

FREEDOM OF CHOICE AND CONFLICT RESOLUTION

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1.1 Introduction

The idea of freedom often arises in economic, political and philosophical debates. However, economic theorists have, as yet, paid little attention to formalizing the concept. It was not until the nineties that we began to see a growing number of theoretical works attempting to accomplish this task. Some of the works published by Amartya Sen during the eighties were a determining antecedent for this stream. Sen suggested that issues other than income or wealth needed to be considered in order to evaluate individual and collective welfare. In particular, according to Sen, the opportunities and capabilities that allow an individual to *function* in society are a closer proxy of personal well-being for the purposes of measuring collective welfare. (See, for example, Sen [48, 49, 50, 51])

Sen's concern posed the question of how to measure and evaluate the freedom of choice that an individual enjoys in a given situation. Nowadays, it is possible to find many theoretical works on the issue, but very few regarding its potential applications. This chapter intends to provide the reader with

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an overview of the most prominent theoretical results on the topic, and with some clues as to the possible applications in conflict resolution.²

1.2 Formal Setting

In almost every work that attempts to formalize the concept of freedom of choice, the central object of analysis is that of an *opportunity set*:

Let X be a set of alternatives: $X = \{x, y, z, \dots\}$, and let Z be the set of all the possible subsets of X . We will denote the elements of Z by capital letters A, B, C, \dots . Thus, any element of Z can be interpreted as an opportunity set. An opportunity set is a set of *mutually exclusive* alternatives, from which *the decision maker chooses one*.

An opportunity set admits of different interpretations: the typical budget set we find in the consumer theory is, actually, an opportunity set: it is a set of alternative baskets of goods available to the consumer. However, many other interpretations are admissible: the political parties one can vote for in the elections, the available brands of a certain product, the different careers that a student can pursue, alternative production plans for an entrepreneur, possible holiday destinations, or, from a more general point of view, the different life plans that society offers the individual. Obviously, another particular interpretation is that of the set of alternative solutions at a certain stage of a conflict. Usually, the related works do not stick to a particular interpretation, and maintain the analysis at the most abstract level, in order to provide theories that are as general as possible.

The opportunity set available to an individual can be seen as containing the information of his freedom of choice. Thus, we are interested in comparing different possible opportunity sets, in terms of the freedom of choice they provide, in order to make judgments about individual freedom.

Formally, we are interested in a binary relation of "freedom-of-choice-preference", \succeq , defined on the elements of Z , whose interpretation is: $\forall A, B \in Z, A \succeq B$ means that opportunity set A offers at least as much freedom to the decision maker as opportunity set B . Associated to \succeq , the binary relations of strict preference (\succ) and indifference (\sim) are interpreted in the usual way: $A \succ B$ as "set A offers strictly more freedom than B " and $A \sim B$ as "sets A and B offer the same degree of freedom".³

Since the relation \succeq over sets has to represent what we mean by freedom of choice, the usual procedure is to impose on the binary relation axioms or conditions that are coherent with simple, basic intuitive ideas of what freedom

² Before going any further, I would like to refer to Barberà et al. ([9], Sects. 1,2 and 4), where readers interested in the theoretical approach can find a much more extensive and detailed survey than what fits the scope of this chapter.

³ For the sake of fluency I will refer to the strict preference with expressions such as "strictly better" or "strictly preferred" and to the weak preference simply as "better" or "preferred".

of choice is or should be, and then, try to discover general criteria to rank all the possible opportunity sets that are logically consistent with the imposed axioms.

As will be discussed later, the quality of the basic alternatives is in many cases highly relevant to the design of the axioms to be imposed. For that reason, it is often assumed that the quality of the alternatives is given and represented by means of another binary relation, R , that is defined on the domain of the basic alternatives, X . Thus, $\forall x, y \in X$, xRy is interpreted as "alternative x is more desirable than alternative y ". Associated to R , the relations of strict preference, P , and indifference, I , are defined and interpreted in the usual way: xPy as " x is strictly more desirable than alternative y ", and xIy as " x and y are indifferent".⁴

In those cases in which the quality of the alternatives is considered for the evaluation of freedom, the formal problem consists of axiomatically exporting (or "extending") the information given by the basic preferences, in order to compare *sets* of alternatives. In other words, the basic question is: from what we know about R , what can be said about \succeq ?

1.3 Why is Freedom of Choice a Good Thing?

Generally speaking, the axioms to be imposed on the preferences over sets may depend on the reasons why freedom of choice is assumed to be of value. This question would require a deep philosophical discussion, harking back to Aristotle.⁵ However, a very naive overview of some economically meaningful views will be enough for the purposes of this chapter:

(i) The value of freedom an opportunity set offers lies in the utility that, given the agent's preferences over the basic alternatives, he⁶ is able to obtain from the set. That is, a set A of alternatives is said to provide strictly with more freedom than a set B , ($A \succ B$), if, according to the basic preferences, the maximal utility attainable in A is greater than the maximal utility attainable in B . This is the so-called *indirect utility* approach. The classical model of consumer theory applies this approach: a budget set A is considered to be better if, and only if, the consumer prefers the best attainable basket in A to the best attainable basket in B . What counts is the final choice, and not the availability of any other option. Therefore, enlargements of opportunity sets are only desirable as far as they provide better options that were previously unavailable.

⁴ Sometimes we will refer to the preferences over the basic alternatives as the "basic preferences", in order to distinguish them from the preferences \succeq , which are defined over sets.

⁵ For recent references on the philosophical foundations of the value of freedom of choice see, for example, Carter [17] or Kramer [31].

⁶ The gender of the generic decision maker has been determined at random by the flip of a coin.

It should be noted that, under this view, an individual that freely chooses an alternative x from a large number of other options will be equally free if he is *obliged* to choose x . For this reason, the indirect-utility approach is somewhat unsatisfactory for authors concerned with a more global view of the value of freedom of choice.

(ii) Sometimes there is a degree of uncertainty in the individual's basic preferences. In such a case, the decision maker would prefer larger opportunity sets and the chance to postpone his final choice, simply as a way to prevent changes in his preferences. Therefore, what matters to the agent is how far an opportunity set allows him to maximize his final utility according to his future and definite preferences, at the point as which he has to make his final choice. This is the so-called "Preference for Flexibility" approach, initially developed by Koopmans [30] and Kreps [32].

(iii) The classical Smithian view defends the freedom to choose (for example, the freedom to decide what to produce, how to produce, what to buy, who to buy from, ...) as a means towards collective welfare; these being the necessary conditions for the invisible hand to work well.

(iv) As pointed out in the introduction, Amartya Sen also brings in the political aspect of freedom, as a necessary condition for economic development in underdeveloped countries.

(v) A tradition grounded on Stuart Mill [34] sees the mere act of choosing freely from alternative options as contributing to develop the faculties of the individual. Sugden [57] and Jones and Sugden [26] are examples of more recent theoretical works rooted in the Millian motivation.

(vi) Another libertarian tradition, well developed by Nozick [36], sees freedom as *intrinsically* valuable for an individual life to be considered meaningful. That is, the mere fact of being able to choose and deciding one's own way of life is valuable, regardless of any other instrumental consideration.

There are other possible sources for the value of freedom of choice. In some non cooperative games, for instance, the mere availability of additional strategies, even if they are dominated, may give an advantage. However, the approaches above are the most frequently mentioned in the related literature.

A possible taxonomy of them is the following: (vi) is non-consequentialist, while (i) to (v) are consequentialist in the sense that the freedom provided by a set is valuable as a means to achieve something. Among the consequentialist motivations, (i) and (ii) are welfarist (what is to be achieved is the maximal possible individual utility according to certain given preferences), while the rest are non-welfarist. I will start with the non-welfarist interpretations, which seem to be closer to the original motivation of the analysis of the value of freedom of choice. I will return later to the second interpretation (the preference for flexibility approach).

1.4 Non-welfarist Approaches

The clearest non-welfarist aspect of the evaluation of freedom of choice in a set is the *number* of opportunities. It appears obvious that more opportunities to choose from should be associated with more freedom of choice. Steiner [56], Pattanaik and Xu [39, 41], Van Hees [59] or Romero-Medina [46] have developed the purely quantitative aspect of freedom.

If the number of alternatives in X is finite, Pattanaik and Xu [39] follow the axiomatic method in order to characterize the *cardinalist rule* to rank opportunity sets. This rule simply counts the number of alternatives in an opportunity set and declares a set to be better than another (in terms of freedom) if it contains more opportunities. These are their axioms:

- *Indifference Between No-Choice Situations* (INCS): $\forall x, y \in X, \{x\} \sim \{y\}$. That is, any pair of situations where there is no freedom of choice at all (there is only one alternative to be chosen) are indifferent in the pure sense of freedom.
- *Strict Monotonicity* (SM): $\forall x, y \in X, \{x, y\} \succ \{x\}$: If, starting from a situation in which there is no choice, we add a new alternative to the opportunity set, then the situation strictly improves in terms of freedom.
- *Independence* (IND): $\forall A, B \in Z, \forall x \in X \setminus A \cup B, A \succeq B$ if and only if $A \cup \{x\} \succeq B \cup \{x\}$. That is, if, for whatever reason, an opportunity set A provides more freedom of than another opportunity set B , then the addition of a new alternative x to each of them should not affect the freedom-ranking between A and B . (The reverse is stated too: If we remove from a pair of sets an alternative shared by both of them, the ranking between them is not affected).

What makes Pattanaik and Xu's proposal theoretically powerful is precisely that such plausible axioms are sufficient to ensure that the only criterion that satisfies them consists on, simply, counting the number of alternatives, that is, the cardinalist rule.

Steiner [56], Van Hees [59] and Romero-Medina [46] propose measurements of relative freedom that take into account both, what the agent can and cannot choose. For example, if n is the number of options that an agent is free to choose in a particular situation, and n^* the number of options that are socially feasible, but not available to the agent, Steiner [56] proposes an index of individual freedom given by $\frac{n}{n+n^*}$.

An important problem of the quantitative rules is that they are not applicable when we admit the possibility of infinite options in opportunity sets. This is a very significant drawback in economic environments, since, for example, the classical budget sets in the consumer theory are a continuum of baskets: counting the number of alternatives is a very obvious way of addressing the size of a finite set, but, what is to be done if we are dealing with infinite sets?

Pattanaik and Xu [41] tackle this question by proposing (and axiomatically characterizing) another rule that calculates the "volume" of (possibly infinite) sets. The cardinalist rule established that enlarging the sets with more alternatives leads to an improvement in terms of freedom. Analogously, the rule based on the volume of the set responds to the intuitive idea that if a set (even if it is infinite, for example, a given budget set) is enlarged (for example, by increasing the consumer's income), then the agent enjoys more freedom of choice.

Some authors are critical of the purely cardinalist view. They find an objection to axioms such as (INCS): it is plausible, for example, that being restricted to reading only one newspaper in one's own language should be viewed as a freer situation than being restricted to reading a newspaper in an unknown language.

Jones and Sugden [26] take into account the qualitative aspect of the alternatives in order to evaluate freedom by introducing the idea of *reasonable preferences*: those preferences over the set of options that are "reasonably admissible", that is, the set of preferences \mathcal{S} that a reasonable person might exhibit when placed in the position of the agent whose freedom we want to evaluate. For example, for the opportunity set $\{\text{pork for dinner, chicken for dinner}\}$ it might be accepted as reasonable for somebody to prefer pork to chicken (P P C), but also for his preferences to be the reverse (C P P), and even to display indifference (C I P); unless we were in the position of an orthodox muslim, in which case the set of reasonable preferences would contain only C P P.

Jones and Sugden [26] define what they call a *significant option* in relation to any given opportunity set. Let any opportunity set $A \in Z$, and let x be an element of A , then x is said to be *significant in A* if there exists at least one ordering R of the alternatives which is reasonable and for which x is the only best alternative in A . In other words, x is a significant option in A if we can imagine a reasonable person choosing x from A as the only best option.

Then, they introduce three axioms:

- (INCS) (the same axiom as in Pattanaik and Xu [39])
- *Principle of Addition of Significant Options*, which establishes that if, to any opportunity set A , we add a new option x , which is significant in the enlarged set $A \cup \{x\}$, then there is a strict improvement in terms of freedom ($A \succ A \cup \{x\}$).
- *Principle of Addition of Insignificant Options*, which establishes that if, to any opportunity set A , we add a new option x , which is not significant in the enlarged set $A \cup \{x\}$, then the degree of freedom does not change ($A \sim A \cup \{x\}$).

Jones and Sugden [26] obtain a negative result: if there exists at least one pair x, y in the universe of alternatives such that every reasonable person would strictly prefer x to y , then it is impossible to find a complete ranking of all the possible opportunity sets that satisfies the three axioms.

Pattanaik and Xu [40] take the notion of reasonable preferences to reformulate their cardinalist rule. What they propose, and axiomatically characterize, is a rule based on counting only the significant options. In a later article, Pattanaik and Xu [41] adapt this rule to economic environments, in which opportunity sets can be infinite.

Foster [20] proposes a different interpretation for the set of preferences \mathcal{S} . \mathcal{S} can be also viewed as the set of the true preference orderings that the individuals in the society have. This interpretation requires for the social agent that evaluates individual freedom a larger amount of information than what is necessary to set up the reasonable-preferences model: in the latter case, it is enough to have a subjective idea of what is reasonable, while in the former, the actual preferences of all need to be known.

Foster investigates what he calls the *Unanimity Relation* over opportunity sets, \succeq_N , which is defined in the following way: set A offers more freedom than set B ($A \succeq_N B$) if, for *each* agent in society, his best available option in A (according to his actual preferences) is better than his best available option in B . In the words of the standard utility theory, $A \succeq_N B$ if everybody attains a greater indirect utility in A than in B .

Clearly \succeq_N is a partial ordering: Imagine that there exists one person in society that strictly prefers chicken for dinner rather than pork, and another that strictly prefers pork to chicken. This circumstance is enough to declare the opportunity sets $\{pork\}$ and $\{chicken\}$ incomparable with respect to the unanimity relation. To solve the problem of incompleteness of the relation, Foster [20] also proposes a complete ranking, based on the number of alternatives in X that a set dominates in terms of the unanimity relation. However, he does not provide axiomatic characterization of such a rule.

Following the criticism of the purely quantitative approach, we find another group of works that could be labeled as *individual-centered*. The rules shown in the previous pages take the position of a social planner who wishes to evaluate the freedom enjoyed by any anonymous individual in society. The rules we are now going to describe try to consider the freedom enjoyed by a *given* individual, taken for granted some information about his particular preferences. The hypothesis again is that individual well-being is not totally captured by the indirect utility, and that the possibility to choose other alternatives is intrinsically desirable. Thus, these works try to evaluate the *overall well-being* that opportunity sets provide to a given individual, considering not only the quality, but also the quantity of the alternatives.

The cardinalist rule by Pattanaik and Xu [39] can be seen as a polar case that considers only the quantity of the alternatives, regardless of their quality. At the other pole, we have the indirect utility criterion, that looks only at their quality (actually it looks only at the quality of one alternative; the best).

Bossert et al. [15] characterize axiomatically some rules that come between the two polar cases: We will mention one that is especially interesting; the

leximax ranking of opportunity sets.⁷ According to this criterion, in order to compare any pair of sets A and B , we first look at the best alternative in each set (with respect to the decision maker's preferences). If the best alternative in A is strictly better than that in B , then the rule declares A as strictly preferred to B . If the two best alternatives are indifferent, then the rule compares the sets by comparing the second best alternative in each set, and so on, until the ties are broken. It may, in the process, turn out that in one set there is an element to compare, while in the other they are exhausted. In such a case, the *leximax* declares the former to be strictly preferred.

As a clarifying example, consider a universe X of three alternatives $X = \{x, y, z\}$, and consider an agent that strictly prefers x to y and y to z ($xPyPz$). Then the possible opportunity sets would be ordered by the *leximax* in the following way: $\{x, y, z\} \succ \{x, y\} \succ \{x, z\} \succ \{x\} \succ \{y, z\} \succ \{y\} \succ \{z\}$.

The *leximax* rule proposes an interesting compromise between the instrumental value of freedom of choice on the one hand (when there is no tie in the respective first-best alternatives, the *leximax* collapses into the indirect utility criterion), and the intrinsic value of freedom of choice on the other (any enlargement of a set leads to a *strict* improvement in terms of freedom). However, the *leximax* rule as defined above is also inapplicable if infinite opportunity sets are admitted. For extensions of the *leximax* criterion to the infinite case, see Arlegi et al. [1] and Ballester et al. [8]

Other works that also consider the role of individual preferences reach impossibility results. According to them, it is impossible under certain axioms to find a ranking of opportunity sets that serve as a compromise between the quantitative and the qualitative aspect of the opportunity sets (see for example Gravel [23], Puppe [44], or Dutta and Sen [19]). Other interesting related references are Puppe [45] and Bossert [13].

1.5 The Preference for Flexibility Approach

Suppose a two-stage decision-making context: At stage t the decision-maker is given a certain opportunity set, while in $t + 1$ he has to make the final choice of one alternative from the set. Suppose also that, at stage t , the decision-maker is not totally sure what his preferences will be at stage $t + 1$. In such circumstances, it is natural to assume that, at stage t , the decision maker will prefer to maintain bigger opportunity sets, as a way of preventing changes in his future preferences or adapting to future contingencies. That is, from this point of view, it is also the case that, if a set A includes another set B , then $A \succeq B$.

Notice that, in this case, the reason why the decision-maker prefers larger opportunity sets is purely instrumental: the desire for more options is no more

⁷ For the formal definition of the *leximax* ranking and other rules see Bossert et al. [15].

than a way of ensuring a maximal indirect utility in the future, when the final choice has to be made. When the desire for larger opportunity sets is of this kind, the agent is usually said to display "preference for flexibility"

Koopmans [30] discusses this problem in a seminal work, and some years later Kreps [32] develops it further. According to Kreps [32], two necessary conditions for a ranking of sets to exhibit preference for flexibility are the following:

- For any pair of sets A, B , if A includes B ($B \subseteq A$), then $A \succeq B$ (**K1**). As said before, an enlargement of an opportunity set can never reduce the flexibility of choice.
- For any three sets A, B and C , if $A \sim A \cup B$, then $A \cup C \sim A \cup B \cup C$ (**K2**). That is, if, for whatever reason the addition of the alternatives in B does not add any flexibility to A , then, the addition of B should neither add flexibility to a set that is bigger than A .

The main result in Kreps [32] is one of representation: an ordering of opportunity sets satisfies those two axioms if and only if we can find a set of contingent utility functions defined on X such that, in order to evaluate opportunity sets, the decision maker maximizes the summation of all the different maximal utilities he would be able to reach with the elements of the sets under the different possible states of the world. Then, if (K1) and (K2) are satisfied, we can interpret that, to evaluate an opportunity set, the decision maker behaves as if he were adding up the different maximal utilities he could reach with the elements of the set for each possible state of the world (possible state of his future preferences).

Arlegi and Nieto [4] also explore the concept of flexibility from a different point of view. They assume that agents may at present be absolutely sure about some parts of their future preferences, while being uncertain about others. This is reflected by a partial ordering on the basic alternatives. The decision maker admits at the current stage that his preferences may be completed at the second stage. Under this formulation, and imposing certain axioms, it is shown how, depending on the "size" of the partial ordering, it generates different orderings over opportunity sets. At one extreme, if the agent is not at all sure of any of his preferences (that is, at stage t , the relation of preferences is empty), then the ranking over sets is always strictly monotonic (any enlargement of any opportunity set leads to a strict improvement in terms of freedom). At the other extreme, if the agent is totally sure of all of his future preferences (formally, they are a linear ordering), then the final ranking over sets collapses into the indirect utility ranking. The last result reveals that, under the preference for flexibility assumption, uncertainty is the only motivation for wanting more possibilities to choose from. In a later work, Arlegi and Nieto [5] propose some additional axioms and conditions of the basic preferences, leading precisely to the cardinalist rule and the leximax.

The message of the two works by Arlegi and Nieto ([4, 5]) is sceptical towards the scope of the results shown in Sect. 4: some of the most paradigmatic

rules that have been characterized as displaying the intrinsic value of freedom of choice (such as the cardinalist rule, the leximax or, in general, all rankings that are strictly monotonic) can be plausibly obtained under a purely welfarist approach, if we assume uncertainty over the future preferences.

1.6 The Value of Diversity

Diversity can be considered as a desirable property for a set of options. Several works have analyzed the value of an opportunity set in terms of the diversity of the options it contains. For some authors, the ideas of diversity and freedom overlap. For others there are important differences. In any case, the measurement and evaluation of diversity has many analogies with the measurement and evaluation of freedom of choice. Indeed, the problem is usually approached with a similar axiomatic methodology. In this case, it is not the quality of the basic alternatives that matters, but rather their similarity. This can be described by means of a binary relation of similarity, or, alternatively, by some kind of measurement of the distance between the alternatives. On the basis of this information, axioms are imposed over opportunity sets based on simple, intuitive ideas about what is meant by offering more (or less) diversity.

As we have shown, (INCS) and (SM) are two axioms of the cardinalist rule that are susceptible to criticism when we want to introduce the role of preferences in the evaluation of sets. The third axiom in the characterization, (IND), turns out to be problematic when considering the diversity aspect of sets: even if a set A is better than B , the addition of a new alternative x to both sets may contribute greatly to the diversity in B while in no way affecting the diversity in A and, may even bring about the reversal of the previous preference between A and B . For example, it is plausible to assume that the menu $\{chicken, pork\}$ is more diverse than the menu $\{potatoes\ from\ Southern\ France, potatoes\ from\ Northern\ Spain\}$, but also that the menu $\{chicken, pork, beef\}$ offers less diversity than $\{potatoes\ from\ Southern\ France, potatoes\ from\ Northern\ Spain, beef\}$, especially for someone who does not like meat.

The problem of the measurement of diversity has already been approached by biologists from the fifties, as a way of evaluating the biodiversity offered by an ecosystem (see the seminal works by Shannon [54], Good [22], and more recent developments by Baczkowski et al. [6, 7] and Magurran [33]). However, there are few works that approach the question of diversity in economic contexts. I will just give a brief overview of the most prominent ones:

Marlies Ahlert (Klemisch-Ahlert [27]) proposes the size of the convex hull of an opportunity set as a proxy of its degree of diversity. Then, an opportunity set A is better (in terms of diversity) than another set B , if B can be transformed and shifted in such a way that its convex hull is contained by A 's convex hull.⁸ One of the problems of Ahlert's proposal is that it is only a partial ordering, making impossible the comparison of many pairs of sets.

⁸ For a related approach see Rosenbaum [47].

Pattanaik and Xu [42] establish a similarity relation over the set of basic alternatives, and propose the following rule for comparing any two sets. For both sets, seek the minimum number of subsets into which they can be split such that all elements within each subset are similar. Then, the set with the larger minimum number of such subsets is declared better. The intuition underlying the rule is that if a set cannot be split into more sets, it means that all alternatives in the set are similar. At the other extreme, if a set can be split into as many subsets as alternatives, and we cannot find any other separation in which there are two alternatives, it means that all the alternatives are dissimilar two-by-two.⁹

There is another group of economists who propose axiomatic models for the measurement of diversity taking as a primitive a numerical measure of the *distance* between the alternatives. Examples of this approach are Weitzman [61, 62, 63], who analyzes the particular case of biodiversity; or Bossert et al. [16] and Nehring and Puppe [35] in an economic framework. However, one of the drawbacks of this approach is that it is usually based on a cardinal notion of diversity. Then, to what extent can we make statements like “potatoes from Southern France and potatoes from Northern Spain are three times more similar than chicken and pork”? Actually, Van Hees [60] shows that, under certain axioms, it is impossible to obtain a ranking of sets made in terms of diversity on the basis of a measure of the distance between alternatives.

1.7 The Distributive Aspect: Equality of Opportunities

As happens with the notion of freedom, the idea of *equality of opportunities* is often acclaimed in political and economic debates, and also when the solution of a conflict is at stake. The models shown in the previous sections are intended to measure and evaluate individual freedom by looking at the decision maker’s opportunity set. In a collective framework, the notion of equality of opportunities can be approached by analyzing how opportunity sets are allocated among agents. This is the approach taken by Kranich [28, 29], Herrero [24], Ok [37], Herrero et al. [25], Kranich and Ok [38] Bossert et al. [14], and Arlegi and Nieto [3] among others.

In this context, the formal object of analysis is that of an *opportunity profile*: vectors of opportunity sets, one set for each agent in society. Then, opportunity profiles represent how opportunities are distributed. Many of the related works start with the simplest case of two individuals. In such a case, an opportunity profile takes the form $[A_1, A_2]$, where A_1 represents the opportunity set of individual 1 and A_2 that of individual 2. Then, axioms are imposed

⁹ For other approaches based on a primitive binary relation of similarity see Bavetta and Del Seta [10], and Peragine and Romero-Medina [43]. See also Bervoets and Gravel [12] for an approach based on a more refined relation of similarity between pairs of alternatives.

on a binary relation of preferences (\succeq^*) defined over the space of opportunity profiles $Z \times Z$. Thus, $[A_1, A_2] \succeq^* [B_1, B_2]$ is interpreted as "situation A (in which agent 1 enjoys opportunity set A_1 and agent 2 opportunity set A_2) is a more egalitarian distribution of opportunities than situation B (in which agent 1 enjoys the opportunity set B_1 and agent 2 opportunity set B_2)".¹⁰

In this framework, we can find axiomatic characterization of two rules, each capturing, from a different point of view, the degree of equality in the distribution of opportunities:

- The *cardinality-difference* ranking (Kranich [28]), which minimizes the difference in the number of opportunities between the two agents. Formally, $\forall [A_1, A_2], [B_1, B_2] \in Z \times Z$, $[A_1, A_2] \succeq^* [B_1, B_2]$ if $|\#A_1 - \#A_2| \leq |\#B_1 - \#B_2|$.
- The *number of common opportunities* ranking (Herrero et al. [25] and Bossert et al. [14]), which maximizes the number of opportunities shared by both agents: $\forall [A_1, A_2], [B_1, B_2] \in Z \times Z$, $[A_1, A_2] \succeq^* [B_1, B_2]$ if $\#(A_1 \cap A_2) \geq \#(B_1 \cap B_2)$.

It is not difficult to find examples to show that each of the above rules can lead to counterintuitive judgments in certain situations when taken separately. In Arlegi and Nieto [3] such examples are given to justify the wisdom of applying rules that combine the two criteria. Thus, two rules which are lexicographic combinations of the cardinality-difference ranking and the number of common opportunities ranking are characterized. The first rule begins by considering the difference in the number of opportunities, and only if two social situations (opportunity profiles) have the same difference in opportunities, does it take into account the number of common opportunities. The second rule is the dual version of the latter. We look first at the number of common opportunities, and only if this number is equal, do we consider the difference in the cardinality. Furthermore, Arlegi and Nieto [3] propose some extensions to the n -agents case and show that, under certain axioms, the only admissible combinations of the above rules are lexicographic combinations.

Other related approaches are Kranich and Ok [38], where an analogy is made between the measurement of income inequality and the measurement of inequality of opportunities, and Ok [37], where the measurement of inequality is not based merely on "counting" alternatives.

1.8 Other Approaches

The opportunity set enjoyed by an agent seems to contain most of the information relevant to evaluating his freedom: e.g. the number of opportunities

¹⁰ We denote the relation of preference over profiles with "*" in order to distinguish it from the relation \succeq , defined over individual opportunity sets, studied in the previous sections.

and what they are. However, in many contexts there are circumstances that may be relevant for the evaluation of freedom of choice, but that cannot be captured by a bare description of the elements of the set.

The theories shown in the preceding pages are rather deterministic: the decision-maker has full power to choose an alternative from his opportunity set, and this choice perfectly determines the consequences with total certainty. Nevertheless, things tend to be more complex in the real world. Individuals interact, and the consequences of the actions of one are often conditioned on the actions and strategies taken by others. This raises the question of how to define the opportunity set of a *player* in a given *game*.

Pattanaik proposes a model in which each basic alternative (strategy) is identified by its corresponding *set of possible outcomes* (which depend on the other player's strategies). Each such set of outcomes is usually called a *prospect*. Therefore, the decision maker does not compare opportunity sets, but *vectors of prospects*. Under this point of view, Pattanaik characterizes a rule that compares such vectors of prospects by looking at the number of the available strategies, regardless of the final outcomes.¹¹

Other authors have followed a *phenomenological* approach. For example, Suppes [58] uses statistical information to apply a certain *entropy* index in order to measure freedom in some paradigmatic contexts. One of those contexts is that of competition in an industry. Suppes applies his index to measure dispersion in supply: the number of enterprises their relative size. Consequently, the index score measures freedom of competition in the industry. Another context in which Suppes applies his index is that of political elections. In an analogous way, the index can measure the dispersion in votes cast for the different parties. Then, according to Suppes, an excessive concentration of votes a limited number of parties would be a symptom of lack of political freedom.¹²

Experimentation is another alternative approach with great potential. To the best of my knowledge Sonsino and Mandelbaum [55] is the only reference that, in the context of ranking opportunity sets, explores the experimental method. These authors' experiments are designed to evaluate the individual preference for flexibility (in the presence of uncertainty), rather than the individual value of freedom of choice. Presumably, experiments might be designed in such a way as to provide clues about whether freedom of choice has a purely intrinsic value or not; on what this intrinsic value depends, and so on. However, in order to check for and isolate the intrinsic value of freedom, uncertainty should be ruled out of the decision problem designed for the experiment.

In certain situations, in order to make judgments about individual freedom, it may be more important to know which things the agent cannot do,

¹¹ This model was proposed by Professor Pattanaik at his Plenary Conference for the Sixth International Meeting of the Society for Social Choice and Welfare, Pasadena, Ca, USA, July 2002. To the best of my knowledge there is not even a mimeographed copy of it.

¹² See also D'Agostino et al. [18] for a more recent analysis of freedom in economically meaningful contexts, which is based on statistical observations.

than which he can. And even more important, the reasons why an agent may be unable to choose certain options. This idea leads to the notion of *negative freedom*; what the agent cannot do, due to the encroachment by others. Barberà et al. [9] propose the following example: It may be relevant to know whether a person can or cannot choose to be a football player in his life, but it may be more relevant for the purpose of evaluating freedom to know whether he is unable to be a football player because of some physical handicap or because he is black and the local law prevents blacks from playing football. The concept of negative freedom was studied by Berlin in [11]. From a more theoretical point of view, things that the agent cannot do can easily be incorporated into the model (remember, for example, Steiner's index of freedom based on the relative number of available options (Steiner [56])). It is less easy, however, to model the reasons why certain options are not available. And even more complicated is the task of determining the boundaries of the notion of "encroachment by others" in societies as complex as ours. For research on the notion of negative freedom and its formalization, the reader may consult Van Hees [60].

Negative freedom can be considered as a particular case of an *external reference* associated to the opportunity set. That is, a circumstance associated to the choice from the opportunity set, that cannot be represented by means of the set, and that is of relevance in order to evaluate how free the choice is. In the case of negative freedom such a "circumstance" might be described by the enumeration of the options that are not available to the decision makers because of the encroachment by others. However, it is possible to imagine other kinds of external references such as the following:

(i) The procedure that generates the alternatives in the set. For example, Gaertner and Xu [21] stress the technological aspect. Many people would be willing to shrink their budget set in order to avoid consuming goods produced in "unfair" conditions, such as the exploitation of children in underdeveloped countries, or highly contaminating technologies. In the case of conflict resolution, we could think of different procedures used by the mediators to make the different alternatives available to the parties. From a more general point of view, one might be interested in considering the ethical desirability of a political system that facilitated a particular set of alternative life plans.

(ii) The way preferences over the alternatives have been formed. For example, in order to evaluate the freedom to choose a government in the elections, apart from the availability of different political options, it might be relevant to consider whether individuals have well-informed preferences or are to some extent coerced, manipulated or persuaded. The same is applicable for the choice of alternative ways to proceed in a conflictive situation.

(iii) The distributive aspect of freedom. Even from the individual point of view, one's feeling of freedom to choose may depend on whether or not others are also free to do so.

(iii) The procedure for making the final choice. The mere act of choosing might involve more or less freedom depending on certain procedural aspects,

such as bureaucratic barriers, the degree of anonymity in the choice (for example whether voting is secret or not), and others.

(iv) The degree of reversibility in the final choice: For example, the choice of who to marry might be considered more or less free according to whether or not divorce is possible.

Arlegi and Dimitrov [2] propose a model to evaluate the freedom offered by an opportunity set when there is some external reference to be taken into account. In their model, the object of axiomatic analysis are "procedure-based" opportunity sets, consisting of a set of opportunities together with the information about the form that the associated external reference takes.

1.9 Applications for Conflict Resolution

Conflicts involve situations and processes in which many of the central questions of the models above often arise. For example, negotiating parties tend to evaluate the freedom to choose different ways during the process of negotiation and resolution, but the final solution of a conflict can also be analyzed from the point of view of the freedom it offers to the different agents in the conflict.

In any case, when analyzing conflicts and possible solutions, there are many questions for which a mediator or facilitator may like to find an answer. For example, how free are the parties at any moment? Why do they want freedom? Is it an intrinsic desire of freedom or is it purely instrumental? If it is purely instrumental, can the problem be simplified by reducing uncertainties? Do parties enjoy diversity in the set of possible solutions or in the opportunity set that the final solution offers them? Do the process of resolution and the final solution ensure equality of opportunities to everybody at any given point of time? To what extent? Do certain vetoes in the process impose a significant degree of negative freedom? Are there procedural aspects in the process of resolution that may affect the agent's freedom of choice? This is the kind of questions for which the works surveyed in the previous sections provide theoretically powerful tools.

Furthermore, the question of freedom could be evaluated from the point of view of the freedom enjoyed by the mediator. He might like to evaluate his own degree of freedom to seek possible solutions to a particular conflict. This could allow him to catalogue conflicts, in order to make a more informed choice of appropriate strategy and way to proceed.

Briefly, therefore, there is in my opinion a huge territory to be explored with respect to the application of freedom of choice (and related) models for the resolution of conflicts. In the following paragraphs I will mention just a few potential lines of research. All of them take for granted that a formal description of the conflict is well specified:

(i) The solution to some conflicts consists of a particular distribution of payoffs. However, in many other conflicts the solution may call for a more

complex distribution of rights, commitments, payoffs, etc. This might be the case for regional conflicts, where the issue what is at stake involves the rights to use certain natural resources, or cultural conflicts in which the question is how to ensure the right of different communities to develop their own culture.

A particular endowment of rights can be represented by means of a set of opportunities. Then, in such a context, an impartial mediator might be interested in comparing the degree of equality between the opportunities offered by alternative solutions. Different criteria of equality of opportunities, such as those mentioned in Sect. 7, provide some clues with respect to the theoretical possibilities. Since all those works follow an axiomatic methodology, one can consider which axioms can most plausibly be assumed to tackle the particular situation, and accordingly, determine the most appropriate rule for evaluating equality in the distribution of opportunities.

(ii) The very process of negotiation and mediation in conflicts can sometimes be interpreted as a succession of decisions over opportunity sets that shrinks progressively in successive steps. That is, at the starting point, the universe of possible solutions might be large, but, as the process advances, the parties or the mediator, reject some potential solutions as being inadmissible. In such a case, the mediator may find it desirable, not only that the final solution, if reached, be fair, but also that all the intermediate steps in the process should allow the different agents sufficient freedom to continue making choices.

(iii) The mediator may consider his own problem as one of choosing from an opportunity set of alternative solutions or ways to proceed. Then the reasonable preferences approach (see Sect. 4) could be applied, in order to restrict in the initial stages the set of possible solutions and simplify the problem of the mediator: it might be the case that the mediator lacks information about the individual preferences of the parties. However, let us assume that he is able to establish, for each party, its set of reasonable preferences regarding the potential solutions. In such a case, we could take Jones and Sugden's approach [26]: all those solutions that, under no reasonable preferences, are preferred by any of the parties could be deleted, thus simplifying the mediator's problem. Note, however, that this way of simplifying the problem may involve drawbacks from the point of view of fairness: imagine two parties, $P1$ and $P2$, and three possible solutions a, b, c . Imagine, further, that the set of reasonable preferences for A are $aPbPc$ and $aPcPb$,¹³ while, from the objective point of view of $P2$, the only reasonable preferences are $bPcPa$. Then, since there is no reasonable situation in which c is the best option for any of the candidates, c should be ignored as a candidate for a solution. Thus, a and b remain. Let us now imagine that the resolution of the conflict develops in such a way that the final solution is b . Suppose, however, that, if no alternative were ruled out in the first step, the conflict might develop in such a way that the final solution

¹³ We will assume, for the sake of simplicity, transitivity of the preferences.

were c . Clearly, if $P1$'s *truel* preferences are $aPcPb$, he has good reason to protest the elimination of alternative c in the first step.

(iv) In another possible scenario the mediator might know the actual preferences of the parties about the possible solutions. In such a case, application of Foster's [20] unanimity relation would be appropriate. This case is simpler, but the problem just mentioned in the reasonable preferences example is not avoided: If $P1$'s actual preferences are $aPbPc$ and $P2$'s actual preferences are $bPcPa$, then c is unanimously dominated for everybody and could be ignored. It could be the case, however, that, once c is ignored, the final solution turns out to be a . If, when all three alternatives are considered there were some chance that the conflict might develop in such a way that c were reached, then, $P2$ may clearly denounce the unfairness of the simplification in the first-step.¹⁴

(v) Very often, the objective of the conflict resolution is the signing of an agreement or a contract, in which the different parties establish their rights and obligations; agreeing to compensate each other in the event of non-fulfillment. At this point, Pattanaik's prospect-based model (See Sect. 8) might be useful. According to Pattanaik, individuals choose among sets of prospects, where each prospect is a set of possible outcomes contingent upon the strategies of other agents. Therefore, a contract can be interpreted as a specific way to determine the game to be played by the parties. From this point of view, a contract establishes for each party a set of admissible strategies, the results of which will depend on the strategies adopted by the other parties.

Then, the solution of the conflict may consist of choosing the appropriate model for the contract that is to be signed. If this is the case, it would be relevant to know how the agents evaluate the different alternative models of contracts, each consisting, formally, of a particular specification of the available vector of prospects. Therefore, it might be of great use to have a good set of theoretically-grounded rules for comparing vectors of prospects.

Furthermore, it is interesting to note that, when looking for a suitable contract, each party tries, on the one hand, to secure the chance to take some decisions. In this sense, agents display a preference for as much flexibility as possible in contracts, that is, contracts which offer a set of admissible strategies as large as possible. On the other hand, each party would also like to specify the contract in such a way as to avoid undesirable results deriving from the use of certain strategies by the other party. That is, there is an incentive to reduce the freedom provided by the contract. Nevertheless, making the contracts more specific, typically, limits one's own strategies. Thus, a trade-off arises between the desire of flexible contracts and the preference for restricted contracts. Again, the axiomatic analysis of rules for comparing

¹⁴ In all the examples we are assuming the existence of an algorithm or mechanism for conflict resolution that selects an alternative, and that such a mechanism may be affected by the expansion of the initial set of alternatives.

vectors of prospects becomes a convenient tool for making explicit positive and normative principles for solving such trade-offs.

(vi) In the previous sections we also mentioned the procedural aspect of freedom. The mere specification of the individual sets of opportunities may not be enough to capture all the aspects needed to evaluate freedom of choice (see Sect. 8). The techniques for conflict resolution typically feature an important *procedural* aspect. For example, in a territorial conflict, the same agreement might be perceived in different ways by the agents according to where the agreement is signed (on home, on foreign territory or on neutral ground), or the person who signs it (his political relevance, for example). Thus, following Arlegi and Dimitrov's model (Sect. 8), it may be useful to describe all the potential states of the conflict by means of *procedure-based opportunity sets*, in which not only the set of opportunities is described, but also the particular state of the external reference.

(vii) As a general consideration, a message of all the freedom of choice literature is that individual well-being consists (or may consist) of something other than the bare consequences of individual actions. For example, individuals may value the mere fact of having autonomy to determine the way of things. From the normative point of view also, there appear to be reasons to agree on the ethical value of autonomous choice. This is something worthy of consideration by mediators. Many proposals for conflict resolution consist of algorithms and automats which are black boxes offering an output (solution to the conflict) in exchange for certain inputs (the relevant elements of the conflict). Such mechanisms have well-known advantages; among others, they tend to prevent agents from manipulating the process. However, it should also be considered how such mechanisms affect individual freedom of choice and consequently collective well-being.

1.10 Conclusions and Final Remarks

It is possible that the reader who expected concrete models for solving conflicts is frustrated by this point in the chapter. Unfortunately there are no specific applications of theoretical models of freedom of choice to the resolution of conflicts. However, I believe in the potential of such a line of research. Through the preceding pages, I have aimed to bring to the knowledge of all researchers interested in conflict resolution the existence of the surveyed field of literature. Needless to say, the survey does not claim to be exhaustive. It is actually quite superficial. I think, however, that the references provided will allow interested readers to search more deeply into the subject. I have made some rough indications for potential applications. They are based on quite simple intuition, and are perhaps not the lines of research with the greatest potential. Experts on conflict resolution may find other much more obvious and promising lines of application, in which case this chapter will have satisfactorily fulfilled its goal.

This work was conceived while I was participating in the project *Procedural Approaches to Conflict Resolution*, coordinated, among others, by Professor Matthias Raith. One of the principal leitmotifs of the project was interdisciplinarity. Interdisciplinarity, on the one hand, as a way towards a better and richer understanding of the problems, and on the other hand, as a network of bridges to cross the barriers nowadays imposed by the extreme specialization in research. I only hope that this chapter may be in some way useful, as far as conflict resolution is concerned, in helping to construct such a network.

References

1. Arlegi, R., M. Besada, J. Nieto and C. Vazquez. (2000) "Freedom of choice: The Leximax Criterion in the Infinite Case", DT 2000/09. Public University of Navarre.
2. Arlegi, R. and D. Dimitrov (2004). "On Procedural Freedom of Choice", *CentER Discussion Paper 2004-9* Tilburg University.
3. Arlegi, R. and J. Nieto (1999). "Equality of Opportunity: Cardinality-based criteria", in: H. De Swart (ed.), *Logic, Game Theory and Social Choice*, Tilburg University Press, Tilburg, 458-481.
4. Arlegi, R. and J. Nieto (2001). "Incomplete Preferences and the Preference for Flexibility", *Mathematical Social Sciences*, 41, 151-165.
5. Arlegi, R. and J. Nieto (2001). "Ranking Opportunity Sets: An Approach based on the Preference for Flexibility", *Social Choice and Welfare*, 18, 23-36.
6. Baczkowski, A.J., D.N. Joanes and G.M. Shamia (1997). "Properties of a Generalized Diversity Index", *Journal of Theoretical Biology*, 188, 207-213.
7. Baczkowski, A.J., D.N. Joanes and G.M. Shamia (1998). "Range of Validity of alpha and beta for a Generalized Diversity Index due to Good", *Mathematical Bioscience*, 148, 115-128.
8. Ballester, M.A. and J.R. De Miguel (2003). "Extending an Order to the Power Set: The Leximax Criterion", *Social Choice and Welfare* 21, 63-72.
9. Barberà, S., W. Bossert and P. Pattanaik. "Ranking Sets of Objects", in: Barberà, S., P. Hammond and C. Seidl (eds.), *Handbook of Utility Theory*, vol. 2, Kluwer Academic Publishers, forthcoming.
10. Bavetta, S. and M. Del Seta (2001). "Constraints and the Measurement of Freedom of Choice", *Theory and Decision* 50, 213-238.
11. Berlin, I. (1969). *Four Essays on Liberty*, Oxford: Clarendon Press.
12. Bervoets, S. and Gravel, N. (2003). "Appraising Diversity with an Ordinal Notion of Similarity: An Axiomatic Approach", mimeo.
13. Bossert, W. (1997). "Opportunity Sets and Individual Well-being", *Social Choice and Welfare* 14, 97-112.
14. Bossert, W., M. Fleurbaey and D. Van de Gaer (1999). "Responsibility, Talent, and Compensation: A Second-best Analysis", *Review of Economic Design*, 4, 35-55.
15. Bossert, W., P. Pattanaik and Y. Xu (1994). "Ranking Opportunity Sets: An Axiomatic Approach", *Journal of Economic Theory*, 63, 326-345.
16. Bossert, W., P. Pattanaik and Y. Xu (2002). "Similarity of Options and the Measurement of Diversity", Technical Report, CRDE, Université de Montréal, WP no. 11-2002.

17. Carter, I. (1999), *A Measure of Freedom*, Oxford: Oxford University Press
18. D'Agostino M., V. Dardanoni and V. Peragine, V. (2003). "A Statistical Theory of Freedom", mimeo.
19. Dutta, B. and A. Sen (1996). "Ranking Opportunity Sets and Arrow Impossibility Theorems: Correspondence Results", *Journal of Economic Theory*, 71, 90-101.
20. Foster, J. (1992). "Notes on Effective Freedom", mimeo.
21. Gaertner, W. and Y. Xu (2004). "Procedural Choice", *Economic Theory* 24, 335-349.
22. Good, I.J. (1953). "The Population Frequencies of Species and the Estimation of Population Parameters", *Biometrika*, 40, 237-264.
23. Gravel, N. (1994). "Can a ranking of Opportunity Sets Attach an Intrinsic Importance to Freedom of Choice?", *American Economic Review* 84, 454-458.
24. Herrero, C. (1997). "Equitable Opportunities: An Extension", *Economic Letters* 55, 91-95.
25. Herrero, C. I. Iturbe-Ormaetxe and J. Nieto (1998). "Ranking Opportunity Profiles on the Basis of the Common Opportunities", *Mathematical Social Sciences* 35, 273-289.
26. Jones, P. and R. Sugden (1982). "Evaluating Choice", *International Review of Law and Economics* 2, 47-69.
27. Klemisch-Ahlert, M. (1993). "Freedom of Choice: A Comparison of Different Rankings of Opportunity Sets", *Social Choice and Welfare* 10, 189-207.
28. Kranich, L. (1996). "Equitable Opportunities: An Axiomatic Approach", *Journal of Economic Theory* 71, 131-147.
29. Kranich, L. (1997). "Equitable Opportunities in Economic Environments", *Social Choice and Welfare* 14, 57-64.
30. Koopmans, T.C. (1964). "On the Flexibility of Future Preferences", in: M.W. Shelley and G.L. Bryan (eds.), *Human Judgements and Optimality*, Wiley, New York, 243-254.
31. Kramer, M.H., (2003). *The Quality of Freedom*, Oxford: Oxford University Press.
32. Kreps, D.M. (1979). "A Representation Theorem for 'Preference for Flexibility'", *Econometrica* 47, 565-577.
33. Magurran, A.E. (1998). *Ecological Diversity and its Measurement*, Princeton, NJ: Princeton University Press.
34. Mill, J.S. (1956). *On Liberty*, Liberal Arts Press, New York (originally published in 1859).
35. Nehring, K. and C. Puppe (2002). "A Theory of Diversity", *Econometrica* 70, 1155-1198.
36. Nozick, R. (1974). *Anarchy, State and Utopia*, Blackwell, Oxford.
37. Ok, E. (1997). "On Opportunity Inequality Measurement", *Journal of Economic Theory* 77, 300-329.
38. Ok, E. and Kranich, L. (1998). "The Measurement of Opportunity Inequality: A Cardinality-based Approach", *Social Choice and Welfare* 15, 263-287.
39. Pattanaik, P.K. and Y. Xu (1990). "On Ranking Opportunity Sets in Terms of Freedom of Choice", *Recherches Economiques de Louvain* 56, 383-390.
40. Pattanaik, P.K. and Y. Xu (1998). "On Preference and Freedom", *Theory and Decision* 44, 173-198.
41. Pattanaik, P.K. and Y. Xu (2000). "On Ranking Opportunity Sets in Economic Environments", *Journal of Economic Theory* 93, 48-71.

42. Pattanaik, P.K. and Y. Xu (2000). "On diversity and Freedom of choice", *Mathematical Social Sciences* 40,123-130.
43. Peragine, V. and A. Romero-Medina (2003). "On Preferences, Freedom and Diversity", mimeo.
44. Puppe, C. (1995). "Freedom of Choice and Rational Decisions", *Social Choice and Welfare* 12, 137-153.
45. Puppe, C. (1996). "An Axiomatic Approach to 'Preference for Freedom of Choice'", *Journal of Economic Theory* 68, 174-199.
46. Romero-Medina, A. (2001). "More on Preferences and Freedom", *Social Choice and Welfare* 18, 179-191.
47. Rosenbaum, E.F. (1999). "On measuring freedom", *Journal of Theoretical Politics* 12, 205-227.
48. Sen, A.K. (1980). "Equality of What?", in: S. McMurrin (ed.), *Tanner Lectures on Human Values*, Vol. I, Cambridge: Cambridge University Press.
49. Sen, A.K. (1985). "Well-being, Agency and Freedom: The Dewey Lectures in 1984", *Journal of Philosophy* 82.
50. Sen, A.K. (1987). *The Standard of Living*, Cambridge University Press, Cambridge.
51. Sen, A.K. (1988). "Freedom of Choice, Concept and Content", *European Economic Review* 32, 269-294.
52. Sen, A.K. (1991). "Welfare, Preference and Freedom", *Journal of Econometrics* 50, 15-29.
53. Sen, A.K. (1993). "Markets and Freedoms: Achievements and Limitations of the Market Mechanism in Promoting Individual Freedoms", *Oxford Economic Papers* 45, 519-541.
54. Shannon, C.E. (1948). "A Mathematical Theory of Communication", *The Bell System Technical Journal*, 27, 379-423.
55. Sonsino, D. and M. Mandelbaum (2001). "On Preference for Flexibility and Complexity Aversion: Experimental Evidence", *Theory and Decision* 51, 197-216.
56. Steiner, H. (1983). "How free: Computing Personal Liberty", in: A. Phillips-Griffiths (eds.), *Of Liberty*, London: Cambridge University Press, 73-89.
57. Sugden, R. (1998). "The metric of opportunity", *Economics and Philosophy* 14, 307-337.
58. Suppes, P. (1987). "Maximizing Freedom of Choice: An Axiomatic Analysis", in: G.R. Feiwel (ed.), *Arrow and the Foundations of the Theory of Economic Policy*, Basingstoke: Macmillan, 243-254.
59. Van Hees, M. (1998). "On the analysis of negative freedom", *Theory and Decision* 45, 175-197.
60. Van Hees, M., (1999). "Freedom of Choice and Diversity of Options: Some Difficulties", in: H. de Swart (ed.), *Logic, Game Theory and Social Choice*, Tilburg University Press, Tilburg, 491-503.
61. Weitzman, M.L. (1992). "On Diversity", *Quarterly Journal of Economics* 107, 363-406.
62. Weitzman, M.L. (1993). "What to Preserve? An Application of Diversity Theory to Crane Conservation", *Quarterly Journal of Economics* 108, 157-183.
63. Weitzman, M.L. (1998). "The Noah's Ark Problem", *Econometrica* 66, 1279-1298.