"Equality of opportunity*"

by

John E. Roemer

and

Alain Trannoy

1. Introduction

In the welfarist tradition of social-choice theory, egalitarianism means equality of welfare or utility[1]. Conservative critics of egalitarianism rightly protest that it is highly questionable that this kind of equality is ethically desirable, as it fails to hold persons responsible for their choices, or for their preferences, or for the way they process outcomes into some interpersonally comparable currency that one can speak of equalizing. In political philosophy, beginning with John Rawls (1958, 1971), this critique was taken seriously, and a new approach to egalitarianism developed, which inserted personal responsibility as an important qualifier of the degree of equality that is ethically desirable. Thus, the development of egalitarian theory, since Rawls, may be characterized as an effort to replace equality of outcomes with equality of opportunities, where opportunities are interpreted in various ways. Metaphors associated with this view are 'leveling the playing field,' and 'starting gate equality.' The main

* We thank Tony Atkinson, François Bourguignon, Marc Fleurbaey, Pedro Rosa Dias and Erik Schokkaert for their comments and advice on previous drafts of this paper, which will appear, in a somewhat different form in the forthcoming *Handbook of Income Distribution* (eds., A. Atkinson and F. Bourguignon).

[1] Welfarism is the view that social welfare (or the social objective function) should be predicated only on the utility levels of individuals; that is, that the only information required to compare social alternatives is that summarized in the utility-possibilities sets those alternatives generate. (Thus, considerations of property rights, or the processes by which the social state came about, are irrelevant, if they cannot be recovered from utility information.) Welfarism is a special case of consequentialism, which says that the ranking of social alternatives should depend only on outcomes.

philosophical contributions to the discussion were, following Rawls, from Amartya Sen (1980), Ronald Dworkin (1981a, 1981b), Richard Arneson (1989) and G.A. Cohen (1989)[2]. The debate is said to be about 'equality of what,' and the philosophical view is sometimes called 'luck egalitarianism,' a term coined by Elizabeth Anderson (1999).

Economists (besides Sen) have been involved in this discussion from 1985 onwards. John Roemer (1993, 1998) proposed an algorithm for calculating policies that would equalize opportunities for achievement of a given objective in a population. Marc Fleurbaey and François Maniquet contributed economic proposals beginning in the 1990s, and recently summarized in Fleurbaey (2008). Other authors who have contributed to the theory include Walter Bossert (1995, 1997), Vito Peragine (2004), and Dirk Van de gaer (1993). An empirical literature is rapidly developing, calculating the extent to which opportunities for the acquisition of various objectives are unequal in various countries, examining the opportunity-equalizing effects of policy, and inquiring whether people hold views of justice consonant with equality of opportunity.

There are various ways of summarizing the significance of these developments for the economics of inequality. Prior to the philosophical contributions that ignited the economic literature that is our focus in this article, there was an earlier skirmish around the practical import of equalizing opportunities. Just before the publication of Rawls's magnum opus (1971), contributions by Arthur Jensen (1969) and Richard Herrnstein (1971) proposed that inequality was in the main due to differential intelligence (IQ), and so generating a more equal income distribution by equalizing opportunities (for instance, through compensatory education of under-privileged children) was a chimera. Economists Samuel Bowles (1973) and John Conlisk (1974) disagreed; Bowles argued that inequality of income was almost all due to unequal opportunities, not to the heritability of IQ. Despite this important debate on the degree to which economic inequality is immutable, prior to Rawls, economists' discussions of inequality were in the main statistical, focusing on the best ways of measuring inequality.

---

[2] The philosophical literature generated by these pioneers is too large to list here. Book-length treatments that should be mentioned are Rakowski (1993) , Van Parijs (1997), and Hurley (2003) .

The post-Rawls-Dworkin inequality literature changed the focus by pointing out that only some *kinds* of inequality are ethically objectionable, and to the extent that economists ignore this distinction, they may be measuring something that is not ethically or politically salient. This distinction between morally acceptable and unacceptable inequality is perhaps the most important contribution of philosophical egalitarian thought of the last forty years. From the perspective of social-choice theory, equal-opportunity theory has sharply challenged the welfarist assumption that is classically ubiquitous, maintaining that more information than final outcomes in terms of welfare is needed to render social judgment about the ranking of alternative policies – in particular, one must know the extent to which individuals are responsible for the outcomes they enjoy – and this is non-welfare information.

One must mention that another major non-welfarist theory of justice, but an inegalitarian one, was proposed by Robert Nozick (1973) who argued that justice could not be assessed by knowing only final outcomes; one had to know the process by which these outcomes were produced. His neo-Lockean view, which proposed a theory of the moral legitimacy of private property, can evaluate the justness of final outcomes only by knowing whether the history that produced them was unpolluted by extortion, robbery, slavery, and so on. Simply knowing the distribution of final outcomes (in terms of income, welfare, or whatever) would not suffice to pass judgment on the distribution's moral pedigree. So the period since 1970 has been one in which, in political philosophy, non-welfarist theories flourished, on both the right and left ends of the political spectrum.

We begin by summarizing the philosophical debate concerning equality since Rawls (section 2). The next three sections (3-5) review economists' reactions to this debate, and present economic algorithms for computing policies that equalize opportunities, inspired by the debate -- or, more generally, methods of ordering social policies with respect to their efficacy in opportunity equalization. Section 6 applies the approach to the conceptualization of economic development. The next sections raise dynamic issues (section 7), discuss policies for equalizing opportunities for three important kinds of objective (section 8), and review measurement issues, with a summary of the empirical literature on inequality of opportunity to date (section 9). We conclude

with mention of some critiques of the equal-opportunity approach, and some predictions (section 10).

2. Egalitarian political philosophy since Rawls

John Rawls (1958) first published his ideas about equality over fifty years ago, although his magnum opus did not appear until 1971. His goal was to unseat utilitarianism as the ruling theory of distributive justice, and to replace it with a type of egalitarianism. He argued that justice requires, after guaranteeing a system that maximizes civil liberties, a set of institutions that maximize the level of 'primary goods' allocated to those who are worst off in society, in the sense of receiving the least amount of these goods. Economists call this principle 'maximin primary goods;' Rawls often called it the difference principle. Moreover, he attempted to provide an argument for the recommendation, based upon construction of a 'veil of ignorance' or 'original position,' which shielded decision makers from knowledge of information about their situations that was 'morally arbitrary,' so that the decision they came to regarding just allocation would be impartial. Thus Rawls's (1971) project was to derive principles of justice from rationality and impartiality.

Rawls did not advocate maxi-minning utility (even assuming interpersonal utility comparisons were available), but rather maxi-minning some index of primary goods. This was, in part, his attempt to embed personal responsibility into the theory. For Rawls, welfare was best measured as the extent to which a person is fulfilling his plan of life: but he viewed the choice of life plan as something up to the individual, which social institutions had no business passing judgment upon. Primary goods were deemed to be those inputs that were required for the success of any life plan, and so equalizing primary-goods bundles across persons (or passing to a maximin allocation that would dominate component-wise an equal allocation) was a way of holding persons responsible for their life-plan choice. The question of how to aggregate the various primary goods into an index that would allow comparison of bundles was never successfully solved by Rawls (and some skeptical economists said that the subjective utility function was the obvious way to aggregate primary goods).

Rawls defended the difference principle by arguing that it would be chosen by decision makers who were rational, but were deprived of knowledge about their own situations in the world, to the extent that this knowledge included information about their physical, social, and biological endowments, which were a matter of luck, and therefore whose distribution Rawls described as morally arbitrary. He named the venue in which these souls would cogitate about justice the 'original position.' In the original position, souls representing persons in the real world were assumed to know the laws of economics, and to be self-interested. They were, moreover, to be concerned with the allocation of primary goods, because they did not know their life plans, or even the *distribution* of life plans in the actual society. Nor were they to know the *distribution* of physical and biological endowments in society.

Here we believe Rawls committed a major conceptual error. If the veil of ignorance is intended to shield decision makers from knowledge of aspects of their situations that are morally arbitrary, and only of those aspects, they *should* know their plans of life, which, by hypothesis, are not morally arbitrary, because Rawls deems that persons are responsible for their life plans. Secondly, although a person's *particular* endowment of resources, natural and physical, might well be morally arbitrary (to the extent that these were determined by the luck of the birth lottery), the *distribution* of these resources is a fact of nature and society, and should be known by the denizens in the original position, just as they are assumed to know the laws of economics. Therefore, Rawls constructed his veil too thickly, on two counts, given his philosophical views.

Given the paucity of information available to the decision makers in the original position, it is not possible to use classical decision theory to solve the problem of the desirable allocation of primary goods. Indeed, the only precise arguments that Rawls gives for the conclusion that the difference principle would be chosen in the original position occur at Rawls (1999[1971], p. 134), and they essentially state that decision makers are extremely risk averse. For example:

> The second feature that suggests the maximin rule is the following: the person choosing has a conception of the good such that he cares very little, if anything, for what he might gain about the minimum stipend that he can, in fact, be sure of by following

> the maximin rule. It is not worthwhile for him to take a chance for the sake of further advantage, especially when it may turn out that he loses much that is important to him. The last provision brings in the third feature, namely, that the rejected alternatives have outcomes one can hardly accept. The situation involves grave risks.

But extreme risk aversion, which Rawls here depends upon for his justification of maximin, is certainly not an aspect of rationality.

Thus, despite its enormous influence in political philosophy, Rawls's argument for maximin is marred in two ways: first, its reliance on deducing the principle of justice from the original position was crucially flawed in depriving the denizens of that position of knowledge of features of themselves (life plans) and of the world (the distributions of various kinds of resources, including genetic ones, and ones possessed by families into which a person is born) which were *not* morally arbitrary[3], and second, for its assumption (despite claims to the contrary by Rawls and others) that decision makers were extremely risk averse. The value of Rawls's contribution is in stating a radical egalitarian position about the injustice of receiving resources through luck – and, in particular, the luck of the birth lottery – and in shifting the equalisandum from utility to a kind of resource, primary goods. In our view, however, the project of deducing equality or maximin from rationality and impartiality alone was a failure. Indeed, Moreno-Ternero and Roemer (2008) argue that some solidaristic postulate is necessary to deduce maximin or, more generally, to deduce some kind of egalitarianism as the ordering principle for social choice. Although egalitarians might wish to deduce their view from postulates that can garner universal approval (like rationality and impartiality), this is not possible. Therefore, an egalitarian theory of justice cannot have *universal* appeal, if the solidaristic postulate, which we believe necessary, is contentious.

Although Rawls is usually viewed as the most important egalitarian political philosopher of the twentieth century, one may challenge the claim that his view is egalitarian: to wit, the just income distribution, for Rawls, allows incentive payments to

---

[3] We reiterate it is the distribution of traits which is a fact of nature, and hence not morally arbitrary, while the endowment of a given individual may well be morally arbitrary, in the sense of being due to luck.

the highly skilled in order to elicit their productive activity, even though this produces inequality. The main philosopher who challenges Rawls's acceptance of incentive-based income inequality is G.A. Cohen, upon whom more below.

In 1981, Ronald Dworkin published two articles that essentially addressed the problems in the Rawlsian argument that we have summarized, although he did not use the Rawlsian language (original position, primary goods). His project was to define a conception of equality that was ethically sound. In the first of these articles, he argued that 'equality of welfare' was not a sound view, mainly because equality of welfare does not hold persons responsible for their preferences. In particular, Dworkin argued that if a person has expensive tastes, and he identifies with those tastes, society does not owe him an additional complement of resources to satisfy them. (The only case of expensive tastes, says Dworkin, that justifies additional resources are those tastes that are addictions or compulsions, tastes with which the person does not 'identify,' and would prefer he did not have.) In the second article, Dworkin argues for 'equality of resources,' where resources include (as for Rawls) aspects of a person's physical and biological environment for which he should not be held responsible (such as those acquired through birth).

But how can one 'equalize resources,' when these comprise both transferable goods, like money, and inalienable resources, like talents, families into which persons are born, and even genes? Dworkin proposed an ingenious device, an insurance market carried out behind a veil of ignorance, where the 'souls' participating represent actual persons, and know the preferences of those whom they represent, but do not know the resources with which their persons are endowed in the world. In this insurance market, each participant would hold an equal amount of some currency, and would be able to purchase insurance with that currency against bad luck in the birth lottery, that is, the lottery in which nature assigns souls to persons in the world (or resource endowments to souls). Dworkin argued that the allocation of goods that would be implemented after the birth lottery occurred, the state of the world was revealed, and insurance policies taken behind the Dworkinian veil were settled, was an allocation that 'equalized resources.' It held persons responsible for their preferences – in particular, their risk preferences—and was egalitarian because all souls were endowed, behind the veil, with

the same allotment of currency with which to purchase insurance. Impartiality with respect to the morally arbitrary distribution of resources was accomplished by shielding the souls from knowledge of their endowments in the actual world associated with the birth lottery (genetic and physical). Thus, Dworkin retained Rawls's radical egalitarian view about the moral arbitrariness of the distribution of talents, handicaps, and inherited wealth, but implemented a mechanism that held persons responsible for their tastes that was much cleaner than discarding preferences and relying on primary goods, as Rawls had done.

Despite the cleverness of Dworkin's construction, it can lead to results that many egalitarians would consider perverse. To illustrate the problem, consider the following example. Suppose there are two individuals in the world, Andrea and Bob. Andrea is lucky: she has a fine constitution, and can transform resources (wealth) into welfare at a high rate. Bob is handicapped; his constitution transforms wealth into welfare at exactly one-half of Andrea's rate. We assume, in particular, that Andrea and Bob have interpersonally comparable welfare. The internal resource that Andrea possesses and Bob lacks is a fine biological constitution (say, a healthy supply of endorphins).

We assume that Bob and Andrea have the same risk preferences over wealth: they are each risk averse and have the von Neumann – Morgenstern utility function over wealth $u(W) = \sqrt{W}$. Suppose that the distribution of (material) wealth in the world to (Andrea, Bob) would be (W^A, W^B), with no further intervention. Thus each individual is endowed with an internal constitution and wealth.

We construct Dworkin's hypothetical insurance market as follows[4]. Behind the veil of ignorance, there is a soul Alpha who represents Andrea, and a soul Beta who represents Bob. These souls know the risk preferences of their principals, and the constitutions of Andrea and Bob, but they do not know which person they will become in the birth lottery. Thus, from their viewpoint, there are two possible states of the world, summarized in the table:

[4] Dworkin did not propose a formal model, but relied on intuition. The model here is a version of an Arrovian market for contingent claims.

State 1	Alpha becomes Andrea	Beta becomes Bob
State 2	Alpha becomes Bob	Beta becomes Andrea

Each state occurs with probability one-half. *We* know that state 1 will indeed occur, but the souls face a birth lottery with even chances, in which they can take out insurance against bad luck (that is, of becoming Bob).

There are two commodities in the insurance market: a commodity x_1, a unit of which pays the owner \$1 if state 1 occurs, and a commodity x_2 a unit of which pays \$1 if state 2 occurs. Each soul can either purchase or sell these commodities: selling one unit of the first commodity entails a promise to deliver \$1 if state 1 occurs. Each soul possesses, initially, zero income (behind the veil) with which to purchase these commodities. In particular, they have *equal wealth endowments* behind the veil in the currency that is recognized in that venue. Thus, the insurance market acts to redistribute tangible wealth in the actual world to compensate persons for their natural endowments, which cannot be altered, in that way which the souls, who represent persons, would desire, had they been able to insure against the luck of the birth lottery. It is an institution that transforms what Dworkin calls 'brute luck' into 'option luck.' The former is luck which is not insurable; the latter is luck whose outcome is protected by insurance, or the outcome of a gamble one has chosen to take.

An equilibrium in this insurance market consists of prices $(1, p)$ for commodities (x_1, x_2), demands $(x_1^\alpha, x_2^\alpha), (x_1^\beta, x_2^\beta)$ by souls Alpha and Beta for the two contingent commodities, such that

(1) (x_1^α, x_2^α) maximizes $\frac{1}{2}\sqrt{W^A + x_1^\alpha} + \frac{1}{2}\sqrt{\frac{W^B + x_2^\alpha}{2}}$
subj. to $x_1^\alpha + p x_2^\alpha = 0$

(2) (x_1^β, x_2^β) maximizes $\frac{1}{2}\sqrt{W^B + x_1^\beta} + \frac{1}{2}\sqrt{2(W^A + x_2^\beta)}$
subj. to $x_1^\beta + p x_2^\beta = 0$

(3) $x_s^{\alpha} + x_s^{\beta} = 0$ for $s = 1,2$.

Let us explain these conditions. Condition (1) says that Alpha chooses her demand for contingent commodities optimally, subject to her budget constraint – that is, she maximizes her expected utility. Her utility if she becomes Andrea (state 1), will be $\sqrt{W_1^A + x_1^{\alpha}}$. Now if Alpha becomes Bob (state 2), her wealth will be $W^B + x_2^{\alpha}$; however, from the viewpoint of her principal, Andrea, that will generate only half as much welfare, so she evaluates this wealth as being worth, in utility terms, $\sqrt{\frac{W^B + x_2^{\alpha}}{2}}$. Condition (2) has a similar derivation, but this time, soul Beta takes the benchmark situation as becoming Bob. Condition (3) says that both markets clear.

The equilibrium is given by

$$p = 1, \quad (x_1^{\alpha}, x_2^{\alpha}) = (\frac{2W^B - W^A}{3}, \frac{W^A - 2W^B}{3}), \quad (x_1^{\beta}, x_2^{\beta}) = (\frac{-2W^B + W^A}{3}, \frac{-W^A + 2W^B}{3}).$$

Now state 1 occurs. Therefore Andrea, after the insurance contracts are settled, ends up with wealth $W^A + x_1^{\alpha} = \frac{2}{3}(W^A + W^B)$ -- two-thirds of the total wealth—and Bob ends up with one-third of the total wealth. The result is perverse because, *Bob is the one with the low resource endowment*, that is, with a low ability to transform money into welfare. It is Bob, putatively, whom an equal-resource principle should compensate, but it is Andrea who ends up the winner.[5] Even should state 2 have occurred, the outcome would have been the same – two-thirds of the wealth would end up being Andrea's.

[5] This perversity of the Dworkin insurance mechanism was first pointed out by Roemer (1985). Dworkin never proposed a model of the insurance market, but conjectured that it would re-allocate wealth in a way to compensate those with a paucity of non-transferable

Why does this happen? Because, even though both souls are risk averse, they are not sufficiently risk averse to induce them to shift wealth into the bad state (of being born Bob); it is more worthwhile (in terms of expected utility) to use wealth in the state when it can produce a lot of welfare (when a soul turns out to be Andrea). If the agents were *sufficiently* risk averse, this would not occur. (If the utility function were $u(W) = W^c / c$, and $c < 0$, then, post-insurance, Bob would end up with more wealth than Andrea. If the utility function is $u(W) = \log W$, then the agents split the wealth equally.) But the example shows that in general the hypothetical insurance market does not implement the kind of compensation that Dworkin desires: for Bob is the one who suffers from a deficit in an internal resource – from morally arbitrary bad luck. For Dworkin's insurance market to avoid this kind of perversity, individuals would have to be sufficiently risk averse, and this it is inappropriate to assume, for the theory should surely produce the desired result (of compensating those with a paucity of internal resources) in the special case that all agents have the same risk preferences[6].

In the model just presented of the hypothetical insurance market, note that it was necessary to make interpersonal welfare comparisons. Alpha, Andrea's soul, has to contemplate how she would feel, if she were to be born as Bob, and with a given amount of wealth. She does this by transforming Bob's wealth into a *welfare-equivalent wealth* for Andrea. And soul Beta has to make a similar interpersonal comparison. We maintain that it is impossible to construct a veil-of-ignorance thought experiment without making such comparisons. The point is simple: if a soul has to compare how it would

---

resources. He continued to use the insurance-market thought experiment to justify social policies (e.g., in the case of national health insurance for the United States), even though his thought experiment did not necessarily produce the compensatory redistributions that he thought it would implement.

[6] When Dworkin was confronted with this example at a conference in Halifax in 1985, he responded that he would not use the insurance device in cases where it produced the 'pathological' result. This is, however, probably an unworkable position, for how does one characterize *a priori* the set of admissible economic environments?

feel when being incarnated as different persons, it must be able to make interpersonal welfare comparisons. Without the ability to compare the lives of different persons in different circumstances, an investment in insurance would have no basis[7].

Despite the problem we have exhibited with Dworkin's proposal, it was revolutionary, in the words of G.A. Cohen, in transporting into egalitarian theory the most powerful tool of the anti-egalitarian Right, the importance of personal responsibility. One might argue, after seeing the above demonstration, that Dworkin's insurance market is an appealing thought experiment, and therefore one should give up on the egalitarian impulse of compensating persons for features of their situations for which they are not responsible: that is, instead of rejecting Dworkin's model as inadequate, one should reject his egalitarian desideratum. Moreno and Roemer (2008) consider this, and argue instead that the veil of ignorance is an inappropriate thought experiment for ascertaining what justice requires. Although their arguments for this are new, the position is not: it was also advocated earlier by Brian Barry (1991).

In the example we have given, there is, for egalitarians, a moral requirement to transfer tangible wealth from Andrea to Bob, because Bob lacks an inalienable resource that Andrea possesses, the ability to transform effectively goods into welfare, a lack which is beyond his control, and due entirely to luck. Dworkin also focused upon a different possible cause of unequal welfares, that some persons have expensive tastes, while others have cheap ones. His view was that persons with expensive tastes do *not* merit additional wealth in order to satisfy them, as long as those persons were satisfied with their tastes, or, as he said, identified with them. There is no injustice in a world where wealth is equal, but those with champagne tastes suffer compared to those with beer tastes, due to the relative consumptions of champagne and beer that that equal wealth permits. So the 'pathology' that we have illustrate with the Andrea-Bob example

[7] Readers may recall that Harsanyi (1955) claimed to construct a veil-of-ignorance argument for utilitarianism without making interpersonal comparisons. But his argument fails – not as a formal mathematical statement, but in the claim that utilitarianism is what has been justified. (See, for an early discussion, Weymark (1991), and for a more recent one, Moreno-Ternero and Roemer (2008).)

depends upon the source of Bob's relative inefficiency in converting wealth into welfare being a handicap, rather than an expensive taste.

Slightly before Dworkin's articles were published, Amartya Sen (1980) gave a lecture in which he argued that Rawls's focus on primary goods was misplaced. Sen argued that Rawls was 'fetishist' in focusing on goods, and should instead have focused on what goods provide for people, which he called 'functionings' – being able to move about, to become employed, to be healthy, and so on. Sen defined a person's *capability* as the set of vectors of functionings that were available to him, and he called for equality of capabilities[8]. Thus, although a rich man on a hunger strike might have the same (low) functioning as a poor man starving, their capabilities are very different. While not going so far as to say utilities should be equalized, Sen defined a new concept between goods and welfare – functionings—which G.A. Cohen (1993) later described as providing a state of being that he called 'midfare.' For Sen, the opportunity component of the theory was expressed in an evaluation not of a person's actual functioning level, but of what functionings were *available* to him, his 'capability.'

Sen's contribution led to both theoretical and practical developments. On the theoretical level, it inspired a literature on comparing opportunity (or feasible) sets: if one desires to 'equalize' capabilities, it helps to have an ordering on sets of sets. See James Foster's (2011) summary of this literature. On the practical side, it led to the human development index, published annually by the UNDP.

Later in the decade, further reactions to Dworkin came from philosophers, notably Richard Arneson (1989) and G.A. Cohen (1989). Arneson argued that Dworkin's expensive-taste argument against equality-of-welfare was correct, but his alternative of seeking equality of resources was not the only option: instead, one should seek to equalize *opportunities for welfare*. This, he argued, would take care of the expensive-tastes problem. Rather than relying on the insurance mechanism to define what resource egalitarianism means, Arneson proposed to distribute resources so that all persons had equal opportunity for welfare achievement, although actual welfares achieved would differ because people would make different choices. There are problems with

[8] Sen has not proposed an ordering of sets that would enable one to compare capabilities.

formalizing Arneson's proposal (see Roemer (1996)) , but it is notable for not relying on any kind of veil of ignorance, in contrast to the proposals of Rawls and Dworkin.

Cohen (1989) criticized Dworkin for making the wrong 'cut' between resources and preferences. The issue, he said, was what people should or should not be held responsible for. Clearly, a person should not be held responsible for his innate talents and inherited resources, but it is not true that a person should be fully responsible for his preferences either, because preferences are to some (perhaps large) degree formed in circumstances (in particular, those of one's childhood) that are massively influenced by resource availability. Indeed, if a person has an expensive taste for champagne due to a genetic abnormality, he would merit compensation under an egalitarian ethic[9]. Cohen's view was that inequality is justified if and only if it is attributable to choices that are ones for which persons can sensibly he held responsible -- so if a person who grows up poor, develops a 'taste' against education, induced by the difficulty of succeeding in school due to lack of adequate resources – a taste with which he even comes to 'identify' – then Cohen would not hold him responsible for the low income due to his consequently low wage, while Dworkin presumably would hold him responsible. Cohen does not propose a mechanism or algorithm for finding the just distribution of resources, but provides a number of revealing examples (see, for example, Cohen (1989, 2004)). He calls his approach 'equal access to advantage.'

Besides criticizing Dworkin for his partition of the space of attributes and actions into ones for which compensation is, or is not, due, Cohen (1997), importantly, critiqued Rawls's difference principle, as insufficiently egalitarian. The argument is based upon Rawls's restriction of the ambit of justice to the design of social institutions – in particular, that ambit does not include personal behavior. Thus, the Rawlsian tax system should attempt to maximize the welfare of the least-well-off group in society, under the assumption that individuals choose their labor supplies to maximize their personal utility. Suppose the highly skilled claim that if their taxes are raised from 30% to 50%, they will

[9] This is not a crazy example. There is a medically recognized syndrome in which people who sustain a certain kind of brain injury come to crave expensive foods: see Cohen (2011, p. 81).

reduce their labor supply so much that the worst-off group would be less well off than it is at the 30% tax rate. If 30% is the tax rate that maximizes the welfare (or income) of the least well off, given this self-interested behavior of the highly skilled, then it is the Rawlsian-just rate. But Cohen responds that, as long as the highly skilled are at least as well off as the worst off at the 50% tax rate, then justice requires the 50% tax rate. This difference of viewpoint between Rawls and Cohen occurs because Cohen requires individuals to act, in their personal choices, according to the commands of the difference principle (that is, to take those actions that render those who are worst off as well off as possible), and Rawls does not. Indeed, Rawls stipulates that one requirement of a just society is that its members endorse the conception of justice. It is peculiar, Cohen remarks, that that conception should apply only to the design of social institutions, and not to personal behavior.

A question that arises from the discussion of responsibility is its relationship to freedom of the will. If responsibility has become central in the conceptualization of just equality, does one have to solve the problem of free will before enunciating a theory of distributive justice? Different answers are on offer. We believe the most practical answer, which should suffice for practicing economists, is to view the degree of responsibility of persons as a parameter in a theory of equality. Once one assigns a value to this parameter, then one has a particular theory of equality of opportunity, because one then knows for what to hold persons responsible. The missing parameter is supplied by each society, which has a concept of what its citizens should be held responsible for; hence there is a specific theory of equality of opportunity for each society, that is, a theory that will deliver policy recommendations consonant with the theory of responsibility that that society endorses. This is a political approach, rather than a metaphysical one.

Another answer to the free-will challenge is to make a distinction prevalent among philosophers. 'Compatibilists' are those philosophers who believe that it is consistent both to endorse determinism (in the sense of a belief in the physical causation of all behavior) *and* the possibility of responsibility; incompatibilists are those who believe that determinism precludes responsibility. Most philosophers (who think about the problem) are probably, at present, compatibilists. For instance, Thomas Scanlon

(1986) believes that the determinist causal view is true, but also that persons can be held responsible for their behavior, as long as they have contemplated their actions, weighed alternatives, and so on. (The issue of sufficient contemplation is independent of the issue of the cause of expensive tastes, raised above.) From a practical viewpoint, the problem of free will therefore does not pose a problem for designing policies motivated by the idea that persons should not be held accountable for aspects of their condition that are due to circumstances beyond their control.

The philosophical literature on 'responsibility-sensitive egalitarianism' continues beyond the point of this quick review, but enough summary has been provided to proceed to a discussion of economic models.

3. A model and algorithm for equal-opportunity policy

Consider a population, whose members are partitioned into a finite set of *types*. A type comprises the set of individuals with the same circumstances, where *circumstances* are those aspects of one's environment (including, perhaps, one's biological characteristics) that are beyond one's control, and influence outcomes of interest. Denote the types $t = 1,...,T$. Let the population fraction of type *t* in the population be f^t . There is an *objective* for which a planner wishes to equalize opportunities. The degree to which an individual will achieve the objective is a function of his circumstances, his *effort,* and the social policy: we write the value of the objective as $u^t(e,\varphi)$, where *e* is a measure of effort and $\varphi \in \Phi$, the set of social policies. Indeed, $u^t(e,\varphi)$ should be considered the average achievement of the objective among those of type *t* expending effort *e* when the policy is φ. Here, we will take effort to be a non-negative real number. Later, we will introduce luck into the problem.

u^t is not, in general, a subjective utility function: indeed u^t is assumed to be monotone *increasing* in effort, while subjective utility is commonly assumed to be decreasing in standard conceptions of effort. Thus, *u* might be the adult wage, circumstances could include several aspects of childhood and family environment, and *e* could be years of schooling. Effort is assumed to be a choice variable for the individual, although that choice may be severely constrained by circumstances, a point to which we

will attend below. The final data for the problem consist of the distributions of effort within types as a function of policy: for the policy φ, denote the distribution function of effort in type *t* as $G_{\varphi}^{t}(\cdot)$. We would normally say that effort is chosen by the individual by maximizing a preference order, but preferences are not the fundamentals of this theory: rather, the data are $\{T, G_{\varphi}^{t}, f^{t}, u, \Phi\}$, where we use *T* to denote, also, the set of types.

Defining the set of types and the conception of effort assumes that the society in question has a conception of the partition between responsible actions and circumstances, with respect to which it wishes to compute a consonant approach to equalizing opportunities. We describe the approach of Roemer (1993, 1998). The verbal statement of the goal is to find that policy which nullifies, to the greatest extent possible, the effect of circumstances on outcomes, but allows outcomes to be sensitive to effort. Effort comprises those choices that are thought to be the person's responsibility, and hence they are consequences of his choices – but not all such consequences, since effort may itself be influenced by one's circumstances. In particular, the *distribution* of effort in a type at a policy, G_{φ}^{t}, is not due to the actions of any person (assume here a continuum of agents), but is a characteristic of the type. If we are to indemnify individuals against their circumstances, we must not hold them responsible for being members of a type with a poor distribution of effort.

We require a measure of *accountable* effort, which, because effort is influenced by circumstances, cannot be the raw effort *e*. (Think of years of education – raw effort—that is surely influenced in a major way by social circumstances.) Roemer proposed to measure accountable effort as the rank of an individual on the effort distribution of her type: thus, if for an individual expending effort *e*, $G_{\varphi}^{t}(e) = \pi$, we say the individual expended the *degree* of effort π, as opposed to the *level* of effort *e*. The rank provides a way of making inter-type comparisons of the efforts expended by individuals. A person is judged accountable, that is to say, by comparing his behavior only to others who share his circumstances. In comparing the degrees of effort of individuals across types, we use

461 the rank measure, which sterilizes the distribution of raw effort of the influence of
462 circumstances upon it[10].

463 Because the functions u^t are assumed to be strictly monotone increasing in *e*, it
464 follows that an individual will have the same rank on the distribution of the objective,
465 within his type, as he does within the distribution of effort of his type[11]. Define:

466 $$v^t(\pi,\varphi) = u^t(e^t(\pi),\varphi)$$

467 where $e^t(\pi)$ is the level of effort at the π^{th} quantile of the distribution G^t_φ, that is,
468 $G^t_\varphi(e^t(\pi)) := \pi$. Then the functions $v^t(\cdot,\varphi)$ are the inverse functions of the distribution
469 functions of the objective, by type, under the policy φ. (In this sense, v^t is like Pen's
470 parade, which is also the inverse of a distribution function.) Inequality of opportunity
471 holds when these *functions* are not identical. In particular, because we are viewing
472 persons at a given rank π as being equally accountable with respect to the choice of
473 effort, the vertical difference between the functions $\{v^t(\cdot,\varphi)\}$ is a measure of the extent
474 of inequality of opportunity (or, equivalently, the horizontal distance between the
475 cumulative distribution functions).

476 What policy is the optimal one, given this conception? We do not simply want to
477 render the functions v^t identical at a low level, so we need to adopt some conception of
478 'maxi-minning' these functions. We want to choose that policy which pushes up the
479 lowest v^t function as much as possible – and as in Rawlsian maximin, the 'lowest'
480 function may itself be a function of what the policy is. A natural approach is therefore to

---

[10] Some authors (Ramos and Van de gaer (2012)) have called this move – of identifying the degree of effort with the rank of the individual on the objective distribution of his type – the Roemer Identification Assumption (RIA). While the name is lofty, the idea is simple: persons should not be held responsible for characteristics of the distribution of effort in their type, for that distribution is a circumstance.

[11] If actual effort is a vector, then a unidimensional measure *e* would be constructed, for example, by regressing the objective values against the dimensions, thus computing weights on the dimensions of raw effort.

maximize the area below the lowest function v^t, or more precisely, to find that policy which maximizes the area under the *lower envelope* of the functions $\{v^t\}$. The formal statement is to:

$$\max_{\varphi\in\Phi} \int_0^1 \min_t v^t(\pi,\varphi)\, d\pi \ . \qquad (3.1)$$

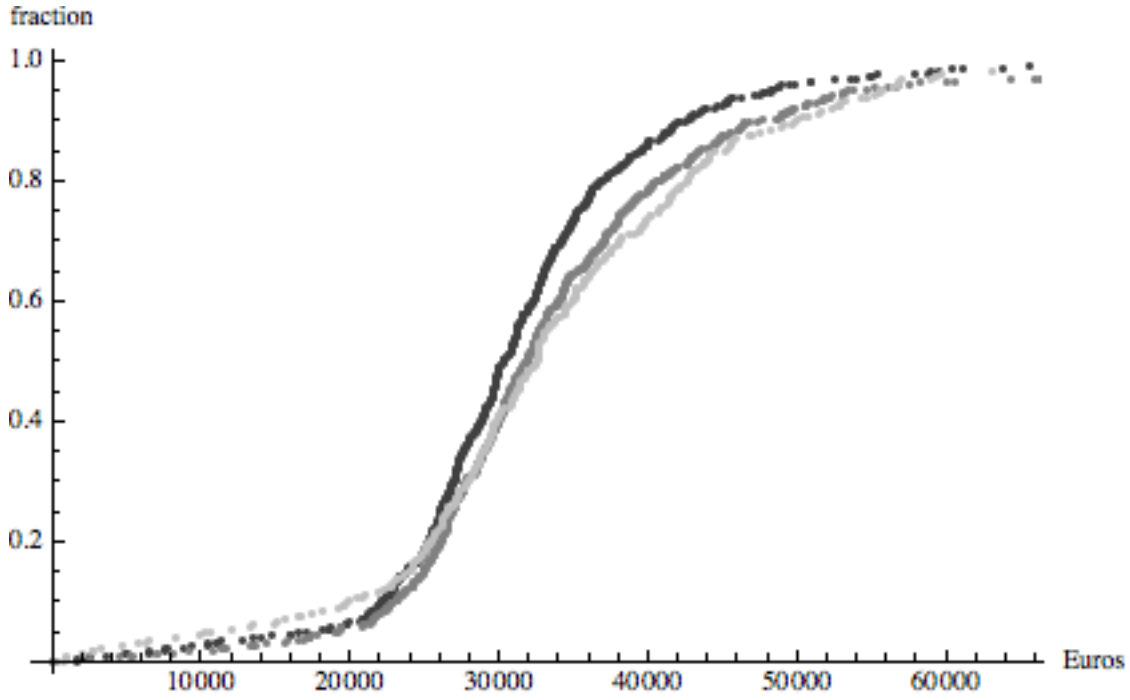
We call the solution to this program the opportunity-equalizing policy, φ^{EOp}. (Computing (3.1) is equivalent to maximizing the area to the left of the left-hand envelope of the type-distributions of the objective, and bounded above by the horizontal line of height one.)

In the case in which the lower envelope of the functions $\{v^t\}$ coincides with the *v* function of a single type (the unambiguously most disadvantaged type), what we have done is simply to maximize the average value of the objective for the most disadvantaged type, since $\int_0^1 v^t(\pi,\varphi)\, d\pi$ is simply the mean value of the objective for type *t* at policy φ.

Thus, the approach implements the view that differences between individuals caused by their circumstances are ethically unacceptable, but differences due to differential effort are all right. Full equality of opportunity is achieved not when the value of the objective is equal for all, but when members of each type face the *same chances*, as measured by the distribution functions of the objective that they face.

One virtue of the approach taken here is that it is easy to illustrate graphically. In Figure 1, we present two graphs, to illustrate inequality of opportunity in Hungary and Denmark. In each graph, there are three cumulative income distributions, corresponding to male workers of three types: those whose more educated parent had no more than lower secondary education, those whose more educated parent just completed secondary education, and those whose more educated parent had at least some tertiary education. (The data are from EU-SILC-2005.) The inverses of these distribution functions are the functions $v^t(\cdot,\varphi)$ defined above. It seems clear that, with respect to this one

506 circumstance (parental education), opportunities for income have been more effectively
507 equalized in Denmark than in Hungary[12]. The graphs are taken from Roemer (2013).
508



509
510
511 Figure 1a Three income distribution functions for Danish male workers, according the
512 circumstance of parental education. (Darkest hue are from least highly educated
513 backgrounds)
514

[12] We say 'seems' clear, because the horizontal-axis Euro scale is different in the two figures.

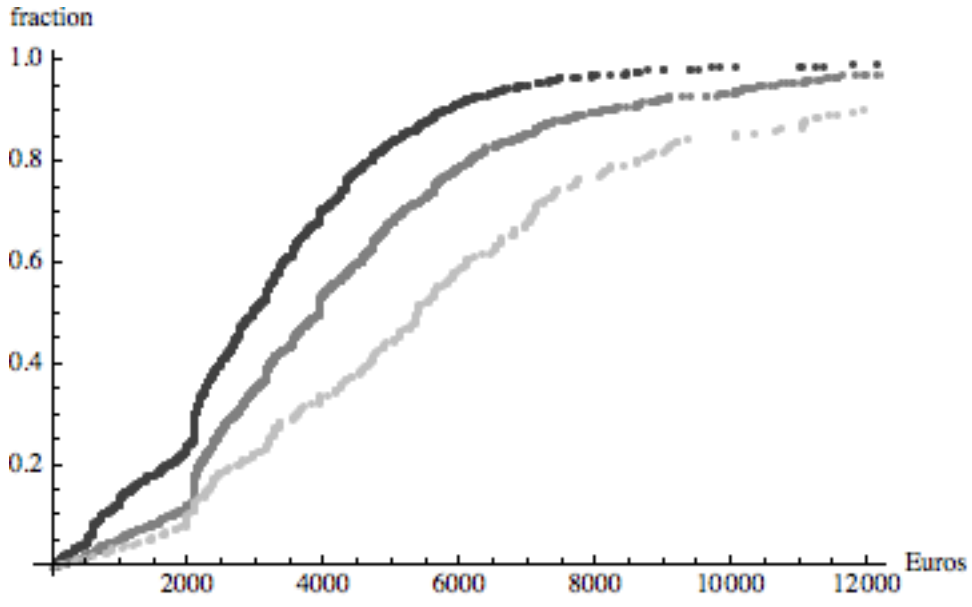


Figure 1b. As in Figure 1a, but for Hungary

The approach inherent in (3.1) is one that treats all causes of inequality not accounted for by a person's type as being due to effort. For example, with respect figure 1, there are many circumstances that influence outcomes not accounted for in the definition of type, and so the inequality of opportunity illustrated in that figure should be considered to be a lower bound on the true inequality of opportunity. Nevertheless, it is often the case that delineating only a few circumstances will suffice to illustrate obvious inequality of opportunity, and one can say that social policy should attempt to mitigate at least that inequality.

Let us note that the equal-opportunity approach is *non-welfarist* or more precisely *non-consequentialist.* A welfarist procedure for ordering social policies uses information only in the objective possibilities sets of the population associated with those procedures. In the income example, it would use only the data of the income distribution of the population, and ignore the data of what individuals were of which types. Circumstances are non-welfare (or non-objective) information. More informally, consequentialism only considers the final results of policies (incomes), and not the causes of those consequences. Here, we say there are two kinds of cause of outcomes with different moral status: circumstances and effort. We must distinguish between these causes, and

social policy should attempt to mitigate the inequality effects of one of them, but not necessarily of the other.

The next example illustrates the difference between the equal-opportunity approach and the approach that is conventional in many areas of social policy, utilitarianism. A *utilitarian* policy maximizes the average value of the objective in a population. Utilitarianism is a special case of welfarism, although there are many welfarist preference orderings of policies.

We consider a population partitioned into T types, where the population frequency of type t is f^t. The population suffers from I diseases, with the generic disease denoted i. The types might be defined by socio-economic characteristics[13], and the Health Ministry is interested in mitigating the affect of socio-economic characteristics on health. There is available in the health sector an amount of resource (money), $\overline{R}$ per capita. We do not address how much of a society's product should be dedicated to health, but only how to spend the amount that has been so dedicated. Effort is here conceived of as life-style quality (exercise, smoking behavior, etc.). We choose the policy space to be allocations of the resource to treating various diseases: that is vectors $R = (R^1,...,R^I)$ which will be constrained by a budget condition, where R^i is the amount that will be spent to treat each case of disease i, regardless of the characteristics of the person who has contracted the disease. Thus, *by definition,* we restrict ourselves to policies that are *horizontally equitable*: any person suffering from disease i, regardless of her type and life-style quality, will receive the same treatment, because treatment expenditure is not a function of these variables. A more highly articulated policy space could allocate medical resources predicated also on the type of patient and the life-style that patient had led. But in the health sector, doing so would set the stage for antagonistic patient-provider relations, and interfere with other values we hold, and so we choose to respect horizontal equity. We will return to this point below.

---

[13] Of course, persons are surely in part responsible for their socio-economic circumstances. But the Health Ministry's mandate might be to eliminate health inequalities due those circumstances, and so formally, it would consider socio-economic aspects of households as circumstances.

For any given vector $R = (x^1, ..., x^I)$ there will ensue a distribution of life-style quality in each type *t,* and a consequent distribution of disease occurrences in each type. Life-style quality may not be responsive to the policy, but we allow for the general case in which it is. Let us denote the fraction of individuals in type *t* who contract disease *i* when the policy is *R* by $p^{it}(R)$. Then the policy is *feasible* when:

$$\sum_{i,t} f^t p^{it}(R) x^i \leq \overline{R}$$

and it exhausts the budget precisely when:

$$\sum_{i,t} f^t p^{it}(R) x^i = \overline{R} \qquad (3.2)$$

The set of *admissible policies* comprises all those for which (3.2) holds: this is the set Φ.

We next suppose that we know the *health production functions* for each type; these are functions that give the probability that a person of type *t* will contract disease *i* if she lives a life-style of quality *q*. Let $i = 0$ represent the case of 'no disease' being contracted. We denote these functions $s^{it}(\cdot)$; thus $s^{it}(q)$ is the probability that a *t*- type will contract disease *i* if she lives life-style quality *q*. We presume it is the case that $\{s^{it}\}$ are monotone decreasing functions: that is, raising life-style quality reduces the probability of disease.

We also have as data of the problem the mapping from the policy space Φ to the space of cumulative distribution functions on the non-negative real numbers. Denote that class of distribution functions by Γ. The map

$$F^t : \Phi \to \Gamma$$

gives us the distribution of life-style qualities that will occur in type *t*, at any policy *R* in Φ. We write $F_R^t = F^t(R)$. Thus an individual with life-style quality *q* in type *t* lies at rank π of the effort distribution of her type, when the policy is *R,* if $F_R^t(q) = \pi$. We denote this value of *q* by $q_R^t(\pi)$.

Finally, we need to postulate the relationship between treatment of disease and health outcome. Let us take the outcome to be life expectancy. We therefore suppose that we know the life expectancy for those in type *t* who have contracted disease *i* and

who are treated with the resource expenditure specified by *R*. Denote this life expectancy by $\lambda^{it}(R)$. (Denote by λ^{0t} the life expectancy of a person of type *t* who contracts no disease.) We could further complexify, here, by assuming that life expectancy is a function, in addition, of the life style quality of the individual, but choose not to do so.

Consider, now, a policy $R = (x^1,...,x^I)$, which induces a distribution of life-style quality in each type. Consider a type *t* and all those at rank π of *t*'s life-style quality distribution. Assume there is a large number of people in each type, so that the fraction of people in a type who contract a disease is equal to the probability that people in that type will contract the disease. Then[14] the average life expectancy of all such people – the (t,π) cohort—will be

$$s^{0t}(q_R^t(\pi))\lambda^{0t} + \sum_{i=1}^{I}\sum_{t} s^{it}(q_R^t(\pi))\lambda^{it}(R) \equiv L^t(\pi,R) .$$

We can now define the EOp policy, which is:

$$R^{EOp} = \arg\max_R \int_0^1 \min_t L^t(\pi,R)d\pi \qquad (3.3)$$

Although we need a lot of data to compute the EOp policy, it is only the Ministry of Health who must have these data: once the policy is computed, a hospital need only diagnose a patient to know what treatment is appropriate (i.e., how much to spend on the case). No patient need ever be asked her type or her life-style characteristics. There is, that is to say, no incursion of privacy necessitated by applying the policy—apart from the initial incursion in the research survey on a population sample that assembles the data set to compute the health production functions. The policy is horizontally equitable. This is an important point, because some philosophers have falsely concluded that applying the equal-opportunity approach will necessitate incursions into privacy, and making distinctions among individuals in resource-allocation questions that are either difficult or socially objectionable in some way (see Anderson (1999)). But this is incorrect: the

[14] In the formula that follows, we have assumed for the sake of simplicity that an individual contracts either no or one disease. Of course, the formula can be generalized to the case where we drop this assumption, as we do in the numerical example that follows.

planner can choose the policy space in a way that makes such distinctions irrelevant for implementing the policy. In other words, not only is the delineation of circumstances a political/social decision that may vary across societies, but so must the specification of the policy space take into consideration social views concerning privacy and fairness.

Let us make this example numerical. We posit a society with two types, the Rich and the Poor. The Poor have life-styles whose qualities q are uniformly distributed on the interval [0,1], while the Rich have life-style qualities that are uniformly distributed on the interval [0.5, 1.5]. The probability of contracting cancer, as a function of life-style quality (q) is the same for both types, and given by:

$$s^{CP}(q) = s^{CR}(q) = 1 - \frac{2q}{3}.$$

Only the poor are at a risk of tuberculosis; their probability of contracting TB is:

$$s^{TP}(q) = 1 - \frac{q}{3}.$$

Suppose that life expectancy for a rich individual is given by:

70, if cancer is not contracted, and

$60 + 10\frac{x_c - 1}{x_c + 1}$, if cancer is contracted, and x_c is spent on its treatment.

Thus, if the disease is contracted, life expectancy will lie between 50 and 70, depending on how much is spent on treatment (from zero to an infinite amount). This is a simple way of modeling the fact that nobody dies of cancer before age 50.

Suppose that life expectancy for a Poor individual is:

70 if neither disease is contracted,

$60 + 10\frac{x_c - 1}{x_c + 1}$ if cancer is contracted and x_c is spent on its treatment, and

$50 + 20\frac{.1x_{TB} - 1}{.1x_{TB} + 1}$ if tuberculosis is contracted and x_{TB} is spent on its

treatment. Thus, the Poor can die at age 30 if they contract TB and it is not treated. With large expenditures, a person who contracts TB can live to age 70. Furthermore, it is expensive to raise life expectancy above 30 if TB is contracted. We further assume that if a Poor person contracts both cancer and TB then her life expectancy will be the minimum of the above two numbers.

639 Finally, assume that 25% of the population are poor and 75% are rich, and that the
640 national health budget is $\overline{R} = \$3000$ per capita.
641 With these data, one can compute that 33% of the rich will contract cancer, 9.3%
642 of the poor will contract only cancer, 26% of the poor will contract only TB, and 56% of
643 the poor will contract both TB and cancer. (Here, we do not exclude the possibility that a
644 person could contract both diseases.)
645 Our policy is $R = (x_C, x_{TB})$, the schedule of how much will be spent on treating
646 an occurrence of each disease. The objective is to equalize opportunities, for the Rich
647 and the Poor, for life expectancy.
648 The life expectancy of a Rich person is given by:

649 $$L^R(\pi, x_C) = \frac{2}{3}(\pi + .5)70 + (1 - \frac{2}{3}(\pi + .5))(60 + 10\frac{x_C - 1}{x_C + 1}),$$

650 and of a Poor person by:

651 $$L^P(\pi, x_C, x_T) = \frac{\pi}{3}\frac{2\pi}{3}70 + \frac{\pi}{3}(1 - \frac{2\pi}{3})(60 + 10\frac{x_C - 1}{x_C + 1}) + (1 - \frac{\pi}{3})\frac{2\pi}{3}(50 + 20\frac{.1x_{TB} - 1}{.1x_{TB} + 1}) +$$
$$(1 - \frac{\pi}{3})(1 - \frac{2\pi}{3})\min[(50 + 20\frac{.1x_{TB} - 1}{.1x_{TB} + 1}), (60 + 10\frac{x_C - 1}{x_C + 1})].$$

652 The solution of the program that maximizes the minimum life expectancy of the
653 two types, subject to the budget constraint, is x_C = \$686, x_{TB} =\$13,027. In figure 2, we
654 present the life expectancies of the Rich and the Poor, as a function of the rank at which
655 they sit on the effort (life-style) distribution of their type, at this solution (the solid
656 curves). The higher curve is that of the Rich. We see that, at the EOp solution, the Rich
657 still have greater life expectancy than the Poor – despite the large amounts being spent on
658 treating tuberculosis[15]. The difference, however, is less one year. Moreover, life
659 expectancy increases with life-style quality – this inequality of outcome is an aspect that
660 EOp does *not* attempt to eliminate.

---

[15] We could further reduce the difference in the life expectancies of the two types if we were willing to predicate the expenditure policy on a person's type, as well on her disease. But we have opted for a policy space that respects the social norm of horizontal equity, and does not distinguish between types in the treatment of illness.

Let us compare this solution to the *utilitarian* solution, the expenditure schedule at which *life expectancy in the population as a whole* is maximized. The solution turns out to be $x_C = \$1915, x_{TB} = \$10{,}571$. Three times as much is spent on cancer as in the EOp solution. Figure 2 graphs the life expectancy of the two types in the utilitarian solution (dashed lines).

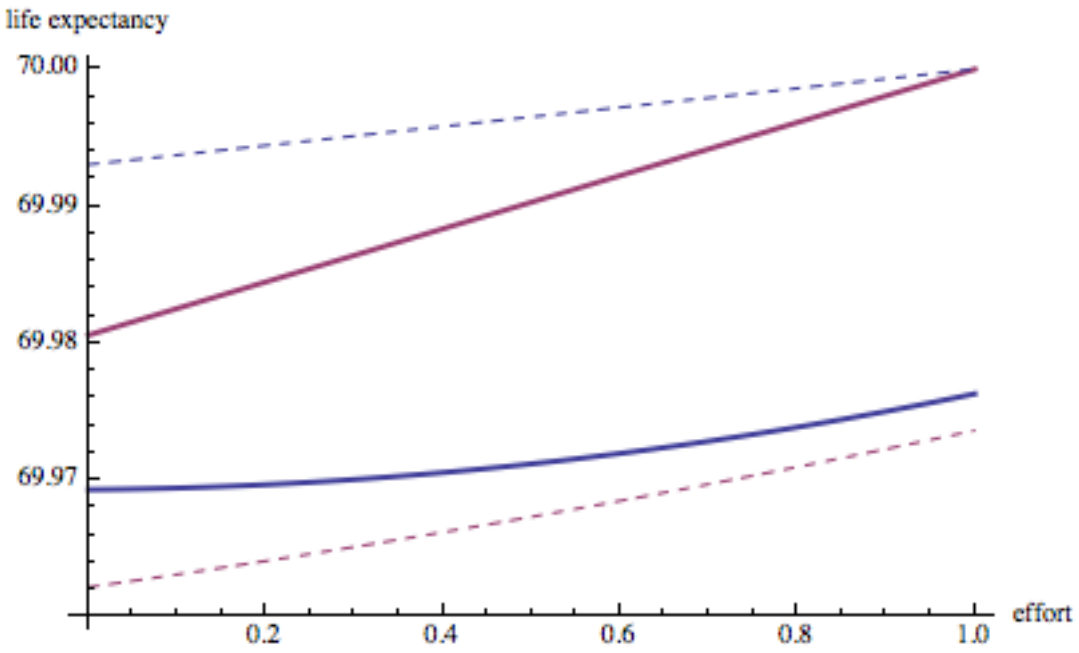


Figure 2: Life expectancies of Rich and Poor, utilitarian (dashed) and EOp (solid) policies

We see that the utilitarian solution narrows the life-expectancy differential between the types less than does the EOp solution (although, in absolute terms, the differences are not great). The EOp solution is more egalitarian, across the types, than the utilitarian solution – the utilitarian cares only about average life expectancy in aggregate, not on the distribution of life expectancy across types.

It is obvious that different objective functions will engender different optimal solutions. The unfortunate habit that is almost ubiquitous in policy circles is to identify the utilitarian solution with the *efficient* solution. Critics of the EOp solution will say that it is *inefficient* because it delivers a lower life expectancy *on average* for the population than the utilitarian solution. But this is a confusion. Both solutions are Pareto efficient, in the sense that it is impossible, for either of them, to find a policy that weakly increases the life expectancies of everyone. Identifying the utilitarian social objective with efficiency is an unfortunate practice, rooted in the deep hold that utilitarianism has in economics. *Social* efficiency is defined with respect to whatever the social objective is, and there are many possible choices for that objective besides the social average. We discuss this point with respect to measuring economic development below in section 5.

4. A more general approach

Formula (3.1) gives an ordering on policies, with regard to the degree to which they equalize opportunities, after the set of circumstances has been delineated. It implements the view that inequalities due to differential circumstances for those who expend the same degree of effort are unacceptable. There is, however, a conceptual asymmetry: while the instruction to eliminate inequalities due to differential circumstances is clear, the permission to allow differential outcomes due to differential effort is imprecise. How much reward does effort merit? There is no obvious answer. To provide a social-welfare function (or a preference order over policies) that question must be answered, at least implicitly. In formula (3.1), the preference order is delineated by stating that, if there is a society with just one type, then policies will be ordered according to how large the average outcome is for that society. Fleurbaey (2008) therefore calls formula (3.1) a 'utilitarian approach' to equality of opportunity.

What are the alternatives? At a policy $\varphi \in \Phi$, the *lower envelope* of the objective functions $v^t(\cdot,\varphi)$ is defined as:

$$\theta(\pi,\varphi) = \min_t v^t(\pi,\varphi) \ . \qquad (4.1)$$

We wish to render the function θ 'as large as possible:' formula (4.1) measures the 'size' of θ by taking its integral on [0,1]. More generally, let the set of non-negative, weakly

increasing functions on [0,1] be denoted Θ; we desire an ordering $\succeq$ on Θ which is increasing, in the sense that if $\theta(\cdot) \geq \theta^*(\cdot)$, then $\theta \succeq \theta^*$, with strict preference if $\theta(\cdot) > \theta^*(\cdot)$ on a set of positive measure. The integral of $\theta\, d\pi$, as in (4.1), provides such an ordering. But many other choices are possible. For instance, consider the mappings $\Gamma : \Theta \to \mathbb{R}$ given by

$$\Gamma(\theta;\varphi) = \left(\int_0^1 \theta(\pi,\varphi)^p \, d\pi \right)^{1/p} \quad \text{for } -\infty < p \leq 1 \ . \quad (4.2)$$

Each of these provides an increasing order on Θ. As *p* becomes smaller, we implement more aversion to inequalities that are due to effort. As p approaches negative infinity, the order becomes the maximin order, where no reward to effort is acceptable.

We do not have a clear view about what the proper rewards to effort consist in, and hence remain agnostic on the choice of ways to order the lower envelopes $\theta(\cdot,\varphi)$. The problem of rewards-to-effort goes back to Aristotle, who advocated 'proportionality,' a view that is incoherent, as it depends upon the units in which effort and outcomes are measured. Because we possess no theory of the proper rewards to effort, this is an open aspect of the theory. We believe that considerations outside the realm of equality of opportunity must be brought to bear to decide upon how much inequality with respect to differential effort is allowable. For instance, G.A. Cohen (2009) has suggested that the inequalities allowed by an equal-opportunity theory should, if they are large, be reduced by appealing to the value of social unity (what he calls 'community'), which will be strained if outcome inequalities are too large.

Our agnostic view concerning the degree of reward that effort deserves contrasts with that of Fleurbaey (2008), who advocates an axiom of 'natural reward' to calibrate the rewards to effort, as will be discussed in section 5.

We can provide somewhat stronger foundations for the view that *an equal-opportunity ordering of policies must maximize some increasing preference order on* Θ. The first step is to note the importance of the lower envelope function θ: for the persons who are most unfairly treated at a given policy are those, at each effort level, who experience the lowest outcomes, across types. (Hence, they are the ones represented on the lower envelope.) This is because the EOp view says outcomes with are different, due

to circumstances, for those who expend the same effort, are unfair. The second step is to state an axiom which encapsulates a requirement of an EOp ordering $\succeq$ of Θ, which is:

Axiom DOM.

A. For any two policies $\varphi,\hat{\varphi}\in\Phi$ such that $\varphi\succ\hat{\varphi}$ there exists a set of positive measure *S* such that $\pi\in S\Rightarrow\theta(\pi,\varphi)>\theta(\pi,\hat{\varphi})$.

B. For any $\varphi,\hat{\varphi}\in\Phi$ such that $\varphi\sim\hat{\varphi}$, either $\theta(\cdot,\varphi)=\theta(\cdot,\hat{\varphi})$ or there is a set of positive measure Y such that $y\in Y\Rightarrow\theta(y,\varphi)>\theta(y,\hat{\varphi})$ and a set of positive Y' measure such that $y\in Y'\Rightarrow\theta(y,\varphi)<\theta(y,\hat{\varphi})$.

Part *A* of Axiom DOM states that if one policy is preferred to another, it must make *some* people who are the among the most unfairly treated better off than the other policy, and Part *B* has a similar justification. Thus DOM is a special case of what is sometimes called the *person-respecting principle* (see Temkin [1993]): that one social alternative is better than another only if some people are better off in the first than in the second.

It is not hard to show that (see Roemer (2012)):

Proposition *Let* $\succeq$ *be an order on* Θ *satisfying* DOM. *Then* $\succeq$ *is represented by an increasing operator* Γ *on* Θ. *Furthermore, if* $\succeq$ *is a continuous order, then* Γ *can be chosen to be a continuous increasing operator.*

Thus, with any continuous order on the lower-envelope functions Θ, we may write the associated EOp program as:

$$\begin{aligned}&\max\Gamma(\theta)\\&\text{s.t.}\\&\theta(\pi,\varphi)\equiv\min_t v^t(\pi,\varphi)\\&\varphi\in\Phi\end{aligned}\qquad\text{(GEOp)}$$

for some increasing operator $\Gamma:\Theta\to\mathbb{R}$. The acronym GEOp stands for 'generalized equality of opportunity.'

We reiterate the main point of this section. Because we possess no theory of what comprise the just rewards to effort, we should not be dogmatic on the exact way to order policies. We have argued that an ordering of policies must come from an increasing order on the set of lower-envelope functions Θ, where the lower-envelope

function induced by a policy φ is given by (4.1). This ambiguity in the theory results in program (GEOp), where the degree of freedom is the choice of the operator Γ. Considerations outside of the theory of equal opportunity might put constraints on the degree of overall inequality that is desirable/admissible in a society, and this can guide the choice of Γ.

We have thus argued that the theory of equal opportunity is not intended as a complete theory of distributive justice, for two reasons. First, we have emphasized its pragmatic nature. We do not have a complete theory for what people are, indeed, responsible, and have advocated the present approach as one that should viewed as providing policy recommendations for societies that are consonant with the society's conception of responsibility. Thus, the choice of the set of types, and even of the policy space, will be dictated by social norms (we have illustrated the policy-space point with the health-expenditure example). Secondly, the theory does not include a view on what the proper rewards to effort consist in, and this is reflected in the openness inherent in program (GEOp).

Because we view the approach as most useful when the objective in question is something measurable like income, or life expectancy, or wage-earning capacity, we shy away from taking an all-encompassing objective of 'utility.' We view the usefulness of the approach as one for policy makers, in particular ministries, who are concerned with narrower objectives than overall utility: the health ministry has an objective of life expectancy or infant survival, the education ministry has an objective of the secondary-school graduation rate, the labor ministry is concerned with opportunities for the formation of wage-earning capacity, or for employment, and so on. All these objectives are cardinally measurable, and it makes sense to use any of the operators defined in (4.2) to generate an ordering on policies.

Nevertheless, we wish to remark that it is possible to apply the theory where the objective is 'utility,' if utility is cardinally measurable. (Actually, to use the operators in (4.2) we require what is called cardinal measurability and ratio-scale comparability.) Because, when thinking about utility, we often conceive of effort as implying a disutility, we now show why this is not a problem for the application. Suppose utility functions over consumption and labor expended are given by $u(x, L; w)$ where $w \in W$ is the

794 individual's wage rate. The distribution function of w in type t is given by F^t. Let us
795 suppose we are considering the space of linear tax policies, where after-tax income is
796 given by $(1-\varphi)wL+b$, where b is a lump-sum demogrant and $\varphi \in [0,1]$ is the tax rate.
797 (It is implicitly assumed, since wage rates are fixed, that production is constant-returns-
798 to-scale.) Then the utility-maximizing individual chooses his labor supply optimally,
799 denoted by $L(\varphi, w)$, and of course, budget-balance requires $b = \varphi \int wL(\varphi, w) dF(w)$
800 where F is the population distribution of w. Define $w'(t)$ by $F^t(w^t(\pi)) = \pi$. Then the
801 outcome functions are just the indirect utility functions:

802 $$v^t(\pi, \varphi) = u((1-\varphi)w^t(\pi)L(w^t(\pi), \varphi) + b, L(w^t(\pi), \varphi)),$$

803 and we are ready to calculate the EOp policy. Here, 'effort' is interpreted not as one's
804 labor supply, but rather as those actions which the person took that gave rise to his wage-
805 earning capacity. There are different distributions of wages in different types, reflecting
806 the differential circumstances that impinge upon wage-formation, but within each type,
807 there is a variation of the wage due to autonomous factors that we view as effort and
808 worthy of reward.
809
810 5. The Fleurbaey-Maniquet approach
811 Marc Fleurbaey and François Maniquet have, in a series of writings, proposed a
812 number of proposals for ordering policies with respect to the degree to which they
813 equalize opportunities, which are similar in spirit to those discussed above, but different
814 in detail. Their work is summarized in Fleurbaey (2008); the general inspiration of the
815 theory is the idea of envy-freeness, pioneered in the works of Duncan Foley (1967),
816 Serge-Christophe Kolm (1972), and Hal Varian (1975). Here, we present one of their
817 main proposals, which falls in the family of egalitarian-equivalent proposals, and as such,
818 descends from the work of Elisha Pazner and David Schmeidler (1978). The approach is
819 substantially different from the one outlined in sections 3 and 4, because it does not take
820 the viewpoint that equalizing opportunities involves maximizing the lower envelope
821 function θ defined in (4.1).
822 Suppose that a population is characterized by an outcome function $u(c, r, \varphi)$
823 where c is a vector of circumstances (characteristics of the individual or his environment

824 for which he is deemed not responsible), *r* is a vector of characteristics for which he is
825 deemed responsible, and φ is a policy. We will specialize to the case where φ is the
826 distribution of some resource to the population: say, an allocation of money. Let us
827 suppose, further, that there is some type (i.e., vector of circumstances c^*) that
828 characterizes the most disadvantaged type. We desire to place an ordering on policies φ
829 that reflects the view that persons should not be held responsible for their circumstances,
830 but should be held responsible for the choice of *r*.
831 Fleurbaey (2008) represents the idea that persons should be held responsible for
832 their circumstances by various 'principles of compensation;' an example would be
833 'equal well-being for equal responsibility,' meaning that if two individuals have the same
834 values of *r,* their outcomes should be the same (i.e., independent of their circumstances).
835 Thus the ordering of policies should reflect this desideratum. He, Bossert (1995) and
836 Maniquet also advocate various 'principles of reward;' for instance, if all individuals
837 have identical circumstances, then the resource should be divided equally among them,
838 called the 'liberal reward principle'. If everyone is of the same type, there is no
839 justification for any compensatory policy. It is clear from simple examples that it is, in
840 general, impossible to respect the liberal reward principle and the 'equal well-being for
841 equal responsibility' principle simultaneously as long as the environment is sufficiently
842 rich, and so Fleurbaey (2008) is a study of social-policy orderings that satisfy weaker
843 versions of postulates inspired by these principles.
844 We summarize a prominent example of such an ordering. Let φ be given, and
845 construct another allocation of the resource, $\hat{\varphi}$ – which need not be feasible, given the
846 budget – defined by:

847 $$u(c_i, r_i, \varphi_i) = u(c^*, r_i, \hat{\varphi}_i) \ ,$$

848 where *i* indicates the individual, and c^* is a reference set of circumstances – say, those
849 of the most disadvantaged type. Thus, under $\hat{\varphi}_i$ each individual receives an amount of
850 resource which makes her as well off as she is in the φ-allocation, but assuming,
851 counterfactually, that she had been a member of the reference type, and had maintained
852 the same values of the responsible factors. In the counterfactual world in which $\hat{\varphi}$ lives,

853 everybody is of the same type (c^*) and so, *no special compensation* should be made to
854 individuals from the opportunity-equalizing viewpoint, according to the liberal reward
855 principle. Hence, the ideal policy φ is one in which the associated $\hat{\varphi}$ is an *equal*
856 *distribution* of the resource. This tells us how to order actual policies φ: we say that
857 $\varphi \succ \varphi'$ if the counterfactual distribution $\hat{\varphi}$ is 'more equal' than $\hat{\varphi}'$; to be precise

858 $$\varphi \succ \varphi' \Leftrightarrow \hat{\varphi} \succ_{lex} \hat{\varphi}'$$

859 where $\succ_{lex}$ is the leximin ordering.

860 This particular version of the egalitarian-equivalent approach to responsibility the
861 authors call zero egalitarian equivalence (ZEE), because the standardization takes place
862 by counterfactually making everyone a member of the worst-off type. Of course,
863 standardizing with respect to some other set of circumstances would do as well, although
864 each choice of how to standardize will (generally) produce a different ordering over
865 policies. One virtue of this approach is that an ordinal outcome function *u* is all that is
866 required, as we only need to compare the outcome for individuals to variants of
867 themselves (where they have different circumstances), which contrasts with the
868 approaches discussed in sections 3 and 4, that require cardinality and even ratio-scale
869 comparability.

870 Of course, the ZEE approach will in general give a different ordering of policies
871 than the GEOP approach; Roemer (2012) calculates some examples. Both approaches
872 are incomplete: GEOP, as has been discussed, does not dictate a choice of the operator
873 Γ and ZEE does not dictate a choice of the way to standardize circumstances.

874 An essential feature of the egalitarian-equivalent approach is the liberal or natural
875 reward principle, that if everyone were of the same type, then no redistribution is called
876 for[16]. To be specific, in the EOp approach, Roemer closes the model by saying that if
877 everyone is of the same type, then policies are preferred if they produce higher *average*
878 outcomes, while Fleurbaey and Maniquet say that policies are better in this case, the

[16] Fleurbaey's 'natural reward principle' is the assertion that the distribution of resources implemented by the policy should be independent of the values of traits assigned to the responsibility of the individual.

879 closer they are to *equal-resources*. But, as we have argued in section 4, we remain
880 agnostic on the right way of closing the model, because we do not think the concept of
881 equality of opportunity contains a theory of just rewards to effort. In particular, the
882 liberal reward principle, described above, will sometimes or often use market institutions
883 to close the model. Consider a problem where all persons have the same circumstances,
884 but preferences differ, due to voluntary choices. The principle of liberal reward might be
885 interpreted as saying that the allocation of goods should be that associated with the
886 competitive equilibrium following from an equal division of wealth. But this means that
887 the welfare of individuals is determined by a particular set of institutions (markets with
888 private property). Our objection, then, to the liberal reward principle is that in some
889 cases there is no obvious benchmark that can be considered 'natural' to define
890 distribution in the case where there is a unique set of circumstances. This point harkens
891 back to the legal realists, who argued that there is no conception of laissez-faire that is
892 free of ethical bias (see Fried [1998]) – or, to put it more starkly, the usual conception of
893 laissez-faire is a misnomer, as it presupposes property rights enforced by state power.
894 One disadvantage of the egalitarian-equivalent approach is that the notation does
895 not force the practitioner to come to grips with the fact that choices people make are
896 themselves influenced by circumstances. Recall that in the EOp approach, it was the
897 *degree* of effort rather than the *level* of effort that was taken as reflecting responsibility,
898 and this distinction was made because the type *distributiosn* of levels of effort are
899 infected with circumstances. Now one can model the same idea in the ZEE approach,
900 but the notation does not invite doing so: there may be a tendency of practitioners to take
901 *r* as *observed* levels of effort and choices of various kinds, and this would fail to take
902 account of the fact that the distribution of choices *r* in a type is itself a characteristic of
903 the type, and something that calls for compensation. So a literal application of the ZEE
904 model, which is insensitive to this fact, will ascribe to persons responsibility for choices
905 that are perhaps heavily influence by circumstances, and should therefore call for
906 compensation.
907 One of the innovative applications of the egalitarian-equivalent approach by the
908 authors is to tax policy. From among feasible tax policies, that policy should be chosen
909 which is most preferred according to the ZEE preference order. As noted, this approach

provides a theory of optimal taxation that does not rely on any cardinalization of the utility function. Therefore, Fleurbaey and Maniquet have produced a theory of optimal taxation liberated from cardinal measurement of utility (that is, from maximizing the integral of some social welfare function). See Fleurbaey and Maniquet (2006) and Fleurbaey and Maniquet (2011, chapter 11).

Fleurbaey and Maniquet also propose a kind of dual to ZEE: namely, imagine a counterfactual where all individuals expend the same reference level of effort, but maintain their actual circumstances. In this case, that allocation is most preferred which most closely equalizes outcomes (that is, each person should be indifferent to how he would feel if he had the circumstances of any other person). The basis of this view is that if persons all expend the same value of the responsible factors *r*, then there is no ethical basis for their having different outcomes. Again, this gives a preference order on policies that can be defined without using cardinal utility functions, but using egalitarian equivalence. The authors name this approach 'conditional equality.'

One way to compare the approaches of Roemer and Fleurbaey-Maniquet is to ask: Can the Fleurbaey-Maniquet preference orders be rationalized as instances of program (GEOP), for some choice of Γ? It turns out that the ZEE approach can be, but the conditional equality approach cannot be. See Roemer (2012) and Fleurbaey (2012).

Fleurbaey and Maniquet, in their work reported in Fleurbaey (2008), take an axiomatic approach, proposing a number of axioms modeling the ideas that persons should be held responsible for their autonomous actions but not for their circumstances. Strong versions of these axioms produce impossibility results, as we noted. (This is immediately clear if one thinks of the EOp model discussed in section 3. There will almost never exist a policy that uses all the budget available and equalizes *for all* π, the outcomes across all types. This would be the *summum bonum*, from the viewpoint of equality of opportunity, but it cannot be achieved in a problem of any complexity. So some compromise is called for.) Their approach is to sequentially weaken axioms until they find possible preference orders over policies. A significant part of their analysis therefore consists in providing axiomatizations of different preference orders over policies, each of which has some purchase as reflecting the equal-opportunity view. The egalitarian-equivalent and conditional-equality families turn out to be the important ones.

941 Before concluding this section, we mention another preference ordering of
942 policies similar in spirit to the EOp ordering, first proposed by Van de gaer (1993): order
943 policies according to the value of

944 $$\min_t \int_0^1 v^t(\pi,\varphi)\,d\pi. \qquad (5.1)$$

945 In other words, maximize the average outcome value of the most disadvantaged type.
946 Formally, this proposal simply commutes the integral and 'min' operators compared to
947 Roemer's approach in (3.1). Its virtue is that it is sometimes easier to compute than
948 (3.1). If there is an unambiguously worst off type (that is a type t such that for all
949 policies φ and for all types t', and all $\pi \in [0,1]$ we have $v^t(\pi,\varphi) \le v^{t'}(\pi,\varphi)$), then (3.1)
950 and (5.1) are equivalent. Unfortunately, (5.1) is not a special case of (GEOP); it does not
951 necessarily maximize the size of the lower-envelope function θ, for any conception of
952 how to measure size (i.e., Γ). See Roemer (2012). Ooghe, Schokkaert and Van de
953 gaer (2007) compare the orderings over social policies induced by (5.1) and (3.1) by
954 introducing a number of axioms that distinguish between the two. They argue that
955 Roemer's approach (3.1) is a 'compensating outcomes' approach, while Van de gaer's
956 (4.3) is an 'equalizing opportunity sets' approach, in the sense that the integral

957 $\int_0^1 v^t(\pi,\varphi)\,d\pi$ can be viewed as a measure of the degree of opportunity available to type *t*.
958 Therefore, these authors link their approach to the large literature on equalizing
959 opportunity sets (e.g., Bossert (1997), Foster (2011)) which derived its inspiration from
960 Sen's capability approach.

961 Our final topic of this section is the attempt to incorporate luck into the theory of
962 equal opportunity. Of course, luck has already to some extent been incorporated, as
963 circumstances are viewed as aspects of luck -- for example, the luck of birth lottery
964 assigns genes, families, and social environments. Besides the luck inherent in
965 circumstances, however, there are two other kinds of luck that are important: first, what
966 might be called episodic luck, which is randomly distributed across individuals, and is
967 often unobservable to third parties (being in the right place at the right time), and the
968 luck due to the outcome of gambles. Dworkin's view was that no compensation is due to
969 anyone who suffers a bad outcome due to a voluntarily taken gamble – such 'option luck'

970 is due to an exercise of preferences for which the person is held responsible. Fleurbaey
971 (2008), however, contests this view. He splits gambles into two parts: the decision to
972 take the gamble, which is the person's responsibility, and the outcome of the gamble,
973 which is an aspect of luck. Let us view the risk-taking preference of the individual as a
974 responsibility characteristic, and the outcome of the gamble as a circumstance –
975 something over which the individual has no control. Fleurbaey proposes giving all
976 persons with a given risk-taking propensity (i.e., responsibility characteristic) the average
977 value of all gambles that such persons take. Thus, everyone with the same
978 responsibility characteristic receives the same outcome. Of course, the informational
979 requirements for implementing such a plan are severe. As well, it seems to countervene
980 the purpose of gambling. If gamblers wanted to protect themselves from bad outcomes,
981 they would insure to receive the expected value of the gamble. If, however, gamblers
982 are risk-loving, then they would only insure to receive something more than the gamble's
983 expected value, and such insurance is not fiscally feasible. So in offering gamblers the
984 expected value of all gambles taken by their risk-type, their welfare is being reduced
985 from actual gambling, assuming that they are risk lovers. This solution, first advocated by
986 Le Grand (1991), has other weaknesses. The different lotteries offered to the individual
987 decision makers can be ranked unambiguously from the most profitable to the least one if
988 Fleurbaey's solution is implemented. Indeed, the lotteries would only differ in terms of
989 the average outcome since all risk is eliminated. All rational decision makers (who prefer
990 more than less) will choose the same lottery. Full equality will be then observed ex post.
991 Fleurbaey's solution then leads fully to eliminate the impact of option luck.
992 Lefranc, Pistolesi and Trannoy (2009) believe that the project of separating
993 influences into circumstances and effort is too binary. They call 'residual luck' a third
994 influence, and recommend something weaker than compensation for residual luck,
995 namely, that the correlation between such luck and circumstances be eliminated.
996 Consider the following examples: some people gain by the chance meeting of another
997 person; popular views do maintain that persons with rare productive talent be specially
998 compensated; the winnings of national lotteries (Belgium, France, UK) are often not
999 taxed. The luck inherent in these examples (especially the first two) is often considered
1000 to be part of life, something that policy should not eliminate. The first example could be

brute luck or due to special effort; the second example is brute luck; the third is option luck. These authors maintain that these kinds of luck should be equally distributed across types, at any given level of effort.

Suppose the income-generating process is given by:

$$y = g(c,e,l)$$

where *c*, *e,* and *l* are circumstances, effort, and residual luck, respectively. The distribution of income, conditional upon *c* and *e* is defined as:

$$H(y \mid c,e) = F_{c,e}(g^{-1}(y,c,e))$$

where $F_{c,e}$ is the distribution of luck in the element of the population characterized by (c,e). The above-described principle says that

$$\text{for any } (c,c') \quad H(\cdot \mid c,e) = H(\cdot \mid c',e) = K(\cdot \mid e) \ .$$

This allows the distribution of virtual luck to depend on effort but not on circumstances. If all luck factors are named as circumstances, then the distribution *K* is simply a point mass. The authors propose further refinements using stochastic-dominance arguments.

6. Economic development

The standard measure of economic development, GDP per capita, is inspired by the utilitarian ethic. If we identify utility with income, then average utilitarianism calls for maximizing average income. Hence this conception of economic development is a corollary to an ethical view. As utilitarianism was ubiquitous in economic thinking until Rawls (1971), and continues to be extremely influential in economics after Rawls, especially in growth theory and policy analysis, it is unsurprising that our central measure of economic development has a basis in utilitarian thought.

There are various ways we might alter our measurement of economic development, based on other ethical views. Indeed, some alterations can be made within utilitarianism. By recognizing that some needs are more urgent than others, we could apply a concave transformation to income, say the logarithm, and measure economic development by $\sum \log x_i$, where x_i is income, which is ordinally equivalent to maximizing $\prod x_i$. Of course, this would place much more policy focus upon avoiding poverty, as a single income of zero is socially catastrophic. Another approach, still

within utilitarianism, is to include other arguments besides income in the utility function – education, health, etc. – but to take the average of an index of these goods over the nation. This is the approach of the UNDP's human development index. But if equalizing opportunities is an attractive ethic, then we should construct measures of economic development that are consonant with it. This section begins that discussion.

As a preliminary consideration, we must clear the deck of an opposing position which argues that economic development is a technical concept, not one related to social welfare. This cannot be correct. Economics is not engineering: its goal is to maximize *social* welfare, however that be conceived. Even for those who abjure the possibility of interpersonal comparisons, Pareto efficiency is a conception of social welfare. An economy consisting of slaves who produce, for a very small elite, huge wealth, should not be considered highly developed, no matter how refined the technology. Economic development must mean the development of human beings (some would include other sentient beings), and how to conceive of it must be corollary to a theory of the good life and good society.

If equality of opportunity is to replace utilitarianism as the ethical view of choice, then we must replace GDP per capita with some measure of opportunity equality as a measure of economic development. We will propose, here, a two-dimensional index of economic development, based upon the EOp approach. The first component of the index is the value of (3.1), and the second is a measure of the extent to which inequality in the society is due to inequality of *opportunity* (as opposed to differential effort).

There are various methods for defining the second component; here is one. Suppose H is the distribution of income in the society, let H^t be the income distribution in type t, and let f^t be the population frequency of type t. Then $H = \sum f^t H^t$. Let μ(resp., μ_t) be the mean of H(resp., H^t). Define the square of the coefficient of variation of H by:

$$C(H) = \frac{\text{var } H}{\mu^2} .$$

Define the distribution:

$$\Phi^T(x) = \sum_{t=0}^{k} f^t \text{ on the interval } \mu_k \le x \le \mu_{k+1}, \qquad (6.1)$$

where $k = 0,...,n$ and $\mu_0 = 0$ and $\mu_k = \infty$. Clearly the mean of Φ^T is μ. If Φ^T were the actual distribution of the objective in society, then everybody in a given type would have exactly the same income, equal to the mean income of that type. (The distribution function Φ^T is a step function with the same mean as *H.*) Were this the case, then the contribution of effort to inequality would be nil, as no variation of the objective would exist within any type. Now it is well-known that we can decompose $C(H)$ as follows:

$$C(H) = C(\Phi^T) + \sum f^t(\rho^t)^2 C(H^t), \qquad (6.2)$$

where $\rho^t = \frac{\mu_t}{\mu}$. Since both addends in this decomposition are positive, it is natural to interpret $C(\Phi^T)$ as a lower bound of the amount of inequality due to circumstances, and $\sum f^t(\rho^t)^2 C(H^t)$ as an upper bound on the amount of inequality due to effort. We therefore propose, as a measure of an upper bound on the *degree* inequality due to effort the index:

$$\eta = 1 - \frac{C(\Phi^T)}{C(H)}. \qquad (6.3)$$

The reason that the measure η is only an upper bound on the fraction of inequality due to effort is that circumstances continue to influence the second term in the decomposition (6.2). See Shorrocks (1980) for a characterization of all inequality indices that can be decomposed in the sense of (6.2).

Our proposal is to measure economic development by the ordered pair $d = (W^{EO}, \eta)$. W^{EO} replaces GDP per capita: it is the average income of those who belong to the most disadvantaged type[17]. Thus, *d* presents both a level of welfare and a degree of inequality.

[17] Or, more generally, as we explained above, it is the average value of the objective of those in the population who comprise the left-hand envelope of the type distributions of the objective. Frequently, the left-hand envelope of the type-income-cdfs is the cdf of a single type.

The proposal to measure the degree of equality of opportunity using the decomposition (6.2) is not original with us. It is a special case of the 'inequality of opportunity ratio (IOR)' defined in Ferreira and Gignoux (2011). Ferreira and Gignoux's preferred measure of inequality is not the square of the coefficient of variation but the 'mean logarithmic deviation.' The same idea for measuring the degree of inequality due to circumstances is proposed in Checchi and Peragine (2010) as well.

In figure 4, we present a graph plotting the points d for a set of European countries, where the are taken from EU-SILC (2005) and the population of male workers is partitioned into three types, depending on the level of education of the more educated parent. (Type 1: Parent completed only lower secondary; type 2: parent completed upper secondary; type 3: parent had some tertiary education.)

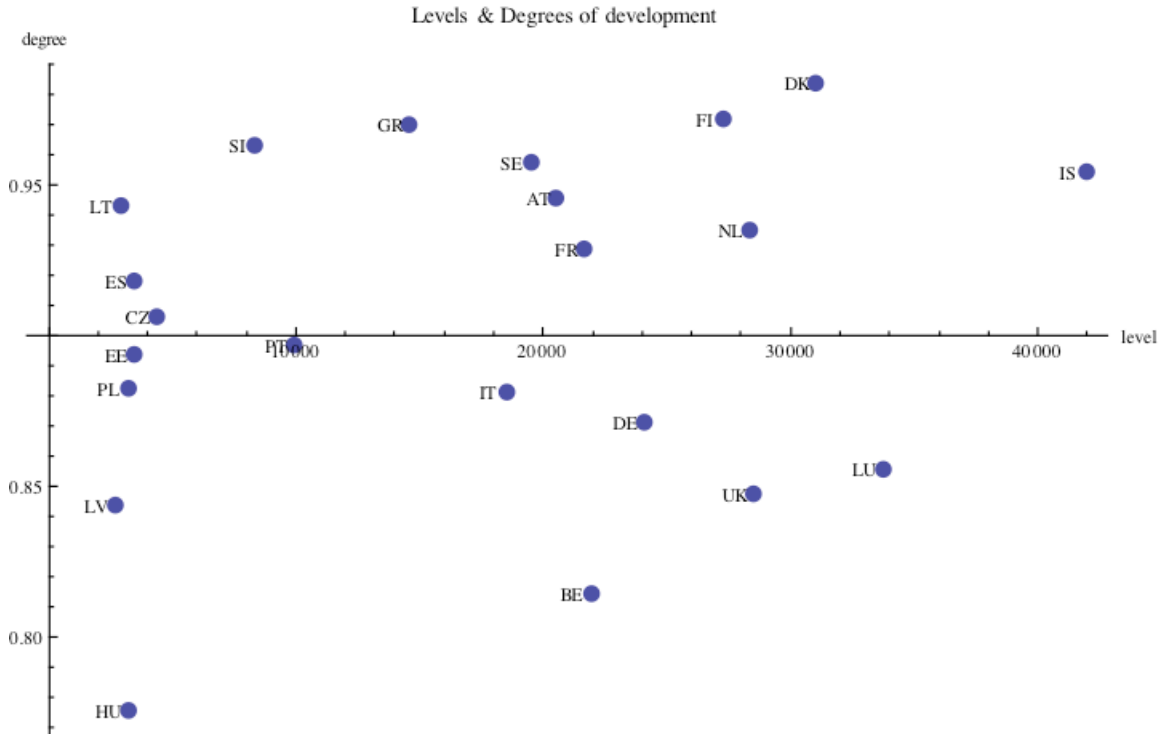


Figure 3. The points $d = (W^{EO}, \eta)$ for a set of European countries

Several remarks are in order. (1) Generally, over 80% of the inequality in income is due to 'effort,' but recall our typology is very coarse: there is only one circumstance, parental

education, partitioned into three levels. A finer decomposition of the population into more types would lower the degree of inequality due to effort. (2) Iceland's (IS) strong position on the first component, it must be remembered, is from data before the bank crisis. (3) No country dominates all others on both components of *d*. But Denmark (DK) dominates all other countries except Luxemburg (LU) and Iceland. (4) Greece's component η is not credible, and may be due to poor data. (5) The Eastern European countries (Lithuania, Lativa, Estonia, Poland, Czech Republic, and Hungary) perform relatively poorly. Finally, recall that we are looking at highly developed countries; were we to calculate the point *d* for developing countries, there would be a much larger spread. (For further details on this calculation, see Roemer [2013].)

Ferreira and Gignoux (2011) calculate their version of the measure η for six Latin American countries as well. Their calculation differs from the one presented here using the SILC data in two ways: they have a different set of circumstances, and they use a different measure of inequality. There is, as one might expect, a lower degree of opportunity equalization in the Latin American countries than in the European ones.

There is one study, of Sweden, in which the population of male workers was decomposed into 1152 types, based upon the observation of seven circumstances (Björklund, Jäntti, and Roemer [2012]). These authors use a Shapley-value method to assign the degree of income inequality due to the various circumstances and to effort. For the coefficient-of-variation-squared measure, the fraction of long-run income inequality due to effort is calculated to be between 59 and 80 percent, considerably lower than the 96% shown in figure 4. It is a testament to the degree of equality of opportunity in Sweden that, with such a fine decomposition of the working population into types, (only) between 20 and 40 percent of income inequality is due to circumstances.

One disadvantage of reporting the level of economic development as a two-dimensional statistic is complexity; in particular, this generates only a partial ordering of countries with respect to the degree of development. One could create a single index by aggregating as follows:

$$\hat{d}_\alpha = (W^{EO})^\alpha \eta^{1-\alpha} \qquad (6.4)$$

for some $\alpha \in (0,1)$. The advantage of the Cobb-Douglas aggregation is that the ordering it imposes on countries is independent of the units in which *W* and η are measured, so it does not matter that *W* is a large number and η is a small one. For the European countries in figure 3, most values of α in (0,1) render a country-ordering which is very highly correlated with the ordering of the first component. We conjecture that this would not occur with a larger set of countries, in which the variation of η would be more substantial.

The World Bank has been an important innovator in bringing considerations of equal opportunity into economic development. Its two important publications, to date, have been the 2006 World Development Report, *Equity and Development,* and a monograph, *Measuring inequality of opportunities in Latin America and the Caribbean* (Paes de Barros et al., 2009). The more recent publication contains a wealth of information on the effects of social circumstances on various measures of achievement and output.

Paes de Barros et al. (2009) propose a measure of equality of opportunity. Consider a particular kind of opportunity, such as 'attaining the sixth grade in elementary school.' Let the total sixth-grade attendance in a country be *H*, and the total number of children of sixth-grade age be *N*, and define $\overline{p} = \frac{H}{N}$ to be the *access* on average of children to the opportunity of a sixth-grade education. $\overline{p}$ measures the level of this opportunity in the country, but not the extent to which access is unequal to different children, based upon their social circumstances. Now using a logit model, they estimate the probability that each child, *j*, in the country has of attending the sixth grade, where that probability is a function of a vector of circumstances; denote this estimated probability by $\hat{p}_j$. Define $D = \frac{1}{2\overline{p}N}\sum |\hat{p}_j - \overline{p}|$. *D* measures the variation in access to the opportunity in question across children in the country. The normalization guarantees that $0 \le D \le 1$. Now define the *human opportunity index* as

$$O = \overline{p}(1 - D);$$

note that $0 \le O \le \overline{p}$.

The human opportunity index is a non-consequentialist measure of development, because the probabilities $\hat{p}_j$ can only be computed knowing the circumstances of the children. The measure combines a concern with the level of provision of opportunities and the inequality of the distribution of them. This is to be contrasted with the ordered pair $(\hat{W}^{EO}, \eta)$, which separates these two concerns into two measures. Obviously, some information is lost in using a single measure rather than two measures.

The concern of the 2009 report is in large part with children. In our view, where children are concerned, all inequality should be counted as due to circumstances, and none to effort, and so the fact that the human opportunity index does not explicitly make the distinction between effort and circumstances is unobjectionable[18]. However, if the measure is used for addressing inequality of opportunity for adults, this may be a defect.

To study this, let us take an opportunity for adults – earning an income above *M*. Suppose there are three types of worker, according to the level of education of their more educated parent. Denote the distribution of income in type *t* as F^t; let the population frequency of type *t* be f^t and let *F* be the distribution of income in the society as a whole. Then $\overline{p} = 1 - F(M)$ is the average access to the opportunity in question in the country. Now for all members *j* of a given type, *t,* compute that $\hat{p}_j = 1 - F^t(M)$: this is because the probabilities $\hat{p}_j$ are computed by taking the independent variables in the logit regression as the circumstances. Hence, the human opportunity measure is:

$$O = \overline{p}\left(1 - \frac{1}{2\overline{p}}\sum f^t \left|1 - F^t(M) - (1 - F(M))\right|\right) = (1 - F(M)) - \frac{1}{2}\sum f^t \left|F(M) - F^t(M)\right| \quad . (6.5)$$

Despite the fact that effort is not explicitly mentioned in defining the index, effort is reflected in measure, because the distributions F^t appear in the calculation. Indeed, the first term $1 - F(M)$ measures the level of opportunity in the country, while the second term is a penalty for the degree to which this opportunity is mal-distributed with respect

[18] Children should only become responsible for their actions after an 'age of consent' is reached, which may vary across societies. Both nature and nurture fall within the ambit of circumstances for the child.

to circumstances (e.g., if there were no inequality of opportunity, then $F^t(M) = F(M)$ for all *t,* and the penalty is zero).

In expression (6.5), the first term on the right-hand side, $1 - F(M)$, plays the role that $\hat{W}^{EO}$ plays in the ordered-pair measure we introduced above: it measures the level of development. But while $\hat{W}^{EO}$ focuses upon how well off the most disadvantaged type is doing, $1 - F(M)$ is a level for the society at large. The second component of our measure, η, is explicitly derived to show the degree to which inequality is due to circumstances, while the second term on the right-hand side of (6.5) is a form of a variance. Certainly these two measures are getting at the same phenomenon. We have a slight preference for our proposal, as it is more carefully justified as measuring what we are concerned with. But these are minor differences; certainly, the measure *O* is in the spirit of thinking of economic development as opportunity equalization.

We finally consider a confusion (from our viewpoint) that infects discussions of 'equity versus development,' similar to the one we mentioned in section 3 when we presented the health-expenditure example. It is often said that equity and efficiency are competing goals, that equity is purchased at the expense of efficiency. There are two senses in which this phrase is uttered. The first is that redistributive taxation may be purchased only at the cost of *Pareto* inefficiency, due to workers' and firms' facing different effective wages. This is true. The second sense is that redistribution may lower total output. These two claims are in principle independent. There may be policies which re-allocate income in a more equitable manner, lower total output, but are not Pareto inefficient. (Think, for example, of re-allocating educational funds from tertiary education to secondary education in a poor country. This might have a purely redistributive effect, without significant consequences for Pareto efficiency.)

We wish to criticize the second usage of the phrase. Saying that there may be a trade-off between equity and efficiency *where efficiency is measured as total output* is equivalent to saying there is a trade-off between equity and the *utilitarian* measure of development, which (in its simplest form) is given by output per person. Consider the following quotations from the otherwise fine report of the World Development Report

2006, issued by the World Bank, entitled *Equity and Development.* In these quotations, equity and development are counter-posed:

> Greater equity is thus doubly good for poverty reduction: through potential beneficial effects on aggregate long-run development and through greater opportunities for poorer groups within any society (p.2)

> If the opportunities faced by children like N. are so much more limited than those faced by children like P. or S., and if this hurts development progress in the aggregate, then public action has a legitimate role in seeking to broaden opportunities….(p.3)

> Third, the dichotomy between policies for growth and policies specifically aimed at equity is false (p.10)

In the first quotation, saying that equity is 'doubly good,' in that it is good for the poor and also good for long-run development, only makes sense if one assumes that equity and long-run development are *different goals.* In our view, long-run development *means* approaching equity – that is, equality of opportunity. We believe that the authors of this sentence had in mind GDP per capita as the measure of long-run development, and so what is being said is that equalizing opportunities will increase GDP per capita. This is peculiar in a report that is devoted to advocating the view that economic development requires the achievement of equal opportunity[19]. In the second quotation, the assumption is that redressing the inequality of opportunity among the children is justifiable because that inequality *hurts development*: but in our view, it is that inequality which *comprises* underdevelopment, and so the sentence is tautological. Here, the authors have in mind a utilitarian concept as the measure of economic development. Finally, the third quotation would likewise be a tautology for us: but in the context, the authors are saying that policies which increase equality of opportunity *also lead to an increase in total income.* (That is, the third quotation is offered as an empirical claim, while for us, it is a tautology.) Again, there is an ambivalence in the conceptualization

[19] To say that development 'requires' equalizing opportunities is weaker than saying that it is synonymous with equalizing opportunities: we have been advocating the latter position in this section.

of economic development: does it mean equalizing opportunities, or increasing per capita output?

It will often be the case that policies that redress inequality of opportunity will also increase total output, because improving opportunities for the disadvantaged releases talents that were, before, unused. But this need not be the case, and we maintain that our justification for redressing inequality of opportunity should not depend on its being the case. There may be groups in society that are so disadvantaged that it is very costly to compensate them: the return in output per funds invested may be small. Equity may be advanced only by shifting investment from uses where it generates high output to ones where it generates lower output. (This may be so, particularly in the short-run.) But if this is the case, it does not mean that the policy in question should not be undertaken, nor does it mean that development is thereby reduced if it is.

The ambivalence in *Equity and Development* is a reflection of the competing conceptions of justice represented by utilitarianism and opportunity-equalization. Utilitarianism, as we said, has a strong hold on economists. This is a hold-over from an earlier period when utilitarianism was the only game in town – let us say, until John Rawls's work (1958, 1971). Economists and mathematicians developed optimization techniques (e.g., the Bellman equation) which are suited to solving problems where utilities are added up across persons, but not to solving problems where the minimum is maximized. And so it is often comfortable to work with utilitarian formulations. We submit, however, that this is a bad habit that we should not continue to practice.

If our view of economic development is adopted, there may be a significant change in policy evaluation. One would not have to justify investment in very disadvantaged social groups by showing that such investment increases total output. As we indicated, in the long run, such a conflict might not exist: but often, policy makers are under political pressure to evaluate the consequences of their policy choices in the short run. If a country is evaluated on the basis of its ordered-pair statistic $d = (W^{EO}, \eta)$ rather than on GDP per capita, policies could be quite different.

7. Dynamics

Equality of opportunity invites a dynamic approach. If we apply an EOp policy today, what effect will it have on the distribution of types in the next generation? One hopes that sequential application of EOp policies would create a society where most of the effect on inequality from circumstances has been eliminated. A natural way to study this question is to analyze stationary states: that is policies which have the property that the society they produce at date $\tau+1$ is a replica of the society that existed at date τ.

We know of only paper on this topic, by Roemer and Ünveren (2012), which presents an extended example. In the society postulated, there are two economic classes, rich (*R*) and poor (*P*), whose pre-tax incomes (inelasticallly produced) are w_R and w_P, $w_R > w_P$. Both the family and state invest in children. Let private investment in its child by a type *J* family be i_J and state investment in a *J* child be s_J, for $J \in \{P, R\}$. At a point in time, the fraction of *R(P)* households is $f_R \left(f_P = 1 - f_R\right)$. Mean income at this time is $\mu = f_R w_R + f_P w_P$. The state investments are funded by a linear income tax at some rate *t*; thus

$$t\mu = f_R s_R + \left(1 - f_R\right) s_P . \qquad (7.1)$$

Let $z_J = i_J + s_J$ be the total monetary investment in a *J* child, $J \in \{P, R\}$. The probability of the child's being successful, in the sense of becoming an *R* adult, is a function of his background. For a child growing up in an *R* household, it is

$$\pi_R\left(z_R, z_P\right) = \frac{e^{z_R}}{e^{z_R} + e^{z_P}}, \qquad (7.2a)$$

while the probability of transition to the *R* class for a child from a *P* background is:

$$\pi_P\left(z_R, z_P\right) = \frac{a e^{z_P}}{e^{z_R} + e^{z_P}}, \; 0 < a < 1. \qquad (7.2b)$$

The fact that *a* is less than one models the idea that the cultural effects of growing up in a *P* household (and neighborhood) reduce the chances of becoming an *R* adult. The formulation of the transition probabilities is a reduced-form representation of a process of competition for the 'good' jobs among young workers.

The *standard of living* of a *J* adult is his after-tax income, which is $y_J = \left(1 - t\right) w_J - i_J$. The *utility* of an adult is a function of his income and the expected

income of his child when she becomes an adult; we may write the utility of a *J* adult at date τ as

$$U_J^\tau = y_J + \varphi(\pi_J^\tau y_R^{\tau+1} + (1-\pi_J^\tau) y_P^{\tau+1}) \quad . \qquad (7.3)$$

A *stationary state* is a stable set of policies and decisions. It comprises a policy (t^*, s_P^*, s_R^*), optimal private-investment choices by households, (i_R^*, i_P^*), and a stable fraction of rich households f_R^*, such that the following hold:

(1) $t^* \mu^* = t^*\left(f_R^* w_R + (1-f_R^*) w_P\right) = f_R^* s_R^* + (1-f_R^*) s_P^*$,

(2) i_R^* maximizes (over *i*)

$$\left.\begin{array}{l}(1-t^*)w_R - i + \\ \varphi(\pi_R(s_R^*+i, z_P^*)((1-t^*)w_R - i_R^*) + (1-\pi_R(s_R^*+i, z_P^*))((1-t^*)w_P - i_P^*))\end{array}\right\} \text{Program } P_R$$

(3) i_P^* maximizes (over *i*)

$$\left.\begin{array}{l}(1-t^*)w_P - i + \\ \varphi(\pi_P(z_R^*, s_P^*+i)((1-t^*)w_R - i_R^*) + (1-\pi_P(z_R^*, s_P^*+i))((1-t^*)w_P - i))\end{array}\right\} \text{Program } P_P$$

(4) $f_R^* \pi_R(z_R^*, z_P^*) + (1-f_R^*)\pi_P(z_R^*, z_P^*) = f_R^*$

Condition (1) is the budget constraint, and condition (4) says that the fraction of *R* households is stable; condition (2) defines the optimal investment choice of an *R* parent, knowing that the next period will look exactly like the present period from the viewpoint of his child. Condition (3) defines the optimal investment choice of a *P* parent in the stationary state.

Write

$$I_J = \left\{i_J \geq 0 : i_J \text{ solves Program } P_J\right\},\ J = R, P \quad .$$

An *environment* is summarized by the data (w_R, w_P, a, φ) with the intergenerational transmission functions (π_R, π_P). For this environment, there will exist a set of stationary states. We are interested in the stationary state that is best from the equal-opportunity viewpoint. We define this as follows. In a stationary state, the expected standard of living of a *J* child is:

$$E_J = \pi_J((1-t)w_R - i_R) + (1-\pi_J)((1-t)w_P - i_P) \, .$$

The equality-of-opportunity ethic maintains we should maximize the expected standard of living of the worse-off type of child. Thus, if ξ and ξ^* denote two stationary states, then EOp weakly prefers ξ to ξ^* if:

$$\min_{J=P,R} E_J(\xi) \geq \min_{J=P,R} E_J(\xi^*). \tag{7.4}$$

Obviously, the ordering on stationary states defined by (7.4) induces an ordering on policies. We wish to compute the most desirable state policy according to the preference order (7.4).

Solving for the optimal stationary state is complicated, because the optimization program is non-convex due to the incentive-compatibility constraints. The authors compute optimal policies for a randomly generated set of economies by analysis and simulation. The striking result is that, in 76% of the economies randomly generated, the optimal stationary state from the EOp viewpoint is *laissez-faire*: that is, the state should neither tax nor invest in children. The reason is that if the state invests in Poor children, Rich families compensate by investing more in their children. State investment in Poor children induces an arms race.

Admittedly, this is just an example. The authors then consider a second type of policy: investment in parents. Formally, this is modeled by devoting state investment to raise the coefficient a (see eqn. (7.2b)), which reduces the handicap that Poor children face due to their background. Now, in the simulations, in 80% of the cases, the state invests in parents (that is, in increasing a), but not in children.

These results are mindful of the work of James Heckman (2011), who has been championing the importance of early childhood education. It appears that much of the disadvantage of being poor has already occurred by the age of three or four. We suggest, based on these results, that investment in Poor families may be more productive, in the long run, than investing directly in children.

A second approach to incentive issues in equality of opportunity is the work of Calsamiglia (2009), who points out that if there are several ministries attempting to equalize opportunities for different objectives, each taking a 'local' approach, the consequence may be to not equalize opportunities globally. Her paper characterizes the types of local EOp policies that will induce global equality of opportunity.

Suppose that Paul and Richard have identical preferences and skills; both want to play professional basketball, and to attend college. They face the same basketball resources in their two neighborhoods, but Richard's (rich) neighborhood has better schools. So Richard is advantaged with respect to the probability of college admission due to a fortunate circumstance. Their probabilities of being admitted to college and a professional basketball team will depend upon their efforts in school and in basketball respectively, and on the resources in their neighborhoods[20]. Suppose initially that both professional basketball and college recruiters adopt a 'market' policy : they admit candidates based only on their scores on relevant tests, which are functions of effort and circumstances in the relevant arena. Facing these policies, Paul and Richard choose basketball and school effort (e_B, e_S) to maximize the total probability of admission to the basketball league and college, minus some convex cost in total effort. Since school effort is relatively less effective for Paul, he devotes less effort to school than Richard and more effort to basketball. It turns out that Richard has a higher utility, although the two boys have identical preferences and skills.

Now the basketball league and college alter their policies, in an attempt to equalize opportunities. Suppose that the league's policy is to admit players based only on their efforts pertaining to basketball: then if Paul and Richard expend the same basketball effort, e_B , they will enjoy the same probability of recruitment by the league, which is locally fair, because they have the same basketball circumstances. Suppose that the college admissions officer decides to give extra points on his college-admission score to Paul as compensation for Richard's advantaged circumstances: she simply adds a lumpsum to Paul's SAT score. This is also a local EOp policy. Given these two policies, Paul and Richard will not alter their efforts, because of the lump-sum nature of the compensation to Paul, and hence Paul and Richard will have the same probability of college admission (locally EOp), but Paul has a higher probability of getting into the basketball league, as he expended more basketball effort. Although the policies are each *locally* EOp, the global result is not opportunity equalizing.

---

[20] We ignore American colleges' propensity to admit star basketball players, regardless of their academic accomplishment.

The problem lies with the lump-sum nature of the EOp policy in the college sector. Calsamiglia proves that, under assumptions that the environment is sufficiently rich, the necessary and sufficient condition for local EOp policies to aggregate to a global policy that is opportunity-equalizing is that the *marginal* returns to effort must be identical for all candidates in each sector. Because Paul's effort in school is less remunerative than Richard's, due to his inferior school, the proper policy is to augment the *returns per unit of school effort* for Paul in terms of the desired outcome (probability of college admission).

Certainly, many affirmative action policies are of the wrong, lump-sum type. For example, universities often given extra points to students from disadvantaged backgrounds, in considering admissions. The empirical implications of Calsamiglia's result have yet to be examined.

8. Opportunity-enhancing policies

A. Conceptual issues

The literature on distributive justice is divided into two strands, a large normative one and a small descriptive one. The previous sections have considered the normative foundations of equality of opportunity. In this section, we briefly review examples of policies which are based on the philosophical view that motivates equality of opportunity, that individuals should be compensated for their disadvantageous circumstances. For these policies to be chosen by a society, it must be that its citizens endorse this idea. The issue of social acceptance of the principle is even more important if one follows Roemer's (1993) view according to which the cut between circumstances and effort should be a social and cultural decision, rather than a metaphysical one. Each society should determine the precise set of variables that describe the circumstances and the effort variables according to the views of its population. Intercultural differences in social preferences will obtain in this pragmatic view of equality of opportunity, and empirical work on these differences in the attribution of the responsibility is then relevant. The state of our knowledge on these matters is still weak. Below, we list the most obvious candidates for an empirical assessment.

The first issue concerns the so-called 'responsibility cut.' In the philosophical literature, there is a debate between those who advocate that people should be responsible for their preferences (for example, Dworkin (1981a, 1981b) and Fleurbaey (2008)) and those who argue that the responsibility variables should be those under the control of the individual (prominently, Arneson (1989) and Cohen (1989)).

The second issue concerns the correlation between effort and circumstances. Life-style choices (patterns of alcohol use, exercise, smoking, diet and so on) are examples of variables under proximate personal control. These choices are, however, influenced by family and social background. As we have said, for the measure of effort to be appropriate for the theory, it must be sterilized of the impact of circumstances upon it. As we wrote earlier, Roemer's technique for sterilizing effort of the effect of circumstances upon it is to measure the degree of a person's effort by her rank on the distribution of effort of those in her type. The same issue arises with preferences: if a large number of persons in a given type have preferences which, let us say, degrade the value of education, one must recognize that educational choices of such persons are influenced by their circumstances, and are not autonomous in the appropriate sense. Dworkin's (1981b) opposition to this move is to claim that *not* holding persons responsible for their preferences is to disrespect them. Another philosopher who opposes sterilizing the effort distribution of its circumstantial causes was Brian Barry, who believed that persons should be rewarded for hard work, even if that was induced by familial culture and pressure.

The responsibility cut must also to be drawn among the different kinds of luck. As we wrote, Dworkin (1981b) distinguished between brute and option luck. A typical example of option luck is the outcome of a deliberate gamble. Fleurbaey (2008) does not advocate holding individuals responsible for the entire consequences of option luck. He attempts to disentangle the risk-taking aspect from the purely random aspect of a gamble, considering the latter to be a circumstance. Various compensation schemes respecting this distinction are proposed.

Implementing equality of opportunity may be viewed as weakening the traditional role of the family. Roemer (2004) has proposed that parents affect the opportunities of their children through four channels: (C1) the provision of social connections, (C2) the

formation of beliefs and skills in children through family culture and investment, (C3) genetic transmission of ability, and (C4) the formation of preferences and aspirations in children. He views the first three as circumstances, deficits in which should be compensated by an equal-opportunity policy. Preferences and aspirations are more complicated. If a coal miner loves coal-mining culture and instills in his child the desire to become a miner, this is a legitimate influence that does not call for compensation. What better conception of immortality is there than transferring one's values to one's children? If, however, the parent instills that desire because he views no other career as being available to the child, that transfer of preference is not legitimate – that is to say, preferences which are themselves induced by resource deficits comprise grounds for compensation. We know of no study that attempts to disentangle the kinds of preferences parents pass on to their children in this way.

One consequence of viewing (at least some) preference transmission to children from parents as morally legitimate is to recognize that even a perfect regime of equal opportunity should not aim at equalizing the rows of the intergenerational mobility matrix. Parents may legitimately induce differential preferences in their children, *leading to differential incomes,* even if the effects of all other circumstances were miraculously compensated for. If one does not admit this, then it is difficult to justify why we do not advocate raising children collectively. At some point, when the unacceptable differential effects of socio-economic circumstances have been largely eliminated it will become important to address the distinction discussed with respect to channel (C4).

Finally, the *nature of the objective* must be taken into account. Three important objectives appear frequently in the empirical discussion. First, education, which takes place mainly during childhood and adolescence; second, income, which is closely related to conditions in the labor market; and third, health, which matters for a lifetime. Education is peculiar because a good part of it occurs before the 'age of consent,' that is, the age at which people should be held at least partially responsible for the various choices they make. Health, by many, is viewed as a right, in which matters of choice

should not count. Thus, the *scope* of equal-opportunity policy may differ substantially depending upon the nature of the objective[21].

We have illustrated how policies should be designed to equalize opportunities in Sections 3 and 7 with abstract examples. Here we focus on more concrete policies and address the issue of their efficacy when the social objective is to maximize the average outcome of those who belong to the most disadvantaged type. We must limit our scope, because the relevant literature is huge, and did not begin with EOp literature that we have reviewed in this article. To some degree, labor-, education-, and health-economists have been addressing these issues for decades. To wit, much of the literature on affirmative action addresses the issue of inequality of opportunity based on race (see, for instance, Fryer and Loury (2005)). We will focus on a few examples : human-capital-enhancing policies, including those which attempt to neutralize the differences in the distribution of effort across types, policies that address differential wealth, and policies to equalize opportunities for health outcomes.

B. Human-capital-enhancing policies

Human-capital policy is a catchword popularized Carneiro and Heckman (1983) to cover policies whose aim is to develop cognitive skills and non-cognitive skills over the entire life-cycle. Education (years of schooling) is an omnibus variable that explains good outcomes in different dimensions during adulthood. In the Mincer equation, education is the main observable variable, along with seniority, that explains job-market success. It influences lifestyle, saving and fecundity, once income is controlled for. Although primary and secondary education are publicly provided in all western democracies, the distribution of years of schooling remains dependent on social origin (for empirical evidence for the US, see Heckman and Krugman (2003)). It does not suffice to provide equal access to achieve equality of opportunity in the acquisition of human capital -- that is, to realize a distribution of human capital that is independent of

[21] For an early survey experiment, which shows that norms of justice differ quite radically depending upon what the *distribuendum* is, see the seminal paper of Yaari and Bar-Hillel (1984).

socio-economic and ethnic/racial background. A human-capital policy that compensates disadvantaged children for the paucity of resources provided by their families is required.

We address two issues: Is the failure of children growing up in poor families to achieve good educational outcomes due to low innate talent? And can we help disadvantaged children other than by raising incomes of parents?

An affirmative answer to the first question was offered by Arthur Jensen (1969) in his attempt to explain the relative failure of the President Lyndon Johnson's War on Poverty. After arguing that environmental factors are not nearly so important in determining IQ as genetic factors, Jensen presented evidence suggesting that social class and racial variation in IQ tests must be attributed partially to genetic differences. Jensen's evidence has, however, not stood the test of time. In the aftermath of the turmoil induced by the publication of *The Bell Curve* (Richard Herrnstein and Charles Murray (1996)), an article published by eleven distinguished American sociologists (Neisser et al(1996)) reviewed what was known about intelligence tests. They reported that the variance in genes explains about 25% of the variance of IQ[22].

To answer whether children growing up in poor environments are less intelligent, we must measure intelligence before the family environment has had an influence, which is to say, very early. Empirical evidence of samples of infants stratified by SES is lacking, but there is evidence of black-white differentials On tests of intelligence, blacks systematically score less than whites although the gap is diminishing. Using a newly available nationally representative data set that includes a test of mental function for children aged eight to twelve months, Fryer and Levitt (2013) find only minor racial differences in test outcomes (0.06 standard deviation units in the raw data) that disappear with the inclusion of a limited set of controls. Interestingly, when introducing SES, higher SES children perform better but the effect is small (a top-quintile SES child outscores a bottom-quintile child by 0.08 of a standard deviation) and the deviation is not

---

22 The earliest intelligence tests were devised to equalize opportunities in primary education. The purpose of these tests, developed by Afred Binet in 1905, was to detect mental handicaps in children, and to provide these children with special courses (see Fancher (1985)).

robust with respect to the introduction of other controls. Black children, however, lose ground in the first years of schooling (Fryer and Levitt (2004a, 2004b). Differences emerge as early as age two, and by the time black children enter kindergarten they lag whites by 0.64 of a standard deviation in math. The gap continues to grow as children progress in schooling. According to these authors, there is suggestive evidence that differences in school quality may be an important part of the explanation for this widening in test scores.

The issue raised by the second question is whether it is possible to improve the schooling chances of the disadvantaged children with "micro surgery" techniques, that is, leaving unchanged the social and economic equilibrium that produce poverty (Heckman (2012)). The spatial location and incomes of poor families are implicitly held constant in this approach.

We are still only beginning to consolidate scientific evidence in this area. Robust causal relationships must be established, which will come only with many empirical studies. We must understand the different channels through which a child develops, and the role of different factors such as genes, investment, and environment. In Heckman's (2013) formulation, we need to "model human capability formation."

All specialists agree about the timing of the state intervention: the younger the better, and the cheaper, because of the accumulative nature of knowledge and the plasticity of the young brain. According to Carneiro and Heckman (2003) cognitive skills are formed very early (by age eight, they are fairly well set, see Heckman (1995)), while non-cognitive skills can still be developed through adolescence. Heckman, and before him, Herbert Gintis (1971), emphasize the importance of non-cognitive skills in schooling and on the job. There is a complex interaction between cognitive skills and non-cognitive skills in the accumulation of knowledge. Successful school learning depends on personal characteristics other than intelligence, such as persistence, interest in school, and willingness to study. The encouragement that is received from peers, family and teachers plays a key role. Good policy must affect all of these factors.

Some authors put more stress on the quality of schools (Krueger (2003)) while Carneiro and Heckman (2003) think that it is more important to offer the children a better family environment by teaching parents to be good teachers at home. Diane Ravitch (2013),

however, is skeptical that opportunities among children can be equalizing without addressing adult poverty.

A recent study by Dobbie and Fryer (2011) presents evidence that micro-surgery can reduce and even eliminate the racial achievement gap in test scores. Harlem Children's Zone is a 97-block area in Harlem, New York, that combines "No Excuses" charter schools with a web of community services designed to ensure the social environment outside of school is positive and supportive for children from birth to college graduation. These schools typically allow the principal considerable administrative freedom, set measurable goals that are regularly tested using interim assessments, emphasize parent participation, and create a culture of universal achievement that make 'no excuses' based on the students' background. The authors exploit the fact that the charter school is required to select students by lottery when the number of applicants exceeds the number of available slots for admission. The treatment group is composed of students who are lottery winners and the control group consists of students who are lottery losers. Both lottery and instrumental-variable identification strategies lead to the same conclusion. The effects of attending the Promise Academy charter middle school are enough to close the black-white achievement gap in mathematics and reduce it by nearly half in English. The effects in elementary school close the racial achievement gap in both subjects. Results also suggest that the school part of the program is suffices to increase academic achievement among the poor. Community investments are neither necessary nor sufficient. First, students who live outside the Zone garner the same benefit from attending the program as the students inside the Zone, suggesting that proximity to the community programs is not important. Second, siblings of Promise Academy students who have access to the same community programs but were ineligible for the Promise Academy because of their age show no detectable gains in achievement. The same authors (Dobbie and Fryer (2013)) try to explain school effectiveness by looking at data from 39 charter schools. They find that traditionally collected input measures – class size, per-pupil expenditure, the fraction of teachers with no certification, and the fraction of teachers with an advanced degree – are not correlated with school effectiveness. In stark contrast, they show that an index of five policies suggested by over forty years of qualitative research – frequent teacher feedback, the use

of data to guide instruction, high-dosage tutoring, increased instructional time, and high expectations – explains approximately 45 percent of the variation in school effectiveness.

One issue that remains unsettled is whether this kind of program will be successful nationwide, and what it would cost in the long run. Frederiksson et al (2013) provides an example of an assessment of a school program at a national scale: they evaluate the long-term effects of class size in primary school in Sweden, exploiting variation in class size created by a maximum-class-size rule. Smaller classes in the last three years of primary school (age 10 to 13) are beneficial for cognitive and non-cognitive ability at age 13, and improve achievement at age 16. They also find that smaller classes have positive effects on completed education, wages, and earnings at ages 27 to 42. A cost-benefit analysis suggests that a reduction in class size from 25 to 20 pupils has an internal rate of return of almost 18%.

Class-size reduction, however, did not reduce the achievement gap among children from families of different SES. For those children from families at the lower end of the parental income distribution, a reduction of class size by one pupil improves employment probability by 2 percentage points but has no effect on wages. For those from families at the high end of the parental income distribution, a reduction in class size yields no effect on the employment probability, but the wage effect is larger than for the rest of the distribution.

It is difficult to find other successful programs. Early childhood interventions such as Head Start, Perry Pre-school, Nurse-Family Partnership, and the Abecedarian Project, looking just at the US, boost kindergarten readiness, but the effects on achievement often fade away once children enter school (Janet Currie and Duncan Thomas 1995; David Olds 2006; Fryer, forthcoming). Other programs that try to break down or at least weaken the social connections between a child and his neighborhood through school vouchers or busing were not found to be particularly effective. For busing, see Angrist and Lang (2004) and for vouchers see Rouse (1998); Krueger and Zhu (2002); Cullen, Jacob, and Levitt (2005); and Hastings, Kane, and Staiger (2006).

James Heckman advocates different solutions, which may involve violation of parent sovereignty. “Paternalistic intervention in the early life of children in certain

dysfunctional families may be appropriate. If we are to violate the principle of family sovereignty anywhere in the life cycle process of learning, the case for doing so is strongest at the preschool stage (and only for some groups (Carneiro and Heckman 2003, p.164))". Clearly, society has values in addition to that of equalizing opportunities, and excessive interference in the family's raising of children is one of them. Here is a case where the specification of the policy space must include constraints that disallow certain kinds of interference. Recall, in the example of section 3 concerning equalizing life expectancies of a Poor and Rich type, that we constrained the policy space to respect privacy and horizontal equity, values that trumped equalizing opportunities. The same may well be the case concerning the formation of skills in children: the policy space must respect a certain degree of parental hegemony. If that is the case, perhaps micro-surgery will never suffice, and we must address poverty, with social policy, in order to equalizing opportunities for children. This is indeed our conjecture.

The formation of non-cognitive skills may be as important as of cognitive ones. Indeed, non-cognitive skills often are associated with what would be called 'effort,' rather than circumstances, in the EOp model. Consider the stigma that is sometimes associated with a person's behavior conforming to behavior of those in another type. 'Acting white,' among African-American youth, describes behavior for which individuals may be ostracized. Changing the role model – for instance, by having a black intellectual president -- may be instrumental in altering this kind of 'effort.' In his keynote address at the 2004 Democratic National Convention, Barack Obama said, "Go into any inner city neighborhood, and folks will tell you that government alone can't teach kids to learn. They know … that children can't achieve unless we raise their expectations … and eradicate the slander that says a black youth with a book is acting white (*Washington Post,* July 27, 2004). "

Although we have referred to charter schools as instruments that might improve opportunities, there is a more general point, that focusing upon the provision of charter schools may have the consequence of dis-equalizing opportunities, because charter schools may draw resources away from public schools generally, and those parents who make use of them may be the most highly motivated ones, leaving the most disadvantaged children to poorly resourced non-charter public schools. Diane Ravitch

(2013) is a strong opponent of the privatization movement in primary and secondary education in the United States, and is critical of charter-school movement for the reason indicated. Although only 6% of students in New York City schools attend charter schools, they provide an escape valve that may reduce citizens' efforts to improve the public school system more generally.

Betts and Roemer (2007) conducted a partial-equilibrium analysis to estimate how the national (US) budget for secondary education would have to be allocated, if it could be targeted to individuals as a function of their type, in order to equalize opportunities for the acquisition of wage-earning capacity. The sample, taken from the National Longitudinal Study of Young Men (NLSYM) consisted of all wage observations of employed male workers between 1966 and 1981 who were 18 years old or older and not enrolled in school in the given year. Using data on secondary school expenditures in the cities where the young men attended high school, the authors are able to estimate the elasticity of future wages with respect to educational expenditures, and to calculate a distribution of the national educational budget that would maximize the expected wage of the most disadvantaged type. The analysis is partial-equilbrium, because no attempt is made to calculate the effect of changing supplies of labor on wages.

Different partitions of the sample into 'types' were studied. The 'socio-economic' typology partitions the sample into four types, based on the level of parental education, where the most disadvantaged type had the more highly educated parent with fewer than nine years of education, and the most advantaged type had a parent with more than twelve years of education. Assuming a national education budget (secondary schools) of $2500 per student (1990 dollars), the distribution of the budget to the four types of student, which is optimal according to the EOp objective, is (5.36, 3.62, 1.88, 1.10) thousands of dollars per student, from the most to the least disadvantaged type. That is, about five times as much would have to be spent on children whose parents had fewer than nine years of education, as on children whose parents had some tertiary education. Of course, the econometric exercise takes the educational technology as it was reflected in the data. The weekly wages of the four types, at the optimal policy, are (0.656, 0.653, 0.638, 0.659) thousands of dollars per worker – substantially equalized. It is noteworthy that the average wage is greater than the actual average wage, by 2.6%, so in this case,

equalizing opportunities does not engender a so-called efficiency-equity trade-off. (We have noted our objections to this term in section 6.)

The authors also report the optimal policy for a typology that partitions the sample into two types, black and white. With the same national budget, $14.76 thousand per annum would be allocated to each black student, and $0.828 thousand to each white student, a ratio of almost 18 to 1. At this policy, estimated weekly wages of black and white workers would be $584 and $604, respectively.

Clearly implementing either of these policies is politically unrealistic, to say the least[23]. Nor would it be efficient to focus entirely on secondary school education as the locus of EOp, as our discussion of early-childhood education demonstrates. Because the educational process is a black box here, reflected only in the data, we cannot conclude why these very unequal allocations of educational finance to types comprise the solution of the EOp program: to what degree are the results reflecting differential school quality which different types of child enjoy, and to what degree is the putative compensation necessary because of disadvantaged family and neighborhood environments, and racism/discrimination in the workplace? Nevertheless, these results do make the point that an opportunity-equalizing policy is very different from a resource-equalizing policy. It is noteworthy, however, that only three OECD countries currently spend less per capita on the education of poor children than of rich children: the United States, Turkey, and Israel (US Dept of Education (2010)).

There have been, roughly speaking, two kinds of opposition to affirmative action policies in the United States. One says that it is a violation of democratic equality to predicate any policy on race; the other says that race is not the salient circumstance for equal-opportunity policy – rather, compensation should be predicated on the socio-economic class of the student[24]. Betts and Roemer (2007) report some results that may

---

[23] Such a policy would not best be implemented by giving vouchers of different values to students of different types, but rather distributing school budgets in such a way as to reflect the distribution of types attending the school.

[24] There is as well the opposition saying that affirmative is fine in principle, but it does not produce the desired results.

be useful in evaluating the second argument. Under the SES typology (using education of the parent as the circumstance, but no racial information), it turns out that, at the optimal policy, only 18% of black workers rise to the top two quintiles of the wage distribution. But with the racial typology (black and white), almost 36% of blacks rise to those two quintiles. (Of course, total equality of opportunity would require that 40% of blacks be in the top two wage quintiles.) Under the *equal resource* policy, where the same amount is spent on all students, 15% of black workers are in the top two quintiles. The upshot is that, with a race-blind opportunity-equalizing educational finance program, black workers do not fare much better, in terms of future wages, than with the equal-resource policy. This would seem to indicate that the disadvantage that black workers face is only very partially addressed by predicating affirmative action on socio-economic status of families.

In contrast to the partial-equilibrium approach just described, Keane and Roemer (2009) take a general equilibrium approach in studying what kind of financial incentives would equalize opportunities for college attendance in the U.S. College graduation rates differ sharply across types characterized by the social class of parents of the individuals in question. Consider four types, defined according to whether a young person's parents did not complete high school (< HS), just completed high school (HS), completed some college (SC), or completed college (COL). In 1990, the fractions of young men of these four types in the United States who attended college were 15%, 24%, 56%, and 70%, respectively, which leads, of course, to large inequalities in lifetime income. Keane and Roemer (2009) study the effect of educational subsidies for college financing, that would be targeted at the two most disadvantaged types, upon equalizing these rates of college attendance. Their study makes both a partial and general equilibrium computation. In the general equilibrium computation, the increased college attendance that subsidies would induce reduces wages for college graduates relative to high school graduates, which will mollify, to some degree, the effect of the subsidy.

The model is complex in accounting for 160 *kinds* of labor: workers can enter one of 10 occupations, be either male or female (2), be college or high school educated (2), and be of four age-experience categories (4). ($10 \cdot 2 \cdot 2 \cdot 4 = 160$.) Each kind of labor will be paid a (different) wage at equilibrium. The individual's *type* (one of the four

stipulated above, based upon parental education) affects the individual's preferences and his/her choice whether or not to attend college, but does not affect the wage, which is determined by the 160 components defining the *kind* of labor.

The model is one of overlapping generations, where each worker decides at age 19 whether or not to attend college. Workers all enter the labor force at age 25, and work for 40 years. They gain experience (and hence their wage changes) over the lifetime of work. Each individual maximizes the present discounted value of future income under the alternatives of attending or not attending college, net of a 'cost' or disutility of college attendance. Critical in the utility function is the cost parameter, which differs across types. This may reflect either financial or psychic costs of attending college. Thus, the lack of preparation in earlier schooling typical of many students from disadvantaged types enters here as a high 'psychic' cost of college education. If education is disvalued in the social milieu of the young person, that will also be reflected in a high value of the cost parameter.

There is a single profit-maximizing firm which hires workers of the 160 kinds to produce a single good; its production function is nested CES. A wage vector, with 160 components, comprises an equilibrium vector, if all 160 labor markets clear. (The price of output is numéraire.) There is a random element in the utility function of workers, which has the effect of sorting them into the ten occupations. Of course, the wages in the occupations also differ, because the production function is estimated from real data.

The details of the estimation procedure are described in Keane and Roemer (2009) and Johnson and Keane (2007). The authors (of the former article) then consider subsidies or bonuses to the '< HS' and 'HS' types, awarded upon their choosing to attend college. They find that a subsidy of $165,000 to the most disadvantaged type and of $78,000 to the 'HS' type will bring the college attendance rates of these two types up to the attendance rate of the 'SC' type – in the general equilibrium computation. These subsidies are very large – larger than average college attendance costs – and so a substantial part of their effect must be to counter the 'psychic' costs of college attendance for disadvantaged types. The effect of the subsidies is to increase the college attendance rate of the '< HS' type by 40 percentage points, and of the 'HS' type by 23 percentage points. The general-equilibrium feedback effects are substantial: in the partial

equilibrium computation (where the wage vector is taken as fixed), the two most disadvantaged types increase their college attendance by 37 and 20 points, respectively, with these subsidies, but in the general-equilibrium variant, these increases drop to 21.4% and 6.6%. For women, the gains are much less: an 8% and 4% increase in the college attendance rates of the two most disadvantaged types. The reduced premium for college-educated labor (due to its increased supply) encourages women to consider more favorably the 'home production' occupation.

The authors also compute optimal subsidy policies according to other social-welfare functions (besides the EOp function). Consider the following family of social-welfare functions, with parameter *r*, here defined for male (*m*) types:

$$W_m^r(\varphi) = \sum_{t=1}^{4} f_t X_m^t(\varphi)^r, \quad -\infty < r \leq 1 \ ,$$

where $X_m^t(\varphi)$ is the present discounted value of income (net of costs) for a male of type *t* under the subsidy policy φ and f_t is the population frequency of type *t*. When $r = 1$,the social welfare function is utilitarian; as *r* approaches $-\infty$, it approaches the EOp social welfare function, which maximizes the income of the most disadvantaged type. For $r = 0$, the social welfare function is the sum of the logarithms of the PDV of incomes.

For the utilitarian social welfare function, the optimal subsidy is to give $45,000 to the '< HS' type and nothing to the 'HS' type. The average PDV of incomes increases 0.03% over the no-subsidy case. For the logarithmic social welfare function, the optimal subsidy is $90,000 to the most disadvantaged type and $22,500 to the 'HS' type. The average PDV of income is reduced by 0.13% compared to the no-subsidy case. This policy approximately equates the college attendance rates of the '< HS' and 'HS' types, but leaves them below the attendance rate of the 'SC' type. When $r = -\infty$, the optimal subsidy is $165,000 to the '< HS' type and $75,000 to the 'HS' type, which equates their rates of college attendance to that of the 'SC' type. The cost in terms of the *average* PDV of incomes is 1.5% compared to the no-subsidy case (the ineptly named 'equity-efficiency trade-off').

Because, as we have said, these large subsidies reflect the large psychic costs of college attendance for disadvantaged types, it would clearly be extremely inefficient to

naively implement these policies. What these subsidies seem to indicate is that early intervention in the education of disadvantaged children is the recommended policy, for this will reduce the cost parameter in the utility functions of these children.

We turn briefly to the issue of credit constraints. In some European countries, tertiary education is almost totally publicly financed (France, Sweden) or the tuition fees are very low (Belgium, Netherlands, Germany). In the Anglo-Saxon countries, tuition fees can be substantial. The lack of collateral for students of poor background may represent an impediment for these students' attending college. Scholarships exist but there are few of them, and they are predominantly awarded to the best-performing students. In view of the widening wage gap between skilled and unskilled labor in the U.S. and in many European countries, it will be inefficient to limit access to tertiary education to only the highest achieving students. Imperfections in the credit market suggest state intervention because the market failure is both unfair and inefficient.

The results of Keane and Roemer (2009) indicated that the costs of tertiary education were not the main feature dissuading students from low SES backgrounds from acquiring it. According to the estimates of Carneiro and Heckman (2003) who control for ability 'at most 8% of the American youth are subject to short term liquidity constraints that affect their post-secondary schooling.' Income-contingent loans, where repayment is contingent upon income earned after graduation, are in use in a growing number of countries including the US (Ionesco 2009), with Australia (Bruce Chapman (1997)) and the UK (Nicholas Barr (2010)) as country leaders. Income-contingent loans are a second best optimal repayment scheme in a world with moral hazard (see Gary-Bobo and Trannoy (2013) for a theoretical analysis).

There are transfer programs in a number of countries whose goal is to increase school attendance among rural children by providing financial incentives to families to send children to school, rather than to work (including taking care of younger children in the home). Brazil's *Bolsa Família* covers 17% of households, and Mexico's *Oportunidades* (originally *Progresa*) provides 5.8 million poor households with conditional cash transfers. Argentina established a transfer program *Jefes y Jefors de Hogar Descocupados* for unemployed household heads. Lustig, Lopez-Calva and Ortiz-

Juarez (2012) argue that these programs have played a significant role in reducing inequality of opportunity.

C. Health

In recent years the field of inequality of opportunity in health status has received growing attention. Most research in this area employs individual-level data to identify, measure and characterize inequality of opportunity in health. Considerable evidence has thus been amassed on both the magnitude and key factors associated with this kind of inequality. Nonetheless, there remain important gaps. First, in contrast to the analysis of inequality of opportunity for the acquisition of income, data from developing countries have not been extensively examined. Second, inequality of opportunity in healthcare access has not been analyzed. Third, and most importantly, little is known about which policy interventions are most likely to advance opportunity equalization in health status acquisition effectively. Recent evidence on field-leveling policies in the areas of labor, education and development economics provides indirect evidence on this issue and points to avenues for further research; the evidence is therefore briefly reviewed below.

Rosa Dias (2009) and Trannoy et al (2010) examine the existence and magnitude of health status inequality, using data from the UK and France, respectively. Both papers adopt the stochastic dominance testable conditions proposed by Lefranc et al (2009) to identify the presence of inequality of opportunity in the data. In both countries, the data are consistent with the existence of inequality of opportunity in self-reported health status between individuals of different parental background (types are defined according to the paternal professional occupation). Jusot et al (2010) extend this line of investigation to the analysis of inequality of opportunity in health for ten European countries. Their results suggest that the magnitude of inequality of opportunity in health varies considerably across regions in Europe: for example, it is systematically higher in Southern Europe than in Northern Europe. Moreover, circumstances such as parental socioeconomic status and education are among those most strongly correlated with the distribution of health outcomes in most countries.

The information available on individual circumstances is never complete. Since some circumstances are unobserved, the measurement of inequality of opportunity is

often understood to be a lower bound of the true inequality of opportunity. Moreover, the impact of circumstances on life-style choices (effort) has been given dealt with differently in these papers. Rosa Dias (2010) examines the practical relevance of the first of these issues using data from a UK cohort study. He proposes a simple behavioral model of inequality of opportunity in health that integrates Roemer's framework of inequality of opportunity with the Grossman (1972) model of health capital and demand for health. The model generates a recursive system of equations for the health stock and each of a series of effort factors such as the weekly consumption of calorific food, alcohol and the weekly frequency of physical exercise. In order to account for unobserved heterogeneity, the system is then jointly estimated by full information maximum likelihood with freely correlated errors. The results suggest that, when unobserved heterogeneity in the set of circumstances is taken into account, the estimates of the recursive relationship between circumstances, effort, and health outcomes changes considerably, thereby corroborating the empirical relevance of the imperfect observability of individual circumstances. Jusot et al (2013) examine the second issue, by estimating a reduced-form model from a large French survey. Interestingly, their results suggest that adopting fundamentally different approaches to the correlation between circumstances and effort makes little difference, in practice, for the measurement of health inequalities.

While this early applied literature measures and characterizes inequality of opportunity in health, it reports only statistical associations and therefore does not provide the evidence required for the design of opportunity-enhancing public policy. Van de gaer et al (2012) take a step in the direction of narrowing this evidence gap. They use data from the Mexican conditional cash transfer scheme *Oportunidades* to evaluate the causal effect of this policy in the health opportunities of needy children. Their analysis exploits the fact that this program has been evaluated in terms of its mean impacts using a randomized control trial, which permits the identification of its causal impact on various dimensions of child development. Van de gaer et al (2012) take advantage of this clean identification strategy, and apply a stochastic dominance approach to the full conditional distribution of health outcomes (conditional on type) of children in the treated and control groups of the trial. Their results show the program had a strong field-leveling causal effect by improving childhood health outcomes (such as hemoglobin concentration and

height for age) of disadvantaged children, in particular those of indigenous origin. This approach can be used to extend our knowledge on the causes of inequality of opportunity and to design policies to tackle it.

Education and health are fundamental and complementary dimensions of human development. This suggests that educational policy may also have significant opportunity enhancing effects in health. Johnson (2010) addresses this issue indirectly by evaluating the causal effect of the US court-mandated school racial desegregation, and subsequent state legislation aimed to change the distribution and level of school funding, on health disparities between blacks and whites in adulthood. He exploits the wide time variation in the implementation of desegregation plans, as well as a rich desegregation case inventory, to identify the causal effect of these policy reforms. His results suggest that a ten percent increase in per-pupil school spending in adolescence is associated with an approximately three point increase in the Health Utility Index of the individuals exposed to it. As an alternative empirical strategy to evaluate the effect of school quality improvements on health in adulthood, Johnson (2010) also uses sibling comparisons: he compares adult health outcomes between siblings who benefited from the Head Start pre-school participations and others who did not. His results suggest that the field-leveling potential of this policy are high, reducing long-run health disparities between socially privileged and disadvantaged children. Although this evidence is obtained outside the strands of research directly concerned with the measurement of inequality of opportunity, it nonetheless provides invaluable evidence to design policies aimed at advancing them[25].

Jones, Roemer and Rosa Dias (2013) use the UK National Child Development Study to evaluate the effect, if any, of the comprehensive secondary school reform in

[25] Evidence amassed outside the traditional economic inequality literature can be invaluable for understanding the causes and to design policies aimed at reducing other dimensions of inequality of opportunity, such as inequalities in educational attainment and the acquisition of income. For example, Havnes and Mogstad (2012) evaluate the expansion of a large program of subsidized child care in Norway and find that this caused a very substantial reduction of the cognitive development and school attainment gaps between middle class and socially disadvantaged children.

England and Wales, which took place in the 1980s, on adult health outcomes. They model circumstances (family background indicators) and effort (life-style) as influencing health outcomes through several channels, as illustrated in figure 4. The relative importance of the various channels is estimated. Only very modest opportunity-equalizing effects on adult health status are observed.

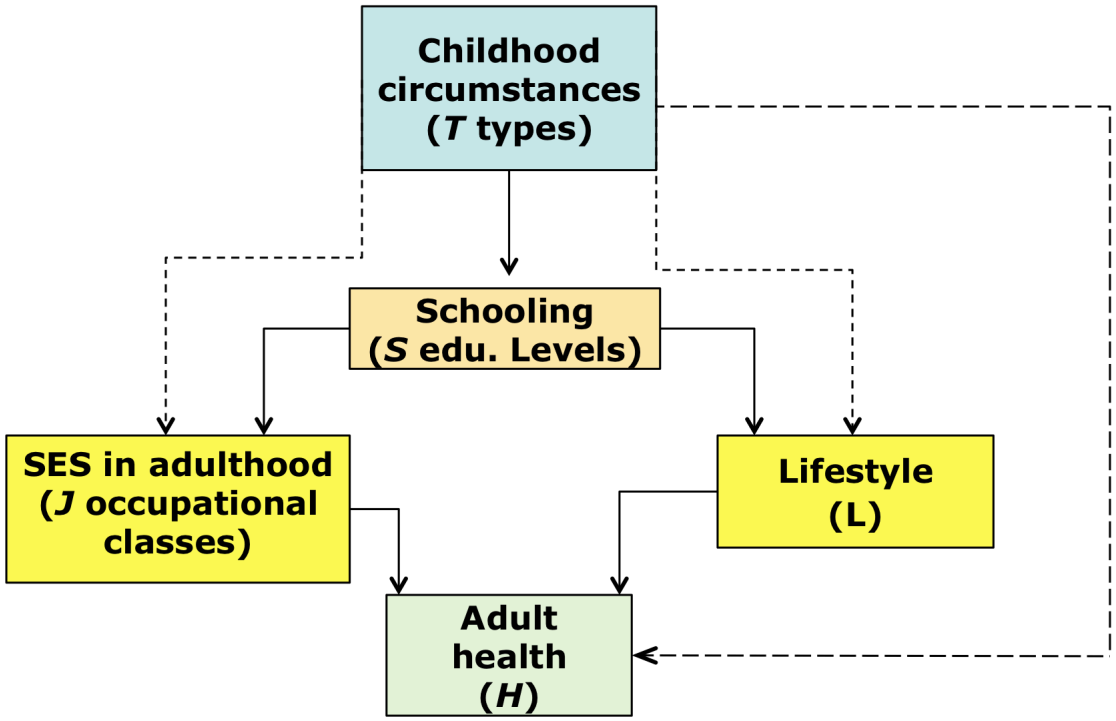


Figure 4. Channels through which circumstances and effort affect health (Jones, Roemer and Rosa Dias (2013))

D. Income and wealth

While the causes of disparities in human capital account for a great deal of opportunity inequality, Piketty and Zucman (2013) argue that the role of inherited capital is becoming important again in the present century, after a period in the second half of the twentieth century when it was of diminishing importance. While inheritance represented only two or three years of national income in the 1950s in European countries,

that figure doubled by 2010. The share of inherited capital in total accumulated capital during the second half of the twentieth century was small. Piketty and Zucman argue that this was due to several adverse shocks -- in particular, the destruction of physical capital in the two world wars, very high marginal tax rates at the top, and the dissipation of financial capital during the Great Depression and the post-war inflation. Capital accumulation has recovered, and these authors predict that the income distribution will be increasingly shaped by inheritance so that equalizing human capital will not suffice to eliminate inequality of opportunity. It goes without saying that inherited wealth is the most obvious cause of inequality of opportunity, as wealth provides a buffer against bad luck, unemployment, and so on. (It is often pointed out, for example, that while wages of black workers in the US are now about 75% of white workers' wages, median black household wealth, at $4995 in 2010, is less than 5% of median white household wealth [http://money.cnn.com/2012/06/21/news/economy/wealth-gap-race/.] Wealth differentials become less important, the stronger is the socially provided safety net.)

According to Hendricks (2003), in the US, only one-third of households report receiving an inheritance during their lifetimes. There have been many proposals to encourage a wider distribution of inherited wealth, beginning with James Meade's (1965) proposal to tax those who receive inherited wealth at progressive rates, as opposed to taxing estates, in order to encourage donors to spread their inheritance across may recipients. Bruck Ackerman and Ann Alstott (1999) have proposed that all young adults receive a stake of $80,000 from the state. Tony Blair introduced the Child Trust Fund in the UK in 2005 with the aim of ensuring every child has savings at the age of 18. The grand plan was to give at birth every eligible child a voucher worth £250 to open the account, and also a further £250 directly into the accounts of children who live in low income families. Because the scheme allowed family and friends to top up trust funds, it was hoped to boost savings rates, particularly among the poor. The scheme was terminated by David Cameron in 2010.

Perhaps the sharpest indication of inequality of opportunity for income and wealth is a high elasticity of the income (or wealth) of fathers and sons. Miles Corak (2013) provides an excellent review of the facts for highly developed countries. The 'Great Gatsby Curve' is a strongly positive relationship between the Gini coefficient of income

and intergenerational income elasticity. For a set of OECD countries, the U.S., U.K. and Italy have both the highest Gini of disposable household income (about 0.35) and of intergenerational income elasticity (about 0.5); Norway, Finland, and Denmark have the lowest of both measures (about 0.23 for the Gini, and less than 0.2 for the elasticity). According to Corak, the main determinants of the high elasticities are the behavior of mobility at the top and bottom of the distribution. In the US, more than half of sons of fathers in the top decile are placed, as adults, in the top three deciles; similarly, about one-half of sons of fathers in the bottom decile are placed, as adults, in the bottom three deciles. In the U.S., high income families pour private resources into their children; Corak reports that these 'enrichment expenditures' (books, computers, summer camps, high quality daycare, and private schooling) total about $8900 per annum per child for families in the top income quintile, while familes in the bottom quintile spend $1300 per annum per child (2006 figures). An equal-opportunity policy should compensate low-income children with similar resources, publicly financed. However, the pessimistic result of Ünveren and Roemer (2013), discussed above in section 7, that investment in the education of poor by the state may induce an 'arms' race' in which the rich counter with even more expenditure on *their* children, might be important in the very competitive and status-conscious U.S. environment. The fact that private schools hardly exist in the Nordic countries surely contributes to the lower intergenerational income elasticities there.

The importance of credit constraints cannot be dismissed in shaping sustainable long-term inequalities (see Aghion, Caroli and Garcia-Penalosa, (2001)). In particular, financial constraints have been found to play a large role in the entrepreneurial process. Evans and Jovanovic (1989) point out at the critical role of liquidity constraints in initiating firms in the US. Of course, the problem is most severe in developing countries. Microfinance (Amendariz, Aghion and Morduch (2010)), that is, the provision of small loans to very small businesses, began in Bangladesh. For a given time, economists were quite positive about micro-finance, but they have become less so. See Karlan and Zinman (2011), Banerjee et al (2009), Crepon et al (2011), and Angeluci, Karlan and Zinmain (2013).

Our final examples concern the allocation of urban housing and rural land.

In a market economy, economic stratification according to income emerges as the urban equilibrium ; see Benabou (1996b) for a description, who writes that "in the US, a person's income, education, ethnic background and lifestyle can be predicted quite accurately from his zip code. Gated communities are multiplying while in other neighborhood, poverty is becoming entranched. " Benabou analyses whether sorting or mixing is better for growth. The answer is complicated and depends on a number of factors, important among which are the degree to which family background and neighborhood quality are substitutes or complements in fostering good outcomes in children. In the short run, if these factors are complementary, stratification encourages growth. However, in the long run, a more integrated society is better at reducing heterogeneity, and so dispersing poor households among affluent communities may be both efficient in the long run while also enhancing equality of opportunity. Doing so requires state intervention.

The second issue of *Housing Studies* (2010) reviews international evidence about desegregation and social mixing (US, UK, Belgium, Netherlands, Sweden and France). In the US, *HOPE VI* demolishes large-scale public housing projects and replaces them with smaller-scale, mixed-income developments (Goetz (2010)). At the individual level, the gains are found to be modest, specifically focused on more safety and less fear of crime and social disorder. It is quite striking that the authors in the issue express pessimistic views about the success of these attempts at creating public housing projects to improve achievements of children. In the Netherlands, those displaced have a tendency to move to neighborhoods with a high percentage of non-Western minorities and a large proportion living in public housing. In the UK, it is concluded that neither demolitions nor dispersal are likely to generate social integration, unless they reënforce positive adaptation strategies that minority ethnic households already tend to pursue. In Sweden, the analysis shows these policies affect levels of segregation only marginally. In France, Bono, Davidson and Trannoy (2013) show that the program that tries to constrain each city in a metropolitan area to have the same proportion of social housing was only modestly successful. The causal effect of the program is estimated to be an increase of 0.5% of social housing for the first decade for treated cities.

Property in agricultural land now comprises a negligible part of total wealth in developed countries, but it remains important in developing countries. Historians agree than the French Revolution accomplished a vast land, and hence wealth, redistribution from the nobility and clergy to the peasantry, and more specifically to the richest of them. The conquest of the American west went together with the distribution of cheap land by federal, state and local governments to pioneers. Under provisions of the 1862 Homestead Act, individuals and families could secure title to 160 acres of land by working it for five years. Land reform did not take place in the colonial societies of South America in the nineteenth century and that fact is said to account for greater wealth inequality today in South than in North America. Land reform remains an issue in Africa.

According to Deininger (1998), the success of twentieth-century land reform was critically dependent on the way in which the land was used. In landlord estates, where tenants already cultivated the land and the reform implemented a reassignment of property rights, it was relatively successful and led to stable systems of production. Since the end of the second world war, landlord estates in Bolivia, large areas of China, Eastern India, Ethiopia, Iran, Japan, Korea, and Taiwan have been successfully transferred to tenants. By contrast, land reform in regions where tenants had small subsistence plots, but worked for most of their time on the landlord's estate, has been much less successful. This characterizes most Latin American cases. A superior alternative in this case to a reassignment of property rights is a wealth tax or comprehensive progressive income tax that reduces the concentration of wealth, and eventually the concentration of land ownership (Piketty (2003, 2008)). A wealth tax, however, often meets fierce opposition from the rich and middle classes, as it impedes the ability to pass down wealth to children.

We conclude this section with the observation that although policies enhancing EOp are to a large extent specific and distinct from policies the aim of which is to reduce outcome inequalities, the latter are often useful to reduce inequality of opportunity. Lefranc, Pistolesi and Trannoy (2007) show that under a loglinear relationship between parent and child earnings, whose slope β is the intergenerational earnings elasticity, and

choosing the mean logarithmic deviation (mld) as inequality index, then the following relation holds :

$$I_t^f = -\alpha_t + \beta_t I_t^p .$$

The mld among descendants, I_t^f, can be written as an affine function of the mean mld among the fathers' incomes at date *t*, I_t^p, which is a circumstance for children. The constant $-\alpha_t$ can be interpreted as residual inequality were there to be no inequality of parental income. We may interpret $\beta_t I_t^p$ as the inequality of opportunity due to the circumstance of parental earnings. Reduction of inequality of opportunity can derive from either a drop in the intergenerational transmission of advantages, or from mitigating income inequality in the parental generation. In the case of France, the authors found that the reduction of inequality of opportunity was a consequence only of a decrease of inequality in fathers' incomes without any clear contribution of the intergenerational link.

9. Measurement of inequality of opportunity

This section will focus on measurement issues . An excellent survey of the topic is provided by Ramos and Van de gaer (2012).

A. Methodological issues: general remarks

Measuring inequality of opportunity may mean different things. At the most basic level, we may want to capture the degree of inequality of opportunity with an index, as has been done for inequality of outcomes with the Gini, Atkinson, Theil and other indices. We may be more modest in only wanting to rank distributions of objectives, and be content with incomplete but robust rankings provided by instruments of a dominance analysis, such as the Lorenz curve. Circumstances, effort, and luck are just sources of outcome inequality, and we may wish to trace their contribution to overall inequality. Decomposition exercises among sources are just as appropriate in EOp empirics as in inequality-of-outcome analysis. Quantifying, ranking, and decomposing are three familiar operations that we may apply to equal-opportunity analysis, and the tools are mainly borrowed from the measurement-of-inequality literature.

A (i). EOp measurement as a multi-dimensional problem

Nevertheless, it seems fair to say that the level of complexity of the analysis is greater because EOp necessarily has a multi-dimensional aspect; as such, one may use the conceptual framework developed by Atkinson and Bourguignon (1987) for multi-dimensional inequality. These authors focus on how to measure income inequality when each income unit belongs to a specific needs group. The information is two-dimensional -- income and needs for each household -- and the aim of the analysis is to rank income distributions taking into account the information provided by the vector of needs. In EOp analysis, we would rank outcome distributions (income, health, education) that are unidimensional, taking into account the information provided by the vector of circumstances, the vector of efforts and perhaps the vector of residuals. EOp measurement then belongs to the family of problems of multi-dimensional inequality when *margins* are fixed, where margins comprise the non-outcome information that matters in EOp assessment (circumstances and effort).

A direct application of the sequential Lorenz quasi-ordering to this setting is not appropriate and it is interesting to see why. Of course, effort can be seen as analytically similar to needs: that is, at the margin, the more effort one makes, the more income one deserves. Reciprocally, circumstances can be seen as negative needs: the better one's circumstances are, the less one deserves. But these two statements have limitations. We may wish not to reward effort excessively, for reasons discussed in section 4. And regarding circumstances, there is an asymmetry: we desire to compensate for disadvantageous circumstances, but do not regard advantaged circumstances as an evil. Furthermore it is the interplay between circumstances and effort that makes the evaluation of the ensuing inequality problematic. We need to know how additional effort should be rewarded across the circumstance dimension; as we discussed, there is no clear answer to this question within the theory. For further discussion, see Bossert (1995), Fleurbaey (1995), Fleurbaey and Peragine (2013).

A (ii). EOp as a process

What also distinguishes EOp empirical analysis from inequality-of-outcome analysis is its two-stage nature: one generally requires an econometric-estimation stage, preceding the inequality-measurement stage. It is not so much the difference in

circumstances *per se* that matters, but the difference in the impact of circumstances. Socio-economic advantage has to be estimated through parametric and non-parametric estimation techniques, captured by the coefficient of the circumstance variable in a linear model regressing the outcome on a set of circumstances and effort variables. An evaluation of inequality must be concerned with the process that generates it. This leads Fleurbaey and Schokkaert (2009) to state, provocatively, that any EOp empirical analysis must be preceded by an estimation phase to discover the best structural model leading to the results. Only in the second step should we be interested in measuring inequality of opportunity as such.

In principle, we agree. This is, however, more easily said than done. Two observations are in order. The two main obstacles to any causal inquiry are reverse causality and endogeneity due to omitted variables. The good news is that, regarding circumstances, reverse causality can often be dismissed since circumstances are frequently characteristics of states that existed in the past (e.g., one's parents' education). However, endogeneity cannot be discarded in that way because EOp measurement is plagued with informational problems. Omitted variables are widespread; a good example is provided by genetic variables which have been found paramount in income attainment by Börklund et al (2012). Omitted variables in empirical EOp analysis cause skepticism with regard to claims of causality we may wish to assert. The situation is even worse when the objective is earnings, since according to Bourguignon et al. (2007), "…. an instrumental variable strategy is unlikely to succeed, since it is difficult to conceive of correlates of the circumstance variables that would not themselves have any direct influence on earnings. " Experiments and quasi-experiments enable one to make causal statements, but experiments can usually only study problems that are much more circumscribed than those which interest researchers in this field. We are trying to understand the whole process by which someone reaches an income level, a health status, or an educational attainment. These processes are dynamic and cover part of the lifespan of an individual, and understanding them fully in a causal way seems out of reach at present.

Should we worry about this lack of causal interpretation? Of course, if we want to give advice to policy makers about the true effect of leveling-the playing-field policies,

impact evaluation needs to be causal. However, if one merely wants to measure the degree of inequality of opportunity -- that is inequality due to circumstances -- a correlation (with variables which occurred in the past) is already something that is relevant.

The challenge is even greater if we take the preference view for responsibility variables advocated by Dworkin and Fleurbaey. Retrieving the true parameter of preferences is perhaps the most difficult issue in econometrics in terms of identification conditions (see, however, Fleurbaey et al (2013) for an attempt to estimate the individual's trade-off between health and income and Bargain et al (2013) for the estimation of cross-country preference heterogeneity in the consumption-leisure trade-off).

A (iii). Lack of relevant information

It should be clear from this discussion that we need a much richer database to perform EOp empirical analysis than a pure inequality-of-outcome analysis. We should have variables describing the situation of the family and social background and variables pertaining to effort. It is quite common that some important background variables are missing and then we have an incomplete description of the circumstances. More importantly, effort variables are generally missing for the very reason that effort is private information, as is emphasized in economic theory. We must use proxies, which are problematical.

The measurement of effort depends upon our view of responsibility. On the one hand, there is the view that effort takes into account what set of actions a person can *access*, where access is a question not simply of physical constraints, but of psychological ones, which may be determined by one's circumstances. On the other hand, there is the view that a person should be held responsible for his preferences, and hence a person is responsible for taking those actions that flow from his preferences. Roemer's measurement of effort as the rank of a person's effort in the distribution of the outcome for his type represents the access (or control) view: one judges the accessibility of actions to members of a type by what people in that type actually do. (This view is also reflected in G.A. Cohen's (1989) phrase 'access to advantage', which he desires to

equalize.) Dworkin and Fleurbaey represent the preference view, in which a person is held responsible for his choices, if they flow from preferences with which he identifies. Because almost all empirical studies (except Fleurbaey et al (2013) and Garcia-Gomez et al (2012)) seem implicitly guided by the control view, the authors should explain in what sense the chosen variables are under the control of the individual. Jusot et al (2013) have argued that lifestyles in health (diet, exercise) are examples of variables under the control of the individual, and inequality of opportunity for achieving health status should be measured with this in mind.

Several points should be made about two variables that appear repeatedly in empirical analysis when trying to measure EOp in income attainment: the number of hours of work and years of education. The number of hours of work is a good effort variable, under the control view, for self-employed occupations, but is clearly less satisfactory for wage-earners. It is true that hours of work correspond to a quantum of effort: the issue is whether they correspond to the *desired* amount of hours. Part-time jobs may be involuntary; overtime work may depend on the orders of the firm, and obviously unemployment may be just bad luck. To a large extent, using hours of work in a given period as an effort variable is therefore problematical for wage-earners. We can be more confident that the number of hours of work over the life span is under the control of the individual because one can compensate for the impact of bad luck and low hours of work during a given period by working more in luckier periods. Using the full data for the lifespan is, however, quite rare (see Aaberge and al. (2011) or Björklund et al (2012) for examples). For snapshot distributions, the question arises of how to purge hours of work of the influence of bad luck, which, by assumption is not under control of the individual. Detecting chosen from involuntary part-time work is a difficult econometric issue. At best, we would estimate a probability that the person works voluntarily part-time, which makes the effort variable a number in the interval $[0, 1]$. Any empirical study that fails to do so will not respect Fleurbaey and Schokkaert's methodological dictum to do the best to estimate the most thorough structural model before any attempt is made to measure inequality of opportunity.

Years of education is also a popular effort variable in empirical studies. It is controversial to consider it as a variable under individual control, because primary and

secondary education take place when the person is a child and adolescent, largely prior to the relevant age of consent. If a child is lazy in school, there might be factors not under his control that explain his laziness. Only tertiary education and lifelong learning are immune from this criticism. The problem with tertiary education comes from its path-dependency: one's probability of being accepted to university depends on one's grades in secondary education, which in turn depend upon achievements in primary school. And, of course, there is the problem of endogenous preference formation, discussed above with reference to the cost parameter in the utility function (Keane and Roemer (2009)).

A good starting point is to attempt to account for achievements in early education by circumstances of the family. Socio-economic circumstances may be available in data sets, but parental pressure to achieve is also an important determinant of educational outcomes, and is usually not measured. We cannot, therefore, usually give a complete account of educational achievement. However, if one views all actions of the child as due to either nature or nurture, both of which are beyond his / her control, by hypothesis, before the age of consent, then one should simply take the child's educational accomplishments at the age of consent as a circumstance with respect to determining outcomes in later life. Family circumstances may still be important in explaining choices after the age of consent: for example, a young adult might not attend college both because his achievements in secondary school were mediocre (which, according to the view just expressed would be a circumstance) and also because his parents put little value on tertiary education (another circumstance). Facing these two circumstances, if a low-achieving eighteen-year–old nevertheless succeeds in going to college, through taking compensatory courses, that would be ascribed to exceptional effort, ceteris paribus.

In both the hours-of-work and education examples, then, we will often not have an accurate measure of effort, which will be measured with error and bias. Broadly speaking, authors do not pay sufficient attention to these problems and overlook their practical implications. Since effort measurement does not have the same robustness as circumstance measurement, choosing effort as the conditioning variable as in the tranche approach (see for instance Peragine (2004 and 2008)) seems risky. True, circumstances may be only partially described, but generally they are not noisy. Since tranche and type

approaches seem incompatible (see below), conditioning on type seems a better choice than conditioning on tranches.

A (iv). Age and sex

The issue of availability of information cannot be raised about age and sex. The problem is how to treat these variables. Under the control view, age and sex are circumstances. Under the preference view, because age and sex are important determinants of preference, they will implicitly enter as factors of effort! Because, under this view, preferences should be respected whatever they are unless they are not well-informed, they are put on the responsibility side of the cut. Of course, as Fleurbaey and Schokkaert (2009) point out, we are free, once the true impact of age and sex has been identified econometrically, to test whether it matters to put age and sex on one side or on the other (see Garcia-Gomez et al (2012) for an application). When we are explaining health, it does not come as a surprise to learn that 45% of the explained variance in health outcomes is due to these two demographic variables (see Jusot et al (2013)). This is not the thorniest issue in EOp measurement, but the reader should be aware that the extent of inequality of opportunity may depend on whether or not one includes these variables in the responsibility set. For instance, Almas et al (2011) put age among the responsibility variables, on the ground that our concern should be with inequality of lifetime earnings. Another solution would be to leave the dual world of the model and to admit that there are variables that are neither under the control of the individual nor for which compensation is due. An example is provided in the health sphere where it is admitted, by most, that health policies cannot erase the impact of demographics. (We should not consider males disadvantaged with respect to females if, due to innate biological factors, their life expectancy is shorter.) For earnings achievement, this stance cannot be easily taken, because differences in returns, linked to gender and perhaps age, may be related to discrimination, which would obviously be a violation of EOp.

As in other domains of econometrics, there is a large issue of what to do with poor data. The mistake to avoid is pretending that a poor data set is rich. Innovative methods exist to deal with missing variables. An important methodological issue that has been raised and partially solved is to deduce what can be said about inequality of

opportunity when we know that the observables are far from recovering the process through which the objective has been attained. We should adapt our empirical strategy to the richness of the informational structure of the database. Basically, we can contrast situations from the richest informational setting to the poorest one. In the first situation, we have a good description of the world, that is, a quite comprehensive set of circumstances and some candidates for effort variables. In the second situation, no effort variables are available and individuals can be ranked in broad type categories. We will contrast the methods accordingly.

B. The estimation phase

B(i). The case of a rich data set

The first choice is to decide between parametric and non-parametric estimation. Because, by assumption, there are many observable variables, a parametric estimation will fit the data better (see, Pistolesi (2009) for a semi-parametric estimation). Bourguignon et al (2007) took the lead regarding the econometric strategy in this case. We should estimate a system of simultaneous equations. The first equation will describe the process of attainment of the outcome. In the income context, it can be called a return equation, the coefficient of each determinant giving the marginal return (in a linear model) to each determinant whether it is a circumstance, effort, or demographic variable. The other equations (one for every effort variable) will relate the effort variable to circumstances and other control variables. In the control view of responsibility variables, we should understand how variables that are outside the control of the individual influence her effort variables. In these 'reaction equations' circumstances must be introduced, including market conditions (prices, any market disequilibrium such as the local rate of unemployment for job decisions) and demographics. One supposes that the reaction of individuals to their environments (market and background conditions) may vary across individuals. We should let the coefficients vary according to demographics. The difference in the value of these coefficients, if any, would be interpreted in a different way according to the control versus the preference view. According to the latter, they are preference shifters, whereas according to the former they are driven by circumstances, and belong to the non-responsibility side of the cut.

We introduce some notation. Let y_i be the outcome of individual i (the original outcome variable or some function of it), C_i the vector of circumstances, $E_i = (e_{i1},...,e_{ik})$ the vector of effort of dimension k, D_i the vector of demographics, M_i the market conditions prevailing for i, ε_i, the mean-zero residual of the return equation and o_{ij} the mean-zero residual of the reaction equation of effort j. The other letters employed are for coefficients of both regressions. In the simplest linear model the following equations have to be estimated:

$$y_i = \mu_{y1} + \alpha_c C_i + \alpha_d D_i + \alpha_e E_{i,} + \varepsilon_{i.}, \qquad (9.1)$$

$$e_{ij} = \mu_{e_j} + \beta_c C_i + \beta_d D_i + \beta_m M_{i,} + \gamma_{cd} C_i D_i + \gamma_{cm} M_i D_i + o_{ij} \quad \text{for each effort variable } j = 1,...,k \qquad (9.2)$$

Equation (9.2) is written in a compact way: the β coefficients describe the average reaction of adjusting effort to external conditions while the γ coefficients are the preference shifters that allow individuals to adjust in a different way according to their age and sex group. (The μ terms are constants.)

It is plausible that market conditions do not always explain the outcome (for instance the price of fruit and vegetables may impact the diet, while having no impact on the mortality rate). If this is the case, we may have exclusion restrictions that will be helpful to identify the system.

The omitted variables (perhaps IQ or any measure of innate talent) may impact the residuals of all equations. The structure of residuals may follow some common pattern that can be captured by a correlation between disturbance terms. (See table 1 in Garcia-Gomez et al (2012) for an implementation for mortality outcome.) If the correlation is significant, it may reveal an omitted covariate that matters for the estimation of the full system. However, we cannot tell if the revealed omitted variables are on the circumstances or effort side.

Many authors (Bourguignon et al (2007) and Trannoy et al (2010), for example) have argued that the estimation of the full system is not necessary if we are only

interested in determining the full impact of circumstances. Estimating the reduced form (9.3) suffices if we want to measure the impact of observable circumstances:

$$y_i = \mu_{y3} + \delta_c C_i + \delta_d D_i + \upsilon_{i.} \quad (9.3)$$

This statement, however, requires some qualification. Neglecting the shift parameter, it is true that in a linear model $\delta_c = \alpha_c + \alpha_e \beta_c$, α_c captures the direct effect of circumstances and $\alpha_e \beta_c$ captures the indirect effect of circumstances through effort, due to the Frisch-Waugh theorem. (The same goes for demographics.) However, the relation is lost for a non-linear model, such as a logit or probit specification, even if Jusot et al (2013) found that the difference between δ_c and $\alpha_c + \alpha_e \beta_c$ is quite small. More importantly, the reduced form (9.3), which has been repeatedly estimated in empirical studies, does not allow the effect of circumstances on outcomes to be mediated by demographics. The information provided by the preference shifters γ introduced in the reaction equations (9.2) is lost. It will be split into the reduced coefficient of circumstances, the reduced coefficient of demographics, and perhaps the residual. A solution would be to introduce a cross effect of circumstances and demographics in the reduced equation but, to some extent, the effect of demographics as shifters of preferences will go beyond the cross effect in the structural model. The basic message is that, with a reduced form, we cannot isolate the effect of demographics as circumstances from the effect of demographics as shifters of preferences, and therefore responsibility variables: to do so, we would need to estimate the full structural model. We recall the claim of Fleurbaey and Schokkaert (2009) that failing to estimate a structural model is costly in terms of the limitations that are thereby imposed in the measurement phase.

We now comment on the impact of omitted variables on the estimation. The coefficients will be biased and cannot be interpreted as causal. An example from health is the presence of lead in a child's home, which could entail health problems for both children and parents. If this variable is missing in the dataset, a correlation between the health status of children and parents will be observed, whereas there is no causal link. It would then be unwise to base policy recommendations on the estimates of the structural model (9.1) and (9.2) or the reduced model (9.3). Other empirical strategies have to be

implemented if we want to use the estimates in this way. Regarding the reduced form, it must be clear that the estimate $\hat{\delta}_c$ [26] conveys the impact of any unobserved variable correlated with observable circumstances. If these variables are circumstances, this is fine from a correlation viewpoint. We can claim that $\hat{\delta}_c C_i$ gives a fair account of the contribution of observable circumstances to the income of individual *i*.

The interpretation becomes trickier if all the unobservables correlated with circumstances are not interpreted as circumstances. Let us take the example of innate talent and suppose that an accurate measure is IQ. We have advocated treating IQ, measured before the age of consent, as a circumstance. However, as is clear from surveys and questionnaires, opinions are quite diverse on this question. If we take the self-ownership viewpoint, IQ should be a responsibility variable (i.e., a person would deserve to benefit from his/her high IQ). Ferreira and Gignoux (2011) have argued that the reduced form will lead (through the computation of $\hat{\delta}_c C_i$) to a lower-bound estimate of circumstances. If the missing variables in the reduced form are classified as efforts and are positively correlated to observable circumstances such as IQ, it is the other way round. Instead of having a downward bias, the impact of circumstances would be biased upward. The remedy is not trivial because any other simple solution fails to solve the problem. Estimating a reduced form with only observable effort would convey the impact of circumstances correlated with effort, which conflicts with the message of EOp. Now the estimates given by the structural model will be even more at odds with the ethic of EOp. The impact of unobservable IQ will be split into the various coefficients estimated in the return equation (9.1) plus the residual, meaning that some part of innate talent would be assimilated with responsibility characteristics and some part with non-responsibility characteristics. Niehues and Peichl (2013) propose an upper bound for inequality of opportunity. Their key assumption is that circumstances (and their effects on the outcome) do not change over time. If this were true, then the fixed effect in a panel regression can be used to retrieve the overall impact of circumstances. Cognitive and non-cognitive skills are certainly more or less constant during adulthood, meaning that they belong to characteristics that the fixed effect captures. They will be treated as

[26] A circumflexed variable denotes an estimate.

circumstances in this approach that then provide an upper bound estimate of the impact of circumstances, when luck is included as a circumstance. Unfortunately, they estimated this upper bound for the share of circumstances in total wage inequality to be 95% for males in the US, with a lower bound of 10%, an interval which is not very informative (the same interval is [20%, 70%] for Germany). At this stage, we should recognize that since innate talent is a form of luck, the parametric estimation is too restricted to cope with luck (see section 9B(ii) below).

One of the virtues of the structural model is in enabling one to decompose the impact of the circumstances into a direct and an indirect term (through effort). Bourguignon et al (2007) and Ferreira and Gignoux (2011) acknowledge that sub-decompositions into direct or indirect effects, or into the effects of individual circumstances, would be strongly affected by the presence of omitted variables. Bourguignon et al (2013) show that it is not so much the magnitude of inequality of opportunity , but rather its decomposition between direct and indirect effects, that will be affected by biased estimates of coefficients of circumstances in both the return and the reaction equations.

We conclude with the interpretation of the residuals of the various equations. We first emphasize that they are not orthogonal to the regressors with omitted variables, which is worrying. That said, the residuals of the reaction equation are close in spirit to the Roemerian effort. They are effort sterilized of the impact of circumstances and external conditions. This leads Jusot et al (2013) to estimate an equation where one substitutes Roemerian effort for effort in equation (9.1), namely:

$$y_i = \mu_{y4} + \delta_c C_i + \delta_d D_i + \alpha_e O_i + \tau_i \ , \qquad (9.4)$$

where O denotes the vector of residuals of equations (9.2). Due to the Frisch-Waugh theorem, the coefficient of Roemerian effort will be the same as the coefficient of true effort, whereas the coefficients of circumstances and demographics will be augmented by their indirect influence through effort and then equal to the coefficients estimated in the

reduced equation (9.3)[27]. This enables these authors to offer a decomposition of the inequality into responsibility, non-responsibility, and demographic parts, in the spirit of Roemer. They contrast the results with the estimates obtained with equation (9.1) where the impact of circumstances is only direct and thus follows Brian Barry's recommendation (individuals should be rewarded for their absolute, not relative, effort).

It should be clear from the previous discussion that the residual of the return equation (9.1) is a mixed bag of error terms and omitted variables, which may be circumstances, effort, or luck variables. Generally the error term represents a large part of the variance, more than 70% in Björklund et al (2012) for the residual of the reduced form (9.3). It is quite normal that the explained part remains small on cross-sectional estimation: 30% is already an achievement. Should we assign the residual to the effort or circumstance side? Several views clash here. Roemer and his co-authors over the years put the residual of the reduced equation on the effort side while Devooght (2008) and Almas et al (2010) put the residual of the structural return equation on the circumstance side[28]. Lefranc et al (2009) and Jusot et al (2013) argue that these solutions are ad hoc. They prefer to maintain the position that we cannot tell what the residual represents. Furthermore, when it represents 50% of the variance or more, putting it on one side or the other will determine the relative magnitude of inequality of opportunity. Consequently, they prefer to discard it in any decomposition analysis and move on with the explained part of the outcome, from (9.1):

$$\hat{y}_i = \hat{\mu}_{y1} + \hat{\alpha}_c C_i + \hat{\alpha}_d D_i + \hat{\alpha}_e E_i, \quad . \qquad (9.5)$$

Parametric methods try to estimate the conditional expectation $\mathbf{E}(y|C,E)$.[29] Non-parametric methods are more ambitious because they try to estimate the conditional

[27] In fact, this is not quite correct if market conditions and shift parameters are introduced as in (9.2). The statement is valid for a simple form of (9.2).

[28] They also present robustness results where the residual belongs to the responsibility set. Almas (2008) considers both alternatives.

[29] **E** denotes the expectation operator.

distribution *F(y|C,E)*. O'Neill et al (2000) were the first to use a kernel density approach to estimate the distribution of income conditional on parental income. It is not by accident that the authors chose a continuous variable (parental income) to perform a non-parametric analysis. The parametric estimation already offers some flexibility for discrete variables. Pistolesi (2009) borrows a semi-parametric estimation technique from Donald et al (2000). In a nutshell, since the hazard rate is defined as,

$$H(y) = \frac{f(y)}{1-F(y)} = \frac{f(y)}{S(y|C,E))} \ ,$$

with $S(\cdot|\cdot)$ the conditional survivor function, one can write :

$$f(y|C,E) = H(y|C,E)\big(S(y|C,E)\big).$$

The trick is then to estimate a hazard-function-based estimator and introduce covariates using a proportional-hazards model. In a second step, the necessary transformations using the above equation are made to obtain an estimate of the associated conditional density function. It is known that the estimation of duration models is more flexible than of linear models. In substance, Pistolesi estimates the conditional distributions corresponding to equations (9.1) and (9.2) with this estimation technique.

B (ii). The case of a poor dataset

The distinctive feature of a poor data set is that no effort variable is available, but we may still have a rich set of circumstances and a large sample. We can construct types but we cannot a priori build tranches. The approach here comes from Roemer (1993, 1996, 1998) with his identification axiom. It is the only assumption that enables us to say something about inequality of opportunity in the poor-information case. It is non-parametric in essence, since effort is deduced from the distribution of outcomes for a type, *F(y|C)*. Two individuals located at the same quantile of their type-conditional distribution are defined as having exerted the same effort, which will be denoted e_{RO}. Formally, starting from the income generating process given by

$$y = g(C,E),$$

the Roemer identification axiom (RIA) reads:

$$F_y(g(C,E)|\,C) = F_y(g(C',E')|\,C') \Rightarrow e_{RO} = e'_{RO}$$

By construction, this effort, which is simply a rank, is distributed uniformly over [0, 1] for all types. This way of identifying effort has been used by O'Neill et al (2000) in a non-parametric setting to depict the opportunity set of an heir defined as the income range that she can reach for all levels of Roemerian efforts belonging to [0, 1]. The opportunity sets are contrasted according to the level of advantage given by the decile of parental income.

This manner of identifying effort has also been used by Peragine (2004, 2008) to build a tranche approach to EOp where the multivariate distribution is described by a matrix whose typical element is the income for a given type and percentile of the type-conditional income distribution. However, this approach is not immune to the omitted variable problem that was discussed above. As was rightly pointed out by Ramos and Van de gaer (2012), omitted circumstances induce an incorrect identification of the Roemerian effort unless the unobserved circumstances, after conditioning on observed circumstances, no longer affect income (see their Proposition 6). This is a strong condition that will be rarely be satisfied in empirical work.

The identification axiom may be questionable from an analytical point of view (see Fleurbaey (1998)), because it is not clear how multi-dimensional effort can be aggregated into one indicator, and luck factors can interact with effort in a complex way. The view that the *distribution* of effort specific to a type is a circumstance makes sense in the control view but not in the preference view. Let us call this the *type-independent effort distribution* axiom: the relevant normative effort distribution should be independent of type. This axiom is weaker than Roemer's identification axiom. It has inspired fruitful empirical strategies, both in parametric and non-parametric settings. In the former case, Björklund et al (2012) estimated a reduced form as in (9.3) with υ_i a Gaussian white noise. They assimilate the distribution of the residual to the distribution of effort. However, the distribution of the residual can vary across types and this variation is a non-responsibility characteristic. They have corrected for variation in the second moment by adding and subtracting to the regression equation a residual term that has the overall variance. Hence the relevant effort in each type is renormalized to have the same variance.

In a non-parametric setting, Lefranc et al (2009) retain this independence view of effort, which is postulated in the Roemer identification axiom, without assuming that one

can identify effort with the quantile of the type-conditional income distribution. Let the distribution of effort conditional on type (supposed to be unidimensional) be given by $G(e|C)$. They assume that the relevant effort is the relative effort denoted e_r given by the quantile within the effort distribution of an individual's type:

$$e_r = G(e|C). \qquad (9.6)$$

Equipped with this conception of effort, they are able to link what we can check (in a poor setting) with what we would want to check if all the information about effort were available. What we can check is obviously the equality of the distribution of income conditional on the observables -- here, only the vector of circumstances:

For any (C,C'), $F(\cdot|C) = F(\cdot|C')$. (*conditional-distribution equality*) (9.7)

We have already stated (see section 5) that we would like luck to be even-handed in a world where all circumstances and effort are observed:

for any (C,C',e) $F(\cdot|C,e) = F(\cdot|C',e) = K(\cdot|e)$ (*equal-luck opportunity*). (9.8)

This allows the distribution of episodic luck to depend on effort but not on circumstances. Their main result, mathematically obvious but of practical importance, is that a necessary condition for equal-luck opportunity to be satisfied is conditional-distribution equality, if we use relative effort. Mathematically, if we replace *e* by e_r, in (9.8), then (9.8) implies (9.7). Is this result false if some circumstances are non-observed? Proposition 5 in Lefranc et al (2009) proves that it is not false. Checking the conditional-distribution equality on the set of observed circumstances is still necessary for the global equality-of-opportunity condition to be satisfied. These results pave the way for using stochastic-dominance tools[30] to measure the unfairness of the distribution, which we discuss below.

C. The measurement phase

[30] It is possible to go beyond stochastic dominance to define the relative advantage of a type (see Herrero et al. (2012) for a proposal involving an eigenvalue of a matrix).

Once a model has been estimated, the question of how to proceed to use the estimations obtained in the econometric phase remains open. Various choices have been proposed concerning three issues: the type versus tranche approach, the direct unfairness versus the fairness gap, and the inequality index. We will deal with these three approaches in turn.

C (i). Types versus tranches

In a discrete setting, we can construct a matrix whose rows correspond to types whose columns to effort levels. An element m_{ij} of the matrix is the outcome for type i and effort level j. It is important to emphasize that this way of proceeding is correct if and only if the knowledge of circumstances and effort is sufficient to determine the outcome level. It means that, with respect to the decomposition of the process allowed by the regression, the residual is assigned to either effort or circumstances, unless the outcome is replaced by the predicted outcome. In this setting, two principles of compensation can be stated.

We define a *tranche* as the set of individuals who expend the same degree of effort. The *tranche-compensation principle* states that the closer each column is to a constant vector, the better. If for some effort level (column), the inequality of outcome across types is reduced, and everything else remains unchanged, equality of opportunity has been improved.

The *type-compensation principle* states that it is always good to transfer from an advantaged type to a disadvantaged type, provided that the ranking of types is respected. Suppose that between two types, one is unambiguously better off than the other, that is, the outcomes can be ranked unambiguously according to first-order stochastic dominance. Then a transfer from the dominant type to the dominated type for some effort level, ceteris paribus, is EOp enhancing. This principle can be extended further to a second-order stochastic dominance test (Lefranc et al (2009)). Indeed if two types have the same average outcome but the first one has a larger variance, any risk-averse individual would prefer to belong to the second type, and consequently one cannot declare that the two types have the same opportunities in terms of risk prospects. The need to take into account the risk dimension echoes the treatment of heteroscedasticity of the residuals in

the parametric case by Björklund et al (2012). This extension leads to a weak criterion of equality of opportunity, which corresponds to a situation of absence of second-order stochastic dominance across types[31].

Fleurbaey and Peragine (2013) show by the means of an example that the two principles clash. There is no complete ordering of the full domain of (positive) matrices, which respects both principles. If we connect this to the results obtained by Lefranc et al (2009), it is as if we said that *equal-luck opportunity* conflicts with *conditional-distribution equality*.[32] They claim that one must choose between the two. Logically this is correct. Empirically, it seems to us, that the conflict is not so deep because the principles are useful in different informational contexts. Either one trusts the information about effort, and the tranche-compensation principle is appropriate, or one lacks the information about effort, or believes it is insufficiently reliable because of the omitted variable problem, and then the type-compensation principle remains available.

Fleurbaey and Peragine (2013) also point out that the tranche-compensation principle clashes with two principles of reward, the principle of natural reward and the principle of utilitarian reward. Ramos and Van de gaer (2012) showed that this incompatibility extends to another principle of reward inspired by a criticism of Roemer against the principle of natural reward. It seems to us that this kind of conflict should not be overemphasized if we agree to prioritize the principles. If we annihilate the inequality due to circumstances according to the tranche-compensation principle, then in each column, each element is equal to its tranche average before the redistribution took place. Hence this redistribution according to the tranche compensation principle respects a simple *natural arithmetic average reward* principle: the arithmetic average income difference due to differences in effort should remain invariant to redistribution. At this

---

[31] These two principles have been dubbed ex ante (type) and ex post (tranche) approaches by Fleurbaey and Peragine (2013). The terms are misleading because ex post and ex ante usually refer to a situation with uncertainty which is not explicit here.

[32] The comparison is not artificial because to some extent, both principles can be viewed as a ranking adaptation of (9.7) and (9.8).

stage, this principle of reward reduces to the principle of natural reward and no more redistribution is required to comply with the requirements of EOp.

We conclude with an insight borrowed from Ramos and Van de gaer (2013), who remark that if we retain the Roemerian effort, annihilating inequality within the columns of the matrix implies equalizing the prospects for each type, since by construction the distribution of Roemerian effort is the same for every type.

C (ii). Direct unfairness versus the fairness gap

Almost the same idea appears in the papers of Fleurbaey and Schokkaert (2009) and Pistolesi (2009) concerning how to measure inequality due to circumstances. We will here retain the nomenclature of the former authors, while we are closer to the latter in terms of the definitions. These authors propose two approaches.

Direct unfairness (DU) is computed as the inequality of the counterfactual distribution when one has removed the effect of effort variables, either by suppressing them, or by imputing to each individual a reference value of effort such as the average value. Following are some examples of possible computations of direct unfairness, where I denotes some inequality index.

For the reduced form (9.3), a natural choice for direct unfairness is to compute the inequality of the conditional expectation of outcomes across types (a solution first proposed by Van de gaer (1993)). Since the regression decomposes the conditional expectation, we get

$$I\left(\mathbf{E}(y|C_i, D_i)\right) = I(\hat{\mu}_{y3} + \hat{\delta}_c\, C_i + \hat{\delta}_d\, D_i), \qquad (9.9)$$

which is a solution chosen by Ferreira and Gignoux (2011). The residual is set to 0, its mean value.

For the more structural model (9.1) or (9.4), where an estimation of the impact of the effort variable has been obtained, it is possible to set the effort variable to 0 or to consider some reference value such as the average effort. The inequality of the conditional expectation of outcome for an average effort level is given by[33]

$$I\left(\mathbf{E}(y|C_i, D_i, \overline{E})\right) = I(\hat{\mu}_{y1} + \hat{\alpha}_c\, C_i + \hat{\alpha}_d\, D_i + \hat{\alpha}_e \bar{E}_i) \qquad (9.10)$$

[33] An overbar on a variable denotes a mean.

A potential problem for both the above calculations is that the distribution of estimated residuals across types may be type-dependent. If so, then the difference in the mean of estimated residuals across types should be taken into account.

The *fairness gap* (FG) measures the difference between the inequality of the actual distribution and the inequality of a counterfactual distribution in which all the effects of circumstantial variables have been removed, either by suppressing them, or by imputing to each individual a reference value of circumstances such as the average one. We give some examples below. If we had estimated a reduced form with only effort variables (something that has not been done in the literature so far), we could have the analog of formula (9.9) with an estimation of the inequality of the expected outcomes across tranches when circumstances are in the residual and have been removed. Computing directly from the data the average outcome of those sharing the same effort, as done by Checchi and Peragine (2010), is a non-parametric way of doing this. The fairness gap is then given by[34]

$$I(y) - I(\mathbf{E}(y|E_i)) \quad . \qquad (9.11)$$

For the more structural model (9.1) or (9.4), where both effort and circumstances variables are introduced as regressors, we can do better and estimate the fairness gap for a counterfactual distribution where the set of circumstances has been set to a reference value, for example, the average one. Then one obtains for the fairness gap

$$I(y) - I(\mathbf{E}(y|\bar{C}_i, \bar{D}_i, E_i) = I(y) - I(\hat{\mu}_{y1} + \hat{\alpha}_c \bar{C}_i + \hat{\alpha}_d \bar{D}_i + \hat{\alpha}_e E_i). \qquad (9.12)$$

Bourguignon et al (2007) propose a similar measure. The problem is, again, how to assign the residual. According to (9.12), the residual has been removed and is considered as measuring a circumstance. The above authors implicitly consider the residual as measuring effort. Another solution is to replace the overall inequality by the explained inequality, that is, remembering that $\hat{y}_i$ is the explained outcome (see equation (9.5)), to compute :

[34] Fleurbaey and Schokkaert (2009) are the only authors who propose to apply the inequality index to the gap. The other authors compute the gap between total inequality and the inequality of the counterfactual distribution.

$$I(\hat{y}_i) - I(\hat{\mu}_{y1} + \hat{\alpha}_c \bar{C}_i + \hat{\alpha}_d \bar{D}_i + \hat{\alpha}_e E_i), \qquad (9.13)$$

a solution chosen by Jusot et al (2013).

The reference values in (9.10) and (9.12) are somewhat arbitrary and we can compute the formula for different values and then take the arithmetic mean. DU and FG as defined above are in absolute value. They can of course be defined in relative terms and be divided by the overall inequality. Several recent empirical studies (e.g. Aaberge et al (2011) and Checchi and Peragine (2010)) perform both estimations of the inequality of opportunity as robustness checks.

The measurement of unjust inequality using direct unfairness is linked to the tranche-compensation principle as follows: if direct unfairness computed according to formula (9.10)[35] for some matrix *m* is lower than for some other matrix m' for all inequality indices, then *m* is preferred to m' according to the tranche-compensation principle where the considered transfers are of the Pigou-Dalton sort. Similarly, there is a link between the type-compensation principle and the fairness gap. Indeed, if *m* is preferred to m' according to the type-compensation principle, then the FG is lower for *m* than for m', computed according to (9.12), for all inequality indices when the reference type is different from the two types involved in the Pigou-Dalton transfer. The statement is not as general for FG as for DU since we cannot extend the above statement whatever the reference type, the choice of which is ad hoc. This leads some authors to consider instead a weighted average of the FGs. In that case it can be proved that, if *m* is preferred to m' according to the type-compensation principle, then the weighted[36] sum of the FGs is lower for *m* than for m', computed according to (9.12), for all inequality indices belonging to the entropy class.

We conclude the discussion of direct unfairness and the fairness gap by observing that the concepts in substance are not new as methods of decomposing inequality among

[35] In a parametric or non-parametric way.

[36] For the statement to be true, the weights cannot be chosen arbitrarily. The weight of a type is given by the weight of this type in the between-type term.

its sources. When Shorrocks (1980) advocated the use of the variance, he observed in his conclusion that when one thinks about the contribution of one source to inequality, one can wonder either about how much inequality is left when the impact of this inequality factor is neutralized, or about how much inequality remains when the other sources are equalized. This is exactly the choice available in the literature on EOp measurement. Shorrocks also observed that when there are two sources (here, the set of circumstances and the set of effort variables) the natural decomposition of the variance given by the covariance of the source with outcome has a nice interpretation: the covariance of a source is just equal to the arithmetic mean of the above two computations. In the context of EOp, this means that the covariance of circumstances with outcome is the arithmetic mean of the direct unfairness and fairness gap when the other source is removed in the computations (not put at a reference level). This point was made by Jusot and al (2013) and by Ferreira and Gignoux (2011) (see their appendix).

C (iii). The choice of an index

The entire spectrum of inequality indices has been used by researchers in EOp, perhaps with the exception of Atkinson's indices. One can speculate that the absence of the Atkinson indices is due to EOp's not being a welfarist theory. Lefranc et al (2009b) and Almas et al (2011) have used the Gini index, and Aaberge et al (2011) have used the rank-independent measures. Elements of the entropy family have been used by Bourguignon et al (2007) who picked the Theil index, and Checchi and Peragine (2010), Ferreira and Gignoux (2011), Lefranc et al. (2012) use the mean logarithmic deviation (mld). Pistolesi (2009) and Björklund et al (2012) are eclectic and use a range of measures. These examples are when the objective is income attainment, and they are relative measures. When the objective is health status (self-assessed health or mortality), it makes sense to use an absolute measure such as the variance, a choice made by Jusot et al (2013) and Bricard et al (2013), which possesses the decomposition property mentioned above. However, the variance is not such a good choice for income attainment since it is not relative. Returning to the income case, there is no first-best choice. The connection with stochastic dominance, which is the advantage of rank-dependent measures, among them the Gini index, is counterbalanced by the

decomposability properties of the entropy family. The relevant decomposition is among sources of inequality, and not so much among sub-populations, and the Shapley decomposition (Chantreuil and Trannoy (2013) and Shorrocks (2013)) can be applied to any inequality index.

The property of path independence of the mld pointed out by Foster and Shneyerov (2000) has recently been emphasized by Ferreira and Gignoux (2011) to single out this index. Indeed, path independence is interesting in the context of EOp because it can be interpreted as saying that the inequality measured by the direct unfairness criterion be equal to the inequality measured by the fairness gap. This proposition has to be qualified. Direct unfairness is computed as the inequality of the average outcome across types. The fairness gap is obtained by rescaling the distribution of the outcome due to effort by the ratio of average income to average income in a type. This is one among many possibilities for nullifying the impact of circumstantial factors. Thus, if we find this way of neutralizing the impact of circumstantial inequalities appealing for the fairness gap, then we do not have to worry about computing two measures of EOp because they are equivalent (under path independence). We conclude by saying that in the health realm, variance may be a better choice, while mld is prominent for income achievement.

D. Results

It is beyond our scope to present a unified treatment of all empirical results. As argued earlier, the estimates of inequality of opportunity are probability a lower bound of the true figure in all cases and the magnitude of the underestimation is inversely related to the richness of the dataset. Consequently, the importance of the empirical results has to be gauged by considering the number of types that can be defined with the dataset. Intriguing issues that may arouse the curiosity of the readers can be easily identified. First, what is the extent of equality of opportunity with respect to overall inequality? What is the contribution of effort to inequality, is it larger than that of circumstances? Is the indirect contribution of circumstances through its impact on the distribution of effort sizeable? Does it make much difference to follow Roemer's viewpoint in measuring

effort, or will using absolute measures of effort give similar results? Among circumstances, what are the most significant? Is there a common pattern among inequalities of opportunity with respect to the objectives of health, education and income? Is there a difference of magnitude in inequality of opportunity between the developed countries and the developing countries? Does the ranking of countries differ when we look at inequality of opportunities versus inequality of outcomes? Do taxes and benefits or other instruments make a large difference when measuring EOp? (I.e., inequality of opportunity for pre-fisc versus post-fisc income.)

Starting from a very coarse definition of types, (three levels for father's education, five levels for income), Lefranc et al. (2009b) found that Sweden and Norway almost achieve equality of opportunity for income, while at the other extreme in the group of western countries lie Italy and the US, with other European countries in the middle. The qualitative results are similar to those of Roemer et al (2003). We will take a closer look at the Nordic countries before reporting the results obtained for Italy and the US. We will then contrast these results with those obtained for Latin America, Africa and Turkey.

Three thorough empirical studies have studied EOp for income in Scandinavia: Aaberge et al (2011) and Almas et al (2011) for Norway, and Björklund et al (2012) for Sweden. Starting with the latter, the authors claim that they have a fine-grained typology (1152 types), which partitions the sample into types based upon parental income quartile group (four groups), parental education group (three groups), family structure/type (two groups), number of siblings (three groups), IQ quartile groups (four groups), and body mass index (BMI) quartile group at age 18 (four groups).[37] The random sample consists of 35% of Swedish men born between 1955 and 1967 and the outcome is an average of pre-fisc income over seven years (age group: 32-38). Looking at the graphs of stochastic dominance reveals something that was already present in Lefranc et al (2009b): the income CDFs of the different educational or parental-income types are quite close. The differences are more pronounced for IQ-types. Parametric results reveal that the three

[37] BMI is measured at a young age. It would be far more controversial to put BMI on the circumstance side for older people. Of course, there are genetic roots of obesity among some subjects, but the main determinant is lifestyle (see the discussion in Bricard et al. (2013)).

most important contributors to inequality of opportunity are parental income, IQ, and the type heterogeneity of the disturbance (which may be due to effort, luck or unobserved type heterogeneity, because the parental-income and education group are still large). Looking at the Gini coefficient (the results are a bit sensitive to the measure, as usual), putting IQ aside, the other 'social' circumstances account for between 15.3% and 18.7% of the overall Gini. That means that in the counterfactual situation where the only factors of inequality would be these social circumstances, the Gini coefficient would attain a modest value of 0.043 for the oldest cohort. The contribution of IQ represents about 12% of the overall Gini. So far, these results are very impressive and confirm that Sweden is close to reaching a situation of equal opportunity. Still, it will remain to see if introducing parental income in a continuous way and perhaps education of both mother and father, thus refining the typology, would alter the results significantly.

The results for Norway obtained by Aaberge et al (2011) are built upon a coarser typology (three educational parental levels, to grow up in a large family or not, to be born in a main city or not , and birth cohort). Tranches are defined by relying upon the Roemer identification axiom. The data come from a rich longitudinal set containing records for every Norwegian from 1967 to 2006, enabling one to build up a permanent income measure. The Gini coefficient in permanent income is as low as 0.17, and the authors graph Pen's parade (the inverses of the permanent income CDFs) for the three educational groups. These inverse CDF's are quite close. The Gini coefficient corresponding to inequality of opportunity is about 0.05 suggesting that opportunity inequality accounts for about 28 percent of income inequality when the analysis is based on permanent income. Since the typology is coarser than in Björklund et al (2012) for Sweden, the results so far are compatible with a higher inequality of opportunity and likely a higher contribution of inequality of opportunity to overall inequality. Almas et al (2010) use a different methodology and the results cannot be easily compared. Nevertheless, we can observe an upper bound for the impact of effort. If we consider the usual candidates for effort variables such as years of education, hours of work (for those who work), working in the public sector, county of residence, choice of university major, then effort's raw contribution to the Gini in Norway in 1986 is about 25.5% in the pre-tax income when we do not sterilize effort variables of the impact of circumstances. However, the impact of parental background on effort variables is quite small. It represents one Gini point over a Gini of 0.26.

Next, we will review results on the 'poor achievers' of the EOp class among developed countries, the US and Italy. Pistolesi (2009) uses panel data -- the PSID from 1968 to 2001 -- and he considers age, race, education of both parents, the region of birth and the occupation of the father as circumstances. The two responsibility variables are the years of education and the hours of work. Their conditional distributions are estimated non-parametrically against the vector of circumstances. Pistolesi then predicts two counterfactual distributions for both educational and working-duration distributions. In the first, the effect of unequal circumstances is removed, whereas each individual is assumed to have exerted the same effort in the second. The circumstances have a weaker impact on hours of work than on education, a finding quite common across empirical studies, and which makes sense. A presentation of the results with the Gini to allow comparisons with previous studies shows that the share of inequality due to circumstances in the direct unfairness sense is about 35% for a five-year average earnings at the mean point of the distribution. It is indisputably higher than in Sweden but it follows a quite remarkable decreasing trend over the period. If the results were confirmed, it would mean that the increase in inequality that has occurred in the US is not due to an increase in inequality of opportunity. Checchi and Peragine (2010) study the inequality of opportunity in Italy. There are three circumstances: parents' education (five types), sex, and regions (North, South). What is striking is that with such a coarse typology, they find that inequality of opportunity accounts for about 20% of overall income inequality in Italy -- that is, higher than the 16% in Sweden with a much finer typology.

Next we will turn to less developed countries. The Latin-American study by Ferreira and Gignoux (2011) provides results that can be compared with previous studies. Circumstances are defined as ethnicity, father's and mother's occupation, and birth region, for Brazil, Ecuador, Guatemala, Panama, Colombia and Peru. The number of types is more than one hundred for the first four countries and about fifty for the latter two countries. The contribution of circumstances to inequality is quite high and it varies quite a lot across the six countries. If we look at income, Guatemala and Brazil have in common a high value of the share explained by observed circumstances, about one-third, followed by Panama (30%) and Ecuador (26%). The contribution of inequality of opportunity to total inequality is about 28% in Peru and only 23% in Colombia. However,

these two countries have fewer types, which biases the estimates downward with respect to the other countries. The authors also provide estimates of the contribution of non-responsibility characteristics to consumption inequality per capita, which may be more similar to permanent income. The degree to which inequality of opportunity explains inequality is even higher for some countries, over 50% for Guatemala. Ferreira et al (2011) study the case of Turkey, which has roughly the same level of development as Brazil, and find that on a sample of ever-married women aged 30–49, inequality of opportunity accounts for at least 26% of overall inequality in imputed consumption, which is by and large a lower value that those found for Latin American countries, except for Colombia. For African countries we refer to the study of Cogneau and Mesple-Soms (2008). The surveys that are selected are the only large-sample nationally representative surveys in Africa that provide information on parental background for adult respondents. They cover two countries under Britain's former colonial rule, Ghana and Uganda, and three countries under France's former colonial rule, Ivory Coast, Guinea, and Madagascar. The types are defined by a small number of occupational, educational and geographical circumstances. For the two most developed countries, Ivory Coast and Ghana, the Gini inequality of opportunity index is about 0.15 (triple of what is found in Sweden) and it represents about one-third of overall inequality (0.45). The information is poorer for other countries but, given the results one has on a comparative basis, one can conjecture that the share of inequality of opportunity is even higher there.

All in all, it seems that inequality of opportunity for income is highly correlated with inequality of income. This observation is confirmed by the high correlation (0.67) between these two kinds of inequality, measured by the Gini coefficient for western countries (Lefranc et al (2009)). Moreover, this strong correlation seems a general pattern that does not depend on the outcome chosen. Indeed, working on the Retrospective Survey of SHARELIFE, which focuses on life histories of Europeans aged 50 and over, Bricard et al (2013) observe a positive correlation of about 0.39 between inequality of opportunity in health and health inequality. Furthermore, since lifestyles are documented in this dataset, the authors are able to show that inequalities of opportunity for health status in Europe represent on average half of the health inequalities due to both circumstances and effort (lifestyles). There are, however, large variations across

countries. The health indicator in this study is SAH (self-assessed health) but using mortality indicators as in Garcia-Gomez et al (2012), the importance of lifestyles also comes out as a distinctive feature. These authors use a rich dataset for the Netherlands (1998-2007), linking information about mortality, health events and lifestyles. They estimate a full structural model that reveals strong educational gradients in healthy lifestyles which in turn have the expected effect on mortality.

We are at the very beginning of solid empirical analyses of inequality of opportunity. Analysis has been hampered so far by the limitations imposed by data sets and the intricacy of the issue. For each recent paper beginning with Bourguignon et al (2007), the same ritual sentence appears in the introduction, to the effect that 'this set of circumstance and effort variables is richer than those used so far in the existing empirical literature on inequality of opportunity.' If this trend continues, we can be optimistic that, in the coming years, data sets will improve, as the stakes become clearer.

10. Conclusion

The main contribution of the equality-of-opportunity literature to the vast literature on inequality is to point out that the *source* of inequality matters from an ethical viewpoint. Most would agree that effects of circumstances on persons' well-being that are beyond their control should be rectified, while at least some differential outcomes due to choice are not compensable at the bar of justice. Thus, measures of inequality *as such* are not terribly useful – unless one is a simple outcome-egalitarian, who views all inequality as unjust. To the extent that economists ignore this ethical principle – and popular view – their measurements of inequality will not persuade people to rectify it[38].

As we said, the theory of equal opportunity involves both an equalizing aspect and a dis-equalizing one. Some philosophers focus – we believe excessively – on the dis-equalizing aspect. We mention the work of Samuel Scheffler (2003) and Anderson (1999), both of whom criticize what they call 'luck egalitarianism' as too focused upon individual choice: to this they oppose a view of 'democratic equality' which involves

[38] See our chapter in the forthcoming *Handbook of Income Distribution* (A. Atkinson and F. Bourguignon, eds.) for evidence on popular views of distributive justice.

treating all persons with equal dignity and respect. Indeed, one would surely be sympathetic to their complaint, if the entirety of the equal-opportunity approach were limited to cases of expensive tastes, whether or not society should pay for the hospitalization of the motorcyclist who crashes having chosen not to wear a helmet, or even with the more socially important issue of the responsibility for smoking-related disease. These examples focus upon the dis-equalizing aspect of the equal-opportunity view – that the effects of poor choices are not compensable in a strict interpretation of the view. However, we believe that the main focus of the EOp view is upon its mandate for *equalization* of outcomes that are due to differential circumstances: most urgently, at this juncture in history, for eliminating differences in income, health, and educational achievement that are due to the vastly different socio-economic backgrounds in which children are raised, due in large part to the institutions of our capitalist societies. The bourgeois revolutions, which eliminated feudalism and inequality of opportunity due to arbitrary social status, although not complete (think of caste in India), marked a huge advance in the equalization of opportunities: but they replaced feudal inequality of opportunity with inequality of opportunity due to differential wealth. (Of course, ancient forms of inequality of opportunity, due to gender, ethnicity, and race still remain as well.) The Nordic social democracies have done most at eliminating inequality of opportunity due to income and wealth[39].

We have characterized economic development as an elimination of inequality of opportunity due to parental socio-economic status. Assuming development continues globally, according to this measure, we will eventually replace the most important circumstance with – we conjecture—inequality due to natural talent. Many people support the 'meritocratic' view, that differential returns to natural talent are just. But if we succeed eventually in eliminating inequalities of important objectives that are due to

[39] One should also query, of those who advocate 'democratic equality' over the kind of equality of opportunity discussed here, whether democratic equality of the kind they envisage can possibly exist before the invidious inequalities due to circumstances are eliminated. How can people treat each other as equals when massive material inequalities among them, due to luck, continue to exist?

differential wealth, the focus may then turn to inequalities due to differential natural talent. This would not necessarily require that untalented people be compensated for not having access to the pleasure which talented people enjoy from exercising their talents, but it may well require that no income advantage accrue to the talented. (The taxman will not bill you because you get great pleasure from exercising your fine tenor voice in the shower.) Think of the communist slogan, "From each according to his ability, to each according to his need." That slogan does not begrudge the psychological pleasure and social respect that talent garners, but advocates a complete separation of *income* from talent.

Skeptics will say that markets will always be necessary in large and complex societies, and markets cannot operate efficiently if earnings are too sharply divorced from productive contribution. But this view accepts without question the assumption that individuals always maximize selfishly against the tax regime, or other redistributive policy, which they face. Economic theory today takes the incentive problem to be a fact of nature, like Newton's laws of gravitation. It is, however, not a fact of that kind, but rather a corollary to a particular human psychology, that has developed in a particular historical epoch, when material scarcity is still prevalent globally, and capitalist economic relations are virtually ubiquitous[40]. It is quite possible (and we believe it to be so) that human material needs are limited, and that an historical period will come, perhaps relatively soon in the scale of human history, when they are more or less universally satisfied (see Skidelsky and Skidelsky (2012)). Keynes (1930) in fact argued that such an epoch was virtually upon us, at least in what he called the progressive countries, and that attitudes towards material acquisition would change radically over the next century. If and when this occurs, it seems to us quite reasonable to conjecture that societies will attempt to eliminate differential rewards to talent, having by then done away with inequalities due to feudal status, and capitalist wealth. The question of how an

[40] We do not claim that humans have no propensity to be self-interested, but rather that the extent to which that propensity is hard-wired may be vastly overblown. It is difficult to know how human psychology will change as material scarcity fades into the past.

economic mechanism can accomplish this efficiently may well be the central problem for economists of that era.

References

Aaberge, R., M. Mogstad and V. Peragine , 2011. "Measuring long-term inequality of opportunity," *Journal of Public Economics* 95, 193-204

Ackerman, B. and A. Alstott, 1999. *The Stakeholder Society*, New Haven: Yale University Press

Aghion, P., E. Caroli and C. Garcia-Penalosa. 1999. "Inequality and economic growth: the role of new growth theories," *Journal of Economic Literature* 37, 1610-1660.

Alesina, A, and G.M Angeletos. 2005. "Fairness and Redistribution." *The American Economic Review*, 95(4): 960-980

Almås, I, Cappelen, A.W., Lind, J.T, Sørensen, E.R. & Tungodden, B, 2011. "Measuring unfair (in)equality,"*Journal of Public Economics*", vol. 95(7-8), 488-499.

Almas, I., 2008. "Equalizing income versus equalizing opportunity: A comparison of the United States and Germany," *Research on Economic Inequality* 16, 129-156

American Law and Economic Review

Anderson, E. 1999. "What is the point of equality?" *Ethics* 109, 287-337.

Andersson, R., Å. Bråmå and E. Holmqvist, 2010. "Counteracting Segregation: Swedish Policies and Experiences" *Housing Studies*, 25(2), 237-256.

Angelucci, M., D. Karlan, and J. Zinman. 2013. "Win Some Lose Some? Evidence from a Randomized Microcredit Program Placement Experiment by Compartamos Banco" NBER WP 19119.

Angrist J. and K. Lang 2004 "How Important Are Peer Effects? Evidence from Boston's Metco Program,"*Amer, Econ. Rev.* 94, 1613-34.

Armendariz de Aghion, B. and J. Morduch. 2010. *The Economics of Microfinance,* Cambridge MA: MIT Press

Arneson, R. 1989. "Equality and equal opportunity for welfare," *Phil.Stud.*56, 77-93.

Banerjee, A., E. Duflo, R. Glennersterx and C. Kinnan, 2013. "The miracle of microfinance? Evidence from a randomized evaluation" NBER WP n° 18950.

Bargain, O., A. Decoster, M. Dolls, D.Neumann, A.Peichl and S. Siegloch, 2013. "Welfare, labor supply and heterogeneous preferences: evidence for Europe and the US" forthcoming in *Social Choice and Welfare*

Barr N., and I. Crawford. 2005. *Financing Higher Education: Answers from the UK*, London and New York: Routledge

Barry, B. 1991. *Theories of justice,* Berkeley: University of California Press

Benabou R. 1996b. "Heterogeneity, stratification and growth: Macroeconomic implications of community structure and school finance," *Amer. Econ. Rev.* 86, 584-609

Benabou, R. 1996a. "Equity and efficiency in human capital investment: The local connection," *Review of Economic Studies* 62, 237-264.

Betts, J. and J.E. Roemer, 2009. "Equalizing Opportunity for Racial and Socioeconomic Groups in the United States through Educational Finance Reform," in P. Peterson (ed.), *Schools and the equal opportunity problem,* MIT Press

Björklund, A., M. Jäntti, and J. Roemer, 2012. "Equality of opportunity and the distribution of long-run income in Sweden," *Social Choice & Welfare* 39, 675-696

Bolt, G. and R. van Kempen, 2010. "Dispersal Patterns of Households who are Forced to Move: Desegregation by Demolition: A Case Study of Dutch Cities" *Housing Studies*, 25(2), 159-180.

Bono, PH., R. Davidson, and A.Trannoy, 2013, "The SRU act and the increase in social housing: a counterfactual analysis" AMSE-WP 2013-05.

Bossert, W. 1995. "Redistribution mechanisms based on individual characteristics," *Mathematical Social Sciences* 29,1–17.

Bossert, W. 1997. "Opportunity sets and individual well-being," *Social Choice & Welfare* 14, 97-112

Bossert, W. and M. Fleurbaey ,1996. Redistribution and compensation, *Social Choice and Welfare* 13, 343-355.

Bourguignon, F., F.H.G. Ferreira and M. Menendez (2007), "Inequality of opportunity in Brazil,"*Review of Income and Wealth* 53, 585-618.

Bourguignon, F., F.H.G. Ferreira and M. Menendez, 2013, "Inequality of opportunity in Brazil, A corrigendum" *Review of Income and Wealth* 53, 551-555.

2988 Bowles, S. 1973. "Understanding economic opportunity," *Amer. Econ. Rev.* 63,
2989 346-356
2990 Bricard, D., F. Jusot, A.Trannoy, and S. Tubeuf, 2013, "Inequality of
2991 Opportunity in Health and the Principle of Natural Reward: evidence from European
2992 Countries" forthcoming *Research on Economic Inequality*, 21.
2993 Bruneri P, F. Ferreira and V.Peragine 2013. " Inequality of Opportunity, Income
2994 Inequality and Economic Mobility: Some International Comparisons," IZA DP No. 7155
2995 Buchanan, J. M. 1986. *Liberty, Market and State: Political Economy in the 1980s*.
2996 NY: NYU. Press, Columbia U. Press.
2997 Calsamiglia, C. 2009. "Decentralizing equality of opportunity," *Intl. Econ.Rev.* 50,
2998 273-290
2999 Carneiro P., and J. Heckman, 2003. "Human capital policy," in (eds.) J.
3000 Heckman and A. Krueger "*Inequality in America,*" Cambridge, MA: MIT press.
3001 Chapman B. 1997. "Conceptual issues and the Australian experience with income
3002 contingent charges for higher education" *Econ. J.* 107 , 738–751
3003 Chantreuil, F. and A.Trannoy, 2013, "Inequality Decomposition Values: a trade-
3004 off between marginality and efficiency" *Journal of Economic Inequality* 11, 83-98
3005 Checchi, D. and V. Peragine , 2010. "Inequality of opportunity in Italy," *J. Econ.*
3006 *Inequality* 8, 429-450.
3007 Cogneau, D. and S. Mesplé-Somps , 2008. "Inequality of opportunity for income
3008 in five countries of Africa, "*Research Econ. Inequality* 16, 99-128.
3009 Cohen, G.A. 1989. "On the currency of egalitarian justice,"*Ethics* 99, 906-944
3010 Cohen, G.A. 1993. "Equality of what? On welfare, goods, and capabilities," in M.
3011 Nussbaum and A. Sen, *The quality of life*, Oxford: Oxford University Press
3012 Cohen, G.A. 1997. "Where the action is: On the site of distributive justice," *Phil.*
3013 *& Pub. Affairs* 26, 3-30
3014 Cohen, G.A. 2004. "Expensive taste rides again," in J. Burley (ed.) *Dworkin and*
3015 *his critics* Oxford: Blackwell
3016 Cohen, G.A. 2006. "Luck and equality: A reply to Hurley," *Philosophy and*
3017 *Phenomenological Research* 70, 439-446
3018 Cohen, G.A. 2009. *Why not socialism?* Princeton: Princeton University Press

Cohen, G.A. 2011. *On the currency of egalitarian justice and other essays in political philosophy,* (edited by M. Otsuka), Princeton: Princeton University Press

Conlisk, J. 1974. "Can equalization of opportunity reduce social mobility?" *Amer. Econ. Rev.* 64, 80-90

Corak, M. 2013. "Income inequality, equality of opportunity, and intergenerational mobility," *J. Econ. Perpsectives* 27, 79-102

Crépon B., F. Devoto, E. Duflo and W.Parienté, 2011. "Impact of microcredit in rural areas of Morocco: Evidence from a Randomized Evaluation" MIT working paper (March 31)

Cullen, J.B, Jacob, B.A and S.D. Levitt. 2006. "The effect of school choice on participants: Evidence from randomized lotteries" *Econometrica*, 74, 1191-1230

Currie, J. and D. Thomas, 1995. "Does Head Start make a difference?" *Amer.*

Davidson, R. and J-Y. Duclos , 2000. "Statistical inference for stochastic dominance and for the measurement of poverty and inequality, "*Econometrica* 6, 1435-1464.

Deininger W. 2003. *Land policies for growth and poverty reduction,* World Bank and Oxford University Press.

Devooght, K., 2008. "To each the same and to each his own: a proposal tomeasure responsibility-sensitive income inequality," *Economica* 75, 280-295.

Dobbie W. and R. Fryer, 2011. "Are high quality schools enough to increase achievement among the poor?" Evidence from the Harlem Children's Zone", *Amer. Econ. Journal: Applied Economics* 3, 158-87

Dobbie, W. and R. Fryer, 2012. "Getting beneath the veil of effective schools: Evidence from New York City," *Amer. Econ. J.: Applied Economics,* 4, 28-60

Donald, S.G., D.A.Green, and H.J.Paarsch, 2000, "Differences in wage distributions between Canada and the United States: an application of a flexible estimator of distribution functions in the presence of covariates". *Rev. Econ. Stud* 67, 609–633

Dworkin, R. 1981a. "What is equality? Part 1: Equality of welfare," *Phil.&Pub.Affairs* 10, 185-246

Dworkin, R. 1981b. "What is equality? Part 2: Equality of resources," *Phil.&Pub.Affairs* 10, 183-345

Evans D. and B. Jovanovic, 1989. "An estimated model of entrepreneurial choice under liquidity constraints" *J. Polit. Econ.* 97, 808-827

Fancher, R. E. 1985. *The intelligence men*. New York: Norton.

Ferreira, F.H.G, J. Gignoux and M. Aran, 2011. "Measuring inequality of opportunity with imperfect data: the case of Turkey, *J. Econ. Inequality* 9, 651-680.

Ferreira, F.H.G. and J. Gignoux , 2011. "The measurement of inequality of

Fleurbaey, M. 1998, "Equality among responsible individuals", in J.-F. Laslier, M. Fleurbaey, N. Gravel and A. Trannoy (eds.), *Freedom in Economics: New Perspectives in Normative Economics*, 206-234. London: Routledge.

Fleurbaey, M. 2008. *Fairness, responsibility, and welfare,* Oxford University PressFleurbaey, M., 1995. "Three solutions for the compensation problem,"*J. Econ. Theory* 65, 505–21

Fleurbaey, M. 2012. "Equal opportunity, reward and respect for preferences: Reply to Roemer," *Econ. & Phil.* 28, 201-216

Fleurbaey, M. and E. Schokkaert, 2009. "Unfair inequalities in health and health care," *J. Health Economics* 28, 73-90.

Fleurbaey, M. and F. Maniquet, 2006. "Fair income tax," *Rev.Econ.Stud.*73, 55-83

Fleurbaey, M. and F. Maniquet, 2011. *A theory of fairness and social welfare*, Cambridge UK: Cambridge University Press

Fleurbaey, M. and V. Peragine , 2013. "Ex ante versus ex post equality of opportunity," *Economica* 80, 118-130

Fleurbaey, M., E. Schokkaert, S. Luchini, and C. Muller, 2013, "Equivalent incomes and the economic evaluation of health care", *Health Economics* 22, 711-729

Foley, D. 1967. "Resource allocation and the public sector," *Yale Econ. Essays* 7, 45-98

Foster J.E. and A. Shneyerov, 2000. "Path independent inequality measures," *J. Econ. Theory* 91, 199-222

Foster, J. 2011. "Chapter 24: Freedom, opportunity and well-being," in K. Arrow, A. Sen and K. Suzumura, *Handbook of social choice and welfare* , vol. 2, Elsevier

Foster, J. and A. Shneyerov, 2000, “Path Independent Inequality Measures,” *Journal of Economic Theory* 91,199–22.

Frederiksson P., B. Ockert and H. Oosterbeek, 2013. “Long term effect of class sizes” *Quart. J. Econ.,* 249–285.

Fried, B.H. *Tbe progressive assault on laissez-faire: Robert Hale and the first law and economics movement*, Cambridge MA: Harvard University Press

Fryer, R. and S. Levitt, 2004. “Understanding the black-white test score gap in the first two years of school” *Rev. Econ. & Stat.,* 86, 447-64

Fryer, R. and G. Loury, 2005. “Affirmative action and its mythology” *J.*

Fryer, R. and S. Levitt, 2006. “The black-white test score gap through third grade”

Fryer, R. and S. Levitt, 2013. "Testing for racial differences in the mental ability of young children." *Amer. Econ. Rev.*, 103, 981-1005

Gaertner, W. and L. Schwettmann, 2007. “Equity, responsibility and the cultural dimension,” *Economica* 74, 627–649.

García-Gómez.P, E.Schokkaert, T.Van Ourti, and T. Bago d’Uva , 2012. “ Inequity in the face of death,” CORE Working Paper n° 2012/14

Gary-Bobo R. and A.Trannoy, 2013. "Optimal student loans and graduate tax under moral hazard and adverse selection,” Cesifo wp *n°*. 4279.

Gintis, H. 1971. "Education, technology, and the characteristics of worker productivity," *Amer. Econ. Rev.* 61, 266-279

Goetz, E. 2010. “Desegregation in 3D: Displacement, Dispersal and Development in American Public Housing”, *Housing Studies*, 25(2), 137-158.

Goldberger S. and C. F. Manski 1995 "Review Article: The Bell Curve by Herrnstein and Murray", *Journal of Economic Literature*, 36(2), 762–76.

Grossman, M. 1972. “On the concept of health capital and the demand for health,” *J. Polit. Econ.* 80, 223-255.

Harsanyi, J. 1955. “Cardinal welfare, individualistic ethics and interpersonal comparisons of utility,” *J. Polit. Econ.* 63, 309-321

Hastings, J., T. Kane, and D. Staiger. 2006. “Gender and Performance: Evidence from School Assignment by Randomized Lottery.” *American Economic Review*, 96(2): 232-236.

Havnes, T. and Mogstad, M. 2012. “Is universal child care leveling the playing field?” Cesifo working paper number 4014

Heckman J. 1995. "Lessons from the Bell Curve". *J. Polit. Econ.*103, 1091–1120.

Heckman J. 2012. *Giving Kids a Fair Chance*. Cambridge, MIT Press, Cambridge. Mass.

Heckman J. 2013. *Economics and Econometrics of Human development*. See http://bfi.uchicago.edu/

Heckman, J. 2011. “The American family in black and white: A post-racial strategy for improving skills to promote equality,” *Daedalus* 140, 70-89.

Hendricks L. 2001. “Bequests and Retirement Wealth in the United States,” working paper, Arizona State University, http://www2.econ.iastate.edu/faculty/hendricks/Research/bequdata_paper.pdf

Herrero C., Mendez I., and A. Villar , 2012. “Relative Equality of Opportunity: A Statistical Approach,” INDICSER working paper

Herrnstein, R. 1971. “IQ,” *Atlantic Monthly*, September, 43-64

Herrnstein, R. and C. Murray, 1996. *The Bell Curve: Intelligence and class structure in American life,* New York: Free Press

Herrnstein, R. and C. Murray. 1994. *The Bell Curve: Intelligence and Class Structure in American Life* Free Press.

Hurley, S. 2002. “Roemer on responsibility,” *Law and Philosophy* 21, 39-64

Hurley, S. 2003. *Justice, luck and knowledge,* Cambridge MA: Harvard Univ. Press

Ionescu, F. 2009. “The Federal Student Loan Program: Quantitative Implications for College Enrollment and Default Rates", *Review of Economic Dynamics*, 12, 205-231.

Jensen, A. 1969. “How much can we boost IQ and academic achievement?” *Harvard Ed. Rev.* 39, 1-123

Johnson, R. 2010. “The health returns of education policies from preschool to high school and beyond,” *Amer. Econ. Rev.: Papers & Proceedings* 100, 188–194

Jones, A., J. Roemer and P. Rosa Dias 2011. “Equalising opportunities in health through educational policy,” Discussion paper, Dept. Political Science, Yale University.

Jones, A., J. Roemer and P. Rosa Dias, 2013. "Equalizing opportunities in health through educational policy," [journal to be added]

Jusot, F., S. Tubeuf and A. Trannoy 2013. "Circumstances and efforts: how important is their correlation for the measurement of inequality of opportunity in health?" forthcoming in *Health Economics* DOI: 10.1002/hec.2896

Jusot, F., Tubeuf, S. and Trannoy, A. 2010. "Inequality of opportunities in health in Europe: Why so much difference across countries?" Health, Econometrics and Data Group (HEDG) Working Paper 10/26, University of York.

Karlan D., and J. Zinman (2011), "Microcredit in Theory and Practice: Using Randomized Credit Scoring for Impact Evaluation", *Science* 332 (6035), 1278-1284

Keane, M. and J.E. Roemer, 2009. "Assessing policies to equalize opportunity using an equilibrium model of educational and occupational outcomes," *J. Public Econ.* 93, 879-898

Keynes, J.M. 1963[1930] ."Economic possibilities for our grandchildren," in J.M.Keyes, *Essays in persuasion,* New York: W.W. Norton

Khandker S. 2005. "Microfinance and Poverty: Evidence Using Panel Data from Bangladesh" *The World Bank Economic Review*, 19(2), 263–286.

Kolm, S-C. 1972. *Justice et équité,* Paris: Editions du CNRS

Krueger, A. 2003 "Inequality, to much of a good thing" in (eds.) J. Heckman and A. Krueger "*Inequality in America,*" Cambridge, MA: MIT press.

Lefranc, A., N. Pistolesi and A. Trannoy 2009a. "Inequality of opportunities vs. inequality of outcomes: Are western societies all alike?" *Rev. Income and Wealth* 54, 513-546.

Lefranc, A., N. Pistolesi and A. Trannoy, 2007. "Une réduction de l'inégalité des chances dans l'inégalité du revenu salarial en France ?" *Revue d'Economie Politique* 117, 91-117

Lefranc, A., N. Pistolesi and A. Trannoy, 2009b. "Equality of opportunity and luck: definitions and testable conditions, with an application to income in France," *J. Pub. Econ.* 93, 1189-1207.

Lefranc.A, N. Pistolesi and A. Trannoy, 2012. "Measuring circumstances: Francs or ranks, does it matter?" in (ed.) J.G. Rodriguez, *Research on Economic Inequality* 19, *Inequality of Opportunity: Theory and Measurement,* Chap 6, 131 – 156.

Meade, J. 1965. *Efficiency, equality, and the ownership of property,* Cambridge, MA: Harvard University Press

Messick, D. M., and K. Sentis, 1983. "Fairness, Preference and Fairness Biases." In ed. D. M. Messick and K. S. Cook, *Equity Theory: Psychological and Sociological Perspectives*, 61-94. New York: Praeger

Moreno-Ternero, J. and J. Roemer, 2008. "The veil of ignorance violates priority," *Econ.&Phil.* 24, 233-257

Neisser, U., G. Boodoo, T. Bouchard, A. Boykin, N. Brody, S. Ceci, D. Halpern, J. Loehlin, R. Perloff, R.Sternberg, and S. Urbina, 1996. "Intelligence: Knowns and Unknowns" *American Psychologist* 51, 77–101.

Niehues J., and A.Peichl, 2013. "Upper bounds of inequality of opportunity: theory and evidence for Germany and the US", *Social Choice & Welfare* (in press)

Nozick, R. 1974. *Anarchy, state and utopia,* New York: Basic Books

O'Neill, D., O. Sweetman and D. Van de gaer , 2000. "Equality of opportunity and kernel density estimation," in T.B. Fomby and R. C. Hill (eds.), *Advances in Econometrics* 14, 259-274. Stamford: JAI Press

Ooghe, E., E. Schokkaert, and D. Van de gaer, 2007. " Equality of opportunity vs. equality of opportunity sets," *Social Choice & Welfare* 28, 209-230

opportunity: Theory and an application to Latin America," *Review of Income and Wealth*, 622-657.

Paes de Barros, R., F. H. G. Ferreira, J. R. Molinas Vega and J.S. Chanduvi, 2009. *Measuring Inequality of Opportunities in Latin America and the Caribbean,* Washington, DC: World Bank.

Pazner, E. and D. Schmeidler, 1978. "Egalitarian equivalent allocations: A new concept of economic equity," *Quart. J. Econ.* 92, 671-687

Peragine, V. and L. Serlenga , 2008. "Higher education and equality of opportunity in Italy, "*Research on Econ. Inequality* 16, 67-97.

Peragine, V., 2004. "Ranking income distributions according to equality of opportunity," *J. Econ. Inequality* 2, 11-30.

Phillips, D. and M. Harrison, 2010. "Constructing an Integrated Society: Historical Lessons for Tackling Black and Minority Ethnic Housing Segregation in Britain", *Housing Studies*, 25 (2), 221-235.

Pignataro, G. 2012. "Equality of opportunity: Policy and measurement paradigms, *J. Econ. Surveys* 26, 800-834

Piketty, T. and G. Zucman (2013) : Capital is back: Wealth-Income ratios in rich countries 1700-2010 WP PASE.

Piketty, T. 2003. "Income inequality in France, 1901-1998", *Journal of political economy*, 111 (5) 2003, 1004-1042.

Piketty, T..2008. "Wealth Taxation in the 21st Century: A Personal View: Comments on "Taxation of wealth and wealth transfers," Mirrlees Review

Pistolesi, N. 2009. "Inequality of opportunity in the land of opportunities, 1968-2001," *J. Econ. Inequality* 7, 411-433.

Ramos, X. and D. Van de gaer, 2012. "Empirical approaches to inequality of opportunity: Principles, measures, and evidence." Working Paper Universiteit Gent, 2012/792.

Ravitch, D. 2013 *Reign of Error: The Hoax of the Privatization Movement and the Danger to America's Public Schools*, New York: Random House.

Rawls, J. 1958. "Justice as fairness," *Phil. Rev.* 67, 164-194

Rawls, J. 1971. *A theory of justice*, Cambridge, MA: Harvard University Press

Roemer, J, E., R. Aaberge, U. Colombino, J. Fritzell, S. P. Jenkins , A. Lefranc , I.Marx , M. Page , E. Pommer , J. Ruiz-Castillo , M.J. San Segundo ,T. Tranaes , A. Trannoy , G. Wagner , I. Zubiri, 2003. "To what extent do fiscal systems equalize opportunities for income acquisition among citizens?" *J. Pub. Econ.* 87, 539-565

Roemer, J. , 2013 . "Economic development as opportunity equalization," forthcoming in *World Bank Econ. Rev.* DOI:10.1093/wber/lht023

Roemer, J. 1985. "Equality of talent," *Econ. & Phil.*1, 151-188

Roemer, J. 1993. "A pragmatic theory of responsibility for the egalitarian planner," *Phil.&Pub.Affairs* 22, 146-166

Roemer, J. 1996. *Theories of distributive justice,* Cambridge MA: Harvard University Press

Roemer, J. 1998. *Equality of opportunity,* Harvard University Press'

Roemer, J. 2004. "Equal opportunity and intergenerational mobility: Going beyond intergenerational income transition matrices," in M. Corak (ed.) *Generational income mobility in North America and Europe* , New York: Cambridge University Press

Roemer, J. 2012. "On several approaches to equality of opportunity" *Econ.&Phil.* 28, 165-200

Roemer, J. and B. Ünveren, 2012. "Dynamic equality of opportunity," http://johnroemer.commons.yale.edu/current-work/

Rosa Dias, P. 2009. "Inequality of opportunity in health: evidence from a UK cohort study," *Health Economics*18, 1057 - 74.

Rosa-Dias P. 2009. "Inequality of Opportunity in Health: evidence from the UK cohort study," *Health Economics* 18, 1057-1074

Rosa-Dias P. and A. Jones, 2007. "Giving equality of opportunity fair innings," *Health Economics* 16, 109-112

Rosa-Dias, P. 2010. "Modelling opportunity in health under partial observability of circumstances," *Health Economics* 19, 252-264

Rouse, C. 1998. "An evaluation of the Milwaukee parental choice program." *Quar. J. Econ.* 113, 553-602

Scanlon, T. 1986. "The significance of choice," in S.M. McMurrin (ed.) *The Tanner Lectures on Human Values*, Salt Lake City: University of Utah Press

Scheffler, S. 2003. "What is egalitarianism?" *Phil. & Public Affairs* 31, 5-39

Sen, A. 1980. "Equality of what?" in S. McMurrin (ed.) *The Tanner Lectures on Human Values*, Salt Lake City:University of Utah Press

Shorrocks A.F, 1999. Decomposition procedures for distributional analysis: a unified framework based on the Shapley value. Unpublished manuscript. University of Essex and Institute for Fiscal Studies

Shorrocks, A. 1980. "The class of additively decomposable inequality measures," *Econometrica* 48, 613-625

Shorrocks, A. 2013. "Decomposition procedures for distributional analysis: a unified framework based on the Shapley value, "*Journal of Economic Inequality* 11, reprinted in *Rediscovering Classics*, 99-126

Skidelsky, R. and E. Skidelsky, 2012. *How much is enough?* New York: Other Press

Temkin, L. 1993. *Inequality*, Oxford University Press

Trannoy, A., S. Tubeuf, F. Jusot, and M. Devaux, 2010. "Inequality of opportunities in health in France: a first pass," *Health Economics* 19, 921-938.

US Dept of Education, 2010. "International education rankings suggest reform can lift US," *Homeroom*, December 8, www.ed.gov/blog/2012/12/

Van de gaer, D. 1993. "Equality of opportunity and investment in human capital," Ph.D. dissertation, Leuven University

Van de gaer, D., J. Vandenbossche, and J.L. Figueroa, 2013. "Children's health opportunities and project evaluation: Mexico's Oportunidades program," World Bank, Development Economics Vice Presidency, Policy Research Working Paper 6345

Van Parijs, P. 1997. *Real freedom for all*, New York: Oxford University Press

Varian, H.R. 1975. "Distributive justice, welfare economics, and the theory of fairness," *Phil. & Public Affairs* 4, 223-247

Weymark, J. 1991. "A reconsideration of the Harsanyi-Sen debate on utilitarianism, in Elster, J. and J. Roemer (eds.), *Interpersonal comparisons of well-being,* Cambridge: Cambridge University Press

World Bank, 2005. *World Development Report 2006: Equity and Development*, Washington, DC: World Bank.

Yaari, M. and M. Bar-Hillel, 1984. "On dividing justly," *Social Choice & Welfare* 1, 1-24