PETER J. HAMMOND

# WHY ETHICAL MEASURES OF INEQUALITY NEED INTERPERSONAL COMPARISONS*

ABSTRACT. An ethical measure of income inequality corresponds to a social ordering of income distributions. Without interpersonal comparisons, the only possible social orderings are dictatorial, so there can be no ethical inequality measure. Interpersonal comparisons allow a very much richer set of possible social orderings, and the construction of ethical measures of inequality.

## 1. INTRODUCTION

Assuming that, *ceteris paribus*, we prefer a more equal distribution of income to a less equal one, any measure of the inequality of income is an indication of how imperfect is the distribution. In fact, it is tempting to identify a decrease in our measure of inequality with an improvement in the distribution of income. Because a measure which has this property is so closely bound up with ethical opinions regarding income distribution, it will be called an *ethical* measure of inequality.

The advantages of such an ethical measure have been noticed by, amongst others, Dalton (1920) and Atkinson (1970). By definition, it is now true that more inequality is bad. Whereas it is by no means clear what is the ethical relevance of an increase or decrease in a non-ethical measure of inequality.

Of course, an ethical measure is not easy to construct, and it is obvious that its construction will involve ethical value judgements. Whether this should deter us is not a question which I propose to answer here. Rather, I shall explore some of the possibilities which are open to us. In particular, I am going to show that we do face a rather stark choice.

On the one hand, we can follow the so-called 'New Welfare Economics'. We can eschew interpersonal comparisons altogether. If we do, however, we shall be quite unable to discuss satisfactorily whether or not one income distribution is preferable to another. This makes it virtually impossible to construct an ethical measure of inequality. And the relevance to distribution policy of any measure which is constructed will be, at best, obscure.

The alternative is to make interpersonal comparisons, to decide when one distribution of income is better than another, and to devise ethical inequality

*Theory and Decision* 7 (1976) 263–274. *All Rights Reserved*

measures. These measures will, however, depend crucially upon the value judgements which are embodied within them. Subjective factors are inescapable.

It is hardly surprising that we face a choice of this kind. Indeed, Graaff (1957) and Atkinson (1970), amongst many others, have clearly recognized the need to make some specific ethical distributional judgements. Yet it appears not to be widely recognized that these judgements must amount to interpersonal comparisons of utility. Consequently it seems worthwhile to demonstrate an impossibility theorem. I shall prove that, without interpersonal comparisons of some kind, any social preference ordering over the space of possible income distributions must be dictatorial; whereas, of course, any ethical measure of inequality has to correspond to a non-dictatorial preference ordering. The theorem is suggested by, and owes much to, some recent work by Parks and by Kemp and Ng on social choice with fixed individual preference orderings.

## 2. PRELIMINARIES

Suppose that society consists of $n$ individuals, labelled $i = 1, 2, ..., n$, so that its membership is the set:

$$N = \{1, 2, ..., n\}.$$

Let $y_i$ denote $i$'s income level. Let $y = (y_1, y_2, ..., y_n)$ denote a distribution of income. Let $Y$ be the set of possible income distributions.

Suppose that each individual $i$ has a real-valued utility function $u_i$ defined on $Y$. Assume that each individual is purely selfish, caring only for his own income, and not for that of anyone else. Then:

$$u_i(y) > u_i(y') \Leftrightarrow y_i > y_i'. \tag{1}$$

I shall assume that each utility function has cardinal significance, as does, for instance, a von Neumann-Morgenstern utility function. If, in fact, each $u_i$ has only ordinal significance, the impossibility theorem of Section 3 remains true *a fortiori*, since there will be even less information which can be used to construct a social ordering.

For any income distribution $y$, write $u(y)$ for the utility vector:

$$u(y) = (u_1(y_1), u_2(y_2), ..., u_n(y_n)).$$

Write $u(Y)$ for the set of possible values of the utility vector $u(y)$ as $y$ varies over the set $Y$.

I can now return to the original problem. It will be assumed that, underlying the ethical measure of income inequality, there is a social ordering $R_Y$ on the set $Y$. One such inequality measure, suggested by Atkinson (1970, p. 250), is the level of income per head, which, if distributed optimally between individuals, would give an income distribution just as good as the existing distribution.

Given $R_Y$, and the vector of utility functions $u$, there is an associated ordering $R$ on the set $u(Y)$ defined by:

$$U R U' \Leftrightarrow \exists\, y, y' \in Y : U = u(y),\ U' = u(y'), y R_Y y' \tag{2}$$

What does it mean to have no interpersonal comparisons of utility? Suppose that each individual $i$ had his utility function $u_i$ transformed in its units and in its levels, so that, for some $\alpha_i$ and some $\beta_i > 0$, it becomes:

$$\tilde{u}_i(y_i) = \alpha_i + \beta_i u_i(y_i) \quad (\text{all } y \in Y). \tag{3}$$

Then, evidently, since no individual's utility function has really changed significantly, in the absence of interpersonal comparisons, these transformations should make no difference to the ordering $R_Y$. But consider the ordering $R$ on $u(Y)$. Without interpersonal comparisons, there is no way of telling whether the transformations should bring about a reversal of any strict preference $U P U'$. Perhaps some individuals for whom $u_i' > u_i$ do receive some kind of extra weight when the utility functions become $\tilde{u}_i$. But even then, one cannot say that $\tilde{U}' R \tilde{U}$ is now right unless some kind of interpersonal comparisons are made. To reverse the preference $U P U'$, one must say that the increased weight for those individuals for whom $u_i' > u_i$ is enough to outweigh the preferences of those individuals for whom $u_i > u_i'$. And, without interpersonal comparisons, it does not seem possible to say this. (A fuller justification is given in the appendix.)

To sum up, if there is no way of making interpersonal comparisons, then neither the ordering $R_Y$ on the space $Y$ of income distributions, nor the ordering $R$ on the space $u(Y)$ of utility vectors, can be affected by transformations for the utility functions of the kind in (3) above. More precisely, suppose that $\tilde{u}$ and $u$ are related by (3), that $R$ is defined on $u(Y)$ by (2), and that $\tilde{R}$ is defined correspondingly on $\tilde{u}(Y)$ by:

$$U \tilde{R} U' \Leftrightarrow \exists\, y, y' \in Y : U = \tilde{u}(y),\, U' = \tilde{u}(y'),\, y\, R_Y\, y'. \tag{4}$$

Then, without interpersonal comparisons, it must be true that, for all $U, U' \in u(Y) \cap \tilde{u}(Y)$:

$$U R U' \Leftrightarrow U \tilde{R} U'.$$

So, if (3) is satisfied, and if:

$$u(y) = \tilde{u}(\tilde{y}), \quad u(y') = \tilde{u}(\tilde{y}')$$

then

$$y\, R_Y\, y' \Leftrightarrow \tilde{y}\, R_Y\, \tilde{y}' \tag{5}$$

This condition, of course, is identical to Axiom 6 of Parks (1976).

## 3. AN IMPOSSIBILITY THEOREM

So far, I have assumed (1) and (5). I shall now show how these, together with the strict Pareto principle, imply the existence of a dictator. Given assumption (1), the strict Pareto principle becomes:

$$\begin{aligned} &\text{If, for all } i,\ y_i \geqslant y_i',\ \text{then } y\, R_Y\, y' \\ &\text{and if also, for some } j,\ y_j > y_j',\ \text{then } y\, P_Y\, y', \end{aligned} \tag{6}$$

(where $P_Y$ is the strict preference relation corresponding to $R_Y$).

I shall make one last assumption. It is that the set $Y$ of possible income distributions is a non-trivial product set. Thus:

$$Y = \Pi_{i \in N}\, Y_i, \tag{7}$$

where each set $Y_i$ is a non-trivial interval of the real line.

LEMMA 1. *Suppose that* (5) *and* (7) *are satisfied. Let $u$ be a fixed vector of utility functions. Define the ordering $R$ by:*

$$\begin{aligned} &U R U' \Leftrightarrow \exists\, \alpha_i, \beta_i > 0\ (i \in N),\ \exists\, y, y' \in Y : \\ &\forall i \in N : U_i = \alpha_i + \beta_i u_i(y_i),\ U_i' = \alpha_i + \beta_i u_i(y_i'),\ y\, R_Y\, y'. \end{aligned} \tag{8}$$

*Then $R$, which is well-defined because of* (5), *is an ordering defined over the whole Euclidean space of utility vectors, $E^n$.*

*Proof.* By (7) there exist, for each $i \in N$, $\underline{y}_i, \overline{y}_i \in Y_i$, such that $\underline{y}_i < \overline{y}_i$. Take any pair of utility vectors $U$ and $U'$ in $E^n$. Then, for each $i \in N$, it is possible to find constants $\alpha_i$ and $\beta_i > 0$ for which:

(a) If $U_i' > U_i$, then $U_i' = \alpha_i + \beta_i u_i(\overline{y}_i)$
and $U_i = \alpha_i + \beta_i u_i(\underline{y}_i)$.

(b) If $U_i' < U_i$, then $U_i = \alpha_i + \beta_i u_i(\overline{y}_i)$
and $U_i' = \alpha_i + \beta_i u_i(\underline{y}_i)$.

(c) If $U_i' = U_i$, then $U_i = U_i' = \alpha_i + \beta_i u_i(\underline{y}_i)$.

So, for each $i \in N$, there exist $y_i, y_i' \in \{\underline{y}_i, \overline{y}_i\}$ such that:

$$U_i = \alpha_i + \beta_i u_i(y_i), \; U_i' = \alpha_i + \beta_i u_i(y_i'). \tag{9}$$

Since $y \; R_Y \; y'$, or $y' \; R_Y \; y$, it follows that $U R U'$ or $U' R U$. Thus $R$ is a connected relation on the whole of $E^n$. It is easy to check that $R$ is reflexive.

To see that $R$ is transitive, suppose that $U R U'$, $U' R U''$. By an argument similar to that above, there exist, for each $i \in N$, constants $\alpha_i$ and $\beta_i > 0$, and income levels $y_i, y_i', y_i'' \in Y_i$, such that (9) is true, and also:

$$U_i'' = \alpha_i + \beta_i u_i(y_i'').$$

Then, by (8), $y \; R_Y \; y'$, and $y' \; R_Y \; y''$. Since $R_Y$ is transitive, it follows that $y \; R_Y \; y''$, and so, by (8), $U R U''$, as required.

LEMMA 2. *If $R_Y$ satisfies the strict Pareto principle* (6), *then $R$, defined by* (8), *satisfies the strict Pareto principle:*

$$\text{If, for all } i,\; U_i \geqslant U_i', \text{ then } U R U', \text{ and if also, for some } j,\; U_j > U_j', \text{ then } U P U' \tag{10}$$

*Proof.* For each $i \in N$, construct $\alpha_i, \beta_i, y_i$, and $y_i'$ as in the proof of Lemma 1, and notice that $y \, R_Y \, y'$ or $y \, P_Y \, y'$, as appropriate, because of (6). This is enough.

The following definitions, as well as the proof, are suggested by Arrow (1967) and also by Parks (1976).

A set of individuals $D$ is *decisive* if, for all $y, y' \in Y$:

$$\text{whenever } y_i > y_i' \text{ for all } i \in D, \text{ then } y \, P_Y \, y'. \tag{11}$$

A *dictator* $d$ is an individual in the set $N$ such that the set $\{d\}$ is decisive – that is:

$$\text{whenever } y_d > y'_d, \text{ then } y\, P_Y\, y'. \tag{12}$$

Given two income distributions $y$ and $y'$, the set of individuals $D$ is *semi-decisive for $y$ against $y'$* provided that:

$$\begin{array}{ll} \text{(a)} & \text{For all } i \in D,\ y_i > y'_i. \\ \text{(b)} & \text{For all } i \notin D,\ y_i < y'_i. \\ \text{(c)} & y\, P_Y\, y'. \end{array} \tag{13}$$

LEMMA 3. *If there exist $y, y' \in Y$ such that $D$ is semi-decisive for $y$ against $y'$, then $D$ is decisive.*

*Proof.* Suppose that (13) is true. Let $x, x' \in Y$ be such that, for all $i \in D$, $x_i > x'_i$. Because $y_i > y'_i$ and $x_i > x'_i$ for all $i \in D$, and because of (7), it is now possible to find $z, z' \in Y$ so that:

$$\begin{array}{ll} \text{(a)} & \text{For all } i \in D:\ z_i = y_i,\ z'_i = y'_i \\ \text{(b)} & \text{For all } i \notin D:\ y_i \leqslant z_i \leqslant y'_i,\ y_i \leqslant z'_i \leqslant y'_i \\ \text{(c)} & z_i \geqslant z'_i \Leftrightarrow x_i \geqslant x'_i \text{ and } z_i \leqslant z'_i \Leftrightarrow x_i \leqslant x'_i. \end{array}$$

Now, because of the strict Pareto principle (6),

$$y'\, R_Y\, z' \text{ and } z\, R_Y\, y.$$

Because of (13) $y\, P_Y\, y'$.

Because $R_Y$ is an ordering, it follows that $z\, P_Y\, z'$.

Because of (c) above, there are, for each $i \in N$, constants $\alpha_i$ and $\beta_i > 0$ such that:

$$u_i(x_i) = \alpha_i + \beta_i u_i(z_i), \quad u_i(x'_i) = \alpha_i + \beta_i u_i(z'_i).$$

Because $z\, P_Y\, z'$, it follows from (5) that $x\, P_Y\, x'$. Therefore, $D$ is decisive.

THEOREM. *Suppose that* (1), (5), (6) *and* (7) *are all true. Then there exists a dictator.*

*Proof.* Because of (6), the set $N$ of all individuals is certainly decisive. Because $N$ is finite, there must therefore be a non-empty smallest decisive set; let this set be $D$. Suppose that $d \in D$. Suppose there is also an individual

$j \in D - \{d\}$. Because of (7), there are now three income distributions $x, y, z \in Y$ such that:

(a) $x_d > y_d > z_d$.
(b) For all $i \in D - \{d\}$: $y_i > z_i > x_i$.
(c) For all $i \notin D$: $z_i > x_i > y_i$.

By hypothesis, $D$ is decisive, and so $y\ P_Y\ z$. By hypothesis, $D - \{d\}$ is not decisive, and so $x\ R_Y\ y$. Because $R_Y$ is an ordering, it follows that $x\ P_Y\ z$. So $\{d\}$ is semi-decisive for $x$ against $z$, and by Lemma 3, $\{d\}$ is decisive. This contradicts the definition of $D$ as the smallest decisive set. So $D - \{d\}$ must be empty, and $d$ must be a dictator.

### *Two Final Observations*

First, the impossibility theorem has been proved for the particular preferences given by (1). There is, however, a corresponding result for more general social choice problems. Of course, there will be social choice problems which do admit a non-dictatorial social ordering. For example, individuals' preferences may be single-peaked, or satisfy one of the other restrictions which are sufficient to ensure that majority rule gives rise to a social ordering (see for instance Pattanaik (1971)). But, provided that individuals' preferences are sufficiently 'diverse', it is impossible to construct a social ordering which is non-dictatorial, as has been noticed by Parks (1976) and by Kemp and Ng (1976).

Second, the impossibility theorem has been proved on the assumption that only positive linear transformations of the utility functions are allowed, as in (3). If instead general increasing transformations are allowed:

$$\widetilde{u}_i(y_i) = \phi_i(u_i(y_i)) \quad (\text{all } i \in N, y \in Y)$$

then (5) is strengthened, and the impossibility theorem remains true *a fortiori.*

## 4. INEQUALITY WITH INTERPERSONAL COMPARISONS

Under mild assumptions, we have seen how, without interpersonal comparisons, the only possible social orderings are dictatorial, responding primarily to increases in a single person's income or utility. Consequently, without interpersonal comparisons, there can be no ethically meaningful measure of inequality. What, then, is the situation if interpersonal comparisons are made?

Sen (1973, 1974) has distinguished two different kinds of interpersonal comparison. The first is a comparison of utility levels of the form $u_i(y_i) > u_j(y_j)$. This can be interpreted to mean that individual $i$ with income $y_i$ is better off than individual $j$ with income $y_j$. If the individuals' utility functions are now transformed, and if the comparisons of utility levels are to remain the same, then the allowable transformations are restricted. If $\widetilde{u}_i$ denotes $i$'s transformed utility function, it must be true that, for all $i, j, y_i$ and $y_j$:

$$\widetilde{u}_i(y_i) > \widetilde{u}_j(y_j) \Leftrightarrow u_i(y_i) > u_j(y_j).$$

So the allowable transformations take the following form, where $\phi$ is any increasing function which is independent of $i$:

$$\widetilde{u}_i(y_i) = \phi(u_i(y_i)) \quad (\text{all } i \in N, y \in Y). \tag{14}$$

This relationship between the allowable transformations of different individuals' utility functions suggests calling them *co-ordinal.*

When the individual utility functions are co-ordinal, condition (5) no longer has the same powerful implications. It is no longer true that the social ordering has to be dictatorial. Indeed, it is now possible to have Rawls' (1971) maximin criterion:

$$y \, R_Y \, y' \Leftrightarrow \min_i u_i(y_i) \geqslant \min_i u_i(y_i')$$

and the associated ordering of utility vectors:

$$U R U' \Leftrightarrow \min_i U_i \geqslant \min_i U_i'.$$

It is easy to check that neither of these orderings is affected by the transformations (14).

Of course, maximin, or Sen's (1971) lexicographic extension of maximin, are not quite the only possible social orderings which take account of interpersonal comparisons of utility levels. Yet, if the social ordering does display some preference for equality, it does seem that maximin or lexicographic maximin do rather easily become the only social ordering embodying just interpersonal comparisons of utility levels (see Hammond (1976), and, for a more general result, some unpublished work by d'Aspremont and Gevers).

The second kind of interpersonal comparison is of utility units or, equivalently, of marginal utilities. These can be traced back at least to Marshall as well as Sidgwick. Comparisons take the form $u_i'(y_i) > u_j'(y_j)$, and can be interpreted as meaning that the benefit to $i$ of an extra pound exceeds that to $j$. If the individuals' utility functions are now transformed, and if the comparisons of marginal utilities are to remain the same, then the allowable transformations are restricted. If $\tilde{u}_i$ denotes $i$'s transformed utility function, it must be true that, for all $i$, $j$, $y_i$ and $y_j$:

$$\tilde{u}_i'(y_i) > \tilde{u}_j'(y_j) \Leftrightarrow u_i'(y_i) > u_j'(y_j).$$

So the allowable transformations take the following form, where $\alpha_i$ and $\beta > 0$ are constants, and $\beta$ is independent of $i$:

$$\tilde{u}_i(y_i) = \alpha_i + \beta u_i(y_i) \quad (\text{all } i \in N, y_i \in Y_i). \tag{15}$$

This relationship between the allowable transformations of different individuals' utility functions suggests calling them *co-cardinal.*

When the individual utility functions are co-cardinal, condition (5) becomes comparible with what is commonly called 'utilitarianism', with the social ordering represented by the utility sum:

$$y\, R_Y\, y' \Leftrightarrow \Sigma_i u_i(y_i) \geqslant \Sigma_i u_i(y_i')$$

and

$$U R\, U' \Leftrightarrow \Sigma_i U_i \geqslant \Sigma_i U_i'.$$

It is easy to check that neither of these orderings is affected by the transformations (15).

This 'utilitarian' social ordering is not the only possible one embodying interpersonal comparisons of marginal utilities. But, if some weak axioms are added – notably, continuity, and a condition which has been called 'separability' – then this 'utilitarian' social ordering does become the only possible one (as has been shown in recent unpublished work by d'Aspremont and Gevers, and by Maskin).

A third case arises when both levels and units of different individuals' utility functions are compared. Thus, both of the following types of comparison are made:

$$u_i(y_i) > u_j(y_j) \quad \text{and} \quad u_i'(y_i) > u_j'(y_j).$$

If the individuals' utility functions are now transformed, and if the comparisons of both utility levels and utility units are to remain the same, then the allowable transformations are restricted. If $\tilde{u}_i$ denotes $i$'s transformed utility function, it must be true that, for all $i$, $j$, $y_i$ and $y_j$:

$$\tilde{u}_i'(y_i) > \tilde{u}_j'(y_j) \Leftrightarrow u_i'(y_i) > u_j'(y_j)$$

and

$$\tilde{u}_i(y_i) > \tilde{u}_j(y_j) \Leftrightarrow u_i(y_i) > u_j(y_j).$$

So the allowable transformations take the following form, where $\alpha$ and $\beta > 0$ are both constants which are independent of $i$:

$$\tilde{u}_i(y_i) = \alpha + \beta u_i(y_i) \quad (\text{all } i \in N, y_i \in Y_i). \tag{16}$$

This relationship between the allowable transformations of different individuals' utility functions suggests calling them *fully co-cardinal.*

When the individual utility functions are fully co-cardinal, then once again condition (5) has weakened implications. It is compatible with both maximin and 'utilitarianism'. It is also compatible with a social ordering of the form:

$$y R_Y y' \Leftrightarrow \min_{i \neq j} [u_i(y_i) + u_j(y_j)] \geqslant \min_{i \neq j} [u_i(y_i') + u_j(y_j')]$$

as is easily verified. Not that this ordering has any special desirable features; it does, however, show that there are now new possibilities.

When the utility functions are fully co-cardinal, Sen (1973) noticed how utilitarianism could come into conflict with our notions of equity. One reaction to this is to abandon utilitarianism; another possible reaction is to think carefully about the interpersonal comparisons we do make, and to see whether it is not possible to harmonize our comparisons of utility levels with our comparisons of utility units, in a way which leads to harmony between utilitarianism and equity. This, however, is a suggestion to be pursued elsewhere.

## 5. CONCLUSIONS

A measure of inequality which is of ethical relevance must correspond to a social ordering of income distributions. I have shown how, without interpersonal comparisons, no such ethical measure of inequality can be constructed. With interpersonal comparisons, there are many possibilities, and exploration of those possibilities is only just beginning.

Of course, interpersonal comparisons raise several difficult questions. How are they to be made? What empirical basis are they to have? Here, there are a number of suggestions, in, for example, Simon (1974), Waldner (1974), Ng (1975), Jeffrey (1971), and a number of the articles reprinted in Phelps (1973).

But these suggestions are all beset with difficulties. Indeed, it seems impossible to know how best to make interpersonal comparisons until we have answered a prior question, and decided what use we intend for the interpersonal comparisons we are going to make. In the end, they are probably a rather convenient grammar for expressing our ethical views concerning the proper social ordering. Here, I have attempted to show the need for such a grammar, and to throw out a few suggestions for the form which it should take.

## APPENDIX

In this appendix, I shall give a fuller justification of condition (5) of the main text, which states that the ordering of income distributions corresponds to an ordering of utility vectors which is independent of the utility representations of individual preferences. To do this, I shall assume that, for each possible vector of utility functions $u$ on $Y$, there is a corresponding social ordering $R_Y = f(u)$ defined on $Y$. Here, $f$ is the *social welfare functional.* It will be assumed too that $f$ satisfies two extra standard conditions:

($I$) (independence of irrelevant alternatives).
Suppose that $A \subseteq Y$, and that for all $y \in A$,
$u(y) = \tilde{u}(y)$.
Let $R_Y = f(u), \tilde{R}_Y = f(\tilde{u})$.
Then, for all $y, y' \in A : y\, R_Y\, y' \Leftrightarrow y\, \tilde{R}_Y\, y'$

($N$) (neutrality)
Let $\sigma : Y \to Y$ be a one-one mapping of $Y$ into itself.
Suppose that, for all $y \in Y : \tilde{u}(y) = u(\sigma(y))$.
Let $R_Y = f(u), \tilde{R}_Y = f(\tilde{u})$.
Then, for all $y, y' \in Y : y\, \tilde{R}_Y\, y' \Leftrightarrow \sigma(y)\, R_Y\, \sigma(y')$.

Under the two conditions ($I$) and ($N$), it is easy to see that there exists a single well-defined ordering $R$, on the space of possible values of the vector of utility functions $u$, such that, when $R_Y = f(u)$, then:

$$y\, R_Y\, y' \Leftrightarrow u(y)\, R\, u(y').$$

Then, since transformations of the form (3) do not affect the ordering $R_Y$, it must be true that:

$$\begin{aligned}&\text{if } u(y) = \tilde{u}(\tilde{y}),\ \tilde{u}(\tilde{y}') = u(y')\\&\text{then } y R_Y y' \Leftrightarrow u(y) R u(y') \Leftrightarrow \tilde{u}(\tilde{y}) R \tilde{u}(\tilde{y}') \Leftrightarrow \tilde{y} R_Y \tilde{y}'\\&\text{which proves (5).}\end{aligned}$$

In this sense, then, condition (5) is equivalent to a form of neutrality, as has been suggested by Parks (1976).

## NOTE

.* I have benefited especially from reading the published and unpublished work of Parks, of Sen, and of d'Aspremont and Gevers, and I claim little originality for the ideas expressed here.

## BIBLIOGRAPHY

K. J. Arrow, 'Values and Collective Decision-Making', in P. Laslett and W. G. Runciman (eds.), *Philosophy, Politics and Society, Vol. 3,* Blackwell (1967) (and reprinted in Phelps (1973)).

A. B. Atkinson, 'On the Measurement of Inequality', *J. Econ. Theory* **2** (3), (September 1970) 244–263.

H. Dalton, 'The Measurement of the Inequality of Incomes', *Econ. J.* **30** (September 1920).

J. de V. Graaff, *Theoretical Welfare Economics,* Cambridge University Press, 1957.

P. J. Hammond, 'Equity, Arrow's Conditions, and Rawls' Difference Principle', *Econometrica* **44** (1976), 793–804.

R. C. Jeffrey, 'On Interpersonal Utility Theory', *J. Philos.* **68** (1971), 647–657.

M. C. Kemp and Y-K. Ng, 'On the Existence of Social Welfare Functions, Social Orderings, and Social Decision Functions', *Economica* **43** (1976), 59–66.

Y-K. Ng, 'Bentham or Bergson? Finite Sensibility, Utility Functions, and Social Welfare Functions', *Rev. Econ. Stud.* **42** (4). (October 1975), 545–569.

R. P. Parks, 'An Impossibility Theorem for Fixed Preferences: a Dictatorial Bergson-Samuelson Welfare Function', *Rev. Econ. Stud.* (forthcoming).

P. K. Pattanaik, *Voting and Collective Choice,* Cambridge University Press, 1971.

E. S. Phelps (ed.), *Economic Justice,* Penguin, 1973.

J. Rawls, *A Theory of Justice,* Harvard University Press, 1971.

A. K. Sen, *Collective Choice and Social Welfare,* Holden-Day, 1970.

A. K. Sen, *On Economic Inequality,* Clarendon Press, 1973.

A. K. Sen, 'Rawls versus Bentham: An Axiomatic Examination of the Pure Distribution Problem', *Theory and Decision* **4** (1974), 301–309.

J. L. Simon, 'Interpersonal Welfare Comparisons Can Be Made – and Used for Redistribution Decisions', *Kyklos* **27** (1974), 63–98.

I. Waldner, 'Bare Preference and Interpersonal Utility Comparisons', *Theory and Decision* **4** (1974), 313–328.