"Equality of opportunity*"

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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 transpired, 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 philosophical contributions to the discussion were, following Rawls, from Amartya Sen (1980), Ronald Dworkin (1981a, 1981b), Richard Arneson (1989) and G.A. Cohen

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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. It is a special case of consequentialism. See chapter 3 for further discussion.

(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, and 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 chapter, there was an earlier skirmish around the practical import of equalizing opportunities. Just prior to 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.

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

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

economists ignore this distinction, they may be measuring something that is not ethically 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 -- whether those outcomes were determined by social (and perhaps genetic) factors beyond their control, or not – 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) does 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.

In this chapter, we begin by summarizing the philosophical debate concerning equality since Rawls (section 2), presenting economic algorithms for computing policies which equalize opportunities – or, more generally, ways of ordering social policies with respect to their efficacy in opportunity equalization (sections 3, 4 and 5), application of the approach to the conceptualization of economic development (section 6), discussion of dynamic issues (section 7), a preamble to a discussion of empirical work (section 8), evidence of population views from surveys and experiments concerning conceptions of equality (section 9), and a discussion of measurement issues, and summary of the empirical literature on inequality of opportunity to date (section 10). We conclude with mention of some critiques of the equal-opportunity approach, and some predictions (section 11).

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 which 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 which 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 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 made 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 that it shifted 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 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 which more below.

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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.

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 actually 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 some external resource.

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:

State 1	Alpha becomes Andrea	Beta becomes Bob

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 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

(x_1^α, x_2^α) maximizes $\frac{1}{2}\sqrt{W^A + x_1^\alpha} + \frac{1}{2}\sqrt{\frac{W^B + x_2^\alpha}{2}}$

(1) subj. to $x_1^\alpha + p x_2^\alpha = 0$

(x_1^β, x_2^β) maximizes $\frac{1}{2}\sqrt{W^B + x_1^\beta} + \frac{1}{2}\sqrt{2(W^A + x_2^\beta)}$

(2) 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.

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 , 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].

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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 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?

This is not the first time that insufficient concavity of preferences causes problems for economic analysis. See, for example, the discussion of money-metric utility in

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 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

29 chapter 3.

30 7 Readers may recall that Harsanyi (1955) claimed to construct a veil-of-ignorance
31 argument for utilitarianism without making interpersonal comparisons. But his argument
32 fails – not as a formal mathematical statement, but in the claim that utilitarianism is what
33 has been justified. (See, for an early discussion, Weymark (1991), and for a more recent
34 one, Moreno-Ternero and Roemer (2008).)

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 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. For development of Sen's capability approach, see chapter 3.

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

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 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) which 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

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).

number of revealing examples (see, for example, Cohen (1989, 2004)). He calls his approach 'equal access to advantage.'

Besides criticizing Dworkin for his partition 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 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) which 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 . 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 , 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^t_φ, 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—which 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*, $G^t_\varphi(e) = \pi$, 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 with his circumstances. In comparing the degrees of effort of individuals across types, we use the rank measure, which sterilizes the distribution of raw effort of the influence of circumstances upon it[10].

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

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

where $e^t(\pi)$ is the level of effort at the π^{th} quantile of the distribution G^t_φ, that is, $G^t_\varphi(e^t(\pi)) \coloneqq \pi$. Then the functions $v^t(\cdot,\varphi)$ are the inverse functions of the distribution functions of the objective, by type, under the policy φ. (In this sense, is like Pen's parade, which is also the inverse of a distribution function.) Inequality of opportunity

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.

holds when these *functions* are not identical. In particular, because we are viewing persons at a given rank π as being equally accountable with respect to the choice of effort, the vertical difference between the functions $\{v^t(\cdot,\varphi)\}$ is a measure of the extent of inequality of opportunity (or, equivalently, the horizontal distance between the cumulative distribution functions).

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

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

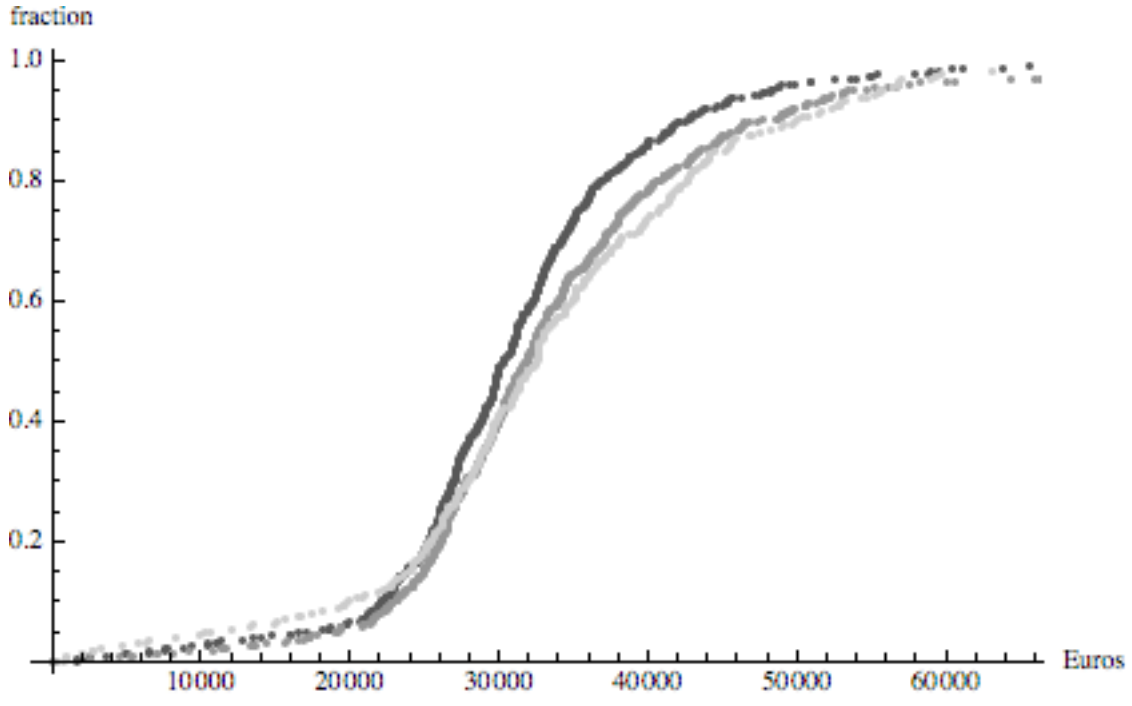
We call the solution to this program the opportunity-equalizing policy, φ^{EOp}. (Computing (3.1) is equivalent to maximizing the area to the left of the left-hand envelope of the type-distributions of the objective, and bounded above by the horizontal line of height one.)

In the case in which the lower envelope of the functions $\{v^t\}$ is the 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. The policy is the status-quo policy. It seems clear that, with respect to this one circumstance (parental education), opportunities for income have been more effectively equalized in Denmark than in Hungary[12]. The graphs are taken from Roemer (2013).



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

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

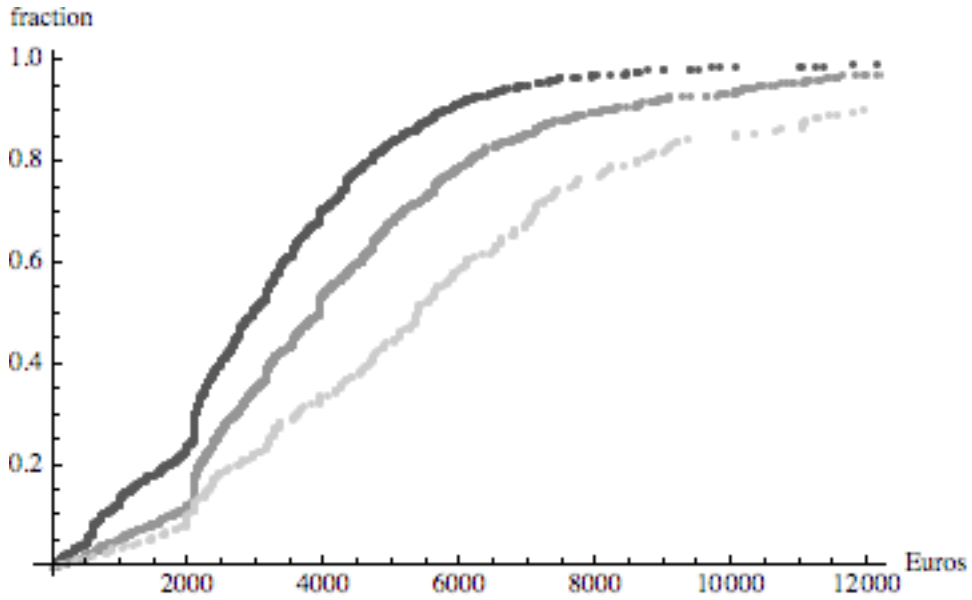


Figure 1b. As in Figure 1a, but for Hungary

The approach inherent in (3.1) is one which 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 which 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 what types. Circumstances are non-welfare (or non-objective) information. More informally, consequentialism

424 only considers the final results of policies (incomes), and not the causes of those
425 consequences. Here, we say there are two kinds of cause of outcomes with different
426 moral status: circumstances and effort. We must distinguish between these causes, and
427 social policy should attempt to mitigate the inequality effects of one of them, but not
428 necessarily of the other.
429 At this point, we return briefly to consider a philosophical critique of this
430 approach – and indeed of the general evolution of responsibility-sensitive egalitarianism,
431 as it was reviewed in section 1 above – offered by Susan Hurley (2002), who writes that
432 "Roemer's account does not show how the aim to neutralize luck could provide a basis
433 for egalitarianism." Hurley says that, absent luck, many possible distributions of the
434 objective could have occurred, and one cannot claim that 'neutralizing' luck means to
435 render outcomes sensitive only to degrees of effort. Moreover, she writes that it is not
436 an *argument* for EOp that it neutralizes the effects of luck.
437 The moral premise of the EOp view is that rewards should be sensitive only to the
438 autonomous efforts of individuals. This is a special case of rewards according to deserts.
439 People deserve, in the EOp view, to acquire the objective in proportion to how hard they
440 try. Thus, strictly speaking, the EOp view is not one whose fundamental primitive is
441 equality: deservingness is fundamental, together with the normative thesis that justified
442 inequality tracks deservingness. Inequalities that are not due to unequal efforts are
443 *defined* as being due to luck: that is, luck is so-called because it is a cause of reward that
444 is illegitimate from the EOp view. The statement that 'EOp intends to neutralize the
445 effects of luck on outcomes' is therefore equivalent to the statement 'EOp intends to
446 render outcomes sensitive only to effort.'
447 So, for example, suppose a child, *A,* does well in life because his parents were
448 rich, not because he exerted great effort, while another child, *B,* from a poor family, does
449 well by virtue of exerting great effort. Some might argue that it may be no less a matter
450 of luck that *B* was the kind of person who works hard than that *A* had rich parents, but
451 that approach, whatever its merits, is not the sense in which responsibility-concerned
452 egalitarians use the word luck. Luck, for us, *means* the source of non-effort caused
453 advantage. To be sure, it is not an *argument* for EOp that it neutralizes luck, it is rather

definitive of the EOp view that it does so. The *argument* for EOp must be that is *right* to render outcomes sensitive only to effort[13].

The next example, which is hypothetical, is given to illustrate 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 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[14], 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 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

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13 This point is due to Cohen (2006).

14 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.

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.

For any given vector 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:

and it exhausts the budget precisely when:

(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 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 .

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 . (Denote by 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 , 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[15] the average life expectancy of all such people – the (t,π) cohort—will be

.

We can now define the EOp policy, which is:

(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

15 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.

socially objectionable in some way (see Anderson (1999)). But this is incorrect: the 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.

Finally, assume that 25% of the population is poor and 75% is rich, and that the national health budget is per capita.

With these data, one can compute that 33% of the rich will contract cancer, 9.3% of the poor will contract only cancer, 26% of the poor will contract only TB, and 56% of the poor will contract both TB and cancer. (Here, we do not exclude the possibility that a person could contract both diseases.)

Our policy is $R =$, the schedule of how much will be spent on treating an occurrence of each disease. The objective is to equalize opportunities, for the Rich and the Poor, for life expectancy.

The life expectancy of a Rich person is given by:

,

and of a Poor person by:

The solution of the program that maximizes the minimum life expectancy of the two types, subject to the budget constraint, is = \$686, =\$13,027. In figure 2, we present the life expectancies of the Rich and the Poor, as a function of the rank at which they sit on the effort (life-style) distribution of their type, at this solution. The higher curve is that of the Rich. We see that, at the EOp solution, the Rich still have greater life expectancy than the Poor – despite the large amounts being spent on treating tuberculosis[16]. The difference, however, is less one year. Moreover, life expectancy increases with life-style quality – this inequality of outcome is an aspect that EOp does *not* attempt to eliminate.

16 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.

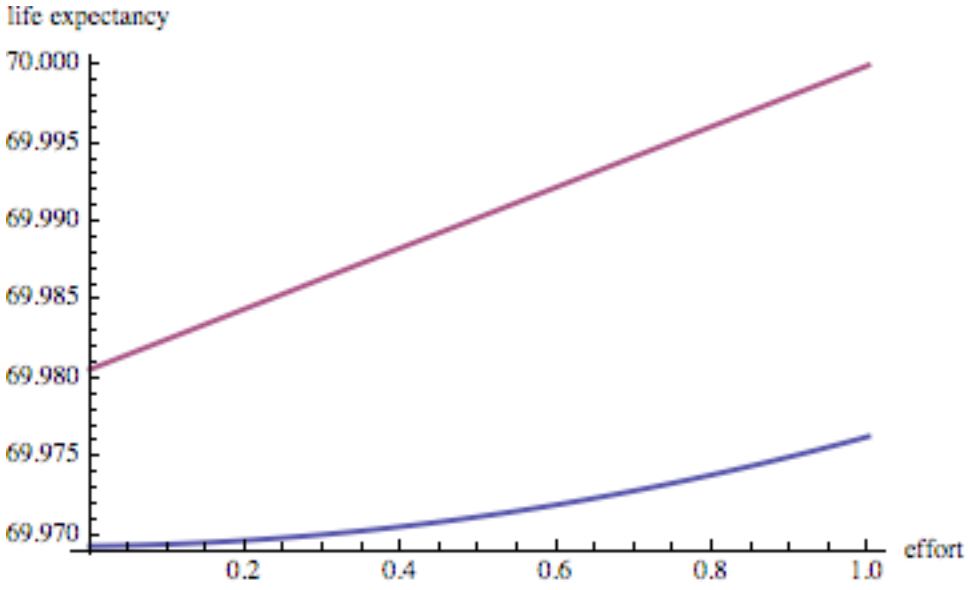

Figure 2. EOp policy: Life expectancy as a function of effort in two types, Rich and Poor

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 . Three times as much is spent on cancer as in the EOp solution. Figure 3 graphs the life expectancy of the two types in the utilitarian solution (dashed lines) as well as the EOp solution (solid lines):

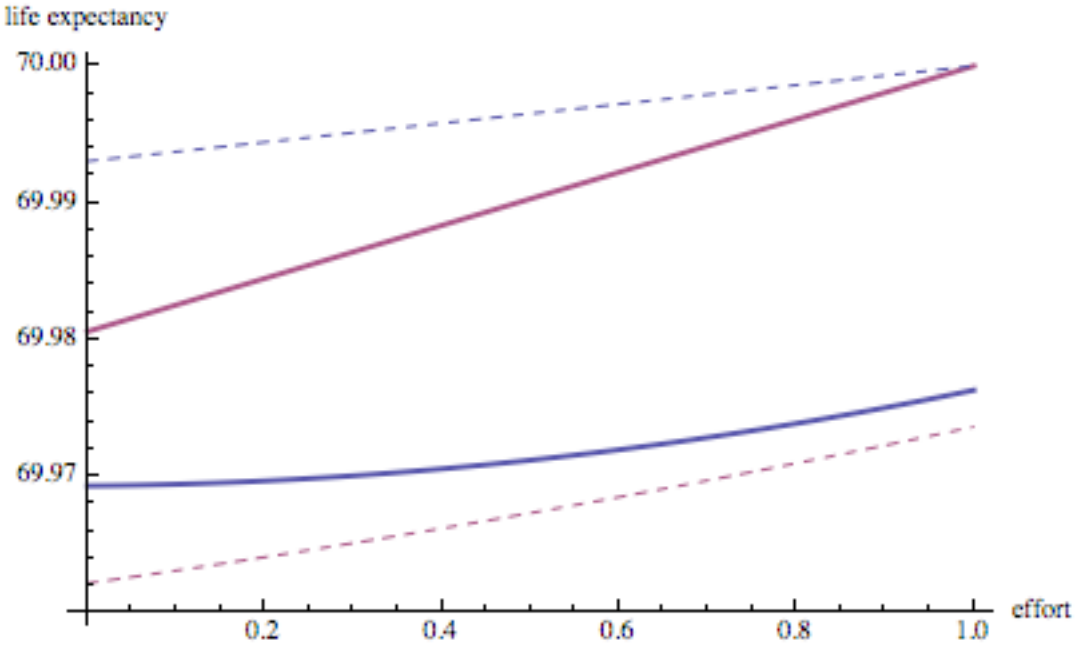

Figure 3: Life expectancies of Rich and Poor, utilitarian (dashed) and EOp (solid) policies

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:

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

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 , then $\theta \succeq \theta^*$, with strict preference if 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 mapping $\Theta \to \mathbb{R}$ 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* $\gneqq$ *on* Θ. *Furthermore, if* $\succeq$ *is a continuous order, then* $\gneqq$ *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

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

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

and we are ready to calculate the EOp policy. Here, 'effort' is interpreted not as one's labor supply, but rather as those actions which the person took that gave rise to his wage-earning capacity. There are different distributions of wages in different types, reflecting the differential circumstances that impinge upon wage-formation, but within each type, there is a variation of the wage due to autonomous factors that we view as effort and worthy of reward.

5. The Fleurbaey-Maniquet approach

Marc Fleurbaey and Francois Maniquet have, in a series of writings, proposed a number of proposals for ordering policies with respect to the degree to which they equalize opportunities, which are similar in spirit to those discussed above, but different in detail. Their work is summarized in Fleurbaey (2008); the general inspiration of the theory is the idea of envy-freeness, pioneered in the works of Duncan Foley (1967), Serge-Christophe Kolm (1972), and Hal Varian (1975). Here, we present one of their main proposals, which falls in the family of egalitarian-equivalent proposals, and as such, descends from the work of Elisha Pazner and David Schmeidler (1978). The approach is substantially different from the one outlined in section 3, because it does not take the viewpoint that equalizing opportunities involves maximizing the lower envelope function defined in (4.1).

753 Suppose that a population is characterized by an outcome function $u(c,r,\varphi)$
754 where *c* is a vector of circumstances (characteristics of the individual or his environment
755 for which he is deemed not responsible), *r* is a vector of characteristics for which he is
756 deemed responsible, and φ is a policy. We will specialize to the case where φ is the
757 distribution of some resource to the population: say, an allocation of money. Let us
758 suppose, further, that there is some type (i.e., vector of circumstances c^*) that
759 characterizes the most disadvantaged type. We desire to place an ordering on policies φ
760 that reflects the view that persons should not be held responsible for their circumstances,
761 but should be held responsible for the choice of *r*.
762 Fleurbaey (2008) represents the idea that persons should be held responsible for
763 their circumstances by various 'principles of compensation;' an example would be
764 'equal well-being for equal responsibility,' meaning that if two individuals have the same
765 values of *r,* their outcomes should be the same (i.e., independent of their circumstances).
766 Thus the ordering of policies should reflect this desideratum. He, Bossert (1995) and
767 Maniquet also advocate various 'principles of reward;' for instance, if all individuals have
768 identical circumstances, then the resource should be divided equally among them, called
769 the 'liberal reward principle'. That is, if everyone is of the same type, there is no
770 justification for any compensatory policy. It is clear from simple examples that it is, in
771 general, impossible to respect the liberal reward principle and the 'equal well-being for
772 equal responsibility' principle simultaneously as long as the environment is sufficiently
773 rich, and so Fleurbaey (2008) is a study of social-policy orderings that satisfy weaker
774 versions of postulates inspired by these principles.
775 We summarize a prominent example of such an ordering. Let φ be given, and
776 construct another allocation of the resource, $\hat{\varphi}$ – which need not be feasible, given the
777 budget – defined by:

778 $$u(c_i,r_i,\varphi_i) = u(c^*,r_i,\hat{\varphi}_i) \quad ,$$

779 where *i* indicates the individual, and is a reference set of circumstances – say, those of
780 the most disadvantaged type. Thus, under $\hat{\varphi}_i$ each individual receives an amount of
781 resource which makes her as well off as she is in the φ-allocation, but assuming,

counterfactually, that she had been a member of the reference type, and had maintained the same values of the responsible factors. In the counterfactual world in which $\hat{\varphi}$ lives, everybody is of the same type (c^*) and so, *no special compensation* should be made to individuals from the opportunity-equalizing viewpoint, according to the liberal rewared principle. Hence, the ideal policy is one in which the associated $\hat{\varphi}$ is an *equal distribution* of the resource. This tells us how to order actual policies φ: we say that $\varphi \succ \varphi'$ if the counterfactual distribution $\hat{\varphi}$ is 'more equal' than $\hat{\varphi}'$; to be precise

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

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

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

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

An essential feature of the egalitarian-equivalent approach is the liberal reward principle, that if everyone were of the same type, then no redistribution is called for. To be specific, in the EOp approach, Roemer closes the model by saying that if everyone is of the same type, then policies are preferred if they produce higher *average* outcomes, while Fleurbaey and Maniquet say that policies are better in this case the closer they are to *equal-resources*. But, as we have argued in section 4, we remain agnostic on the right way of closing the model, because we do not think the concept of equality of opportunity

contains a theory of just rewards to effort. In particular, the liberal reward principle, described above, will sometimes or often use use market institutions to close the model. Consider a problem where all persons have the same circumstances, but preferences differ, due to voluntary choices. The principle of liberal reward might be interpreted as saying that the allocation of goods should be that associated with the competitive equilibrium following from an equal division of wealth. But this means that the welfare of individuals is determined by a particular set of institutions (markets with private property). Our objection, then, to the liberal reward principle is that in some cases there is no obvious benchmark that can be considered 'natural' to define distribution in the case where there is a unique set of circumstances. This point harkens back to the legal realists, who argued that there is no conception of laissez-faire that is free of ethical bias (see Fried [1998]) – or, to put it more starkly, the usual conception of laissez-faire is a misnomer, as it presupposes property rights enforced by state power.

One disadvantage of the egalitarian-equivalent approach is that the notation does not force the practitioner to come to grips with the fact that choices people make are themselves influenced by circumstances. Recall that in the EOp approach, it was the *degree* of effort rather than the *level* of effort that was taken as reflecting responsibility, and this distinction was made because the *distribution* of levels of effort is infected with circumstances. Now one can model the same idea in the ZEE approach, but the notation does not invite doing so: there may be a tendency of practitioners to take *r* as *observed* levels of effort and choices of various kinds, and this would fail to take account of the fact that the distribution of choices *r* in a type is itself a characteristic of the type, and something that calls for compensation. So a literal application of the ZEE model, which is insensitive to this fact, will ascribe to persons responsibility for choices that are perhaps heavily influence by circumstances, and should therefore call for compensation.

One of the innovative applications of the egalitarian-equivalent approach by the authors is to tax policy. From among feasible tax policies, that policy should be chosen 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.

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

$$\min_{t} \int_{0}^{1} v^{t}(\pi,\varphi)\, d\pi. \qquad (5.1)$$

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

$\int_{0}^{1} v^{t}(\pi,\varphi)\, d\pi$ can be viewed as a measure of the degree of opportunity available to type *t*. Therefore, these authors link their approach to the large literature on equalizing opportunity sets (e.g., Bossert (1997), Foster (2011)) which derived its inspiration from Sen's capability approach.

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

(2008), however, contests this view. He splits gambles into two parts: the decision to take the gamble, which is the person's responsibility, and the outcome of the gamble, which is an aspect of luck. Let us view the risk-taking preference of the individual as a responsibility characteristic, and the outcome of the gamble as a circumstance – something over which the individual has no control. Fleurbaey proposes giving all persons with a given risk-taking propensity (i.e., responsibility characteristic) the average value of all gambles that such persons take. Thus, everyone with the same responsibility characteristic receives the same outcome. Of course, the informational requirements for implementing such a plan are severe. As well, it seems to countervene the purpose of gambling. If gamblers wanted to protect themselves from bad outcomes, they would insure to receive the expected value of the gamble. If, however, gamblers are risk-loving, then they would only insure to receive something more than the gamble's expected value, and such insurance is not fiscally feasible. So in offering gamblers the expected value of all gambles taken by their risk-type, their welfare is being reduced from actual gambling, assuming that they are risk lovers. This solution, first advocated by Le Grand (1991), has other weaknesses. The different lotteries offered to the individual decision makers can be ranked unambiguously from the most profitable to the least one if Fleurbaey's solution is implemented. Indeed, the lotteries would only differ in terms of the average outcome since all risk is eliminated. All rational decision makers (who prefer more than less) will choose the same lottery. Full equality will be then observed ex post. Fleurbaey's solution then leads fully to eliminate the impact of option luck.

Lefranc, Pistolesi and Trannoy (2009) believe that the project of separating influences into circumstances and effort is too binary. They call 'residual luck' a third influence, and recommend something weaker than compensation for residual luck, namely, that the correlation between such luck and circumstances be eliminated. Consider the following examples: some people gain by the chance meeting of another person; popular views do maintain that persons with rare productive talent be specially compensated; the winnings of national lotteries (Belgium, France, UK) are often not taxed. The luck inherent in these examples (especially the first two) is often considered 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:

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

where is the distribution of luck in the element of the population characterized by . The above-described principle says that

for any .

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 , where x_i is income, which is ordinally equivalent to maximizing . 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)[17].

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 frequency of type t. Then $H = \sum f^t H^t$. Let be the mean of . Define the square of the coefficient of variation of H by:

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

Define the distribution:

17 For instance, take income as the objective, and define a typology by parental education levels.

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

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 value of 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:

. (6.3)

The reason that the measure 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[18]. Thus, *d* presents both a level of welfare and a degree of inequality.

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.)

18 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.

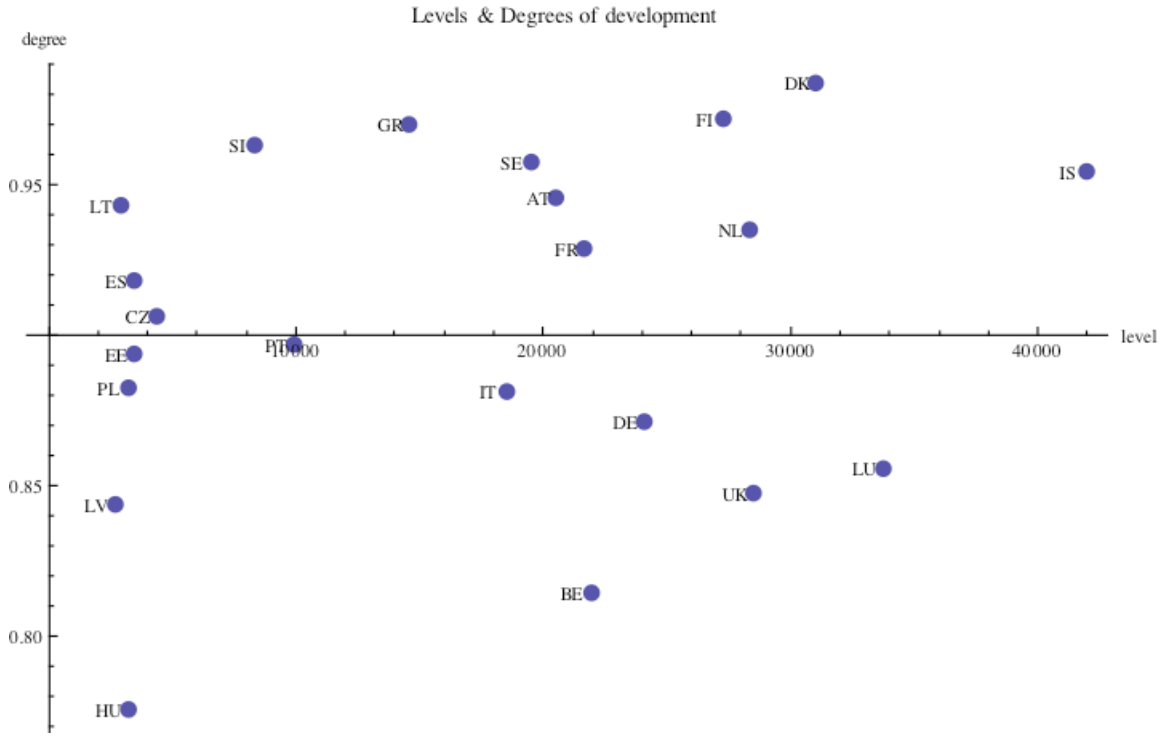

Figure 4. The points $d = (W^{EO}, \eta)$ for a set of European countries

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 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 4, 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 , 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[19]. 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 fraction 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 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, , plays the role that plays in the ordered-pair measure we introduced above: it measures the level of development. But while focuses upon how well off the most disadvantaged type is doing, is a level for the society at large. The second component of our measure, ∅, is explicitly derived to show the degree to which inequality is due to circumstances, while

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19 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.

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 at 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[20]. 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 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

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20 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.

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 (inelasticallly produced) incomes 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 $f_R (f_P = 1 - f_R)$. Mean income at this time is . The state investments are funded by a linear income tax at some rate *t*; thus

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

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

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

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

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

The fact that $a < 1$ 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 $y_J = (1 - t) w_J - i_J$ $y_J = (1 - t) w_J - i_J$. 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 ⊔+⊔ as

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

(2) i_R^* maximizes (over i)

(3) i_P^* maximizes (over i)

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

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

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

.

An *environment* is summarized by the data $\left(w_R, w_P, a, u, \phi\right)$ with the intergenerational transmission functions . 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:

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

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

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.

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[21]. Suppose initially that both pro-basketball and college recruiters adopt a 'market' policy : they admit candidates

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

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: he 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.

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. Preparing the ground for empirical analysis

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. This section and the next review the empirical evidence showing that in many societies, ordinary people distinguish between two causes of inequality: those for which individuals should not held responsible, and those for which they should be. If people do make this distinction when discussing inequality, then implementing opportunity-equalizing policies may be politically more feasible than otherwise. 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. Empirical work on intercultural 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. "If we could somehow disembody individuals from their circumstances, then the distribution

of the propensity to exert effort would be the same in every type" wrote Roemer (1998). 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. As we wrote, 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 importance of 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[22].

9. Do people advocate equality of opportunity? Lessons from questionnaires and experiments

22 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).

The information reviewed here is derived both from the answers of respondents on questionnaires and from the actions chosen by players in laboratory or field experiments. Questionnaires are sometimes regarded with skepticism by economists, whereas they are used extensively by psychologists and political scientists (see chapter 14 for more methodological issues). Gaertner and Schokkaert (2012) made a plea for the use of questionnaires in the field of social choice and justice and here we build upon their reasoning. What we desire is a procedure or protocol that helps subjects to reveal their norms of distributive justice. We recognize that respondents can lie; Gaertner and Schokkaert (2012) ask why respondents would do so. In the absence of self-interest, they assert, respondents will choose to reveal their true norms. (We often assume that when an agent is indifferent between cheating and telling the truth, he will tell the truth.) The main risk with questionnaires is that respondents answer at random when the question is too complex, a difficulty of which social psychologists are well aware.

A. Questionnaire on the empirical validity of equality of opportunity

A first source of information is provided by value surveys conducted by polling companies or scientific associations like the World Values Survey. In our opinion, these are not fully satisfactory, because the questions remain quite vague and are not related to specific normative theories. Rather, they address the beliefs of respondents concerning the determinants of success in a given country.

Since Schokkaert and Lagrou's (1983) early work, many surveys have been conducted, most of which propose vignettes about different aspects of life in order to inquire whether individuals' opinions about justice coincide with the theoretical propositions put forward by social scientists (for references and overviews see Schokkaert (1999), Konow (2003), and Gaertner and Schokkaert (2012)). The literature related to our topic can be divided in two subsets. The first tests the raw idea of responsibility. The second is rooted in the theories of equality of opportunity proposed by Roemer and Fleurbaey. Konow (1996, 2001)'s studies, although not anchored in a theory, introduced the distinction between discretionary and exogenous variables which is very close to the responsibility cut as viewed by Cohen (1989), although Konow was apparently unaware of Cohen's work. A discretionary variable affects output and can be

controlled or influenced by the person, while an exogenous variable can have an influence on the amount or quality of output but cannot, under normal circumstances, be influenced by personal choice. His findings (telephone interviews with a general adult population of Los Angeles and written questionnaires completed by college students) support the view that for income acquisition, variables that are deemed to be controlled by the individual are viewed as legitimate influences upon income, whereas exogenous variables are not.

Perhaps the most thorough empirical study related to the philosophical project of equality of opportunity is that of Schokkaert and Kurt Devoogth (2003) (see also, Schokkaert and Overlaet, (1989) and Schokkaert and Capeau (1991)). First, the authors test the two principles of "full compensation" and "natural reward" which are at the heart of Fleurbaey's approach. (Fleurbaey (1995) and Bossert and Fleurbaey (1996)). The principle of full compensation states that two individuals who exert the same effort should enjoy the same outcome; thus, the effect of differential circumstances is fully compensated. The principle of natural reward states that, if individuals have the same circumstances, there is no reason to transfer income between them (thus, full responsibility for effort). Second, there is an intercultural dimension in their study, as they distributed the questionnaire to first-year university students in three very different countries: Belgium (April 1996), Burkina Faso (May 1996) and Indonesia (August 1997). (See also Gaertner and Schwettmann (2007)). Finally, this study highlights whether views of responsibility are sensitive to what we have defined as the objective (or the opportunity equalidandum), as the questionnaire addresses views of responsibility with respect to income acquisition and health.

Four situations are contrasted in a two-person society. The two persons differ in only one characteristic. Possibilities of redistribution between the persons are then offered, and students are asked to choose what they think is the fair ex-post tax income distribution.

The first vignette describes a difference in preferences in income-leisure space. No explanation is offered to explain this difference in tastes, whereas the second vignette stipulates that this difference comes from different backgrounds. That vignette tests the disagreement between Roemer and Barry about sterilizing the distribution of effort of the

influence of circumstances. It is important here to notice that the issue raised is not the transmission of wealth, or social networks, but the transmission of values and preferences across different generations. People convinced by Roemer's reasoning should be more inclined to redistribute from hard-working Elizabeth to easy-going Catherine in the second situation than in the first. The third and fourth vignettes concern differences in productivity. In the third vignette, the difference originates in a difference of effort in the past. The fourth vignette describes a difference in innate talent.

The results are instructive and we will present them in terms of how the majority voted. The Belgian sample made the most clear-cut choice: A majority vote for no compensation at all (no redistribution) in case of Vignettes 1, 2 and 3, and for full compensation for the situation described in Vignette 4. Thus, the Belgians endorse the view that preference for leisure is a responsibility variable -- they agree with Brian Barry not to take the causal relationship with parents' preferences into account. Innate talent, however, is considered as a circumstance. Were that vote representative of Belgian choices as a citizenry, this society would possess the basic ingredients to implement an equal-opportunity policy.

The authors find that the intercultural differences are much less pronounced than one might have thought. Still, they cannot be completely ignored entirely, since, according to the majority vote criterion, the Burkina- Faso sample is indecisive for all four vignettes. The Indonesian vote is closer to the Belgian one. Indonesians share the same views on the three first vignettes but no majority is found on the last issue, even if the full compensation for talent has a plurality of votes.

At this stage, it is useful to ask whether the objective matters. Schokkaert and Devooght (2003) attempted to adapt their questionnaire to health-care situations. From the start, two differences with income scenarios must be noticed that render the comparison less than clear-cut. In the income case, the stakes belong to the domain of gains, whereas they belong to the domain of losses in the health-care case: the health vignettes describe illness and how to cope with health-care expenditures. Since the work of Tversky and Kahneman (1991), we know a peron's tendency strongly to prefer avoiding losses to acquiring gains. This may explain a stronger inequality aversion in the health vignettes. In addition, if questions are asked about how to allocate a budget

between two sick persons, an efficiency issue is raised, which makes it difficult to deduce views about fairness. All studies about fairness in health care (Dolan and Tsuchiya (2009), Ubel et al. (1999) and the above cited paper) have chosen to formulate the vignettes in a scarcity context. Of course scarcity of resources is an important issue in the health domain (as in others) but a sequential approach with two steps might better elicit preferences about the responsibility cut.

As an example consider two of the four vignettes proposed by Schokkaert and Devooght (2003), concerning Luke and Mark who are both suffering from lung cancer. They have the same wealth at their disposal and earn the same income. Luke and Mark have to be admitted to a hospital for treatment. It is supposed that all treatments are effective. The two vignettes raise the relevance of factors that are under the control (smoking) or beyond the control (genetic) of the individual for covering lung-cancer expenditure. The respondents have the choice between different divisions of the amount of public resources: equal split between the two patients, all resources for the extra cost of treating Mark, and intermediate solutions between these two.

It is noteworthy that in all three societies, equal-split garners a majority of votes in vignette 1. A majority favor an intermediate solution when genetics calls for extra cost. The social policy that this study suggests is clear-cut: smokers should purchase private insurance for coverage of smoking-related illness. This conclusion holds as long as the society is able to attribute the cause of the extra cost to life-style. These results suggest that the reason that the welfare state in many countries does not appear to be inspired by responsibility-sensitive egalitarianism is not due to popular ethics, but to the difficulty of identifying an indisputable causal link in health matters. Off-piste skiing is 'the exception which proves the rule,' where the cost of an accident is generally borne by the individual. One salient issue remains unsettled: we know of no questionnaire focusing on the link between life-style and family background. The difference of opinion between Roemer and Barry has not been reflected in the empirical literature on fairness in health.

Education is another domain where we can conjecture a different attitude with respect to responsibility. Primary and secondary education take place when the person is still, arguably, below the age of consent. Richard Arneson (1990 p.179) has appealed to this fact in egalitarian debates. Lu and Trannoy (2013) have investigated whether primary

education elicits different responses from income acquisition in the degree to which persons are held responsible for outcomes. They contrast the results obtained with two vignettes.

In the sales vignette, there are salesmen whose sales compensation is composed of two parts: a salary and a bonus. The issue concerns the fairness of the bonus. Sales depend on characteristics which are described as follows. The salesman's circumstances are identified with his parents' network of acquaintances. Effort is described as the salesman's hard work, and talent is described as the salesman's skill. A salesman's brute luck is defined by the territory to which he is randomly assigned. Finally, option luck is described as the risks the salesman takes: he has to choose between selling an old product that has been on the market for a long time and is familiar to customers, or a more recent product with unknown customer reaction. If a bonus is to be paid to the successful salesman, respondents are asked how fair it is to judge the salesman by his circumstances, effort, talent, brute luck, or option luck. The respondent has to choose exactly one answer among very unfair, rather unfair, quite fair, or absolutely fair for each of these choices.

In the school vignette, pupils face difficulties at school. Remedial tuition is supposed to help schoolwork. Five factors are related to school difficulties. Circumstances are determined by parents' ability to help children with their homework. Effort is identified as the zeal with which the child does his homework. Talent is defined as cognitive ability, which is precisely described as an ability to concentrate. Brute luck occurs when the child missed part of the previous school year because of illness. Finally, option luck is risk-taking. The child wants to be in the advanced class, with his friends, but he cannot keep up with the class. Respondents were asked to judge the fairness of remedial tuition, if were necessary because of circumstances, effort, talent, brute luck, or option luck.

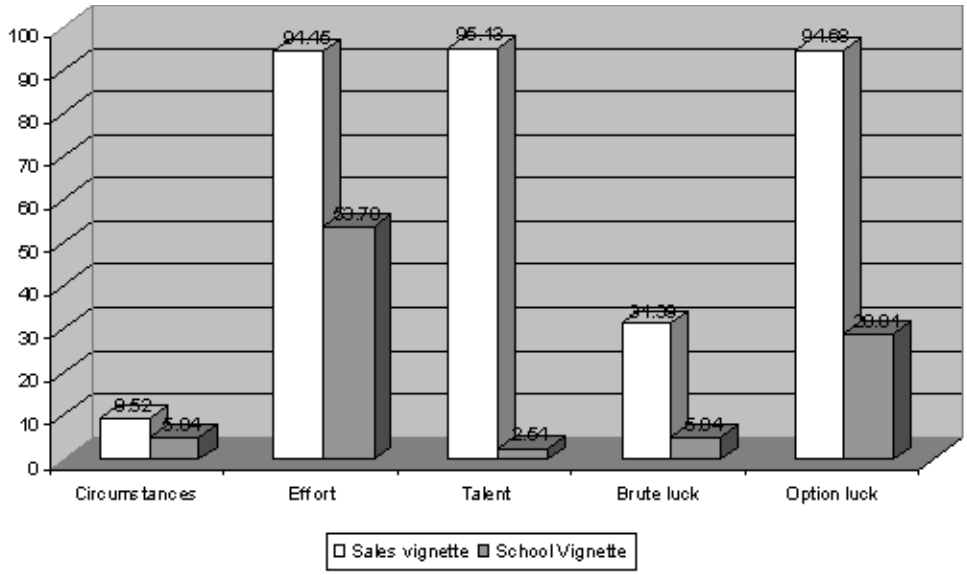

Figure 5. The fraction of subjects holding the agent responsible for each factor (Source Lu and Trannoy (2013)).

Figure 5 presents the differences in the answers to both vignettes (432 respondents in Marseilles). In the sales vignette, we interpret the answers 'quite fair' or 'absolutely fair' as indicating that the respondent holds the salesman responsible for the factor. In the school vignette, we interpret the answers 'very unfair' or 'rather unfair' as revealing that the pupil was deemed responsible for the factor by the respondent. A chi-square test for goodness of fit is used to test whether, subjects treated each factor similarly in the two vignettes. Respondents evaluated moral responsibility with respect to all causal factors except circumstances differently in the two vignettes. More specifically, salesmen were held responsible for talent, while almost no subjects held pupils responsible for talent. Only a small minority deem students responsible for risk-taking while almost everyone deem the opposite for salesmen. The difference for effort is less impressive, since a small majority of respondents still agree to hold schoolboys responsible for their effort in doing homework. Our results are preliminary as they are perhaps influenced by framing. Nevertheless, they cast doubt on holding children responsible for educational outcomes, at least at the primary level. If that decision is implemented, then primary-school achievements should be treated as a circumstance in studying opportunity-equalization of outcomes in later life.

B. Experiments

Fairness attitudes in sharing a cake have been studied in laboratory experiments with the ultimatum game and the dictator game (Camerer 2003), which provide a neat elicitation of preferences. These experiments reproduce exchange or distribution economies where resources are manna from heaven. Various authors (Frohlich et al; (1987 ,2004), Rutström and Williams(2000), Konow (2000), Cappelen et al. (2007, 2010, 2013), and Almas et al. (2010)) have conducted experiments to study explicitly what happens to people's distributive preferences by introducing an earned-money or production stage prior to a distribution phase consisting of a dictator game. The most recent articles test the prevalence of responsibility egalitarianism among distributive justice theories. More explicitly, they investigate the control view of responsibility advocated by G.A. Cohen, summarized by the principle that "only inequalities that arise from factors under individual control should be accepted"[23].

Cappelen et al. (2007) study a situation in which individuals differ with respect both to their investments and to the rates of return that they enjoy. The agent chooses the amount to be invested while the rate of return is assigned randomly. The former factor is clearly an effort variable, while the rate of return is brute luck, like talent. They assume that an individual endorses either strict equality of earnings, laissez-faire, libertarianism (each keeps his income), or responsibility egalitarianism, in which case total income is shared in proportion to investments. The distribution phase is a two-person setting in a one-shot dictator game. A parametric utility function is a weighted sum of a purely selfish element, and an altruistic quadratic loss term, which is larger, the more the distribution differs from the ideal distribution according to the individual's ethical view. The econometric analysis attempts to retrieve the parameters of the utility function, the marginal utility of money, and the preferred distributive ethic view of the subject. The authors deduce that 43.5 percent of subjects are strict egalitarians, 38.1 percent are responsibility egalitarians, and 18.4 percent are libertarians. The subject pool consisted of approximately one hundred students at the Norwegian School of Economics and Business Administration (NHH), a sample that cannot be viewed as representative of the

79 23 Cappelen et al. (2007), p.818.

Norwegian society. In addition, the results may depend on the specific form of the utility function, which balances self-interest and fairness. Nevertheless, their results confirm that responsibility-sensitive egalitarianism is endorsed by a fraction of the population and competes with libertarianism and outcome egalitarianism. But we do not learn much about the responsibility cut.

In a companion paper, Cappelen et al. (2010) use the same methodology and pool of students to enlarge the set of proposed fairness views. Individuals now differ with respect to three characteristics: working time, productivity, and the market price of their product. Subjects choose their working time (effort), market price is set randomly (brute luck), and productivity (talent) is determined through a test in the experiment (the number of correctly typed words in a short period). The authors consider four competing distributional views expressed by the list of responsibility factors. An empty list corresponds to outcome egalitarianism. If effort is the only factor belonging to this list, the view is control-responsibility egalitarianism. When this list comprises effort and talent, the view is named meritocratic[24] by the authors. (In other words, people may rightfully benefit from their inborn talent.) Finally when this list comprises effort, talent, and brute luck, it is said that the participant endorses the libertarian view. The subject pool includes students from all undergraduate years and some alumni. The differences in preferred distributive views, as estimated by the econometric model, are not pronounced among students, but alumni have quite different ethical preferences. Whatever the age group, the meritocratic view is the most popular view among students whereas the libertarian view is slightly more popular among alumni. The striking fact is that the control view of equality of opportunity is only supported by a tiny fraction of the pool: 6% among students and 2% among alumni. At this stage, it is premature to declare that these results are biased by a selection effect: however, let us remark that business-school students and alumni are very likely among the least egalitarian people in society.

In a less sophisticated way but using the same framework, Almas et al. (2010) investigate how the views about distributive justice evolve as pupils mature between the 5th and 13th grades. At the beginning of this span, schoolboys favor outcome

24 See Arrow, Bowles and Durlauf (2000) for a discussion of meritocratic ideas.

egalitarianism (2/3) and libertarianism (1/3). As the children get older, they become increasingly sensitive to equality-of-opportunity arguments and by the end of the grade span, meritocracy[25] becomes the plurality view, even if it does not garner a majority of votes. Indeed it is striking that the distribution of views in this study for the 13th grade is almost the same as that obtained for the first year of college obtained by Cappelen et al (2010).

If we assemble the lessons of these two instructive studies, they lead to the following conjecture for the development of distributive ideals over the life cycle. Starting with the stark and simple views of outcome egalitarianism and libertarianism in childhood, the development of cognitive skills induces understanding of more complex and less clear-cut views, like equality of opportunity. Views appear not to change significantly between the end of the high school and the end of the university.

Those successful in the labor market tend more towards laissez-faire opinions. Were that true in the real world, we should observe a self-serving bias (Messick and Sentis (1983)) on a large scale, in the sense that individuals, given their degree of success, would (tend to) endorse the fairness ideal that most benefits themselves. In that sense, experiments are superior to surveys and vignettes in that they enable one to measure the extent of this self-serving bias. This phenomenon should be at its minimum when subjects are students. At this stage of development, subjects are able to understand all theories of justice but they are still shielded by a veil of ignorance regarding their degree of success (in the US, where 50% of a generation enrolls in tertiary education). The prediction would be that the difference between surveys and experiments would be minimal for this adult group.

We turn now to testing popular views about option luck. Buchanan (1986) identifies four factors that determine the distribution of income and wealth: luck, choice, effort, and birth. He considers the acceptability of rewarding effort the least controversial, and believes that the only inequalities that conflict with common views of justice are ones caused by birth (pp. 129-30). The difficulty with option luck comes from the fact that it is

25 This study does not make the distinction between control-responsibility egalitarianism and meritocracy.

a mix of two more fundamental factors, one for which we want to hold people responsible, choice, and the other that is exogenous, luck. A similar difficulty prevails for talent which is a mix of birth, an exogenous factor, and past effort, which is a responsibility variable. (Buchanan does not observe the semantic convention that talent is an inborn factor, and skill results from the application of effort to talent.)

Two papers, Cappelen et al. (2013) and Chanel et al. (2013), investigate the views of people about option luck and risk taking vis-à-vis the responsibility cut. The first article endeavors to shed light on the relative popularity of three views about option luck. The first view is Dworkin's, according to which no redistribution of gains or losses from risk-taking is ethically required. Dworkin argues in favor of a laissez-faire stance, because risky lifestyles or risk-taking are expressions of preferences. The second view considers it fair to eliminate all inequalities resulting from risk-taking. The third view is intermediate between the first two: it would approve ex post redistribution between lucky and unlucky gamblers but not between gamblers and non-gamblers. This view is reminiscent of a position first defended by Le Grand (1991) and refined by Fleurbaey (2008), who considers that people should be fully insured and only bear the consequences of their decisions over the expected value of the lottery. Gamblers will then receive the expected gain corresponding to their class of risk. The experiment consists of a risk-taking phase followed by a distribution phase. In the risk-taking phase, subjects face a sequence of choices between a risky and a safe alternative, where the value of the safe alternative varies. Estimates of the choice model reveal that subjects (students at the Norwegian School of Business in Bergen) have diverse opinions and split quite evenly into three groups. Roughly speaking, two thirds of the subject pool think that people should be deemed responsible for their choice of risk-taking. The same proportion but not the same individuals think that people should not bear the consequences of luck. If we interpret the econometric results as a vote, Le Grand-Fleurbaey's view is the Condorcet winner among the three alternatives offered to participants. This interesting result needs to be confirmed by other studies.

Chanel et al (2013) are less precise in studying option luck but their aim is to deduce the relative importance of option luck in the set of factors for which individuals should be held responsible. They conduct an experiment on a large scale whose purpose

is to reveal the preferences of agents when four factors matter for earnings: circumstances, effort, brute luck, and option luck. Three experimental sessions were organized involving a treatment of about 100 subjects each, who are told that they form a small society. Each treatment involves an earned-money phase followed up by a redistribution phase, where the allocation rule is determined by majority vote. In the first phase, participants can earn money through four different channels, each of which reflects a specific factor: the place of one's birth represents a circumstance and success at a visual-spatial attention task requires effort. Brute luck and option luck are easily contrasted by a random draw and taking a bet, respectively. Votes are then organized on whether or not to redistribute the gains from each step, which corresponds to a given factor. A self-serving vote is found to be prevalent (about 1/3 of the sample who succeeded in earning money vote not to redistribute) and non-parametric econometrics are mobilized to retrieve the true ethical preferences beneath the votes. The distribution of ethical preferences among the subject pool is described in Figure 6.

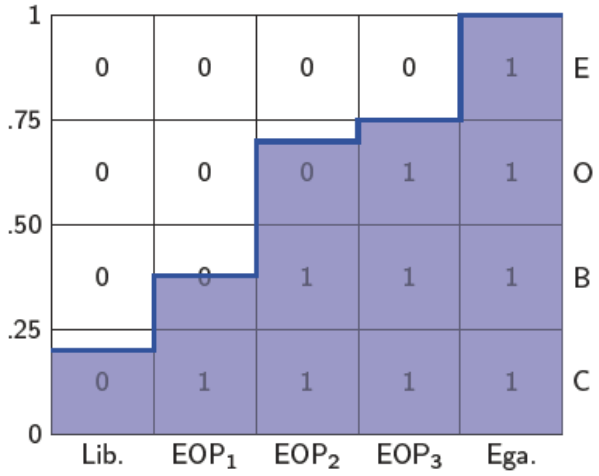

Figure 6. Distribution of ethical preferences about the responsibility cut (source: Chanel et al 2013). On the left vertical axis, the figures are proportions. On the right vertical axis, E stands for effort, O for option luck, B for Brute luck, C for circumstances. In each

square, 0 (respectively 1) means no compensation (resp. compensation). For example, egalitarians think redistribution is mandated regardless of the cause of earnings.

Five ethical positions are represented here[26]. At the two extremes, we find the libertarian and outcome-egalitarian stances. Three intermediate positions are allowed: in EOP1, only differential circumstances merit compensation; in EOP2 brute luck in addition merits compensation. Option luck joins the compensation set with EOP3. The two extreme positions attract almost a quarter of the views. This means that 60% of the sample endorse some version of equality of opportunity. There remains a large diversity of opinion regarding the locus of the responsibility cut. In the aggregate, the result of this experiment supports Dworkin's view according to which we should draw a distinction between option luck and brute luck, option luck being on the responsibility side along with effort, and brute luck being on the compensation side with circumstances. Nevertheless, we need to be more careful before a more definitive conclusion is reached, for many areas of uncertainty must addressed. More specifically, the design of the experiment tests Le Grand-Fleurbay's position against that of Dworkin. Redistributing gains from bettors to non-bettors has not been proposed to voters.

C. A progress report

In agreement with Roemer's suggestion (1993), we have developed the view that theory and empirical work are more complements than substitutes. As stated by Schokkaert and Gaertner (2012) "The theory of equality of opportunity offers a general and consistent framework which can be applied for any cut between effort and circumstances, while empirical work supplies the necessary information about where the boundary is drawn in different societies."

If we take again the four "primary factors" identified by Buchanan, -- birth, luck, choice and effort[27] -- it seems indisputable that subjects make a clear distinction between

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26 Fewer than 10% of the subjects convey an ethical preference that is not captured by one of these.

27 One wonders why it is important to distinguish between effort and choice. An answer is suggested by G.A. Cohen who distinguishes difficulty from costliness. It is difficult to lift a weight, but not costly; it is costly to sign a large check, but not difficult. Effort is difficult. Choice is often costly (as in taking a bet) but not difficult in the natural sense of the word. Barry's view that effort deserves remuneration even if not due to the person's choice can be explained if one believes that difficult actions deserve reward, regardless

the first two and the last two. In questionnaire-experiments, the assumption that choice and effort are under the control of the individuals and that participants are well-informed about the consequences of the acts cannot be disputed, since the protocols of the experiments are clear. Even if more research is welcome, the conclusion reached by Konow (2001) ten years ago appears to stand: "To summarize, the evidence from experiments and surveys generally indicates that someone whose contribution is more highly valued is more deserving if that person bears responsibility for the contribution but not if it is due to factors outside his or her control." Does this mean that from an empirical perspective, the control view of Arneson and Cohen prevails over the preference view of Dworkin and Fleurbaey-Maniquet ? Not exactly, for the proper test has not been conducted. Except for Schokkaert and Devooght (1983), we know of no study testing both theories in a competitive way through questionnaire-experiments. The control theory has been repeatedly tested by psychologists and economists but not against the preference theory. We observe choices, not preferences. Economists are keen on promoting the concept of preference among social scientists; the main weakness of the concept is that preferences are not easily revealed to experts, let alone laymen. It is asking a lot to make preferences pivotal in a theory of distributive justice that will garner mass agreement, when, at best, only some experts can argue that they have been able to deduce what preferences people hold.

Equality of opportunity involves an *equalizing* aspect and a *disequalizing* one.[28] Equalization, or compensation, takes place with respect to those factors deemed circumstances; inequality is non-compensable, however, if it is due, tautologically, to factors for which individuals are held responsible. The difficulties arise when some causes of success or failure, with respect to a desirable objective, involve mixtures of these two kinds of element. Skill is a mixture of talent, due to birth, and past effort; option luck is a mixture of choice and luck. Self-protection as defined by Ehrlich and

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of the intent of the actor.

28 No empirical study has tested whether people support the liberal or the utilitarian approach to reward (as far as we know).

Becker (1972) is an expenditure that reduces the probability of a loss, which can be generalized to any effort that transforms the probability distribution of states in a good way for the agent. We do not know whether the differences in views that people hold about distributive justice are due to the ambiguities introduced by the mixtures of these two kinds of factor in real life, or to fundamentally different ethical principles. See figure 7.

Non-responsibility set		Responsibility set	
Birth	Luck	Choice	Effort
Talent	Choice or effort influenced by birth	Option luck	Self-protection

Figure 7 . Binary combination of primary factors

10. Inequality of opportunity: measurement issues and empirical results

This section will focus on methodological issues and applications of the theory. An excellent survey of the material covered in this section is provided in Ramos and Van de gaer (2012).

A. Methodological issues : general remarks

We begin with some general remarks for the reader who is familiar with the literature on the measurement of inequality of outcomes. Measuring inequality of

opportunity may mean different things. At the most basic level, we may want to encapsulate the inequality of opportunity with an index, as has been done for inequality of outcomes with the Gini, Atkinson, Theil and others indices. We may be more modest in just wanting to rank distributions, 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 which we may apply to equal-opportunity analysis, and the tools are mainly borrowed from the measurement of inequality literature.

A1. 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 is multi-dimensional. Equality-of-opportunity analysis may use the conceptual framework developed by Atkinson and Bourguignon (1987) in the field of 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) which 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, effort and perhaps the residual). The inequality in the objective must be assessed conditional on the types and efforts of the population.

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 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).

A2. 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 since 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 alii (2012). Omitted variables in empirical EOp analysis cause skepticism in 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 which 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. The processes are dynamic and cover part of the lifespan of an individual and, 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 use the preference view for responsibility variables advocated by Dworkin and Fleurbaey. Retrieving the true parameter of the 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.)

A3. 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 effort of 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 that 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 and al. (2012) for examples.) For snapshot distributions, the question arises of how to purge hours of work of bad luck, which, by assumption is not under control of the individual. Detecting chosen part-time from involuntary part-time 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. The above-mentioned problem for the two early stages of education then contaminates higher education attainment.

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 or 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 (also a 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. It will be measured with error and bias. Broadly speaking, the 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.

A4. 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) pointed 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 comes from 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 exit 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 argued, 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

B1. The case of 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) of 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, $E_i = (e_{i1},..., e_{ij,},..., e_{ik})$ 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:

$$y_i = \mu_{y1} + \alpha_c C_i + \alpha_d D_i + \alpha_e E_{i,} + \varepsilon_{i.}, \qquad (10.1)$$

$$e_{ij} = + \beta_c C_i + \beta_d D_i + \beta_m M_{i,} + \gamma_{cd} C_i D_i + \gamma_{cm} M_i D_i + o_{ij.}, \text{ for each effort variable } j = 1,...,k \qquad (10.2)$$

Equation (10.2) is written in a compact way: coefficients β describe the average reaction of adjusting effort to external conditions while coefficients γ are the 'preference shifters' which allow individuals to adjust in a different way according to their age and sex group.

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 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), 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 (10.3) suffices if we want to measure the impact of observable circumstances:

$$y_i = \mu_{y3} + \delta_c C_i + \delta_d D_i + \upsilon_{i.}, \qquad (10.3)$$

This statement, however, requires some qualification. Neglecting the shift parameter, it is true that in a linear model $\delta_c = \alpha_c + \alpha_e \beta_c$, due to the Frisch-Waugh theorem, α_c captures the direct effect of circumstances and $\alpha_e \beta_c$ captures the indirect effect of circumstances through effort. (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 (10.3), 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 (10.2) 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 here 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 (10.1) and (10.2) or the reduced model (10.3). 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 [29] 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 gives a fair account of the contribution of all factors linked to 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 (see section 8), opinions are quite diverse on this question. If we follow the self-ownership view, it should be a responsibility variable (i.e., persons would deserve to benefit from their high IQs). Ferreira and Gignoux (2011) have argued that the reduced form will lead (through the computation of 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

29 A circumflexed variable denotes an estimate.

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 ethics of EOp. The impact of unobservable IQ will be split into the various coefficients estimated in the return equation (10.1) plus the residual, meaning that some part of innate talent would be assimilated with responsibility characteristics and some part would be non-responsibility characteristics. 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 below).

One of the virtues of the structural model is that it enables 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 no 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 we substitute Roemerian effort for effort in equation (10.1), namely:

$$y_i = \mu_{y4} + \delta_c C_i + \delta_d D_i + \alpha_e O_i + \tau_{i.}, \qquad (10.4)$$

where O denotes the vector of residuals of equations (10.2). 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 (10.3)[30]. 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 (10.1) 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 (10.1) 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 (10.3). 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[31]. 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 (10.1):

$$_{i} = {}_{y1} + {}_{c}\, C_i + {}_{d}\, D_i + {}_{e} E_{i,} \quad . \qquad (10.5)$$

30 In fact, it is not quite correct if market conditions and shift parameters are introduced as in (10.2). The statement is valid for a simple form of (10.2).

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

Parametric methods try to estimate the conditional expectation $\mathbf{E}(y|C,E)$.[32] Non-parametric methods are more ambitious because they try to estimate the conditional distribution $F(y|C,E)$. O'Neill et al (2000) were the first to use a kernel density estimator 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,

$$H(y) = \quad ,$$

with S (.|.) the conditional survivor function, one can write :

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 (10.1) and (10.2) with this estimation technique.

B2. 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 outcome 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

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98 32 $\mathbf{E}$ denotes the expectation operator.

the Roemer identification axiom (RIA) reads:

By construction, this effort 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 way 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 wrong 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 coin this axiom as the *type-independent effort distribution*: the relevant normative effort distribution should be independent of type. This axiom is clearly weaker than Roemer's identification axiom. It has inspired fruitful empirical strategies, both in a parametric and non-parametric setting. In the former case, Björklund et al. (2012) estimated a reduced form as in (10.3) 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 we 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 They assume that the relevant effort is the relative effort denoted given by the quantile within the effort distribution of an individual's type:

(10.6)

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 we had all the information about effort. 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 . (*conditional-distribution equality*) (10.7)

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 (*equal-luck opportunity*) (10.8)

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 , in (10.8), then (10.8) implies (10.7). Is this result false if some circumstances are non-observed? Proposition 5 in Lefranc et al (2009) proves that this is not the case. 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[33] to measure the unfairness of the distribution, which we discuss below.

C. The measurement phase

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 types versus tranches approach, the direct unfairness versus the fairness gap, and the inequality index. We will deal with these three approaches in turn.

C1. Types versus Tranches

A way to organize the information in a discrete setting is to construct a matrix in which rows are types and columns effort. An element 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. First, 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 (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 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

33 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).

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 decision maker 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[34].

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.*[35] They claim that a choice should be made between the two principles. Logically this is correct. Empirically, it seems to us, that the conflict is not that 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

34 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 explici here.

35 The comparison is not artificial because to some extent, both principles can be viewed as a ranking adaptation of (10.7) and (10.8).

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 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.

C2. Direct Unfairness versus 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 (10.3), 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

$$I\left(\mathbf{E}(y|C_i, D_i)\right) = I(\gamma_3 + \gamma_c C_i + \gamma_d D_i) \qquad (10.9)$$

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

For the more structural model (10.1) or (10.4), 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[36]

$$I\left(\mathbf{E}(y|C_i, D_i,)\right) = I(\ _{y1} +_c C_i +\ _d D_i +\ _{ei,}) \qquad (10.10)$$

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 gap 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 (10.9) 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[37]

$$I(y) - I\left(\mathbf{E}(y|E_i)\right) \quad . \qquad (10.11)$$

For the more structural model (10.1) or (10.4), where both effort and circumstances variables are introduced as regressors, we can do better and estimate the fairness gap for a

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36 An overbar on a variable denotes a mean.

37 Fleurbaey and Schokkaert (2009) are the only 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.

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

$$I(y) - I(\mathbf{E}(y|_i, _i, E_i)) = I(y) - I(_{y1} +_{c\,i} +_{d\,i} +_{e}). \qquad (10.12)$$

Bourguignon et al. (2007) propose a similar measure. The problem is, again, how to assign the residual. According to (10.12), 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 $_i$ is the explained outcome (see equation (10.5)), to compute :

$$I(_i) - I(_{y1} +_{c\,i} +_{d\,i} +_{e}), \qquad (10.13)$$

a solution chosen by Jusot et al (2013).

The reference values in (10.10) and (10.12) 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 defined 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), 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 (10.10)[38] for some matrix *m* is lower than for some other matrix for all inequality indices, then *m* is preferred to 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 according to the type-compensation principle, then the FG is lower for *m* than for , computed according to (10.12), for all inequality indices when the reference type is

38 In a parametric or non-parametric way.

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 FG. In that case it can be proved that, if *m* is preferred to according to the type-compensation principle, then the weighted[39] sum of the FGs is lower for *m* than for , computed according to (10.12), 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 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 and by Ferreira and Gignoux (2011) (see their appendix).

[39] 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.

C3. 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 and 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 subpopulations, 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 likely 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 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 range 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).[40] The random sample is consists of 35% of Swedish men born between 1955 and 1967 and the outcome is an average of pre-fisc income over 7 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 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.

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40 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)).

The results for Norway obtained by Aaberge and 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 last 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 will 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 (the 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 guess that the share of inequality of opportunity is even higher there.

All in all, it seems that the 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 limitation of 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.

11. 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 the control of individuals 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.

As we said, the theory of equal opportunity involves both an equalizing aspect and a disequalizing one. Some philosophers focus – we believe excessively – on the disequalizing aspect, which induces criticisms of the approach from the left. We mention the work of 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 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 motor cyclist 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 disequalizing aspect of the equal-opportunity view – that the effects of poor choices are not compensable in the 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 which 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[41].

We have characterized economic development earlier 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 in the experiments we reported support the meritocratic view, that returns to natural talent are just. Perhaps, as we succeed gradually in eliminating inequalities of important objectives that are due to differential wealth, the focus will 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 singing 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.

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41 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?

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. In other words, the incentive problem, so central to economic theory today, takes that problem as 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[42]. It is quite possible (and we believe it to be so) that human material needs are limited, and an historical period will arrive, perhaps relatively soon, when they are more or less universally satisfied. 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 economic mechanism can accomplish this efficiently may well be the central problem for economists of that era.

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

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