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Discussions

Interactive comment on "Resolving conflicts over trans-boundary rivers using bankruptcy methods" *by* M. Zarezadeh et al.

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This paper is on the application of the bankruptcy literature to the problem of sharing scarce river water, focusing on spatial and temporal variation in water availability. A case study provides an illustration of the proposed method.

I like part of this paper (see final bits of this report), but I also have three major comments. My first comment is that the paper ignores the backbone of the bankruptcy literature, or claims literature, by ignoring the rules' *properties*. My two other comments are on the mathematical specification of the method and the novelty of the paper's contribution.

1. Two immediate questions that arise when reading the paper are: (a) Why focus on these 4 bankruptcy rules and ignore the many other rules?, and (b) Why perform a stability analysis on the bankruptcy solutions?
   In my view, the answer to both questions is that the authors ignored the backbone of the bankruptcy literature, or claims literature, by ignoring the rules' *properties*. In this literature, the attractiveness of rules is based on their properties, such as monotonicity or independence properties, with respect to various possible perturbations of the problem at hand (for an overview of these properties see Herrero and Villar, 2001; Thomson, 2003).
   By ignoring this aspect of the bankruptcy literature, it appears that the authors have selected arbitrary rules. By applying these arbitrary rules to a case study, the outcomes are also arbitrary, which is why they need some stability analysis to evaluate the attractiveness of the outcomes. This stability analysis is redundant had the authors not ignored the properties of the rules.
   From the paper, it becomes clear that the authors are interested in variability. Given this interest they could have chosen or designed properties that are desirable with respect to this variability and subsequently derive the rules that satisfy these properties. In fact, for river runoff variability this is the procedure that has been followed by Ansink and Weikard (2013) with respect to so-called *composition* properties.

2. The specification of the proportional rule is not clear, because:

   (a) The interpretation of the objective function is not clear, i.e. why are you minimizing the difference between λ_{P_t} and the product of the other λ's?; My gut feeling is that for this specification to lead to a proportional solution requires that all claims are equal, but there is so little motivation that I cannot prove this. Please motivate and elaborate on how we should interpret this rule and what is its relation to the standard proportional rule in the bankruptcy literature (cf. Thomson, 2003).

(b) Equation (1) does not specify the variable over which the objective function is minimized. Is λ_{P_t} in (1) and (11) endogenous?

Similar comments apply to the other 3 rules introduced in Section 3.

3. One of the paper's objectives is (final sentence Section 1): *"developing a new water allocation mechanism that . . . provides allocations solutions with respect to the temporal and spatial variability of water flows in trans-boundary river systems."* In Section 2 it becomes clear that this variability is modeled as constraints in an optimization model. For temporal variability this implies that solutions are computed for each period separately, which is a weak interpretation of the paper's objective. For spatial variability, this implies that solutions are constrained by water flowing downstream (i.e. equation (5)), which is not really novel (cf. İlkılıç and Kayı, 2012, and other papers), and for which more elegant alternatives are available (Ansink and Weikard, 2012). Also, spatial variability, as modeled in this paper cannot deal with excess flow. Suppose that downstream inflow is high while downstream claims are low. How is excess water allocated? Equation (4) assures that no riparian receives more than his claim, but the system is closed since the most downstream riparian m cannot dispose more than (fixed) SD.

To close on a more encouraging note, I appreciate several aspects of this paper, including:

1. I enjoyed the thorough explanation of the benefits and advantages of applying bankruptcy rules to the sharing of scarce river water. As the authors explain, sometimes benefit sharing is just not realistic or there may be insufficient information to apply benefit-sharing approaches grounded in cooperative or non-cooperative game theory (such as Van den Brink et al., 2012; Ambec and Sprumont, 2002; Ambec et al., 2013).

2. I appreciate the careful consideration of the basis for (exogenous) claims in the case study section. The three explored alternatives are relevant for actual negotiations and should therefore be considered in a cooperative analysis as presented in this paper.

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