Interpersonal comparisons with or without formal welfarism[1]

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Introduction

Social Choice Theory, as a discipline devoted to the axiomatic study of collective mechanisms, can be divided into two broad fields. In one field, the main object is *collective decision-making*, and the acceptability of the resulting social state is fully determined by the justifiability of the decision procedure. The study of voting rules for political elections is the main domain of application in this field. As we will see, the results of such rules cannot always be acceptable in terms of justice and equity. In the other field, the main object is the *evaluation of social states*, individually as well as globally, on the basis of interpersonal comparisons of some kind, and Welfare Economics is the main domain of application. It is this part of Social Choice Theory that is intrinsically linked to ethics (to social ethics, more precisely) and to two basic ethical concepts, the *right* and the *good*. In that respect the relevant distinction in ethics is between *deontological* theories and *teleological* ones, the former giving priority to the right, the latter deriving the concept of rightness from a conception of the good.

The predominant example of the teleological approach is classical utilitarianism and the associated concept of utility. But even within the utilitarian tradition, the term "utility" has received many different interpretations, so that the distinguishing mark of the utility approach to the evaluation of social states by an ethical observer is to assign to each member of the collectivity a uni-dimensional individual indicator. These indicators combine in various ways the "subjective" appreciation of the social states by each individual and their "objective" evaluation by the observer. Bentham introduced an interpersonally summable notion of utility based on the objective property of things to procure either pain or pleasure, but it is the subjective reinterpretation by J.S. Mill, for whom utility means "pleasure itself" and "exemption of pain", which has been retained (see the discussion in Mongin and d'Aspremont 1998). The modern treatment of utilitarianism as represented by Harsanyi (1955, 1977) Aggregation Theorem is based on von Neumann and Morgenstern (NM) utility theory. The criterion is expected utility computed from the individual NM-utility functions, but "corrected" for factual errors and "censored" for anti-social attitudes. Also, the criterion is applied to select the principles or the rules that should orient individual actions, leaving some room to individual decisions (rule-utilitarianism instead of act-utilitarianism).

The classic example of deontological ethics is Kant's practical philosophy. Modern examples are Rawls' *Theory of Justice*, claiming explicitly the priority of the right over the good, and Nozick's *Anarchy, State and Utopia* and the anteriority attributed to individual property right and other natural rights. In fact the distinction between teleological

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and deontological theories is also akin to the opposition between freedom and happiness in reference to Rawls' (2000) distinction between a "liberalism of freedom" and a "liberalism of happiness" and his claim that "principles of political and civic freedoms" have priority over others. Rawls' (1971) principles of justice are agreed upon in some original negotiation. In this negotiation, the representatives of the individual citizens are behind a "veil of ignorance", meaning that all irrelevant personal features (including personal conceptions of the good) are ignored. The negotiators should agree on the distribution of different categories of "primary goods" as fundamental resources allocated to each person to promote his own conception of the good. The first two categories concern rights and have priority: (i) the basic liberties and (ii) the access to various occupations and functions. Also chosen behind this "veil of ignorance" is an "index of primary goods" defined as an objective indicator of the other categories of primary goods: (iii) powers and prerogatives; (iv) income and wealth; (v) the social bases of self-respect (the first two, liberties and access to occupations, are preliminarily and equally divided). If such an indicator can be called "utility" it is not in the sense of "happiness" or "preference satisfaction". Desires (however intense) and tastes (however inexpensive) are not relevant per se. A similar view is represented by Sen's (1992) notion of capabilities, that is the set of doings or "functionings" available to a person, leading to an "index of functionings". What is at stake here, as in other theories concerned with opportunities (e.g. Roemer 1996), are the objectively defined conditions allowing individuals to exercise their freedom.

In the following, we shall see that a unifying approach can be used to study the two kinds of theories, in particular by specifying what individual features should be considered as relevant to evaluate and compare social states. This specification is obtained through so-called "invariance axioms", restricting the measurability and the comparability properties of individual evaluation profiles, and leading, together with other axioms, to different social rankings. In the next section these other axioms will be sufficient to define a simplified framework, which we call "formal welfarism", since it is open to different interpretations of the technical notion of utility (including the one given in terms of primary goods), whereas the original framework of "welfarism" referred to the standard interpretation of utility in terms of happiness or desire-fulfillment. The section "Interpersonal comparisons through scoring methods" will introduce another kind of interpersonal comparisons which is based on some adequately constructed intermediate indicators (the scores), respecting and complementing standard individual utilities as measures of preference satisfaction.

Interpersonal comparisons of utility and formal welfarism

Since Pareto introduced the distinction between an objective notion of *utilité* (in the Bentham sense) and the subjective notion of *ophélimité*, as an ordinal measure of actual preference satisfaction, the latter concept of utility has become dominant in economics (the only one in the New Welfare Economics), forbidding interpersonal utility comparisons and, in its narrowest form, reducing preferences to observable individual choices (Revealed Preference Theory). But, Samuelson (1947) insisted that welfare economics cannot avoid ethical and interpersonal assumptions, and Arrow (1951, 1963) derived an "impossibility theorem" leading to the same conclusion. For a set $N = \{1, 2, \dots, n\}$ of individuals and a set $X = \{x, y, \dots\}$ of (more than two) social states, if the only relevant informations are (non-comparable) individual preference orderings of X (an ordering of X is a complete

and transitive binary relation[2] defined on X), then there is no *non-dictatorial* (in the sense that no individual could impose its strict preference) *Social Welfare Function*, associating to any profile of individual preference orderings a "collective" preference ordering of X, and satisfying *Weak Pareto* (if all strictly prefer one state to another, so should society) and *Independence of Irrelevant Alternatives* (if individual preferences are modified except for some alternatives, then the collective preference should not be modified on these).

Sen's framework and invariance axioms

To examine formally the role of interpersonal utility comparisons in social choice it is now usual to start within a framework introduced by Sen (1970) in which the basic ingredient is a utility profile given by a real-valued function U defined on elements (x, i) of the Cartesian product $X \times N$. The function U can be seen as a vector of individual indicators $U_i(x) \equiv U(x, i)$, or as the *extended utility function* of an individual, evaluating from a moral viewpoint what it is to be any one in any social state (exercising "extended sympathy" or "empathy"). Moreover if, for individual i, one interprets the name i as designating all the characteristics of i, then one could look at the function U as a *fundamental utility function* (Harsanyi 1977), itself a representation of "human nature" (Kolm 1972), which would then justify why every individual, when adopting the viewpoint of an ethical observer, has the same extended utility function (or at least the same fundamental preference).[3]

The function U is a very flexible informational basis to start with. For every x, we can denote U_x the *utility vector* $(U(x, 1), \ldots, U(x, n))$ in P^N. Taking all functions U in some domain of admissibility $\mathcal{D}$ determines the set of all admissible utility vectors. Sen's (1970) concept of *Social Welfare Functional* (SWFL) associates to each admissible extended utility function U in $\mathcal{D}$ a (collective) preference ordering R_U. We denote I_U and P_U the corresponding indifference and strict preference relations. Using this notation, *Pareto Indifference* means "$U_x = U_y$ implies xI_Uy" and *Strong Pareto* requires in addition that "$U_x \geq U_y$ and $U_x \neq U_y$ implies xP_Uy". Also Arrow's Independence of Irrelevant Alternatives can be weakened to *Binary Independence* whereby, for any two functions U and V with equal values on two social states x and y we have $xR_Vy \Leftrightarrow xR_Uy$.

An alternative framework is to define directly a *Social Welfare Ordering* (SWO) denoted R^* on the set of admissible utility vectors. If the set of admissible utility vectors is large enough (e.g., equal to P^N), then, under Pareto Indifference and Binary Independence, the two frameworks coincide: $u = U_x$ and $v = U_y$ implies $uR^*v \Leftrightarrow xR_Uy$. This is called *Welfarism* and is an extreme form of consequentialism. All the information required for social evaluation is contained in the final utility values. For instance, under Welfarism, Strong Pareto reduces to *SP*: $u \geq v$ and $u \neq v$ implies uP^*v (P^* denoting strict collective preference).

But to make these two frameworks meaningful one has to specify the measurability and comparability properties of the term "utility" and there are several ways to do this. Measurement theory (Krantz *et al.* 1971; Roberts 1980) associates to different measurement scales the associated meaningful statements. We are interested in meaningful

[2] This is a binary relation R on X such that: for all x, y in X, xRy or yRx (completeness) and, for all x, y, z in X, xRy and yRz implies xRz (transitivity).

[3] The fundamental utility approach is also used in econometric estimations, to define "adult-equivalent scales" and different forms of exact aggregation (Christensen *et al.* 1975; Blackorby and Donaldson 1991; Deaton and Muellbauer 1980). Other measurement techniques, such as the one using the number of "just-noticeable-differences" between two alternatives (discussed in Arrow 1963) or the "social indicators" approach using questionnaires about degree of happiness (discussed in Hammond 1991; Fleurbaey and Hammond 2004) are differently founded.

statements about intrapersonal and interpersonal comparisons of utility. For instance, the Arrowian informational basis for SWFLs requires that only *intrapersonal level comparisons* are meaningful: $R_U = R_V$ whenever, for every i and all x, y, $U(x,i) \geq U(y,i)$ if and only if $V(x,i) \geq V(y,i)$. Another example (for this and others see Bossert and Weymark 2004) is to consider meaningful *interpersonal comparisons of utility differences*: $R_U = R_V$ whenever, for all w, x, y, z and all i, j, $U(w,i) - U(x,i) \geq U(y,j) - U(z,j)$ if and only if $V(w,i) - V(x,i) \geq V(y,j) - V(z,j)$.

The more standard way (e.g., Sen 1977) to specify the measurability and *comparability* properties of "utility" is to introduce invariance transformations $\varphi = (\varphi_1, \varphi_2, \ldots, \varphi_n)$, each φ_i being a real-valued function on P. In the Arrowian framework, we get the invariance axiom of *Ordinality and non-comparability*: if each φ_i is increasing and if for every x, $V(x,i) = \varphi_i(U(x,i))$, then $R_U = R_V$. Corresponding to interpersonal comparisons of utility differences, we get *Cardinality and unit-comparability*: if each φ_i is a positive affine transformation ($\varphi_i(u_i) = a_i + bu_i$, with $b > 0$) and if, for all (x,i), $V(x,i) = a_i + bU(x,i)$, then $R_U = R_V$.

But there is a third way to specify such conditions. We have stated the last two axioms as restrictions on SWFLs. Under Welfarism, they can be translated into two axioms on SWOs, respectively as *ON*: for any increasing φ_i's, uR^*v if and only if

$$(\varphi_1(u_1), \ldots, \varphi_n(u_n))R^*(\varphi_1(v_1), \ldots, \varphi_n(v_n)).$$

CU: for any a_i's, $b > 0$, uR^*v if and only if

$$(a_1 + bu_1, \ldots, a_n + bu_n)R^*(a_1 + bv_1, \ldots, a_n + bv_n).$$

Invariance axioms determine the informational basis for social evaluation. They should not be considered as purely factual. By specifying the kind of information that a social evaluation can or cannot use, these axioms are taking an ethical stance. But, the strong ethical implications of an invariance axiom is better measured when combined with other kinds of axioms.

To illustrate, the following axiom allows for (and only for) comparisons of utility differences that are intrapersonal. This is *Cardinality and non-comparability*: for any a_i's and positive b_i's, if $V(x,i) = a_i + b_iU(x,i)$, for all (x,i), then $R_U = R_V$.

As a condition imposed on the SWFL, such an axiom does not exclude interpersonal utility comparisons. It does permit to compare *ratios of utility differences* of the sort $(U(w,i) - U(x,i))/(U(y,i) - U(z,i))$ between different individuals, and hence to compare measures of risk aversion in case X is specified as a set of lotteries and each $U_i(x)$ as a von Neumann-Morgenstern (NM) utility function. But, the possibility of such comparisons is erased by Welfarism (the SWFL satisfying Pareto indifference and Binary Independence). Under Welfarism cardinal non-comparability is defined as *CN*: for any a_i's, positive b_i's, uR^*v if and only if

$$(a_1 + b_1u_1, \ldots, a_n + b_nu_n)R^*(a_1 + b_1v_1, \ldots, a_n + b_1v_n),$$

a condition which can be shown (d'Aspremont and Gevers 1977, 2002) equivalent to ordinal non-comparability (axiom *ON*). Adding Strong Pareto, we get dictatorship (by Arrow's theorem).

If *CN* is replaced by *CU* and dictatorship is eliminated by *Anonymity* (any utility vector is socially indifferent to any of its permutations), then the only possibility is the *pure utilitarian* SWO: uR^*v if and only if $\Sigma_{i \in N} u_i \geq \Sigma_{i \in N} v_i$ (d'Aspremont and Gevers 1977, 2002).

This characterization of utilitarianism is directly related to Harsanyi's Aggregation Theorem since, under Welfarism (and NM-preferences), *CU* becomes equivalent to NM-independence of the collective preference ordering (Mongin and d'Aspremont 1998).

Rawls' framework and formal welfarism

Rawls' theory of "Justice as Fairness" is a theory about how to equalize opportunity through the fair distribution of primary goods. By giving priority to liberties and access to occupation (which should be equally distributed), Rawls clearly departs from Welfarism, even in a formal sense. However, to allocate other primary goods, a common index $V(x_i)$ is fixed, where x_i is the vector of primary goods to be allocated to individual i. Letting, for an allocation $x = (x_1, \ldots, x_n)$, $U(x, i) = V(x_i)$, we can fall again in the welfarist formal framework. Since the index is common to all, the associated invariance axiom is *Ordinality and Comparability*.

OC: for any increasing transformation $\hat{\varphi}$ and $u, v \in \mathrm{P}^N$, uR^*v if and only if

$$(\hat{\varphi}(u_1), \ldots, \hat{\varphi}(u_n))R^*(\hat{\varphi}(v_1), \ldots, \hat{\varphi}(v_n)).$$

Two other axioms are clearly required by Rawls: Anonymity and Strong Pareto, the latter being the reason why equal distribution of all primary goods is not the agreed upon solution. To any u in P^N, one can associate an (re-)ordered vector $u_{i(\cdot)}$ in $\{v \in \mathrm{P}^N : v_1 \leq v_2 \leq \ldots \leq v_n\}$, the set of ordered utility vectors. One should never give priority to the best-off individual over the worst-off (*Minimal Equity*). Then, under *Separability* (in choosing between two utility vectors the indifferent individuals should not be taken into account), the solution is the "lexicographic maxi-min" (*leximin*) SWO: for any u, v in P^N, uP^*v if and only if, for some k, $1 \leq k \leq n$, $u_{i(k)} > v_{i(k)}$, and, $\forall j < k$, $1 \leq j \leq n$, $u_{i(j)} = v_{i(j)}$. Leximin formalizes Rawls' "Difference Principle".

Other concepts of opportunity equalization can be so translated in welfarist terms (see Maniquet 2004). One approach consists in coming back to fundamental utility and consider that individuals are characterized by two kinds of variables, the ones which are under their control (like effort) and the others which are not (like talents and handicaps). Supposing, for simplicity, that the controlled variables can only take a finite set of values, $a = 1, 2, \ldots, A$, we can introduce an extended utility $U(x, a, i)$ denoting the utility of an individual i in social state x when choosing the value a for its controlled variables. Thus, the vector $(U(x, 1, i), \ldots, U(x, A, i))$ represents the "opportunity set" of individual i in social state x. Now let the utility function U_i be the aggregate utility through the function $W(.)$

$$U_i(x) = W\big(U(x_i, 1, i), \ldots, U(x_i, A, i)\big),$$

associating to every opportunity vector $(U(x_i, 1, i), \ldots, U(x_i, A_i, i))$, the aggregate opportunity value for individual i in social state x. We are now back into our previous setting. Of course the properties of the extended utility have to be specified and various invariance axioms can be used (for examples, see Ooghe *et al.* 2007).

From a formal viewpoint, in formalizing Rawls' "Difference Principle", we have supposed that only utility levels are both intrapersonally and interpersonally comparable. If we add the same possibility for utility differences we get *Full Comparability*, that is *FC*: for any a, $b > 0$, uR^*v if and only if

$$(a + bu_1, \ldots, a + bu_n)R^*(a + bv_1, \ldots, a + bv_n).$$

With this type of invariance and the same other assumptions (Deschamps and Gevers 1978), the SWO R^* can either be leximin or utilitarianism, but in a weak sense (i.e., $\Sigma_{i \in N} u_i \geq \Sigma_{i \in N} v_i$ implies uP^*v).

Many other invariance axioms can be introduced (e.g., see d'Aspremont 1985). Let us give only two more, *Ratio-scale measurability*, without or with interpersonal comparisons of utility:

RN: for any positive b_i's, and $u, v \in \mathrm{P}^N$, uR^*v if and only if

$$(b_1u_1, \ldots, b_nu_n)R^*(b_1v_1, \ldots, b_nv_n);$$

RC: for any positive b, and $u, v \in \mathrm{P}^N$, uR^*v if and only if

$$buR^*bv.$$

Under *RC*, all utility levels and differences are comparable. Moreover with ratio-scale measurability the origin is fixed, so that, under *RN*, utility levels are interpersonally comparable if they are of opposite sign (below or above the zero line). These axioms are most often applied on a positive domain (denoted P^N_{++}). Under *RN*, ratios of utilities or percentage changes in utility are interpersonally comparable. If we add *SP*, then a continuous SWO on P^N_{++} can only be the Nash bargaining solution with status quo point normalized to zero: for some positive θ_i's, uR^*v if and only if $\Pi^n_{i-1}u_i^{\lambda_i} \geq \Pi^n_{i-1}v_i^{\lambda_i}$. Under *RC* and *SP* the set of continuous and anonymous SWOs are characterized by all homothetic, increasing, continuous and symmetric functions on P^N_{++} (for these and other results, see Bossert and Weymark 2004).

Interpersonal comparisons through scoring methods

Even when "utility" simply represents actual preference satisfaction, it can be severely adjusted by the ethical observer (or rule designer). This is the case for various voting rules or more generally for *scoring rules*. These rules violate Binary Independence in one way or another. So Welfarism is excluded. Voting methods, however, are generally not acceptable for social evaluation (see Moulin 1988). An example is *Borda method* of voting.

To define the Borda method simply, we suppose that $\mathcal{D}$ is such that every individual evaluation indicator represents a strict ordering[4] on X (assumed finite). Thus, $\mathcal{D} \subset \{U \in \mathcal{U} \mid \forall i \in N, \forall x, y \in X, U(x,i) \neq U(y,i)\}$. In this case, we let $B(x,i)$ denote the number of alternatives of X which are less preferred than x by i for the given profile $U \in \mathcal{D}$. Formally,

$$\forall x \in X, \forall U \in \mathcal{D}, \forall i \in N, B(x,i) = \#\{y \in X \mid U(x,i) > U(y,i)\}$$

The Borda rule says that x is ranked socially higher than y if, and only if, the total score of x is greater than the total score of y:

$$\forall x, y \in X, \forall U \in \mathcal{D}, xR_Uy \Leftrightarrow \sum_{i=1}^{n} B(x,i) \geq \sum_{i=1}^{n} B(y,i)$$

Consider now the following example (d'Aspremont and Gevers 2002). Suppose N consists of three selfish people who have to divide a cake (normalized to 1). The set of alternatives is defined as some *finite* subset of the set of all non-negative triples such that the first individual gets less than one-third of the cake, whereas the other two people share evenly the balance:

$$X \subset \{(x_1, x_2, x_3) \in \Re^3_+, \frac{1}{3} < x_2 = x_3 = (1 - x_1)/2\}$$

[4]The Borda voting method extends easily if the domain of the SWFL allows for individual indifference among alternatives.

Following the Borda method, we see that xP_Uy if and only if $x_1 < y_1$: between two alternatives the highest score is reached by the one where the poor becomes poorer and the rich richer. Hence the results of the Borda voting rule in this case cannot be acceptable in terms of justice and equity. This is also true for other scoring rules of the Borda family (obtained by applying the same increasing transformation to every $B(\cdot, i)$ for every individual and for every profile in $\mathcal{D}$). In each case, the social ranking is fully determined by the positions occupied by the alternatives in the individual rankings. Notice that, for this example, the same conclusion would hold for *majority voting* formally defined by, $\forall x, y \in X$, $\forall U \in \mathcal{D}$,

$$xR_Uy \text{ if and only if } \#\{i \in N \mid U(x,i) > U(y,i)\} \geq \#\{i \in N \mid U(y,i) > U(x,i)\}.$$

In this example majority voting is no more acceptable than Borda rules.

Another "scoring" method is *Relative Utilitarianism* (axiomatized by Dhillon and Mertens 1999). Each $U_i(.)$ is supposed to have both a maximum $U_i^{\max}$ and a minimum $U_i^{\min}$ and to represent a NM-preference ordering on X and the observer associates to it a NM-utility function $V_i(.)$ ordinally equivalent to $U_i(.)$, and then, through individual affine transformations, defines the scoring function $S_i(x) = (V_i(x) - V_i^{\min})/(V_i^{\max} - V_i^{\min})$. The score $S_i(x)$ is the same whatever the arbitrarily chosen NM-utility function $V_i(.)$ representing the preference ordering underlying the initial utility function $U_i(.)$ and measures of curvatures are preserved. The SWFL F is taken to be pure utilitarianism applied to the scores. It satisfies *Ordinality and non-comparability* with respect to the utility functions $U_i(x)$ representing the individual preferences. Since the scores are defined as ratios of utility differences, they could be interpersonally compared. But, because their aggregation is utilitarian, it only relies on interpersonal comparisons of differences of scores.

Other concepts have been proposed in the literature on fair allocations, excluding Welfarism in terms of the initial utility functions, but ending up applying some SWFL to some recalibrated utility. An example is the Pareto Efficient Egalitarian-equivalent Allocation concept (Pazner and Schmeidler 1978). To illustrate, let ϖ in P_+^L be the vector of total quantities of L goods and X be the set of feasible allocations $(x_1, \ldots, x_n)$: each x_i in P_+^L and $\Sigma_{i-1}^n x_i \leq \varpi$. If $U(x,i) = U_i(x_i)$ is increasing in each argument and continuous then one can define an ordinally equivalent function $V_i(x_i)$ such that $U_i(x_i) = U_i(V_i(x_i)\varpi)$. A Pareto efficient allocation $\hat{x}$ in X is *Egalitarian-equivalent* if $U_i(\hat{x}_i) = U_i(V_i(\hat{x}_i)\varpi)$ and $V_i(\hat{x}_i) = V_j(\hat{x}_j)$ for all i, j. As observed in Fleurbaey and Hammond (2004), if individual preferences are convex, $\hat{x}$ can be obtained by applying the Leximin SWFL on the $V_i(x_i)$'s. Again, starting with a concept defined in terms of purely ordinal and non-comparable utilities (the U_i's), we end up comparing and equalizing utility levels in terms of the V_i's.

Conclusion

Formal welfarism, as a method for the evaluation of social states on the basis of interpersonal comparisons of utility indices, can accommodate both the teleological approach and the deontological approach to social ethics. As we have seen, formal welfarism can be used not only to characterize utilitarianism, but also Rawls' Difference Principle. However, the interpretation of the term "utility" may vary fundamentally from one theory to the next and the adapted "invariance axiom" varies accordingly. In particular Rawls relies on an index of primary goods in order to rank the individuals from the least to the most favored in each allocation of primary goods. Therefore he requires ordinality and comparability. More generally, if a social evaluator has some rule in mind, he should realize that this requires that some minimal set of comparisons be possible and that this set corresponds

to some invariance axiom. In that respect an invariance axiom is effectively restrictive from an ethical point of view: forbidding some types of comparisons reduces the set of possible rules.

But the compatibility of formal welfarism with deontological theories in ethics leads to another remark: formal welfarism does not always imply consequentialism. It all depends on the interpretation given to the uni-dimensional individual indicator assigned to each member of the collectivity. In Rawls' theory and, more generally in theories of equal opportunity, the indicator is less a measure of the individual well-being resulting from a final outcome (which also depends on the choices which are the responsibility of the individuals) and more an aggregate measure of the resources or the general means given to the individual to realize this well-being.

Scoring methods have an intermediate position. They usually determine the final outcome (or some subset of outcomes) and they take into account the desires of the individuals (but only their preference orderings). However, the final outcome (or outcomes) are determined by the chosen scoring method and the equity properties (and the ethical acceptability) of the method are linked to the choice of those scores.

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