WORKING PAPER

ITLS-WP-19-04

Context Dependent Process Heuristics and Choice Analysis: A note on the Behavioural Setting Guiding the Research Focus

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February 2019

ISSN 1832-570X

INSTITUTE of TRANSPORT and LOGISTICS STUDIES

The Australian Key Centre in
Transport and Logistics Management

The University of Sydney

Established under the Australian Research Council's Key Centre Program.

NUMBER: Working Paper ITLS-WP-19-04

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ABSTRACT: This note is written to remind us of the recognition of behavioural realism in the economic literature over 60 years ago, which seems to have been given limited recognition in the formal axiomatic development of economic theories commonly associated with the application of discrete choice models, especially where the interest is on obtaining welfare measures such as willingness to pay estimates of specific attributes for use in cost-benefit analysis. We need to be reminded from time to time of the importance of context dependency in defining a choice problem and the value that behavioural realism can add despite risks of violating often some axioms of economic rationality and utility maximisation.

KEY WORDS: ***Behavioural relevance, economic theory, welfare economics, process heuristics, context dependency, irrationality***

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Acknowledgements: I thank Richard Batley and Edward (Ted) MConnell for discussions on the topic of welfare analysis and comments from Kenneth Train.

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DATE: February 2019

Introduction

Homo economicus and/or homo psychologicus: Full knowledge to maximise utility and/or no big deal and plenty to occupy the mind?

One motivation for the growing interest in context dependent process rules in choice analysis is a view, well articulated by a growing number of economists since the classic contributions of Herbert Simon (1957) and Harvey Lieberman (1976), which questions the very rigid or oversimplification view of the theory of microeconomics centred on 'economic man'. It promotes the view that while some real problems do lend themselves admirably to the type of analysis that can be conducted on the basis of existing micro-theory, producing useful results, there are a great many other problems where current economic theory is either not very useful or the 'essential points are actually obscured or masked by the conventional mode of thought' (Leibenstein page 8). Leibenstein suggests that there is a wide range of problems for which a broader based theory (in terms of behavioural assumptions) is called for as a basis of analysis and diagnosis. He further comments on the standard economic model as being "… only concerned with logic, not with realism, and hence need not worry about the artificial nature of such a world (page 5)."

The simplification is often the result of a desire to be able to satisfy very strong axiomatic conditions that have elegant mathematical properties but which typically deviate from reality and relevance in consumer choice and decision making. Leibenstein characterises the conventional economic approach by the phrase 'complete constraint concerned "calculation" in the pursuit of precise objectives' (page 72). He promotes the idea of replacing the idea, in the traditional economic approach, that decision techniques or procedures (what we now refer to as process heuristics) which involve no choice whatsoever (i.e., they are the underlying processing mechanism), do indeed have choice merit and are related to rationality in what he describes as calculatedness. This draws on inspiration from Herbert Simon (fn. page 73) who distinguished between rationality as viewed by cognitive psychology and the views of economics. Under cognitive psychology, rationality applies to a process of partial calculation and choice under which the complete consequences of different options are not given at the outset.

The concept of constraint concern is a vector of traits along a continuum interpreted as reflecting degrees of rationality, and includes realism of context assessment, non-reflexibility of assessments (i.e., cool and calm compared to knee jerk responses), and learning from experience. Situation assessment realism is of particular importance to research on process heuristics that are context dependent, which Leibenstein comments on as (page 82) '… individuals in a decision situation usually have to assess the nature of the situation and the nature of the alternatives. At one extreme we can try to make as realistic as assessment as possible; at the other we can base our assessments entirely on wishful thinking'.

Leibenstein (page 8) discusses the interpretation of utility and suggests that although one can interpret utility in such a way that *all* behaviour is subsumed under some version of utility maximisation, this would 'rob the concepts of utility and maximisation of real meaning'. 'If we are presumed to do something which has some degree of specificity, then there must be something else for which it can be said we are not filling the criteria of the first type of action. That is, the idea of utility maximisation must contain the possibility of choice under which utility is not maximised'. This aligns with the position of many economists and cognitive psychologists that '…it was desirable to loosen the psychological assumptions behind normal economic behaviour in such a way so that rationality did not necessarily imply maximising utility, as that concept is normally used.' Although utility maximisation is consistent with rational behaviour, it is not a necessary ingredient of it. A good example is random regret minimisation. More generally, the message here is that '…as a basis for individual behavior, variations in the psychological assumptions which are presumed to be the determination of behavior'

should be permissible and supported. Among the insufficiently considered aspects of micro-theory is the analysis of effort (page 7).

This aligns with Leibenstein's promotion of the theory of selective rationality, suggesting that there is an important sense in which non-maximising behaviour is not at all irrational. Rationality has components. Individuals are willing to forgo some of the advantages of 'extreme rationality' or some components of rationality because of the costs of the decision process, and they may be willing to bear the pressure costs of behaviour under less than full rationality. This aligns well with the idea that individuals use various context-linked rules (or heuristics) to process situations in arriving at a choice, and hence a preference revelation. Leibenstein goes on to talk about habit (in some sense linked to repeat effort). Economic theory usually does not distinguish explicitly between one-time only situations or a variety of contexts whose appearance over time is in a clear-cut pattern. If contexts are periodic (like the regular commute trip), individuals may work out a simplified decision procedure in which they find it convenient to repeat their behaviour pattern time after time. Individuals in situations where contexts are repeated are likely to have present position preference which is a mode of behaviour called 'ratchet rationality' (Leibenstien page 88). This is where the status quo or referenced experience makes good sense as a habitual reference point (as well as Value Learning) which they prefer not to leave unless the potential gain of moving out of the groove or the potential loss of not moving (as reflected in RAM) are beyond some threshold values. Clearly there is also the matter in part on whether or not an individual has a strong preference for novelty (variety seeking). All of this discussion aligns with an interest in process heuristics as behavioural mechanisms used by an individual to assist or simplify the assessment of contexts (essentially a preference accommodation process) leading to a choice outcome.

In summary, maximising behaviour implies that individuals will use their capabilities or capacities to the greatest degree possible in order to obtain, from the context, the largest economic gain. However, under a number of psychological postulates, so clearly set out by Leinbenstein amongst others, most individuals (perhaps all) do not behave in this manner. This is described as constraint concern and is reflected in the various ways we would want to explore the context in which individuals bring to bear one or more rules to assist them in choice making. While these rules become complex analytical functions, they are no more than behaviourally simplifying rules made by individuals to help in processing information and making decisions. This is the sentiment of our note. This means some degree of violation (on non-compliance) with the very strict assumptions of the economic man model, but this is the trade-off which Leibenstein promotes as value adding and necessary.

Kenneth Train in his 2003 book on 'Discrete choice Modelling and Simulation' says "Discrete choice models are usually derived under an assumption of utility-maximizing behavior by the decision maker. Thurstone (1927) originally developed the concepts in terms of psychological stimuli, leading to a binary probit model of whether respondents can differentiate the level of stimulus. Marschak (1960) interpreted the stimuli as utility and provided a derivation from utility maximization. Following Marschak, models that can be derived in this way are called random utility models (RUMs). It is important to note, however, that models derived from utility maximization can also be used to represent decision making that does not entail utility maximization. The derivation assures that the model is consistent with utility maximization; it does not preclude the model from being consistent with other forms of behavior. The models can also be seen as simply describing the relation of explanatory variables to the outcome of a choice, without reference to exactly how the choice is made." This aligns well with the position promoted by Leibensten in paragraph four above.

Appendix: A note on Welfare Measures

Although the focus of this note is not on welfare implications, which was the initial motivation for writing this short paper when questions of context dependency were raised with the author in a recent paper, and a reason why it might be problematic in focussing on willingness to pay (WTP) estimates under non-linear context dependent choice models with embedded process heuristics, it might be useful to provide a short summary of the key challenges facing context dependent choice models in establishing WTP estimates compliant with standard economic theory.

In general, marginal valuations (i.e., WTP) rely upon the concept of indifference, and welfare measurements (i.e., consumer surplus) rely upon the concept of integrability. In turn, these two concepts are underpinned by two constructs - namely utility and demand and the mapping between them (Batley and Ibanez 2013a,b). These two conditions are synonymous with the conventional economic framework. Against this background, if a researcher specifies a model which - on the face of it - departs from utility maximisation (or random utility maximisation (RUM), if in a probabilistic context), then there are (at least) two scenarios which could arise:

a) The model is reconcilable with utility maximisation (e.g., as would apply to elimination by aspects (EBA) and the inclusion of risk attitude and perceptual conditioning, for example), and this form can be defensibly used to generate indifference and integrability.
b) The model is not reconcilable with RUM (e.g., as would apply to relative advantage model (RAM), for example), and this form cannot be defensibly used to generate indifference and integrability.

Violations of the Batley and Ibanez (2013a) assumptions may arise quicker than one may expect. If such violations occur, the labelling of U as an indirect utility function, is incorrect as the connection with a rational consumer maximising his or her direct utility subject to a budget constraint no longer holds. This poses choice modellers with a trade-off between behavioural relevance and the possibility of conducting meaningful welfare analysis. Behavioural relevance allows researchers to exploit the wide range of econometrically possible formulations of the 'indirect utility function', i.e., the regression equation defining the attractiveness of a specific alternative. In the context of discrete choice models, where demand is restricted to unity (i.e., no induced demand and pure substitution), non-linear income effects are not consistent with economic theory. Any additional income must be spent on the numeraire good which by definition has to be path independent, i.e., not subject to an income effect. In many applications it is relatively safe to assume that there is no income effect, and only substitution effects, which is reasonable in most urban mode choice applications. Hence the usefulness of b) is in explaining and predicting behaviour[1].

Although we understand the conditions that need to be satisfied to be able to use WTP estimates in the traditional cost-benefit framework, we can draw on the important contribution of 'McConnell (1995, pages 264-5) who states that 'One ought to be able to compute intuitively appealing measures of consumer surplus well-being that do not depend on the primitive utility function. If there is a change in behavior, there is also a welfare change." There is huge value in investigating this possibility and the trade-offs that have to be made under context dependent process heuristics such as value learning (VL) and RAM. We offer some commentary below on the issues that need specific consideration. If the analyst focusses on behavioural responses (such as the elasticity output), they do not have to be

[1] On a more pragmatic note, there could be a middle ground where predictions from a non-RUM were combined with marginal valuations from a RUM to generate measures of expected consumer surplus. We thank Richard Batley for this observation.

concerned about the economic welfare interpretation, making their model still useful in prediction (in contrast to economic evaluation via CBA).

In an important paper, Dekker and Chorus (2018) promote an approach to be able to obtain consumer surplus for choices and WTP estimates for attributes of alternatives under process heuristics that do not satisfy indifference and integrability. It is in line with the position taken by McConnell (1995, pages 264-5) cited above. Dekker and Chorus add that '… if one is willing to accept that a model is a viable representation of (potentially irrational) choice behaviour, this opens a door towards meaningful welfare analysis, albeit … in a limited number of cases.' Furthermore, by treating the choice probabilities '*as if they were'* probabilistic demand functions, Dekker and Chorus are able to develop a monetary analogue to the traditional Marshallian consumer surplus, drawing on ideas from McConnell. Although such an approximation is inherently imperfect, as Dekker and Chorus state, it reflects the price paid for adopting a behavioural economics approach, which is the emphasis of a growing number of papers where process heuristics such as VL and RAM are inherently behavioural phenomenon that do not strictly, in all cases, align with the conventional economic framework.

Dekker and Chorus (2018) measure (changes in) consumer surplus by studying (changes in) observed behaviour, i.e., the choice probability, in response to price (changes). They interpret the choice probability as a well-behaved approximation of the probabilistic demand curve, and accordingly measure the consumer surplus as the area under this demand curve. The developed welfare measure enables researchers to assign a measure of consumer surplus to specific alternatives in the context of a given choice set (which is the context dependency assumption associated with VL and RAM). In addition, the approach presented by McConnell, and implemented by Dekker and Chorus, is able to value changes in the non-price attributes of a specific alternative (the standard output being a WTP estimate) such as travel times. They illustrate how differences in consumer surplus between random regret and random utility models follow directly from the differences in their behavioural premise, which is aligned with, for example, a recent paper by Balbontin et al. (2019).

In order to assess a change in an attribute level (say 1 and maybe 5 mins travel time) to obtain a probability change, we can use equation (11) of McConnell to obtain the change in consumer surplus in monetary units (see proof below). This enables us to obtain a welfare measure (see below) from the behaviour responses (through choice probabilities) regardless of the functional form of the utility expressions, assuming no income effect. Note that the Dekker and Chorus contribution is essentially that of McConnell, except they apply it in an RRM setting.

In this proof, we focus on a change in an attribute associated with an alternative although the same method can be applied to a change in the choice set (e.g., removing an alternative).

Define:

$$Ln\left[\frac{\sum_{j>1} e^{v_j^0} + e^{v_1^*}}{\sum_{\forall j} e^{v_j^0}}\right] = \ln(1-\pi_1^0) - \ln(1-\pi_1^*)$$

where 0 is the before change situation and * is the after change situation.

Let $D_o = \sum_j e^{v_j^0}$; $D^* = \sum_{j>1} e^{v_j^0} + e^{v_1^*}$

Hence $Ln[\frac{\sum_{j>1} e^{v_j^0} + e^{v_j^*}}{\sum_{\forall j} e^{v_j^0}}] = \text{Ln}[\frac{D_*}{D_0}]$

$1-\pi_1^0 = \frac{D_0 - e^{v_j^0}}{D_0}$ and $1-\pi_1^* = \frac{D^* - e^{v_1^*}}{D^*}$

Note that $D^* - e^{v_1^*} = D_0 - e^{v_1^0} = \sum_{j>1} e^{v_j^0}$

$$\text{Ln}[\frac{D_*}{D_0}] = \text{Ln}[\frac{D_*}{D_0} \text{x} \frac{D_0 - e^{v_1^0}}{D^* - e^{v_1^*}}]$$

$$= \text{Ln}[\frac{D_0 - e^{v_1^0}}{D_0}] - \text{Ln}[\frac{D_* - e^{v_1^*}}{D_*}]$$

$$= \ln(1-\pi_1^0) - \ln(1-\pi_1^*)$$

The welfare effect is

$$= \text{CV} = [\ln(1-\pi_1^0) - \ln(1-\pi_1^*)]/\beta$$

where β is the parameter associated with the cost attribute (marginal utility of income). This assumes that choice is independent of income, although one still needs the marginal utility of income (MUI) to convert the welfare measure into money units, and if demand is constrained by budget then the MUI will exhibit certain properties which point back to integrabillity.

What we have here is a simple comparison of the choice probability before and after a change in the level of an attribute. McConnell shows that this is equivalent to the Marshallian change in consumer surplus as the area under a demand curve. Moreover, as soon as the analyst starts integrating the demand curve then, irrespective of how demand is specified, one is pointing back to utility.

In summary, the issue of getting useful information from non-RUMs is huge and needs further research. It also comes up in the contingent valuation (CV) debate: if CV estimates are inconsistent with utility maximisation (i.e., adding-up does not hold), can the estimates be used as a measure of welfare loss/gain? There is more to investigate, but there is a growing sense that context dependent representation of choice is so appealing that this is a research theme ripe for substantial effort. The question often put to the author is – what difference does it make in practice in respect of policy outputs such as willingness to pay estimates? We do not know, but we need to find out.

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