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journal homepage: www.elsevier.com/locate/econbaseFairness and well-being measurement[☆]Marc Fleurbaey^a, François Maniquet^{b,*}^a Princeton University, United States^b CORE, Université catholique de Louvain, Belgium

HIGHLIGHTS

- We study well-being measures that satisfy fairness properties.
- We first require consistency with indifference curves dominance.
- We study two stronger axioms, related to the lattice structure of the class of indifference curves.
- Well-being measures based on ray utility belong to the family of measures satisfying the first strengthening.
- Well-being measures based on money-metric utility belong to the family of measures satisfying the second strengthening.

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ABSTRACT

We assume that economic justice requires resources to be allocated fairly, and we construct individual well-being measures that embody fairness principles in interpersonal comparisons. These measures are required to respect agents' preferences. Across preferences well-being comparisons are required to depend on comparisons of the bundles of resources consumed by agents. We axiomatically justify two main families of well-being measures reminiscent to the ray utility and money-metric utility functions.

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1. Introduction

Economists evaluate social and economic policies based on their impact on agents' well-being. Given that policies that benefit all agents are unfrequent, that requires some comparability across agents' well-being. One main theory of well-being used by economists consists of comparing agents' well-being on the ground of the bundles of resources that they consume. There are cases in which this is easily done. If all agents are assumed to have the same preferences, as it is the case in the optimal taxation literature following Mirrlees' (1971) seminal contribution, then the well-being measure is simply required to be consistent with these common preferences. If all agents have (possibly heterogeneous) quasi-linear preferences in money, then the money measure of

satisfaction level is natural and creates an easy way of comparing well-being. Identical or quasi-linear preferences are extremely common assumptions.

It is not always relevant to make those assumptions, however. If some agents are close to their liquidity constraints, for instance, it is hard to assume away all income effects. One may also wish to take account of agents' different ways of reacting to policies. As soon as one acknowledges that there are income effects and that agents have heterogeneous preferences, it is no longer clear how well-being should be measured.

Many authors have directly or indirectly studied the construction of well-being measures. This construction has been studied directly in the literature on consumer surplus. This abundant literature has culminated in Samuelson's (1974) and Samuelson and Swamy's (1974) concept of money-metric utility, and Samuelson's (1977) and Pazner's (1979) concept of ray utility, that will play a crucial role in what follows. The money-metric utility consists in a priori fixing a vector of prices and measuring well-being by the budget, at those prices, that leaves the agent indifferent with her actual consumption. The ray utility consists in a priori fixing a ray of goods in the consumption set of the agents and measuring well-being by the only bundle of resources along that ray that leaves an agent indifferent with her actual consumption.

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* Corresponding author.

E-mail addresses: mfleurba@princeton.edu (M. Fleurbaey), francois.maniquet@uclouvain.be (F. Maniquet).

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The question of how to measure well-being has also been raised indirectly in the literature on fair allocation. In this literature, economic justice is conceived as equality in the way resources are allocated among agents. The formal study of economic justice as fairness began with [Kolm \(1968, 1972\)](#) and [Varian's \(1974\)](#) works on no-envy and Pareto efficiency in private good models. Later on, studies have been extended so as to include a large variety of fairness properties (see, among many others, [Moulin \(1996\)](#), for a general discussion of lower and upper bounds on welfare) in a large variety of models (see, among many others, [Moulin, 1987](#), for a study of fairness with public goods). Hervé Moulin has been one of the main leaders in these developments (see, for instance, the survey [Moulin and Thomson, 1997](#)). Solutions from that literature can be seen as answering simultaneously the following two questions: how to measure individual well-being and how to aggregate it over the population (see the recent surveys in [Thomson, 2011](#), and [Fleurbaey and Maniquet, 2011](#)).

In this paper, we stick to the idea that well-being should reflect the individual value of bundles of resources, but we disentangle the question of how to measure individual well-being from the question of how to aggregate it, and we focus on the former (see [Bossert and Weymark, 2004](#), or [d'Aspremont and Gevers, 2002](#), for detailed surveys of the theory of well-being aggregation). Starting with an abstract model of consumption set, we axiomatically study how to construct well-being measures when well-being is evaluated at a bundle of goods on the basis of the preferences of the agent consuming that bundle. This is in line with undertakings recently launched by [Fleurbaey and Tadenuma \(2014\)](#) and [Fleurbaey and Blanchet \(2013\)](#).

We study the case in which goods are infinitely divisible and more of any good is always preferred to less. Two families of measures emerge. One family is consistent with the idea that comparing well-being requires to determine worst preferences. Worst preferences are preferences that make the experience of consuming any bundle of resources worse than with any other preferences. Worst preferences are naturally connected to the difficulty of trading off between goods. The other family is consistent with the idea that comparing well-being requires to determine best preferences. Best preferences are the ones that make the experience of consuming any bundles of resources better than with any other preferences. Best preferences are naturally connected to the ease with which one is able to trade off between goods.

This first set of results sheds some light on the previous literature on well-being measures. Indeed, the ray utility belongs to the first family of well-being measures we obtain. Our results give an axiomatic characterization of that measure, but it also shows that many other measures can be similarly justified.

Money-metric utility belongs to the second family of well-being measures we obtain. Again, our results can be viewed as providing an axiomatic justification to that measure, but they also show that other measures can receive similar justification.

Our results also shed some light on the theory of fair allocation. In that theory, two prominent allocation rules receive considerable justification. An allocation rule identifies the set of best allocations among the feasible ones. The first one is the egalitarian equivalent allocation rule, introduced by [Pazner and Schmeidler \(1978\)](#) and later characterized, among others, by [Moulin \(1987\)](#) and [Sprumont and Zhou \(1999\)](#). It consists in allocating goods in such a way that each agent is indifferent between the bundle she is assigned and a common, reference bundle. This is consistent with a way of measuring well-being that belongs to our first family of measures. Of course, the egalitarian equivalent allocation rule also shows how well-being should be aggregated: all agents should have the same well-being.

The second main allocation rule is the equal income Walrasian rule, first studied by [Kolm \(1968\)](#) and [Varian \(1974\)](#). It consists in

allocating goods in such a way that the resulting allocation can be thought of as a competitive equilibrium allocation from an equal split of the resources. This allocation rule can be decomposed into a way of defining well-being and a way of aggregating it. The way of defining well-being is by looking at equivalence with Walrasian budgets computed at equilibrium prices, those that would prevail if resources were first allocated equally among all agents. This well-being measure belongs to our second family of measures.

The theory of fair allocation has recently looked at social ordering functions instead of allocation rules. A social ordering function is a complete ordering on allocations. The study of social ordering functions, studied in [Fleurbaey and Maniquet \(2011\)](#), has provided us with two main conclusions. The first conclusion is that there was one and only one prominent aggregator of individual well-being levels, the maximin aggregator. That is, simple and weak requirements on social ordering functions force us to maximize the lowest well-being level among agents. The second conclusion is that many different individual well-being measures receive justification from fairness requirements. Many of those measures are of the equivalence type: the well-being of an agent is measured with respect to the bundle of goods, in a set of reference bundles, that leaves this agent indifferent with her actual consumption. Some other measures are closer to the money-metric type: the well-being of an agent is measured with respect to the income that leaves her indifferent to her actual bundle, with prices being chosen so as to maximize the minimal income (see [Fleurbaey and Maniquet, 2008, 2011](#)).

Our results come close to and are inspired by the recent study of [Decancq et al. \(2015\)](#) on poverty measures. A measure of individual poverty is no more than the inverse of a well-being measure. The authors of that paper axiomatized a poverty measure that consists in first defining an individual poverty measure consistent with the ray utility function and then aggregating individual poverty in a way that is only required to be consistent with dominance. Some of their results are reproduced here in the limited frame of well-being measurement.

The well-being measures that we justify in this paper are consistent with the view that economic justice arises from a fair allocation of resources. The measures we propose are solutions to the difficulty arising from the heterogeneity of preferences. We have not addressed, however, the difficulty arising from heterogeneity in needs or in abilities.

The remainder of the paper is organized as follows. In Section 2, we present the model, we define what a well-being measure is, and we state the basic property such a measure needs to satisfy. In Section 3, we strengthen the basic property in one direction, and we prove that the new property leads us to a family of well-being measures that includes the ray utility. In Section 4, we strengthen the basic property in another direction, and we prove that the new property leads us to a family of well-being measures that includes the money-metric. In Section 5, we show how the results of the previous sections are related to the lattice structure of the space of indifference sets. In Section 6, we gather all the proofs. In Section 7, we give some concluding comments.

2. A model of well-being measurement

We assume that there are K divisible goods, and quantities of goods are cardinally measurable (so that, for instance, arithmetic averages of quantities are meaningful). The consumption set is $X = \mathbb{R}_+^K$. Agents have continuous, convex and monotonic¹ preferences

¹ We use $>$, $\geq$ and $\gg$ to denote the vector inequalities. Preferences R are monotonic if and only if $x > x'$ implies $x R x'$ and $x \gg x'$ implies $x P x'$.

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