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Erratum

Inequality of opportunity in the United Kingdom, 1991–2008

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Abstract

We investigate the extent to which the tax-and-transfer system of the United Kingdom equalizes opportunities for income attainment among citizens. Within the framework of Roemer's theory of equality of opportunity, and using individual data from the *British Household Panel Survey* from 1991 to 2008, we calculate the tax rates necessary to equalize opportunities for different circumstances. We provide a ranking of these circumstances by the degree to which they influence income attainment. Although pre-fisc equality of opportunity increases over time, the tax rate necessary to equalize opportunities remains higher than the observed tax rate. Only under a relatively high labour supply elasticity the observed UK tax rate fares well in equalizing opportunities for income attainment.

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1. Introduction

Considerations of individual responsibility and opportunity increasingly have been introduced into formal economic theories that evaluate social states. The economic literature on Equality of opportunity (henceforth EO) explicitly builds on this new approach to egalitarianism, and transpires from Rawls (1971), introducing personal responsibility as an important qualifier of the

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degree of equality that is ethically desirable.¹ According to [Ferreira and Peragine \(2015\)](#), EO has become ‘the most prevailing conception of social justice in contemporary western societies’.

The key feature of responsibility-sensitive egalitarian theories is the idea that an equitable society is not necessarily a society that ensures all its citizens are equally rich or educated, but rather a society that ensures all its citizens have equal opportunities to attain the outcomes they care about. The development of this egalitarian theory is therefore characterized by shifting the focus from equality of outcomes to opportunities. This paper intends to evaluate the tax-and-transfer system of the UK between 1991 and 2008 with respect to the policy objective of EO. It bases its analysis on Roemer’s theory of EO, which suggests that fiscal policies must only redress inequalities of income due to circumstances beyond the individual’s control, leaving inequalities arising due to choices for which individuals are deemed responsible untouched.

Fiscal policies warranted under EO can serve as an important benchmark for policy makers when designing public policies. This analysis helps to identify those circumstances which most hinder citizens in their income attainment, and serves as a means to prioritize those groups of society which are most in need in fiscal policy. Fiscal policies based on EO can thereby improve the targeting of these groups.

We use the framework in [Roemer et al. \(2003\)](#) to determine both observed and EO policies. The empirical analysis applies this framework to different individual circumstances to investigate the extent to which these circumstances influence income acquisition across time. We compute the tax-and-transfer regime which would equalize opportunities, as far as possible, across citizens under each circumstance. Our empirical analysis uses data from the *British Household Panel Survey* (BHPS), observing roughly 5000 individuals from the UK for the time period of 1991 to 2008.

In short, the results suggest that if UK fiscal policy intends to equalize opportunities for income acquisition across citizens, policymakers should pay more attention to redress inequalities arising due to differences in gender as well as family background. We show that the extent to which the UK fiscal policy equalizes opportunities for income attainment depends on the societal judgment of relevant circumstances and the labour supply elasticity.

The outline of the paper is as follows. Section 2 recapitulates the main features of Roemer’s theory of equality of opportunity. Section 3 presents the theoretical framework by formalizing the fiscal policy required to attain EO. Our empirical strategy is outlined in section 4, presenting a description of the data and methodological considerations. Section 5 presents the results. Section 6 closes with a discussion of the results and the final conclusions.

2. Roemer’s theory of equality of opportunity

Roemer’s theory of EO seeks to identify policies which would equalize opportunities in domains such as income, education and health (first in [Roemer \(1993\)](#), but applied more broadly in [Roemer \(1998\)](#)). Roemer distinguishes between two types of inequalities in outcomes: those deemed ethically unacceptable and those deemed justifiable. Ethically unacceptable inequalities are related to individual’s circumstances. Circumstances are aspects of an individual’s environment which are beyond their control and can aid or hinder the capacity to achieve a certain outcome. According to EO, individuals should not be held accountable for their circumstances, and the

¹ These ideas have been further developed by others among [Dworkin \(1981a, 1981b\)](#), [Arneson \(1989\)](#), [Cohen \(1989\)](#) and [Vandenbroucke \(2001\)](#).

inequalities that they cause should be compensated for by society. The inequality argued to be acceptable arises through one's efforts. It is the individual's choice and responsibility to exercise effort in order to attain an outcome, and this effort should be rewarded. Part of the challenge for equalizing opportunities consists in deciding what is in the realm of the individual's responsibility and what lies outside it, and is thus considered a circumstance. We identify four different relevant circumstances and rank them according to their impact on inequality of opportunity.

The theory of EO revolves around five key concepts: objective, circumstances, effort, type and policy (Roemer et al., 2003: 541). Consider a population, divided into finite sets of types which comprise individuals with the same set of circumstances. Government desires to equalize the opportunities of individual attainment of the objective. The attainment of the objective is a function of the individual's effort, circumstances and the implemented social policy. Effort is assumed to be a choice variable to the individual, positively influencing the attainment of the objective, although this choice may be constrained by one's circumstances. The goal of the government is to find a policy which nullifies, to the greatest extent possible, the influence of circumstances on outcomes, whilst allowing outcomes to remain sensitive to effort. Not only is differentiating between what lies within and beyond the realm of the individual's control a challenge, but also comparing effort levels across different types is difficult, as effort may itself be influenced by one's circumstances.

Suppose, for example, children with parents from a low educational background on average tend to exercise less than other children. If the objective is life expectancy, one may consider the weekly hours of physical exercise as an effort variable. Its distribution will however differ across types. The individual's raw effort is therefore not an appropriate measure of effort as it is polluted by characteristics of the effort distribution of the respective type (see also Page & Roemer, 2001). Roemer et al. (2003) propose to construct an inter-type comparable measure of effort, that is, the quantile where an individual sits in the effort distribution of his or her type. Individuals are ranked on the effort distribution of their type, where two people from different types that lie in the same quantile of the effort distributions of their respective types are considered to expend the same level of effort. The use of the quantile measure of effort therefore removes the effect of circumstances on the distribution of effort across types, allowing to make comparisons of the degree of expended effort across types. Individuals are then to be held accountable for only the relative degree of expended effort and not the absolute levels of effort. Returning to our example of hours spent exercising, it might be the case that say three hours per week for someone from the lowest type is on a par, that is at the same quantile position within its type, with eight hours for a member of the highest type. The policy instrument succeeds in equalizing opportunities if individuals of different types at the same quantile of their respective effort distributions sit at the same quantile of the overall outcome distribution. Following this argument, EO of a certain objective is attained when the distributions of the objective are identical across types.

3. Equalizing opportunities through income taxation and transfers

This section gives the methodology of equalizing opportunity through income taxation and transfers, as set out in Roemer et al. (2003). Let *type*: $t \in T$, define a set of persons with the same circumstances. Individuals are partitioned into several types, characterized by their circumstances which may be social, genetic or biological. *Effort*: $\pi \in [0, 1]$, is an individual choice variable which positively influences the outcome. *Policy*: $\varphi \in \Phi$, is the opportunity-equalizing policy φ chosen from the set of feasible policies, Φ . Individual attainment of the objective, in this case income acquisition, is influenced by their respective circumstances, degree of effort, and the

applied policy. In this analysis, the policy is characterized as a tax-and-transfer system mapping pre-fisc (x) to post-fisc income (y). The generic policy applied is the pair (a, c) , where $y = (1 - a)x + c$ is post-fisc income under policy (a, c) . Each type has a distribution of the value of the objective, in this case post-fisc income. The *objective* $v^t(\pi, \varphi)$ is the value of the objective of an individual who is at the π_{th} quantile of the effort distribution in type t under policy φ .

If net income is taken as the objective, then EO seeks the fiscal policy φ which equalizes, as far as possible, the distributions of post-fisc income across types at any degree of effort (or effort quantile π) by solving the following problem:

$$Max_{\varphi \in \Phi} \int_0^1 Min_t v^t(\pi, \varphi) d\pi \tag{1}$$

Basically, the maximin procedure described by Eq. (1) first requires to identify the most disadvantaged type and then to select the tax-and-transfer policy which maximizes the average value of the objective for this type. Given a fiscal policy (a, c) , $y = (1 - a)wL + c$ is the post-fisc income of an individual with wage w and labour supply L . A uniform, quasi-linear utility function is assigned to each individual:

$$u(y, L) = y - \alpha L^{1+\frac{1}{\eta}} \tag{2}$$

with η representing the elasticity of labour supply with respect to wage. The optimal labour supply for individuals earning wage w and facing fiscal policy (a, c) , where $\hat{\alpha} \equiv \alpha(1 + 1/\eta)$, is:

$$L^* = \left[\frac{(1 - a)w}{\hat{\alpha}} \right]^\eta \tag{3}$$

and the associated pre-fisc income is:

$$x = wL^* = \left[\frac{(1 - a)}{\hat{\alpha}} \right]^\eta w^{1+\eta} \tag{4}$$

The government’s balanced budget constraint, with $f(w)$ giving the density function of wages, is:

$$a \int \left[\frac{(1 - a)}{\hat{\alpha}} \right]^\eta w^{1+\eta} f(w) dw = c + g \tag{5}$$

The LHS of Eq. (5) shows that government revenues are raised taxing gross income ($x = wL$) by a flat rate a . On the RHS are government expenditures, composed of per capita lump sum transfer c and non-transfer spending g . Solving for c , we then have:

$$c = a \left[\frac{(1 - a)}{\hat{\alpha}} \right]^\eta B - g \tag{6}$$

with $B = \int w^{1+\eta} dF$

Taking type 1 as the most disadvantaged group (defined by the circumstance), the average post-fisc income of the most disadvantaged group at policy (a, c) is:

$$\bar{y}_1 = (1 - a) \left[\frac{(1 - a)}{\hat{\alpha}} \right]^\eta A + a \left[\frac{(1 - a)}{\hat{\alpha}} \right]^\eta B - g \tag{7}$$

with $A = \int w^{1+\eta} dF_1$, dependent on the distribution of wages of the worst-off group.

The tax rate which maximizes tax revenues is $a = 1/(1 + \eta)$. The EO policy requires to maximize the value of post-fisc income \bar{y}_1 with respect to a , which gives the EO policy $\varphi(a^{EO}, c^{EO})$ with:

$$a^{EO} = \text{Max} \left[1 - \frac{\eta B}{(1 + \eta)(B - A)}, 0 \right] \tag{8}$$

B will typically be larger than A , so that $a^{EO} > 0$. However, if $(1 + \eta) A > B$, i.e. if the distribution of wages of the worst-off group (A) does not differ greatly from the distribution of wages of society as a whole (B), the equal opportunity tax will be zero. Generally, the higher η , the more A can be below B while still ending up with a zero a^{EO} . Stated otherwise, if pre-fisc inequality of opportunity is rather limited and η high, taxation would be counterproductive given the deadweight losses incurred.

As presented above, the wage distributions are used to compute the equal opportunity tax. Roemer et al. (2003) explain how these wage distributions are computed using the observed pre-fisc income. The assumption is made that pre-fisc income is produced by individuals which maximize utility, given their wage earning capacity w . At the observed policy a^{obs} , income must then be related to wages by the following relation (as defined in Eq. 4):

$$x^{obs} = \left[\frac{1 - a^{obs}}{\hat{\alpha}} \right]^\eta w^{1+\eta} \tag{9}$$

where α is calibrated assuming that the individual with median income x_m works one unit of time, which using Eq. (4) implies $\hat{\alpha} = (1 - a^{obs})w_m$. This relation can then be inverted to find the distribution of wages, F , which will be used to calculate the optimal EO fiscal policy.

From Eq. (9) follows that $w_i^{1+\eta} = x_i^{obs} w_m^\eta$, which makes it possible to express a^{EO} as a function of gross incomes. We rewrite A and B as follows, where \bar{x} represents mean gross income, and \bar{x}_1 represents the mean gross income of the most disadvantaged group:

$$\begin{aligned} B &= \int w^{1+\eta} dF = \int x_i^{obs} x_m^\eta f(x) dx = x_m^\eta \int x_i^{obs} f(x) dx = x_m^\eta \bar{x} \\ A &= \int w^{1+\eta} dF_1 = \int x_i^{obs} x_m^\eta f(x) dx_1 = x_m^\eta \int x_i^{obs} f(x) dx_1 = x_m^\eta \bar{x}_1 \end{aligned} \tag{10}$$

Substitution then yields a second definition of a^{EO} :

$$a^{EO} = \text{Max} \left[1 - \frac{\eta \bar{x}}{(1 + \eta)(\bar{x} - \bar{x}_1)}, 0 \right] \tag{11}$$

The actual tax regime is compared to the EO regime and to a benchmark policy, with $c = 0$. The benchmark policy is the rate at which pre-fisc income is to be taxed to raise just sufficient government revenues to fund non-cash, in-kind expenditures (g), but zero cash transfers. To determine g , set $c = 0$ in Eq. (6). Using $\hat{\alpha} = (1 - a^{obs})w_m$, this gives $g = aB/w_m^\eta$. Under the benchmark policy, \bar{y}_1^{bench} is the average post-fisc income of the worst-off type, defined by the relevant circumstance. Similarly, \bar{y}_1^{obs} is defined as the average post-fisc income of the worst-off type at the observed policy and \bar{y}_1^{EO} at the EO policy (each post-fisc income estimate is obtained using Eq. (7) under each tax policy). The index to measure the degree to which fiscal policy

equalizes opportunities for income acquisition, relative to the benchmark policy, is defined by Roemer et al. (2003: 548-9) as:

$$v = \frac{\bar{y}_1^{\text{obs}} - \bar{y}_1^{\text{bench}}}{\bar{y}_1^{\text{EO}} - \bar{y}_1^{\text{bench}}} \quad (12)$$

The value of v is the extent to which the observed policy equalizes opportunities, with the extremes of $v = 1$ when the observed policy is the EO policy and $v = 0$ when the observed policy is the benchmark policy.

The final step is to calculate the efficiency costs, or gains, of achieving EO, that is, to see the loss or increase in average incomes if the EO tax policy was to be enacted. Efficiency is then defined as the ratio of average pre-fisc income at the EO policy and the observed policy:

$$\varepsilon = \frac{\int x(w; \varphi^{\text{EO}}) dF(w)}{\int x(w; \varphi) dF(w)} \quad (13)$$

Therefore, $\varepsilon < 1$ indicates an efficiency cost when moving from the observed policy to the EO policy.

4. Empirical strategy

The objective of the empirical part of this study is to investigate the extent to which the fiscal system in the UK equalizes opportunities for income acquisition under different circumstances. We compute the existing and subsequently the opportunity equalizing tax-and-transfer system for each circumstance in order to judge to what extent the observed policy equalizes opportunities in the acquisition of income. This will be investigated for different sets of circumstances and over the time period of 1991-2008.

4.1. Data

The empirical analysis employs individual data from the original sample of the *British Household Panel Survey* (BHPS, 2009). This sample is representative of the British population (excluding Northern Ireland and North of the Caledonian Canal), and in the first wave consisted of 5050 households and 9092 individuals. In addition to extensive information on income and individual characteristics, the BHPS contains a range of variables on the background of respondents which will be used to classify types. The sample has been restricted to prime aged adults of 25–50 years and contains over 60,000 observations, where the average age is 38.

The outcome variable of this analysis is individual post-fisc income. Pre-fisc income is calculated using the individual's annual labour income, for which the BHPS contains a measure. The measure for individual net income from labour however had to be estimated. To this end, the BHPS was merged with the *Derived Current and Annual Net Household Income* dataset, which provides derived household net income variables for the BHPS. Individual annual net income from labour (\hat{y}_i) was derived using the ratio of gross individual (x_i) to gross household annual

Table 1

Annual levels of \bar{x} and \bar{x}_1 (in nominal GBP) for selected years, number of observations are between brackets.^a

	Gender		PED		PSEC		School type	
	A (φ)	B (All)	A (Low)	B (All)	A (Low)	B (All)	A	B (All)
1991	5652 (2604)	9574 (4888)	8371 (612)	9486 (1631)	8386 (1762)	9731 (4619)	8331 (1867)	9583 (4849)
1995	7434 (2124)	11,451 (3860)	9665 (676)	11,405 (1977)	9892 (1138)	11,964 (3116)	9725 (1162)	11,876 (3324)
1999	8679 (1872)	12,900 (3412)	11,581 (746)	13,286 (2330)	11,357 (873)	13,456 (2356)	10,838 (791)	13,504 (2503)
2003	11219 (1587)	16,319 (2918)	14,185 (823)	16,655 (2755)	14,540 (584)	17,092 (1656)	14,866 (465)	17,232 (1760)
2007	13570 (1326)	19,025 (2428)	16,932 (528)	20,105 (1948)	16,190 (366)	20,025 (1064)	17,564 (248)	20,339 (1139)

^a Due to missing observations for certain variables, estimations of B slightly differ between the typologies. There are no missing observations for gender, hence making these estimations of B those for the entire sample. Attrition explains the lower number of observations in later years.

labour income (x_{hh}), assuming this same ratio holds with net household income (y_{hh}),² according to Eq. (14). All income variables are expressed in annual nominal British pounds.

$$\hat{y}_i = \frac{x_i}{x_{hh}} \cdot y_{hh} \quad (14)$$

In order to analyse EO for income in the UK, the types are partitioned using information on individual circumstances available in the datasets. These measures include the educational qualifications and occupations of respondents' parents, respondents' gender and the type of school the respondent attended. We exploit the panel nature of the dataset, as for certain circumstances questions were only posed in a select number of waves. As these circumstances pertain to individual-level constants, such as gender, we can use the answers respondents gave in one wave to define this respondents' type in all waves. For circumstances related to parental background, we use highest educational qualification and occupation between both parents.

Table 1 shows levels for \bar{x} and \bar{x}_1 when partitioning individuals into the four main typologies applied in this paper.

4.2. Method

The empirical strategy largely mirrors Roemer et al. (2003) in the calculation of the optimal EO policy. The following steps were undertaken:

4.2.1. Identification of observed taxation policy

In order to obtain estimates of the actual mapping of pre-fisc income (x_i) into estimated post-fisc income (\hat{y}_i), post-fisc income is regressed on pre-fisc income for each year:

$$\hat{y}_i = \beta_0 + \beta_1 x_i + \varepsilon_i \quad (15)$$

² For annual net household income we take total annual net income minus annual investment income.

The estimated value of β_0 is the observed value of the lump-sum household transfers (c^{obs}) and that of β_1 is one minus the observed value of the tax rate ($1 - a^{\text{obs}}$). All types are taxed at the same rate which means there is no change of rank between pre- and post-fisc income distributions and no change in rank position between types. These regressions are run for each year under analysis to calculate the observed tax-and-transfer regime of the UK.³ Finally, the difference between average pre-fisc and average post-fisc income under the observed fiscal policy is taken as an approximation of per capita government expenditures, g , as expenditures on public goods and in-kind services such as education and health care which are financed by taxing pre-fisc incomes while not contributing to post-fisc incomes. In other words, taxation and redistributing the revenues in the form of lump sum cash transfers does not drive a wedge between mean gross and net income, whereas taxation of gross income to fund non-cash, in-kind expenditures causes mean pre-fisc income to be higher than post-fisc income.

4.2.2. Division into types

Identifying all circumstances that influence income acquisition is clearly beyond reach. In practice, only some of these circumstances are observable and can be identified, which are then used to define and partition the types. The EO policy will therefore tend to undercompensate those individuals with disadvantageous circumstances (Roemer et al., 2003: 542), as effort is considered as the entire residual (for example, luck and natural ability are not accounted for and therefore enter the effort residual along with other, unidentified or unobservable, circumstances).⁴ The sample is partitioned into types based on the following circumstances: educational qualifications and occupation status of respondent's parents, gender and the type of school the respondent attended.

4.2.3. Calculation of the optimal taxation policy

The next step is to simulate the opportunity-equalizing tax policy that tries to equalize the expected post-fisc income between different types. Simulations are made using a wage elasticity of labour η of 0.06, in line with Roemer et al. (2003: 549). Generally, the smaller the labour supply elasticity, the smaller the disincentive effects of taxation, and hence the higher the EO tax rate will be. The opportunity equalizing fiscal policy is then calculated under each circumstance by maximizing the average post-fisc income under policy (a, c) for the most disadvantaged type.

5. Results

Fig. 1 shows differences in the distribution of pre-fisc income for gender for the year 1991. Pre-fisc income distributions across different types are unlikely to be identical unless educational and other pre-fisc policies have effectively made up for disadvantageous circumstances that individuals face (Roemer et al., 2003).⁵ The tax-and-transfer system of the UK can therefore play an important role in levelling the playing field in income acquisition and rectifying the existent inequality. The equal opportunity fiscal policy aims to make the distributions of post-fisc income as close as possible, thus equalizing opportunities in income acquisition across types. Following the applied

³ On the basis of Cook's distance estimates (where Cook's $D > 1$), we drop fourteen influential outlier observations which exert high leverage and hence distort our tax estimates.

⁴ This component of luck is however argued to average out across individuals.

⁵ Partitioning the sample by an arbitrary variable (for instance odd or even survey identification number) however gives distribution functions of pre-fisc income which are identical. This shows the importance of choosing relevant circumstances beyond individual control which in reality hinder or aid the attainment of pre-fisc income across individuals.



Fig. 1. Cumulative distribution functions of pre-fisc income for male and females (for 1991).

Table 2

Equality of opportunity policy for even years, circumstance: gender ($\eta = 0.06$).

	a^{obs}	c^{obs}	a^{bench}	a^{EO}	c^{EO}	v	ε	p	q	q^{EO}
1992	0.30	1383	0.09	0.85	6934	0.71	0.91	0.44	0.50	0.87
1994	0.32	1706	0.10	0.84	7313	0.76	0.92	0.46	0.53	0.86
1996	0.33	1776	0.11	0.84	7845	0.76	0.92	0.46	0.53	0.86
1998	0.31	1791	0.11	0.83	8187	0.75	0.92	0.46	0.53	0.86
2000	0.31	2204	0.10	0.83	9416	0.76	0.92	0.48	0.55	0.86
2002	0.32	2662	0.11	0.82	10463	0.79	0.92	0.50	0.58	0.86
2004	0.34	3063	0.11	0.81	11101	0.82	0.93	0.52	0.60	0.86
2006	0.34	3403	0.10	0.80	11823	0.84	0.93	0.53	0.61	0.86
2008	0.35	3784	0.10	0.80	12820	0.83	0.93	0.52	0.61	0.86

framework the policy maker thus seeks a policy which maximizes the area to the left of the post-fisc distribution function of the most disadvantaged type, which is bounded by the axes and line $F = 1$ (Roemer et al., 2003: 546).

Fig. 1 shows males on average are more active on the labour market, as the vertical section at zero labour income is shorter. Traditional household roles may account for a large part of this variation, implying part of the inequality of opportunity does not stem from gender per se, but from outcomes certain social norms can have through gender. Though ideally we would discern between both aspects, we could argue, as does Roemer (1998), that the distribution of effort levels in each type is itself a characteristic of the type.

Tables 2–5 present the calculations for differently defined types under the assumption of $\eta = 0.06$ for the 18 years under analysis. Table 2 includes the calculations of a^{obs} and c^{obs} , which are the regression coefficients of the best fitting line of Equation 15. a^{bench} is the proportional tax rate just sufficient for non-transfer government expenditures. Under the observed UK fiscal policy, the effective tax rate is around 30%, noting the UK spends around ten percent of national income on government services. The difference between a^{obs} and a^{bench} represents the part of income taxation used for redistribution.

We find that pre-fisc EO, reported in the p column, is very low for the earlier years of analysis, where the average pre-fisc income of the worst-off type (females) is less than half of the average pre-fisc income of the best-off type (males). This ratio increases to just above 50 percent in later

Table 3

Equality of opportunity policy for even years, circumstance: type of school attended ($\eta = 0.06$).

	a^{EO}	c^{EO}	v	ε	p	q	q^{EO}
1992	0.66	5523	0.94	0.95	0.60	0.65	0.83
1994	0.65	5944	0.95	0.96	0.46	0.52	0.71
1996	0.71	7032	0.92	0.95	0.54	0.60	0.80
1998	0.69	7205	0.93	0.96	0.60	0.65	0.82
2000	0.65	7783	0.95	0.97	0.55	0.60	0.76
2002	0.58	7919	0.97	0.98	0.63	0.69	0.79
2004	0.64	9414	0.96	0.96	0.59	0.65	0.80
2006	0.66	10550	0.96	0.96	0.50	0.57	0.74
2008	0.60	10591	0.97	0.97	0.53	0.60	0.73

Table 4

Equality of opportunity policy for even years, circumstance: parental education ($\eta = 0.06$).

	a^{EO}	c^{EO}	v	ε	p	q	q^{EO}
1992	0.61	5073	0.98	0.97	0.68	0.72	0.83
1994	0.70	6028	0.96	0.95	0.68	0.73	0.86
1996	0.67	6238	0.97	0.96	0.68	0.73	0.85
1998	0.64	6439	0.98	0.96	0.71	0.75	0.85
2000	0.68	8002	0.98	0.96	0.70	0.74	0.86
2002	0.69	9018	0.96	0.95	0.68	0.74	0.86
2004	0.70	9998	0.96	0.95	0.67	0.72	0.86
2006	0.71	11070	0.96	0.95	0.66	0.72	0.86
2008	0.70	11885	0.96	0.95	0.63	0.69	0.84

Table 5

Equality of opportunity policy for even years, circumstance: parental socio-economic status ($\eta = 0.06$).

	a^{EO}	c^{EO}	v	ε	p	q	q^{EO}
1992	0.67	5722	0.93	0.96	0.61	0.66	0.83
1994	0.64	5850	0.96	0.96	0.61	0.66	0.80
1996	0.64	6409	0.96	0.96	0.62	0.67	0.81
1998	0.62	6428	0.96	0.97	0.63	0.68	0.81
2000	0.61	7289	0.96	0.97	0.62	0.67	0.80
2002	0.64	8709	0.95	0.96	0.60	0.65	0.80
2004	0.65	9486	0.96	0.96	0.56	0.62	0.78
2006	0.71	11,260	0.93	0.95	0.57	0.64	0.82
2008	0.75	13,007	0.90	0.94	0.59	0.66	0.86

years. The increase in pre-tax EO is partly reflected in the decline of the optimal equal opportunity tax, a^{EO} , declining by just over 5 percentage points over the time period. The v column reports the distance between the observed fiscal policy and the equal opportunity policy. We can see how this parameter increases over the twenty years under analysis where, by 2008, the observed policy achieves equalization of opportunity to a degree of 83%. The efficiency ratio, ε , slowly increases over time, where efficiency costs ($\varepsilon < 1$) in terms of national income from moving towards the EO tax rate are around 7 percent in 2008. The efficiency costs of moving to this very high tax rate are

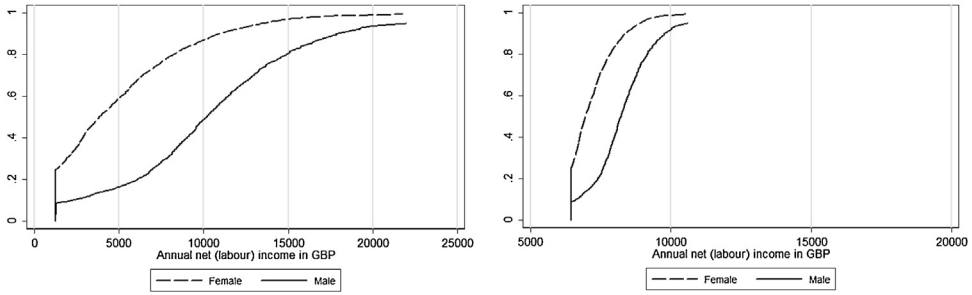


Fig. 2. Post-fisc income distributions under observed (left) and EO (right) fiscal policy in case of gender (for 1991).

relatively small, as we operate under the assumption of a low labour supply elasticity ($\eta = 0.06$).⁶ Labour supply thus reacts very little to tax increases, and hence the costs of implementing the equal opportunity policy in terms of individual labour earnings are small. Note that although a^{EO} declines, v increases, which can only happen if p has increased, that is, a decline in a^{EO} still gives a higher value for v due to a decline in pre-fisc inequality of opportunity.

The final columns q and q^{EO} report post-fisc inequality of income respectively. These are calculated as the ratio of the average post-fisc income of the lowest type to the average post-fisc income of the highest type under the observed fiscal policy in the case of q and under the EO policy in the case of q^{EO} . Under the EO tax, as expected, there is a much higher equality of post-fisc income, where female’s average post-fisc income is around four-fifths that of males. Fig. 2 shows the extent to which each of the fiscal policies equalize the distribution functions of post-fisc income across types defined according to gender. As expected, the equal opportunity fiscal policy narrows the gap between the distribution functions of post-fisc income across types — equalizing, as far as possible, opportunities for income attainment where the remaining differences in income are attributed to differences in effort.

In order to better grasp changes in the EO tax over time, we take the total differential of Eq. (8) with respect to A and B , which gives:

$$da^{EO} \geq 0 \Leftrightarrow \frac{\eta(1 + \eta)}{[(1 + \eta)(A - B)]^2} \{AdB - BdA\} \geq 0 \tag{16}$$

We can rewrite this to the following inequality, implying it is the relative degree to which income of the worst-off group (A) changes compared to how income of society as a whole (B) changes, which causes EO to either increase or decrease over time:

$$da^{EO} < 0 \Leftrightarrow \frac{dA/A}{dB/B} > 1 \tag{17}$$

Eq. (17) shows that if the worst-off group (e.g. in this case females) catch up, that is their mean income rises faster than mean income of the whole population, then a^{EO} will fall. A rising tide of economic growth lifting all boats is only conducive to EO if the rising tide lifts certain boats (i.e., A ’s) more than others. For estimates of this relationship between economic growth and income dynamics of specific income groups, see Herzer and Vollmer (2013).

Table 3 presents the results when defining types by the type of school attended. Those who attended grammar or private schools have on average a higher pre-fisc income than the worst-off

⁶ In Fig. 4, we present results for η equal to 0.12.

group who attended secondary modern schools.⁷ The mean age of members of this latter group significantly differs from the mean age of all respondents, as, on average, those who attended secondary modern schools are around three years younger.⁸ As this fact may distort our estimation of mean income B , we correct for age applying a two-fold Blinder–Oaxaca decomposition (see e.g. Neumark, 1999; Oaxaca, 1973). This technique decomposes the EO tax rate into an outcome differential which can be explained by differences in age between types and an unexplained outcome differential, which we can then argue to directly follow from inequality of opportunity.

We find an a^{EO} of on average 0.64, roughly twice that of a^{obs} . The worst off group on average earn 56% (see column p) of the best performing group (former grammar or private school students). Post tax-and-transfer this increases to 62% (column q), while EO tax rates would, on average, bring this post-fisc figure to 78% at an efficiency cost ε of on average 4%.

The educational qualifications and social status of one's parents certainly are beyond one's control. The worst-off group are those whose parents never went to school or left school with no qualifications (Table 4) and with respect to social status, those respondents whose parents are or were plant and machine operatives or have or had non-classifiable occupations according to the Standard Occupational Classification (SOC group levels 8 and 9) (Table 5). Both measures capturing parental background show similar findings with respect to EO. In both cases v is below unity for all years, while polarization captured by p remains rather constant.

We tested a number of additional circumstances, such as birth order. We find the worst-off group constitutes those born second or later, yet note this group represents over 75% of the sample. This fact causes the difference between the wage distributions of the worst-off group (A) and of society as a whole (B) to be small, driving a^{EO} to zero. When the difference between the overall wage distributions and the worst-off group is very small, the EO tax becomes zero, as the low inequality of opportunity can only be reduced by applying a positive tax, but incurring deadweight loss. One should in these cases be cautious interpreting such a zero tax rate as the realization of equal opportunities for all, but rather as achievement of EO, given the scope for redistribution in the face of potential deadweight losses. In other words, given a wage elasticity of η , the deadweight loss may in certain cases be greater than the counteracting benefit of more EO (Roemer et al., 2003, p. 548). We are hence more likely to find positive EO tax rates when defining circumstances such that the worst-off group constitutes a small minority, as is the case for all the circumstances captured above (with the exception of gender). One way to arrive at such minorities is to take into account more than a single circumstance, by further refining types in the calculation of equality of opportunity.⁹

⁷ Can we define school type as a circumstance? One may for instance consider one's choice of school type a choice rather than a circumstance. Dworkin's (1981b) competing theory of Equality of Resources would argue if one's choice of school type follows from one's preferences, one should be held accountable for one's school choice. 'According to Dworkin's view', writes Roemer (1998: 19), 'the type 1 young person who cuts school because she has a distaste for it – a distaste not uncommon among those of her type – would be accountable for that action, as long as she identifies with her preferences, is glad she has them, and sees no reason to change them.' Roemer disagrees, in turn claiming her preferences may be merely what she falsely deems to be necessity, and hence would argue one's school type to be a circumstance, fitting within the EO framework.

⁸ The early tripartite system of state funded secondary school education in the UK was made up of grammar schools, secondary technical and secondary modern schools. Allocation was based on pupils' performance in an examination. As this system has since been abolished and today comprehensive schools are in place, the observed differences in the mean ages of respondents between the groups are likely a function of these institutional changes.

⁹ As Roemer (1998: 31) remarks "... it is intuitively reasonable to believe that as the set of types becomes very large, and each type comes to comprise a very small fraction of the population, the equal-opportunity policy approaches the Rawlsian policy."

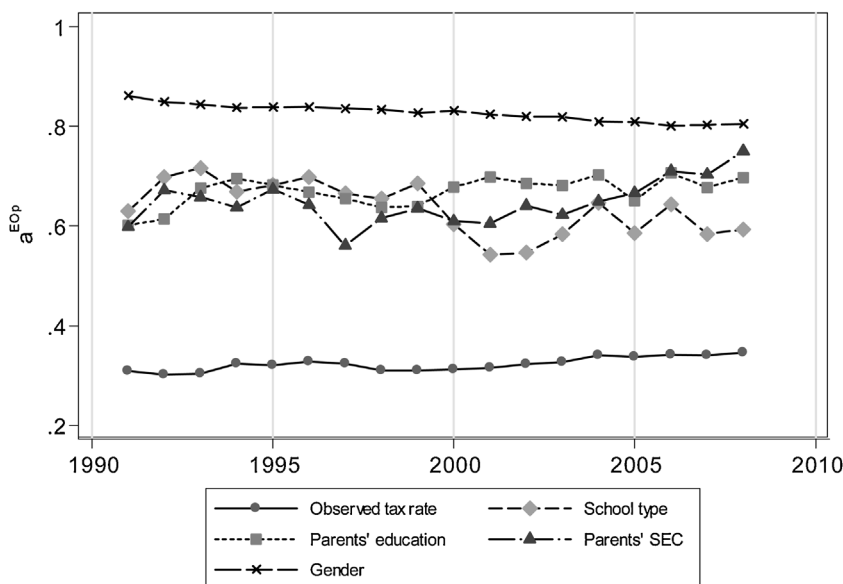


Fig. 3. The observed UK tax rate and the opportunity-equalizing tax rate under single circumstances, $\eta=0.06$.

Fig. 3 collapses the EO tax rates under each of the circumstances into one graph, pitched against the observed UK tax regime for every year under analysis. This serves as a ranking in terms of the importance of each of the circumstances in terms of their influence on income attainment. We see that gender is the circumstance which most influences individuals' attainment of gross income. Parents' education and socio-economic class can be seen to acquire a relatively important and similar influence on income attainment, as does school type, and would require tax levels above those we observe for the UK.

This final association shows that both parental education and socio-economic class as defined by occupation—often used as family background measures in inequality and intergenerational social mobility studies, serve almost identical as predictors of income attainment. While the transmission mechanisms of advantages from parents to children arguably differs between both these circumstances (see Davis-Kean, 2005; Chevalier, Harmon, O'Sullivan, & Walker, 2013), where the cultural channel of transmission of advantages from parents to children may be captured by the educational level of the parents, while the financial channel may be better captured by the parents socio-economic class, we find both circumstances are strongly associated and hence require similar tax rates to equalize opportunities. Using just one of the measures in isolation may thus be sufficient to capture the need for redistribution based upon family circumstances.

Fig. 4 presents the results under the assumption of a labour supply elasticity with respect to wage of 0.12, as opposed to 0.06. A higher value for η will mean a larger income loss due to taxation, and hence lead to a lower EO tax rate (Roemer et al., 2003: 549). For the circumstance of gender, we find the observed fiscal policy in the UK is still unable to equalize opportunities, while the UK tax-and-transfer system seems to accommodate EO relatively well with respect to all other typologies. Under the assumption of a higher wage elasticity the UK tax regime clearly fares much better with respect to equality of opportunity.

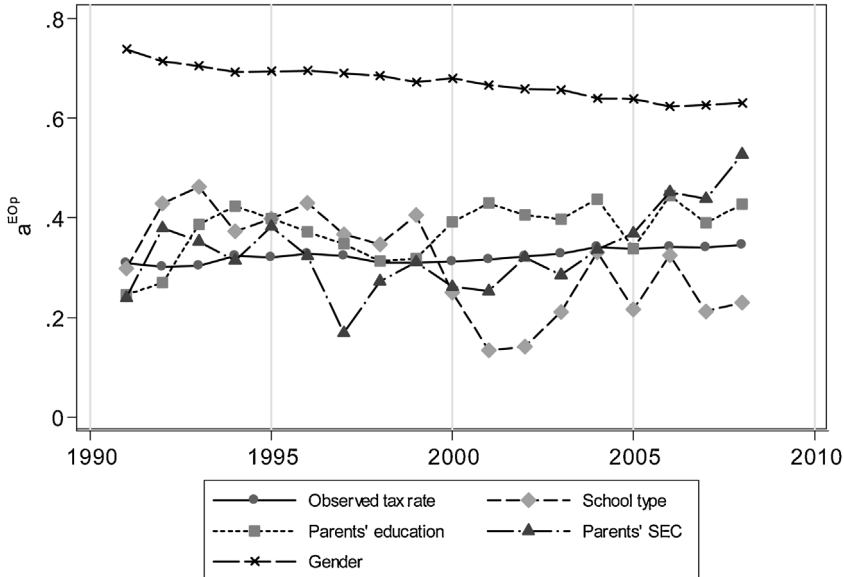


Fig. 4. Equality of opportunity tax rate with labour supply elasticity of 0.12.

6. Discussion and conclusions

Identifying those circumstances which most limit individuals in the attainment of income in a given society and identifying the part of inequality related to these observable circumstances can be of great value to policymakers in improving and updating the design and implementation of practical redistributive public intervention. Although Roemer regards opportunities as the appropriate equalizandum, he does not explore the precise grounds on which compensation should be sought — merely endorsing a distinction between effort and circumstances, where on the basis of the latter compensation is sought (Risse, 2002). The extent to which opportunities are to be equalized, its particular conception of what equalizing opportunities requires and those disadvantageous circumstances for which compensation is required, are to be determined by the society at hand.

We investigate the extent to which the observed UK tax-and-transfer regime equalizes opportunities for income for gender, parental background and school choice. If fiscal policy is to be successful in correcting inequality of economic opportunity in the UK, policymakers must go further in mitigating effects of gender as well as socio-economic characteristics of individuals on income attainment. We find observed tax rates are around half those necessary to correct for parental background variables, and around one third those necessary to correct for gender differences in income attainment. We however do show findings largely depend on both the labour supply elasticity with respect to wages. If individuals' labour supply decisions are affected more by tax increases than assumed above, there is less room to use the tax-and-transfer system to reach equality of opportunity.

Beyond redistributive policies through the tax-and-transfer system, our findings could call for redistributive policies, aiming to curb income inequalities in the distribution of pre-fisc incomes deriving from circumstances beyond individuals' control. A promising avenue for such policies is in education. As our findings show the type of primary school to be an important determinant

of one's income later in life, reducing its importance through policies such as expanding free schools and the reviving (selective) grammar schools may be in order. Betts and Roemer (2005) argue Roemer's EO theory has such implications for educational policies, and show EO educational policies in the United States would require fivefold spending on each child from the lowest parental educational background, compared to children with parents from the highest educational background.¹⁰ This is in line with the current debate in the UK, following the PM Meritocracy speech of September 16, 2016. Under a given educational budget, policies would imply spending more resources on disadvantaged children, ranging from free child care in the early years, placing high-quality teachers in poor areas, and improving the quality of technical educations in which most children from a low parental educational background end up, which, given a limited educational budget, implies less funding for other school types.¹¹

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¹⁰ Fields (2007: 584) in discussing the dynamics of income inequality in the USA also advocates for a program 'offering improved opportunities to the lower classes'. See also Mongan, Santin, and Valiño (2011) for a similar analysis of EO policy in education in the Buenos Aires area.

¹¹ See e.g. the cross-partisan plea against more grammar schools and selection by Nicky Morgan, Lucy Powell and Nick Clegg in *The Guardian*, March 19, 2017.