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Agency decision making in freight distribution chains: Establishing a parsimonious empirical framework from alternative behavioural structures ☆

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Abstract

In designing an approach to parameterise the preferences of agents in a distribution chain for retail goods, Hensher and Puckett [Hensher, D.A., Puckett, S.M., 2007. Theoretical and conceptual frameworks for studying agent interaction and choice revelation in transportation studies. International Journal of Transport Economics XXXIV (1), 17–47] set out a general framework in which two or more agents negotiate a contractual arrangement to provide distribution services. In developing a framework to guide the empirical study, recognition of the difficulty in sourcing agent pairs is a major challenge and one that entails some amount of practical compromise. In this paper we present a new conceptual framework capable of capturing, through ideas of concession and power, without explicit interaction between agents, the interactive element of choice and show how we implement this to deliver an empirical method that is tractable in terms of securing an adequate sample as well as being cost effective. We find that transporters appear to hold strong relative power with respect to on-time reliability and variable charges, regardless of the degree of concession offered by either type of decision maker; whereas shippers' preferences appear to dominate the supply chain response to policy measures influencing transit time. Importantly both transporters and shippers do have a significant role to play in the formation of distribution chain preferences.

Keywords: Distribution chains; Interactive agents; Stated choice experiment; Mixed logit; Willingness to pay; Transporters; Shippers

1. Introduction

Individuals are inherently social beings who interact in many and varied ways, either by some direct relationship or through the conditioning that one or more groups in society have on the choices they make in

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particular circumstances. Recognising the interactive nature of decision making adds substantial reality and complexity to the task of modelling an individual's choice outcome. Whereas we have a long history of development of choice models, driven behaviourally by the rule of utility maximisation, when one is interested in the outcome from a multi-agent choice process, the conversion from agent-specific utility maximisation to group utility maximisation is less than clear.

Individual agents are often required to compromise to secure an agreement between the parties, which may be sub-optimal within the utility maximisation framework. Agents may also accept a less than ideal outcome in the short run in order to maximise the opportunity in the long run to establish an ongoing relationship between the agent set. That is, the immediate utility function of an agent is conditioned on the shadow value to the relationship of a particular act (Hensher and Puckett, 2007). This shadow value represents the benefit or detriment that an agent believes a particular negotiation act would have on future interactions between agents[1].

In reviewing the theoretical literature (Hensher and Puckett, 2007) and undertaking extensive in-depth interviews with agents in the empirical context of distribution chains for retail goods (Puckett et al., 2006 and Hensher, 2006), we have identified a number of *alternative* frameworks within which to specify relationships between agents that influence the *choice outcomes* of the group. Central to all the approaches is identification of the preferences of each agent, and the bargaining process (strategic or non-strategic) that leads to agreement or non-agreement on the final choice outcome.

There are clear elements of agent-specific precursors that are imposed on the way that each agent comes to the negotiation table. For example, the importance of an organisation to the success of the other organisation within a negotiation, the history of interaction between agents in a negotiation, and the experience each agent has in similar settings may all impact an interaction between two agents. Such an ensemble of background-enabling conditions (BECs) can be studied as a stand-alone agency problem under the generic label of preference revelation choice process. Conditional on the BECs, each agent interacts in various ways, strategic and non-strategic, to establish a rapport that is necessary in order to dialogue in a process designed to produce a final choice outcome. This outcome may be one of agreement or non-agreement, may be cooperative or non-cooperative, and may be optimal or sub-optimal in an agent-specific utility-maximising sense. Furthermore, it may involve a recursive dialogue pattern (*choose-feedback-review-revise-decide*) in which agents update information about the other agent based on their sequential choice, or it may simply be an historical synthesis of the other agent's likely response based on accumulated knowledge in any period in the past in dealing with the exact or similar agents.

Whatever approach one adopts, the preferences of the agents of interest in applications to choice models are those associated with the *final* choice outcome and in particular the choice agreement pairs. Importantly, in a two-agent context (the focus herein), the choice outcome is not a single agent outcome but a pairwise agent choice outcome. This has the advantage of avoiding choice endogeneity, while recognising the real meaning of a multi-agent choice outcome. The logic is that it is only the agreement choice outcomes that provide the relevant preference information that matters to decisions observed in real markets. While an understanding of the choice between agreement and non-agreement is important in revealing ways in which decision makers might be encouraged to review and revise their choices in favour of agreement, this information plays no role in the current equilibrium outcome where the focus is on the prediction of demand. That is, the implications of non-agreement at any point in time are indeterminate with respect to the eventual actions of a group. It does matter, however, if there are revisions in the market circumstance that may lead to a review of the contractual agreement and hence produce a new equilibrium (agreement choice) outcome.

With this brief overview of intent, this paper sets out a framework within which a number of variations can be obtained as mixtures of behavioural appeal and empirical parsimony. Given the potential difficulty, often,

[1] For example, an agent may believe that accepting the other agent's offer would have lasting benefits to the relationship; in this case, the shadow value is positive. Conversely, an agent may believe that conceding to the preferences of the other agent would set a precedent that enabled the other agent to demand more in the future; in such a case, the shadow value is negative. In a manner consistent with prospect theory (Kahnemann and Tversky, 1979) and case-based decision theory (Gilboa and Schmeidler, 1995), the shadow value is specified such that potential future losses are weighted more strongly than potential future gains. Potential losses of great significance are the termination of the relationship and an increasing lack of cooperation by the other agent in future negotiations.