



Provided by the author(s) and NUI Galway in accordance with publisher policies. Please cite the published version when available.

Title	On the Axiomatic Approach to Freedom as Opportunity: A General Characterization Result
Author(s)	Gekker, Ruvin
Publication Date	2000
Publication Information	Gekker, R. (2000). "On the Axiomatic Approach to Freedom as Opportunity: A General Characterization Result" (Working Paper No. 0045) Department of Economics, National University of Ireland, Galway.
Publisher	National University of Ireland, Galway
Item record	http://hdl.handle.net/10379/1331

Downloaded 2017-12-13T05:21:14Z

Some rights reserved. For more information, please see the item record link above.



On the Axiomatic Approach to Freedom as Opportunity: A General Characterization Result

Ruin Gekker¹

Working Paper No. 45

March 2000

Department of Economics
National University of Ireland, Galway

<http://www.nuigalway.ie/ecn>

1 Department of Economics, National University of Ireland, Galway, Ireland
E-mail: ruin.gekker@nuigalway.ie

Abstract

The aim of this paper is to provide a different, somewhat more general, approach to the axiomatic ranking of opportunity sets in terms of freedom of choice. The opportunity ranking is defined axiomatically relative to some standard of freedom or theory of freedom. The paper then provides a general characterization result of the opportunity ranking in terms of the family of freedom standards.

Keywords: axiomatic ranking, freedom of choice, opportunity sets

JEL Classification: D71

Introduction

Recently a growing number of researchers have suggested a great variety of axioms trying to capture different intuitions of the intrinsic value of freedom, see Bossert et al. (1994); Gravel (1994); Jones and Sugden (1982); Klemisch-Ahlert (1993) Pattanaik and Xu (1990, 1996); Puppe (1996); Sen (1985, 1991, 1993); Sugden (1996) and Suppes (1987) among others. Some authors have proposed a set of axioms which are completely independent of an underlying preference relation among basic alternatives, see Klemisch-Ahlert (1993); Pattanaik and Xu (1990); Suppes (1987) among others. On the other hand Sen (1991, 1993) and, subsequently, Arrow (1995); Nehring and Puppe (1996); Puppe (1996) and Sugden (1996) have all strongly advocated the incorporation of preference as an essential ingredient in the evaluation of freedom of choice. This paper suggests a different, somewhat more general, approach to the axiomatic analysis of opportunity ranking in terms of freedom of choice.

The central tenet of the proposed model is an assumption that in order to make comparisons of opportunity sets in terms of freedom, individuals would require a certain standard of freedom or a theory of freedom which would reflect what is essential from individuals' point of view for evaluating opportunity sets. Of course, individual preferences might be an essential part of a freedom standard. However, we believe that, in general, a theory of freedom should include much more than individual preferences only. Although we do not specify precisely what is included in a freedom standard, we do impose a minimal set of requirements on it as well as on the opportunity ranking. In this respect we follow Nehring and Puppe (1996) and Puppe (1996) who believe that, in view of the conceptual complexity and elusiveness of the concept of "freedom of choice", we should start with a minimal set of requirements. What is important to emphasize is that we impose that minimal set of requirements on the opportunity ranking always relative to some standard of freedom or some theory of freedom. In fact, our basic set of axioms for freedom of choice corresponds closely to that of Puppe (1996) However, instead of his central axiom for freedom of

choice (Axiom F) which roughly states that every opportunity set contains at least one basic alternative essential for freedom, we utilize a somewhat different axiom on freedom standards (Axiom S) which simply stipulates that those opportunity sets that are included in a freedom standard offer, at least, some degree of freedom. Actually, Axiom S allows us to say somewhat more, namely, that those opportunity sets that belong to a standard or a theory of freedom offer strictly more freedom than those sets that do not.

The plan of this paper is as follows. In Section 2, we introduce some basic notation and axioms. In Section 3, we establish a general characterization result of opportunity ranking in terms of standards of freedom. Specifically, we show that the opportunity ranking can be defined set-theoretically from the family of freedom standards as follows: A offers at least as much freedom as B if and only if A belongs to every freedom standard to which B does. Finally, Section 4 provides a brief assessment of the results.

2. Basic definitions and axioms

Let X be a finite, non-empty, set of basic alternatives and let $P(X)$ denote the set of all subsets of X . The elements of $P(X)$ will be denoted by A, B, C, \dots , and are referred to as opportunity sets. Notice that we include the empty set \emptyset in $P(X)$. In fact, in our framework \emptyset represents an opportunity set which offers zero degree of freedom. In order to compare opportunity sets in terms of freedom, we need some kind of a freedom standard, or theory, which reflects what is essential for freedom from the agent's point of view. Let Δ be a non-empty subset of $P(X)$ which represents such a standard. Naturally we want to exclude empty set from Δ , so we assume that $\emptyset \notin \Delta$. We also assume that Δ is closed under supersets.

Let \geq be a binary relation defined over $P(X)$. For all $A, B \in P(X)$, $A \geq B$ will be interpreted as “A offers at least as much freedom as B” relative to Δ . The asymmetric and symmetric part of \geq will be denoted by $>$ and \sim , respectively.

We want to impose a minimal set of requirements on \geq . First of all, because we are interested in comparisons of opportunity sets in terms of freedom from the point of view of an agent who is rational, we impose a transitivity requirement on \geq . Formally, **Axiom T (Transitivity)**. For all $A, B, C \in P(X)$, $A \geq B$ and $B \geq C \Rightarrow A \geq C$.

Axiom T figures prominently in every paper on the axiomatic approach to freedom as opportunity.

The next axiom is also fairly uncontroversial and is utilized by virtually every researcher in the field, for example, see Arrow (1995); Bossert et al (1994); Gravel (1994); Klemisch-Ahlert (1993); Nehring and Puppe (1996); Puppe (1996); Sen (1991); Suppes (1987). Actually, its origin could be traced to the literature on flexibility under uncertainty about future tastes introduced by Koopmans (1964), see also Kreps (1979). It simply says that if B is a subset of A, then A offers at least as much freedom as B. Formally,

Axiom M (Monotonicity). For all $A, B \in P(X)$, $B \subseteq A \Rightarrow A \geq B$.

Notice that Axiom M implies reflexivity of \geq .

The next axiom is an analogue of Puppe’s freedom condition in this framework, see Puppe (1996). It stipulates that those opportunity sets that are in Δ offer some degree of freedom, to wit, they offer strictly more freedom than \emptyset . Formally,

Axiom S (Standard of Freedom). For all $A \in P(X)$, $A \in \Delta \Leftrightarrow \text{not } (\emptyset \geq A)$.

In fact, Axiom S also stipulates that those opportunity sets that are not in Δ offer strictly less freedom than those that are in Δ . The following lemma establishes that, in presence of transitivity and monotonicity, Axiom S is equivalent to the combination of the following two requirements:

$$\text{For all } A, B \in P(X), A \in \Delta \text{ and } B \notin \Delta \Rightarrow A > B. \quad (1)$$

$$\text{For all } A, B \in P(X), A \notin \Delta \text{ and } B \notin \Delta \Rightarrow A \sim B. \quad (2)$$

Lemma 1. Let \geq be a binary relation on $P(X)$ which satisfies Axioms T and M. Then Axiom S \Leftrightarrow (1) and (2).

Proof. Clearly (1) and (2) imply Axiom S. To show the converse, suppose $A \in \Delta$ and $B \notin \Delta$. Then by Axiom S, we have not $(\emptyset \geq A)$ and $\emptyset \geq B$. But, we also have, by Axiom M, $A \geq \emptyset$. Therefore, $A > \emptyset$. By Axiom T, then $A > B$. So, we have established that Axiom S implies (1). To show that Axiom S implies (2), assume $A \notin \Delta$ and $B \notin \Delta$. By Axiom S, we have $\emptyset \geq A$ and $\emptyset \geq B$. By Axiom M, we also can derive $A \geq \emptyset$ and $B \geq \emptyset$. Therefore, by Axiom T, we have $A \geq B$ and $B \geq A$, i.e. $A \sim B$. Q. E. D.

We want to point out some obvious differences between Puppe's Axiom F and our Axiom S. Axiom F maintains that every opportunity set offers some degree of freedom, while Axiom S implies that only opportunity sets belonging to Δ offer some degree of freedom. Next, Axiom F compares every set only with some of its subsets. Obviously, Axiom S does not impose this restriction. The following example clearly illustrates the difference between these two axioms. Imagine a state where politics is dominated by extremist political parties. We assume that there are ten extreme left-wing parties and, also, ten extreme right-wing parties. However, there are only two centrist (moderate) parties (say, c_1 and c_2). Our agent's theory of freedom is expressed

by the motto “extremism is no virtue”, that is, his or her freedom of choice can only be represented by c_1 or c_2 (and also by their supersets). Suppose $A = \{c_1, c_2\}$ and B consists of three extreme left-wing parties and, also, three extreme right-wing parties. Then Axiom S implies that $A > B$ while, according to Axiom F, A and B are incomparable (incidentally, according to Pattanaik and Xu’s (1990) characterization of \geq , $B > A$).

Notice that according to Axiom F, B must offer some degree of freedom, while Axiom S implies that B offers none from the agent’s point of view. In this regard, Axiom S is immune to the criticism that is advanced toward Axiom F, namely that one could easily imagine cases where an opportunity set contains only terrible and dreadful alternatives between all of which an agent is indifferent (see Puppe (1986, p. 181).

Also, notice that Δ simply represents some fixed family of sets. We do not impose any specific restrictions on Δ except assuming that it is somewhat “large”. Next we will show that an algebraic construction of a filter specialized to \geq can be interpreted as a somewhat refined standard or theory of freedom (see Lemma 2 below).

3. Characterization results

Our ultimate goal is to prove that an opportunity ranking can be defined set-theoretically from freedom standards (or filters). To do this, we introduce an algebraic construction of a filter specialized to \geq (for more details on specialized filters, see Rasiowa (1974). A non-empty family Σ of sets is a filter relative to \geq if it satisfies the following conditions:

- (f1) $\emptyset \notin \Sigma$;
 (f2) $B \in \Sigma$ and $A \geq B \Rightarrow A \in \Sigma$;

Let $\mathbf{F}(\geq)$ be the class of all filters. We will also refer to the elements of this class as freedom standards relative to a binary relation \geq which satisfies Axioms T, M and S.

Lemma 2. The class $\mathbf{F}(\geq)$ of all filters (or freedom standards) with respect to \geq has the following properties:

- (i) If Ξ is a non-empty subclass of $\mathbf{F}(\geq)$, then $\cap \Xi \in \mathbf{F}(\geq)$ and $\cup \Xi \in \mathbf{F}(\geq)$.
 (ii) If $\Gamma \in \mathbf{F}(\geq)$, then $\Gamma \subseteq \Delta$.
 (iii) $\Delta \in \mathbf{F}(\geq)$.

Proof. (i) Let $\Xi \subseteq \mathbf{F}(\geq)$. Take $\cap \Xi$. Clearly $\emptyset \notin \cap \Xi$. Suppose that $B \in \cap \Xi$ and $A \geq B$. Then $B \in \Phi$, for all Φ in Ξ . Since Φ is a filter, we have $A \in \Phi$ for all Φ in Ξ , i. e. $A \in \cap \Xi$. Similarly, we can prove that $\cup \Xi \in \mathbf{F}(\geq)$.

- (ii) To the contrary, suppose $A \in \Gamma$ but $A \notin \Delta$. Since $\emptyset \notin \Delta$, we have $A \sim \emptyset$,
 by Lemma 1. But then $\emptyset \in \Gamma$ and $\emptyset \notin \Gamma$, a contradiction. Hence $\Gamma \subseteq \Delta$.

- (iii) By our assumption $\emptyset \notin \Delta$. Suppose $B \in \Delta$ and $A \geq B$. By Axiom S, we can derive not $(\emptyset \geq B)$. By Axiom T then, we have not $(\emptyset \geq A)$. Again applying Axiom S, we can conclude that $A \in \Delta$. Q. E. D.

Let Σ be any non-empty family of sets and let $[\Sigma]$ denote the smallest filter containing Σ . $[\Sigma]$ is called the filter generated by Σ and can be constructed as the intersection of all filters containing Σ .

Lemma 3. $[\Sigma] = \{A : A \geq B \text{ for } B \text{ in } \Sigma\}$.

Proof. Let $\Gamma = \{A : A \geq C \text{ for } C \text{ in } \Sigma\}$. We establish that $\Gamma = [\Sigma]$. First, we prove that $[\Sigma] \subseteq \Gamma$. To do this, we have to show that Γ is a filter containing Σ . Suppose $A \in \Sigma$. By Axiom M, we have $A \geq A$. Hence $A \in \Gamma$, by the definition of Γ . Therefore $\Sigma \subseteq \Gamma$. Clearly, $\emptyset \notin \Gamma$.

Suppose now that $B \in \Gamma$ and $A \geq B$. Then we have $B \geq C$ for C in Σ . By Axiom T, we derive $A \geq C$. Therefore, $A \in \Gamma$.

To prove that $\Gamma \subseteq [\Sigma]$, let $\Phi \in \mathbf{F}(\geq)$ such that $\Sigma \subseteq \Phi$. Suppose $A \geq C$ for C in Σ . Then, since Φ is a filter, we have $A \in \Phi$. Hence $\Gamma \subseteq [\Sigma]$. Q. E. D.

Lemma 4. (i) $\Sigma \subseteq [\Sigma]$;

(ii) $\Sigma \subseteq \Gamma \Rightarrow [\Sigma] \subseteq [\Gamma]$;

(iii) $[\Sigma] = [[\Sigma]]$;

(iv) $[\Sigma] = \cup \{[\Gamma] : \Gamma \subseteq \Sigma\}$.

Furthermore, $\mathbf{F}(\geq) = \{\Sigma \subseteq P(X) : [\Sigma] = \Sigma\}$.

Proof. To prove (i), suppose that $A \in \Sigma$. Since $[\Sigma] = \cap \{\Phi : \Sigma \subseteq \Phi\}$, $A \in \Phi$ for all Φ such that $\Sigma \subseteq \Phi$ and, hence, $A \in \cap \{\Phi : \Sigma \subseteq \Phi\}$. Therefore, $A \in [\Sigma]$. (ii) and (iii) can be handled similarly. To prove (iv), assume first that $A \in [\Sigma]$. Then $A \in \Phi$ for all Φ such that $\Sigma \subseteq \Phi$. Since $\Gamma \subseteq \Sigma$, $A \in \Phi$ for all Φ such that $\Gamma \subseteq \Phi$, that is, $A \in \cap$

$\{\Phi : \Gamma \subseteq \Phi\}$, i. e. $A \in [\Gamma]$. Hence $A \in \cup\{[\Gamma] : \Gamma \subseteq \Sigma\}$. Conversely, suppose $A \in \cup\{[\Gamma] : \Gamma \subseteq \Sigma\}$. Then $A \in [\Gamma]$ for some $[\Gamma]$ such that $\Gamma \subseteq \Sigma$. By Lemma 3, we have $[\Gamma] = \{A : A \geq B \text{ for } B \text{ in } \Gamma\}$. But then we also have $A \geq B$ for $B \in \Sigma$. Therefore, $A \in [\Sigma]$.
Q. E. D.

Proposition 1. $A \geq B \Leftrightarrow$ for all $\Phi \in \mathbf{F}(\geq)$, if $B \in \Phi$, then $A \in \Phi$.

Proof. (\Rightarrow) . Suppose $A \geq B$ and let Φ be any filter from $\mathbf{F}(\geq)$ such that $B \in \Phi$. Then $A \in \Phi$.

(\Leftarrow) . To prove the converse, suppose that not $(A \geq B)$. Take $\Psi = \{C : C \geq B\}$. We prove that Ψ is a filter such that $A \notin \Psi$ and $B \in \Psi$. By Axiom M, we have $B \geq B$ and hence $B \in \Psi$ while $A \notin \Psi$ by the assumption. Now suppose $C \in \Psi$ and $D \geq C$. Then we have $C \geq B$ and, by Axiom T, can derive $D \geq B$. Therefore, $D \in \Psi$. Q. E. D.

Corollary . $A \geq B \Leftrightarrow [A] \subseteq [B]$.

Let \mathbf{F} be a family of freedom standards satisfying conditions (i) -(iii) of Lemma 2. We call $\mathbf{F}(\geq)$ the family of freedom standards determined by \geq , where $\mathbf{F}(\geq)$ is the class of all filters relative to \geq . By Lemma 2, $\mathbf{F}(\geq)$ is indeed a family of freedom standards, and Proposition 1 guarantees that \geq can be defined in terms of $\mathbf{F}(\geq)$. Next, we establish that, for any family of freedom standards \mathbf{F} , the opportunity ranking \geq defined by:

$$(*) A \geq B \Leftrightarrow \text{for all } \Phi \in \mathbf{F}, \text{ if } B \in \Phi, \text{ then } A \in \Phi$$

is, indeed, an opportunity ranking. Namely, there is a one-to-one correspondence between opportunity rankings and families of freedom standards such that for any

opportunity ranking \geq the corresponding family of freedom standards can be defined set-theoretically from it and vice versa. Moreover, $\mathbf{F} = \mathbf{F}(\geq)$.

Proposition 2. Let \mathbf{F} be any family of freedom standards and \geq the corresponding opportunity ranking on $P(X)$ defined by condition (*). Then \geq is an opportunity ranking in terms of freedom relative to Δ . Furthermore, $\mathbf{F} = \mathbf{F}(\geq)$.

Proof. We have to verify that \geq satisfies Axioms T, M and S. We start with verification of Axiom M. Suppose $B \in \Phi$ and $B \subseteq A$. Since Φ is a freedom standard, we have $A \in \Phi$. By (*) then we derive that $A \geq B$.

To verify Axiom S, suppose first that not $(\emptyset \geq A)$. Then, by (*) and condition (iii) of Lemma 2, we have $\emptyset \notin \Delta$ and $A \in \Delta$. Conversely, assume $\emptyset \geq A$. Again, by (*) and condition (iii) of Lemma 2, we derive that if $A \in \Delta$, then $\emptyset \in \Delta$. Suppose $A \in \Delta$. Then, we have both $\emptyset \in \Delta$ and $\emptyset \notin \Delta$, a contradiction. Therefore, $A \notin \Delta$. By contraposition then if $A \in \Delta$, then not $(\emptyset \geq A)$.

To verify Axiom T, suppose $A \geq B$ and $B \geq C$. Then, by (*), we have that if $A \in \Phi$, then $B \in \Phi$ and, also, if $C \in \Phi$, then $B \in \Phi$. Suppose $C \in \Phi$. Then, we can derive that $A \in \Phi$. Therefore, by (*) we have $A \geq C$.

To prove that $\mathbf{F} \subseteq \mathbf{F}(\geq)$, assume $\Phi \in \mathbf{F}$. We have to show that Φ is a filter. By our assumption $\emptyset \notin \Phi$. Suppose now that $B \in \Phi$ and $A \geq B$. Using (*), we derive that if $B \in \Phi$, then $A \in \Phi$. Therefore, $A \in \Phi$, i. e. $\Phi \in \mathbf{F}(\geq)$.

To prove the converse, assume $\Phi \in \mathbf{F}(\geq)$. By condition (iv) of Lemma 4, we have $[\Phi] = \cup \{[\Sigma] : \Sigma \subseteq \Phi\} = \cup \{[A] : A \in \Phi\}$. By Lemma 3, we also have

$[A] = \{B : B \geq A\}$. Therefore, using (*), we can obtain $B \in [A] \Leftrightarrow$ for all Γ in \mathbf{F} , if $A \in \Gamma$, then $B \in \Gamma$, i. e. $[A] = \bigcap \{\Gamma \in \mathbf{F} : A \in \Gamma\}$. By condition (i) of Lemma 2, we can conclude that $[A] \in \mathbf{F}$ for any A . Clearly $\{[A] : A \in \Phi\}$ is a non-empty class. Therefore, again by condition (i) of Lemma 2, $\bigcup \{[A] : A \in \Phi\} \in \mathbf{F}$. Hence $\Phi \in \mathbf{F}$. Q. E. D.

Notice that we have not imposed a completeness requirement on \geq :

$$\text{For all } A, B \in P(X), \text{ either } A \geq B \text{ or } B \geq A$$

In this respect we follow many researchers in the field. For instance, Sen (1993, p. 529) maintains that “comparisons of opportunity-freedom must frequently take the form of incomplete orderings”. Klemisch-Ahlert (1993); Pattanaik and Xu (1990, 1996); Puppe (1996) all do not assume completeness. In fact, characterization results above provide a natural explanation for incompleteness of \geq in terms of freedom standards. We can easily imagine the following situation: for any pair of opportunity sets $A, B \in P(X)$, let $A \in \Gamma$ but $B \notin \Gamma$. On the other hand, let $B \in \Sigma$ but $A \notin \Sigma$. Then, neither $A \geq B$ nor $B \geq A$.

The following lemma provides a rather natural requirement in this framework for \geq to be complete.

Lemma 5. An opportunity ranking \geq is complete if and only if the corresponding family of freedom standards is a chain.

Proof. (\Rightarrow). Suppose that \geq is complete but $\mathbf{F}(\geq)$ is not a chain. Then, there are Φ and Γ in $\mathbf{F}(\geq)$ such that neither $\Phi \subseteq \Gamma$ nor $\Gamma \subseteq \Phi$. Hence, there are A, B such that $A \in \Phi$,

$A \notin \Gamma$ and $B \in \Gamma$, $B \notin \Phi$. By the definition of a filter, neither $A \geq B$ nor $B \geq A$ contrary to the completeness condition.

(\Leftarrow). To prove the converse, suppose that $F(\geq)$ is a chain. Take any pair of sets A, B . We have either $[A] \subseteq [B]$ or $[B] \subseteq [A]$. By Corollary, we then derive that either $A \geq B$ or $B \geq A$. Q. E. D.

4. Concluding remarks

In this paper we have suggested a somewhat different approach to the axiomatic ranking of opportunity sets in terms of freedom, namely, we have relativized the axiomatic ranking of opportunity sets relative to some standard of freedom or to some theory. The central axiom of this model is Axiom S which guarantees that opportunity sets belonging to a freedom standard, offer, at least, some degree of freedom. We then provide a general characterization result of the opportunity ranking in terms of the family of freedom standards. A natural question then arises: Can we extend this characterization result if we impose some additional requirements on the opportunity ranking which would be entirely plausible from a freedom point of view? For example, we can easily extend the characterization result if we impose the following condition on the opportunity ranking:

$$\text{For all } A, B, C \in P(X), A \geq C \text{ and } B \geq C \Rightarrow A \cap B \geq C.$$

However, this condition is clearly unacceptable for those who value the intrinsic value of freedom as opportunity (the reader can easily construct a suitable counterexample).

Another natural extension of this work is to examine the dynamics of the standards of freedom. How can rational agents change or update their standards? We believe that the recent work on the logic of theory change might be relevant in providing an answer (for an excellent survey of this field, see Gardenfors (1988)).

It is also possible to extend all the proofs of Section 3 to a case where X is an infinite set. Naturally, in this case we have to modify and reformulate some conditions. However, we have decided not to pursue this generalization in this paper.

Finally, van Hees and Wissenburg (forthcoming) have recently criticized preferential approaches to freedom as opportunity. They argue that any preferential approach to freedom must ultimately be based on some moral standard. The present paper might lend some formal ammunition to their argumentation. However, we do not claim that standards must necessarily be moral or ethical. It seems that neither morality nor ethics enters into consideration in numerous comparisons of opportunity sets.

References

- Arrow, K.J. 1995. A note on freedom and flexibility. In: K. Basu, P.K. Pattanaik and K. Suzumura, eds., *Choice, Welfare and Development: A Festschrift in Honour of Amartya K. Sen*. Oxford: Oxford University Press.
- Bossert, W., P.K. Pattanaik and Y. Xu. 1994. Ranking opportunity sets: an axiomatic approach. *Journal of Economic Theory*, 63: 326-345.
- Gardenfors, P. 1988. *Knowledge in Flux: Modeling the Dynamics of Epistemic States*. Cambridge: Bradford Books, MIT Press.
- Gravel, N. 1994. Can a ranking of opportunity sets attach an intrinsic value to freedom of choice? *American Economic Review*, 84: 454-458.
- Jones, P. and R. Sugden. 1982. Evaluating choice. *International Review of Law and Economics* 2: 47-65.
- Klemisch-Ahlert, M. 1993. Freedom of choice: a comparison of different rankings of opportunity sets. *Social Choice and Welfare*, 10: 189-207.
- Koopmans, T.C. 1964. On the flexibility of future preferences. In M.W. Shelly and J.L. Bryans, eds., *Human Judgments and Optimality*, New York: Wiley.
- Kreps, D.M. 1979. A representation theorem for “preference for flexibility”, *Econometrica* 47: 565-577.
- Nehring, K. and K.C. Puppe. 1996. *On the multi-preference approach to evaluating opportunities*, Mimeograph. Vienna: University of Vienna.

Pattanaik, P.K. and Y. Xu. 1990. On ranking opportunity sets in terms of freedom of Choice, *Recherche Economique de Louvain*, 56: 383-390.

Pattanaik, P.K. and Y. Xu. 1988. On preference and freedom. *Theory and Decision* 44: 174-199.

Puppe, C. 1996. An axiomatic approach to “preference for freedom of choice”, *Journal of Economic Theory*, 68: 174-199.

Rasiowa, H. 1974. *An Algebraic Approach to Non-Classical Logics*. Amsterdam: North-Holland.

Sen, A.K. 1985. *Commodities and Capabilities*. Amsterdam: North-Holland.

Sen, A.K. 1991. Welfare, preference and freedom. *Journal of Econometrics* 50: 15-29.

Sen, A.K. 1993. Markets and freedoms. *Oxford Economic Papers*, 45: 519-541.

Sugden, R. 1996. *The metric of opportunity*, Discussion Paper 9610. University of East Anglia: The Economics Research Centre,

Suppes, P. 1987. Maximizing freedom of decision: an axiomatic analysis. In: G. Feiwel, ed., *Arrow and the Foundations of Economic Policy*. New York: New York.

Van Hees, M. and M. Wissenburg, Freedom and opportunity. (Forthcoming in *Political Studies*).

National University of Ireland, Galway

Working Paper Series

No. 45 March 2000 “On the Axiomatic Approach to Freedom as Opportunity: A General Characterization Result.” Ruvin Gekker.

No. 44 March 2000 “On the Axiomatic Ranking of Opportunity Sets in a Logical Framework.” Ruvin Gekker.

No. 43 March 2000 “Does the Exchange Rate Regime Affect Export Volumes? Evidence from Bilateral Exports in the US-UK Trade: 1900-1998,” Stilianos Fountas and Kyriacos Aristotelous.

No. 42 November 1999 “Cambridge Distribution in a World Economy,” Joan O’Connell. (Forthcoming in *The Journal of Income Distribution*).

No. 41 November 1999 “Commuting Distances and Labour Market Areas: Some Preliminary Insights from a Spatial Model of Job Search,” Michael J. Keane.

No. 40 September 1999 “The Impact of the Exchange Rate Regime on Exports: Evidence from Bilateral Exports in the European Monetary System,” Kyriacos Aristotelous and Stilianos Fountas.

No. 39 June 1999 “Measuring Trends in Male Mortality by Socio-Economic Group in Ireland: A Note on the Quality of Data,” Eamon O’Shea.

No. 38 June 1999 “The Impact of the Exchange Rate Regime on Exports: Evidence from the European Monetary System,” Stilianos Fountas and Kyriacos Aristotelous.

No. 37 June 1999 “Emerging Stock Markets Return Seasonalities: the January Effect and the Tax-Loss Selling Hypothesis,” Stilianos Fountas and Konstantinos N. Segredakis.

No. 36 June 1999 “Agricultural entrepreneurs as entrepreneurial partners in land-use management: a policy-based characterization,” Scott R. Steele

No. 35 June 1999 “The Monetary Transmission Mechanism: Evidence and Implications for European Monetary Union,” Stilianos Fountas and Agapitos Papagapitos.

No. 34 May 1999 “Exchange rate pass-through, the terms of trade and the trade balance,” Eithne Murphy and Lelio Iapadre.

No. 33 May 1999 “The Impact of Health Status on the Duration of Unemployment Spells and the Implications for Studies of the Impact of Unemployment on Health Status,” Jennifer Stewart.

No. 32 December 1998 “Subsidies in Irish Fisheries: Saving Rural Ireland?,” Vilhjálmur Wíium.

No. 31 October 1998 “Has the European Monetary System Led to More Exports? Evidence from Four European Union Countries,” Stilianos Fountas and Kyriacos Aristotelous. (Published in *Economics Letters*, Vol. 62, No. 3, 1999).

No. 30 October 1998 “Real Interest Rate Parity under Regime Shifts: Evidence for Industrial Countries,” Jyh-lin Wu and Stilianos Fountas. (Forthcoming in *The Manchester School*).

No. 29 October 1998 “Analyzing Gender-Based Differential Advantage: A Gendered Model of Emerging and Constructed Opportunities,” Scott R. Steele.

No. 28 September 1998 “The Impacts of Transition on the Household in the Provinces of Kazakhstan: The Case of Aktyubinsk Oblast,” Pauric Brophy.

No. 27 July 1998 “A Comparison of the Effects of Decommissioning, Catch Quotas, and Mesh Regulation in Restoring a Depleted Fishery,” J. Paul Hillis and Vilhjálmur Wíium.

No. 26 July 1998 “The Sensitivity of UK Agricultural Employment to Macroeconomic Variables,” Patrick Gaffney.

No. 25 July 1998 “The Economic and Social Costs of Alzheimer's Disease and Related Dementias in Ireland: An Aggregate Analysis,” Eamon O'Shea and Siobhán O'Reilly. Published in *International Journal of Geriatric Psychiatry*, Vol. 14, 1999.

No. 24 July 1998 “Testing for Real Interest Rate Convergence in European Countries,” Stilianos Fountas and Jyh-lin Wu. (Published in the *Scottish Journal of Political Economy*, Vol. 46, No. 2, 1999).

No. 23 April 1998 “Production, Information and Property Regimes: Efficiency Implications in the Case of Economies of Scope,” Scott R. Steele.

No. 22 April 1998 “An Empirical Analysis of Short-Run and Long-Run Irish Export Functions: Does Exchange Rate Volatility Matter?,” Donal Bredin, Stilianos Fountas, Eithne Murphy.

No. 21 April 1998 “Technology and Intermediation: the Case of Banking,” Michael J. Keane and Stilianos Fountas.

No. 20 March 1998 “Are the US Current Account Deficits Really Sustainable?” Stilianos Fountas and Jyh-lin Wu. (Published in the *International Economic Journal*, Vol. 13, No. 3, 1999).

No. 19 December 1997 “Testing for Monetary Policy Convergence in European Countries,” Donal Bredin and Stilianos Fountas. (Published in the *Journal of Economic Studies*, Vol. 25, No. 5, 1998).

No. 18 September 1997 “New Fields of Employment: Problems and Possibilities in Local and Community Economic Development,” Michael J. Keane.

No. 17 September 1997 “Estimation of the Impact of CAP Reform on the Structure of Farming in Disadvantaged Areas of Ireland,” Eithne Murphy and Breda Lally.

No. 16 May 1997 “Exchange Rate Volatility and Exports: the Case of Ireland,” Stilianos Fountas and Donal Bredin. (Published in *Applied Economics Letters*, Vol. 5, No. 5, 1998)

No. 15 May 1997 “Tests for Interest Rate Convergence and Structural Breaks in the EMS,” Stilianos Fountas and Jyh-lin Wu. (Published in *Applied Financial Economics*, Vol. 8, No. 1, 1998)

No. 14 May 1997 “Cointegration Tests of the Profit-Maximising Equilibrium in Greek Manufacturing 1958--1991,” Theodore Lianos and Stilianos Fountas. (Published in *International Review of Applied Economics*, Vol. 11, No. 3, 1997)

No. 13 April 1997 “Agriculture and the Environment in Ireland: Directions for the Future,” Eithne Murphy and Breda Lally. (Published in *Administration*, Vol. 46, No. 1, 1998)

No. 12 March 1997 “Male Mortality Differentials by Socio-Economic Group in Ireland,” Eamon O'Shea. (Published in *Social Science and Medicine*, Vol.45, No.6, 1997)

No. 11 July 1996 “Testing for the Sustainability of the Current Account Deficit in Two Industrial Countries,” Jyl-Lin Wu, Stilianos Fountas and Show-Lin Chen. (Published in *Economics Letters*, Vol. 52, No. 2, 1996)

No. 10 April 1996 “Towards Regional Development Programmes in Russia,” Michael Cuddy.

No. 9 April 1996 “Uncertainty in the *General Theory* and *A Treatise on Probability*,” Joan O'Connell.

No. 8 December 1995 “Some Evidence on the Export-Led Growth Hypothesis for Ireland,” Stilianos Fountas. (Published in *Applied Economics Letters*, Vol. 7, No. 4, pp. 211-214, 2000).

No. 7 November 1995 “Caring and Theories of Welfare Economics,” Eamon O’Shea and Brendan Kennelly.

No. 6 September 1995 “The Relationship Between Inflation and Wage Growth in the Irish Economy,” Stilianos Fountas, Breda Lally and Jyh-Lin Wu. (Published in *Applied Economics Letters*, Vol. 6, No. 6, 1999).

No. 5 September 1995 “Quality and Pricing in Tourist Destinations,” Michael J. Keane. (Published in *Annals of Tourism Research* , Vol. 24, No. 1, 1997)

No. 4 September 1995 “An Empirical Analysis of Inward Foreign Direct Investment Flows in the European Union with Emphasis on the Market Enlargement Hypothesis,” Kyriacos Aristotelous, Stilianos Fountas. (Published in the *Journal of Common Market Studies* , Vol. 30, No. 4, 1996)

No. 3 September 1995 “The Social Integration of Old People in Ireland,” Joe Larragy and Eamon O’Shea.

No. 2 September 1995 “Caring and Disability in Long-Stay Institutions,” Eamon O’Shea and Peter Murray. (Published in the *Economic and Social Review*, Vol. 28, No. 1, 1997)

No. 1 September 1995 “Are Greek Budget Deficits ‘too large?’” Stilianos Fountas and Jyh-lin Wu. (Published in *Applied Economics Letters*, Vol. 3, No. 7, 1996).

Enquiries:

Department of Economics,
National University of Ireland, Galway.

Tel: +353-91-524411, ext. 2177

Fax: +353-91-524130

Email: claire.noone@nuigalway.ie

Web: <http://www.nuigalway.ie/ecn/>