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Equality of Opportunity for Well-Being

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Abstract

There is a growing political concern about assuring that people have equal opportunities for acquiring income and going beyond income when measuring well-being. This paper attempts to bridge these two concerns by measuring the extent to which individuals have equal opportunities to achieve a high level of well-being. The German Socio-Economic Panel is used to measure well-being in four different ways including log incomes. This makes it possible to determine if the way well-being is measured matters for identifying who the opportunity deprived are and for tracking inequality of opportunity over time. We find that the measurement of well-being does not matter much for characterizing who the opportunity deprived are. It matters a bit more when tracking inequality of opportunity over time, particularly as we change what individuals are held responsible for.

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1 Introduction

The notion that individuals ought to have equal opportunities in life is popular among politicians, the general public and philosophers alike. A sizable number of empirical studies have been carried out analyzing the extent to which individuals have equal opportunities for income acquisition (see Ramos and Van de gaer (2016), Roemer and Trannoy (2015), and Ferreira and Peragine (2016) for excellent recent reviews). Given the growing interest in going beyond income to measure individual welfare, it seems pertinent to apply this discussion to the equality of opportunity framework. If individuals ought to have equal opportunities for welfare, then using income as the acquisition variable could be problematic. Using income ignores the disutility of effort, the welfare individuals receive from other dimensions of life, and the differences in preferences over income and these other dimensions. We use different approaches to measure welfare in an attempt to address these concerns. In particular, we seek to determine if the measurement of welfare matters for delineating who the opportunity deprived are and for tracking equality of opportunity over time.

This approach unifies two developments in welfare economics, each of which has a rich body of literature and policy applications. The first development is the recognition that to measure a nation's progress we need to go beyond GDP. Well-being is inherently multidimensional and growth and income statistics fail to capture this multiplicity. This conviction has seen increasing political traction after the Fitoussi *et al.* (2010) report. Once it is acknowledged that income is not a sufficient measure of progress, the door opens for many alternatives. Which other dimensions are necessary? Should we measure different dimensions separately or somehow aggregate these to a single number? How can we incorporate the fact that individuals have different preferences over these various dimensions? Should we try to measure well-being directly by alluding to self-reported happiness levels?

The second development in welfare economics is an understanding that when evaluating the progress of societies, looking only at the levels of income or well-being may provide an incomplete picture. Arneson (1989), for example, argued that a just distribution necessitates that individuals have equal opportunities for welfare. This entails accepting inequalities that individuals should be held personally responsible for while removing inequalities outside the realm of individual responsibility. Theories of equality of opportunity have been operationalized in economics through the works of Roemer (1993), Van de gaer (1993), and Fleurbaey (1994) amongst others.

To our knowledge, this is the first paper to explicitly address both of these developments simultaneously in an equality of opportunity framework. We are not

the first, however, to relate notions of fairness with welfare measurement. Fleurbaey and Maniquet (2011) summarizes extensive work on this topic. This prior work generally incorporates concerns about fairness directly into the well-being measure. Our approach, in contrast, first computes measures of welfare and then analyzes the extent to which welfare levels are driven by factors beyond individual control. A particularly relevant paper is Ravallion (2015), which incorporates the disutility of effort into estimates of inequality of opportunity. We go in a different direction by analyzing whether the concept of welfare matters for estimates of equality of opportunity. In previous studies the measurement of welfare has been shown to matter for assessments of how welfare has developed over time (Blanchflower and Oswald, 2004), for how inequality in welfare has developed over time (Stevenson and Wolfers, 2008), and for the identification of who the most welfare deprived are (Decancq and Neumann, 2016).

It should be noted that Roemer (2012) explicitly argues against using welfare as the outcome variable in estimates of equality of opportunity. He does so on the grounds that policy makers are interested in dimensions of well-being separately, such as health, income or education, rather than well-being itself. This may certainly be the case, but if the ultimate objective is to equalize opportunities for well-being, then equalizing opportunities for only one dimension of well-being might actually bring about the opposite results. To see this, consider a policy that targets people living outside of the main cities on the grounds that they have less opportunities to acquire a high income. If these people simultaneously have better health, more leisure or different preferences over the importance of income, they need not have less opportunities to acquire a high level of well-being.[1] Our framework will help clarify if such examples have empirical leverage.

We use data from the German Socio-Economic Panel (GSOEP) to measure welfare in four different ways; 1) log income, 2) life satisfaction, 3) a multidimensional index and 4) equivalent incomes. Log incomes are used to facilitate comparisons with the generic way of assessing equality of opportunity. The other three measures have their roots in different philosophical theories about well-being (Parfit, 1984; Griffin, 1986). Life satisfaction explicitly tries to measure mental states, the multidimensional index defines and aggregates an objective list of dimensions of importance for well-being, and equivalent incomes incorporate preferences into assessments.

We will look at whether the measure of welfare matters for classifying the opportunity deprived and for tracking inequality of opportunity over time. In both cases, this entails firstly regressing the various welfare measures on a set of effort and

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[1]For a similar argument see Calsamiglia (2009).

circumstance variables - or equivalently, variables which the individuals are and are not held responsible for. In order to characterize who the opportunity deprived are, we select a reference level of each effort variable and predict the welfare individuals would have with this reference effort. The resulting predicted welfare levels only use variation in circumstances and can thus be considered unfair advantage. Using these unfair welfare levels we are able to compare what characterizes the opportunity deprived across the four well-being measures.

In order to compare equality of opportunity developments over time we use the norm-based approach (see Ramos and Van de gaer (2016) for more information on this approach). Upon regressing the welfare measures on circumstance and effort variables, this implies assigning a fair welfare level to each individual which only depends on the individual's effort variables. Next, norm-based inequality metrics that calculate the divergence between the actual welfare levels and these fair welfare levels are computed.

Since the four welfare measures follow different distributions and have different degrees of random noise, unfortunately, we are not able to compare the *extent* of inequality of opportunity across the different measures. This is little different from the fact that it is impossible to compare the level of welfare or inequality of welfare across the different measures. We will deal with this problem by indexing the extent of equality opportunity and tracking the development over time. The development over time is comparable between the different measures.

We find that the measure of well-being matters little for characterizing who the most opportunity deprived are. This is encouraging news for policy makers interested in equalizing opportunities for well-being, as they may broadly get things right if they proxy well-being with income. When tracking whether inequality of opportunity has changed over the past 20 years, we are either unable to detect changes due to wide confidence bans, or we find that inequality of opportunity has decreased. For the most part, these results are robust to changing our measurement approach and to changing the responsibility cut.

The rest of the paper is organized as follows. Section 2 explains both the philosophical and axiomatic theory behind measuring equality of opportunity for well-being. Section 3 details our data and measurement approach. Section 4 outlines the results and provides several robustness checks. Section 5 concludes.

4

2 Theory

2.1 Theories of Well-Being

Three overarching theories of well-being exist in the philosophical literature; objective list theory, preference satisfaction theory, and mental state theory (Parfit, 1984; Griffin, 1986). *Preference satisfaction theory* is the most commonly assumed in economics. It claims that an individual's welfare depends on the degree to which his preferences are satisfied. Often preference orderings are assumed to be revealed through choice behavior. The underlying tenet behind these revealed preferences is that if an agent chooses bundle A over bundle B when both are available, then the agent must prefer A over B, and the agent must be better off with A rather than B. *Mental state theory* takes its starting point in what goes on inside the mind of individuals rather than their observed choices. According to this theory, well-being is the degree to which individuals are happy or the extent to which they experience pleasure over pain. *Objective list theory* argues that individuals' lives go well to the degree that they are in possession of certain items on a list, which could be income, education, health, safety, etc.

In short, mental state theories care about what individuals feel, (revealed) preferences about what individuals choose, and objective list theories about external circumstances independent of the choices or feelings of individuals. This division is still very much in use today in both theoretical and empirical literature about well-being (see for example the chapter division in the Oxford Handbook of Well-Being and Public Policy (Adler and Fleurbaey, 2016) and the Stanford Encyclopedia of Philosophy on Well-Being (Crisp, 2016)). We will operationalize a measure of well-being with roots in each of these theories to see if they lead to different conclusions about equality of opportunity than if income is used as the outcome variable.

2.2 Distributive Justice

Until Rawls published his Theory of Justice (Rawls, 1971) the predominant view of justice was defined in utilitarian terms, as the outcome that maximizes total well-being. Rawls emphasized that we should not equalize marginal utilities, but rather primary goods, which is a broader notion that also encompasses rights and liberties. A number of subsequent scholars proposed variations of what the right equalizandum ought to be, building on the work of Rawls. Sen (1980) argued that neither utilities nor primary goods were enough to judge just outcomes. He concluded that we need to look at what individuals are capable of achieving with these goods, thus

advocating for basic capability equality. Dworkin (1981) contended that resources is the right equalizandum, while Arneson (1989) and Cohen (1990) argued that the right equalizandum is, respectively, equality of opportunity for welfare and equal access to advantage. See Roemer and Trannoy (2016) for a more complete account on the developments in distributive justice since Rawls.

Although these philosophers differ in their exact approach, they agree on the need to go beyond welfarism and accept some degree of individual responsibility, and thereby some degree of just inequalities. Notably, none of them want to equalize opportunities/access/capabilities for income alone. Rather, they consider broader notions such as welfare, advantage or functionings. Our approach attempts to empirically get a bit closer to these frameworks. In particular, our framework is closely related to that of Arneson (1989), who precisely argues for equalization of opportunities for welfare.[2]

2.3   Equality of Opportunity with the Norm-Based Approach

The philosophical theories of distributive justice have been operationalized in economics through the works of Roemer (1993), Van de gaer (1993), and Fleurbaey (1994) amongst others. The starting point in these operationalizations is to consider a population, $\mathcal{N} = \{1, 2, \ldots, n\}$ and a distribution of an outcome variable for this population, $\boldsymbol{y} = (y_1, y_2, \ldots, y_n)$. Often $\boldsymbol{y}$ is considered to be income, but here we will take welfare/well-being (we use these interchangeably) as the outcome, such that y_i is the welfare of individual $i \in \mathcal{N}$. An individual's outcome is a product of two sets of variables: circumstances, $\boldsymbol{a^C}$, and effort, $\boldsymbol{a^E}$. Circumstances are those factors which are outside the realm of control for the individual, the factors one ought not to hold an individual responsible for. These are often taken to be, gender, region of birth, parental education, parental income etc. Effort is that which one ought to hold an individual responsible for. The well-being of individual i is thus assumed to be given by $y_i = f(\boldsymbol{a_i^E}, \boldsymbol{a_i^C})$. We consider the welfare levels to be cardinal and interpersonally comparable.[3]

Based on this set-up, the literature proceeds with measuring the extent to which the outcome variable is driven by circumstance or effort variables. The axiomatic literature on fair allocations has put forward two criteria which equality of opportunity estimates ideally ought to satisfy, these being the compensation principle and the reward principle. The compensation principle states that differences in well-being

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[2]That being said, Arneson (1989) considers welfare to be preference satisfaction, thus differing from our take, where we will look at different theories of welfare.

[3]Our set-up could also work in a ordinal framework where we convert the welfare levels into welfare ranks.

due to differences in circumstances should be eliminated. The reward principle is concerned with the proper reward of effort for individuals with the same circumstances. Unfortunately, these two criteria are mutually incompatible (Bossert, 1995; Fleurbaey, 1995). The literature has proposed allocation rules that weaken these two principles in order to make them compatible. Two such rules are the egalitarian equivalent (Bossert and Fleurbaey, 1996) and the generalized proportionality (Cappelen and Tungodden, 2017) principles. The egalitarian equivalent principle seeks a distribution which mimics what would be obtained if everyone had the same set of circumstances, while the generalized proportionality principle seeks a distribution where individuals should have the share of total income that they would have had if everyone had the same set of circumstances, defined by the average set of circumstances.

To estimate the fair counterfactual distributions, $\boldsymbol{z}$, that derive from these two fair allocation rules, we have to define a norm or reference vector of circumstance variables, $\tilde{\boldsymbol{a}}^{\boldsymbol{C}}$, and calculate the well-being individuals *would have had*, if they had this norm level of circumstances, $f(\boldsymbol{a_i^E}, \tilde{\boldsymbol{a}}^{\boldsymbol{C}})$. This neutralizes the effect of circumstances on well-being and the resulting welfare differences can therefore be thought of as expressing fair advantage. The Egalitarian Equivalent (EE) principle, then, distributes the difference between the size of the two distributions equally across individuals.

$$z_i^{EE} = f(\boldsymbol{a_i^E}, \tilde{\boldsymbol{a}}^{\boldsymbol{C}}) + \left(\mu(\boldsymbol{y}) - \frac{\sum_{j \in \mathcal{N}} f(\boldsymbol{a_j^E}, \tilde{\boldsymbol{a}}^{\boldsymbol{C}})}{n} \right) \tag{1}$$

This principle has the advantage that if the well-being function is linearly separable in circumstances and effort, such that $y_i = g(\boldsymbol{a_i^E}) + h(\boldsymbol{a_i^C})$, then the fair well-being levels do not depend on which norm vector of circumstances is chosen.

The Generalized Proportionality (GP) principle, instead, respects the well-being shares of the fair well-being allocation $f(\boldsymbol{a_i^E}, \tilde{\boldsymbol{a}}^{\boldsymbol{C}})$ by scaling them by the same factor, which is inequality neutral:

$$z_i^{GP} = f(\boldsymbol{a_i^E}, \tilde{\boldsymbol{a}}^{\boldsymbol{C}}) \frac{\mu(\boldsymbol{y})}{\sum_{j \in \mathcal{N}} f(\boldsymbol{a_j^E}, \tilde{\boldsymbol{a}}^{\boldsymbol{C}})/n} \tag{2}$$

2.4 Norm-Based Inequality Metrics

Once these fair well-being levels are obtained, the distance between the actual and the fair well-being distributions can be measured by means of the *fairness gap* Fleurbaey and Schokkaert (2009), also called the *norm-based approach* by Ramos and Van de gaer (2016). The fairness gap can be calculated by employing a divergence measure, $D(\boldsymbol{y} \| \boldsymbol{z})$, which evaluates the divergence between the two distributions, $\boldsymbol{y}$

and $\boldsymbol{z}$.[4] Here $\boldsymbol{y}$ is the actual distribution while $\boldsymbol{z}$ is the norm distribution resulting from the chosen fair allocation rule. Conventional inequality metrics that assume full symmetry are of no use in this setting. We can no longer perform permutations of the elements in $\boldsymbol{y}$ without changing the inequality level, as each person is tied to a specific z_i. Instead we need to assume partial symmetry, which means that the measure must be invariant to permutations of pairs of (y_i, z_i).

Magdalou and Nock (2011) build on function ϕ, for all $c \in \mathbb{R}_{++}$:

$$\phi(c) := \begin{cases} \frac{1}{r(r-1)} c^r, & \text{if} \quad r \neq 0, 1, \\ c \ln c, & \text{if} \quad r = 1, \\ -\ln c, & \text{if} \quad r = 0. \end{cases} \tag{3}$$

to put forth the general class of divergence measures $D_{MN}(\boldsymbol{y}\|\boldsymbol{z})$:

$$D_{MN}(\boldsymbol{y}\|\boldsymbol{z}) = \sum_{i \in \mathcal{N}} \left[\phi(y_i) - \phi(z_i) - (y_i - z_i)\phi'(z_i) \right], \tag{4}$$

which satisfies partial symmetry along with other relevant properties. The class $D_{MN}(\boldsymbol{y}\|\boldsymbol{z})$ is suitable only for distributions with equal means and sizes. The equality of means condition is not a problem since the fair allocation rules we employ yield norm distributions with the same mean as our actual distribution. However, we need measures that can deal with distributions of different sizes, as our analysis over the period 1984-2014 entails comparing distributions with different sizes. Thus, we need to normalize $D_{MN}(\boldsymbol{y}\|\boldsymbol{z})$ to obtain a class that satisfies the population principle. We can do so by simply dividing $D_{MN}(\boldsymbol{y}\|\boldsymbol{z})$ by n.[5] By using the function ϕ in (3), one obtains

$$D_{MN}^p(\boldsymbol{y}\|\boldsymbol{z}) = \begin{cases} \frac{1}{n}\frac{1}{r(r-1)} \sum_{i \in \mathcal{N}} \left[y_i^r + (r-1)z_i^r - r\,y_i\,z_i^{r-1} \right], & \text{if} \quad r \neq 0, 1, \\ \frac{1}{n} \sum_{i \in \mathcal{N}} \left[y_i \ln \left(y_i/z_i \right) \right], & \text{if} \quad r = 1, \\ \frac{1}{n} \sum_{i \in \mathcal{N}} \left[y_i/z_i - \ln \left(y_i/z_i \right) - 1 \right], & \text{if} \quad r = 0. \end{cases} \tag{6}$$

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[4]We are heavily indebted for comments and advice from Brice Magdalou on the use and interpretation of appropriate divergence measures.

[5]The population principle requires our index to be invariant to replications of the population. Had not our actual and norm distributions had the same mean we could have normalized our divergence class further to obtain a (strong) scale invariant class:

$$D_{MN}^{ps}(\boldsymbol{y}\|\boldsymbol{z}) = \frac{1}{n} \sum_{i \in \mathcal{N}} \left[\phi(\hat{y}_i) - \phi(\hat{z}_i) - (\hat{y}_i - \hat{z}_i)\phi'(\hat{z}_i) \right], \tag{5}$$

where $\hat{y}_i = y_i/\mu(\boldsymbol{y})$ and $\hat{z}_i = z_i/\mu(\boldsymbol{z})$ are relative incomes, and $\mu(\boldsymbol{z}) = \sum_{i=1}^{n} z_i/n$. It is worth noting that this class boils down to the generalized entropy class of standard inequality measures if the reference distribution is assumed to be the mean of the actual distribution.

Cowell (1985) suggests a different class of divergence measures, which he calls measures of distributional change and that satisfies different properties. The population invariant measure equivalent to (4) is:[6]

$$D_C^p(\boldsymbol{y}\|\boldsymbol{z}) = \frac{1}{n} \sum_{i\in\mathcal{N}} [z_i\,\phi(y_i/z_i)]. \tag{7}$$

By using the function ϕ in (3), $D_C^p(\boldsymbol{y}\|\boldsymbol{z})$ can be written as

$$D_C^p(\boldsymbol{y}\|\boldsymbol{z}) = \begin{cases} \frac{1}{n}\frac{1}{r(r-1)}\sum_{i\in\mathcal{N}}\left[y_i^r z_i^{1-r}-1\right], & \text{if } r\neq 0,1, \\ \frac{1}{n}\sum_{i\in\mathcal{N}}y_i\ln\left[y_i/z_i\right], & \text{if } r=1, \\ \frac{1}{n}\sum_{i\in\mathcal{N}}z_i\ln\left[z_i/y_i\right], & \text{if } r=0. \end{cases} \tag{8}$$

The two different classes of divergence measures $D_{MN}^p(\boldsymbol{y}\|\boldsymbol{z})$ and $D_C^p(\boldsymbol{y}\|\boldsymbol{z})$ in (6) and (8) coincide for one – and unique – parameter value, $r=1$. For this reason we are going to use $r=1$ in our baseline empirical analysis. Parameters $r=0$ and $r=2$ with $D_{MN}^p(\boldsymbol{y}\|\boldsymbol{z})$ will be used for our robustness analysis. Why these two values? One of the features of D_{MN}^p is that a progressive transfer in the actual distribution $\boldsymbol{y}$ reduces the divergence between $\boldsymbol{y}$ and the reference $\boldsymbol{z}$ as long as the individuals involved in the transfer have the same reference well-being, $\boldsymbol{z}$. It is a kind of priority given to the worse-off individuals – when the individuals involved in the transfer share the norm level of well-being. Moreover, if (and only if) $r<2$, the further down the distribution $\boldsymbol{y}$ such transfer takes place, the more the divergence between $\boldsymbol{z}$ and $\boldsymbol{y}$ is reduced. This property resembles the principle of diminishing transfers in the context of inequality measurement, which holds for the class of entropy indices when $r<2$. When $r=2$ the measure is ordinally equivalent to the Euclidian distance, and it is thus insensitive to the position on the distribution where the progressive transfer (among individuals with equal reference income) takes place. Thus, the parameter value $r=2$ can be seen as a threshold. Contrary to this, the parameter value $r=0$ yields a measure that is more sensitive to transfers lower down the distribution than our baseline measure with $r=1$.

As another robustness check we will use a generalization of the standard Gini coefficient developed by Almås *et al.* (2011), called "the Unfairness Gini", $D_{Gini}(\boldsymbol{y}\|\boldsymbol{z})$:

$$D_{Gini}(\boldsymbol{y}\|\boldsymbol{z}) = \frac{1}{2n(n-1)\mu(\boldsymbol{y})}\sum_{i\in\mathcal{N}}\sum_{j\in\mathcal{N}}|(y_i-z_i)-(y_j-z_j)| \tag{9}$$

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[6]A scale invariant measure can be obtained by replacing well-being levels y and z by relative well-being $\hat{y}$ and $\hat{z}$ in (7). Devooght (2008) provides an empirical application of this measure to equality of opportunity in Belgium.

2.5 Direct Measures of Equality of Opportunity

An alternative to the norm-based approach is what Fleurbaey and Schokkaert (2009) call *direct unfairness* and Ramos and Van de gaer (2016) call the *direct approach*. We will use this approach as a robustness check. The approach tries to clean the well-being levels of any fair differences in order to arrive at a vector of unfair well-being levels, y^{unfair}. Inequality of opportunity is then measured by directly measuring the inequality in these unfair well-being levels. To estimate the unfair well-being levels we follow Schokkaert *et al.* (1998) and Pistolesi (2009). We start by defining a reference vector of effort variables, $\tilde{a}^E$, and then determine the well-being individuals would have with this effort level, $y_i^{unfair} = f(\tilde{a}^E, a_i^C)$. These well-being levels have neutralized the effect of effort variables and any differences left can thus be considered unfair advantage.[7] Conventional inequality metrics can be used to calculate inequality of opportunity using the direct approach, as individuals no longer are tied to a norm level.

3 Data & Measurement

To measure inequality of opportunity we use data from the German Socio-Economic Panel (GSOEP). GSOEP is a yearly panel which started in 1984 and continues today. The panel contains detailed questions on household income, life satisfaction, other well-being dimensions, as well as biographical and historical data that can be used to construct circumstance variables. We use data from 1984-2014 and include all working and unemployed individuals but drop individuals outside the labor market. In total we have 170,135 person-year observations meeting our baseline specification. These are spread around 19,835 individuals in 14,495 different households.

Our baseline analysis will use the following circumstance variables: gender, father's education (3 categories), mother's education (3 categories), father's occupation (6 categories), polynomial of age, height, place of birth (West Germany, East Germany, abroad), degree of urbanization at place of birth (4 categories) and number of siblings. As baseline effort variables we use years of education, work hours and a dummy for whether the respondent is self-employed or works in the public sector. Summary statistics of the circumstance and effort variables are given in Table 1.

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[7]An alternative to estimate the unfair counterfactual, suggested by Ferreira and Gignoux (2011), would be to use a specification that includes only circumstance variables, $f(a_i^C)$. Consistent with the specification we use in the norm-based approach, we do not follow this route and instead include effort variables in the model.

Table 1: Summary Statistics

	mean	sd	min	max
Circumstance Variables				
Father's Educ.: Primary School	0.67	0.47	0	1
Father's Educ.: Secondary School	0.20	0.40	0	1
Father's Educ.: More Than Secondary School	0.13	0.34	0	1
Mother's Educ.: Primary School	0.71	0.46	0	1
Mother's Educ.: Secondary School	0.23	0.42	0	1
Mother's Educ.: More Than Secondary School	0.07	0.25	0	1
Father's Occupation: Blue-Collar (untrained)	0.14	0.35	0	1
Father's Occupation: Blue-Collar (trained)	0.34	0.47	0	1
Father's Occupation: Not Employed	0.06	0.24	0	1
Father's Occupation: White-Collar	0.26	0.44	0	1
Father's Occupation: Self-Employed	0.12	0.32	0	1
Father's Occupation: Civil Servant	0.08	0.28	0	1
Place of Upbringing: Large City	0.22	0.41	0	1
Place of Upbringing: Medium City	0.18	0.38	0	1
Place of Upbringing: Small City	0.23	0.42	0	1
Place of Upbringing: Countryside	0.37	0.48	0	1
Place of Birth: West Germany	0.66	0.47	0	1
Place of Birth: East Germany	0.27	0.45	0	1
Place of Birth: Abroad	0.07	0.25	0	1
Height	173	9.14	80	210
Female	0.47	0.50	0	1
Number of Siblings	1.94	1.67	0	17
Age	42	12.06	17	91
Effort Variables				
Years of Education	12.6	2.72	7	18
Weekly Working Time	35.9	15.90	0	80
Self-Employed	0.09	0.29	0	1
Works in Public Sector	0.18	0.39	0	1

Notes: Summary statistics of circumstance and effort variables. $n = 170,135$.

3.1 Constructing Welfare Variables

We will use four welfare variables in the analysis. Firstly, we will use log incomes. This is the most frequently used outcome variable in equality of opportunity studies and it will allow us to have this as a baseline for comparison to the other well-being measures. We will use annual net household income expressed in 2010 constant EUR. The other three welfare variables each take their inspiration from the three concepts of well-being that Parfit (1984) and Griffin (1986) put forward.

The second welfare measure we use is life satisfaction, which has its root in mental state theories. Life satisfaction is the answer to the question, 'How satisfied

are you with your life, all things considered?' The answer categories range from 0 (completely dissatisfied) to 10 (completely satisfied). For the purpose of this study we consider the answers to be cardinal and interpersonally comparable. This is not meant as an endorsement of this particular account of well-being but rather as an inquiry into how inequality of opportunity estimates would look if one accepted these assumptions.

The third advantage variable we use is a multidimensional welfare measure which has roots in objective list theories. To construct the measure of multidimensional welfare we partly follow Decancq and Neumann (2016). We consider four dimensions; income, health, leisure, and unemployment.[8] Income is measured in the same way as above. Unemployment is a binary variable indicating whether the respondent had a job at the time of the survey. Leisure is measured as the log of the amount of daily hours spent on leisure (capped at 6 hours). Health is itself a composite index composed of 1) an indicator for whether the individual is disabled, 2) a log transformation of the number of doctor appointments the respondent had last year and 3) a log transformation of the number of inpatient nights in hospitals the respondent had last year. To aggregate these sub-dimensions into one health dimension we regress a health satisfaction question on the three variables and use the coefficients as weights. The health satisfaction variable is composed of answers to how satisfied individuals are with their health on a scale from 0 (not at all satisfied) to 10 (completely satisfied). For the income, leisure and health dimension we standardize the values such that the highest possible level is 1 and the lowest possible level is 0. Now we have four dimensions each bounded between 0 and 1. To arrive at the final multidimensional index, we simply add these four together.

The fourth advantage variable, equivalent incomes, is based on preference satisfaction theory.[9] Equivalent incomes are the incomes individuals need together with a reference bundle, to be indifferent between this hypothetical scenario and their actual bundle. Although preferences often are estimated from choice behavior, this is hardly possible when the arguments are dimensions of well-being. An alternative method to recover preferences as used by Decancq *et al.* (2015) is to regress life satisfaction on the dimensions of well-being and interpret the weights as marginal

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[8]Although we would like to include more dimensions such as education, we run into estimation problems since this also could be considered an effort variable. As we will regress the welfare variable on circumstance and effort variables, and since we do not want to have the same variables on each side of the regression, we omit this dimension.

[9]By employing equivalent income as a welfare measure in our analysis we are implicitly taking sides in a rich philosophical debate about whether individuals are to be held responsible for their preferences. Our approach deems differences in well-being arising from preference heterogeneity unfair if they stem from variety in circumstances. This is in contrast to most applications of equivalent incomes.

rates of substitution. The resulting utility functions seem to be highly correlated with the utility functions one would recover from choice behavior (Akay *et al.*, 2015). This approach easily accommodates preference heterogeneity by simply allowing for interactions between sociodemographic characteristics, z_{it}, and the various dimensions, dim_{it}. We follow this approach and use a subset of the circumstance and effort variables as preference heterogeneity parameters:

$$lifesat_{it} = (\beta^{lninc} + \gamma^{lninc} z_{it}) lninc_{it} + (\beta^{dim} + \gamma^{dim} z_{it}) dim_{it} + \mu_t + \alpha_i + \varepsilon_{it} \quad (10)$$

where $z_{it} = \{birthlocation_i, sex_i, age_{it}, age_{it}^2, educ_{it}, workhours_{it}, selfempl_{it}, public_{it}\}$ and $dim_{it} = \{health_{it}, unemployed_{it}, leisure_{it}\}$. In order to calculate the equivalent incomes, we first select a reference vector, $\tilde{dim}$, of all other dimensions than income. Here we choose the mean outcome (mode for categorical variables), since this avoids favoring any extreme marginal rates of substitution. Then we calculate the income necessary for individuals to be indifferent between their current bundle and the bundle where they have the reference vector and this income. That is, we isolate $lninc_{it}^{eq}$ below:

$$lifesat(lninc_{it}, dim_{it}) = lifesat(lninc_{it}^{eq}, \tilde{dim})$$
$$\Leftrightarrow lninc_{it}^{eq} = lninc_{it} + \frac{\beta^{dim} + \gamma^{dim} z_{it}}{\beta^{lninc} + \gamma^{lninc} z_{it}} (dim_{it} - \tilde{dim}) \quad (11)$$

The resulting measure is an interpersonally comparable measure of individual welfare that takes differences in preferences into account.

We place a lower bound on our four welfare levels at 0.1, since negative values do not work with all of our divergence measures and since some of the divergence measures are very vulnerable to values close to zero. This lower bound impacts less than 0.1% of our observations. Histograms of the four advantage variables are presented in Figure 1 and a Spearman's rank correlation matrix of the four welfare variables is given in Table 2. The rather low correlations suggest that the different measures may yield very different equality of opportunity estimates. In the table - and throughout the paper - we bootstrap confidence intervals in order to take all derived uncertainty into account, including the uncertainty when generating the welfare measures. We bootstrap 500 resamples at individual level clusters.

Figure 1: Histograms

(a) Log Net Income

(b) Life Satisfaction

(c) Multidimensional Index

(d) Log Equivalent Incomes
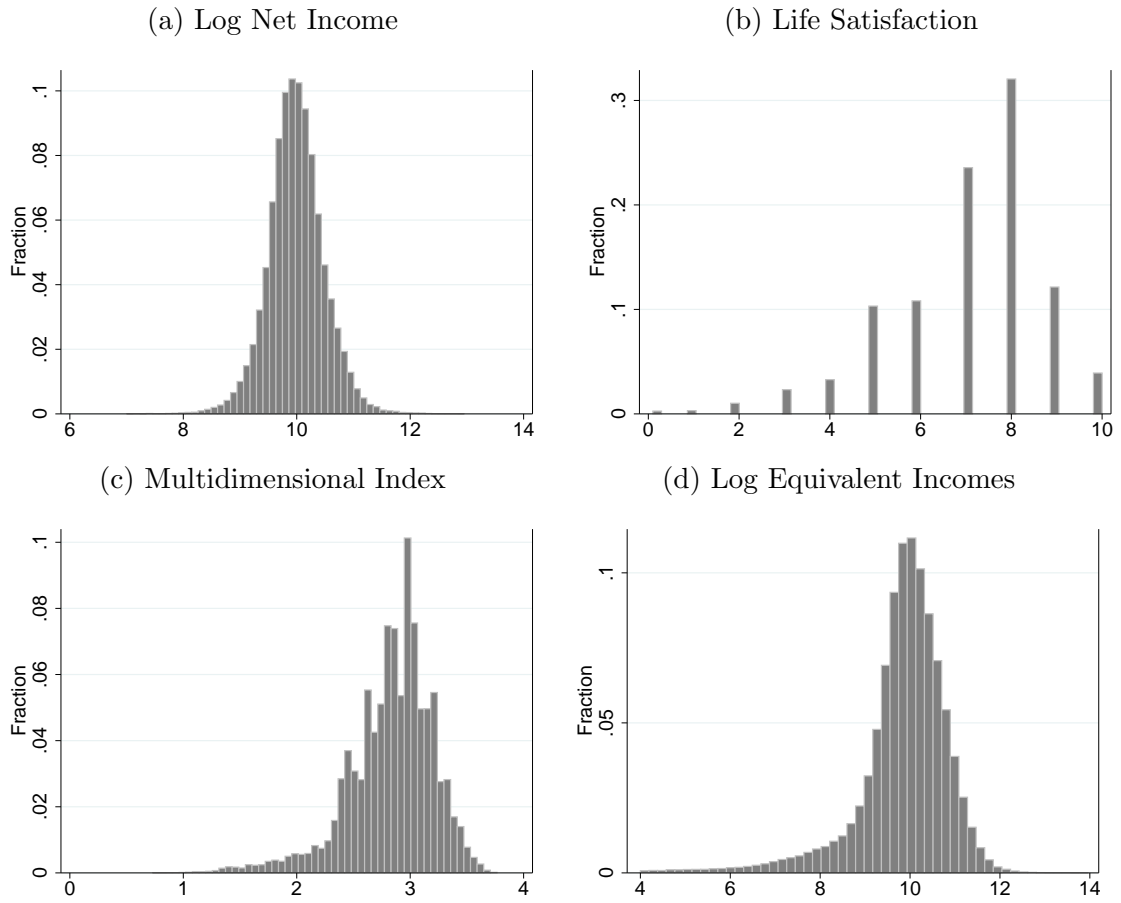
Notes: Histograms over the four welfare variables.

Table 2: Correlation Between Welfare Measures

	Log Income	Life Sat.	Multidim. Index	Log Equiv. Inc.
Log Income	-	-	-	-
Life Satisfaction	0.21	-	-	-
	(0.20, 0.22)			
Multidim. Index	0.19	0.19	-	-
	(0.17, 0.20)	(0.18, 0.20)		
Log Equiv. Inc.	0.63	0.27	0.64	-
	(0.58, 0.69)	(0.26, 0.28)	(0.59, 0.67)	

Notes: Spearman' rank correlation between welfare measures. Bootstrapped 95th percentile confidence intervals in parenthesis.

3.2 Estimating Equality of Opportunity

For our empirical specification we consider well-being to be linear in effort and circumstance variables:

$$y_{it} = \beta^C a_{it}^C + \beta^E a_{it}^E + \epsilon_{it} \tag{12}$$

Two important issues remain unsettled. First is the issue of how to interpret the error term, ϵ_{it}. The error contains omitted effort variables, omitted circumstance variables, measurement error, and general uncertainty. It is unclear whether this should be considered something individuals are to be held responsible for. This is an important decision as it accounts for most of the variation in the welfare levels. In our baseline specification we will consider it an effort variable, but as a robustness check we shift it to the other side of the responsibility cut.

The other unsettled issue is what to do with the correlation between the effort and circumstance variables. Individuals' effort levels are partly determined by their own choices and partly by their circumstances. Years of education, for example, is partly influenced by individuals' social background. In our baseline set-up we will follow Roemer's approach (Roemer, 1998) and consider this correlation to be outside the realm of responsibility for individuals.[10] In practice this means that prior to estimating the impact of circumstances and efforts on well-being we perform an auxiliary regression of the following form:

$$a_{it}^E = \gamma a_{it}^C + \eta_{it} \tag{13}$$

We perform such a regression for each effort variable and use the residuals from these regressions as our effort variables in our main regression, which then becomes:

$$y_{it} = (\beta^C + \gamma \beta^E) a_{it}^C + \beta^E \eta_{it} + \epsilon_{it} \tag{14}$$

Due to the Frisch-Waugh-Lowell theorem, the coefficients on the effort variables will be the same in (12) and (14). The coefficients on the circumstance variables will be different as they in (14) also incorporate the indirect effect of circumstances on effort. We will later report specifications where we omit this auxiliary regression.

To compare who the opportunity deprived are across the four well-being measures we use equation (14) to compute counterfactual unfair well-being levels, $y_i^{unfair} =$

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[10] Jusot *et al.* (2013) likewise call this approach Roemer's view, while not correcting for this correlation is termed Barry's view (Barry, 2005). A final possibility, where the correlation between effort and circumstances is considered an effort variable, is called Swift's view (Swift, 2005).

$f(\tilde{a}^E, a_i^C)$, which capture the sole effect of circumstances on well-being:

$$y_{it}{}^{unfair} = (\beta^C + \gamma\beta^E)a_{it}^C + \beta^E\tilde{\eta} + \tilde{\epsilon} \tag{15}$$

Next, we rank individuals according to their opportunity profile. That is, we calculate each person's yearly rank as $r_{it} = F_t\big[(\beta^C + \gamma\beta^E)a_{it}^C\big]$, where F_t is the yearly cumulative distribution of individuals' unfair advantage. This allows us to compare the average rank for individuals with a given circumstance. For example, if women on average take a rank of 0.45 in one welfare measure, this would imply that women have below average opportunities with this measure. We can compare this figure across the four welfare measures.

To estimate equality of opportunity over time we use the norm-based approach. This entails firstly choosing a reference vector, $\tilde{a}^C$, and using (14) to predict the level of well-being each individual would have with this set of circumstances, $f(a_{it}^E, \tilde{a}^C)$. Next we use the egalitarian equivalent mechanism, equation (1), to assign a fair level of well-being to each individual:

$$z_{it}^{EE} = f(a_{it}^E, \tilde{a}^C) + \left[\mu(y_t) - \frac{\sum_{j=1}^{n_t} f(a_{jt}^E, \tilde{a}^C)}{n_t}\right] = \beta^E\eta_{it} + \epsilon_{it} + \frac{\sum_{j=1}^{n_t}(\beta^C + \gamma\beta^E)a_{jt}^C}{n_t}$$

Since our specification is linear in efforts and circumstances, the reference vector of circumstance variables does not matter for the results (this is evident from the equation above, where the $\tilde{a}^C$ terms cancel). Hence, an individual's fair well-being is given by the part of well-being arising from effort plus the average well-being individuals derive from their circumstances.

Using a divergence measure we are now able to compute the level of inequality of opportunity for each of the welfare variables for each year of the survey. It is important to stress that the level of inequality using any metric will not be comparable across the different welfare measures. This is the case because the different degrees of noise in the welfare variables allow the circumstance and effort variables to explain a varying degree of variation. For example, when the residual term is considered an effort variable, any inequality metric will show very low inequality in opportunities for life satisfaction since circumstances can explain very little of the variation in life satisfaction. In contrast, circumstances can explain relatively more of the income variation. The inequality metrics will be normalized to equal 100 at a base year to foster comparisons in equality of opportunity over time. We can make this transformation since the divergence measures only have an ordinal interpretation.

4 Results

4.1 Who are the Opportunity Deprived?

Table 4 in the Appendix shows the results of equation (14). Based on this regression output and the approach described above, we calculate each person's unfair advantage, y^{unfair}. Table 3 shows Spearman's rank correlations between y^{unfair} for the four welfare measures. The correlations reveal the extent to which the same people are opportunity deprived across the four measures. We can compare these correlations with Table 2, which showed the same correlations for the raw well-being figures, y. The correlations are significantly higher when we look at y^{unfair} in all but one case. This indicates that the way welfare is measured matters less if we target the opportunity deprived rather than if target the welfare deprived.

Table 3: Correlation Between Opportunity Ranks

|	Log Income	Life Sat.	Multidim. Index	Log Equiv. Inc.
Log Income	-	-	-	-
Life Satisfaction	0.56	-	-	-
	(0.51, 0.61)			
Multidim. Index	0.34	0.86	-	-
	(0.29, 0.40)	(0.82, 0.90)		
Log Equiv. Inc.	0.93	0.61	0.49	-
	(0.87, 0.96)	(0.52, 0.68)	(0.37, 0.58)	

Notes: Spearman' rank correlations between y^{unfair} for the four welfare measures. Bootstrapped 95th percentile confidence intervals in parenthesis.

Next we rank individuals according to their y^{unfair}, calculate the average rank for individuals with a given circumstance, and compare these across the four welfare measures. Results are shown in Figure 2. The higher the rank, the less opportunity deprived individuals with the given circumstance are in the particular measure of well-being. If the rank is less than 0.5, the particular group is more than average opportunity deprived.

There are many similarities across the welfare measures. Individuals with low educated parents or with a father who was a blue-collar worker or not employed have low opportunities. The same applies to individuals who grew up in the countryside, individuals born in East Germany, short individuals, females, and individuals with many siblings.

Important differences emerge only in two places, for people born abroad and for different age groups. People born abroad are more opportunity deprived in

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Figure 2: Who are the Opportunity Deprived?
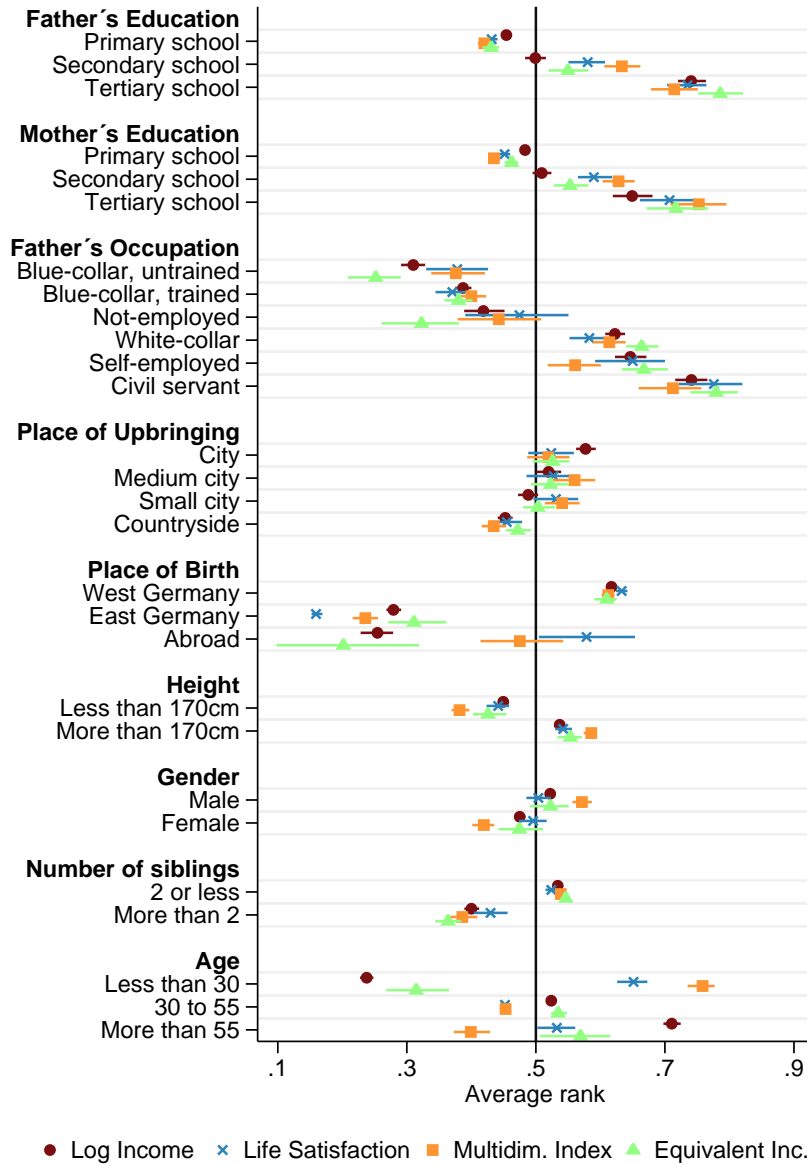
all measures but life satisfaction. A possible explanation for this is that people born abroad perceive the life satisfaction scale differently than Germans, in which case this difference has little to do with differences in opportunity sets. Indeed, the regression output in Table 4 in the Appendix reveal that the only time where being born abroad, ceteris paribus, is not associated with lower welfare is for life satisfaction. With respect to age, young people are opportunity deprived in income

but not in the multidimensional index. The opposite applies to elderly. This is hardly surprising as the multidimensional index includes health. It is questionable whether resources should be allocated such that individuals have equal opportunities in every part of their life. For this reason, we will later on place age on the other side of the responsibility cut. This may seem counterintuitive but it amounts to saying that individuals should have equal opportunities on expectation over their lifecycle rather than in every point of their life (see Almås *et al.* (2011) for a similar approach).

In sum, there seems to be relatively large agreement about who the opportunity deprived are across the four measures. Hence, if a policy maker strives to target the most opportunity deprived, it matters relatively little how welfare is measured.

4.2   Equality of Opportunity over Time

Before analyzing how equality of opportunity has evolved over time, and whether this depends on the well-being variable used, let us start with two preliminary analyses: How has well-being evolved over time and how has inequality in well-being developed over time? This is displayed in Figure 3. Panel (a) of the figure shows the level of well-being in Germany from 1984-2014. The level of well-being is normalized to 100 in 1984 to foster comparisons between the different measures. The figure shows that it matters what measure of welfare we adopt. For equivalent income and log income, the well-being level has slowly increased over the past 30 years. For the multidimensional index, it increased over the '90s but is now back to the 1984 level. For life satisfaction it decreased in the '80s and '90s and then increased in recent years.

If we look at the development in inequality over time, the measure of well-being we adopt once again matters. Panel (b) of Figure 3 shows the development in inequality in the four welfare measures using the general entropy index with $r = 1$, the so-called Theil index. The inequality measures are once again normalized to 100 in 1984 to foster comparisons. Since 2000, inequality in log incomes have increased, inequality in multidimensional well-being has stayed flat while inequality in the last two measures has decreased slightly.

Thus, the measure of welfare matters both when we look at the development of welfare and the inequality of welfare over the past 30 years in Germany. How do things look for the development of inequality of opportunity over time? This is displayed in Figure 4. Note that we now start the figure in 1992, the first year East Germany enters our sample. The introduction of East Germany caused such a large increase in inequality of opportunity that if we include observations prior to 1992,

Figure 3: Development in Level and Inequality of Well-Being, 1984-2014

(a) Level of Well-Being

(b) Inequality of Well-Being
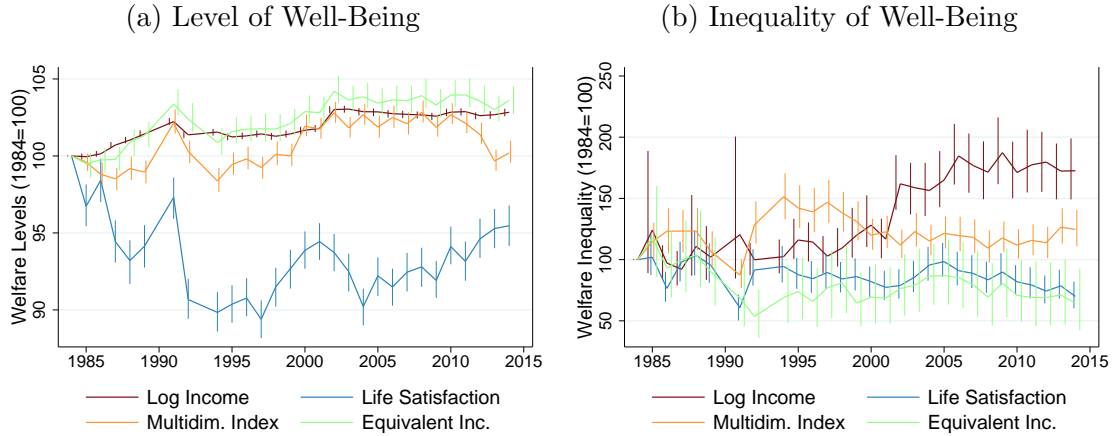
Notes: Development in the level of well-being and inequality in well-being from 1984-2014. All measures are normalized to equal 100 in 1984 to foster comparisons. Inequality is measured using the general entropy index with $r = 1$. Bars indicate bootstrapped 95th percentile confidence bans.

the development is virtually flat in all other years.

Figure 4: Inequality of Opportunity in Well-Being, 1992-2014
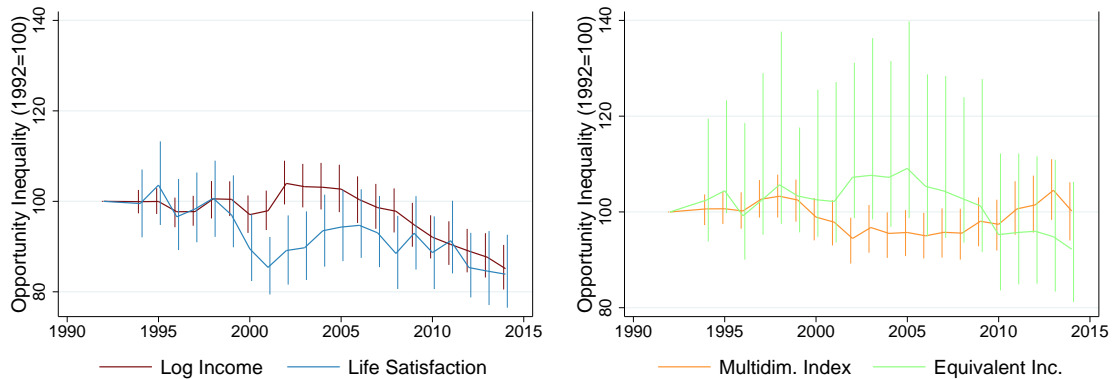
Notes: Development in inequality of opportunity in each well-being variable from 1992-2014. All measures are normalized to equal 100 in 1992 to foster comparisons. The estimates are based on the Magdalou-Nock divergence measure with $r = 1$. The egalitarian equivalent mechanism is used to derive fair well-being levels. Bars indicate bootstrapped 95th percentile confidence bans.

We see a very different picture than when we looked at inequality in well-being. For log income and life satisfaction, inequality of opportunity has decreased, particularly in recent years. The pattern for income is particularly interesting, as inequality in income has increased. Hence, although inequality has gone up, fair inequalities have gone down. For the multidimensional index and equivalent incomes, the confidence bans are too wide to conclude anything. At a broad level, the figure shows that - in contrast to the development in levels and inequality - there are few sig-

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nificant differences in how inequality of opportunity has evolved. Although this partially is due to wide confidence bans, it suggests that how we measure welfare is less important for estimates of unfair inequalities.

4.3 Altering the Responsibility Cut

The analysis thus far was based on important normative assumptions regarding what individuals were to be held responsible for. So far we assumed that individuals were responsible for four variables (*4var*); their education, work hours, and whether they are self-employed or work in the public sector. It was further assumed that individuals should not be held responsible for the part of these variables that could be accounted for by circumstance variables. That is, the correlation (*cor*) between circumstance and efforts was itself considered outside the control of individuals. We further assumed that the part of individual well-being that was unaccounted for by circumstance or effort variables (*residual*) was within individual control. Finally, we implicitly considered well-being differences across different age groups (*age*) as unfair without considering expected lifetime well-being.

In this section we try to shift the responsibility cut by changing these four assumptions. First we look at whether the characteristics of the opportunity deprived change, as we change the opportunity cut. This is analyzed in Figure 5 for log income. We use log income as an example for two reasons. Firstly, comparing Figure 3(b) with Figure 4 revealed biggest changes for log income, suggesting that the responsibility cut may matter most for this variable. Secondly, because we can measure log incomes most precisely. Hence, if we are to find significant differences in who the most opportunity deprived are across different effort sets, chances are they will be easiest to find when we use log incomes.

Figure 5 shows that the size of the effort set matters little for determining whether a group is opportunity deprived (whether it is on the left or right side of the 0.5 line). The responsibility cut does matter, however, for quantifying the degree to which a particular group is opportunity deprived. For example, individuals born in East Germany have an average opportunity rank of 0.18 with the largest effort set and 0.39 when the effort set is empty. This means that if we rank individuals according to raw income levels, individuals born in East Germany are in the lower end of the scale - but not markedly so. On a theoretical level, this could be because East Germans induce less effort or because they come from disadvantageous backgrounds. If we try to parcel out the effect of effort on incomes, East Germans on average rank even worse. This suggests that East Germans are lacking behind because of circumstances, not effort.

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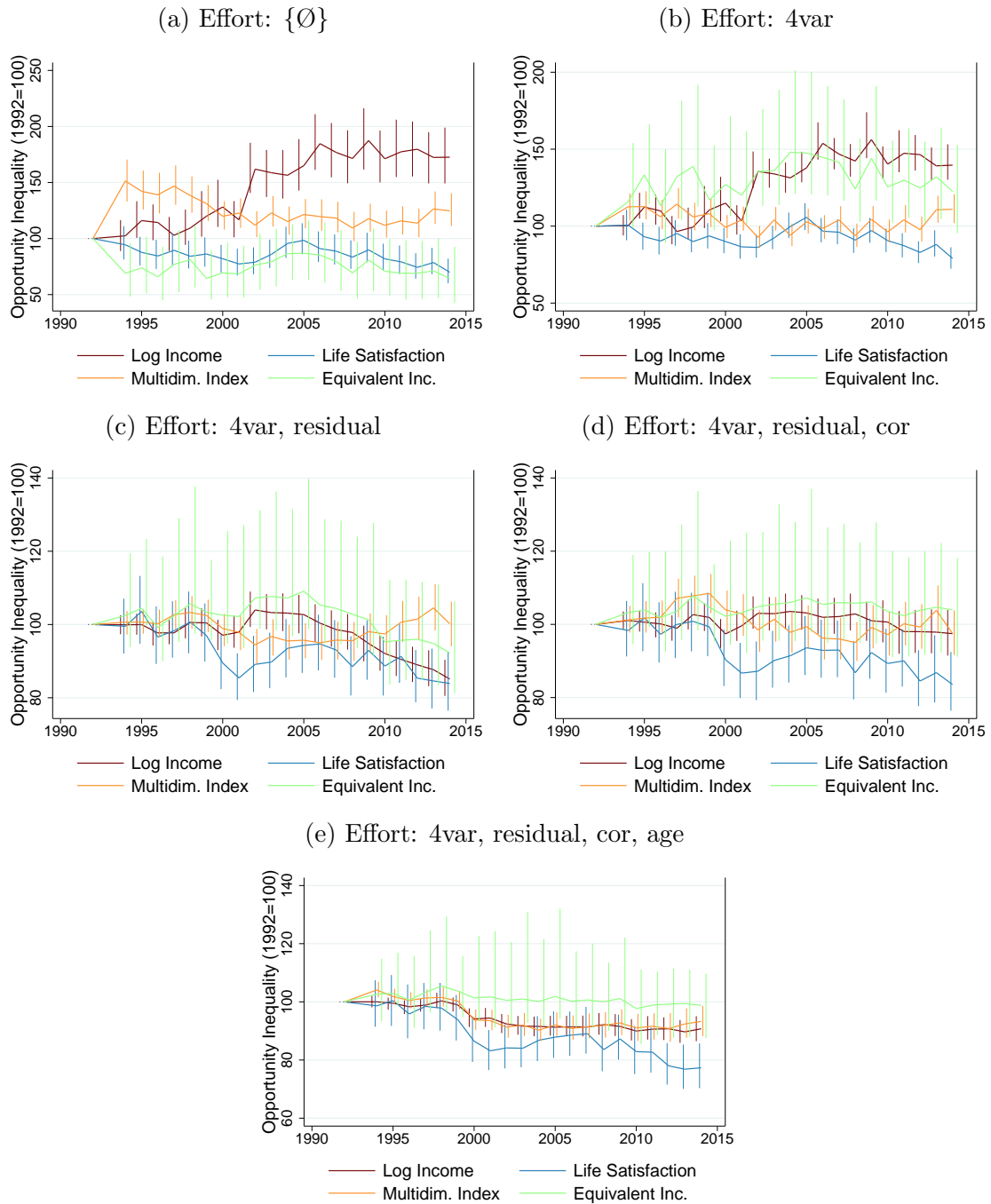Figure 5: Changing the Responsibility Cut: Who are the Opportunity Deprived?
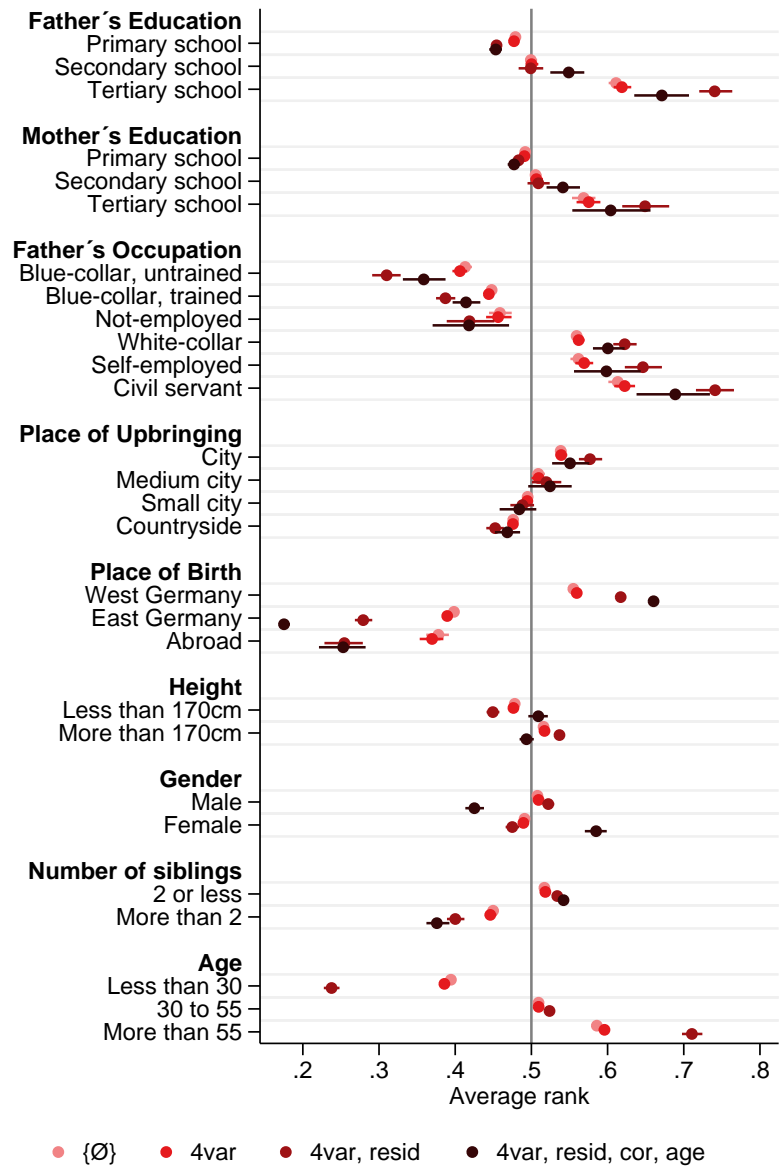
Notes: The figure shows the average rank in opportunity profiles for differ-
ent responsibility cuts when log income is considered the outcome variable.
Bars indicate bootstrapped 95th percentile confidence bans.

Next we look at whether developments over time depend on where we place
the responsibility cut. We try five different specifications. Results are displayed in
Figure 6.

The panels have sequentially larger sets of effort variables. Our baseline result is
given in panel (c). Panel (a) assumes that individuals cannot be held accountable for
anything and hence corresponds to the development in pure inequality. The respon-
sibility cut seems to matter for all measures but life satisfaction, where opportunities

Figure 6: Altering the Responsibility Cut

(a) Effort: {Ø}

(b) Effort: 4var

(c) Effort: 4var, residual

(d) Effort: 4var, residual, cor

(e) Effort: 4var, residual, cor, age

Notes: Development in inequality of opportunity in each well-being variable from 1992-2014 for different responsibility cuts. *4var:* The four variables work hours, education, self-employed, and works in public sector are considered effort. *Residual:* The residuals from the regressions of the well-being variables on circumstance and effort variables are considered effort. *Age:* Age is considered effort (implying we are equalizing lifetime opportunities). *Cor:* The correlation between effort and circumstance variables is not considered a circumstance. Our baseline specification used 4var and residual as effort.

have improved since 1992 no matter the size of the effort set. In particular, where we place the residual and our four key effort variables matters a lot. This is not surprising as this is what distinguishes equality of opportunity from equality of outcomes. More subtle changes, such as putting age on the other side of the responsibility cut or not correcting for the correlation between effort and circumstance matters less. In panel (c)-(e) inequality of opportunity estimates have either decreased or contain so large confidence bans that no change can be concluded. This is in line with our baseline results.

In sum we find that when characterizing who the opportunity deprived are, neither the measure of welfare nor the precise location of the responsibility cut is of great importance. When analyzing developments in equality of opportunity over time, whether we place the residual and the four key variables on the other side of the responsibility cut matters greatly, while enlarging the effort set further has few implications.

4.4   Robustness Checks

The main analysis was based on a number of theoretical choices. In this section we test whether our findings are sensitive to changing these choices. Only our results on the development over time depend on these assumptions.

Firstly, consider the choice of a *fair allocation rule*. In the main analysis we used the egalitarian equivalent mechanism, which had the advantage that we did not have to select a norm vector. In Figure 7 in the Appendix we show the result when the generalized proportionality principle is used instead. Since these results depend on what norm vector is chosen, we show the results separately when the norm vector is the worst circumstances, the best circumstance and the mean circumstances (mode for categorical variables). The best and worst circumstances are identified by tabulating the particular circumstance against log income. The results are broadly unchanged for equivalent incomes, log incomes and the multidimensional index - we either see a decreasing pattern or an insignificant pattern. Only with life satisfaction do the results change markedly. When the worst circumstances are used, inequality of opportunity in life satisfaction has increased rather than decreased.

We also try to look at other *norm-based inequality metrics*. We use the Magdalou-Nock divergence measures with $r = 0$ and $r = 2$ as well as the fairness Gini. Results are displayed in Figure 8 in the Appendix. The results are qualitatively unchanged when the Magdalou-Nock divergence measures with $r = 2$ or the fairness Gini is used. When the Magdalou-Nock divergence measures with $r = 0$ is used, the development for equivalent incomes and life satisfaction becomes quite erratic. This divergence

measure puts great emphasis on divergences at the bottom of the distribution and is particularly sensitive to values close to zero. If we put a lower bound of the equivalent income measure of 1 (which impacts less than 0.2% of our observations), the pattern using $r = 0$ is similar to our baseline case.

Finally, we try to use *the direct approach* to measure equality of opportunity rather than the norm-based approach. Estimates over time are shown in Figure 9. Again, the results are broadly unchanged. Hence, for the most part our results are robust to other statistical assumptions.

5   Conclusion

We have investigated if equality of opportunity estimates depend on what, precisely, it is that we seek to equalize opportunities for. Based on philosophical literature on theories of well-being, we constructed four measures of welfare that are candidates for what we ought to equalize opportunities for. Upon constructing these, we checked if the way welfare is measured matters for 1) characterizing the opportunity deprived and 2) tracking inequality of opportunity over time. We found that for the most part, characterizing who the opportunity deprived are does not depend on what measure of well-being we use. This is encouraging news for researchers and policy-makers interested in going beyond GDP, as it suggests that alternative measures of GDP have relatively little importance for questions of distributive justice. When looking at the development in inequality of opportunity over time, we face rather large uncertainty and can either not conclude much or find decreasing inequality of opportunity. These results are robust to most alternative measurement assumptions and changes to the responsibility cut.

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A   Appendix

Table 4: Predicting Welfare with Circumstances and Effort

|	Log Income		Life Satisfaction		Multidim. Index		Log Eq. Income	
	Coef.	Std. err.	Coef.	Std. err.	Coef.	Std. err.	Coef.	Std. err.
Circumstance Variables								
Father's education (ref: primary school)								
Secondary school	0.08***	(0.01)	0.11***	(0.03)	0.03***	(0.01)	0.13***	(0.02)
More than secondary school	0.15***	(0.01)	0.17***	(0.04)	0.03***	(0.01)	0.23***	(0.02)
Mother's education (ref: primary school)								
Secondary school	0.06***	(0.01)	0.07***	(0.03)	0.02***	(0.01)	0.07***	(0.02)
More than secondary school	0.08***	(0.01)	0.13***	(0.05)	0.04***	(0.01)	0.12***	(0.03)
Father's occupation (ref: blue collar, untrained)								
Blue-collar, trained	0.06***	(0.01)	0.06*	(0.03)	0.01**	(0.01)	0.11***	(0.02)
Not employed	0.04***	(0.01)	0.06	(0.05)	0.00	(0.01)	0.03	(0.03)
White-Collar	0.14***	(0.01)	0.15***	(0.04)	0.04***	(0.01)	0.24***	(0.02)
Self-Employed	0.13***	(0.01)	0.15***	(0.04)	0.02***	(0.01)	0.24***	(0.03)
Civil Servant	0.14***	(0.01)	0.19***	(0.05)	0.04***	(0.01)	0.25***	(0.03)
Place of upbringing (ref: large city)								
Medium city	-0.00	(0.01)	0.03	(0.03)	0.02***	(0.01)	0.04**	(0.02)
Small city	-0.01	(0.01)	0.06**	(0.03)	0.02***	(0.01)	0.06***	(0.02)
Countryside	-0.00	(0.01)	0.03	(0.03)	0.00	(0.01)	0.08***	(0.02)
Place of Birth (ref: West-Germany)								
East-Germany	-0.24***	(0.01)	-0.60***	(0.02)	-0.11***	(0.00)	-0.23***	(0.01)
Abroad	-0.19***	(0.01)	0.01	(0.04)	-0.03***	(0.01)	-0.27***	(0.03)
Height	0.01***	(0.00)	0.01***	(0.00)	0.00***	(0.00)	0.01***	(0.00)
Female	0.06***	(0.01)	0.14***	(0.03)	-0.01**	(0.01)	0.11***	(0.02)
Number of Siblings	-0.03***	(0.00)	-0.02***	(0.01)	-0.01***	(0.00)	-0.04***	(0.00)
Age	0.02***	(0.00)	-0.04***	(0.00)	-0.01***	(0.00)	0.04***	(0.00)
Age Squared	-0.00***	(0.00)	0.00***	(0.00)	0.00***	(0.00)	-0.00***	(0.00)
Effort Variables								
Years of Education	0.05***	(0.00)	0.04***	(0.00)	0.00***	(0.00)	0.06***	(0.00)
Weekly Working Time	0.01***	(0.00)	0.01***	(0.00)	0.01***	(0.00)	0.03***	(0.00)
Self-Employed	0.13***	(0.01)	-0.04	(0.03)	-0.01	(0.01)	0.16***	(0.02)
Works in Public Sector	0.01*	(0.01)	0.16***	(0.02)	0.04***	(0.00)	-0.01	(0.02)
r^2	0.32		0.06		0.16		0.25	

Notes: * p< 0.10, ** p< 0.05, *** p< 0.01. Based on a pooled OLS with individual level clustered standard errors. $n = 170,135$.

Figure 7: Using the Generalized Proporality Principle with Different Norm Vectors
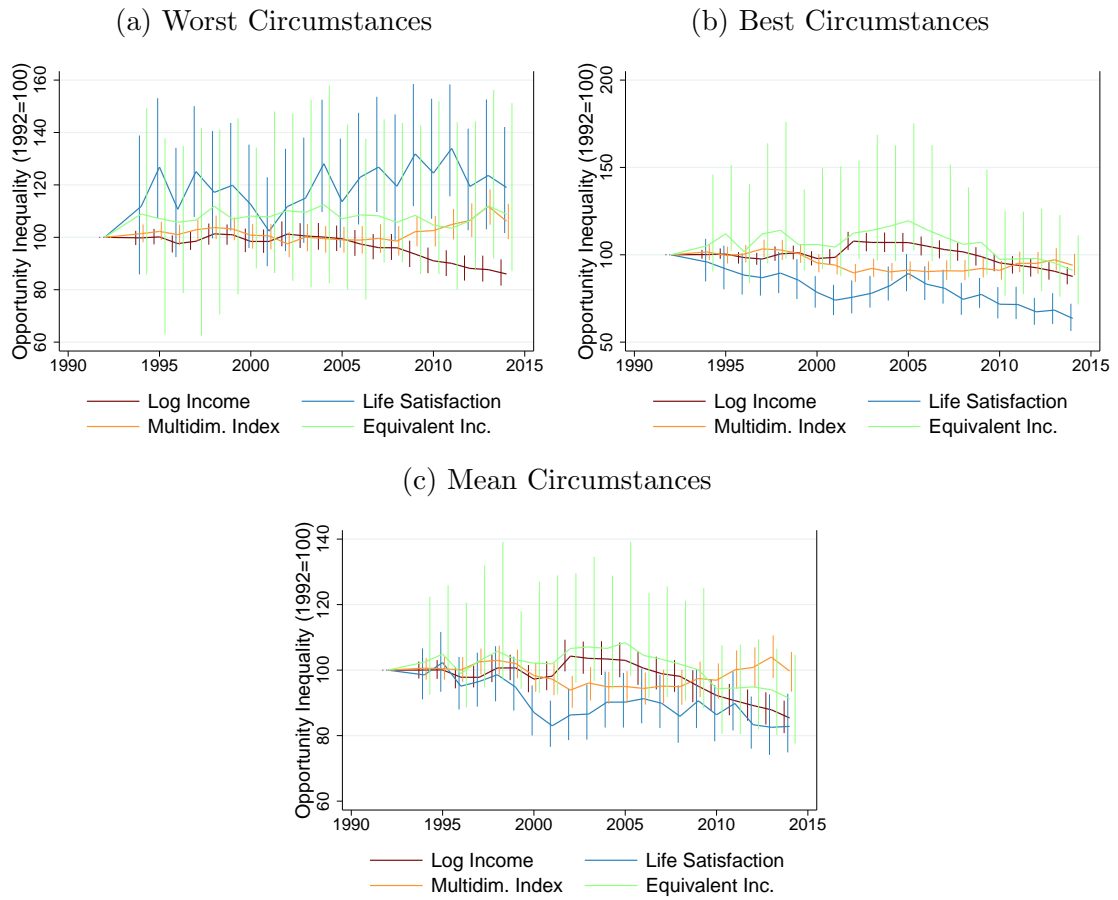
(a) Worst Circumstances

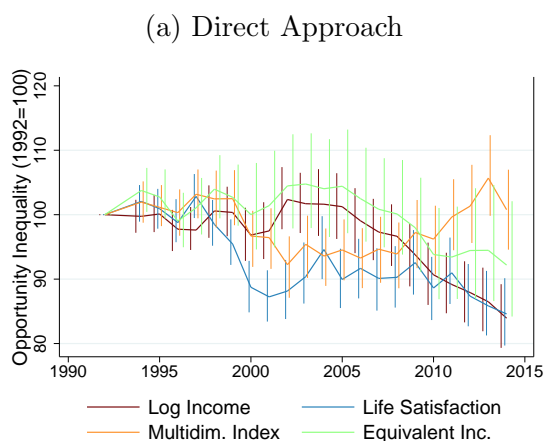(b) Best Circumstances

(c) Mean Circumstances

Notes: Development in inequality of opportunity in each well-being variable from 1992-2014 using the Generalized Proportionality Principle for different norm vectors. All estimates use the Magdalou-Nock divergence measure with $r = 1$.

Figure 8: Changing the Inequality Metric
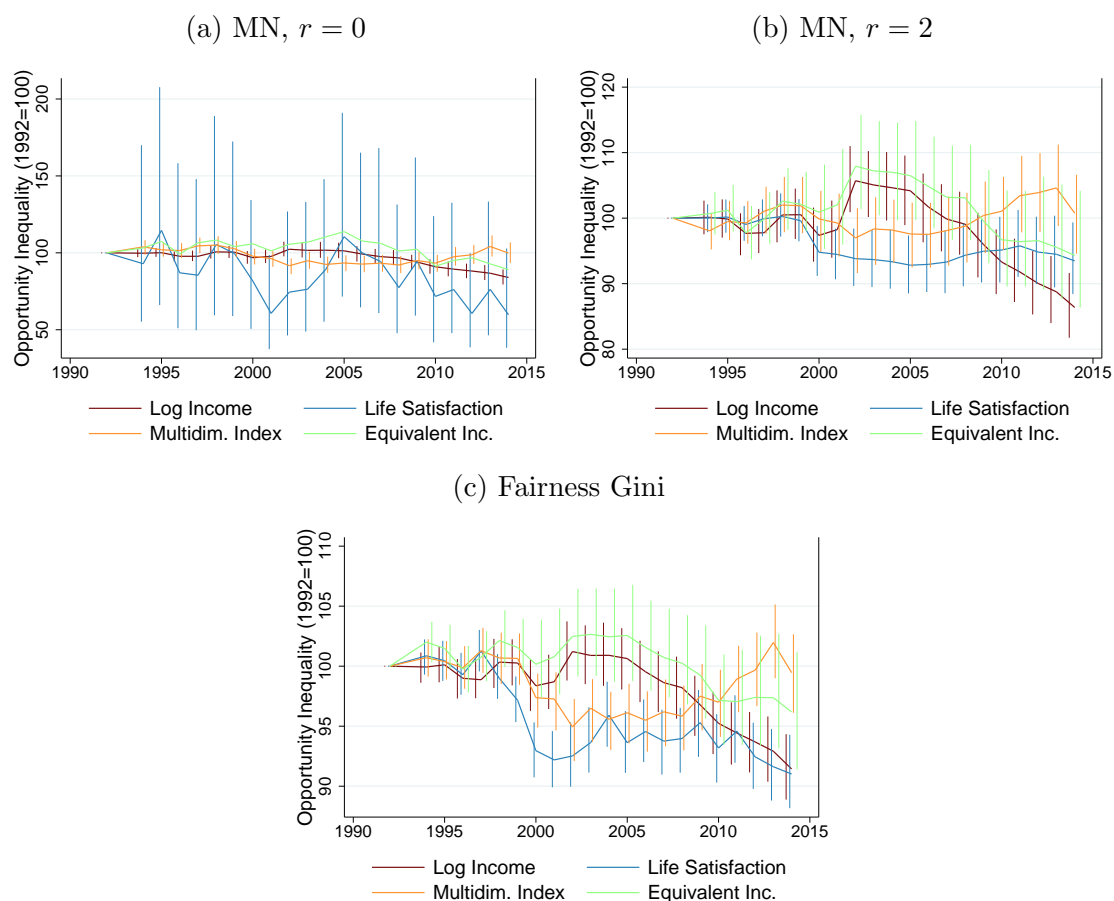
(a) MN, $r = 0$

(b) MN, $r = 2$

(c) Fairness Gini

Notes: Development in inequality of opportunity in each well-being variable from 1992-2014 using different divergence measures. All estimates use the egalitarian equivalent principle as fair allocation rule. Confidence bans for equivalent incomes in panel (a) explode and are therefore omitted from the figure.

Figure 9: Changing the Measurement Approach

(a) Direct Approach

Notes: Development in inequality of opportunity in each well-being variable from 1992-2014 using the direct approach. The estimates are based on the general entropy index with $r = 1$. To facilitate comparisons with our baseline approach, we likewise adjust the distribution of the unfair well-being levels to have a similar mean to the distribution of actual well-being levels before computing the inequality.

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