ADVANCES IN ACCOUNTING BEHAVIORAL RESEARCH

Edited by Khondkar E. Karim

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VOLUME 27

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FAIRNESS IN COST ALLOCATIONS: PROPORTIONALITY VS. EQUALITY

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ABSTRACT

Allocation problems in accounting require joint costs to be allocated among participating agents. In this setting, however, unfair allocations can stifle cooperation and lead to inefficient group outcomes. Then, what qualifies as fair enough for individual agents to agree to cooperate and extract joint benefits? Building on prior analytical literature that has offered perspectives involving joint cost allocations, we experimentally evaluate two common notions of fairness that present competing predictions in the cost allocation context – proportionality and equality. We operationalize two notions of fairness using a behavioral approach and examine which fairness notion prevails in cost allocation problems. More specifically, we examine fairness considerations in the cost allocation context using a modified ultimatum game, where joint cost savings can only be acquired through cooperation between two agents and individual contributions are varied transparently. Our experimental evidence suggests that fairness considerations in cost allocations coincide more with the proportionality notion when individuals make different contributions to create joint benefits. These findings provide important insights on the key rationale underlying the prevalent cost allocation method in accounting practices and the design of fair cost allocations that promote cooperation among agents.

Keywords: Fairness; equality; proportionality; cost allocation; behavioral accounting; cooperation

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INTRODUCTION

Cost allocations are pervasive in accounting practice where participating agents incur joint costs with a shared goal of achieving cost savings. Tracing jointly incurred costs directly to each participating agent is often costly, demanding, and impractical. Firms, therefore, routinely allocate these joint costs to participating agents based on some convenient, reasonable cost drivers. Building on prior analytical work that yields game theoretical joint cost allocations schemes (Banker, 1981; Billera & Heath, 1982; Hamlen et al., 1980; Roth & Verrecchia, 1979; Shapley, 1953), our current study takes a behavioral approach to examine fairness considerations associated with cost allocation schemes.

Understanding the fairness considerations associated with cost allocation problems has become increasingly important. As the sharing economy rapidly transforms traditional notions of work (Etter et al., 2019), individuals are encountering new and consequential forms of cost sharing problems. For example, the growing popularity of co-working and co-living environments (e.g., WeWork, Impact Hub) raises issues around how to appropriately allocate costs across participating agents who use various services with different frequencies. In addition, issues regarding the increasing number of gig workers who benefit from coordination offered through digital platforms (e.g., Uber/Lyft, TaskRabbit, Instacart) but also contribute their own personal resources raise complex questions around the allocation of costs associated with delivering these services to consumers (Chai & Scully, 2019). Although reaching mutual agreements between participating agents often generates greater economic value for all agents (Forcadell, 2005; Garriga, 2009; Gemser & Leenders, 2011; Singh, 1997), cooperation is frequently stifled by concerns for fairness. People are in fact quite willing to give up materially significant financial benefits in order to reject practices or outcomes that they deem to be unfair (Bellemare et al., 2008; Fehr & Gächter, 2000; Güth et al., 1982). We adopt a behavioral accounting approach toward understanding how individuals perceive fair and unfair cost allocations.

Our objectives in this paper are threefold. First, we experimentally operationalize two common fairness notions – proportionality and equality – drawing on the game theoretical solutions prescribed for cost allocation problems. In particular, we focus on the analytical solutions driven from the Shapley value (Shapley, 1953) and Banker's modified Shapley value (Banker, 1981) that provide competing predictions in alignment with the proportionality and equality notions of fairness. Second, using the controlled experiment, we document experimental evidence suggesting proportionality as the prevailing fairness notion in the cost allocation context. Third, we provide insights into the role of fairness as a key rationale underlying the prevalence of the proportionality allocation method in accounting practices.

In our study, we are particularly interested in two common notions of fairness – proportionality and equality – within the context where individual contributions vary transparently.[1] We experimentally identify which of the two fairness notions prevails and promotes cooperation. Understanding fairness considerations in allocation problems is important because perceptions of fairness can drive cooperative behavior. Unfairness in allocation problems can be costly if inequity provokes resentments and conflicts (Dawes & Thaler, 1988; Fehr & Gächter, 2000; Fehr & Schmidt, 1999), as many of these conflicts end up in courts. Most court decisions for allocation problems often side with either the equality notion of fairness or the proportionality notion, aligning with the fairness notions of our interest. We introduce two examples of legal cases below to highlight the common application of both the equality notion and proportionality notion of fairness in allocation problems that involves costly economic consequences for the involved parties.

State Contracting & Engineering Corp v. Condotte America, Inc. is an example where the equality notion of fairness is applied. Two counsels worked on a patent infringement case together and had a disagreement on the attorney fee allocation, one demanding more than the other based on their contributions. Since no official evidence existed to prove clear distinction in individual contribution levels, the court concluded that the attorney fee be split equally between the two counsels. For the case *United States v. Atlas Minerals and Chemicals, Inc. et al.* where the United States sued corporations that contaminated a landfill by disposing the hazardous waste, the court applied the proportional allocation method to split the cost among the sued corporations. The court held those corporations responsible for the cleanup cost based on the relevant "equitable factors" such as the relative volume and toxicity of the waste disposed by each corporation. These two cases illustrate that when information on individual contribution levels is available, legal arguments can justify the proportionality notion of fairness in allocation problems.

In our study, unlike these legal cases, we evaluate fairness notions in the cost allocation context where individual contribution levels are known, and conflict or resentment induced by unfair allocations is designed to drive the involved agent's decision to either accept or reject cooperation. Yet, these court rulings are useful for our study because they provide us with social, institutional, and normative grounds to formulate our conjecture that the proportionality notion often prevails and promotes cooperation in cost allocation problems where individual contributions vary and are known. We conduct an experiment to examine which notion of fairness between proportionality and equality better aligns with individual fairness considerations in such cost allocation problems where individual contributions vary and are known. More specifically, we use a modified, anonymous, one-shot ultimatum game as an experimental tool to examine fairness considerations in economic decision-making. This controlled experiment setting allows us to focus on fairness considerations as a sole driver for cooperation, excluding alternative explanations for cooperation including reputation, reciprocity, or relationship building (Güth et al., 1982).

In a typical two-player, one-shot ultimatum game (Güth et al., 1982), the proposer allocates a sum of money between the proposer and the responder and offers allocations to the responder. The responder either *accepts* the offer (if deemed to be sufficiently fair) or *rejects* the offer (if deemed to be sufficiently unfair). If the responder accepts the offer, both players economically benefit from cooperation. If the responder rejects the offer, both players walk away with nothing. In our study, we modify the typical ultimatum game by casting a cost allocation problem within an ultimatum game framework. Utilizing special features of a cost allocation problem, we set up our experiment so that we can address our specific research question: Which notion of fairness prevails in cost allocation problems and drives cooperation when individual contributions vary? In our modified context, instead of asking our participants to allocate an endowment, we frame the joint benefit as a cost savings that requires the cooperation of both players to realize. Each player incurs inevitable costs at varying degrees and if both players cooperate, they can both benefit from cost savings. In our context, not achieving cooperation thus becomes more costly for both players. Therefore, unfair cost allocations that lead players to reject cooperation have direct negative economic consequences to the players. We operationalize two notions of fairness as experimental treatments and compare the rate of rejection between the two treatments. Using the modified ultimatum game, we find that fairness considerations coincide more with the proportionality notion when individuals make different contributions to achieve join benefits through cooperation.

We derive our experimental treatments from the game theoretical solutions prescribed by the Shapley value (Shapley, 1953) and Banker's (Banker, 1981) modified Shapley value in a two-person cooperative game. The Shapley value allocates joint benefits or cost savings equally to the players in a two-person cooperative game, taking into account all possible orders of entry of the players into the game to allocate the expected marginal contribution. In contrast, Banker's modified Shapley value, which incorporates additional information on individual contribution levels, allocates joint benefits or cost savings in proportions with individual contribution levels. In our study, we design two experimental conditions based on these analytical allocation solutions. In one condition, cost savings are split between two participating agents equally, regardless of the individual contribution levels, yet as prescribed by the Shapley value and supported by the equality notion of fairness. In the other condition, cost savings are allocated between two agents proportionally based on their individual contributions, as prescribed by Banker's solution and as supported by the proportionality notion of fairness. Our study is the first to evaluate these competing fairness notions that align with the corresponding allocation solutions and experimentally identify which notion prevails in the cost allocation context.

With our study, we contribute to the accounting literature by shifting the focus beyond what has been done in accounting research so far. In accounting practices, joint cost allocation has been pervasive for a long time and accounting researchers have recognized the importance of the design of joint cost allocation in pricing decisions, cost control and management, and fostering desired behavior at the managerial level (Banker, 1981; Banker et al., 1988; Hamlen et al., 1977, 1980; Roth & Verrecchia, 1979; Zimmerman, 1979).[2] However, the importance of fairness considerations underlying the design of allocations has not yet received the kind of attention it deserves in the accounting literature. By examining fairness considerations in allocation problems experimentally at an agent level, our findings provide important insights into fairness not only as a key rationale underlying the prevalence of the proportional allocation method in accounting practices but also as a central component in designing allocations that promote and sustain cooperation.

Our study also adds to the behavioral economics literature on other-regarding preferences, by exploring the cost allocation problem in a special context where cost contribution levels differ. More specifically, previous findings show that if the allocation share is considerably below the equal split (usually below 30% of the total endowment), most individuals perceive such allocation scheme as unfair and prefer to forego the material benefit that can only be achieved by cooperating with the other party. However, our study shows that in the cost allocation context where individual contribution levels vary and can be distinguished, the proportional split is rather more acceptable than the equal split. Thus, in the cost allocation context, more unequal (but proportional) allocation proposals can actually be perceived as fairer, leading to greater cooperation with the other party.

We proceed to the next section by introducing the discussion of fairness considerations in allocation problems in various fields of studies, including accounting, economics, behavioral economics, and the wider social sciences. Then, we describe our experiment and develop hypotheses to examine which allocation solution represents individual notion of fairness in the context where individual contribution levels vary. We conclude our paper with results and discussion.

LITERATURE ON FAIRNESS CONSIDERATIONS AND ALLOCATIONS

Accounting Literature

Joint cost allocation has a long history of practice in accounting (Ahmed & Scapens, 2000; Balachandran & Ramakrishnan, 1996; Dasgupta & Tao, 1998; Hamlen et al., 1977; Moriarity, 1975). In the cost accounting context, a joint cost allocation problem arises when at least two agents use shared resources. Total costs incurred jointly are then allocated to each party based on the resource usage level, ideally. In practice, since tracking and measuring shared resource usage levels can be costly or impossible, joint costs are often allocated to each party based on the most appropriate cost driver (Balachandran & Ramakrishnan, 1981; Gangolly, 1981; Tijs & Driessen, 1986; Zimmerman, 1979). Because the allocation process involves estimation to some extent, fairness becomes a particularly important concern in joint cost allocation problems, yet this factor has still been overlooked in accounting research (Horngren et al., 2002; Young, 1994).

Cost allocation is important in making managerial decisions such as budgeting decisions (e.g., Baldenius et al., 2007; Pfaff, 1994; Rajan, 1992; Zimmerman, 1979), pricing decisions (e.g., Cohen & Loeb, 1990; Lere, 1986), control and management systems (e.g. Gordon, 1951; Suh, 1987), financial reporting (e.g., Khumawala et al., 2005; Tinkelman, 1998), and performance evaluations (e.g. Reichelstein, 1997; Rogerson, 1997; Wei, 2004). Therefore, it is critical that the cost allocation method charges each responsible party a fair share of the total cost, reflecting true cost incurred by each party. Unfair allocations may create disutility and psychological tension in the workplace, which can result in undesired management behavior and decisions. Although the cost allocation method in accounting research, driven from the economic game theory, has been evaluated for its efficiency, optimality, and practicality, little has been studied as to whether the allocation is perceived as fair. Our study uses a behavioral approach to examine fairness considerations associated with the cost allocation methods.

Economics Literature: Game Theory

Using an axiomatic approach, scholars have proposed allocation solutions that align with both the equality and proportionality notions of fairness. The equal distribution of resources among players can be seen as a Nash equilibrium solution to the classic Nash bargaining game (Nash, 1950). Nash equilibrium is a set of each player's strategy that generates the best possible outcome for every player, taking into account other players' decisions. The equal distribution is also the outcome prescribed by the Shapley value mechanism in situations involving two players (Shapley, 1953).

The Shapley value is a unique solution to the cooperative *n*-player game that satisfies Shapley's axioms of symmetry, efficiency, and additivity (see Appendix A). The "symmetry" axiom implies that it is only the value added to the game by the player that matters in determining the allocation, not any other characters of the player – that is, if any two players add the same value to any coalition, they should get the same allocations. The "efficiency" axiom states that the total amount distributed to all players adds up to the total value yielded by the cooperative game. The "additivity" axiom states that adding the allocations of two independent games yields the solution of the sum of those games. The Shapley value is the unique solution satisfying these axioms. It allocates to a player i the amount given by $\sum_{S \subset N} \frac{(s-1)!(n-s)!}{n!}[v(S) - v(S-i)]$, where N is the set of all n players, S is a subset of N comprising s players, and $v(S)$ is the value generated by the subset S of players. In effect, this method allocates the expected marginal contribution to each player. In the n-player setting, the Shapley value is determined considering all possible orders of entry of the players into the game, giving each player the expected marginal contribution. In the two-player case subset, the mechanism reduces to the solution that each player receives an equal allocation of the costs or benefits – same as the Nash equilibrium.

Analogous to Shapley's axiomatic approach to the justification of the Shapley value method, Banker (1981) proposes the proportional allocation method in the form of a unique mechanism that satisfies a set of axioms similar to the Shapley axioms (see Appendix A). Banker states Shapley's "efficiency" axiom as the "full cost allocation" axiom, which requires that $\sum_{i=1}^{n} x_i = c$, where c is the total cost (or benefit) to be allocated. This full cost allocation axiom ensures that all of the costs (or benefits) are allocated to the players – total burden is shared by all participants. The "symmetry" axiom requires that individuals who consume (or contribute) the same level of resources should be responsible for the same share of the costs (or benefits) – or more formally, that $q_1 = q_2 \rightarrow x_1 = x_2$, where q_i is the size of player i and x_i is the amount allocated to player i. Finally, Banker modifies Shapley's "additivity" axiom as the "additivity of players (or cost centers)" axiom, which requires that if a specific player (or cost center) k is subdivided into two players (or cost centers), f and g, such that $q_k = q_f + q_g$, then the sum of costs allocated to each of the two component players (cost centers), f and g, should be the same as the cost allocated solely to k, unless their resource consumption levels change.

Banker proposes the "additivity of cost centers" axiom to replace Shapley's "additivity" axiom because the Shapley value method determines allocations that are determined by the way players are organized rather than their resource consumption levels. Banker argues that unless the resource consumption levels of different players (or "cost centers") change, consolidating players into one player should not influence the amount allocated to other players. For example, consider two players, A and B, and their sub-players, A1 and A2 under A, B1 and B2 under B, who agreed to share the cost of using a shared resource. The best way to split the cost is to allocate it based on the number of days each sub-player uses the shared resource, as each needs to use the resource for a certain number of days. According to Banker's assertion, unless the number of days used by each sub-player changes, whether player A1 and player A2 enter the agreement as a single party or as two separate sub-parties should not influence the cost amount allocated to player B. However, according to the Shapley value method, the allocated cost amount for player B differs from when sub-player A1 and A2 play as a single party against B to when they play as two separate sub-parties.

The axioms of the Shapley value – especially the "additivity" axiom – has been subject to criticism when applied to various situations and contexts in which the Shapley value does not necessarily seem to yield fair allocations (Banker, 1981). An alternative mechanism to allocate costs or benefits is the proportional allocation method. Proportional allocation method is widely applied in cost accounting systems. This method takes into account additional information on q_i, the relative magnitudes of resource consumption (or contribution) by each individual player i (Banker, 1981). If additional information on individual consumption (or contribution) levels is permitted to enter into the specification of the allocation mechanism, the common accounting method prescribes fair allocations to be in the proportions of the consumption (or contribution) by each player.

Based on these game theoretical solutions, we design our experiment to examine which notion between the equality notion and the proportionality notion better represents individual notion of fairness.

Behavioral Economics Literature

A classic demonstration of the fact that fairness matters is provided by the ultimatum game, first studied by Güth et al. (1982). In a two-player ultimatum game, a proposer is given an endowment, y (usually in the amount of \$10 in laboratory experiments), and the proposer offers a proportion of the endowment, x, to the responder. The responder can either accept or reject the offer, x. If the responder accepts the offer, the responder takes x and the proposer is left with $y-x$. If the responder rejects the offer, both players are left with a payoff of zero. Theoretically, a unique subgame-perfect Nash equilibrium predicts that when the game is played as a one-shot anonymous interaction game, a rational economic responder is expected to accept any offer $x > 0$ from the proposer since rejection of the offer would forego the material benefit of x. Behavioral findings, however, deviate significantly from these theoretical predictions: if the offer, x, is below 30% of the endowment, y, responders reject the offer at rates of around 40%–60% (Camerer & Thaler, 1995).

These findings suggest that individuals often prefer the fair solution to the rational solution. When offered an unfair allocation, individuals prefer an inefficient outcome (getting zero) to an efficient but unfair outcome (getting $x > 0$). This indicates that motivations to achieve fairness can indeed outweigh self-interested materialistic desires. These findings are very robust and have been demonstrated in a number of industrialized societies and with stakes as much as several months' expenditures, giving further sustenance to the power and fundamental nature of the aspirations for fairness (Cameron, 1999; Hoffman et al., 1996; Roth et al., 1991).

Motivations to achieve fair outcomes promote socially efficient, cooperative outcomes. Research findings, both at the behavioral level and at the neural level, suggest that cooperation and fairness may be desirable in and of itself, not because of the subsequent material benefits. Behavioral studies document that when disciplinarian players – who are seriously concerned about achieving fair outcomes over unfair outcomes even at their own costs – are given the opportunity to sanction selfish players by imparting punishments for their selfish acts, those strongly motivated disciplinarians may be able to rationally induce some of the selfish players to realize fair outcomes that are socially efficient and eventually to cooperate toward achieving fair outcomes (Fehr & Gächter, 2000; Gürerk et al., 2006; Kahneman et al., 1986).[3]

Recent studies employing neuroimaging methods have even begun to uncover the proximal mechanisms involved in the implementation of the motivation to achieve fair outcomes. In particular, some evidence has revealed that mutual cooperation and the realization of fair outcomes can be intrinsically rewarding experiences, while unfairness can be distressing. For example, implementing a cooperative outcome in a prisoner's dilemma game yielded increased activations in brain regions implicated in reward processing, including nucleus accumbens, caudate nucleus, and ventromedial orbitofrontal cortex (Rilling et al., 2002). Similar patterns were documented using a modified ultimatum game – in response to fair rather than unfair offers, increased activations in brain regions related to reward processing were observed, including ventral striatum, ventromedial prefrontal cortex, and orbitofrontal cortex (Tabibnia et al., 2008). Furthermore, transfers of money that generate equitable outcomes yielded increased activations in ventral striatum and ventromedial prefrontal cortex (Tricomi et al., 2010). However, when individuals receive unfair offers in an ultimatum game, they can experience more negative emotion, yielding increased activations in the right anterior insula that is associated with an increased