Norwegian School of Economics

Bergen, Spring 2016

Fairness and Inequality

Measuring Fairness Preferences and Identifying the Unfair Income Inequality in Germany

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Master Thesis in Economics

NORWEGIAN SCHOOL OF ECONOMICS

Abstract

The standard measures of economic inequality seem not to be in accordance with the way people tend to think about inequality. Rather than considering all economic inequality unfair, people seem to accept inequalities arising from some sources of income, while rejecting those arising from other sources. Following and extending the framework of Almås et al. (2011), this thesis sheds light on the difference between *actual*, *unfair*, and *believed unfair* inequality. The notion of an unfair outcome is captured by evaluating whether an individual should be held responsible for that particular outcome. We ask a representative sample in Germany which factors they think *should play* an important role in determining a person's income, and which factors they think *do play* an important role in determining a person's income. These statements identify fairness views and beliefs about the income generating process. To our knowledge, this is the first time that surveyed fairness views are applied in the generalised Gini framework developed by Almås et al. (2011). This framework allows responsibility-sensitive fairness theories distinguish between actual and unfair inequality. We expand this model to allow for the measurement of believed unfairness, and suggest a principle of evidence-based beliefs to address unexplained variation. We argue that the prevailing "responsibility cut" in the representative sample may correspond to the luck egalitarian fairness theory. Our results show that the level of unfair income inequality is greater than the actual income inequality in Germany. The believed unfair inequality is considerably lower than both actual and unfair inequality. Unfair inequality has increased more than actual inequality from 1984 to 2013, and believed unfairness has decreased since 1984. Furthermore, redistribution reduces more actual inequality than unfair inequality, a gap that has increased over the last thirty years.

Acknowledgements

First and foremost, we would like to thank our supervisor Ingvild Almås for inspiring guidance and contagious enthusiasm. We would also like to thank The Choice Lab research group at the Norwegian School of Economics for including us in a vital research environment.

Furthermore, we want to thank The Choice Lab research group for providing us with data that allowed us to identify German beliefs and fairness preferences. We also want to thank the German Socio-Economic Panel (SOEP) for providing us with German income data. A special thank goes to Michaela Engelmann, who always answered our requests and questions with outmost patience.

Thanks to Magne Ludvigsen for valuable IT-assistance, enabling our humble student desktops to handle the large SOEP dataset. Thanks to the lovely canteen staff for smiles and dinners throughout the semester.

Thanks to Anne-Lise Breivik, Øystein Lysne, Morten Sæthre, Aline Bütikofer, Jan Wilhelm Støren, Anne-Hilde Nagel, Olav Slettebø, Siv Marit Stavem and Jens Plahte for valuable comments. It takes a village to get it right.

Bergen, 20 June 2016

Frøya Plahte Stavem and Bendik Nagel Støren

Contents

1 Introduction

The literature on quantitative measurement of economic inequality has mainly been occupied with measuring *actual* inequality. The purpose of the standard Gini coefficient is to establish an accurate description of reality, by measuring the deviations between the actual income distribution and a hypothetical uniform distribution. Such measures of actual inequality do not address the question of whether a specific level of inequality is desirable.

In the normative discussion of economic inequality and welfare economics, considering all deviations from uniformity corresponds to the fairness view of *strict egalitarianism*. As equality of outcome is the desired goal, the strict egalitarian does not distinguish between different sources of economic inequality. Hence, the standard Gini is an appropriate measure of relevant economic inequality from the perspective of a strict egalitarian.

In contrast, *libertarianism* argues that measures of actual inequality are morally irrelevant. Robert Nozick (1973) claims that the justness of an outcome depends solely on the justness of the transfers of wealth causing the outcome. For Nozick there are three possibilities for just wealth transfers: initial acquisition, i.e. finding unowned resources, voluntary transfer, and rectification of a previous unjust acquisition.[1] A sole distribution reveals nothing about the properties of the transaction preceding the distributive outcome, or the controllability of the factors affecting the outcome. Hence, measures of actual economic inequality have no value for moral judgment in the libertarian and the luck egalitarian view.

These fairness theories correspond to two opposing direct normative interpretations of the Gini measure. For the strict egalitarian, the Gini is an apt measure of undesired inequality. Proponents of other fairness views would claim that the measure in itself is morally irrelevant or imprecise, while the libertarian represents the absolute rejection. Of course, there may be instrumental reasons why economic inequality may be (un)desirable, such as influencing power relations in society, or

[1] Given that all transactions in the market are voluntary and the original distribution meets the criteria, this would legitimize laissez-faire economics.

causing consequences for economic growth.[2] However, for actual economic inequality to be morally relevant in itself, one must assume a strict egalitarian stand.

An increasing body of evidence suggests that people tend to hold alternative fairness views rather than the strict egalitarian or the strict libertarian fairness view. People seem to accept inequalities resulting from some sources, such as hard work, while rejecting inequalities resulting from other sources, such as luck (Cappelen et al., 2007, Cappelen et al., 2010, Schokkaert and Devooght, 2003, Møllerstrøm et al., 2015).

This thesis explores the difference between actual, unfair and believed unfair inequality. Using German data, we identify fairness preferences for how six different factors should affect income, and estimate the *unfair* economic inequality in Germany. We apply the generalised Gini framework developed by Almås et al. (2011), which allows for a distinction between fair and unfair economic inequality according to any responsibility-sensitive fairness view. Additionally, we expand the model to allow for a distinction between unfair and *believed unfair* inequality. We also identify beliefs about how the six factors affect income, and estimate the believed unfair inequality.

The paper proceeds as follows. Chapter 2 presents the theoretical and empirical context within which this thesis operates by reviewing selected literature on developments in fairness theory and empirical findings. Chapter 3 presents the generalised Gini framework developed by Almås et al. (2011), which allows for the measurement of unfair inequality. Chapter 4 presents the data sources and briefly describes the data. Chapter 5 presents our findings. We identify German fairness preferences, estimate an income function, and the according level of unfairness. We measure both actual, unfair and believed unfair inequality. Chapter 6 discusses some limitations and chapter 7 concludes.

[2] Cingano (2014) finds a negative and statistically significant impact on subsequent growth from income inequality.

2 Literature review

In this chapter, we review how the debate on fairness and economic inequality has evolved from debating economic inequality as such, to a discussion of equality in opportunity, where fairness is a question of what individuals can be held responsible for. Second, we explore a sample of recent empirical findings, which illustrates the necessity of a nuanced measure of the unfair, and thus relevant, economic inequality.

2.1 Developments in egalitarian theory

Egalitarianism can take many forms, such as equality in treatment, in outcomes, or moral status. In the tradition of social-choice theory, known from welfare economics, egalitarianism means equality of outcome in terms of utility. Critics protest that egalitarianism is ethically undesirable because it does not hold individuals responsible for their choices and preferences. Additionally, egalitarianism implicitly assumes that it is possible to translate all possible outcomes into a common currency that can be equalized (Roemer 2013). In reaction to this criticism, several attempts have been made to develop a new theory of egalitarianism. This debate marks a move from a theory of equality of outcomes, to a theory of equality of opportunities (Roemer 2013). Roemer holds that the distinction between morally acceptable and inacceptable inequality following this debate is one of the most important contributions of philosophical egalitarianism over the last 40 years.

John Rawls' publication "A Theory of Justice" in 1971 represents a turning point in moral philosophy. Utilitarianism in various forms had historically dominated moral philosophy, often meeting heavy criticism but always re-emerging (Richardson, 2016). Unsatisfied with this ruling theory of justice, Rawls complained that the doctrine of the "greatest good for the greatest number" of Mill and Bentham forced a uniform set of principles on every individual, and failed to take seriously the distinctions between persons. He confronted the utilitarian aim of organizing society such that aggregate utility or expected well-being is maximised. Rawls' aim was to replace utilitarianism with a kind of egalitarianism, which would reconcile the notions of liberty and equality in one theory. This move shifted the philosophical debate to egalitarianism, and produced ned theories answering the question of what the relevant kind of (in)equality is.

Rawls theory of *Justice as Fairness* introduces two main principles: the first states that all individuals have the same indefeasible claim to a fully adequate scheme of basic liberties. The

second defines the terms under which social and economic inequalities are legitimate. The latter has two parts: First, they are to be attached to offices and positions open to all under conditions of fair equality of opportunity, and second, they are to be to the greatest benefit of the least-advantaged (Wenar, 2013). The latter is often referred to as the difference-principle, or simply "maximin", describing its dictum that the minimum benefit to any person should be maximized. The most important inequality, according to Rawls, is the inequality in *primary goods*, which he assumes to be of fundamental interest to all individuals. The primary goods include income and wealth, basic rights and liberties, freedom of movement, opportunity for a range of occupations as well as positions of power, and the recognition by social institutions. Rawls thus parts with the utility of utilitarianism and welfare as utility, and shifts the objective of the egalitarian debate from equalising utility to equalising the potential and opportunity inherent in the primary resources. He delineates between fair and unfair inequality based on the inequality's source and consequence, and underlines the injustice of resource allocation through luck, such as the lottery of birth.

There are several objections to Rawls' theory of *Justice as Fairness*. Amartya Sen (1980) argues that Rawls is mistakenly putting too much weight on the primary goods, contending that it is not the primary goods themselves that is of interest, but what they provide in terms of capability. A person's capability is the set of vectors of 'functionings' such as being able to move, to work, to play. Instead of equality of resources, he calls for equality of capabilities (Sen, 1980).

Another objection is that Rawls' argument seems to assume a strong risk aversion in all individuals. Rawls arrives at his principles by way of a thought experiment designed to produce a fair and unbiased view. He imagines a situation where individuals have no knowledge of their own characteristics, like income, wealth, race, gender, talents, or year of birth. Individuals do however have "common sense", and knows inter alia that they are interested in the primary goods of which there are limited amounts. Rawls argues that while in this "original position", behind a "veil of ignorance" about your own characteristics, individuals faced with a choice of distribution will choose to maximize their own worst outcome. Roemer (2013) points out that risk aversion is not a feature of rationality, and Harsanyi (1975) even holds that maximin is irrational. Harsanyi's argument is that while under complete uncertainty in the original position, it would be more rational

to assume equal likelihood for every outcome, following the principle of insufficient reason. Under the assumption of equal probability, it would be most rational to choose the average outcome[3].

Ronald Dworkin (1981a, 1981b) addresses the problems with Rawls' argument, arguing that 'equality of welfare' is not an ethically defensible goal because it does not hold people responsible for their preferences. He introduces the notion of responsibility by *delegation* through identification. Responsibility is attributed by delegation over the characteristics that define our identity. Preferences, including those for risk, or labour, are a good example of such characteristics. For these factors, we would not accept interference even though we are not in control ourselves (Schokkaert and Devooght, 2003). Similar to Rawls, Dworkin argues for equality of resources, including resources acquired through birth. To preserve the notion of responsibility for preferences, he proposes to imagine an insurance market available in the original position (or a situation like it), where people endowed with equal amounts of currency could buy insurance against bad luck in the lottery of birth. In Dworkin's situation, individuals would know their preferences, but not the resources they gain from birth. Dworkin argues that when all who desire to purchase insurance have done so, this scheme would yield equality of resources, including physical and biological ones. This would hold people accountable for their preferences in risks and other matters, while still addressing the morally arbitrary distribution of resources at birth (Roemer, 2013). Dworkin did not address the problem of measuring people's welfare, and his scheme was proved by Roemer to produce some strange outcomes, however, Dworkin had introduced a more sophisticated mechanism for addressing personal responsibility that that of Rawls'.

Richard Arneson (1989) responded to Dworkin's work with a theory of *equality of opportunity for welfare*. He held it impossible to practically ensure equal opportunity through education and technological aid. He also questioned the possibility of finding the right amount of compensation, since the value of an individual's talents varies according to its life plans. Similar to Dworkin,

[3] Rawls risk aversion is a contested topic. Roemer makes the argument that the only precise arguments Rawls give for the maximin rule, occurring in *A Theory of justice* (1999[1971], p. 134), seem to presuppose risk aversion. He cites this argument (extract): "the person choosing has a conception of the good such that he cares very little, if anything, for what he might gain about the minimum stipend that he can, in fact, be sure of by following the maximin rule. It is not worthwhile for him to take a chance for the sake for further advantage." In *Some Reasons for the Maximin Criterion (1974)*, Rawls write, "from the standpoint of the original position, the parties would be very considerably risk-averse". However, Freeman (2014) argues that Rawls does not claim that parties have a psychological disposition to risk-aversion, but rather that it would be rational, in the circumstances of the original position, to act *as if* they were risk-averse because the factors at risk are so fundamental to all humans. In other words, even an otherwise risk-seeking person would act as if risk-averse in the original position.

Arneson emphasises the need to hold people responsible for their choices and preferences. A question of what constitutes a real choice permeates. According to Arneson, people should be held responsible not only for their preferences per se, but for forming and perhaps reforming their preferences as well. If one chooses to aspire to be a singer but cannot sing, that is within her control and thus her responsibility, he argues. This distinction between alterable and non-alterable preferences is already practiced in law and public policy, such as people's deeply felt aversion to nudity, but lack of aversions towards tasteless clothing. Arneson argues that:

> "when a person enjoys equal opportunity for welfare in the extended sense, any actual inequality of welfare in the position they reach is due to factors that lie within each individual's control. Thus any such inequality will be non-problematic from the standpoint of distributive equality" (Arneson, 1989, p86).

A similar line of reasoning is found in G.A. Cohen's response to Dworkin, also published in 1989. Cohen argues that Dworkin's "cut" between welfare and resources is misplaced, and that the fundamental distinction for an egalitarian is that between choice and luck. Cohen even argues that this is a better answer to Dworkin's own intentions (Cohen, 1989). The fundamental target for egalitarianism, according to Cohen, must be to undo the effect on economic distribution caused by both exploitation and brute luck. Exploitation is defined as taking unfair advantage, and (bad) brute luck is defined as when bad luck was not a possible result of a choice. For Cohen, egalitarianism should eliminate involuntary disadvantage, by which he means "disadvantage for which the sufferer cannot be held responsible, since it does not appropriately reflect choices that he has made or is making or would make" (Cohen, 1989, p916). Thus, he draws the line of fairness in distribution with one's interpretation of responsibility. Inequality is justified if and only if it arises from choices that a person can be held responsible for. Anderson (1999) calls this theory "luck egalitarianism". In response to Arneson's theory of equal opportunity for welfare, Cohen proposes a theory of *equal access to advantage*, where advantage is understood as a broader term than welfare.

2.2 Empirical literature on fairness

A growing body of empirical literature has aimed at identifying people's real fairness preferences as well as possible ways of explaining these preferences through surveys and experiments.

Although the literature supports the idea of the existence of strict libertarians and strict egalitarians, it also identifies other fairness views that are localised between the two extremes.

E. Schokkaert and K. Devooght (2003) investigate differences in preference for redistribution in Belgium, Burkina Faso and Indonesia. Pursuing a demarcation of "responsibility-sensitive fair compensation" in students of business and law, they find that the *notion of control* seems to play an important role in determining what individuals are to be held responsible for. They also find support for the notion that people are held responsible for the preferences with which they identify. On average, the different cultures take similar positions on where to place the "responsibility cut", but within each culture there is little consensus. The notion of full egalitarianism is generally rejected in favour of a less redistributive "intermediate compensation", perhaps reflecting a feeling of, at least partially, being capable of affecting certain characteristics, or partially identifying with them, the authors argue. Supplementary, Alesina and Giuliano (2011) find that personal characteristics such as age, race, gender and socio-economic status, as well as culture identify which individuals seem to think similarly about preferences for redistribution.

Cappelen et al. (2010) demonstrate through experiments how the willingness to redistribute depends on the judgement of choice and luck, supporting the awareness of notion of control cf. Schokkaert and Devooght (2003). Participants in the experiment were randomly assigned to transcribe a text, where they could choose a short version or a long version, while the payoff per correctly typed word was random. The value of their work thus depended on skill, choice and luck. Cappelen et al. interpret the skill factor as purely a matter of innate abilities beyond individual control, given the absence of incentive not to work at one's full capacity. Effectively, ability therefore equals luck. In the distributional phase, individuals were paired with other players, and given information about each other's production, working time and production value. Each player was then asked to propose a distribution of the total production value of the two participants. The study finds that more than 75 percent of participants reject a strict egalitarian distribution. Participants do generally not hold individuals responsible for the randomly assigned price, but do hold people responsible for the length of their working time as well as their productivity. Assuming maximum effort from the participants, Cappelen et al. interpret individuals holding people responsible for productivity as a sign that participants did not differentiate between choice of working time and the assumed random allocation of skill. Rather, they seem to differentiate between the personal factors (skill) and impersonal factors (assigned price), which both are

assumed to be allocated randomly. This corresponds with Dworkin's notion of responsibility of preferences and identifying characteristics.

These findings are supported in a later study by Almås et al. (2015), who find that Norwegians are more accepting of inequalities that are due to effort and talent than to those that are due to luck. There is also a strong negative correlation between preferences for redistribution and acceptance of both talent and luck, meaning that less acceptance for inequalities from talent and luck corresponds to more willingness to redistribute, and vice versa. The authors argue that the different view on talent and luck, accepting inequalities from the former and not the latter may be due to a notion that talent is a factor that can be developed through effort, which might explain participants' willingness to reward productivity in Cappelen et al. (2010). Alternatively, it might be viewed as a personal characteristic that warrants payoff, an interpretation in line with Cohen's theory of responsibility for identifying characteristics. The study finds a discrepancy between what respondents *believe* has an effect on income and what they think is fair, but this deviation has no effect on their preference for redistribution.

Cappelen et al. (2013) study participants' fairness views about risk-taking. The experiment consists of a risk-taking phase, where participants must choose a risky option or a safe option, followed by a distributional phase, where paired individuals knowing the outcome of the risk-taking phase distribute the pair's total income. Thus, there was equality in opportunity, with the possibility of redistribution ex ante. They study finds that a majority supports redistribution ex-post, and a minority focuses on the ex-ante equal opportunity. They also find, looking separately at inequalities between risk takers who are lucky and unlucky, and between people taking and not taking risk, that a majority holds people responsible for their choices, but not for their luck. This is consistent with choice egalitarianism.[4]

Approaching the topic of fairness and economic inequality by questioning what types of inequalities should be eliminated. Møllerstrøm et al. (2015) find that equalising both all inequality and no inequality is represented by about one third of respondents, respectively. The last third of respondents, referred to as choice compensators, represents a fairness preferences not previously described in the literature of fairness theories. The study conducts a spectator game where

[4] According to Lang (2006) there is a difference between choice egalitarianism and luck egalitarianism, as Cohen sees luck as a more fundamental term than control.

disinterested third parties are asked to allocate resources between two other agents. The resources have been generated in a preceding process where the agents have chosen whether to buy an insurance eliminating risk, or not. In addition to good and bad luck with or without insurance, there is also a possibility of unavoidable bad luck. Thus, the spectators distributing resources are able to differentiate between bad luck resulting from chosen exposure to risk, and bad luck resulting from pure randomness. The study finds that many spectators condition their allocation decision on the agents' choice of exposure to risk, even if the decision turned out not to be relevant for the outcome. The study does not find evidence consistent with luck egalitarianism, as spectators do not differentiate between disadvantage resulting from unavoidable and avoidable risk. Following the luck egalitarian view, the important factor would be whether the outcome was a result of luck or choice, but in the choice compensating view, the relevant factor seems to be the choice of exposure to luck. The most important factor for a choice compensator is not the individual incident or its causes, but the actor's agency and behaviour. Differentiating on whether the agent was willing to suffer a loss in pursuing a greater gain, or acted to shield herself from adverse outcomes, the choice compensating view can be interpreted to compensate for the type or character of the actor. It could also represent an effort to reward "good behaviour", provided taking a precaution such as buying insurance is regarded as such.

Almås et al. (2011) develops a framework for identifying unfair inequalities, which is a generalisation of the standard Gini and Lorenz curve framework. It allows for a distinction between responsibility and non-responsibility income variables to determine the implications of a responsibility-sensitive fairness theory. The unfairness Gini is a measure of actual deviations from a constructed fair income, and the unfairness Lorenz curve graphs the differences cumulatively from smallest to largest. Almås et al. (2011) finds that both the pre-tax and post-tax income distributions in Norway became less fair from 1986 to 2005. Actual inequality decreased over the period. Almås (2008) applies the same framework to compare unfair income inequality in Germany and the United States. The study finds that Germany is less unfair than the United States for all constructed responsibility sets if individuals are not held responsible for unexplained variation. If individuals are held responsible for the unexplained variation, the United States is less unfair. It is suggested that not holding individuals responsible for unexplained variation, referred to as a "benefit of the doubt", might be preferred by actors not willing to hold individuals responsible for incorrectly measured effects.

3 Model

This chapter presents the theoretical framework applied in the analysis.

3.1 Framework for identifying fairness views and beliefs

This section describes the framework for establishing a reference responsibility cut, i.e. the average non-responsibility scores for each variable and the average non-responsibility cut, which will be applied in sections 5.1.1 and 5.1.2.

We assume that every individual in a population has a *fairness view*, which in this thesis means that every individual has an opinion about which factors he or she thinks should affect a person's income. Similarly, we assume that every individual has a *belief* about which factors affects a person's income. Through a survey, we aim at materialising these fairness views and beliefs into stated preferences for, and perceptions of, the role of six factors in determining a person's income. These factors are education, hours worked, age, gender, sector of employment (public/private) and area of residence (urban/rural).

Survey respondents were asked to indicate with which of the following statements they agreed the most: "It is *fair* if [factor] plays an important role in determining a person's income", and "It is *not fair* if [factor] plays an important role in determining a person's income," where 1 was the strongest indication of fair and 10 was the strongest indication of not fair. They were similarly asked to indicate with which of the following statements they agreed the most: "[Factor] *plays* an important role in determining a person's income", and "[Factor] *does not play* an important role in determining a person's income," where 1 was the strongest agreement to the former, and 10 the strongest agreement to the latter. Following the notion of fairness as responsibility introduced in chapter 2, these statements on both fairness and beliefs can be interpreted as questions of whether individuals are held responsible for the outcomes of the variable in question. The answer, ranging from one to ten, represents the individual's non-responsibility score for the relevant variable (since it increases towards non-responsibility). We assume linear scaling in the answer options. If nothing else is stated, we define factors with non-responsibility scores below 5.5 as responsibility factors, and factors with non-responsibility scores above 5.5 as non-responsibility factors.

A set of responsibility and non-responsibility factors is a responsibility cut, and the fair responsibility cut is conceptually identical to that in Almås (2008). The believed responsibility cut

is analogous, and describes the responsibility and non-responsibility factors as a respondent believes they do affect income, rather than how they should affect income.

The average non-responsibility score for a variable is calculated in the following way:

$$\lambda_{k,s} = \sum_{i=1}^{n} \frac{a_{k,s}}{n} \qquad (1)$$

where λ indicates the non-responsibility score of the variable, *k* indicates the variable, *s* takes the value of p for the fair responsibility cut and b for the believed responsibility cut. *a* indicates respondents' answer, and *n* equals the number of participants in the survey.

3.2 Estimating the pre-government income generating process

This section explains the model for estimating the income function estimated in section 5.2, and builds on the framework presented in Almås et al. (2011). First, we construct the pre-government income generating process, defined by the individual characteristics variables hours worked, years of education, age, gender, sector of employment (public/private) and area of residence (urban/rural). The pre-government income function is given by the linear model of the logarithm of labour earnings. Our main specification is:

$$log(y_i) = \beta_1 hours_i + \beta_2 age_i + \beta_3 female_i + \beta_4 edu_i + \beta_5 public_i + \beta_6 rural_i + \varepsilon_i \qquad (2)$$

where $\log(y_i)$ is the labour earnings of the individual, $hours$ is annual hours worked, age is the age of the individual, $female$ is a dummy that takes the value of 1 if the individual is a woman and 0 otherwise, edu is years of education, $public$ is a dummy that takes the value of 1 if the individual is employed in public administration and 0 otherwise, and $rural$ is a dummy that takes the value of 1 if the individual lives in a rural area and 0 otherwise. Among these variables, some are responsibility variables, and some are non-responsibility variables:

$$\log(y_i) = \boldsymbol{\beta x_i^R} + \boldsymbol{\gamma x_i^{NR}} + \varepsilon_i \qquad (3)$$

where $\boldsymbol{x_i^R}$ are the explanatory variables for which *i* is to be held responsible, and $\boldsymbol{x_i^{NR}}$ are the explanatory variables for which *i* is not held responsible. ε is the error term.

3.3 Evaluating unfair and believed unfair income distributions

This section explains the framework we utilize to calculate the unfairness and believed unfairness distributions in section 5.3.

We generalise the difference-based framework by Almås et al. (2011), which allows for the estimation of believed unfair inequality in addition to unfair and actual inequality. We estimate the actual and unfair income distributions, similarly to Almås et al. (2011). Additionally, we estimate the believed unfair income distribution, where believed unfair income is measured as the deviation between believed and fair incomes. Distinguishing between unfairness and believed unfairness highlights possible biases in perceptions of how factors affect income.

We establish the *count* of the individual, which is a generalisation of the *claim* of the individual in the framework of Almås et al. (2011). The count is given by what would have been the average income in a hypothetical situation where everyone had the same responsibility vector as this individual, following the general proportionality principle (GPP) developed by Cappelen and Tungodden (2010) (Cappelen and Tungodden in Almås et al., 2011). For individual *i*, the count, $g_s(\boldsymbol{x_i^R}; \cdot)$, is given by:

$$g_s(\boldsymbol{x_i^R}; \cdot) = \frac{1}{n}\sum_{\boldsymbol{j}} f(\boldsymbol{x_i^R}, \boldsymbol{x_j^{NR}}) \qquad (4)$$

where *n* is the total number of observations, subscript *i* and *j* indicates that the variable belongs to individual *i* and *j*, respectively, and *s* takes the value of *p* for preference or *b* for belief, depending on the responsibility cut on which the count is based. The count depends on the individual's own responsibility variables, and on the *non*-responsibility variables of all individuals. Income from the responsibility variables contributes directly to the count, whereas income from the non-responsibility variables contributes indirectly as this "excess income" is distributed equally among all individuals. However, in order to estimate the unfair and believed unfair income distributions, we need to estimate fictive fair and believed incomes. We cannot generate income additional to what already exists in the society, and therefore we estimate the fictive income of the individual, which scales the count such that total fictive income equals total actual income. The fair income is therefore:

$$z_{i,}^{GPP} = \frac{g_s(\boldsymbol{x_i^R}; \cdot)}{\sum_j g_s(\boldsymbol{x_j^R}; \cdot)} \sum_j y_j \qquad (5)$$

where z is fair income. The expression determines the count as a fraction of total counts, and multiplies this fraction with the total income in society. The believed income is similarly:

$$x_{i,}^{GPP} = \frac{g_s(\boldsymbol{x_i^R};\cdot)}{\sum_j g_s\left(\boldsymbol{x_j^R};\cdot\right)}\sum_j y_j \qquad (6)$$

and x for belief-based income. By substituting equation (3) into equations (5) and (6), the estimation of the fictive income is given by:

$$z_{i,s}^{GPP} = \frac{\exp(\boldsymbol{\beta x_i^R})}{\sum_j \exp(\boldsymbol{\beta x_j^R})}\sum_j y_j \qquad (7)$$

for fair income, and

$$x_{i,s}^{GPP} = \frac{\exp(\boldsymbol{\beta x_i^R})}{\sum_j \exp(\boldsymbol{\beta x_j^R})}\sum_j y_j \qquad (8)$$

for believed income. Note that the non-responsibility variables are constant and thus disappear, leaving the fraction of responsible incomes and total income to determine fictive incomes.[5] Note also that the standard errors of the point estimates that will be used for the estimations of fictive incomes are carried on from those of the (actual) income function regression.

Almås et al. (2011) establish that the conditions for Lorenz curves can be justified in a similar way when measuring unfair inequality as when measuring (actual) inequality in the standard way.[6] We argue that the conditions also hold for the measurement of believed unfairness, since there should be no difference between interpreting "actual" unfairness and believed unfairness. Scale invariance implies that if all actual, fair or believed incomes are rescaled with the same factor, then the level of (believed) unfairness remains the same. Anonymity states that the ranking of alternatives should

[5] Let $C_i = \exp\left(\boldsymbol{\beta x_i^R}\right)$ and $D_i = \exp\left(\boldsymbol{\gamma x_i^{NR}} + \varepsilon_i\right)$, so $f(\boldsymbol{x_i}, \varepsilon_i) = C_i D_i$.
Then $\frac{g(x_i^R)}{\sum_j g\left(x_j^R\right)} = n^{-1}\sum_j C_i D_j / (\sum_h n^{-1}\sum_j C_h D_j) = C_i \sum_j D_j / \sum_h C_h \sum_j D_j$. Since $\sum_j D_j$ is a constant, this simplifies to $C_i / \sum_h C_h$. (Almås et al. 2011)

[6] **Definition 1.** Scale invariance: For any $a > 0$ and $\mathbf{A}, \mathbf{B} \in \Xi$, if $\mathbf{A} = a\mathbf{B}$, then $\mathbf{A} \sim \mathbf{B}$.
Definition 2. Anonymity: For any permutation function $\rho : \mathbf{N} \to \mathbf{N}$ and for $\mathbf{A}, \mathbf{B} \in \Xi$, if $\left(y_i^A, z_i^A\right) = \left(y_{i(\rho)}^B, z_{i(\rho)}^B\right)$ for all $i \in \mathbf{N}$, then $\mathbf{A} \sim \mathbf{B}$.
Definition 3. Generalized Pigou-Dalton: For any $\mathbf{A}, \mathbf{B} \in \Xi$, where $z_i^A = z_i^B$ for all i, if there exist j, k such that $u_j^A < u_j^B \leq u_k^B < u_k^A$ and $u_i^A = u_i^B$ for all $i \neq j, k$ and $y_j^B - y_j^A = y_k^A - y_k^B$ then $\mathbf{A} \succ \mathbf{B}$.
Definition 4. Unfairism: For any $\mathbf{A}, \mathbf{B} \in \Xi$ such that $\mu(\mathbf{A}) = \mu(\mathbf{B})$, if $u_i^A = u_i^B$ for all $i \in \mathbf{N}$, then $\mathbf{A} \sim \mathbf{B}$.
Definition 5. Unfairness Lorenz dominance: For any $\mathbf{A}, \mathbf{B} \in \Xi$, $\mathbf{A}$ $\mathbf{LD^u}$ $\mathbf{B}$ if and only if $\sum_{i=1}^{[ns]} u_{i(\mathbf{A})}^{\mathbf{A}} / n\mu(\mathbf{A}) \geq \sum_{i=1}^{[ns]} u_{i(\mathbf{B})}^{\mathbf{B}} / n\mu(\mathbf{B})$ for all $0 \leq s \leq 1$, and there exists s such that $\sum_{i=1}^{[ns]} u_{i(\mathbf{A})}^{\mathbf{A}} / n\mu(\mathbf{A}) > \sum_{i=1}^{[ns]} u_{i(\mathbf{B})}^{\mathbf{B}} / n\mu(\mathbf{B})$. (Almås et al. 2011)

be unaffected by a permutation of the identity of individuals, which means that a redistribution of (believed) unfairness does not affect the total measure of (believed) unfairness. As stated in Almås et al. (2011) the generalised Pigou-Dalton principle states that any fixed transfer of income from a person who is less unfairly treated to a person who is more unfairly treated reduces the level of unfairness. It also holds for believed unfairness that any fixed transfer of income from a person who is believed to be less unfairly treated to a person who is believed to be more unfairly treated reduces the level of believed unfairness. Unfairism states that the only concern is how unfairly each person is (believed to be) treated, defined as the absolute deviation between fair income and actual (or believed) income. Unfairness Lorenz dominance is equivalent to a strict ranking of the alternatives for any partial ordering that satisfies the basic conditions. The same counts for believed unfairness Lorenz dominance.

If (believed) unfairness Lorenz dominance is not satisfied, there will exist other unfairness measures, satisfying the Pigou-Dalton criterion while not equalising the weight of unfairness, which will rearrange the ranking of two Gini coefficients. One such weighting may be to assign more weight to those that are underpaid than those that are overpaid. In the case of no (believed) unfairness Lorenz dominance, there is no robust conclusion that one Gini coefficient is more or less unfair than another.

Unfair income and believed unfair income is given by the difference between actual and fair income, and believed and fair income, respectively, so that for unfair income,

$$u_i = y_i - z_i^{GPP} \qquad (9)$$

where u_i is the unfair income, measuring the deviation between actual income, y_i, and fair income, z_i^{GPP}.

For believed unfair income,

$$bu_i = x_i^{GPP} - z_i^{GPP} \qquad (10)$$

where bu_i is the believed unfair income, measuring the discrepancy between believed income, x_i^{GPP}, and fair income z_i^{GPP}.

Formally, we assume that any alternative, $\boldsymbol{A}$, contains a set of individuals, $N = \{1, \dots, n\}$. We allow each individual, *i*, to be characterized by the triplet $(y_i^{\boldsymbol{A}}, z_i^{\boldsymbol{A}}, x_i^{\boldsymbol{A}})$, where the former represents actual

income, the second represents fair income, the latter represents belief-based income, and $y_i^{\boldsymbol{A}} > 0$, $z_i^{\boldsymbol{A}} > 0, x_i^{\boldsymbol{A}} > 0$. Thus, we can establish $\boldsymbol{A} = [(y_1^{\boldsymbol{A}}, z_1^{\boldsymbol{A}}, x_1^{\boldsymbol{A}}), \dots, (y_n^{\boldsymbol{A}}, z_n^{\boldsymbol{A}}, x_n^{\boldsymbol{A}})]$. Average income is defined as $\mu(\boldsymbol{A}) = n^{-1} \sum_i y_i^{\boldsymbol{A}}$. However, we assume that for any $\boldsymbol{A}$, $\sum_{\boldsymbol{i}} y_i^{\boldsymbol{A}} = \sum_{\boldsymbol{i}} f_i^{\boldsymbol{A}}$, which implies that the distribution of fictive incomes reflects a perception of how total income in society is or should be distributed, and so the set of possible alternatives to consider is given by

$$\boldsymbol{\Xi} = \left\{ \boldsymbol{A} \middle| f_i^{\boldsymbol{A}} \geq 0 \; for \; all \; i \; and \; \sum_i y_i^A = \sum_i f_i^{\boldsymbol{A}} \right\} \qquad (11)$$

When estimating a standard Lorenz curve, $\boldsymbol{L}(s; \boldsymbol{A})$, $y_{1(A)} \leq y_{2(A)} \leq \cdots \leq y_{n(A)}$ represents the ranking of the individuals according to their actual income in a non-decreasing order, where $y_{1(A)}$ represents the person with the lowest income in $\boldsymbol{A}$. However, a standard Lorenz curve can also be expressed by ranking the individuals according to the difference between actual income and average income.

$$L(s; \boldsymbol{A}) = \frac{\sum_{i=1}^{[ns]} y_{i(\boldsymbol{A})}}{n\mu(\boldsymbol{A})} = \frac{\sum_{i=1}^{[ns]} (y_{i(\boldsymbol{A})} - \mu(\boldsymbol{A}))}{n\mu(\boldsymbol{A})} + s, 0 \leq s \leq 1 \qquad (12)$$

where [ns] is the highest integer not greater than [ns], and the second part of the equation is a normalized version of the initial expression, so that alternatives are still comparable in the same manner as before. The standard Lorenz curve can therefore be defined as the difference between the average income and the actual income as a fraction of total income, plus a fraction of the population, s. When dropping the s, what then remains can be expressed as the difference-based Lorenz curve:

$$L^U(s; \boldsymbol{A}) = \frac{\sum_{i=1}^{[ns]} d_{i(\boldsymbol{A})}}{n\mu(\boldsymbol{A})}, 0 \leq s \leq 1, z_i^{\boldsymbol{A}} \geq 0 \; for \; all \; i \qquad (13)$$

where *d* is either unfair income or believed unfair income. If *d* is the deviation between actual and mean income, we would estimate a standard Lorenz curve. However, this formulation allows for incomes from any other responsibility cut. We can now derive the difference-based Gini coefficient, which similarly allows for incomes derived from any responsibility cut:

$$G^d(\boldsymbol{A}) = \frac{1}{2n(n-1)\mu(\boldsymbol{A})} \sum_i \sum_j |d - d_j^{\boldsymbol{A}}| \qquad (14)$$

Since we only study cases where labour earnings are non-zero, it follows that the (believed) unfairness Gini has maximum value of 2. The unfairness Gini reaches its maximum value in the

case when one individual, who should not have any income, has all income, and one of the individuals with zero income should have all income in the economy. Analogously, the believed unfairness reaches its maximum value in the case when one individual, who, is believed to not deserve any income, has all income, and one individuals with zero income is believed to deserve all income. In the case where everyone's fair income equals everyone's actual income, the unfairness Gini will equal the standard Gini. In the case where everyone's believed income is equal to the unfair incomes, the unfairness Gini equals the believed unfairness Gini. It follows that if actual, fair and believed incomes are identical for all individuals, then the standard Gini, the unfairness Gini and the believed unfairness Gini will be equal.

4 Data

We combine and analyse data from two different sources. First, we apply data on fairness preferences and beliefs for six factors determining income, primarily from Germany, and subsidiary from USA and Norway. We use these to analyse fairness preferences and beliefs, and determine reference fair and believed responsibility cuts. Second, we analyse income data from Germany, and establish income coefficients for the six variables questioned in the first data set. Data from the two datasets are combined in the final analysis of unfair and believed unfair income inequality.

4.1 Fairness data

The survey was executed in Germany, Norway and the United States in early 2012. The German data was collected in a collaboration between the survey provider Norstat and ODC Germany, now a part of Norstat. Norstat collected the Norwegian sutvey, while the US data were collected by Norstat's collaborator, SSI Sweden.

First, respondents indicated the extent to which they think a specific factor *plays* an important role in determining a person's income. Second, respondents indicated the extent to which they think it *is fair if* the factor plays an important role in determining a person's income. The factors questioned were years of education, hours worked, age, gender, sector of employment (private/public) and area of residence (urban/rural). The survey also asked respondents about their belief and fairness preferences on the influence of luck, talent and effort on income. Additionally, there were some background questions (see Appendix 1).

4.2 Income data

We estimate the income function for Germany using data from the German Socio-Economic Panel, which is a longitudinal study of private households starting in 1984. The point estimates from the estimated regression will apply when estimating fair incomes (see chapter 5.3). The latest data included in the dataset is for 2013, which is the primary year of interest for our analysis. Data before 1989 is from the BRD, while data after this year is for both East and West Germany. We considered excluding the old East Germany from our analysis, but concluded that even though the

comparability between the years before and after the reunification of Germany is not perfect, we are able to discuss Germany as a whole from 1990.

When estimating Gini coefficients, individual household income serves as the measure of actual income, which is a measure of the individual's share of household income adjusted with the modified OECD equivalence weight.[7] This measure assumes that the total household income is shared equally between the household members, and is chosen to get a measure of income close to individual consumption. Note that, the income function estimation uses individual labour earnings, as it is likely that this measure corresponds best to how we think respondents have interpreted the fairness survey. [8]

The variables used are the natural logarithm of annual pre- and post-government income on individual household-level, individual labour earnings, years of education, annual labour hours, age, gender, sector (public/private) and area of residence (urban/rural) (see Appendix 2 for details). To avoid disturbances on the effect of income, we restrict our sample to complete observations on demographics and education, and persons with labour income greater than zero. The greatest restriction is to exclude observations without labour hours, which almost halves the sample size.

From the descriptive statistics, we see that the proportion of females in the total sample has increased by 35 percent from 1984 to 2013, which, since we restrict our analysis to persons with working hours and labour income, can be seen as a result of the entry of women into the labour market (see Table 1). The proportion of individuals working in the public sector is increasing, and so is the share of individuals living rurally. The latter might seem counterintuitive, however, there might be more urban areas in 2013 than in 1984, which makes it more likely to live near one.

Total sample, individuals	1984	2013

[7] The OECD equivalence weight adjusts individual household income, such that household income is divided by one plus 0.5 for every additional adult and 0.3 for every child.

[8] The point estimates estimated from individual labour earnings will be used to predict fair and believed pre-government and post-government individual household income. It might seem contradictory to compare fictive incomes that are based on point estimates from individual labour earnings with household-level pre- and post-government incomes to estimate unfair income (where private transfers etc. are included). However, recall that the Gini is scale invariant, so that the count from the predicted fictive incomes (based on individual labour earnings point estimates) will be scaled according to its share of total fictive incomes and total pre- or post-government incomes (see chapter 3.2). The only consequence of changing the dependent variable is therefore that the relative size of the point estimates might change, which makes responsibility variables with high point estimates crowd out the income effect of the other responsibility variables. From trial and error, we also find that the Gini results are relatively robust to which income variable is used in the income estimation.

Proportion, female	0.37				0.50			
Proportion, public sector	0.08				0.09			
Proportion, rural area	0.31				0.34			
Number of observations	5,386				7,535			
	Mean	SD	Min	Max	Mean	SD	Min	Max
Education	10.9	2.45	7,00	18,00	13	2.7	7	18
Hours worked	1996	717.32	17	5144	1,950	757	22	5,301
Age	38.3	12.09	17	78	47.1	10.9	18	86
Pre-government income	15,466	9,564	236	19,7844	39,772	35,289	1,300	1,265,449
Post-government income	11,439	5,305	641	94,603	29,156	21,192	533	736,347
Individ. Labour Earnings	16,565	12,961	147	283,256	37,071	38,811	90	1,860,000

Table 1 Descriptive statistics of total income data sample from the German Socio-Economic Panel, excluding individuals with incomplete information on education or demographics, zero labour hours and/or zero income.

Average years of education have increased from 10.9 years in 1984 to 13 years in 2013. For countries like Germany, where students follow different paths of education, it has become common practice to use different types of education paths or higher education as dummies in the regression equation rather than years of education. However, we use years of education because it corresponds better to the question asked in the fairness and belief survey. The average age increased slightly more than the increase in life expectancy for people with the mean age in 1984 and 2013 (German Statistics, 2016). Average pre-government income increased with 157 percent.

5 Analysis

Our analysis is threefold, and follows the chronology described in chapter 3. First, we investigate the data on fairness preferences and beliefs about the six factors determining income, and establish the responsibility cuts that will be utilized in the Gini analysis. Second, we estimate the pre-government income generating function, determining the change in income associated with a change in the independent variables. Third, by combining the two data sources as described in the model, we establish unfair, actual and believed unfair income distributions.

5.1 Identifying fairness views and beliefs

Empirical evidence shows that the notion of responsibility is a valid approach to fairness and economic outcomes (see chapter 2). There is also a plurality of fairness views, and no clear consensus for any view. The following chapter explores data on beliefs and fairness preferences, which describe the descriptive and normative role of the six factors in the income generating process, respectively. First, we identify the frequency of a selection of responsibility cuts, establish a reference responsibility cut and examine deviations between fairness preferences and beliefs. Second, we explore whether it is plausible that the selected responsibility cuts represent the corresponding fairness theories.

5.1.1 Distribution of responsibility cuts

We restrict our analysis to six selected responsibility cuts that we construct with inspiration from the fairness theories presented in chapter 2. The "strict egalitarian" and "strict libertarian" responsibility cuts are defined by consistent answers of 10 and 1 on every variable, respectively. The "egalitarian" and the "libertarian" responsibility cuts are defined by non-responsibility scores less than 5.5 and greater than 5.5 on every variable, respectively. Assuming education and hours worked are perceived as the most controllable factors, the "luck egalitarian" responsibility cut holds individuals responsible for these variables only. The "luck libertarian" responsibility cut holds individuals responsible for sector and area of residence as well.

Only 1.6 percent choose the "strict egalitarian" responsibility cut, and only 0.4 percent choose "strict libertarian" responsibility cut (see Table 2). A minority prefers these responsibility cuts, while 98 percent prefer an interior solution. To capture the unfair inequality as perceived by individuals, we thus need another measure for inequality than the standard Gini, such as that of

Responsibility cut		Fairness (%)	Belief (%)
Strict egalitarian	10,10,10,10,10,10	0.4	1.1
Egalitarian	Θ (empty)	7.2	3.5
Luck egalitarian	E, H	20.1	0.9
Luck libertarian	E, H, S, R	2.2	0.7
Libertarian	E, H, S, R, G, A	11.1	37.7
Strict libertarian	1,1,1,1,1,1	1.6	0.3
SUM		42.6	44.2

Table 2 Frequency of six different responsibility cuts, labels inspired from the literature. Factors are education (E), hours (H), sector (S), area of residence (R), gender (G), age (A).

Almås et al. (2011).

The most frequently observed fair responsibility cut is the "luck egalitarian", accounting for 20 percent of the answers. Eleven percent chooses the "libertarian" fairness cut, indicating that under the broader definition of this fairness view, the support for libertarianism increases substantially. The same is true for the "egalitarian" cut, chosen by 7 percent of respondents. The diversity in responsibility cuts suggests pluralism in fairness views.

The "libertarian" responsibility cut is the most frequently observed believed responsibility cut chosen by 37.7 percent of the respondents, indicating that the most common belief is that all variables affect income. Notably, the most frequent fair responsibility cut, the "luck egalitarian", receives only 0.9 percent of the believed responsibility cuts, indicating a substantial difference between the most common fair and the most common believed responsibility cuts. The "egalitarian" cut has the second highest percentage of responses among our selected cuts, chosen by 3.5 percent of the respondents. Only 1.1 and 0.3 percent choose the "strict libertarian" and "strict egalitarian" cuts. For a complete list of responsibility cut frequencies, see Appendix 3.

Investigating the heterogeneity in respondents that chose one specific fair responsibility cut reveals some of the prevalent characteristics. Among the respondents who hold the "luck egalitarian" fair responsibility cut, 60 percent are women and 40 percent are men. The likelihood that individuals holding the "luck egalitarian" fair responsibility cut have higher education is statistically higher than for the overall sample. This positive relationship also counts for the likelihood of living rurally. Respondents are more likely to be luck egalitarian the more they favour economic growth (see Appendix 4).

For “egalitarians”, gender is not a significant factor. Respondents are more likely to hold an “egalitarian” responsibility cut if they believe hard work determines income. In addition, the more respondents dislike economic growth, the more likely they are to be egalitarians. Belief in luck as a determining factor for income is a significant predictor for “egalitarians” as respondents are *less* likely to be egalitarians the more they believe in luck (see Appendix 5).

Among respondents choosing the “libertarian” fair responsibility cut, 59.7 percent are men and 40.3 percent are women. Reduced belief in luck is a significant predictor for “libertarians” as respondents are less likely to hold this responsibility cut if they think luck plays a significant role in determining income (see Appendix 6). There is a negative and statistically significant relationship between choosing the “libertarian” fair responsibility cut and thinking that economic growth is good. This might be surprising, Nonetheless, there is a positive and statistically significant relationship between choosing the “libertarian” fair responsibility cut and believing that income inequality is good for economic growth. It might seem intuitively odd that “libertarians” do not like economic growth better than others, holding individuals responsible for all inequalities and believing that inequalities are good for growth, but still comparatively disliking economic growth. However, there is no logical inconsistency as we see it, and the average approval of economic growth is generally high (see Appendix 7).

5.1.2 Score distributions for each variable

To identify a reference cut, we analyse the frequency distributions variable by variable. Recall the cut-off between responsibility and non-responsibility variables at 5.5, introduced in chapter 3. The reference responsibility cut will be determined variable by variable, by whether the average non-responsibility score is above or below the cut off. We identify that the reference fair responsibility variables are education and hours worked, which corresponds to the “luck egalitarian” responsibility cut.

The frequency distributions are heterogeneous across the variables, and mean non-responsibility scores range from 3.66 to 8.24 (see Table 3). Education and hours worked are clearly skewed towards the left, indicating that it is fair if these variables influence income (see Figure 1). Distributions for age, area of residence and sector are skewed to the right, indicating that it is not fair if inequalities are influenced by these variables. Notably, the distributions of these three variables all have peaks at

Fairness	Gender	Education	Hours	Sector	Area	Age
Mean	8.239	4.426	3.664	6.753	6.839	6.292
Median	10	4	3	7	7	6
% above 5.5	80	27	19	61	63	54

Belief	Gender	Education	Hours	Sector	Area	Age
Mean	4.140	4.767	4.424	3.765	4.048	4.145
Median	4	5	4	3	4	4
% above 5.5	22	33	27	18	21	22

Table 3 Respondents' fairness preferences for, and beliefs about, six income variables. Respondents were asked to indicate which of the following statements they agreed with the most, on a scale from 1-10 where 1 indicates agreement with the first statement and 10 indicates agreement with the latter statement. For fairness preference: "It is fair *if [factor] plays an important role in determining a person's income", and "It is* not fair *if [factor] plays an important role in determining a person's income". For beliefs: [Factor]* plays *an important role in determining a person's income", and "[Factor]* does not play *an important role in determining a person's income"*

option 5 and 10. Finally, gender has the highest average response of 8.2, with more than half of responses answering option 10.

The reference believed responsibility cut holds individuals responsible for all six variables, which corresponds to the "libertarian" responsibility cut (see Figure 2). The distributions are homogenous, all skewed towards the left and with mean answers between 3.8 and 4.8. Sector has the clearest consensus, with 82 percent of respondents believing that sector plays an important role in determining income. Education has the most dispersed distribution, with only about two thirds of respondents believing that education significantly affects income.

It is evident that respondents differentiate between factors that should and should not play an important role in determining income. In terms of average and median scores, the consensus on whether a variable should affect income is by far strongest for gender. This seems reasonable in light of the prevalent awareness of the gender wage gap in the public debate. In terms of percentage of respondents on the same half of the scale, the consensus is strongest in favour of hours worked having an important influence on income. The distributions for the belief data show that respondents hold individuals responsible for all the six variables. However, it remains an open question whether they would think individuals are held responsible for all variables that might affect income.

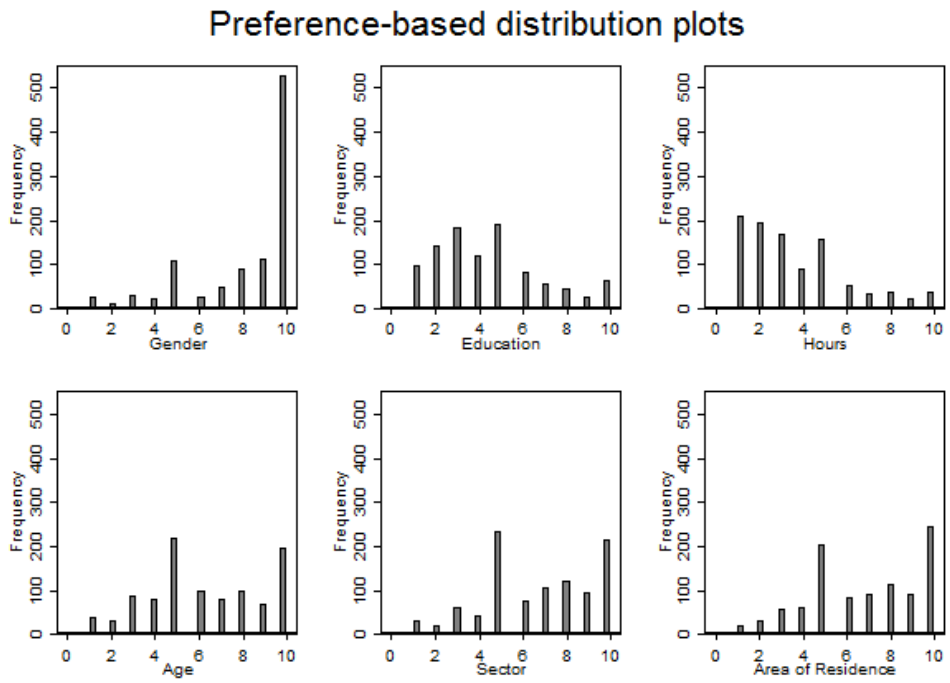


Figure 1 Frequency distribution plots, fairness data. Respondents were asked to rate to what extent they agreed with the statement: "It is fair if [factor] plays an important role in determining a person's income", on a scale from 1 to 10, where 1 means agree and 10 means disagree

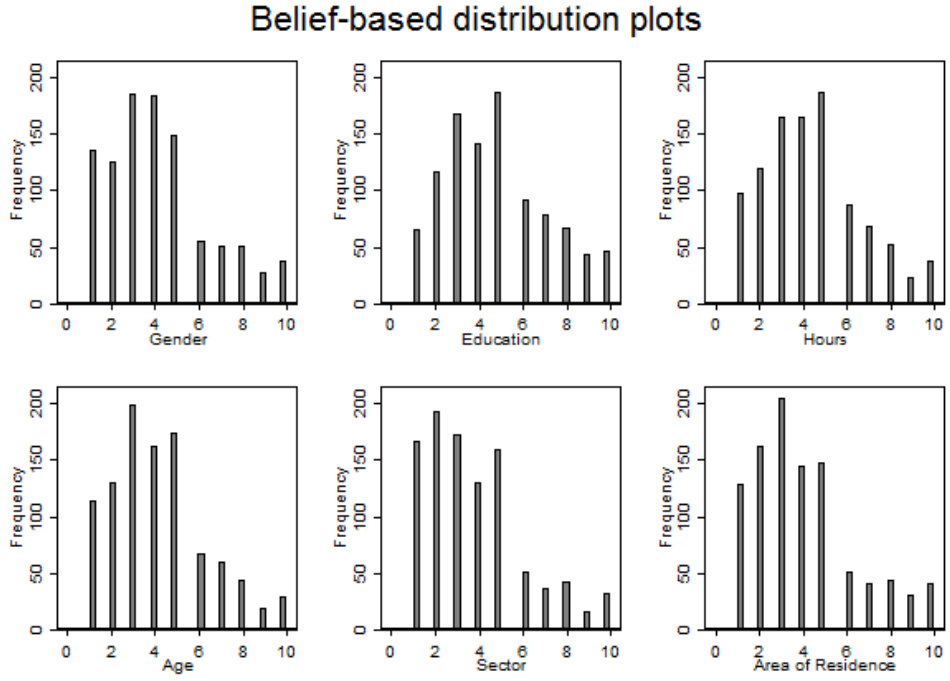


Figure 2 Frequency distribution plots, belief data. Respondents were asked to rate to what extent they agreed with the statement: "[Factor] plays an important role in determining a person's income", on a scale from 1 to 10, where 1 means agree and 10 means disagree

Factor	Absolute sum of individual fairness/belief deviation
Gender	4611
Age	2887
Education	1807
Hours	1876
Rural/urban	3335
Public/private	3542

Table 4 Absolute sum of individual deviations between beliefs and fairness preference for six income variables. Indications on preferences and beliefs both range from 1-10, 1 representing strongest agreement in fairness of and belief in variables significance.

Comparing fairness views and beliefs by subtracting individual non-responsibility belief scores from non-responsibility fairness scores, reveals a measure of the perceived level of unfairness for each variable (see Figure 3). We compile the absolute sum of deviations for the full sample for each variable, and identify the level of total dissatisfaction for every variable (see Table 4) The dissatisfaction is strongest for gender, illustrated by the skew towards the left and the aggregated dissatisfaction of 4,611. Nearly every respondent prefers a lower impact from gender on income than he or she thinks is the case. All variables except gender has a clear peak at zero, indicating no perceived unfairness associated with the factor. The deviation is significantly lower for the responsibility variables than for the non-responsible counterparts. Responsible variables education and hours worked both have on average 1.8 points of deviation, distributed fairly evenly in both directions, while the non-responsible variables have average points of deviation ranging from 2.88 to 4.6 for, indicating an average preference for a lower influence than what is believed to be the case.

We would like to attribute some attention to the formulation of the survey questions. The respondents were asked to rate to which extent they agreed to the two statements "[Factor] *plays* an important role in determining income" and "It is *fair* if [factor] plays an important role in determining a person's income" (italics included). First, there is some ambiguity in whether the respondents have interpreted the question as one of causation or correlation (or a mix of the two). In the case of gender, some might answer on the question of equal-pay-for-equal work, while others might substitute gender with other factors, such as working part-time, which is more common among females than males. These different possible ways of interpreting the questions may explain the double-peaks in some of the frequency distributions, although this might also be a heuristic for "other than all or none", average, or it may be due to the absence of the possibility of answering neutrally. Second, there may be ambiguities related to whether the questions asks about the extent

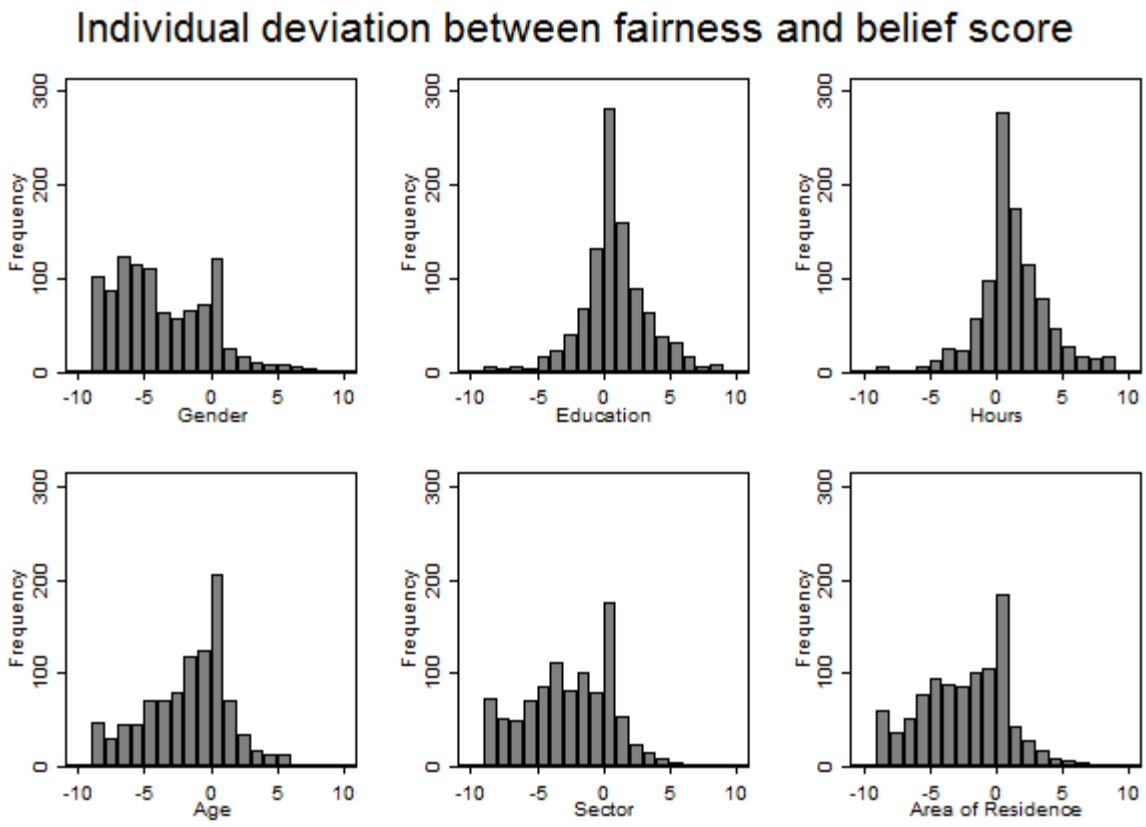


Figure 3 *Frequency of individual deviation between belief and fairness preference scores for the significance of six variables' influence on income. 0 means that the respondent has the same answer for beliefs and preferences. -9 means that the respondent answers 1 for believed significance, and 10 for fair significance of the factor.*

to which a respondent agrees on *a* relationship between the factor and income level, or the magnitude of the income level that should be associated with the factor. The latter interpretation comes with a problem on its own, since there is no nominal way of interpreting e.g. an answer of 7 in terms of income level.

5.1.3 Cross-country analysis

Comparing the fair responsibility cuts in Norway, the United States and Germany reveals that the average responsibility cut in all three countries is the "luck egalitarian" (see Table 5). This responsibility cut is also the most frequently chosen in all countries, accounting for about 20 percent of responses in each country. There may be cultural differences in how the questions are interpreted in the three countries, but supposing a similar interpretation, we can conclude that the responsibility cuts are the same in all three countries.

Mean non-responsibility	Gender	Education	Hours worked	Sector	Area	Age
United States	7.667	3.766	3.336	5.708	6.166	6.818
Norway	8.425	3.362	3.519	6.878	6.948	5.876
Germany	8.239	4.426	3.664	6.753	6.839	6.292

Table 5 Fair responsibility cuts in Norway, the United States and Germany

5.1.4 The luck egalitarian "control hypothesis"

The "luck egalitarian" responsibility cut is both the average cut and the most frequently chosen fairness responsibility cut. Therefore, we investigate the likeliness that this responsibility cut corresponds to the luck egalitarian fairness theory. Recall that under this theory, responsibility for an outcome is to be determined by whether individuals are able to control its cause, or whether the outcome is determined by luck (see chapter 2). The following sub-sections therefore aim at investigating the "control hypothesis" of luck egalitarian fairness theory. First, we examine respondents' likely perception of the controllability of the six factors. Second, we investigate the relationship between choosing the "luck egalitarian" responsibility cut and acceptance of luck. We also determine this relationship for choosing the "libertarian" fairness cut.

5.1.4.1 Perception of controllability

Kohler and Spitznagel (1996) find that 75 percent of overtime work was due to factors beyond individuals' control, such as unexpected or regular fluctuations in demand and production, short-term frictions in the production process, a high capacity utilization or short-term staff shortages due to illness and holidays (Kohlner and Spitznagel in Bauer and Zimmermann, 1999). Presuming that respondents are aware of these results, this would be an argument against holding people responsible under the control hypothesis. However, if not constrained by force or subsistence risk, it seems intuitive to think that individuals are able to control their number of labour hours, ultimately by changing their employment situation.

Perceptions on the controllability of years of education are perhaps harder to predict. This might seem straightforward, as individuals can choose to either enrol at any number of voluntary studies, or start working, after compulsory school years are finished. However, there are both financial and cultural factors likely to have an influence. In the SOEP dataset, we find a correlation of 0.49 between individuals' education and fathers' education as measured by vocational or university

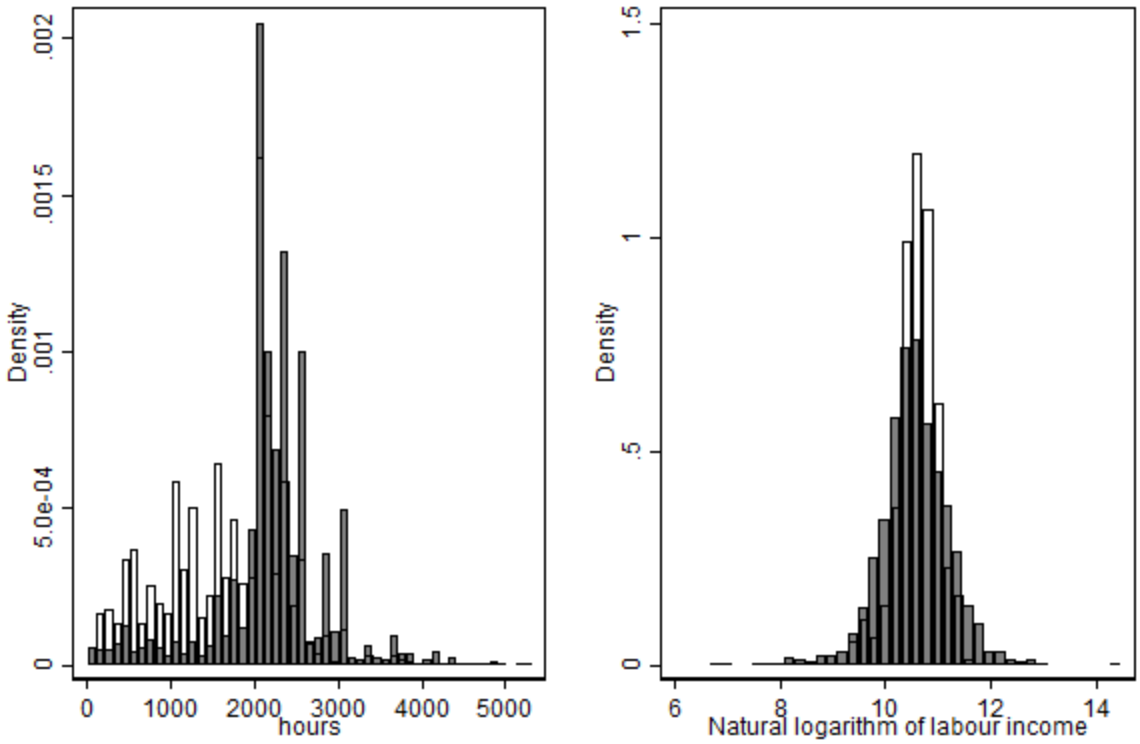


Figure 4 Density plot of annual number of hours worked for male and female (left), and density plot of the natural logarithm for labour income in private and public sector

degrees. Zwick (2012) finds that not having to work part-time while studying has a positive effect on achievements, a factor that is likely to be influenced by the wealth of your family. These are factors that individuals cannot control themselves. On the other hand, Zwick asserts that the mentioned effect of parents' education on their children's education (a common finding, he says) disappears if other individual characteristics are included in the regression. Another common finding, that one's academic achievements are boosted if you are female, Zwick attributes to females' choice of subjects that have relatively higher final grades on average. Presuming knowledge of such contrasting evidence, this suggests a nuanced or dispersed view of the controllability of education.

If people are to be held responsible for the factors they control, gender follows as perhaps the clearest example of a factor not to be held responsible for. The fairness answers for gender fits this interpretation, with over 80 percent on the non-responsibility half of the scale and over 50 percent answering the most denying option. As mentioned above, there has been a strong emphasis on income inequality due to gender in the public debate over many years that might explain the strong consensus on the normative relationship between gender and income.

It seems reasonable to assume that age is not a controllable characteristic, since date of birth and process of aging clearly is not within control of the individual. On the other hand, to the extent that you can control your life and reasonably choose between short- or long-term gains, one could hold people responsible for these choices and efforts over time by holding them responsible for age. Interpreting the question on whether age should have an impact in income causally, the question asked is effectively "If you could turn a 50-year old into a 20-year old, while keeping everything else equal, should she still get the same income?" This is perhaps an unintuitive way of thinking for some, who might replace it with a question of correlation, for example with experience. From our SOEP dataset, we find a correlation of 0.6 between age and experience in the labour market.

It seems intuitive that sector of employment is a relatively free choice. The correlation between age over 40 years and tenure in current position can be a measure of how often employees change jobs. We find hardly any correlation between age and tenure in current position, indicating that a significant proportion of the mature working stock has not worked at their current job for very long (see Figure 4). To the extent that job changes are voluntary, and that individuals can choose sector when choosing jobs, this indicates that sector of employment is perceived as within the control of the individual, given knowledge of such relationships. However, it is difficult to estimate how challenging people regard job changes between public and private sector in particular. Only a small fraction of individuals in the SOEP dataset has worked in both sectors.

Area of residence is likely to be thought of as primarily within the control of the individual, although respondents are likely to assume some cultural, economic or familial restrictions.

5.1.4.2 Alternative interpretations

Other underlying theories may motivate the fairness responses, either instead of or in addition to the control hypothesis examined above. Responsibility could also be interpreted as assigned through identifying characteristics and preferences (Schokkaert and Devooght, 2003). It might be a common assumption that people identify strongly with their field and subsequent practice, and consistently, to hold them responsible for the consequences of this association. Individuals reasoning in accordance with the identifying characteristics theory could think that gender should not be relevant to the worker identity, or the characteristics of a worker.

Individuals might use other variables as proxies for the variables in question. Gender might be seen as a proxy for hours worked, since women on average work fewer hours than men (see Figure 4). Education might be seen as a proxy for ability.

The theory of choice compensation might provide motivation for differentiating between responsibility and non-responsibility variables. Public sector wages are more centred on the mean income, while private sector has a more dispersed distribution. It seems likely that respondents to a certain extent perceive a trade-off between a safe average income and a high but more volatile income (see Figure 4). Given that individuals are able to choose sector, taking a job in the public sector could be seen as an insurance against a low wage. In the case of a macroeconomic shock, a choice compensator would find it reasonable if the riskier private sector worker is hit harder by the shock, even if she had no way of anticipating or influencing the occurrence. However, the non-responsibility fairness score of 6.8 indicates that the average respondent prefer sector of employment to be irrelevant in determining a person's income.

5.1.4.3 Fairness views and the view on luck

By exploring the relationship between respondents' normative views on luck in the income generating process and choice of fair responsibility cut, we find evidence in favour of a connection between the responsibility cuts and the hypothesised underlying fairness theories. The conclusions are applicable for both the fair and the believed responsibility cuts. We regress a dummy that takes the value of one if a person holds a particular responsibility cut, on acceptance of luck, with robust standard errors (see Appendix 8).

According to the luck egalitarian fairness theory, individuals should be held responsible for factors within the control of the individual, and not for factors determined by luck. We find the statistically significant result that less acceptance for luck in the income generating process is associated with increased probability that this person has a luck egalitarian responsibility cut. Including the "luck libertarian" responsibility cut in the dummy as well as two intermediate responsibility cuts increases the coefficient of acceptance for luck, and is still statistically significant. The intermediate responsibility cuts are not significant when regressed on their own, although this might be due to much smaller sample sizes for these responsibility cuts (see Table 2 on p 22). This relationship between acceptance for luck and holding the responsibility cuts inspired by luck egalitarianism

supports our theory that respondents choosing these cuts have preferences in accordance with the luck egalitarian fairness theory.

The libertarian fairness theory implies that individuals should be held accountable for all factors, including factors where the outcome is controlled by luck. There is a statistically significant relationship between increased acceptance of luck in the income generating process, and holding the "libertarian" responsibility cut. This supports our hypothesis that respondents choosing the "libertarian" fairness cut have fairness preferences in accordance with the libertarian fairness theory.

Finally, we find no statistically significant relationship between holding the "egalitarian" responsibility cut and being in favour or disfavour of luck as an income determinant. This does not support a hypothesized connection between the egalitarian responsibility cut and the egalitarian fairness theory, as followers of the egalitarian fairness theory is assumed to not hold individuals responsible for any factors. However, this might be due to a somewhat smaller sample size. The histogram for the frequency distribution for preferences for luck has a skew to the right, indicating a preference for not holding individuals responsible for luck, but according to the regression this is not significantly different to preferences of the total population.

5.2 The income function

Inspired by the classical Mincer equation and its repercussions, the following section presents the income function that determines the point estimates applied in section 5.3 as described in chapter 3.2.

Determining the effects of individual characteristics on labour income remains one of the major questions within labour economics. The classical Mincer equation attributes particular attention to the return of education in the labour market (Mincer, 1974). Although Mincer represents a cornerstone of the wage equation discussion, new evidence available due to more and better data poses some doubts about some of Mincer's predictions. Some argue that the standard Mincer equation provides a poor approximation of the true relationship between earnings and experience (Murphy and Welch, 1990). Others discuss how to best incorporate uncertainty about future earnings into the Mincer framework (Heckman et al., 2003), or that the average impact of an additional year of education on earnings varies with the number of completed educational years

(Trostel, 2005). The ability bias between education and income has been the source of interest to many modifications of the original equation. Already in 1945, Noyes commented on the issues of ability bias, noting that returns to education could largely be a return to ability that arises independently of years of education (Noyes in Heckman et al., 2006). This bias results in endogeneity in the education variable, i.e. that it correlates with the error term.

A common way of reducing the endogeneity in the education variable is to use instrumental variable regression (IV). For this method to be valid, an instrument must meet the criteria of validity and relevance:

$$Cov(z, u) = 0 \qquad (16)$$

$$Cov(z, x) \neq 0 \qquad (17)$$

where z is the instrument, u is the error term, z is the endogenous variable and $Cov(.)$ is the covariance between the arguments. The relevance criterion implies that the instrument must correlate with the endogenous variable. The validity criterion, known as the exclusion restriction, implies that the instrument must only affect the dependent variable through the endogenous variable. The latter criteria is the most difficult to satisfy, as it is impossible to test formally, which means one can only use intuition to validate it. Common instruments for education are of institutional nature, such as the minimal school leaving age, tuition costs for higher education, or geographic proximity of schools (Card, 2001; Staiger and Stock, 1994). Others have used family background variables (Card, 1999; Heckman, 2005).

We specify three different models and run both OLS and IV regressions on all of them. Number of siblings is the instrument in all the IV regressions. Although it may be argued that number of siblings could affect income directly or through ability, which is unobservable, using number of siblings as instrument for education is not uncommon (see e.g. Carneiro, Heckman and Vytlacil (2010) and Jochmann and Pohlmeier, (2004)). First, we specify one model using the full sample with individual household pre-government income as the dependent variable. Furthermore, we specify the same model, but for single households only, to get a more precise link between income and individual characteristics. Finally, we utilise the full sample again, with individual labour earnings as dependent variable. Unlike pre-government income variables, which include cash flows such as private transfers and asset flows, individual labour earnings are only affected through

indirect labour market torsions such as government regulations or different trade and labour unions exercising market power. Using labour income, we aim at capturing the effect of the variables in the labour market. Years of education, hours, hours squared, age, age squared, sector, area of residence and gender are independent variables in all the specified models.

Our wage equation consists of an income variable and six independent variables. The independent variables correspond to the six factors that were questioned in the fairness and belief survey (education, annual labour hours, gender, area of residence [rural/urban] and sector [public/private]). Due to the apparent non-linear relationship between income and both age and hours worked when plotting the data, we add squared variables for both. The returns to age and hours are typically positive, but are marginally decreasing, and might even turn negative for large values.

We want to estimate an income function that corresponds as closely as possible to the respondents' interpretation of the survey questions. It may be intuitive to assume that respondents have answered the questions while considering the *labour market* outcome of a factor. Hence, to identify this effect, we want to use a pre-tax income variable, which is also in line with Almås et al. (2011). We estimate the following wage equation:

$$log(y) = \alpha + \beta \boldsymbol{R} + \gamma \boldsymbol{NR} + \varepsilon \qquad (15)$$

where the dependent variable is the natural logarithm of an income variable, **R** is a vector of responsibility variables, and **NR** is a vector of non-responsibility variables. We apply population weights in our estimations.

From the estimations (see Table 7), we see that coefficients for education, hours, age and gender are statistically significant in all the regressions. Gender is not significant when household-income is the dependent variable (model 1 and 2), which is in line with our expectations. Households often consist of both a male and a female, and the income gap between them is not taken into account in the household weights, which is one of the main reasons why we do not apply these regressions. Both the models with the full sample and the single household models have significant gaps between the IV and the OLS in the estimations of the returns to education. Using individual labour earnings as dependent variable (model 5 and 6) thus seems to make the model more robust, as the difference between the IV and the OLS decreases to less than 0.025. However, in these two models,

the gender gap becomes surprisingly high. Similarly, there is a somewhat surprising wage increase associated with working in public sector. [9]

	(1) OLSpre b/se	(2) IVpre b/se	(3) OLSpre_ b/se	(4) IVpre_ b/se	(5) OLSlabour b/se	(6) IVlabour b/se	(7) firststage b/se
edu	0.0825***	0.1573***	0.0820***	0.2192**	0.0802***	0.1049***	
	(0.0036)	(0.0252)	(0.0080)	(0.0698)	(0.0037)	(0.0230)	
hours	0.0005***	0.0005***	0.0017***	0.0016***	0.0017***	0.0017***	0.0005**
	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0001)	(0.0001)	(0.0002)
hours2	-7.16e-08***	-6.98e-08***	-2.42e-07***	-2.3e-07***	-2.65e-07***	-2.64e-07***	-8.47e-09
	(1.19-08)	(1.3e-08)	(2.97e-08)	(3.75e-08)	(1.26e-08)	(1.28e-08)	(4.46e-08)
public	0.0015	-0.0314	0.0360	-0.0614	0.0992***	0.0883**	0.3797**
	(0.0327)	(0.0375)	(0.0538)	(0.0854)	(0.0271)	(0.0306)	(0.1430)
rural	-0.0467*	-0.0120	-0.0864	-0.0343	-0.0506*	-0.0391	-0.4449***
	(0.0220)	(0.0260)	(0.0504)	(0.0687)	(0.0223)	(0.0251)	(0.0916)
age	0.0362***	0.0393***	0.0482**	0.0768**	0.0607***	0.0617***	-0.0267
	(0.0080)	(0.0084)	(0.0183)	(0.0263)	(0.0082)	(0.0083)	(0.0273)
age2	-0.0004***	-0.0004***	-0.0004*	-0.0007*	-0.0006***	-0.0006***	0.0002
	(0.0001)	(0.0001)	(0.0002)	(0.0003)	(0.0001)	(0.0001)	(0.0003)
gender	0.0005	-0.0123	-0.1847***	-0.1865**	-0.2778***	-0.2819***	0.1662
	(0.0227)	(0.0241)	(0.0471)	(0.0568)	(0.0225)	(0.0227)	(0.0963)
sibl							-0.2637***
							(0.0271)
_cons	7.7367***	6.7516***	5.6234***	3.2240*	5.6081***	5.2828***	13.2670***
	(0.1905)	(0.3870)	(0.4444)	(1.2790)	(0.1812)	(0.3406)	(0.5730)
R^2	0.244	0.166	0.497	0.290	0.599	0.595	0.056
N	7265	7265	908	908	7260	7260	7265
F-stat.							93.9109

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6 Pre-government regressions. Dependent variables in the models are individual household-level pre-government income (model 1 and 2), the same variable for single households (model 3 and 4) and individual labour earnings (model 5 and 6). Education is dependent variable in model 7.

A thorough discussion on the possible biases in the OLS and the IV estimates for return to education can be found in Card (1999). He argues that, usually, there is an upward bias in both OLS and IV estimates, particularly in the IV estimates, that are often up to 20 percent higher than the OLS estimations. This gap between OLS and IV is consistent with our estimates (0.080 vs 0.105) when individual labour earnings is the dependent variable (see Table 7). However, when comparing our results with estimations studies of returns to education in Germany in particular, it is not clear

[9] For a discussion on the public-private wage differential, see for example Melly (2005)

which regression is closer to existing evidence as existing evidence is mixed. In IV regressions, different instruments relate different individuals to the endogenous variable. This can lead to different results, although all instruments are valid. Jochmann and Pohlmeier (2004) use IV regressions to estimate the returns to education, and their results range between 0.054 and 0.097, which shows that the results are sensitive to which instrument is used. Flossmann and Pohlmeier (2006) find returns ranging up to 0.11. Steiner and Lauer (2000) find that the return is 0.08 for men while women have one of 0.10. A more recent study that uses several different IV models with different family background variables as instruments finds the results that returns to education in Germany lies between 0.092 and 0.109 (Reilich 2013).

The RESET test does not rejects the null hypothesis of no non-linearities in neither the OLS (Ramsey-test) nor the IV model (Ramsey/Pesaran-Taylor), although the p-value is considerably lower for the IV model. This could indicate that there are non-linearities in education (which would not be unlikely due to the discussed separate education streams in Germany), that are reduced when using 2SLS. The Hausman test for endogeneity rejects the null hypothesis of no endogeneity in education. The F-test of the first stage regression of the 2SLS gives a value of 93.91, which is considerably above the rule of thumb-value of 10 for a good instrument, suggested by Staiger and Stock (1994), which means that the instrument most likely fulfils the relevance criterion. We conclude that both the OLS and the IV could be used as our income function. We use the IV model in the following analysis. Both education estimates are within conventional estimates on the returns to education in Germany, but the IV regression seems to reduce non-linearities.

Having discussed the chance of endogeneity in education, the possibility of endogeneity in the other factors should also be subject to discussion. In our case, endogeneity implies that income determinants pick up effects from the error-term, which, according to the principle of "benefit of the doubt", is a non-responsibility factor. Consequently, if the variable that becomes biased due to the endogeneity is a responsibility factor, the estimations of fictive incomes will become accordingly biased. This results in individuals being mistakenly held responsible for non-responsibility variables.

Annual working hours might be biased because skilled people might choose to work more if they know they are more productive, and consequently, the price of their leisure time is higher than that of less skilled people. Additionally, the coefficient might not reflect return to one hour worked

purely, because people that have worked full-time for a long time are more likely to get a wage (per hours) increase than individuals that only work part-time. The other point estimates might be subject to other selection biases. If average salaries in private sector are higher than in the public sector, people might be attracted to jobs in the private sector, and given that the most skilled people get these jobs, less skilled people will work in public sector, thus increasing productivity gaps between sectors. Similarly, on average, females and males might choose professions with certain wage properties, resulting in overrepresentation of males in some sectors, for example the financial sector and females in other sectors, such as the health sector. There might also be analogous selection biases in age and area of residence.

Although there may be reason to suspect endogeneity in the remaining variables, we only treat education as endogenous in our models. It is difficult to identify more than one causal question at the same time, which is why it is common to discuss primarily the effect of one variable on another, rather than trying to identify the causal effect of six factors simultaneously. When several variables are endogenous, it normally does not make sense to think of one endogenous variable as a "control variable" for another, or at least the result can be difficult to interpret. The relevance criterion becomes more complicated because we must rule out perfect multicollinearity in the population regressions (Stock and Watson, 2007). This means that including multiple endogenous variables in a regression requires that the instruments assigned must explain enough of the exogenous variation in these variables to distinguish their individual effects on the dependent variable.

5.3 The unfair income distribution

Recall from chapter 3.3 that the unfair income is estimated by subtracting fair income from actual income, while believed unfair income is estimated by subtracting fair income from believed income. The equivalent for actual inequality is estimated by subtracting the mean income from the actual income. Both the reference fair responsibility cut and the most frequent individual fair responsibility cut hold individuals responsible for education and hours worked (see chapter 5.1).

Cut	Responsible	Non-responsible
Actual (E)	Θ	E, H, G, A, R, S, ε
Fair (LE)	E, H	G, A, R, S, ε
Belief (L)	E, H, G, A, R, S	E

Table 7 The applied responsibility cuts in the following analysis. The egalitarian (E), the luck egalitarian (LE) and the libertarian (L) responsibility cut. Responsibility- and non-responsibility factors are education (E), hours (H), gender (G), age (A), area of residence (R) and sector (S).

The corresponding believed responsibility cuts hold individuals responsible for all six variables (see Table 7).

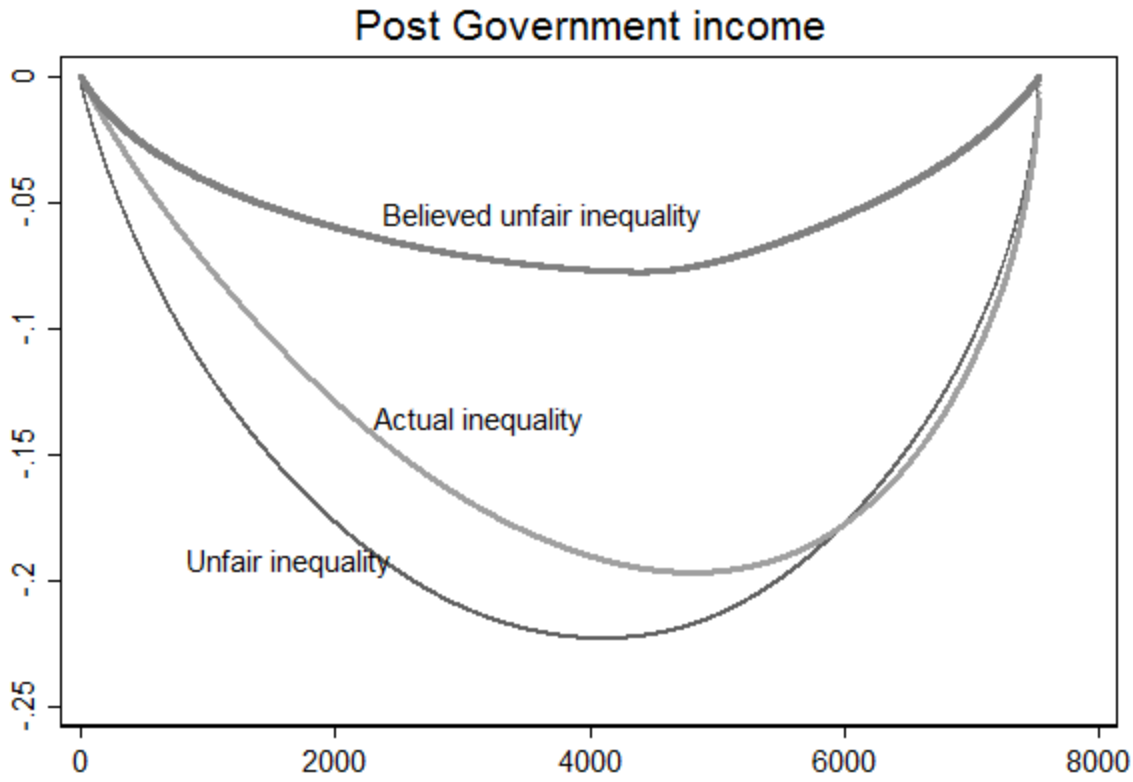
This chapter presents income distributions based on the established reference responsibility cuts and the income function determined in chapter 4.2. We present unfair income distributions based on post-government incomes, discuss the interpretation of the unexplained variation in the income function, and discuss the government's ability to redistribute according to fairness preferences by comparing unfair pre- and post-government income distributions. Furthermore, we follow the development in unfairness over time, and finally, present an alternative way of identifying a reference fairness cut.

5.3.1 Post-government income inequality

The generalised Gini index reveals that in Germany, unfair inequality (0.327) is higher than actual inequality (0.271) (see Table 8). This means that, given the fairness preferences to hold individuals responsible for education and hours worked, unfair inequality is greater than actual inequality. In other words, there is more income in inconsistency with the fairness preferences for income, than there is income in inconsistency with a perfectly egalitarian distribution, where everyone has identical incomes. However, this conclusion requires a uniform weighting of inequality. Since the Lorenz curves cross, there is no Lorenz dominance and hence no robust ranking of the two distributions (see Figure 5).[10] It might seem counterintuitive that holding individuals responsible for some types of inequality increases the inequality. Nevertheless, this finding is in accordance with the findings of Almås (2008), who finds that the unfair inequality in Germany is higher than the actual inequality, although measuring a smaller increase. The standard Lorenz curve is skewed towards the right, indicating that the number of individuals earning more than the average income is smaller than the number of individuals earning less than the average income. The unfairness Lorenz curve has a lesser skew, indicating that an approximately equal number of individuals are over- and underpaid when only respecting their years of education and hours worked (see Figure

Figure 5 Difference-based Lorenz curves for believed unfair inequality, actual inequality and unfair inequality in post-government income.

[10] This means that there exists other inequality measures, in this case assigning more weight to the largest positive deviations, which would make the actual inequality more unequal than the unfair inequality.



5). The difference between actual and unfair inequality is constituted by the difference in non-responsibility factors, which for actual inequality correspond to all income factors, and for unfair inequality equals all factors except education and hours worked (see Table 7 and eq. (5) & (6)) Thus, the change in inequality is driven by unfair compensations for individuals' education and hours worked, and, due to the skew, especially individuals earning too little according to their characteristics in these variables.

The believed unfair income represents the deviation between the believed and fair incomes, i.e. between income according to the believed (libertarian) responsibility cut, and income according to the fair (luck egalitarian) cut. The believed unfairness Gini is 0.095, strikingly lower than the unfairness Gini. The level of believed unfairness is lower for all unfairness measures, such that we may robustly conclude that there is more unfair inequality than believed unfair inequality. This means that, given the respondents' fairness preferences, individuals believe there is less unfair inequality than there actually is.

These findings correspond to those of Norton and Ariely (2011), who identifies the actual, believed and fair income distributions by asking respondents to assign shares of total wealth to quantiles of the population. Similar to us, they find a deviation between what people think is a fair distribution and believe is the actual distribution, which in our case is measured by the believed unfairness Gini. Additionally, parallel to our significant deviation between (actual) unfair inequality and believed unfair inequality, they find a deviation between actual inequality and believed inequality. Thus, they support our finding that people are downward-biased in their perception of (in our case, the unfair) inequality.

Aiming at addressing such deviations between perceptions and reality, Benabou and Tirole (2006) discusses how people convince themselves that the world is more fair than what it actually is. They find an upward bias in the extent to which people think they can influence the world in a predictable way. This bias arises because it is in people's interest to tell themselves that their efforts will pay off, because this will eventually increase their final output, although perhaps not as much as they expect. However, as discussed in the next section, given our reference believed responsibility cut, the entire difference between unfair inequality and believed unfair inequality is determined by the error term, which might modify the deviation.

Gini	Post-government income
Actual	0.271
Unfair	0.327
Believed unfairness	0.095

Table 8 Gini coefficients for the actual/standard Gini, the unfairness Gini and believed unfairness Gini.

5.3.2 Unexplained variation

Since we do not know whether respondents would hold individuals responsible for the error term, we excluded it from the responsibility variables in the measure of unfair inequality, following the principle of "benefit of the doubt". This principle states that individuals should not be held responsible for variation for which we do not have an explanation nor precise measure. This is somewhat related to the law principle of presumption of innocence until there is evidence to think otherwise, applied as a presumption of non-responsibility when there is no identified cause. Both Almås (2008) and Devooght (2008) argue in favour of excluding the error term from the set of responsible factors.

Respondents' views on the inclusion of the error term in the fairness set is likely to be influenced by views on what the term contains. If the income function point estimates capture the causal relationships for all relevant responsibility variables, then the error term would only include non-responsibility factors. However, if causality is questionable, or if the term contains additional unknown but would-be responsible factors, then individuals should be held responsible for at least a part of the error term. For example, we do not have a direct measure of ability (albeit an indirect one, education), so it is likely that the income effect of ability is at least partially contained in the error term. Almås (2008) underlines the large variations in results when including and not including the error term as a responsible variable, and notes that the ranking of unfairness in different countries and under different responsibility cuts change depending on whether the error term is held as responsible.

There is no direct belief-equivalent to the principle of benefit of the doubt. However, we suggest that the underlying notion could be transferred to a similar principle. If respondents are presented to all factors documented to have an influence on income, individuals guiding their beliefs by evidence would have no reason to believe there existed additional factors influencing income. Note that it is not required that the factors presented to respondents perfectly describe income in the income function, but only that it describes all reported and published effects on income. This principle, which we can term the principle of evidence-based belief, presumes full knowledge of documented effects on income, and a corresponding set of at least all evidence-supported income factors in the questionnaire.

Arguing against including the error term in the believed responsibility set, individuals are perhaps likely to think there might always be other factors influencing income than those presented. In our case, we find it likely that respondents might think a factor like ability is not fully represented by the presented variables. Individuals might also believe in luck, which would likely be partially contained in the error term. From the belief data, we find that 53 percent of respondents believe in luck as an important determinant of income. However, the average and thus reference answer on belief in luck is 5.542, slightly above the cut-off, thus rendering luck a non-responsibility variable.

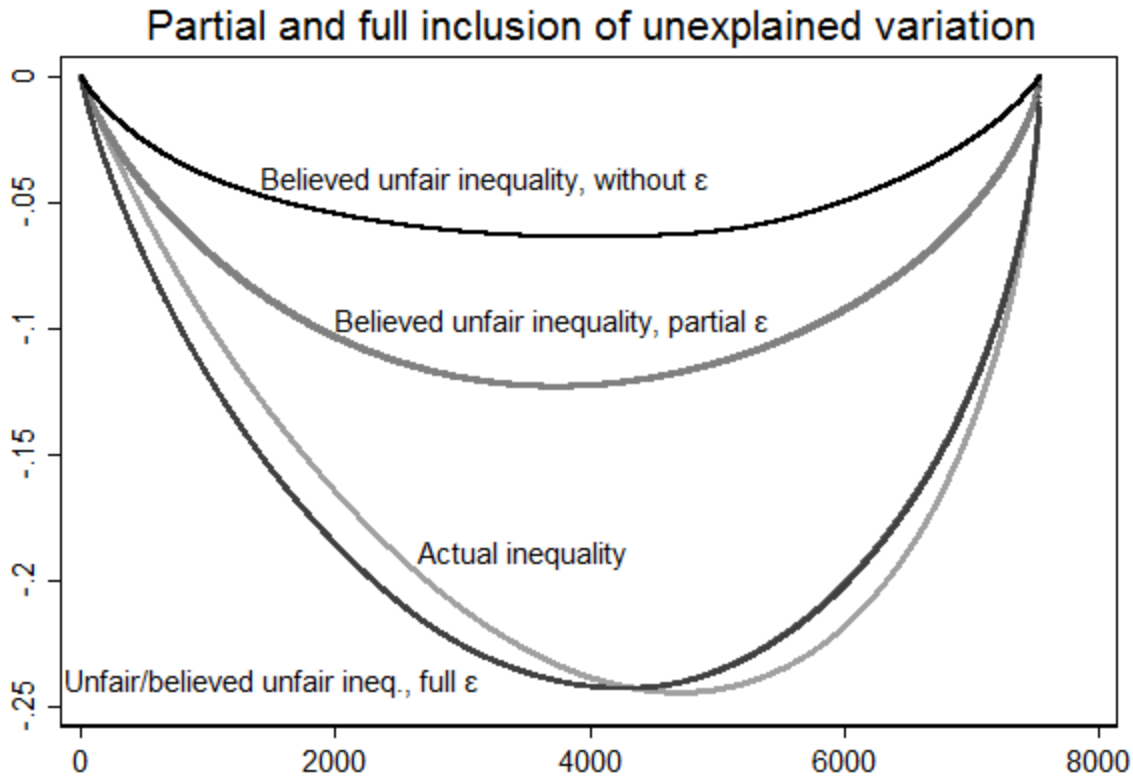


Figure 6 Difference-based Lorenz curves for actual, unfair and believed unfair inequality for pre-government income. We include graph where the error term is excluded from the believed income, one graph where 50 percent of it is included, and one where the entire term is included, which makes the unfair and the believed unfair Lorenz curves identical. For this effect to be clear, it was necessary to use the same income variable in the income function estimation as in the Gini estimation, so the income function in this sub-section is based on the natural logarithm of household-level pre-government income.

Since we do not have respondents' answers on whether (or how much of) the error term they think should be included, we estimate a believed unfair income distribution including half of the error term (see Figure 6). Including the entire error term in the estimation of believed income makes the believed unfairness Lorenz curve identical to the unfairness Lorenz curve.

5.3.3 Unfair redistribution

As Almås et al. (2011) points out, a progressive tax system may have two opposing effects on unfairness. On the one hand, it may reduce economic inequality between individuals who are identical with the respect to responsibility factors. On the other hand, it may reduce fair inequality between individuals who differ with the respect to responsibility factors (ibid.). From pre- to post-government, the actual inequality Gini is reduced from 0.340 to 0.271, a noteworthy reduction of 0.069 (see Table 9). The unfairness Gini is reduced by 0.028 from pre- to post-government income, which is less than half of the reduction in actual inequality. This means that the German tax system

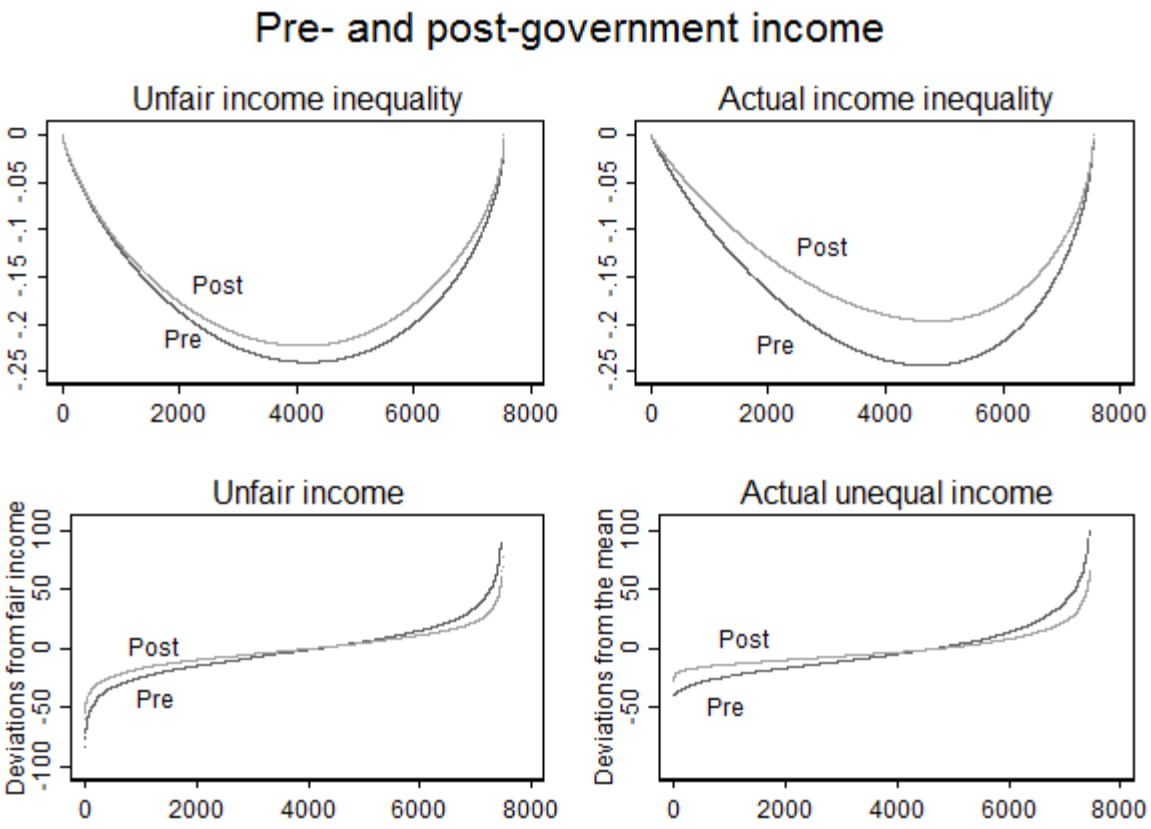


Figure 7 Pre- and post-government actual and unfair income distributions, Lorenz curves (upper) and non-cumulative graphs measuring individual unfairness, ranked from smallest to largest (lower) (some few extreme observations are excluded to see the variation within the majority of individuals)

redistributes income in a way that partly eliminates unfair economic inequality between individuals who are identical with the respect to years of education and hours worked. However, the reduction in actual inequality is consistently higher than the reduction in unfair inequality (still assuming equalised weighting of unfairness). This indicates that a significant share of the German tax system does not address the relevant inequality as perceived by the population. The tax system is more in line with the egalitarian responsibility cut than the luck egalitarian responsibility cut.

Gini	Pre-government	Post-government
Standard	0.340	0.271
Unfairness	0.355	0.327
Believed unfairness	0.095	

Table 9 Pre- and post-government Ginis

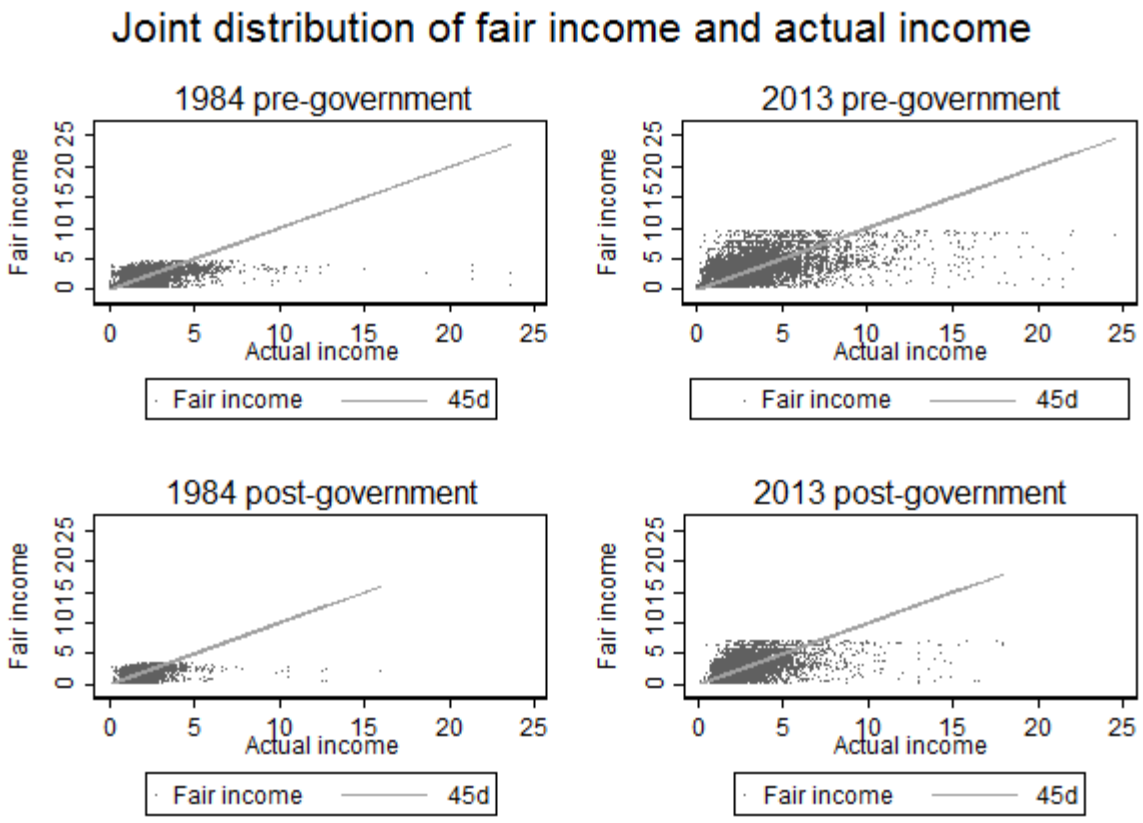


Figure 8 The joint distribution of fair incomes and actual incomes in 1984 and 2013, CPI-adjusted. The figure relates each individual's actual income to his or her fair income (in thousands of euro). The observations with the top 5 incomes in the upper right figure are excluded. Sample sizes are similar for each year, such that when the observations cover a small area it means that many individuals have similar incomes.

The believed unfairness Gini is the same for both pre- and post-government income distributions since the fair and the believed count is estimated from the same regression point estimates in both the pre- and post-government case.[11]

Both Lorenz curves and a non-cumulative presentation of the pre-and post-government actual and unfair income inequality are included (see Figure 7). In the upper panels, the post-government graphs are flatter than the pre-government graphs, which shows that both actual and unfair post-government inequality than the pre-government inequality. Since the Lorenz curves do not cross, we have a robust conclusion that the pre-government distributions are less uniform than the post-government distributions.

[11] For believed unfairness, the transition from pre- to post-government income is only a question of scaling, for which the Gini is invariant.

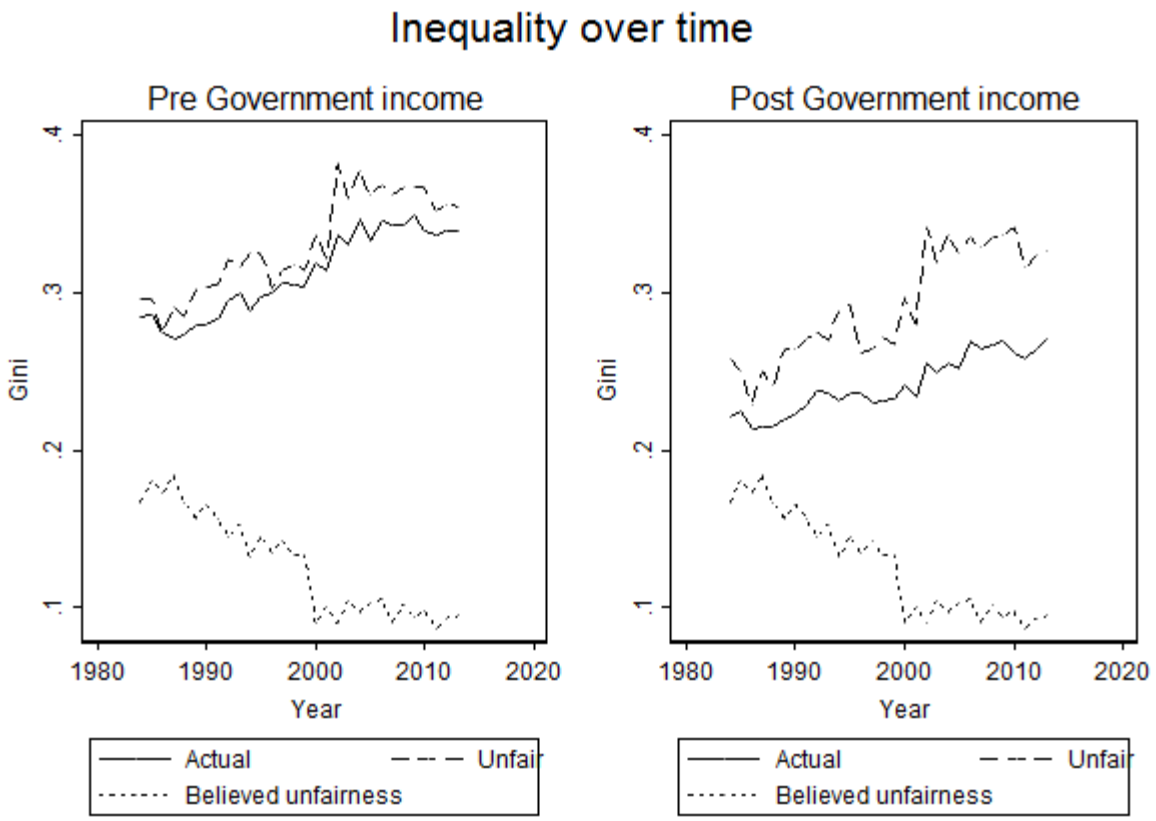


Figure 9 Inequality over time from 1984 to 2013. The figure shows Ginis for actual, fair and believed income

5.3.4 Unfairness over time

We analyse both pre- and post-government income in Germany from 1984 to 2013. Before determining the aggregated level of unfairness, we look at the individual-level unfairness by comparing the joint distribution of fair income and actual income pre- and post- government intervention in 1984 and 2013 (see Figure 8). The variation in both fair and actual incomes increase over time, illustrated by increased dispersion along both the y-axis and the x-axis in 2013 relative to 1984. The clusters move up and to the right over time, indicating a higher average fair income as well as a higher average actual income. Along the x-axis, the post-government distributions are more concentrated than the pre-government distribution, indicating an equalising effect of the redistribution for both years.

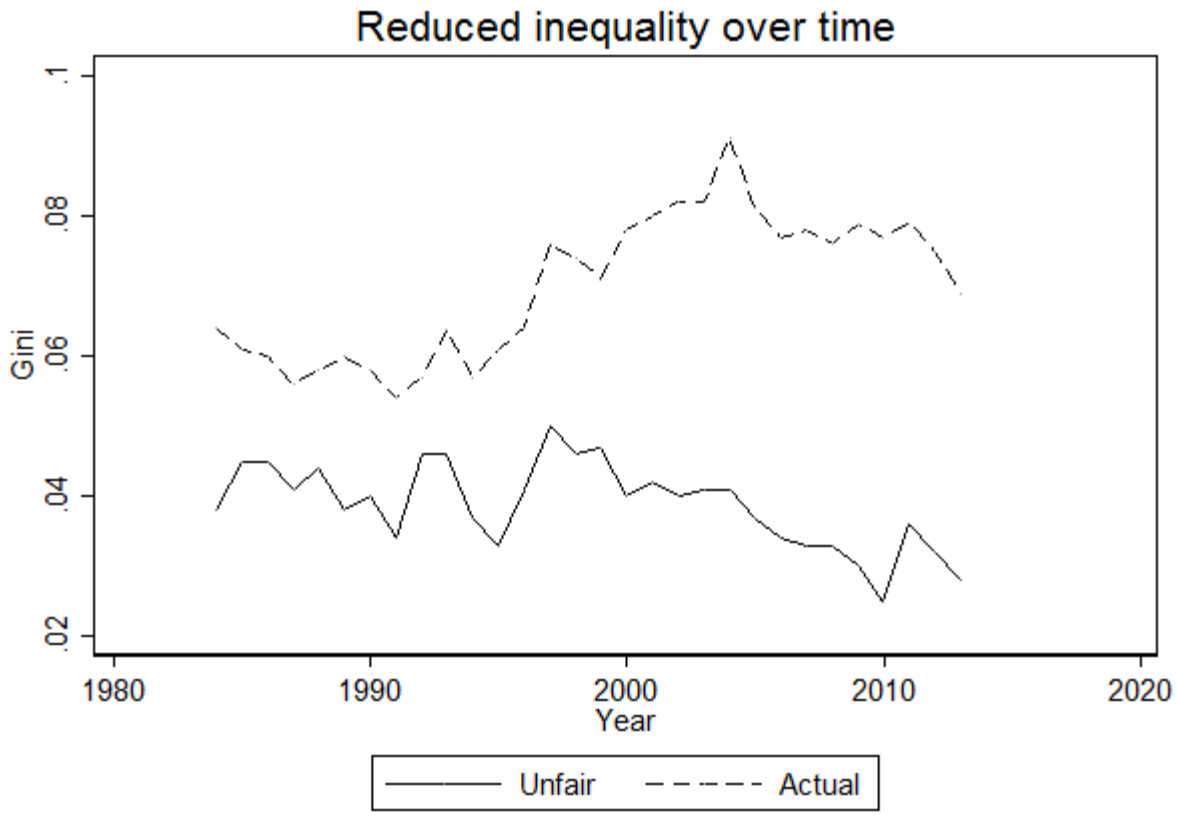


Figure 10 Reduction of unfair and actual inequality from 1984 to 2013, measured as pre-government Gini subtracted by post-government Gini

We estimate unique OLS regressions with robust standard errors for every year from 1984 to 2013 (see Appendix 9). Equalized weighting of unfairness is assumed. shows that the pre-government unfairness Gini increased from 0.296 in 1984 to 0.355 in 2013, while the pre-government standard Gini increased from 0.285 to 0.340 over the period. This equals an increase of 19.9 percent for the unfairness Gini, and 19.3 percent for the standard Gini.

Over the last years, there has been increased focus on the accumulation of top earnings in several countries (Atkinson et al., 2011; Almås et al., 2011). In this sample, the top percentile accounted for 5.69 percent of the total pre-government income in 2013, while the corresponding number for 1984 is 4.57 percent. If we rescale the top percentile in 2013, so that its share of total income in 2013 equals its share of total income in 1984, the standard Gini drops to 0.336 and the unfairness Gini drops to 0.351.

The pre-government believed unfairness Gini is reduced by 57 percent over the period, from 0.167 in 1984 to 0.095 in 2013. This indicates that people think there is considerably less unfairness in

2013 than in 1984, even though the unfair inequality has increased by 19.9 percent. Notably, the fluctuations in the believed unfairness Gini is greater than those in the remaining Ginis. The reason is that believed unfair income is determined independent of the error term, as opposed to unfair income, where the error term is contained in actual income. Consequently, believed unfair income will be more volatile to changes in the responsibility factors.[12]

The increase in unfair inequality can partially be explained by greater variations in hours worked, as the standard deviation in annual hours worked has increased with 10 percent. However, other variables still play a major role. For most levels of hours worked in 2013, it would be fair for one person to earn two and a half times as much as another person who worked the same number of hours, due to the variation in other variables and unexplained variation (similar to what Almås et al. (2011) finds). Notably, the reduced income associated with females relative to males has decreased from 13.7 percent on average in 1984, to 10.8 percent in 2013. Since gender is a non-responsibility factor, this reduction may have reduced the unfairness Gini.

Observing the reduction in unfair and actual inequality, it is clear that the finding in previous sub-section that the actual reduction in unfairness is greater than the reduction in unfairness, is consistent for all years between 1984 and 2013 (see Figure 10). The gap between the reduction in actual inequality and the reduction in unfair inequality was semi-parallel until the end of the 90s, when they started diverging. For the latest 5-10 years, it is unclear whether the graphs have been converging, diverging or moving parallel.

5.3.5 Alternative reference responsibility cuts

The mode fairness responsibility cut, which in this analysis represents the reference fair responsibility cut, is held only by 20 percent of the sample, meaning that 80 percent of the sample does not directly agree with the luck egalitarian Gini. We construct an alternative reference Gini by subtracting a share of the income function coefficients, which corresponds to the share of respondents who think that an individual should not be held responsible for the respective variables (see Table 3 in NRS analysis). Given this method of identifying a reference fair responsibility cut, the post-government unfairness Gini is 0.302, compared to 0.327 under the reference cut as defined in the preceding analysis (see Table 10). For pre-government, the unfairness Gini is 0.336 under

[12] Believed income (libertarian) will therefore fluctuate with changes in all six factors, while fair income (luck egalitarian) will fluctuate with changes in years of education and number of hours worked

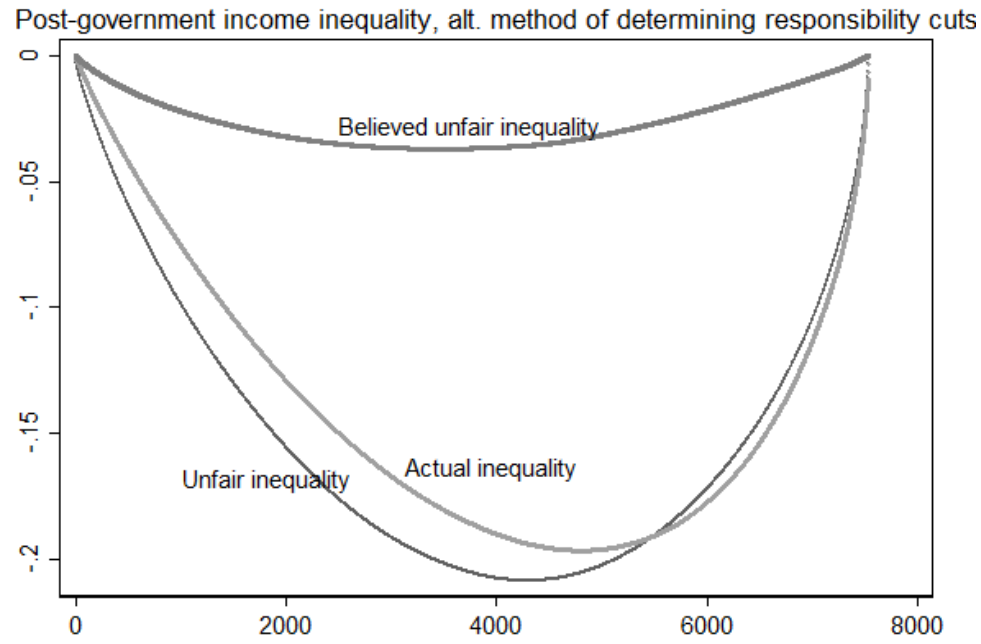


Figure 11 Difference-based Lorenz curves for post-government actual, unfair and believed unfair inequality. Responsibility cuts are identified using an alternative method than in the rest of this thesis.

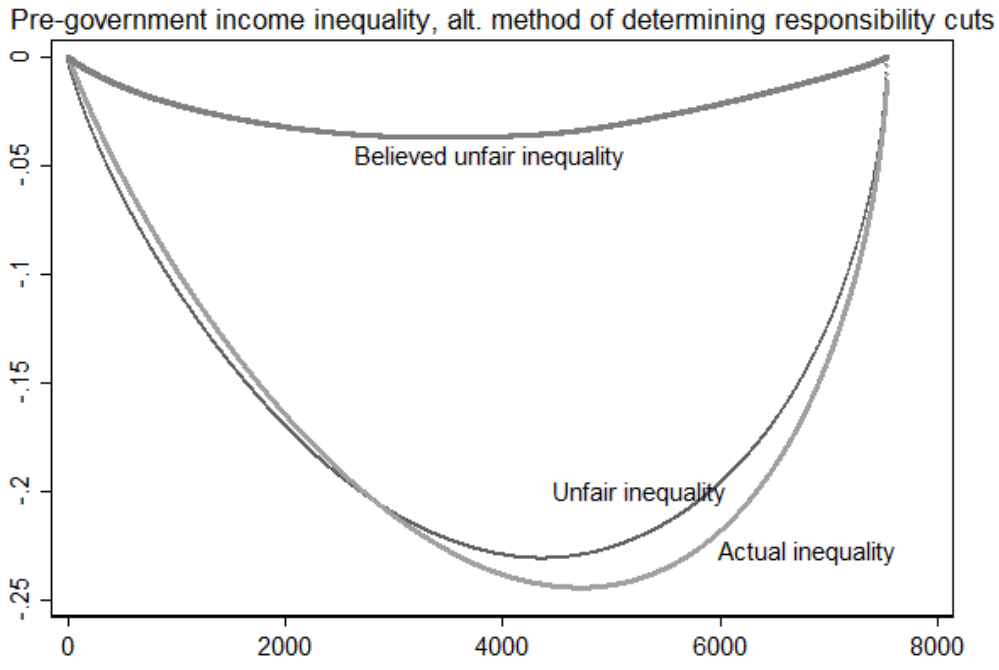


Figure 12 Difference-based Lorenz curves for pre-government actual, unfair and believed unfair inequality. Responsibility cuts are identified using an alternative method than in the rest of this thesis

Gini	Pre-government	Post-government
Standard (unchanged)	0.340	0.271
Unfair (alt.)	0.336	0.302
Unfair (old)	0. 355	0. 327
Believed unfairness (alt.)	0.051	
Believed unfairness (old)	0.095	

Table 10 Gini coefficients illustrating how the Gini is sensitive to how the method of identifying a reference responsibility cut

the alternative cut, compared to 0.355 above. Notably, for pre-government income, unfair inequality is larger than actual inequality under the references cut above, while actual inequality is larger than unfair inequality under the alternative cut. This illustrates that the ranking of inequality is sensitive to the method of identifying a reference responsibility cut. This conclusion is given equalised weighting of unfairness. Since both the pre-government and the post-government Lorenz curves cross, there is no robust ranking of the Ginis (see and Figure 12).

6 Limitations and discussion

6.1 Unexplained variation revisited

The error term in our income function accounts for more than 60 percent of the variation in income. Addressing heterogeneity in the variables could reduce the error term, and improve the measurement of unfairness. One way to do so is to identify marginal returns to a factor, such as returns to different numbers of years of schooling, and different levels of hours worked. There might also be heterogeneity in returns to different sub-sections of a factor, such as fields of study and work, and heterogeneity in quality or efficiency, such as differences in a person's average return to an hour's work.

As our model specification is relatively simple, there is likely to be unspecified heterogeneity in the variables, contained in the error term. However, specifying additional variables has a limited potential. In a heterogeneous population, people are not identical in terms of income and characteristics. Thus, it is likely that even after including all thinkable variables, there would still be unexplained variation, which could not be identified further without merely estimating the individual effects of each person being him- or herself. Hence, whether to include the error term remains an important issue in the fairness debate.

The fair return from a factor is defined as the average return of that factor. Therefore, all deviations from the average return will be captured in the error term, and will be measured as unfair. In this model specification, we do not specify sub-categories such as different fields of study and work that is associated with different income levels. Measuring this unspecified heterogeneity as unfair could therefore be seen as an egalitarian trait of this model implementation.

It is not given that the heterogeneity captured in the error term is deemed as either fair or unfair. Asking respondents to evaluate whether or to which extent the error term should be included would improve the measurement of unfairness. It could be interesting to present respondents to a greater range of variables addressing the heterogeneity in the factors, as well as whether the remaining unspecified heterogeneity should be included. As seen in section 5.3, the inclusion of the error term would reduce the gap between actual and fair income. Additionally, if the error term is included in the believed income and not in the fair income, believed unfair inequality and unfair inequality would become identical. We follow the principle of "benefit of the doubt" as applied in Almås

(2008) for the fairness responsibility cuts. We suggest a similar principle of evidence-based beliefs, arguing that it may be reasonable to assume that respondents do not think individuals are held responsible for unspecified effects, thus excluding the unexplained variation in the believed responsibility cuts.

If the principle of evidence-based beliefs is valid, the main challenge is to estimate a more precise income function. However, if we have reasons to suspect that it does not hold, we should ask respondents whether to hold individuals responsible for the error term. If they think it should be a responsibility factor, we can exclude that they rely on documented evidence only when defining their beliefs. In this case, one should expand the range of variables in the survey to contain all possible variables that respondents might think affect income.

6.2 Level of income measurement

Defining the level of income measurement may have large implications for estimation results, and affects both the Gini coefficients and the interpretations of it. When we estimate the German Ginis based on individual labour income, we find a lower level of unfair inequality, while in our main estimation above we use individual household income, finding higher unfair inequality than actual inequality (see Appendix 10).

In the individual household-level approach, all individuals in a household are assumed to equally share the total amount of household income. Consequently, income not only from the labour market, but also from the household, is included in individuals' income, thus redistributing income within the household. This within-household redistribution would reduce unfair income inequality in a household where one person is underpaid and the other is overpaid according to their responsibility characteristics. It would also increase unfair inequalities when equalizing incomes between household members that differ in responsibility variables. For example, a person of low labour income living together with a person of high labour income will dispose a much higher individual income than she earns herself, given a shared economy within the household. If this person has low education as well, she will be evaluated as overpaid given the reference fairness cut. Thus, the approach in this paper does not measure sole labour market inequalities, but rather a broader measure of individual consumption. If the labour market effects were the unfairness subject of interest, it would be better to use individual labour earnings to represent actual income in the estimation of unfair income.

Whether it is reasonable to include income from the household in individuals' income is in part a question of how to define income. If income is extended to include income from the household, perhaps labour should be extended to include non-market labour in the household as well. For example, if there is an unequal division of labour market participation in a household, perhaps there is also an unequal division of non-market labour within the household, such as housekeeping, which is not included in the income measure. This could create an upward bias in unfair income from the household for the domestic worker, as he would work more hours and create more value than what is registered. One approach could be to price in the market value of domestic work, and count hours worked domestically in the personal characteristics.

Differences in labour market outcomes and individual household outcomes seems like complimentary measures, both relevant to understanding inequalities in outcomes and opportunities between individuals.

7 Conclusion

The standard measures of economic inequality are not in accordance with the way people tend to think about inequality. People seem to accept inequalities from some sources of income, while rejecting inequalities from other sources. Standard measures of inequality does not allow for such a differentiation. Introducing fairness views and beliefs about how factors affect income in the measurement of economic inequality, the approach applied in this thesis provides researchers and decision-makers with a tool to discuss economic inequality and unfairness quantitatively.

To our knowledge, this is the first application of surveyed fairness views in the framework of Almås et al. (2011) to determine unfair inequality. We generalise the difference-based Gini and Lorenz framework developed by Almås et al. (2011), to allow for *believed unfair* inequality in addition to unfair and actual inequality. Furthermore, we suggest a principle of evidence-based beliefs legitimising the exclusion of the unexplained variation.

We find that the prevailing responsibility cut holds individuals responsible for education and hours worked. We find evidence suggesting that this responsibility cut corresponds to the luck egalitarian fairness theory. The corresponding *believed* responsibility cut holds respondents responsible for all the six variables questioned.

We find that, given a uniform weighting of unfair income, the level of unfair income inequality in Germany is greater than the actual income inequality. This means that there is more income in discordance with the fairness preferences for income, than there is income in discordance with a perfectly equal distribution of income. We find that redistribution reduces more actual inequality than unfair inequality, and that this gap has increased over the last thirty years. Since 1984, unfair inequality has increased even more than actual inequality. Additionally, we find that believed unfair inequality is considerably lower than unfair inequality. This difference is, under the given responsibility cuts, fully contained in the unexplained variation. We find that the measured level of believed unfair inequality is sensitive to the inclusion of the error term. This corresponds to the findings of Almås (2008) for unfair inequality.

The differences between unfair, believed unfair and actual inequality illustrates the relevance of including fairness views and beliefs in the discussion on economic inequality. Public policy-makers may take this into account when discussing redistributive policies, and may consider unfairness on

household-level as well as in labour market outcomes. Future research may address heterogeneity issues in the income function estimation, and identify fairness views on how to include the unexplained variation in the estimation of unfair economic inequality.

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9 Appendix

A.1 Survey questions

It is fair that [variable] plays an important part in determining a person's income level							It is *not* fair that [variable] plays an important part in determining a person's income level		
1	2	3	4	5	6	7	8	9	10

1 indicated that the respondent completely agreed with the statement on the left-hand side, while 10 indicated that the respondent completely agreed with the statement on the right-hand side. The second part of the survey asked about respondents' descriptive views on the relationships between a factor and a person's income level:

[Variable] play an important part in determining a person's income level							[Variable] *does not* play an important part in determining a person's income level		
1	2	3	4	5	6	7	8	9	10

where [variable] is:

- Hours worked per week
- Age
- Education
- Gender
- Labor sector (private/public)
- Geographic location (urban/rural)

Additional questions applied in this thesis, stated in the similar manner as those above:

- It is fair/it is not fair if luck plays an important role in determining a person's income
- Luck plays/does not play an important role in determining a person's income
- Economic growth is good/not good

A.2 Variable descriptions

Variable	Description
Pre-government income	Total income from labour earnings, asset flows, private retirement income and private transfers.
Post-government income	Labour earnings, asset income, private transfers, public transfers, social security pensions and private retirement income on household level, minus total household taxes.
Education	Years of education, counting from first year of primary school
Hours	Annual labour hours
Hours2	Annual labour hours squared
Age	Age of individual
Age2	Age of individual squared
Public	Dummy; 1 if employed in public sector
Rural	Dummy; 1 if living more than 25 km from metropolitan area
Gender	Dummy; 1 if female

Table 11 Variable descriptions

A.3 Complete list of responsibility cuts for preferences and beliefs

Responsibility variable	Frequency (%)	
	Preferences	Belief
Θ [empty]	7.2	3.5
G	0.4	0.9
H	6.4	0.5
E	2	0.4
A	0.4	0.6
R	0.5	0.8
P	0.4	0.5
GH	0.1	0.1
GE	0.2	0.4
GA	0.2	0.2
GR	0.4	0.3
GP	0.2	0.4
HE	20.1	0.9
HA	1.8	0.1
HR	0.8	0.2
HP	1.1	0.3
EA	0.4	0.1
ER	0.4	0
EP	0.2	0.2
AR	0.5	0.3
AP	0.2	0.2
RP	0.5	0.4
GHE	1.4	1
GHA	0.1	0.4
GHR	0	0.1
GHP	0.3	0.1
GEA	0.1	0.1
GER	0	0.3
GEP	0	0.6
GAR	0.2	0.4
GAP	0.1	0.4
GRP	0.2	1.4
HEA	9	0.4
HER	2.6	0.4
HEP	3.9	0.7
HAR	0.3	0.5
HAP	0.8	0.3
HRP	0.5	0.7
EAR	0.3	0.2
EAP	0.2	0.3
ERP	0.5	0.2
ARP	0.8	1.3
GHEA	0.7	1
GHER	0.1	0.8
GHEP	0.3	1
GHAR	0	0.7
GHAP	0.4	0.8
GHRP	0.2	1.1
GAER	0.1	0.5
GEAP	0.1	0.8
GERP	0.3	0.9
GARP	0.7	4
HEAR	4	0.7
HEAP	3.3	1.1
HERP	2.2	0.7
HARP	0.8	1.9
EARP	0.5	0.6
GHEAR	0.5	1.2
AHEAP	0.5	2.9
GHERP	0.6	2.4
GHARP	0.2	9.1
GEARP	0.3	5.7
HEARP	7.4	3.3
EAHPRG	11.1	37.7
SUM	*100*	*100*

Table 12 Complete list of responsibility cuts for preferences and beliefs. G=Gender, H=Hours worked, E=Education, A=Age, R=Area of residence (rural/urban), P=Sector of labour (public/private)

A.4 Regressions for characteristics associated with the LE responsibility cut

Luck egalitarian

	(1) le	(2) le	(3) le	(4) le
Luck_not_play_role	0.0137**	0.0129*		0.0107
	(0.00512)	(0.00584)		(0.00586)
Hardwork_not_play_role	0.00178	0.00305		0.00508
	(0.00609)	(0.00688)		(0.00688)
Talent_not_play_role	-0.0162*	-0.0115		-0.00720
	(0.00713)	(0.00813)		(0.00827)
Resp_age		0.00160		0.00146
		(0.00117)		(0.00118)
Resp_sex		0.0751*		0.0714*
		(0.0298)		(0.0296)
Urban		0.0666*		0.0678*
		(0.0295)		(0.0294)
Resp_pretaxinc.		0.000264		0.00101
		(0.00445)		(0.00443)
Resp_high_edu		0.0637*		0.0679*
		(0.0311)		(0.0309)
Resp_hoursworked		-0.000114		-0.000307
		(0.00106)		(0.00106)
Growth_not_good			-0.0266***	-0.0256**
			(0.00674)	(0.00802)
Ineq._not_good_for_growth			0.00589	0.00995
			(0.00597)	(0.00676)
_cons	0.181***	0.0106	0.246***	0.0275
	(0.0379)	(0.0793)	(0.0331)	(0.0864)
N	1000	772	1000	772
R^2	0.012	0.034	0.015	0.047

Table 13 Regression analysis for "luck egalitarian" respondents. Bluck is belief in luck as determining for income on a scale from 1-10 where 1 is the most agreeing, bhardwork is belief in hard work, btalent is belief in talent, rage is respondent's age

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

A.5 Regressions for characteristics associated with the EG responsibility cut

Egalitarian

	(1) eg	(2) eg	(3) eg	(4) eg
Luck_not_play_role	0.00575	0.00810*		0.00858*
	(0.00327)	(0.00386)		(0.00387)
Hardwork_not_play_role	0.0110**	0.0130**		0.0114*
	(0.00389)	(0.00454)		(0.00455)
Talent_not_play_role	0.00813	0.0109*		0.00724
	(0.00456)	(0.00537)		(0.00546)
Resp_age		0.000905		0.00121
		(0.000774)		(0.000778)
Resp_sex		0.00460		0.00616
		(0.0197)		(0.0196)
Urban		0.0262		0.0249
		(0.0195)		(0.0194)
Resp_pretaxinc.		-0.00370		-0.00381
		(0.00294)		(0.00293)
Resp_high_edu		-0.00913		-0.0109
		(0.0205)		(0.0204)
Resp_hoursworked		0.00111		0.00124
		(0.000701)		(0.000699)
Growth_not_good			0.0184***	0.0149**
			(0.00432)	(0.00530)
Ineq._not_good_for_growth			0.00746	0.00393
			(0.00383)	(0.00446)
_cons	-0.0371	-0.132*	-0.0156	-0.189***
	(0.0242)	(0.0524)	(0.0212)	(0.0570)
N	1000	772	1000	772
R^2	0.028	0.048	0.027	0.061

Table 14 Heterogeneity analysis for "egalitarian" respondents

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

A.6 Regressions for characteristics associated with the L responsibility cut

Libertarians

	(1) lib	(2) lib	(3) lib	(4) lib
Luck_not_play_role	-0.0217***	-0.0285***		-0.0259***
	(0.00397)	(0.00467)		(0.00466)
Hardwork_not_play_role	-0.00969*	-0.00895		-0.0104
	(0.00473)	(0.00550)		(0.00548)
Talent_not_play_role	0.00735	0.00495		0.00212
	(0.00553)	(0.00651)		(0.00658)
Resp_age		-0.000322		-0.000385
		(0.000937)		(0.000937)
Resp_sex		-0.0483*		-0.0446
		(0.0238)		(0.0236)
Urban		-0.0101		-0.0106
		(0.0236)		(0.0234)
Resp_pretaxinc.		-0.00644		-0.00739*
		(0.00356)		(0.00353)
Resp_high_edu		-0.0259		-0.0303
		(0.0248)		(0.0246)
Resp_hoursworked		0.000327		0.000486
		(0.000849)		(0.000841)
Growth_not_good			0.0227***	0.0228***
			(0.00526)	(0.00638)
Ineq._not_good_for_growth			-0.0166***	-0.0172**
			(0.00465)	(0.00538)
_cons	0.242***	0.374***	0.129***	0.399***
	(0.0294)	(0.0634)	(0.0258)	(0.0687)
N	1000	772	1000	772
R^2	0.032	0.064	0.025	0.087

Table 15 Heterogeneity analysis for "libertarian" respondents

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

A.7 Frequency distribution for preferences for economic growth

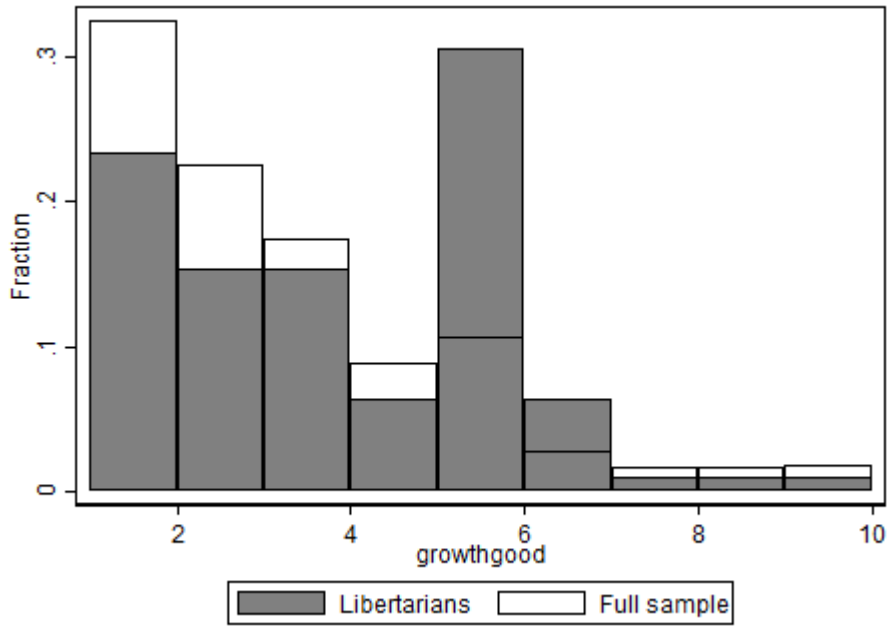

Figure 13 Preferences for economic growth, full sample (n=1000) vs "libertarians"(n=111). Low numbers indicate a preference for economic growth, while high numbers indicate aversion against economic growth.

A.8 Regressions for responsibility cuts associated with preference for luck

Luck and fairness cuts

	(1) LE b/se	(2) LIB b/se	(3) EG b/se	(4) ehp b/se	(5) ehr b/se	(6) ehpr b/se	(7) allehpr b/se	(8) nallehpr b/se
Luck_nf	0.0280***	-0.0375***	0.0017	0.0041	0.0006	-0.0005	0.0321***	0.0042
	(0.0045)	(0.0042)	(0.0032)	(0.0021)	(0.0022)	(0.0018)	(0.0053)	(0.0035)
Luck_ni	0.0036	-0.0121***	0.0062	-0.0050*	0.0010	-0.0014	-0.0018	-0.0054
	(0.0049)	(0.0036)	(0.0036)	(0.0022)	(0.0023)	(0.0019)	(0.0057)	(0.0036)
Rgender	0.0801**	-0.0404*	0.0081	-0.0171	-0.0034	0.0208*	0.0804**	0.0003
	(0.0247)	(0.0185)	(0.0164)	(0.0121)	(0.0102)	(0.0094)	(0.0281)	(0.0179)
R_age	0.0017	-0.0008	0.0004	0.0002	-0.0001	-0.0001	0.0017	0.0000
	(0.0010)	(0.0007)	(0.0007)	(0.0004)	(0.0004)	(0.0003)	(0.0011)	(0.0006)
R_res	0.0074*	0.0018	-0.0012	-0.0009	-0.0014	-0.0008	0.0043	-0.0031
	(0.0029)	(0.0020)	(0.0020)	(0.0015)	(0.0011)	(0.0010)	(0.0033)	(0.0021)
R_area	0.0060	-0.0031	0.0000	0.0035	0.0020	0.0015	0.0130	0.0070
	(0.0071)	(0.0050)	(0.0046)	(0.0030)	(0.0025)	(0.0021)	(0.0078)	(0.0043)
Rincom	0.0006	-0.0055**	-0.0022	0.0015	0.0004	0.0008	0.0034	0.0027
	(0.0025)	(0.0018)	(0.0016)	(0.0011)	(0.0010)	(0.0009)	(0.0028)	(0.0017)
R_urban	0.0481	0.0033	0.0049	0.0199	-0.0220*	-0.0139	0.0322	-0.0159
	(0.0253)	(0.0188)	(0.0172)	(0.0126)	(0.0095)	(0.0094)	(0.0285)	(0.0178)
_cons	-0.3528***	0.5703***	0.0150	0.0078	0.0567	0.0214	-0.2669**	0.0859
	(0.0767)	(0.0731)	(0.0486)	(0.0355)	(0.0339)	(0.0232)	(0.0867)	(0.0532)
R^2	0.063	0.135	0.008	0.015	0.008	0.010	0.053	0.012
N	1000	1000	1000	1000	1000	1000	1000	1000

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 16 Regressions for responsibility cuts associated with preference for luck. "nf" stands for "not fair" and "ni" stands for "not important". R indicates that the characteristic belongs to the respondent.

The dependent variables are dummies that takes the value of 1 when the respondent holds the following responsibility cuts.

Responsibility variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model8
Θ (empty)			■					
EH	■						■	
EHP				■			■	■
EHR					■		■	■
EHPR						■	■	■
EHPRGA		■						

A.9 Unique regressions for each years from 1984 to 2013

Pre Government OLS

	(1) 1984 b/se	(2) 1985 b/se	(3) 1986 b/se	(4) 1987 b/se	(5) 1988 b/se	(6) 1989 b/se	(7) 1990 b/se	(8) 1991 b/se	(9) 1992 b/se	(10) 1993 b/se	(11) 1994 b/se	(12) 1995 b/se	(13) 1996 b/se	(14) 1997 b/se	(15) 1998 b/se
edu	0.044***	0.058***	0.078***	0.075***	0.057***	0.064***	0.058***	0.054***	0.057***	0.073***	0.057***	0.049***	0.056***	0.041**	0.062***
	(0.0130)	(0.0105)	(0.0200)	(0.0113)	(0.0100)	(0.0111)	(0.0095)	(0.0088)	(0.0103)	(0.0105)	(0.0108)	(0.0103)	(0.0151)	(0.0144)	(0.0097)
hours	0.0014***	0.0010***	0.0013***	0.0014***	0.0011***	0.0017***	0.0010***	0.0015***	0.0017***	0.0016***	0.0017***	0.0016***	0.0021***	0.0014***	0.0013***
	(0.0002)	(0.0002)	(0.0002)	(0.0003)	(0.0002)	(0.0003)	(0.0002)	(0.0002)	(0.0002)	(0.0001)	(0.0002)	(0.0002)	(0.0003)	(0.0001)	(0.0002)
hours2	-0.2e-06***	-0.1e-06*	-0.2e-06***	-0.2e-06**	-0.2e-06***	-0.2e-06***	-0.1e-06**	-0.2e-06***	-0.2e-06***	-0.2e-06***	-0.3e-06***	-0.3e-06***	-0.4e-06***	-0.2e-06***	-0.2e-06***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
age	0.086**	0.120***	0.089***	0.045*	0.093***	0.060***	0.100***	0.092***	0.116***	0.085***	0.097***	0.074***	0.075**	0.055*	0.075***
	(0.0274)	(0.0165)	(0.0210)	(0.0173)	(0.0188)	(0.0152)	(0.0199)	(0.0176)	(0.0226)	(0.0165)	(0.0198)	(0.0171)	(0.0257)	(0.0273)	(0.0192)
age2	-0.001**	-0.001***	-0.001***	-0.000*	-0.001***	-0.001**	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001*	-0.001	-0.001**
	(0.0003)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0003)	(0.0002)	(0.0002)	(0.0002)	(0.0003)	(0.0003)	(0.0002)
rural	-0.092	-0.103	0.002	-0.148	-0.112	-0.078	0.010	-0.011	-0.065	-0.128	-0.143*	-0.005	0.009	-0.178*	-0.234**
	(0.0979)	(0.0955)	(0.0887)	(0.0862)	(0.1204)	(0.0767)	(0.0630)	(0.0551)	(0.0635)	(0.0821)	(0.0728)	(0.0596)	(0.1018)	(0.0717)	(0.0896)
public	0.146	0.135*	0.052	0.087	0.034	0.152	-0.041	-0.034	0.093	-0.006	-0.016	0.063	0.078	0.040	0.024
	(0.0929)	(0.0629)	(0.0625)	(0.0547)	(0.0630)	(0.0784)	(0.0647)	(0.0477)	(0.0709)	(0.0588)	(0.0593)	(0.0834)	(0.0602)	(0.1105)	(0.1032)
gender	-0.189**	-0.052	-0.167	-0.198**	-0.167*	-0.125	-0.023	-0.093	-0.084	-0.143*	0.032	-0.073	-0.095	-0.201**	-0.139*
	(0.0676)	(0.0669)	(0.0942)	(0.0646)	(0.0654)	(0.0947)	(0.0596)	(0.0566)	(0.0679)	(0.0569)	(0.0687)	(0.0612)	(0.0713)	(0.0621)	(0.0652)
_cons	5.502***	5.128***	4.983***	5.841***	5.559***	5.448***	5.731***	5.171***	4.583***	5.119***	4.855***	5.750***	5.109***	6.378***	5.684***
	(0.4723)	(0.4181)	(0.6277)	(0.4665)	(0.3364)	(0.4464)	(0.2892)	(0.3931)	(0.4298)	(0.3450)	(0.4025)	(0.3262)	(0.5692)	(0.4731)	(0.3788)
R^2	0.538	0.465	0.365	0.485	0.470	0.327	0.504	0.552	0.510	0.490	0.446	0.394	0.513	0.468	0.428
N	594	538	486	496	464	541	507	541	615	682	658	688	702	709	806

	(16) 1999 b/se	(17) 2000 b/se	(18) 2001 b/se	(19) 2002 b/se	(20) 2003 b/se	(21) 2004 b/se	(22) 2005 b/se	(23) 2006 b/se	(24) 2007 b/se	(25) 2008 b/se	(26) 2009 b/se	(27) 2010 b/se	(28) 2011 b/se	(29) 2012 b/se	(30) 2013 b/se
edu	0.053***	0.065***	0.067***	0.077***	0.069***	0.064***	0.067***	0.066***	0.076***	0.069***	0.068***	0.080***	0.090***	0.070***	0.076***
	(0.0099)	(0.0074)	(0.0108)	(0.0085)	(0.0095)	(0.0123)	(0.0085)	(0.0096)	(0.0098)	(0.0109)	(0.0140)	(0.0094)	(0.0100)	(0.0078)	(0.0080)
hours	0.0018***	0.0017***	0.0016***	0.0017***	0.0017***	0.0017***	0.0019***	0.0018***	0.0019***	0.0019***	0.0020***	0.0020***	0.0017***	0.0017***	0.0018***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0001)	(0.0001)	(0.0001)
hours2	-0.3e-06***	-0.3e-06***	-0.2e-06***	-0.2e-06***	-0.3e-06***	-0.3e-06***	-0.3e-06***	-0.3e-06***	-0.3e-06***	-0.3e-06***	-0.3e-06***	-0.3e-06***	-0.3e-06***	-0.3e-06***	-0.3e-06***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
age	0.083***	0.026*	0.028	0.023	0.030	0.025	0.033*	0.066***	0.033	0.018	0.003	0.003	0.017	0.035*	0.002
	(0.0183)	(0.0122)	(0.0160)	(0.0158)	(0.0199)	(0.0169)	(0.0141)	(0.0168)	(0.0189)	(0.0187)	(0.0233)	(0.0180)	(0.0128)	(0.0151)	(0.0133)
age2	-0.001***	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.001***	-0.000	-0.000	0.000	0.000	-0.000	-0.000	0.000
	(0.0002)	(0.0001)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0003)	(0.0002)	(0.0001)	(0.0002)	(0.0001)
rural	-0.066	-0.110*	-0.105	-0.046	-0.011	-0.107	-0.008	0.067	-0.052	-0.063	-0.011	-0.094	-0.017	0.000	-0.053
	(0.0679)	(0.0458)	(0.0579)	(0.0531)	(0.0516)	(0.0693)	(0.0500)	(0.0497)	(0.0524)	(0.0517)	(0.0623)	(0.0534)	(0.0557)	(0.0541)	(0.0587)
public	0.197***	0.059	0.142**	0.013	0.081	0.096	0.120*	0.142*	0.038	0.010	-0.077	-0.002	0.105*	0.089	0.112*
	(0.0546)	(0.0555)	(0.0519)	(0.0625)	(0.0503)	(0.0527)	(0.0479)	(0.0585)	(0.0706)	(0.0488)	(0.1022)	(0.0660)	(0.0484)	(0.0461)	(0.0536)
gender	0.046	-0.067	-0.083	-0.053	-0.042	-0.184***	-0.001	-0.002	-0.139**	-0.095	-0.053	-0.042	-0.151**	-0.043	-0.066
	(0.0560)	(0.0367)	(0.0469)	(0.0452)	(0.0475)	(0.0538)	(0.0494)	(0.0479)	(0.0492)	(0.0515)	(0.0790)	(0.0519)	(0.0480)	(0.0429)	(0.0470)
_cons	5.057***	6.352***	6.261***	6.132***	6.165***	6.318***	5.933***	5.248***	5.848***	6.205***	6.277***	6.403***	6.088***	6.086***	6.522***
	(0.3619)	(0.2255)	(0.3137)	(0.2923)	(0.3447)	(0.3554)	(0.2597)	(0.3405)	(0.3833)	(0.3291)	(0.4225)	(0.3589)	(0.3210)	(0.3099)	(0.2588)
R^2	0.584	0.485	0.462	0.537	0.497	0.502	0.537	0.540	0.547	0.582	0.498	0.570	0.532	0.543	0.568
N	779	1713	1468	1481	1372	1369	1369	1400	1429	1335	1272	1199	1564	1630	1579

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 17 Regression estimations from 1984 to 2013

A.10 Difference-based Lorenz curves

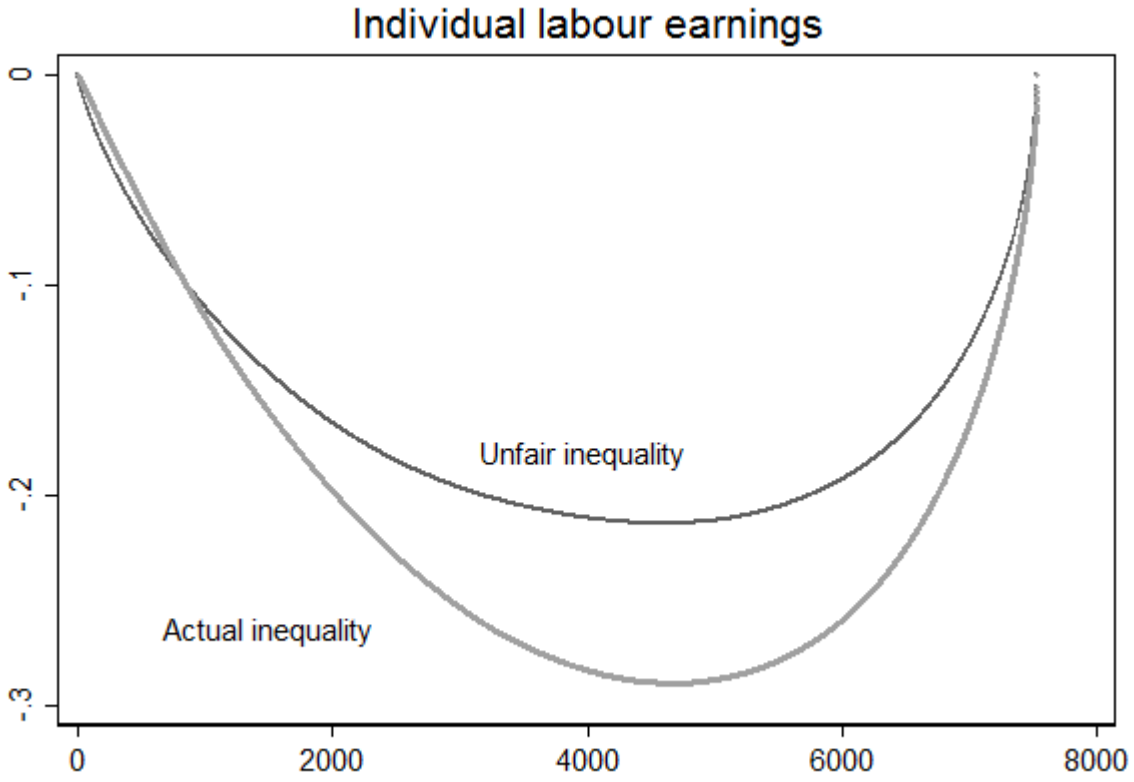

Figure 14 Difference-based Lorenz curves when actual income is individual labour earnings