comparing to the curve with homogenous relative income effects.

5. Discussion

This paper shows that allowing for relative income effects' heterogeneity can significantly affect optimal income tax rates as well as progressivity. While the selection of wage distribution and whether absolute or relative income dominates do not play important roles in deciding the progressivity degree, whether the effects are positively or negatively related to own income is critical. Greater optimal progressivity arises as wealthier taxpayers have stronger relative income effects. Given the specific type of heterogeneity's importance for optimal tax progressivity, additional empirical analysis is

²⁸ In Peng (2015)'s study, the relative income effect has a uniform distribution on the natural logarithm of income. But here we make an assumption for simplification purposes that the relative income effect has a uniform distribution on income.

desirable to discover how individuals respond to reference-group income as own income changes.

The income tax policy is always an important political topic. When designing an optimal income tax system, an important concern is the equity-efficiency tradeoff. Most countries around the world now have progressive income tax systems, which is primarily based on the grounds of equity (Bos & Tillmann, 1985). In this analysis, we assume a utilitarian social welfare function with no inequality aversion parameter. Thus, a generally regressive tax schedule is justified on the grounds of efficiency (high-income earners should be less distorted because of their high productivity). Thus, taxing the poor more heavily makes sense when they are more sensitive to the income gap than the wealthy and have a more regressive tax structure. From the social planner's perspective, this tax system is not designed for reducing income inequality. Instead, taxing the poor more heavily in this situation is purely based on efficiency purposes.

The practical impact of relative income effects runs counter to the traditional behavioral responses typically considered in optimal income tax models. Specifically, taxable income's elasticity with respect to marginal tax rates is known to be higher for high-income taxpayers for a variety of reasons, including access to various opportunities for manipulating income (Gruber & Saez, 2002; Saez et al., 2012). While this would typically generate lower optimal marginal rates for higher-income taxpayers, considering relative income effects can work in the opposite direction, thus supporting greater optimal progressivity.

This study considers relative income effects monotonically correlating with income level. Future research should explore other possible forms of heterogeneous relative income effects. At the extreme, relative income effects are likely individual-specific and depend on a variety of factors (e.g., age, gender, marital status, religious background). Indeed, two individuals with identical incomes may have very different views of the reference group income's importance. This individual-specific consideration also likely transfers to our consideration of a universal lump-sum transfer; individuals are likely to evaluate that transfer differently in a way that might or might not be correlated with income. Numerous studies (e.g., Fischbacher et al., 2013) have shown that agents may benefit heterogeneously from public good provision.

Finally, examining how relative income effects vary across countries is also important. For example, China has experienced rapid economic growth during the past several decades, and an estimated 29% of the world's luxury purchases in 2013 were made by Chinese nationals—more than any other country.²⁹ The extent to which this is indicative of more substantial relative income effects, and the extent to which that information could be used for welfare-enhancing policy, is worthy of additional research.

²⁹ China Luxury Goods Market Study, Bain & Company, 2013.

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Appendix

Table 2.1 Summary of cases evaluated

	Relative income effect	Min(φ)	Max(φ)
Case A	No effect	0	0
Case B	Symmetric effect	1	1
Case C	Heterogeneous effect	0	1

Table 2.1 Numerical results of lognormal-Pareto distribution

w(wage)	F(w)	Case A ($\varphi = 0$)			Case B ($\varphi = 1$)			Case C ($\varphi \in [0, 1]$)		
		L (labor)	X (disposable income)	MTR	L (labor)	X (disposable income)	MTR	L (labor)	X (disposable income)	MTR
0.01	0.05	0	3.1381	0.9980	0	5.0940	0.9992	0	3.2588	0.9982
7.01	0.1827	0.0228	3.2131	0.5309	0.0647	5.2765	0.5976	0.0145	3.3066	0.5280
14.01	0.5072	0.3237	5.7870	0.3892	0.4495	8.3025	0.4618	0.3276	5.9741	0.3831
17.51	0.6357	0.3674	6.9841	0.3695	0.5008	9.6701	0.4468	0.3741	7.2227	0.3632
24.51	0.8005	0.4083	9.2668	0.3610	0.5486	12.2695	0.4456	0.4197	9.6341	0.3543
35.01	0.9071	0.4205	12.1825	0.3995	0.5651	15.6363	0.4865	0.4389	12.8145	0.3903
49.01	0.9525	0.4097	15.0842	0.4786	0.5578	19.1104	0.5591	0.4370	16.1606	0.4666
108.51	0.9903	0.4379	28.2988	0.5361	0.5901	33.7755	0.6203	0.4912	31.9036	0.5251
203.01	0.9975	0.4722	50.7143	0.5267	0.6261	57.3589	0.6222	0.5550	59.6937	0.5299
301.01	0.9991	0.5091	79.6003	0.4613	0.6632	86.2944	0.5744	0.6142	94.9142	0.4896
402.51	0.9997	0.5557	122.3789	0.3157	0.7111	128.0784	0.4494	0.6805	144.9565	0.3753
500.51	1.0000	0.6154	192.4808	0.0000	0.7827	203.4953	0.0646	0.7677	231.1537	0.0060

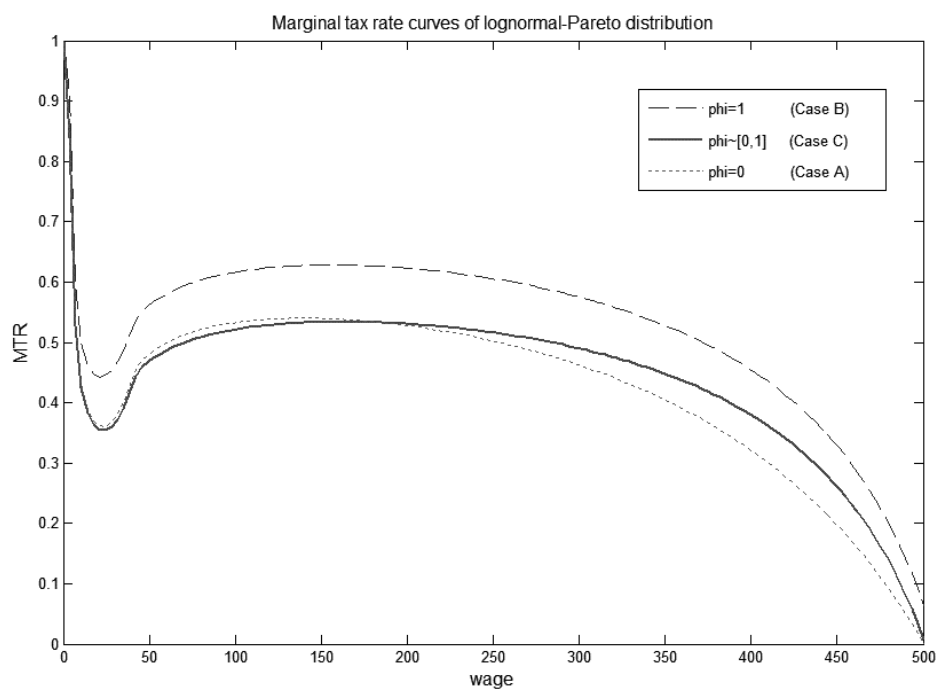


Figure 2.1 Tax structure for lognormal-pareto distribution (benchmark)

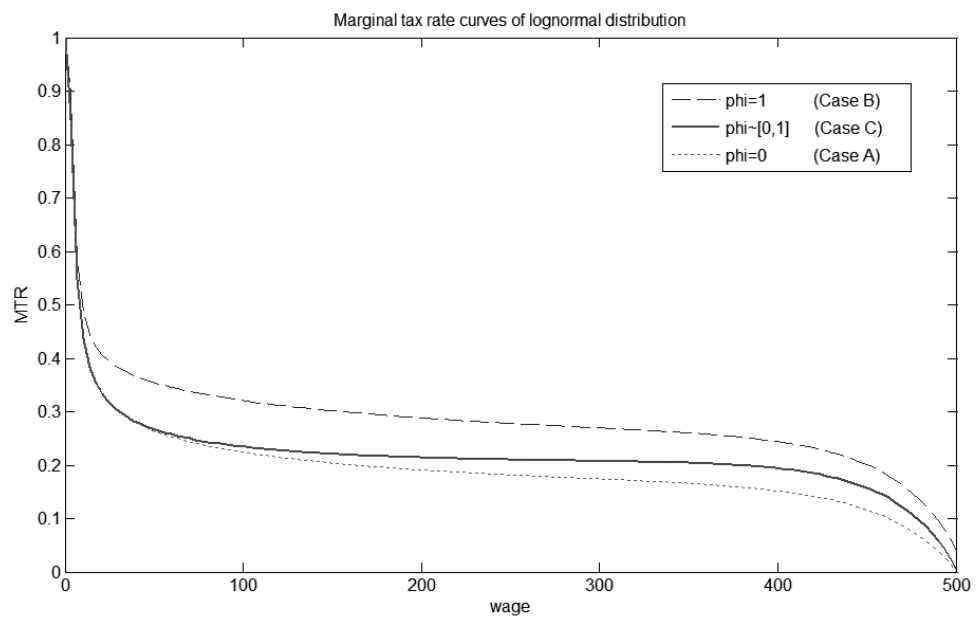


Figure 2.2 Tax structure for lognormal distribution

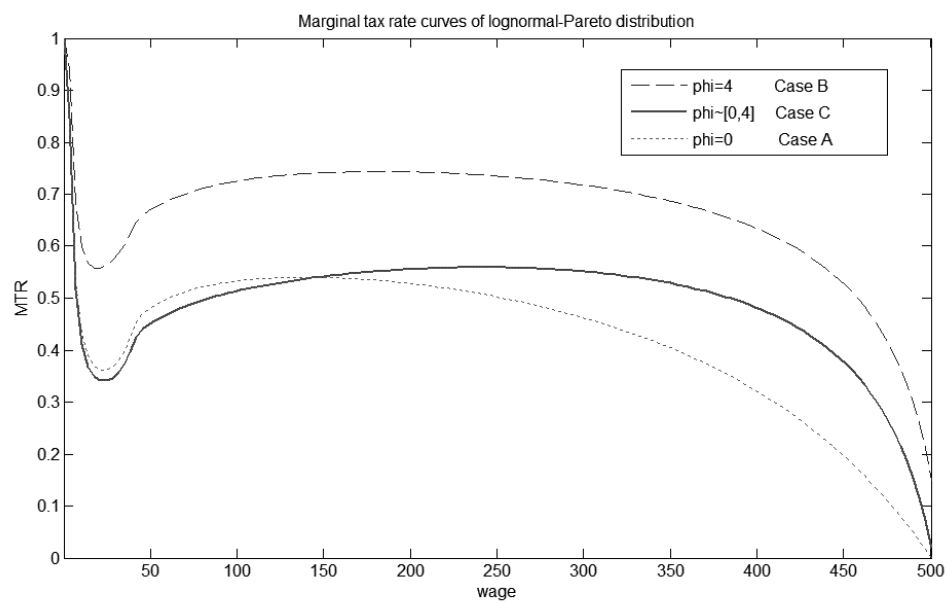


Figure 2.3 Tax structure for lognormal-pareto distribution, relative income effects dominate

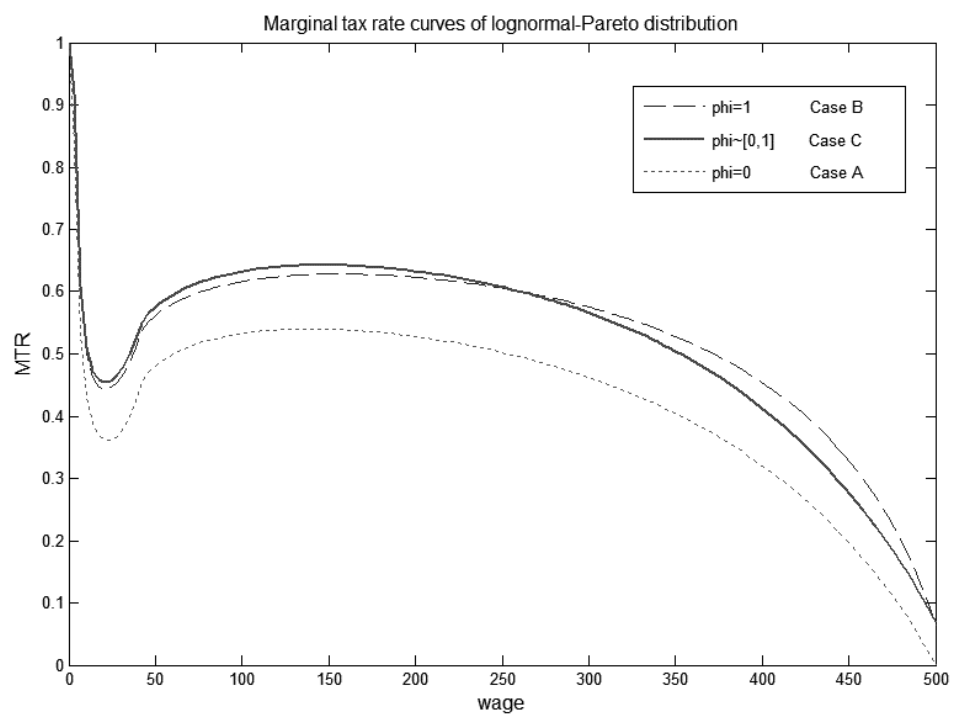


Figure 2.4 Tax structure for lognormal-pareto distribution, the poor have larger concerns

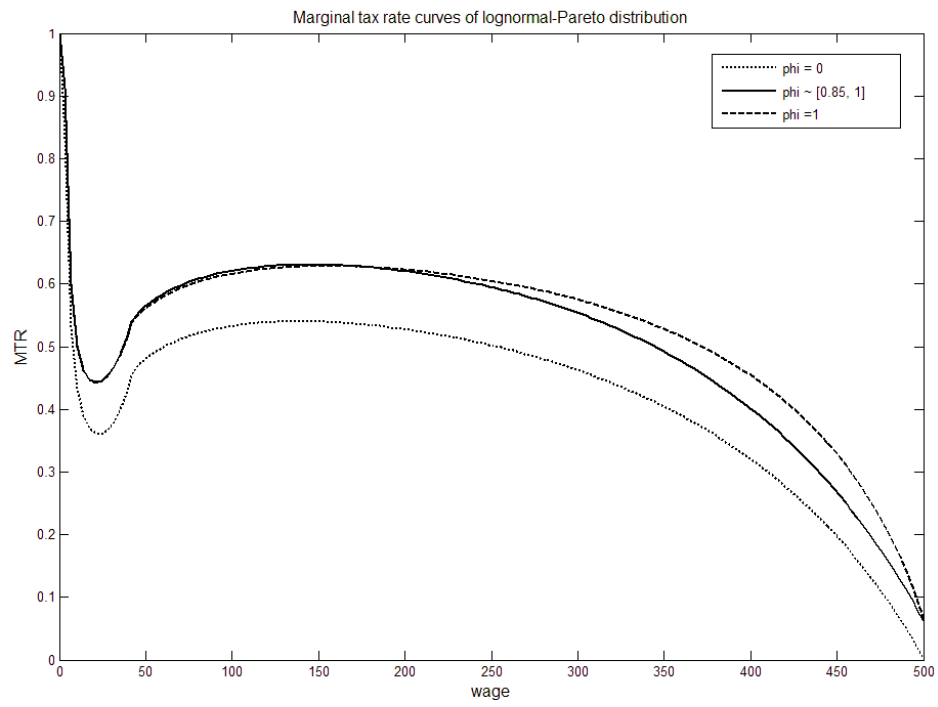


Figure 2.5 Tax structure for lognormal-pareto distribution, evidence from BHPS

CHAPTER III

OTHER REGARDING PREFERENCES AND INEQUALITY

1. Introduction

Traditional microeconomic models assume selfish motivations of economic agents that drive decision-making. For individuals, this includes optimizing choices like labor supply and consumption. As powerful as these models have proven to be, they cannot explain certain behaviors that have been observed in market, social, and experimental settings. For example, individuals give more to charity, comply more with the tax system, and transfer more of their endowment in dictator games than standard theory would predict. While economists have long recognized that individuals have various tastes for fairness that may help explain these and similar behaviors, formal modeling is a relatively recent phenomenon.

In the realm of fiscal policy and redistribution, selfish preferences have similarly dominated modeling. Issues of equity and fairness have typically been imposed by positing social welfare functions that capture tastes for redistribution, often with the companion assumption of declining marginal utility of income. In classic optimal tax applications without lump-sum redistribution, these preferences are then balanced against the tax/transfer system's efficiency consequences yielding the familiar equity-efficiency tradeoff. Such optimal tax models generally offer no organic mechanism for eliciting underlying individual preferences for redistribution.

Notions of fairness and equity have been introduced formally into several modern constructs of individual preferences falling under the general headings of social or other-regarding preferences. These alternative formulations of preferences are being used to better understand fiscal policy choices and their consequences, including the degree of

redistribution the tax/transfer system imparts. One important class of models considers positional goods (like extravagant yachts or large personal estates) where utility depends on own consumption relative to the average consumption of society or some reference group.³⁰ Status-seeking agents are willing to expend resources to increase their consumption relative to the reference group in order to increase utility, while more consumption by the reference group diminishes the status-seeking agent's utility. These models have important and often novel implications. For example, Wendner and Goulder (2008) show that consumption taxes can be efficiency enhancing by reducing taxation's marginal excess burden in the presence of positional goods as taxes diminish the pursuit of status.³¹

This analysis is built on a closely related class of models capturing preferences for inequality aversion. Examples include Fehr and Schmidt (1999) and Bolton and Ockenfels (2000). Like models of positional goods, own utility with other-regarding preferences depends in part on other economic agents' consumption or utility. However, models of inequality aversion allow for more general forms of utility interdependency. For example, an agent may be averse to being ahead of others in income or consumption distribution or be competitive and derive utility from being ahead. Similarly, agents may be averse to themselves or others being behind in income or consumption. This allows for a more

³⁰ Examples include Easterlin (1995), Ireland (2001, 1998), Allgood (2006) and Wendner and Goulder (2008). For an introductory survey, see Hopkins (2008).

³¹This application has some similarity to that of Feldstein (1972) who considered distributional equity in the context of the Ramsey rule. However, consistent with the optimal tax literature of the era, Feldstein imposed a social welfare function that is a weighted average of household marginal utility.

flexible model than what might be called “classic models” of behavior, where labor supply and consumption decisions are simply based on the population’s average consumption.

As Hopkins (2008) pointed out, inequality-averse preferences are usually observed in experimental economics while competitive preferences dominate empirical evidence from surveys. This observation signifies the necessity of considering both while modeling human behavior. Prior literature either considers only inequality averse preferences (e.g., Fehr and Schmidt, 1999) or competitive preferences (e.g., Ireland, 2001). Some studies categorized competitive preferences based on whether you are ahead of or behind your reference group. However, they did not involve inequality aversion. Our study takes a step beyond by evaluating a broader form of other-regarding preferences.

We specify a model that allows inequality aversion as well as competitive preferences where the government collects taxes through a linear income tax and then redistributes evenly. The agents are differentiated by their endowed skill levels, which in a competitive labor market yields a wage equal to the value of each agent’s marginal product of labor. The agents are assumed to be other regarding in the sense that the consumption of other agents affects own utility levels. The baseline analysis is the total output and degree of income inequality for a simple economy with standard (myopic) agents. We compare these outcomes against alternative models with other regarding preferences. By allowing agents to view the consumption of those who are *ahead* differently than those who are *behind* and the existence of both competitive and inequality-averse preferences, we find including inequality-averse preferences can cause some significantly different outcomes. For example, many studies (e.g., Frank, 2008) suggest that these non-traditional

preferences cause more labor supply. Our study shows that the effect on labor-supply decisions is complicated when concerning inequality-averse preferences. This directly leads to the complexity of the effect on total tax revenue collected for redistribution. Further, we also explore the consequence on social inequality.

2. The Model

All agents have identical preferences, although they have differing productivity levels and exogenous incomes. Let C denote consumption and L denote the supply of Labor. An individual's productivity, w , is also the wage rate (the composite good is produced according to a CRS technology that uses L as the sole variable input). Labor income is taxed at rate τ and all individuals receive a lump sum subsidy S . Agent i receives direct utility from the consumption of leisure and the composite good.

Agents differ in their skill levels which are distributed on the interval $[\underline{w}, \overline{w}]$ according to cumulative distribution $H(w)$ with corresponding density $h(w)$. Let the consumption of an agent with skill level w be denoted by $C(w)$, where we have suppressed the other factors, such as the tax rate and subsidy, affecting an agent's consumption choice.

Meanwhile, consumption C has a corresponding distribution $G(C)$ determined by skill levels. For the moment, we simply assume that the consumption and leisure choices are normal so that $C(w)$ and $\lambda(w)$ are increasing in skill levels, other things equal. For a given tax policy, an agent i with skill level w_i chooses C_i to maximize:

$$U(C_i, \cdot) = C_i - \alpha \int_{C(\underline{w})}^{C_i} [C_i - z] g(z) dz - \beta \int_{C_i}^{C(\overline{w})} [z - C_i] g(z) dz - \frac{\xi \cdot (\frac{C_i - S}{(1-\tau)w_i})^\sigma}{\sigma}$$

where we substitute labor L from $C_i = (1 - \tau)w_i L_i + S$.

The α term reflects the utility/disutility an agent receives from being ahead of others in the population, while the β term reflects the magnitude of the disutility from being behind.³² We do not generally restrict the sign of α . A positive α indicates that agents are inequality averse, while a negative α indicates that agents are competitive. Throughout we assume $\beta > 0$ implying that agents do not like being behind others in consumption. We also assume $\alpha \in [-\beta, \beta]$, which implies that competitive agents dislike being behind at least as much as they enjoy being ahead (when $\alpha < 0, -\alpha < \beta$)³³, and that all inequality averse agents, including those the highest income, prefer more consumption to less (when $\alpha > 0, \alpha < \beta$). Note that this utility specification implicitly assumes that the agent would be indifferent to any permutation of consumption levels across other agents. That is, there is an anonymous nature to the other regarding preferences.

3. Results

3.1 Labor Supply Effects

The necessary first-order condition for the utility maximizing consumption is given by.

$$1 - \alpha \int_{c(\underline{w})}^{c_i} g(z) dz + \beta \int_{c_i}^{c(\overline{w})} g(z) dz - \frac{\xi \cdot (C_i - S)^{\sigma-1}}{[(1 - \tau)w_i]^\sigma} = 0$$

³² In the current analysis, we consider a static model; in other words, the whole population shares the same α and β .

³³ Many empirical studies (e.g., Ferrer-i-Carbonell) support this idea called “upward asymmetry.” They find that agents feel worse about being behind, but not as much as how much they feel better about being ahead.

$$1 - \alpha G(C_i) + \beta(1 - G(C_i)) - \frac{\xi \cdot (C_i - S)^{\sigma-1}}{[(1-\tau)w_i]^\sigma} = 0 \quad (1)$$

The assumption $\alpha \in [-\beta, \beta]$ guarantees that following second order condition is satisfied:

$$-(\alpha + \beta)g(C_i) - \frac{\xi \cdot (\sigma-1)(C_i - S)^{\sigma-2}}{[(1-\tau)w_i]^\sigma} < 0 \quad (2)$$

The second order condition ensures that a maximum consumption for individual i exists. For any individual i , $G(C_i(w_i)) = H(C^{-1}(C(w_i))) = H(w_i)$ because consumption level and skill level are monotonically correlated with each other. Substituting this result into (1), we then have:

$$\frac{\xi \cdot (C_i - S)^{\sigma-1}}{[(1-\tau)w_i]^\sigma} = 1 - \alpha H(w_i) + \beta(1 - H(w_i)) \quad (3)$$

We can substitute labor and get the optimal labor supply:

$$L_i^* = \left[\frac{(1-\tau)w_i \{1 - \alpha H(w_i) + \beta[1 - H(w_i)]\}}{\xi} \right]^{\frac{1}{\sigma-1}} \quad (4)$$

Furthermore, we also can evaluate the impact on the elasticity of taxable income with respect to tax rate. Straightforward algebra shows that this elasticity is $\frac{\tau}{(\sigma-1)(1-\tau)}$, which is independent of the other-regarding parameters. Also worth noting is that although labor supply's elasticity is constant across the population, those other-regarding parameters as well as each agent's position in the skill distribution still affect the optimal labor supply itself.

Proposition 1

(a) For any given w , a competitive agent ($\alpha < 0, \beta > 0$) provides more labor than a self-interested agent.

(b) Suppose agents are inequality averse ($\alpha > 0, \beta > 0$), and let $\phi = \frac{\alpha}{\beta}$. A $\tilde{w} \in [\underline{w}, \overline{w}]$ exists such that any agent i with skill level $w_i < \tilde{w}$ ($> \tilde{w}$, resp.) provides more (less, resp.) labor than a self-interested agent with the same skill level. Furthermore, $\tilde{w}(\phi)$ can be written as a decreasing function of ϕ such that $\tilde{w}(0)$ is the maximum wage level while $\tilde{w}(1)$ is the median wage level.

$\tilde{w}$ is the kink point for changes of optimal labor supply. As long as inequality-averse agents increase (decrease, resp.) their labor supply, they gain from the decreasing gap with agents that are ahead of (behind, resp.) them while losing from increasing the gap with agents that are behind (ahead of, resp.) them. Only at this kink point $\tilde{w}$ do these two opposing effects on own utility level balance each other. As a result, for anyone whose hourly wage is less than $\tilde{w}$, the disutility he suffers from increasing his labor supply is dominated by the utility he gains from increasing his labor supply, and vice versa. Furthermore, increasing α relative to β decreases the kink point $\tilde{w}$, leading more individuals to provide less labor at optimum. Decreasing α means lowering the disutility of being ahead so that more people suffer less from increasing their labor supply.

Last, $\phi = 0, \alpha = 0$ says each agent's utility is independent from whomever is behind him. Under this condition, everyone except the wealthiest suffer from comparing with the people ahead. As a result, all agents except the wealthiest work harder to try to decrease the gap. When $\phi = 1, \alpha = 1$, agents are equally averse to others ahead of and behind. For any person lower than the median level, increasing his labor supply is advantageous since he is behind more agents than he is ahead of; for any person higher than the median level,

decreasing his labor supply is advantageous since he is ahead of more agents than he is behind.

Simulations are run to illustrate our proposition. Our wage date is parameterized from March CPS data of 2007, using a lognormal approximation. We follow Mankiw et al. (2009) and assign several fixed parameters: $\xi = 2.55$; $\tau = 0.35$; $\sigma = 3$. (Note that we use the same set of parameters for the following simulations, unless specified.)

We illustrate the propositions developed above. Table 3.1 shows the optimal labor supply at different skill distribution positions under several distinct sets of other-regarding parameters.

It can be seen that compared with the selfish scenario (Benchmark), competitive agents always provide more labor at the optimum (wherever the agent is at the skill distribution, his optimal labor supply is higher if he is competitive instead of self-interested); however, inequality-averse preferences make wealthy agents provide less labor and make poor agents provide more. As Table 3.1 shows, if he is at the relatively low end of skill distribution ($H(w)=5\%$), inequality averse preferences increase his labor supply; but if he is at the relatively high end of skill distribution ($H(w)=82.71\%$), inequality averse preferences decreases his labor supply.

3.2 Revenue Effects

The government uses tax revenue to fulfill its functions, such as providing public goods or more redistributive transfer. In this scenario, the government returns the collected taxes equally as a lump-sum transfer.

Proposition 2

(a) For a given skill distribution and a given tax rate, competitive agents ($\alpha < 0, \beta > 0$) generate larger total tax revenue than self-interested agents. The society that consists of competitive agents also produces more and has larger average consumption than that consists of self-interested agents.

(b) Define $\Omega = \frac{d\alpha}{d\beta}$. When agents are inequality averse ($\alpha > 0, \beta > 0$), for a given skill distribution and a given tax rate, if Ω is sufficiently close to 1, the total tax revenue and the average consumption are smaller than with self-interested agents; if Ω is sufficiently close to 0, the total tax revenue and the average consumption are larger than with self-interested agents.

(c) Tax revenue's elasticity with respect to tax rates is a function of only the tax rate and labor supply's elasticity.

Proof of proposition 2(a):

Since $S = \tau \int_{\underline{w}}^{\bar{w}} zL(z)h(z)dz = \tau \int_{\underline{w}}^{\bar{w}} z \left[\frac{(1-\tau)z\{1-\alpha H(z)+\beta[1-H(z)]\}}{\xi} \right]^{\frac{1}{\sigma-1}} h(z)dz$, we have:

$$\begin{aligned} \frac{\partial S}{\partial \alpha} &= \tau \int_{\underline{w}}^{\bar{w}} \frac{z}{\sigma-1} \left[\frac{(1-\tau)z\{1-\alpha H(z)+\beta[1-H(z)]\}}{\xi} \right]^{\frac{2-\sigma}{\sigma-1}} \frac{(1-\tau)z}{\xi} (-H(z))h(z)dz \\ &< 0 \end{aligned} \quad (10)$$

and

$$\begin{aligned} \frac{\partial S}{\partial \beta} &= \tau \int_{\underline{w}}^{\bar{w}} \frac{z}{\sigma-1} \left[\frac{(1-\tau)z\{1-\alpha H(z)+\beta[1-H(z)]\}}{\xi} \right]^{\frac{2-\sigma}{\sigma-1}} \frac{(1-\tau)z}{\xi} (1-H(z))h(z)dz \\ &> 0 \end{aligned} \quad (11)$$

Clearly, tax revenue is a decreasing function of α and an increasing function of β . For a given skill distribution and tax rate, competitive agents ($\alpha < 0, \beta > 0$) generate more tax revenue than self-interested agents ($\alpha = \beta = 0$). Also, it follows from proposition 1(a) that competitive agents' increasing their labor supply leads to higher income for each than for self-interested agents, and the society's average consumption is larger under competitive agents than under self-interested agents.

Proof of proposition 2(b):

Take total derivative of S , we can get:

$$dS = \frac{\partial S}{\partial \alpha} d\alpha + \frac{\partial S}{\partial \beta} d\beta \quad (12)$$

dS

$$\begin{aligned} &= \tau \int_{\underline{w}}^{\bar{w}} \frac{z}{\sigma-1} \left[\frac{(1-\tau)z\{1-\alpha H(z) + \beta[1-H(z)]\}}{\xi} \right]^{\frac{2-\sigma}{\sigma-1}} \frac{(1-\tau)z}{\xi} (-H(z))h(z)dz d\alpha \\ &+ \tau \int_{\underline{w}}^{\bar{w}} \frac{z}{\sigma-1} \left[\frac{(1-\tau)z\{1-\alpha H(z) + \beta[1-H(z)]\}}{\xi} \right]^{\frac{2-\sigma}{\sigma-1}} \frac{(1-\tau)z}{\xi} (1 \\ &- H(z))h(z)dz d\beta \end{aligned} \quad (13)$$

Given $\Omega = \frac{d\alpha}{d\beta}$, we can have:

$$\begin{aligned} dS &= \tau \int_{\underline{w}}^{\bar{w}} \frac{z}{\sigma-1} \left[\frac{(1-\tau)z\{1-\alpha H(z) + \beta[1-H(z)]\}}{\xi} \right]^{\frac{2-\sigma}{\sigma-1}} \frac{(1-\tau)z}{\xi} [1 - (1 \\ &+ \Omega)H(z)]h(z)dz d\beta \end{aligned} \quad (14)$$

When $\Omega = 0$,

$$dS = \tau \int_{\underline{w}}^{\bar{w}} \frac{z}{\sigma-1} \left[\frac{(1-\tau)z\{1+\beta[1-H(z)]\}}{\xi} \right]^{\frac{2-\sigma}{\sigma-1}} \frac{(1-\tau)z}{\xi} [1-H(z)]h(z)dz d\beta$$

$$> 0 \quad (15)$$

When $\Omega = 1$,

$$dS = \tau \int_{\underline{w}}^{\bar{w}} \frac{z}{\sigma-1} \left[\frac{(1-\tau)z\{1-\alpha H(z) + \beta[1-H(z)]\}}{\xi} \right]^{\frac{2-\sigma}{\sigma-1}} \frac{(1-\tau)z}{\xi} (1$$

$$- 2H(z))h(z)dz d\beta$$

$$= \tau \int_{\underline{w}}^{w^{med}} \frac{z}{\sigma-1} \left[\frac{(1-\tau)z\{1-\alpha H(z) + \beta[1-H(z)]\}}{\xi} \right]^{\frac{2-\sigma}{\sigma-1}} \frac{(1-\tau)z}{\xi} (1$$

$$- 2H(z))h(z)dz d\beta$$

$$+ \tau \int_{w^{med}}^{\bar{w}} \frac{z}{\sigma-1} \left[\frac{(1-\tau)z\{1-\alpha H(z) + \beta[1-H(z)]\}}{\xi} \right]^{\frac{2-\sigma}{\sigma-1}} \frac{(1-\tau)z}{\xi} (1$$

$$- 2H(z))h(z)dz d\beta \quad (16)$$

From (16), the sign of dS is determined by two terms: the overall effect caused by the population's lower 50 percent and the population's higher 50 percent. Since the higher 50 percent has larger optimal labor supply and pre-tax income than the lower 50 percent, the second term should dominate the first. Finally, since the second term integrates over all people above the median, it is negative. As a result, $(16) < 0$.

When $\Omega = 0$, $dS > 0$ and when $\Omega = 1$, $dS < 0$, a Ω must exist between 0 and 1 such that $dS = 0$. In general, with inequality-averse agents, the total tax revenue's aggregate effect depends on the ratio of changes on α and on β . As the change on α becomes

relatively larger, the total tax revenue becomes more likely to be smaller than with self-interested agents. As the change on α becomes relatively smaller, the total tax revenue becomes more likely to be larger than with self-interested agents.

This proposition in fact reflects Proposition 1. Under inequality-averse preferences, some increase their labor supply and some decrease, the overall effect on tax revenue will no longer be strictly increasing or decreasing as in the competitive situation. This is because tax revenue is an aggregate impact originating from the effects on labor supply.

Finally, we use simulations to numerically calculate the average consumption and the average tax revenue under different settings to illustrate these propositions. Tables 3.2 and 3.3 show the average consumption and average tax revenue under different sets of α and β . If both α and β increase in absolute terms while α is negative, people become more competitive. As the society becomes more competitive, the average tax revenue undoubtedly increases, as well as the average consumption.

However, when both α and β are positive, agents are inequality averse. Based on proposition 2, the effects should be a bit more complicated. The starting point is where $\alpha = \beta = 0$. Tables 3.2 and 3.3 show that the average consumption under this scenario is 42.9402, and the average tax revenue under this scenario is 15.0291. First, if $\Omega = 0.5$, then $d\alpha = 1/2d\beta$. If agents become more inequality averse and α rises to 0.1, β will increase to 0.2, respectively. Tables 3.2 and 3.3 show that the average consumption decreases to 42.2171 and that the average tax revenue under this scenario is 14.7760. This illustrates half of proposition 2(b): when Ω is sufficiently large, the total tax revenue is smaller than with self-interested agents, as well as the average consumption. Second, if $\Omega = 0.25$, so

$d\alpha = 1/4d\beta$. Let's say $\alpha = 0.1, \beta = 0.4$. Tables 3.2 and 3.3 then show that the average consumption under this scenario is 43.1557 and that the average tax revenue under this scenario is 15.1045. This illustrates the second half of proposition 2(b): when Ω is sufficiently large, the total tax revenue and the average consumption are larger than with self-interested agents..

Proof of proposition 2(c):

The elasticity of tax revenue is

$$\varepsilon_2 = \frac{\partial S}{\partial \tau} \cdot \frac{\tau}{S} = \left\{ \int_{\underline{w}}^{\bar{w}} z \left[\frac{(1-\tau)z \cdot \{A\}}{\xi} \right]^{\frac{1}{\sigma-1}} h(z) dz + \tau \cdot \int_{\underline{w}}^{\bar{w}} (-z) \cdot \frac{1}{\sigma-1} \left[\frac{(1-\tau)z \cdot \{A\}}{\xi} \right]^{\frac{1}{\sigma-1}-1} \cdot \frac{z \cdot \{A\}}{\xi} h(z) dz \right\} \cdot \frac{1}{\int_{\underline{w}}^{\bar{w}} z \left[\frac{(1-\tau)z \cdot \{A\}}{\xi} \right]^{\frac{1}{\sigma-1}} h(z) dz} = 1 - \frac{\tau \int_{\underline{w}}^{\bar{w}} z \cdot \frac{(1-\tau)^{\frac{1}{\sigma-1}-1} \left[\frac{z \cdot \{A\}}{\xi} \right]^{\frac{1}{\sigma-1}} h(z) dz}{\int_{\underline{w}}^{\bar{w}} z \left[\frac{(1-\tau)z \cdot \{A\}}{\xi} \right]^{\frac{1}{\sigma-1}} h(z) dz}}{1} = 1 - \frac{\tau}{(\sigma-1)(1-\tau)} \quad (17)$$

This elasticity does not correlate with α or β . ■

3.3 Degree of Inequality Effects

The simplest way to inspect a society's inequality is to investigate the gap between the wealthiest person and the poorest. In this study, we use the difference between the two for illustration.

For an other-regarding agent with skill level $w = \underline{w}$, his/her optimal labor supply is:

$$L_i^*|_{w=\underline{w}} = \left[\frac{(1-\tau)\underline{w}\{1+\beta\}}{\xi} \right]^{\frac{1}{\sigma-1}} \quad (18)$$

This says, for the other-regarding agent with skill level $w = \underline{w}$, he always provides more labor than a self-interested agent with skill level $w = \underline{w}$. Also, it can be seen that

$\frac{\partial L_i^*|_{w=\underline{w}}}{\partial \alpha} = 0$ and $\frac{\partial L_i^*|_{w=\underline{w}}}{\partial \beta} > 0$. This result is intuitive. For the lowest-skilled person, his/her optimal labor supply is not affected by how much he/she cares about being ahead (since he/she will always be the last), but is affected by how much he/she cares about being behind. The larger disutility he falls behind creates the larger incentive he has for increasing his labor supply.

For an other-regarding agent with skill level $w = \bar{w}$, his/her optimal labor supply is:

$$L_i^*|_{w=\bar{w}} = \left[\frac{(1-\tau)\bar{w}\{1-\alpha\}}{\xi} \right]^{\frac{1}{\sigma-1}} \quad (19)$$

This says, for the other-regarding agent with skill level $w = \bar{w}$, he provides more labor than a self-interested agent with skill level $w = \bar{w}$ if and only if $\alpha < 1$, which is the usual situation. Similarly, $\frac{\partial L_i^*|_{w=\bar{w}}}{\partial \alpha} < 0$, $\frac{\partial L_i^*|_{w=\bar{w}}}{\partial \beta} = 0$, meaning that for the highest skilled person, his/her optimal labor supply is affected by how much people care about being ahead, but is not affected by how much people care about being behind.

Let $\bar{C}$ and $\underline{C}$ denote the after-tax income of the wealthiest person and the poorest person in the society, respectively. According to the incentive compatibility condition, $\bar{C}$ and $\underline{C}$ must also correspond to $\bar{w}$, $\underline{w}$. Based on (18) and (19):

$$\eta = \bar{C} - \underline{C} = (1-\tau) \left\{ \bar{w} \cdot \left[\frac{(1-\tau)\bar{w}\{1-\alpha\}}{\xi} \right]^{\frac{1}{\sigma-1}} - \underline{w} \cdot \left[\frac{(1-\tau)\underline{w}\{1+\beta\}}{\xi} \right]^{\frac{1}{\sigma-1}} \right\} \quad (20)$$

It can be shown that $\frac{\partial \eta}{\partial \alpha} < 0$ and $\frac{\partial \eta}{\partial \beta} < 0$, meaning that either increasing α or β will decrease the gap between the wealthiest and the poorest. Next, we evaluate analytically how inequality-averse and competitive preferences affect the consumption gap.

Proposition 3

(a) For a given skill distribution and a given tax rate, the consumption gap is smaller when agents are inequality averse ($\alpha > 0, \beta > 0$) rather than self-interested.

(b) Recall that $\Omega = \frac{d\alpha}{d\beta}$. When agents are competitive ($\alpha < 0, \beta > 0$), for a given skill distribution and a given tax rate, if Ω is sufficiently close to -1, the consumption gap is larger than with self-interested agents; if Ω is sufficiently close to 0, the consumption gap is smaller than with self-interested agents.

Proof of proposition 3(a):

Following eq. (20),

$$\begin{aligned} d\eta &= \frac{\partial \eta}{\partial \alpha} d\alpha + \frac{\partial \eta}{\partial \beta} d\beta \\ &= -\frac{(1-\tau)\bar{w}}{(\sigma-1)(1-\alpha)} \left[\frac{(1-\tau)\bar{w}(1-\alpha)}{\xi} \right]^{\frac{1}{\sigma-1}} d\alpha \\ &\quad - \frac{(1-\tau)\underline{w}}{(\sigma-1)(1+\beta)} \left[\frac{(1-\tau)\underline{w}(1+\beta)}{\xi} \right]^{\frac{1}{\sigma-1}} d\beta \end{aligned} \quad (21)$$

When agents are inequality averse instead of self-interested, $d\alpha > 0, d\beta > 0$. It can be seen from (21) that $d\eta < 0$. So when agents become more inequality averse, the consumption gap between the wealthiest and poorest shrinks.

Proof of proposition 3(b):

Starting with (21), when agents are competitive instead of self-interested, $d\alpha < 0, d\beta > 0$. The sign of $d\eta$ becomes more complicated. Remember that $\Omega = \frac{d\alpha}{d\beta}$, and $\Omega \in [-1, 0]$. Substitute this into (21), and we get:

$$\begin{aligned}
d\eta &= \frac{\partial \eta}{\partial \alpha} d\alpha + \frac{\partial \eta}{\partial \beta} d\beta \\
&= -\frac{(1-\tau)\bar{w}}{(\sigma-1)(1-\alpha)} \left[\frac{(1-\tau)\bar{w}(1-\alpha)}{\xi} \right]^{\frac{1}{\sigma-1}} \Omega d\beta \\
&\quad - \frac{(1-\tau)\underline{w}}{(\sigma-1)(1+\beta)} \left[\frac{(1-\tau)\underline{w}(1+\beta)}{\xi} \right]^{\frac{1}{\sigma-1}} d\beta \tag{22}
\end{aligned}$$

First, if $\Omega = -1$, then $d\alpha = -d\beta$. Since we are investigating how the consumption gap with competitive agents is affected compared with self-interested agents, if we substitute this into (22), we have:

$$\begin{aligned}
d\eta|_{\alpha=\beta=0} &= -\frac{(1-\tau)\bar{w}}{(\sigma-1)(1-\alpha)} \left[\frac{(1-\tau)\bar{w}(1-\alpha)}{\xi} \right]^{\frac{1}{\sigma-1}} \Omega d\beta \\
&\quad - \frac{(1-\tau)\underline{w}}{(\sigma-1)(1+\beta)} \left[\frac{(1-\tau)\underline{w}(1+\beta)}{\xi} \right]^{\frac{1}{\sigma-1}} d\beta \\
&= \frac{(1-\tau)^{\frac{1}{\sigma-1}+1}}{(\sigma-1)\xi^{\frac{1}{\sigma-1}}} \left(\bar{w}^{\frac{1}{\sigma-1}+1} - \underline{w}^{\frac{1}{\sigma-1}+1} \right) d\beta > 0 \tag{23}
\end{aligned}$$

This says when $d\alpha = -d\beta$, the consumption gap is larger than with self-interested agents.

Second, if $\Omega = 0$, then $d\alpha = 0, d\beta > 0$. If we substitute these into (22), we have:

$$\begin{aligned}
d\eta|_{\alpha=\beta=0} &= -\frac{(1-\tau)\bar{w}}{(\sigma-1)(1-\alpha)} \left[\frac{(1-\tau)\bar{w}(1-\alpha)}{\xi} \right]^{\frac{1}{\sigma-1}} \phi d\beta \\
&\quad - \frac{(1-\tau)\underline{w}}{(\sigma-1)(1+\beta)} \left[\frac{(1-\tau)\underline{w}(1+\beta)}{\xi} \right]^{\frac{1}{\sigma-1}} d\beta \\
&= -\frac{(1-\tau)\underline{w}}{(\sigma-1)} \left[\frac{(1-\tau)\underline{w}}{\xi} \right]^{\frac{1}{\sigma-1}} d\beta < 0 \quad (24)
\end{aligned}$$

This says when $d\alpha = 0$, the consumption gap is smaller than with self-interested agents.

Lastly, assuming the consumption gap is continuous on α , we get proposition 3(b). ■

Proposition 3 is intuitive. Compared with self-interested agents, when agents are inequality averse, the consumption gap undoubtedly decreases. However, compared with self-interested agents, when agents are competitive, the conclusion is not that straightforward. To ensure competitiveness leads to more consumption gap, agents need to be concerned enough about being ahead relative to being behind. Thus, we can simulate the wealthy work more; and since they are much more productive than the poor, the gap is enhanced.

Of course the consumption gap above is a very limited and restricted way to represent a society's income inequality. In economics literature, the Gini coefficient is a commonly used measure to evaluate a society's income inequality (Dorfman, 1979; Lorenz, 1905). It is defined as a ratio between 0 and 1, where 0 stands for perfect income equality, and 1 stands for perfect income inequality. As a result, as the Gini coefficient increases, the society's income inequality increases, too.

In this case, the Gini coefficient is calculated from the following formula:

$$\text{Gini} = 1 - \frac{\sum_{i=1}^n h(w_i)(S_{i-1} + S_i)}{S_n}$$

where $S_i = \sum_{j=1}^i h(w_j)C_j$ and $S_0 = 0$.

Since analytically deriving the Gini coefficient and evaluating using the comparative statics are too complicated, we will skip to simulations. In Table 3.4, we assume there is no tax. The other parameters remain the same as in the tables above.

From Table 4, we observe the following:

(a) If both α and β increase in absolute terms while α is positive, people become more inequality averse. We will then have a smaller Gini coefficient than with self-interested agents, implying a smaller degree of income inequality.

(b) If both α and β increase in absolute terms while α is negative, agents become more competitive. As long as $-\alpha < \beta$, the Gini coefficient is smaller than with self-interested agents, implying that competitiveness actually decreases the degree of income inequality under this situation; as long as $-\alpha > \beta$, the Gini coefficient is larger than with self-interested agents, implying that competitiveness increases the degree of income inequality under this situation.

In observation (b), the assumption established earlier that $\alpha \in [-\beta, \beta]$ is broken because $\alpha < -\beta$ is needed to give the story's complete description. The observation above exists because when $-\alpha < \beta$, competitive agents are more concerned about falling behind than being ahead. It leads to a general "catching up" trend in the society, causing a higher degree of equality since this "catching up" trend is very weak for the top wealthy, who are much more productive than the rest and can potentially dramatically decrease income inequality. If using the opposing assumption ($-\alpha > \beta$, meaning we enjoy being ahead of

others more than suffering from being behind), the Gini coefficient is actually larger than self-interested agents, implying a larger degree of income inequality.

(c) As long $\alpha = -\beta$, the Gini coefficient doesn't change because $L^*|_{\alpha=-\beta} = \sqrt{\frac{(1-\tau)w(1+\beta)}{\xi}}$. Here the optimal labor does not depend on where one is in terms of wage distribution anymore. Hence, all people increase their labor supply relatively the same compared with the traditional case ($\alpha = \beta = 0$), and the society's consumption distribution does not change.

Lastly, we use simulations to show how the other-regarding preferences *per se* can be served as a redistributive tool. Table 3.5 shows the Gini coefficients under two different settings. Note that we still assume $\xi = 2.55$ and $\sigma = 3$. As Table 3.5 shows, when the tax rate is 0.0735 and agents are self-interested, the Gini coefficient is 0.4388. The same coefficient can also be achieved when there is no tax and when agents are inequality averse ($\alpha = \beta = 0.3$). This suggests that we do not need a government to use the income tax tool to redistribute income; appropriate inequality-averse preferences can do that for us. The same can also happen with competitive preferences. For example, when the tax rate is 0.0085 and agents are self-interested, the Gini coefficient is 0.4696. This same level of inequality can also be accomplished when agents are competitive ($\alpha = -0.2, \beta = 0.3$) without an income tax system.

4. Conclusion

Rich and nuanced models of behavior are being developed to capture various facets of fairness and the implications for individual choice and collective action. In this study,

we develop a model allowing for both competitive and inequality-averse preferences. The model allows the externality of being behind to differ from the externality of being ahead. Our goal is to assess the role of other regarding preferences in influencing the degree of redistribution and the effect on social-inequality degree and ultimately the equity-efficiency tradeoff.

We show that relative to agents with traditional self-interested preferences, competitive agents work more and consume more, leading to greater total income and tax revenue. However, when with inequality-averse agents, we find a threshold wage exists where all agents higher than that threshold provide less labor while all agents lower than that threshold provide more. Thus, the effect on total tax revenue is also more complicated. This complexity suggests that, including the possibility of inequality aversion, the government may no longer be able to collect more taxes based on these other-regarding preferences in a society consisting of purely competitive agents. Finally, analytical and simulation results jointly show that a society consisting of inequality-averse agents has less of a consumption gap and a smaller Gini coefficient than a society consisting of self-interested agents. In other words, preferences for equality may lead to more equitable outcomes even without changes in the tax policy. On the other hand, stronger competitive preferences increase the degree of inequality only when concerns for being ahead is sufficiently large relative to concerns for being behind. The above results suggest that a more equitable outcome may be achieved, at least to some extent, by fostering an aversion to inequality, or sometimes even a competitiveness at the preference level. Further, these various types of other-regarding preferences can be equivalent to a linear income tax

regulated by a social planner. This contrasts with the view that a planner or government with these “preferences” is required to pursue a goal of equity distribution. The work that has been presented here is preliminary and reflects the first steps in our inquiry. Ultimately, our interest is to understand the consequences of other-regarding preferences for redistribution on the size of the tax base, efficiency, and the equity-efficiency tradeoff. An especially important question is whether other regarding preferences will allow the pursuit of social-equity objectives without harming economic efficiency. Also, the assumption of a linear income tax was made primarily for simplicity and ease of exposition. It is thus intriguing to explore the consequences of including a non-linear income tax and how these other-regarding parameters may influence the optimal tax schedule.

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Appendix

Table 3.1 The optimal labor supply

<i>H(w)</i>	Benchmark ($\alpha = \beta=0$)	Competitive ($\alpha=-0.5; \beta=0.8$)	Inequality Averse ($\alpha=0.5; \beta=0.8$)
5%	0.0485	0.0648	0.0639
52.34%	1.8156	2.3272	1.9211
82.71%	2.4015	2.9916	2.0444

Table 3.2 The average consumption

Average Consumption	$\beta=0$	$\beta=0.1$	$\beta=0.2$	$\beta=0.3$	$\beta=0.4$	$\beta=0.5$
$\alpha= -0.5$						52.5908
$\alpha= -0.4$					50.8075	51.2134
$\alpha= -0.3$				48.9594	49.3803	49.7948
$\alpha= -0.2$			47.0386	47.4765	47.9071	48.3308
$\alpha= -0.1$		45.0361	45.4930	45.9418	46.3828	46.8166
$\alpha= 0$	42.9402	43.4190	43.8884	44.3490	44.8014	45.2461
$\alpha= 0.1$		41.7340	42.2171	42.6908	43.1557	43.6124
$\alpha= 0.2$			40.4694	40.9575	41.4363	41.9063
$\alpha= 0.3$				39.1374	39.6316	40.1164
$\alpha= 0.4$					37.7263	38.2278
$\alpha= 0.5$						36.2202

Table 3.3 The average tax revenue

Average Tax Revenue	$\beta=0$	$\beta=0.1$	$\beta=0.2$	$\beta=0.3$	$\beta=0.4$	$\beta=0.5$
$\alpha = -0.5$						18.4068
$\alpha = -0.4$					17.7826	17.9247
$\alpha = -0.3$				17.1358	17.2831	17.4282
$\alpha = -0.2$			16.4635	16.6168	16.7675	16.9158
$\alpha = -0.1$		15.7626	15.9226	16.0796	16.2340	16.3858
$\alpha = 0$	15.0291	15.1967	15.3610	15.5222	15.6805	15.8362
$\alpha = 0.1$		14.6069	14.7760	14.9418	15.1045	15.2643
$\alpha = 0.2$			14.1643	14.3351	14.5027	14.6672
$\alpha = 0.3$				13.6981	13.8711	14.0407
$\alpha = 0.4$					13.2042	13.3797
$\alpha = 0.5$						12.6771

Table 3.4 The Gini coefficient

	$\beta=0$	$\beta=0.1$	$\beta=0.2$	$\beta=0.3$	$\beta=0.4$	$\beta=0.5$
$\alpha = -0.5$	0.4920	0.4880	0.4842	0.4805	0.4770	0.4736
$\alpha = -0.4$	0.4891	0.4850	0.4811	0.4773	0.4736	0.4702
$\alpha = -0.3$	0.4859	0.4817	0.4776	0.4736	0.4699	0.4663
$\alpha = -0.2$	0.4824	0.4779	0.4736	0.4696	0.4657	0.4620
$\alpha = -0.1$	0.4783	0.4736	0.4692	0.4650	0.4610	0.4572
$\alpha = 0$	0.4736	0.4688	0.4642	0.4598	0.4557	0.4517
$\alpha = 0.1$		0.4632	0.4584	0.4539	0.4496	0.4454
$\alpha = 0.2$			0.4517	0.4470	0.4425	0.4382
$\alpha = 0.3$				0.4388	0.4342	0.4298
$\alpha = 0.4$					0.4243	0.4197
$\alpha = 0.5$						0.4075

Table 5 Other-regarding preferences as a redistributive tool

Gini coefficient	$\alpha = \beta = 0$	$\alpha = \beta = 0.3$	$\alpha = -0.2,$ $\beta = 0.3$
$\tau = 0$	0.4736	0.4388	0.4696
$\tau = 0.0735$	0.4388	0.4066	
$\tau = 0.0085$	0.4696		0.4656

CONCLUSION

The current project contributes to the burgeoning literature on other-regarding preferences. Since the “Easterlin Paradox” was discovered, many studies interested in the relationship between income and happiness have found that it is not, at least primarily, our own income that determines our reported well-being. Chapter 1 contributes to this growing body of literature and finds that after controlling for a series of control variables, the absolute income’s effect has a negligible effect on happiness. Just as the Easterlin Paradox suggests, this finding may explain why many countries’ subjective well-being levels did not increase as GDP levels increased during recent decades.

Furthermore, chapter 1 explores the role of relative income. Previous studies in this area have focused on either homogenous or uniformly asymmetric relative income effects. In contrast, chapter 1 takes a different approach and assumes each person’s relative income effect depends on own that person’s income level. We find that as the absolute income level increases, the magnitude of these income-dependent relative income effect decreases (in absolute value).

Chapter 2 applies the income-dependent relative income effects in a traditional non-linear optimal income tax model. It shows that allowing for relative income effects’ heterogeneity can significantly affect optimal income tax rates as well as progressivity. While the selection of wage distribution and whether absolute or relative income dominates do not play important roles in deciding the progressivity degree, whether the effects are positively or negatively related to own income is critical. Greater optimal progressivity arises as wealthier taxpayers have stronger relative-income effects.

In chapter 3, we not only consider relative income (competitive) effects, but also inequality averse preferences. We develop a model allowing for both. The model allows the externality of being behind to differ from the externality of being ahead. We show that relative to agents with traditional self-interested preferences, competitive agents work more and consume more, leading to greater total income and tax revenue. However, when with inequality-averse agents, we find a threshold wage exists where all agents higher than that threshold provide less labor while all agents lower than that threshold provide more. Thus, the effect on total tax revenue is also more complicated. We also use analytical and simulation results jointly to show that a society consisting of inequality-averse agents has less of a consumption gap and a smaller Gini coefficient than a society consisting of self-interested agents. In other words, preferences for equality may lead to more equitable outcomes even without changes in the tax policy. On the other hand, stronger competitive preferences increase the degree of inequality only when concerns for being ahead is sufficiently large relative to concerns for being behind. The above results suggest that a more equitable outcome may be achieved, at least to some extent, by fostering an aversion to inequality, or sometimes even a competitiveness at the preferable level.

VITA

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