J Evol Econ (2013) 23:39–60
DOI 10.1007/s00191-012-0268-2

REGULAR ARTICLE

The impossibility of rational consumer choice

A problem and its solution

Jakob Kapeller · Bernhard Schütz · Stefan Steinerberger

Published online: 14 April 2012

Abstract In this paper we show that a rational consumer choice along the lines traditionally suggested might lead to paradoxical results if one considers multidimensional goods, which incorporate a series of incommensurable aspects. Thereby, we explore the similarity between the resulting paradox and Kenneth Arrow's well known Impossibility Theorem. Based on these considerations we suggest a solution for the former problem along the lines of Herbert Simon and Amos Tversky, which might—if driven to its extreme—even provide a unique *and* arguably rational solution for consumer choice among multidimensional goods. Eventually, we argue that the resulting framework poses a potentially useful starting point for further developing an evolutionary theory of consumer choice.

Keywords Demand · Consumption · Rationality · Choice · Evolutionary economics

JEL Classification B52 · D01 · D11 · D71

J. Kapeller (✉)
Department of Philosophy and Theory of Science, University of Linz,
Altenbergerstraße 50, 4040 Linz, Austria
e-mail: jakob.kapeller@jku.at

B. Schütz
Department of Economics, University of Linz, Altenbergerstraße 69,
4040 Linz, Austria
e-mail: bernhard.schuetz@jku.at

S. Steinerberger
Mathematical Institute, University of Bonn, Endenicher Allee 60,
53115 Bonn, Germany
e-mail: steinerb@math.uni-bonn.de

1 Introduction

The standard economic model of rational choice, which serves as a basic starting point of our endeavour can be most easily summarised by identifying its main axioms. According to a classical formulation (Savage 1954), which is in line with most modern versions as found in economic research and teaching (Mas-Colell et al. 1995; Varian 1992; Sugden 1991), a rational agent can be described by the following attributes.

(1) Completeness—the agent is fully informed about all possible alternatives.[1]
(2) Ordinality—the agent is able to rank all possible alternatives in terms of 'better' and 'worse', but cannot quantify these differences.
(3) Consistency—this ranking is consistent, that is, based on a transitive preference ordering.
(4) Optimisation—the agent optimises her expected returns/utility based on this ranking.

Such a theory is employed in a positive as well as normative way. The former variant utilises the framework of rational choice for analysing, interpreting or explaining real-world decisions while the latter invokes rational choice as the hallmark of reason.

This article tries to explore the effect of complex, multidimensional alternatives within this setup. It is based on the idea that, in practice, *the alternatives to choose from are not necessarily identical to the alternatives ranked by the individual's preference ordering.*[2] This is the case if we are unable to rank alternatives directly but only certain (indecomposable) properties or characteristics of these alternatives. Here we make use of this idea when referring to the case of choosing among different consumption goods.

The structure of this paper is as follows: Section 2 introduces the basic concept of multidimensional goods. Combining this concept with the traditional axioms of rational choice leads to an 'Impossibility Theorem of Rational Consumer Choice' which is presented in Section 3. Section 4 is dedicated to evaluating this result and sketching a possible strategy to avoid it. Based on these considerations we develop a procedure circumventing the impossibility problem in Sections 5 and 6 by introducing a broader, more flexible and most probably more realistic conception of rationality. In Section 7 we develop our model in more detail and show how it relates to current research on con-

[1] Or, in a more modest sounding formulation, is able to rank any two given alternatives over the whole set.

[2] There is a vast amount of literature based on this basic idea, with various fields of application such as environmental economics or supply chain management (see exemplary Arrow and Raynaud 1986; Pohekar and Ramachandran 2004; Mendoza and Martins 2006; Wang et al. 2004). However, we have not come across a contribution which applies an ordinal variant of this framework on traditional consumer choice theory in full depth.

sumer behaviour in Evolutionary Economics. Section 8 offers some concluding thoughts.

2 The case of multidimensional goods in consumption

The concept of multidimensional goods was introduced in the seminal work of Kelvin Lancaster (1966; see also Lancaster 1971), where he argues that

> The chief technical novelty lies in breaking away from the traditional approach that goods are the direct object of utility and, instead, supposing that it is the properties or characteristics of the goods from which utility is derived. We assume that consumption is an activity in which goods, singly or in combination, are inputs in which the output is a collection of characteristics. (Lancaster 1966, 133)

This very well resembles the general problem mentioned in the introduction that *the alternatives to choose from (different goods) are not necessarily identical to the alternatives ranked by the individual's preference ordering (different characteristics of these goods)*. In short, Lancaster argues that any good possesses a variety of aspects, different dimensions, which are distinct as well as incommensurable and have a decisive impact on consumer behaviour. Lancaster amounts to infer from this approach how different types of consumption goods are related, e.g. why some combinations of goods are substitutes or complements, issues on which traditional theory had little to say. Thereby, Lancaster claims his approach to be applicable to any domain of consumption goods including even the simplest ones.

> A meal (treated as a single good) possesses nutritional characteristics but it also possesses aesthetic characteristics, and different meals will possess these characteristics in different relative proportions. (Lancaster 1966, 133)

In Lancaster's spirit we would argue that the existence of different dimensions (that are 'alternatives to rank') in consumption goods (which represent the 'alternatives to choose from') are not restricted to any specific types of goods but constitute a general phenomenon. Quite on the contrary, it seems hard to imagine any product that can be ranked according to a single criterion. In any case, neither acceptance nor rejection of this point of view has any implications on the validity of our reasoning, however, it does determine its scope.

According to Einav and Levin (2010) this very basic idea of Lancaster's analysis is still a commonplace in the mainstream economic field of industrial organisation.[3] Their description of a multidimensional good is less general and has a modern leaning, but still resembles Lancaster's original description.

[3]Within heterodox economics Lancaster's conception is used by a variety of authors including at least post-Keynesian (Lavoie 1994) and evolutionary approaches (e.g. Nelson and Consoli 2010).

> The typical situation in most industries is that consumers face a choice of products that vary along different dimensions. Product differentiation bestows firms with a degree of market power. For instance, one factor weighing into Apple's pricing of the iPhone is that some consumers just prefer the iPhone to comparable phones made by Palm or Nokia. Moreover, consumers who value the iPhone interface may be different from those who value the Blackberry's ability to synch with corporate email servers. (Einav and Levin 2010, 148)

Buying a car provides another simple example: Any ordinary car has a series of at least partially incommensurable characteristics, like design, size, colour, speed, acceleration, technical reliability or safety properties, to just name a few. Each of these characteristics provides a qualitatively different dimension along which the convenience of any given car might be judged.

The common ground of these descriptions of non-decomposable[4] multidimensional goods is the absence of a single benchmark in order to evaluate the different dimensions associated with a given product on a one-dimensional scale. This introduces a certain complexity in consumer choice carrying interesting properties, which have been exploited in some well known experimental setups. One of these setups[5] (May 1954) very early showed that combining an ordinal understanding of utility with multidimensional 'goods' (in May's case it was actually a choice between possible spouses differing in intelligence, beauty and wealth) might lead to cyclical, that is intransitive, rankings and, thus, violate the consistency requirement incorporated in the very same model. The next section shows how such a paradoxical result is 'natural' in the sense that it might arise even when respondents are playing by the standard rules of rationality as sketched in Section 1.

3 Why rational choice might be inconclusive with regards to multidimensional goods

An interesting implication of the concept of multidimensional goods in rational choice is that a 'rational choice' might be inconclusive if guided by the four axioms proposed at the beginning of the paper. It is well known that if the alternatives to rank differ from the alternatives to choose a paradoxical situation might occur, that is structurally equivalent to the famous results of Condorcet ('Condorcet-Paradox' 1785) and Arrow ('Arrow's Impossibility Theorem' 1950, 1951).

[4]One might differentiate three types of multidimensional goods: (a) goods with different and competing ends (e.g. meat to feed me or my dog), (b) decomposable goods (a good with different parts, e.g. a suit decomposable into a shirt, a jacket, trousers...), where the different dimensions might be separated from each other and (c) non-decomposable goods (as the car in the example above). In this article we only refer to the third type where the different dimensions of a specific good are not decomposable (see Bianchi (1997) for further examples).

[5]See also Tversky and Shafir (1992).

Table 1 Comparing three cars along three dimensions

	Speed	Safety	Design
Car A	∘	∘	+
Car B	++	−	∘
Car C	+	+	-

Table 1 represents such a contradicting example comparing three different cars along three different dimensions (all remaining possibly relevant characteristics, including price, are assumed to be equal). While the former represent the alternatives to choose from, the latter are identified with the characteristics along which these alternatives might be ranked. To capture the main idea of the ordinality of rankings we use symbols to depict the performance of the cars in each dimension—such symbols may be ranked (in ordinal terms of better or worse), but not quantified (differences can not be expressed in meaningful numbers).

Assuming that each of the above dimensions is of equal weight[6] the decision for the right car becomes an intriguing issue. So how do we cope with a situation as illustrated in Table 1, where our fictitious showcase-individual argues that 'I like the design of car A, while I do not like the design of car C very much and think that the design of car B is okay', and makes a similar statement for all other relevant dimensions too? The economists' standard answer is of course a 'money-metric' approach, that is to recur to the idea of compensation to quantify these differences in monetary terms by asking the consumer how much money he would demand in order to bear the worst design as compared to the best. Regrettably, such an approach is not compatible with two of our basic assumptions, namely an ordinal utility-ranking (this suggestion would amount to cardinalise the expected utilities of the different product-characteristics) and the supposed multidimensionality of goods (which would be reduced to a single 'value-for-money' benchmark).

An alternative decision routine, which is compatible with optimisation as well as ordinal rankings is that the consumer will engage in pairwise comparisons of the available goods. It seems reasonable to argue that—if all dimensions are of equal importance—the consumer will select the product which dominates the others in a majority of dimensions. However, as indicated in the above case, this principally plausible strategy nevertheless results in a cyclical choice: When choosing between car A and B, she will take car A since it beats car B in design and safety. If she had to choose between car B and C, she would pick car B, since it's faster and has got a better design. It looks as if we had $A \succ B \succ C$. If she, however, had to choose between A and C, she would pick C, since it's safer and faster. Therefore, a

[6]In an *ordinal* setup a weighting of the different dimensions does not represent a well-defined problem since it remains, due to the incommensurability between dimensional weights and concrete product performance within a certain dimension, unclear whether the decision should be based on *either* weight *or* concrete performance (with the exceptional case where all weights are exactly equal for all the relevant dimensions, which again reduces to our standard scenario).

pairwise comparison of the different cars leads to the following ranking, which represents an intransitive preference ordering.

$$A \succ B \succ C \succ A$$

The agent can therefore not choose 'rationally' according to the standard definition of a rational preference relation.[7] Quite on the contrary, she is pitifully stuck in a vicious circle. This is what we term the 'Impossibility of Rational Consumer Choice'.

The striking similarity between the problem posed here and the results of Condorcet and Arrow have their common focal point in the difficulty of integrating complex individual micro-structures into a collective rational choice framework on the macro-level. In the case of Condorcet or Arrow, this complex structure resides in the possibility that people might have different preferences (or utility functions). If we assume preferences to be constant over the whole population (Stigler and Becker 1977) the posed problem vanishes (as does the paradox of multidimensional goods if we assume goods to be one-dimensional). In the case of multidimensional goods the inner-dimensional rankings of products play exactly the same role as do individual preference orderings in the case of Condorcet and Arrow. They all are the source of the complexity in their respective problems. We explore this structural equivalence between Arrow's Impossibility theorem and its cousin on consumer choice on a formal level in the Appendix.

4 Shifting the perspective: why a rational solution might nonetheless be feasible

There are of course a variety of possibilities to evade this problem, most easily by changing the underlying assumptions. One could abstain from (1) purely ordinal rankings, (2) the consistency requirement (see Sugden 1985) or (3) the assumption of multidimensional goods to eschew the above result. However, if we read the multidimensionality of goods as its Arrowian equivalent—distinctive utility functions—these arguments would also apply for the original Impossibility Theorem and are therefore rather well known.

In contrast to these approaches we propose a different solution, namely to give up the assumption of *optimisation*. This could be justified by claiming that optimisation is not what we observe when looking at actual consumer behaviour. In this context Herbert Simon argues that

> For most problems that Man encounters in the real world, no procedure that he can carry out with his information processing equipment will

[7] We would get a similarly paradoxical result if the individual cared equally about speed and design but not at all about safety. In this case $A \succ B$ because it is better in both dominant categories. Furthermore $B \sim C$, since each of them is better than the other in one of the dominant categories. However for the same reason $C \sim A$. In sum we get the rather impossible result $A \succ B \sim C \sim A$, which strongly resembles the results presented in Arrow (1950).

> enable him to discover the optimal solution, even when the notion of 'optimum' is well defined. There is no logical reason why this need be so; it is simply a rather obvious empirical fact about the world we live in—a fact about the relation between the enormous complexity of that world and the modest information-processing capabilities with which Man is endowed. (Simon 1976, 135)

However, our point against optimisation does not rely solely on an argument about empirical adequacy. Quite on the contrary, we argue that in this context it is thoroughly *rational* to give up the ambition to 'optimise' one's result. If optimisation is not a tractable target of an otherwise rational operation (as defined in Section 1), no matter whether this is due to painstaking complexity (as in Simon) *or* indefinite results (as in the impossibility-case above), then it seems most plausible to change the aim of the very same, otherwise fully rational operation. So if optimisation for some reasons were impossible, it would seem quite rational to search for an alternative approach to guide one's decision.

The most obvious candidate for such a manoeuvre is Simon's concept of a satisficing choice (Simon 1955, 1956). The term satisficing is a combination of the words 'satisfying' and 'suffice' and represents an attempt to approximate actual human decision-making in a complex environment. The presupposition is that individuals have an aspiration level when choosing between different options. The individual will take the first option satisfying this requirement. A hungry person for example may have the minimum requirement that the chosen meal is satiable, does not exceed a certain price and provides some minimum taste experience. Since the offer of potential meals is enormous, the individual does neither possess all necessary information nor the cognitive capacity to do optimisation, therefore she stops searching when she finds the first meal that satisfies her needs.

In contrast to Simon, the empirical appropriateness of the assumptions underlying optimisation is not decisive for our argument. Although we define fully informed individuals as knowledgeable on any aspect of a certain product (meaning that they are familiar with the full spectrum of relevant product dimensions) and additionally as possessing unlimited cognitive abilities, any decision procedure might nonetheless be inconclusive when accounting for the multidimensionality of goods. This result is, as already indicated, due to the ordinal nature of inner-dimensional rankings, which cannot be summarized into single benchmark by means of any calculus (such a procedure would necessarily imply their 'cardinalization').

In other words, we presume that understanding the human 'mind as the scarce resource' (Simon 1978, 9) is a sufficient, but not necessary condition for establishing the rational character of satisficing behaviour. Quite on the contrary, the introduction of multidimensional goods also serves as a sufficient condition for satisficing behaviour, even if we assume that consumer knowledge is indeed complete, thereby offering a new form of justification for utilising a satisficing approach to consumer choice. Note that, while

'completeness' also refers to the full variety of different product dimensions, this does not preclude the possibility that novel product dimensions might arise exogenously—an issue we will revisit in Section 7.

However, though the adoption of satisficing avoids paradoxical results, the outcome may still be unsatisfactory in the sense that the set of acceptable alternatives may be very large when the aspiration level is low. This comes from the fact that our decision problem does not involve any search activity. Our individual already knows about the available set of cars, therefore any of these cars that passes the minimum requirement is a possible solution and the individual is by definition indifferent between them in that particular moment. Furthermore, while it may be justifiable to assume that a hungry person will choose the first meal that satisfies her aspiration level, this assumption may be less appropriate when the decision is about more expensive goods, like cars. An individual looking for a car will usually not buy the first one that passes her minimum requirements. Based on these considerations we will, contrary to Simon, sustain the assumption of complete information to explore the implications of our argument for these more important and more consciously planned consumption choices.

Therefore we have yet to add another feature to our decision process, which Tversky (1972) refers to as *choice by elimination*. Accounting for the multidimensionality of goods, Tversky proposes a decision routine where in each round the individual sets an aspiration level for *one* dimension. Every alternative not fulfilling this single requirement is eliminated. In the next round, she puts a minimum requirement on another dimension and again those goods, which fail to satisfy this criterion are dismissed. In this context the concrete ordering of decisions with respect to specific dimensions is decisive: Changing the succession of decisions might lead to different probabilities for certain outcomes, since the evaluation for each dimension is modeled as a distinct act.

In contrast to Tversky, we propose that individuals do not evaluate 'one dimension after another', thereby leading to a successive elimination of dimensions and goods throughout the decision process, but consider all dimensions instantaneously by assigning specific 'threshold values' or 'aspiration levels' to every dimension. These aspiration levels in turn determine a set of goods, which fulfills these basic requirements. The main difference between Tversky's and our approach is, thus, that all aspects of a given set of goods are evaluated simultaneously.

5 Satisficing choice by sequential elimination

Combining Tverky's basic idea of sequential eliminations with Simon's concept of satisficing choice yields a solution to the posed impossibility problem: Therefore we suppose that every individual has a certain aspiration level in each category and all these aspiration levels are applied to a given set of goods simultaneously. Every alternative that meets those minimum

requirements belongs to the set of acceptable solutions. Although individuals are fully informed on all relevant product dimensions, they are not forced to consider them all relevant but may also disregard certain dimensions entirely. From a technical perspective this implies that aspiration levels in disregarded dimensions are set at the lowest value.

In such a scenario there are three possible outcomes: First, if the result of this operation is the empty set, there will either be no product chosen or aspirations have to be lowered in the next round. Second, if the resulting set consists of only one good, the solution is maximal and rational in the sense that it meets the other requirements outlined in Section 1 (consistency, completeness and ordinality). Third, if the set consists of more than one alternative, the resulting situation is more complicated than in the first two cases, since the individual is by definition indifferent between all the remaining goods (all these fullfill her basic requirements). In such a framework there are various possible ways how to move on; these will be explored in the following sections.

Let us consider some examples first (Fig. 1): Assume an individual whose aspiration level is such that she wants her car at least to be 'acceptable' (which corresponds to '○' in our scale) in each category, and call her a 'balanced' individual. In this case car *B* and *C* drop out, leaving car A as the optimal choice. Now think of an individual heavily concerned about safety issues while being overly modest in other respects—a 'paranoid' individual so to say. The only thing such a person cares about is that the car is 'extremely safe' (corresponding to '++' in our scale), while accepting any performance in speed and design (corresponding to an aspiration level of '– –' in our scale). In turn the set of the remaining acceptable alternatives would be empty. This individual would either not buy a car at all or would have to stop worrying so much about safety, which is equivalent to lowering her aspiration level in this category (which would then leave her with car *C*).

Next consider an individual who only wishes a car's design to be acceptable ('○'), but has a rather low aspiration level in speed and safety (say '–' in our scale), let us call her an 'aesthetic' individual. In this case, only car *C* is eliminated, leaving her indifferent between car *A* and *B*. Next, she could

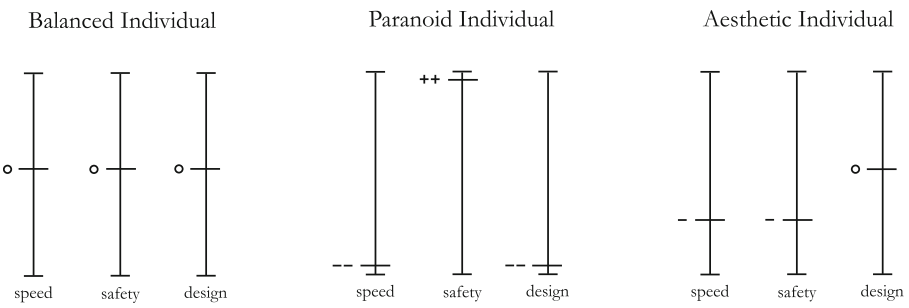

Fig. 1 Aspiration levels for three types of individuals

either increase her aspiration level in speed, safety or design, but also in two or all three of them, or choose according to some other scheme or heuristic. Increasing her aspiration level in design, safety or both of them would leave her with car A. Doing so only in the speed-category would keep her indifferent, which would require a third round. In this round increasing her aspiration level in safety and/or design would make her choose car A, further increasing it only for 'speed' would make her choose car B. If she increases her aspiration level in speed and any of the two other categories, this would leave her with an empty set. In this case, she would have to lower it again in either 'speed' (leaving her with car A) or any of the two other categories (leaving her with car B). The following section delivers a formal definition of such a solution procedure.

6 A formal sketch

We assume a customer has to choose a product from a set of n products $\mathcal{P} = \{p_1, p_2, \ldots, p_n\}$, which are supposed to be ranked among m dimensions. The ranking within each dimension is ordinal in nature, which can be modelled by assuming for each dimension the existence of a ranking function $f_i : \mathcal{P} \to \{1, 2, \ldots, n\}$ such that

$$p_j \succcurlyeq_i p_k \Leftrightarrow f_i(p_j) \geq f_i(p_k).$$

This function has the purpose of assigning a rank to each product (i.e. 'the best', 'the second best'). Note that, as soon as two products are ranked equally within one dimension, the function will no longer be bijective, but instead rank several products equally. An example of such a function is given by

$$f_i(p_j) = \#\left\{1 \leq k \leq n : p_k \preccurlyeq_i p_j\right\},$$

which simply counts the number of products ranked lower or equal. It is important to see that this ranking does not cardinalise the problem: the numbers $\{1, 2, \ldots, n\}$ are here solely used to denote n different symbols, which themselves are ordinally ranked via the usual relations $\leq$ and $\geq$—one could as well use symbols along the lines of $\{\square, \nabla, \ldots\}$ with a given ranking of these symbols (for example $\square \leq \nabla \leq \ldots$). We will not use the symbols $\{1, \ldots, n\}$ in any cardinal fashion except with respect to their ordering properties (or, put differently, we do not cardinalise the problem any more than it is already cardinalised for a linear transitive ordering already gives meaning to 'the best', 'the second best' and so forth).

Formally, our solution is now given by the following schematic procedure.

Procedure

(1) Define the initial set of feasible elements $\mathcal{F}_0$ by $\mathcal{F}_0 := \mathcal{P}$.
(2) Define the criterion vector $\boldsymbol{a} \in \{1, 2, \ldots, n\}^m$, which describes the minimal requirement a satisfactory product has to satisfy within each dimension and set it to $\boldsymbol{a} := (1, 1, \ldots, 1)$.

(3) Update the criterion vector $\boldsymbol{a} := (a_1, a_2, \ldots, a_m) \in \{1, 2, \ldots, n\}^m$.
(4) Update the feasible set

$$\mathcal{F}_{k+1} := \mathcal{F}_k \setminus \left\{ p_j \in \mathcal{P} : \exists_{1 \leq i \leq m} f_i(p_j) < a_j \right\}$$

(5) Evaluate.

- If $\mathcal{F}_k = \emptyset$ then either no product is feasible or the procedure has to be restarted with lowered aspirations.
- If $\mathcal{F}_k = \left\{ p_j \right\}$ then p_j constitutes a rational and unique choice among given circumstances.
- If $\#\mathcal{F}_k \geq 2$, then either select an element according to a prescribed scheme (e.g. random choice; see Section 7 for a further elaboration of this aspect) or go to step 3.

Let us remark that the precise setup of this procedure actually implies that within each update of the criterion vector $\boldsymbol{a}$ each coordinate a_i is either increased or remains the same. If a certain aspiration level is not increased during any update it remains at the lowest possible value and represents the case of a disregarded dimension. Decreasing the coordinate a_i will have the same effect as keeping it the same because all products with lower qualities within dimension i have already been eliminated from the feasible set $\mathcal{F}_k$ in the previous step. Therefore, if reducing the aspiration level should have an impact, the decision procedure has to be re-initiated at step (1).

Furthermore, it is of course possible to introduce a backtracing step, which, when encountering $\mathcal{F}_k = \emptyset$, will allow the consumer to go back to the last setting where this was not the case, but we did not include this in the formal description for reasons of brevity.[8] As is evident in the above procedure the case $\#\mathcal{F}_k \geq 2$ of a non-unique solution is formally equivalent to the original form of the problem. Coming from a psychological point of view it is indeed conceivable that once the feasible set $\mathcal{F}_k$ has been reduced by means of several updates and if furthermore the consumption choice is not an important one (i.e. buying napkins instead of cars) the consumer will indeed employ a random choice of elements or some other simple heuristic (e.g. the 'most balanced' choice, a habitual choice or a choice maximising a single criterion...).

However, from an abstract point of view, if a consumer does indeed accept the above procedure as a rational means to deal with the problem of consumption choice, it will follow that the only possible generally prescribable, that is normatively defendable, scheme used to deal with nonunique solution will be the above procedure itself (and hence the jump to step 3). If the consumer were to apply a different method one would be inclined to ask why the consumer did not use this procedure in the original problem. Cognitive limitations and lack of information are, of course, obvious candidates to answer this question. Moreover, once the above procedure has reduced the set of feasible options,

[8] Formally, this can be obtained within the above scheme by reiterating all but the last update of the criterion vector in the same order.

then indeed another scheme might be appropriate, i.e. random choice if the set is already sufficiently homogeneous or deciding by means of the ranking within a single dimension if the products are effectively identical with respect to all but one dimension. Note that the examples of random choice or choosing by looking at a single dimension can only be said to constitute (normatively) rational choices for a very small set of initial products $\mathcal{P}$ and rankings f_i and the preceding simplification step given by the above procedure can truly be said to be necessary.

An interesting property of the suggested procedure is that although it eschews the optimising principle, it still delivers a maximising solution, if maximisation is loosely defined as picking an alternative, which is not judged worse than any other. Sen (1997) elaborates this difference between optimisation and maximisation on various levels.[9]

7 Adjustment strategies

So far nothing has been said about the prescribed schemes mentioned in step (5) of our solution procedure. From an analytical perspective, an agent's behavioural options can be exhaustively illustrated by the following three basic alternatives namely,

(1) choice by using an idiosyncratic or erratic heuristic (habitual choice, random choice, pick the first, pick the average...),
(2) selecting a single decisive criterion or dimension along which to choose (the cheapest, the fastest...) or
(3) updating the whole criterion vector.

The first option is relatively trivial: A deliberatively choosing entity may always stop further inquiry or evaluation and simply *choose* according to some heuristic, which does not necessarily contribute to a well-considered choice, but simply ends the process of deliberation. Habitual preference formation and learning effects are one aspect within option (1) often associated with path dependent developments. It is the most obvious procedure within this category given that at least one satisfying past consumption experience with a certain product exists. Such experiences serve as a trigger for the formation of consumption routines. Since habitual choice constitutes a relatively well-explored issue in evolutionary consumption theory (see Loasby 2001, Metcalfe 2001 and the literature cited in Nelson and Consoli 2010), this paper focuses

[9] "The characterisation of *maximising behaviour as optimisation*, common in much of economic analysis, can run into serious problems [...], since no *best* alternative may have been identified for choice. In fact, however, optimisation is quite unnecessary for 'maximisation', which only requires choosing an alternative that is not judged worse than any other. This [...] is also how 'maximality' is formally defined in the foundational set theoretic literature." (Sen 1997, 746, Italics in original) Optimisation, on the contrary, implies the existence of some kind of mathematical extreme value problem.

on other aspects more closely related to 'conscious thinking' in contrast to the role of 'routine or habit' (Nelson and Consoli 2010, 669).

The second option is also based on a simplifying heuristic, but still exhibits an evaluative character. In this case, the evaluation process focuses on the most relevant aspect, given that some other basic requirements are fulfilled ('one-reason decision making' in the spirit of Gigerenzer and Todd 1999). Thereby it is important to note that this strategy only works when using a single dimension for a final evaluation. If more than one dimension is utilised in this process, then one must, in order to avoid incommensurabilities, update the whole criterion vector, that is, following option (3). Thus, the three behavioural options lined out here are exhaustive as well as disjunctive.

It is quite obvious that option (3) is the most complex and most sophisticated procedure among these three options, which implies that it is presumably and despite its advantages in terms of precision not always practically utilised. Our conjecture is that the utilisation of option (3) is strongly related to empirical criterions relevant for the decision at hand. We would suggest the following hypotheses on this relation in detail: We presume that the utilisation of option (3) (in contrast to the other two possibilities) is positively correlated with (a) the stakes involved in the respective choice act (buying a car vs. buying chewing gum; Nelson and Consoli 2010, 673), (b) the amount of goods left in the set of feasible elements (two goods left vs. one-thousand goods left) and (c) the satiation of acquired wants in contrast to basic needs (Witt 2001). In this context basic needs refer to those desires, which directly follow from human genetical endowments (the need for air, food, sexual engagement, warmth and so on), whereas acquired wants are represented by habitually formed or socially mediated preferences for certain (types of) consumption goods. So our last hypothesis can be traced back to an empirical argument about differing satiation patterns as related to different forms of consumption needs. Additionally, one should note that the sphere of acquired wants is also a potential origin of completely novel dimensions becoming relevant through social change or product innovation (Witt 2001).[10]

In this context, a further differentiation of this conception might be most helpful for a more pronounced elaboration of our argument. Witt himself (2001, 26–28) proposes a further distinction within the realm of basic needs and distinguishes those basic needs, which may be satiated by certain direct physiological inputs (air, food, medicine) and those, which are satiated by the utilisation of *services* as provided by a series of *tools* (clothes or heating facilities to keep body warmth constant or television sets as a tool for satisfying the need for cognitive arousal). Given that the empirical argument of different satiation levels for different categories of human consumption needs also

[10]Learning would be another empirically relevant and more endogenous source of creating new wants and thereby 'discovering' new product dimensions (as heavily emphasized by Witt (2001)). Exploring this issue would, however, force us to retain the assumption of completeness, which is beyond the scope of this paper: our aim is to illustrate what happens if one drops the assumption of optimisation.

applies to this distinction (satiation levels on direct inputs are relatively more binding than those on services provided by tools), one is tempted to refine the above hypothesis (c) by proposing a certain order for the probability of an update: The probability of the utilisation of option (3)—updating the criterion vector—is highest for acquired wants, followed by services of tools and direct inputs, where the latter two are dedicated to the satiation of basic needs.

A similar argument can be made for the sphere of acquired wants—a case in which Witt (2001) emphasises the importance of cognitive and non-cognitive learning effects, which may be individually anchored or culturally mediated. Especially when it comes to the role of culturally mediated preferences two different types of influence are regularly distinguished. Broadly speaking, one might differentiate between (a) the wish for social integration and (b) the striving for a specific and distinct individual identity. In the former case one is using other members of one's community as a reference level (Rabin 1998) for estimating the *conventional consumption standards* of a given community, whereas in the latter case one is searching for *identity markers*, which allow for a certain 'individualistic differentiation' with respect to the rest of the community. In mainstream economic literature, these two distinct consumption motives have been referred to as the 'bandwagon' and the 'snob' effect on the level of market demand (Leibenstein 1950; see Mayhew 2002 for a critique). However, the basic distinction stems nonetheless from an institutional perspective, which is evidenced by the writings of one of its most prominent historical archetypes:

> For the great body of people in any modern community, the proximate ground of expenditure in excess of what is required for physical comfort is not a conscious effort to excel in the expensiveness of their visible consumption, so much as it is a desire to live up to the conventional standard of decency in the amount and grade of goods consumed. (Veblen 1899, 49; see also: Peukert 2001, especially note 20 on page 552)

Whereas Veblen emphasises the quantitative importance of conventional standards over identity markers, he readily acknowledges the existence of both motives and their possible impact on consumption activities. In the context of the present paper, we suggest to further differentiate acquired wants along these lines, where the conventional standards represent those consumption requirements, which are perceived as necessary in order to participate in a given community. In modern western civilisations some types of requirements—for instance the need for mobility or digital communication—are interpreted as quite natural requirements, although they do not follow directly from human genetical endowment, but are eventually socially mediated preferences. Identity markers on the other hand allow for some kind of individualistic differentiation signalling a specific social or cultural position. Quite in contrast to the conventional standards they are prone to lead to a kind of social distinction rather than to social integration. Both effects might trigger preference changes in a given society or community. In some cases, where formerly disregarded dimensions gain in importance because they become (part of)

a social convention, one could speak of 'fundamental' preference changes. Similarly, both effects may be related to the creation of novel dimensions.

Figure 2 summarises this conceptualisation of different needs. Additionally it shows how the distinction between conventional standards and identity markers complements our hypothetical framework, since we suggest that in the case of a search for identity markers the probability of an update of the criterion vector is highest and followed by conventional standards, indirect services (provided by tools) and direct inputs.

So far we utilised this distinction of different types of consumption motives for discussing the probability of updating the criterion in contrast to the other two basic behavioural options an agent faces. However, one could additionally explore the idea how these motives relate to the concrete form of an updated criterion vector. In this context, one should note that all four kinds of human requirements correspond rather well to what we called product dimensions. This smooth alignment between the theory of needs and wants and our argument related to the multidimensionality of goods allows for the introduction of further empirical hypotheses directly related to an update of the criterion vector, that is, to possible adjustment strategies. A direct consequence of this connection would be the assertion that, in case of an update (i.e. the formation of a new criterion vector $\mathbf{a}^*$), the probability that the aspiration level in a certain dimension is raised follows the same order as suggested above, identity marker > conventional standard > indirect services > direct input.

Let us illustrate this idea by using two short examples. First, imagine a situation where a person's basic need for caloric energy is satiated by eating a hamburger for lunch. In this case it seems plausible that, when raising consumption ambitions, this increase is related to other dimensions than nutritional value (for instance to taste experience representing a typical example of an acquired want; see Mayhew 2002). Another example is provided by the clothing industry, where the fulfilment of basic needs—like the need for body warmth—is in many cases not the decisive criterion for consumption choice. Quite on the contrary the rising importance of brands of labels in this sector suggests that both kind of acquired wants—conventional standards as well as identity markers—play a decisive role in this context. In sum, we think there are various ways to align the concept of multi-dimensional goods with

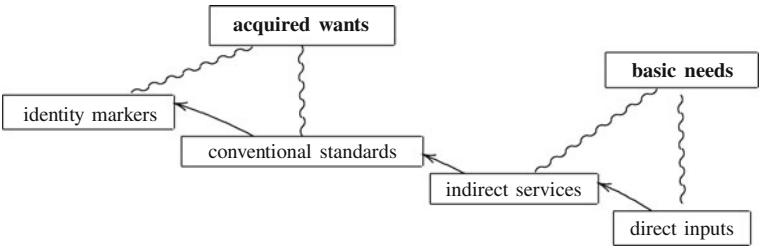

Fig. 2 Chances of triggering an update in relation to different consumption needs (*arrows* point to higher likelihood)

the theory of needs and wants as proposed by Witt (2001). They seem rather complementary, leading to an empirical enrichment of the more analytical arguments offered in the preceding sections.

Note, however, that the suggested alignment between product dimension and human needs is not always as unambiguously as in the above examples. When returning to our prime case—the choice which car to buy—we may get a grasp for the potential difficulties and complexities which may arise from such an interpretation. Taking the 'speed-dimension' as a starting point, we immediately observe that some minimal performance in this category is necessary in order to fulfil conventional societal standards. On the other hand, however, very high values in this category are a clear sign that this dimension is utilised as an identity marker, since very fast cars are normally associated with a distinctive kind of societal prestige. Thus, in this case we observe a gradual change of motives, where the motive for social integration is replaced by the motive for social differentiation if the speed of the selected car rises. Introducing plausible threshold values in order to differentiate these two competing motives could depict such a change. In the concrete case it seems plausible to relate these threshold values to the average values as they are found in the respective reference population: Choosing a car with a speed-value comparable to other members in the same community is motivated by conventional standards, choosing a much higher speed level is motivated by identity markers. So there could be changes of motives within the same dimension depending on the intensity with which the consumer pursues a certain dimension.

In a similar sense the attribution of product dimensions to identity markers and conventional standards might fluctuate over time (Nelson and Consoli 2010, 683), simply because

> yesterday's novel pleasures become today's habits and tomorrow's socially defined necessities. (Ackerman 1997, 658; see also Reinstaller and Sanditov 2005).

This implies that the social impact on preferences might not only lead to 'fundamental' preference changes, such that formerly disregarded dimensions might now be taken into account (novels becoming necessities), but also allows for the creation of completely new products or product dimensions through certain types of innovation (the emergence of novelties). Whereas in the case of new products a new decision procedure has to be initiated at step (1), the introduction of new product dimensions in a certain category requires redefining the relevant criterion vector (step (2)). Finally, a ('fundamental') change in preferences requires a simple update of the existing criterion vector (step (3)). Interestingly, the converse case, a formerly important dimension becoming disregarded requires a re-initiation of the decision process at step (1), thereby possibly recovering some products which were excluded during the previous evaluations. While 'fundamental' preference changes may occur in the sphere of basic needs as well as in the realm of acquired wants, the emergence of completely novel dimensions will typically give rise to the latter, since 'the

formation of acquired wants usually adds new elements to already existing combinations of wants' (Witt 2001, 34). A simple example for such a new want would be the desire to take photographs with one's cell-phone—a desire induced by adding a qualitatively different, novel dimension to the already existing ones. If such a novel dimension resembles the impact of an indirect service (e.g. the integration of heating facilities or television sets in cars), it will lead to additional comfort when satisfying an already existing acquired want (e.g. mobility). If this additional comfort is rather exceptional it is to be seen as a potential identity marker, while a rather widespread modification can be interpreted as a social convention, that is, as representing a society's typical comfort of living.[11] In these cases the relation between product dimensions and human needs might be more complex and volatile than is obvious at first sight and demand a diligent operationalisation depending on the concrete question at hand.

Nonetheless this provides an illustration for the potential fruitfulness of such a research avenue, since the introduction of preference change and novel dimensions allows our model to be applied to questions of social change. In this spirit one could argue that profit-oriented firms operating in industries serving primarily basic needs (e.g. shoes as a tool for body warmth and minimal comfort) in comparably rich economies (where the basic needs of most of the population are satiated by a variety of already existing inputs and tools), will try to attach new dimensions to their products appealing to conventional standards or identity markers, since these attributes are more suitable to increase the demand for their products. In other words, they will try to address those categories of consumption needs with a lesser, or less constraining, satiation level, thereby possibly inducing ('fundamental') preference change or the emergence of new product dimensions serving additional wants. Thus, some obvious developments—like the increasing importance of brands or the continuous diversification of consumption goods—can be given a very clear and simple explanation (as already proposed in a similar vein by Witt 2001). Note that, especially when discussing the adoption of new products and dimensions it is necessary to relax the assumption of completely informed agents, since, from an empirical viewpoint, adoption always implies some sort of learning experiences (Nelson and Consoli 2010), that is the generation of consumption knowledge (Witt 2001). So while our model provides a clear link between choice strategy and individual preference, especially for cases of more conscious decision-making, it does not yet integrate the boundedness

[11] Note that a heating facility or a television set may, by itself, primarily be a tool to satisfy a basic need (body warmth or cognitive arousal). However, when such tools become part of a car, they add novel dimensions to an established product. Since in most cases the underlying basic needs are already satiated by a variety of other tools and the introduction of such a multi-purpose good is not intended to satisfy a deprivated basic need, but mostly aims to make the satisfaction of an acquired want generally more pleasurable, these novel dimensions are also to be seen as related to acquired wants.

of rationality appropriately. On the other hand, we explicitly tried to show how complex supposedly simple consumption choices factually are even if sustaining the assumption of completely informed individuals.

8 Concluding thoughts

Discussing the concept of rationality with respect to multidimensional goods is, as we believe, not a futile exercise in logic, but at the very heart of the consumption problem itself and still undervalued in its importance. Naturally, this is in part due to the fact that multidimensionality renders the problem more difficult but also more realistic and thus more interesting. As is evidenced by the formal equivalence between the problem of rational consumer choice and Arrow's social choice problem, it is not only difficult to find a solution but, maybe somewhat surprisingly, under the standard notion of rationality such a solution is indeed impossible to guarantee (see also the Appendix for further details).

In confronting this problem we drew on a series of ideas stemming form a variety of fields and traditions including mainstream economics (Arrow), early behavioural economics (Simon, Lancaster), institutional economics (Veblen), economic psychology (Tversky) and evolutionary economics (Witt, Nelson/Consoli) to show that a rational solution to the posed problem is possible if one drops the requirement of an optimisation process. The resulting model of satisficing by sequential elimination even allows, although not based on optimisation, to find a 'maximising' choice. In this context, our work strengthens Amartya Sen's (1997, 772) argument for 'eliminating the tension between satisficing and maximising ([while] the tension with optimisation remains).' Additionally, we showed how such a model of rational choice may be understood from an empirical viewpoint by aligning it to arguments common in evolutionary economic theory. This integration does not only illustrate the complementarity of these streams of thought but also enhances our understanding of consumption in general.

Finally, the formal equivalence to Arrow's Theorem allows us to meditate on a possible connection between our solution and Arrow's original problem. If we truly deem the suggested procedure—setting minimal requirements and treat all remaining alternatives as principally acceptable—to be rational, it might also provide a hint on why democracy could be judged a kind of 'rational' order. And indeed in political philosophy there is a comparable argument based on the idea that the foundation of democracy is a *constitution*, which defines the rules of the game and the minimum standards which have to be fulfilled by all players, including those currently in power.

> If law's function is to settle what ought to be done through determinate rules, constitutional law's function is to settle the *most basic matters* regarding how we ought to organise society and government. (Alexander 2011, 3)

Constitutional law represents the *conditio sine qua non* of modern democracy and incorporates the idea of codifying standards excluding certain social states. It thereby leaves a set of acceptable alternatives to choose from, which is what we call freedom, while explicitely excluding other social states for more principal and essentially moral reasons, which is what we call civilisation. This shows that democracy is—given some moral premises and an appropriate conception of rationality—indeed a basis for a 'rational' social order.

Acknowledgements The authors are grateful to an anonymous referee for helpful suggestions and to Michael Landesmann for fruitful discussions.

Appendix: Arrow's theorem and the impossibility of consumer choice: an analogy

This section is devoted to a formal treatment of the aforementioned topics. We are going to define a rational ordering process and set down several axioms this process should satisfy. The treatment mirrors the discussion in Arrow (1950, 1951), but is presented completely independently. We aim to show that the problem of collective choice as posed by Arrow is formally equivalent to the problem of consumption choice among multidimensional goods. Table 2 provides a first overview by showing some basic terminological similarities between these two approaches.

Linear, transitive orderings We will demand that the ordering $\succcurlyeq_d$ of the products within each product dimension d is linear and transitive. Linearity states that for any two products P and Q we either have

$$P \succcurlyeq_d Q \quad \text{or} \quad Q \succcurlyeq_d P.$$

Table 2 Some basic structural analogies between Arrow's impossibility theorem and the problem of consumption choice among multidimensional goods

	Social decision	Individual decision
Choosing entity	Society	Individual
Alternatives to choose	Alternative social states $x, y, z, \ldots$	Alternative products $P, Q, R, \ldots$
Source of complexity	Different individuals with varying preference orderings	Different dimensions, with varying ranking of products
Individual orderings	R_i: ordering relation of alternative social states from the standpoint of individual i	$\succcurlyeq_d$: ordering relation of available products within product dimension d
Aggregated rankings	R: social ordering relation	$\succcurlyeq$: ordering of products by a given individual
Choice rule	Social welfare function: a process or rule which, for each set of individual orderings $R_1, \ldots, R_n$ for alternative social states, delivers a corresponding social ordering of alternative social states, R.	Rational ordering function: a process or rule which, based on the rankings $\succcurlyeq_1, \succcurlyeq_2, \ldots, \succcurlyeq_d$, delivers an ordering $\succcurlyeq$ of the products accounting for their overall desirability.

This excludes the possibility that two products are incomparable within said dimension. Furthermore, we shall assume transitivity.

Rational ordering process and axioms Assume now we are given a set of products and dimensions in which those products are ranked following a linear and transitive order relation. How would a rational consumer rank the products according to their desirability based on their dimensional rankings alone? A rational ordering function will be any process satisfying certain axioms which, based on the dimensional orderings $\succcurlyeq_{d_1}, \succcurlyeq_{d_2}, \ldots$ alone, extracts an ordering $\succcurlyeq$ of the products reflecting their overall desirability.

Axiom 1 (Unrestricted domain) Although somehow already inherent in our discussion, *we explicitly state that the rational ordering process should yield a product ordering for any possible orderings within the dimensions.*

Axiom 2 (Account for ordinal superiority) So far, any universally applicable process is regarded as a rational ordering process, we therefore need to make certain that the dimensional orderings are reflected in the overall ranking. Suppose we are given m products in d dimensions and are given the dimensional rankings and a rational ordering process assigns the overall ranking

$$P_1 \succcurlyeq P_2 \succcurlyeq P_3 \succcurlyeq \ldots$$

Assume now furthermore that from this we create a second set of dimensional rankings by choosing one product P and setting up the new dimensional rankings by using the old rankings and moving the product P to the left or leave it at the same place while, at the same place, leaving all other interproduct relations the same. This corresponds to a manufacturer improving the product in some dimensions while leaving it untouched in other dimensions. *Then, in the overall product ranking, any rational ordering process $\succcurlyeq$ should rank the improved product P superior to all products to which it was superior before.*

Axiom 3 (No prejudices) This axiom is in somewhat the same spirit as the last axiom and states that for any two distinct products P and Q, there are dimensional rankings such that

$$P \succcurlyeq Q \quad \text{and other rankings yielding} \quad Q \succcurlyeq P.$$

Axiom 4 (Independence of irrelevant alternatives) If the rational ordering process assigns an overall ranking $\succcurlyeq$ to a given set of products based on their dimensional rankings $\succcurlyeq_d$ and if then furthermore one product turns out to be unavailable and is then removed from the dimensional rankings, then any rational ordering process applied to the reduced dimensional relations should yield the same overall ranking as before with the single change of the unavailable product being removed.

The surprising result is now that although all these conditions are very natural within this framework, there is only a simple type of rational order function satisfying all these conditions.

Theorem 1 (Impossibility of rational order functions; Arrow 1950) *Suppose we are given at least three products and a rational order process satisfying all the conditions above. Then this process is monomanical, i.e. there exists a 'dictatorial' dimension such that the process assigns to each possible set of dimensional relations an overall rating, which is identical to the product rating within this dimension.*

Proof We deduce the result from Arrow's Impossibility theorem. The linearity and transitivity conditions imply Arrow's axioms 1 and 2; the universality condition implies Arrow's condition 1 [unrestricted domain], the second and the third axiom imply Arrow's conditions 2 [positive association of social and individual values] and 4 [citizens' sovereignty], while the axiom of independence of irrelevant alternatives is the same in both settings. Arrow's theorem then implies that the social process must be dictatorial, which corresponds to our definition of monomanical. □

Remark (*Two products*) The assumption that at least three products be presented is a necessary one: there is a rational ordering process if we are only given two different products P and Q ordered in d dimensions according to $\succcurlyeq_1, \ldots, \succcurlyeq_d$ given by saying that product P is ranked superior to Q if it is ranked superior to Q in more or the same number of dimensions than Q is ranked superior to P. In the latter case both products are equal.

References

Ackerman F (1997) Consumed in theory: alternative perspectives on the economics of consumption. J Econ Issues 31(3):651–664
Alexander L (2011) What are constitutions, and what should (and can) they do? Soc Philos Policy 28(1):1–24
Arrow KJ (1950) A difficulty in the concept of social welfare. J Polit Econ 58:328–346
Arrow KJ (1966[1951]) Social choice and individual values. Wiley, New York
Arrow KJ, Raynaud H (1986) Social choice and multicriterion decision-making. MIT Press, Cambridge, MA
Bianchi M (1997) Collecting as a paradigm of consumption. J Cult Econ 21:275–289
Condorcet MJ (1785) Essai sur l'application de l'analyse a la probabilité des décisions rendues a la pluralité des voix. L'Imprimerie Royal, Paris
Einav L, Levin J (2010) Empirical industrial organisation: a progress report. J Econ Perspect 24(2):154–162
Gigerenzer G, Todd P (1999) Simple heuristics that make us smart. Oxford University Press, New York
Lancaster KJ (1966) A new approach to consumer theory. J Polit Econ 74(2):132–57
Lancaster KJ (1971) Consumer demand. Columbia University Press, New York
Lavoie M (1994) Foundations of Post-Keynesian economic analysis. Edward Elgar, Cheltenham
Leibenstein H (1950) Bandwagon, snob and Veblen effects in the theory of consumers' demand. Q J Econ 64:183–207

Loasby BJ (2001) Cognition, imagination and institutions in demand creation. J Evol Econ 11:7–21
Mas-Colell A, Whinston MD, Green JR (1995) Microeconomic theory. Oxford University Press, New York
May KO (1954) Intransitivity, utility and the aggregation of preference patterns. Econometrica 22(1):1–13
Mayhew A (2002) All consumption is conspicous. In: Fullbrook E (ed) Intersubjectivity in economics: agents and structures. Routledge, London, pp 43–55
Mendoza GA, Martins H (2006) Multi-criteria decision analysis in natural resource management: a critical review of methods and new modeling paradigms. Forest Ecol Manag 230:1–22
Metcalfe JS (2001) Consumption, preferences and the evolutionary agenda. J Evol Econ 11:37–58
Nelson RR, Consoli D (2010) An evolutionary theory of household consumption behavior. J Evol Econ 20:665–687
Peukert H (2001) On the origins of modern evolutionary economics: the Veblen legend after 100 years. J Econ Issues 35(3):543–555
Pohekar SD, Ramachandran M (2004) Applications of multi-criteria decision making to sustainable energy planning—a review. Renew Sust Energ Rev 8:365–381
Rabin M (1998) Psychology and economics. J Econ Lit 36(1):11–46
Reinstaller A, Sanditov B (2005) Social structure and consumption: on the diffusion of consumer good innovation. J Evol Econ 15:505–531
Savage LJ (1972[1954]) The foundations of statistics. Dover, New York
Sen A (1997) Maximisation and the act of choice. Econometrica 65(4):745–79
Simon HA (1955) A behavioural model of rational choice. Q J Econ 69:99–118
Simon HA (1956) Rational choice and the structure of the evironment. Psychol Rev 63:129–38
Simon HA (1976) From substantive to procedural rationality. In: Latsis SJ (ed) Method and appraisal in economics. Cambridge University Press, Cambridge, pp 129–148
Simon HA (1978) Rationality as process and as product of thought. Am Econ Rev 68(2):1–16
Stigler G, Becker GS (1977) De gustibus non est disputandum. Am Econ Rev 67(2):76–90
Sugden R (1985) Why be consistent? A critical analysis of consistency requirements in choice theory. Economica 52:167–83
Sugden R (1991) Rational choice: a survey of contributions from economics and philosophy. Econ J 101:751–85
Tversky A (1972) Choice by elimination. J Math Psych 9:341–67
Tversky A, Shafir E (1992) Choice under conflict: the dynamics of deferred decision. Psychol Sci 3:358–61
Varian HR (1992) Microeconomic analysis. Norton, New York
Veblen TB (1899) The theory of the leisure class. Macmillan, New York
Wang G, Huang SH, Dismukes JP (2004) Product-driven supply chain selection using integrated multi-criteria decision-making methodology. Int J Prod Econ 91:1–15
Witt U (2001) Learning to consume—a theory of wants and the growth of demand. J Evol Econ 11:23–36