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Decision Support

Self-interest and equity concerns: A behavioural allocation rule for operational problems

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ABSTRACT

In many economic situations, individuals with different bargaining power must agree on how to divide a given resource. For instance, in the dictator game the proposer has all the bargaining power. In spite of it, the majority of controlled experiments show that she shares an important amount of the resource with the receiver. In the present paper I consider how behavioural and psychological internal conflicting aspects, such as self-interest and equity concerns, determine the split of the resource. The individual allocation proposals are aggregated in terms of altruism and value for the resource under dispute to obtain a single allocation. The resulting allocation rule is generalized to the *n*-individuals case through efficiency and consistency. Finally, I show that it satisfies a set of desirable properties. The obtained results are of practical interest for a number of situations, such as river sharing problems, sequential allocation and rationing problems.

1. Introduction

In many economic situations of interest individuals must agree on how to divide a given resource. However, not all individuals have the same bargaining power and consequently some individuals are in a better position than others. Situations of this kind tend to be the rule rather than the exception (see, Ambec & Sprumont, 2002; Curiel, Pederzoli, & Tijs, 1989; Herings & Predtetchinski, 2012; Moulin, 2000; Kilgour & Dinar, 2001). For instance, in the river sharing problem, upstream individuals benefit from a better strategic location than downstream individuals. Similarly, sequential allocation and rationing problems establish priorities among individuals. In this type of problems the equal split of the resource is unlikely to result because the best positioned individuals claim a larger share of the resource. In those contexts, the difficulty in implementing a practical solution arises when assessing each individual position and how to incorporate it into a negotiated solution that would be accepted by the involved parties (Babcock & Loewenstein, 1997; Babcock, Loewenstein, Issacharoff, & Camerer, 1995).

In order to resolve this situation, I start by noting that the dictator game (Kahneman, Knetsch, & Thaler, 1986) and the ultimatum game (Güth, Schmittberger, & Schwarze, 1982) have structures that are similar to the problem described above. The proposer (the individual with more bargaining power, higher priority or upstream) may or may not share a given resource with the responder (the individual with less bargaining power, no priority or downstream). Despite the fact that rationality predicts that individual behaviour should be mainly self-interested, the vast majority of controlled experiments show that agents do not act in accordance with this postulate (Aguiar, Brañas-Garza, & Miller, 2008; Camerer, 2003; Engel, 2011). The main message of these and other studies (discussed below) is that individuals promote altruism.

The question is whether we can use the knowledge accumulated through these games to solve actual operational problems having a similar sequential structure and in which the restrictions faced by the proposer are mostly ethical and not material.

Since the proposer can freely consume the full resource without any punishment, the starting point is to understand when and why people share the available resource in social dilemmas of this kind. This has been a key issue in all social sciences (Dreber, Fudenberg, & Rand, 2014; Engel, 2011; Fehr & Fischbacher, 2003). In this context, the individuals' willingness-to-give is usually interpreted as altruism (Camerer, 2003): a sacrifice of one's resources for the benefit of others.

This internal trade-off between self-interest and equity concerns has motivated a vast body of literature. Ravallion, Thorbecke, and Pritchett (2004) note that extreme unequal agreements raise concerns about social and political stability. In this sense, the large majority of subjects avoid being considered as unfair (Brañas-Garza, 2007; Reuben & Van Winden, 2010; Rodriguez-Lara & Moreno-Garrido, 2012), regardless of their altruistic concerns (Dana, Cain, & Dawes, 2006).

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Several theories have been put forward to explain these empirical regularities. They consider behavioural motives such as altruism, fairness, reciprocity, inequity and guilty aversion as possible explanations for the observed departures from pure selfish behaviour. For instance, Bolton and Ockenfels (2000) and Fehr and Schmidt (1999) – through the inequality aversion theory – defend that individuals dislike inequity, which is measured by deviations from the equal split. Hence, individuals are willing to forgo some monetary payoffs in order to help others that are worse off. Charness and Rabin (2002) suggest that people have maximin preferences. They care about their own payoff but they also want to maximize the minimum social welfare.[1]

In the present paper, I do not specify an explicit utility function. Expected utility models require assumptions about individuals' utilities with implications for the results (see Baron, 2000 for a discussion on these and other related issues). This aspect distinguishes the model in the present paper from the existing models in the literature (Bolton & Ockenfels, 2000; Charness & Rabin, 2002; Fehr & Schmidt, 1999; Kőszegi & Rabin, 2006). Furthermore, there is no social planner, welfare or fairness maximization objective which are commonly assumed in the resource allocation literature (Kaplow & Shavell, 2000; Thomson, 2001; 2015). Instead, the objective is to offer a practical but consensual solution that can be applied in real life operational problems. This deliberate practical and applied focus is akin to that advocated by those working within the growing area of behavioural Operational Research (Franco & Hämäläinen, 2016; Hämäläinen, Luoma, & Saarinen, 2013).

It is noteworthy that during the last decades we have observed a growing number of experimental studies in bargaining and conflict resolution but without a correspondence in terms of theoretical models. There have been almost no practical or operational solutions to real life problems derived from these studies, with a few exceptions that are mostly in contexts outside resource allocation problems (Brailsford & Schmidt, 2003; Brailsford, Harper, & Sykes, 2012; Franco & Meadows, 2007; Morton & Fasolo, 2009; Rouwette, Korzilius, Vennix, & Jacobs, 2011). The present paper attempts to fill this gap – the fundamental argument is that the division of a resource should be based on evidence about human behaviour in similar circumstances.[2]

In line with these comments, I propose a simple theory in which individuals are simultaneously self-interested and equity concerned. Hence, the interception of these conflicting but non-contradictory aspects frames the heterogeneity of individual proposals between the most egalitarian and the most self-interested allocation - the most and the least altruistic allocation, respectively.

Subsequently, the individuals' proposals are aggregated according to the behavioural principle of empathy, and the political concepts of participatory democracy and representativeness. These universal principles are captured through a distribution over the set of reasonable proposals. Furthermore, since the level of altruism may depend on the importance given to the resource under dispute, I consider a distribution that aggregates all possible valuation.[3]

I start by analyzing the two-individual case. Specifically, I consider a binomial/Poisson model to capture the different levels of altruism and the importance that individuals assign to different values of the resource. This case shows some interesting insights. For instance, the proposed allocation rule endogenously replicates the empirical evidence, suggesting that the value of the resource is determinant for the individual's willingness to give (Engel, 2011; List & Cherry, 2008; Sefton, 1992): the higher the value of the resource, the lower the desire to be altruistic, and vice versa.

Subsequently, I generalize the allocation rule for the n-individuals case by imposing *efficiency* and some form of *consistency* (Moulin, 2000; Thomson, 2011; Young, 1987). The result is a practical rule founded on behavioural arguments that determine how a resource should be split among individuals in a society that is characterized by some degree of altruism and expected valuation for the resource under dispute. It is also shown that the proposed sharing rule satisfies some relevant properties that are considered as basic in the resource allocation literature (Thomson, 2001; 2015).

The obtained results are of interest for several practical problems. For instance, the n-individuals sequential structure in the present paper is similar to that in the river sharing problem (Ambec & Sprumont, 2002; Kilgour & Dinar, 2001), in bargaining problems in which each individual share of the resource is sequentially determined (Curiel et al., 1989; Herings & Predtetchinski, 2012), or in rationing problems (Moulin, 2000). To the best of my knowledge, the proposed sharing rule is the first attempt to introduce behavioural and psychological considerations into this type of problems.

The exposition concludes with an illustrative example taken from the river sharing literature and discusses some relevant issues for applied work. Throughout the paper there is an intentional balance between realism and simplicity that can help researchers and practitioners in operational work.

The paper is organized as follows. Section 2 describes the problem and some behavioural aspects. Section 3 considers the two individuals case. Section 4 generalizes to the n-individuals case. Section 5 analyses some properties. Section 6 provides an example and guidelines for applied work. Section 7 concludes.

2. The problem and behavioural characteristics

Consider a scenario in which individual 1 (the proposer) decides on how to divide some resource with value $y \in [0, \infty)$ between herself $y_1 \in [0, y]$ and individual 2 (the responder), $y_2 = y - y_1$. Empirical evidence shows that the value of the resource is determinant in the individuals' altruistic decisions (Engel, 2011; List & Cherry, 2008; Sefton, 1992). Consequently, y is assumed to follow some distribution with different proposers giving different value to the resource under dispute.

The individual 1 is free to make any choice whatsoever. Individual 2 may irrationally disagree and block the possibility of a negotiated solution (Babcock & Loewenstein, 1997; Babcock et al., 1995) but in practical terms is unable to change the decision of individual 1. In this context, what would be the most adequate split

[1] Engelmann and Strobel (2004) compare the relative performance of these theories. They conclude that efficiency and maximin preferences have greater explanatory power than inequality aversion. Edgeworth (1881); Griesinger and Livingston (1973) and Loewenstein, Thompson, and Bazerman (1989) are examples of other early attempts to formalize the individuals' trade-off between their own payoffs and the payoffs of others. In the same line, Sanfey, Rilling, Aronson, Nystrom, and Cohen (2003) find that low offers activate emotional brain areas (insula and dorsolateral prefrontal cortex) associated with judgement, planning, and conflict resolution, see also Reuben and Van Winden (2010). Other approaches, such as the guilt aversion theory, posit that people feel guilty if their behaviour falls short of the others expectations (Charness & Dufwenberg, 2006; Ellingsen, Johannesson, Tjøtta, & Torsvik, 2010).

[2] The same reasoning can be extended to other contexts in order to establish the basis for new research that would aim at seeking practical solutions to real life problems. Similar ideas have been put forward by Bendoly, Donohue, and Schultz (2006) or Gino and Pisano (2008) in the context of operations management.

[3] The proposed theory is normative. It suggests how some resource should be allocated between individuals according to a set of desirable principles (Baron, 2004; Brams & Taylor, 1996; Thomson, 2001). These principles are grounded on empirical evidence of actual behaviour in resources allocation problems (rather than on ideal models of behaviour). In the behavioural operational research literature the paper locates within the "behaviour in models" stream (Brocklesby, 2016; Franco & Hämäläinen, 2016).