

Social Preferences in Dynamically Complex Supply Chains:

Reciprocity in the Beer Distribution Game

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Abstract

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The purpose of our research paper is to examine the effect of social considerations on a dynamically complex supply chain. In order to model the dynamic supply chain, we use Vensim modeling software to depict a modified version of the Beer Distribution Game. For the underlying social utility concept, which demonstrates the social considerations that steer the simulated player behavior in our model, we use Falk and Fischbacher's (2006) reciprocity concept.

Research in supply chain theory about social preferences has, thus far, mostly focused on analyzing simple, one-shot dyads from a game-theoretical or mathematical perspective. In addition, earlier work concerning dynamically complex settings has dealt only with kindness perception, corresponding to the first half of Falk and Fischbacher's (2006) reciprocity concept. Our approach is novel as we add the second half of the concept, the reciprocation term, in order to model a behavioral response of the players to perceived kindness. This means that our model not only tracks the socially induced utility or kindness levels of the players like previous research, but also includes the impact of reciprocal considerations on the strategies chosen by the players. In other words, the objective for this conference paper is to examine and depict the impact of reciprocal concerns on simulated supply chain behavior.

In order to allow the players in the dynamic supply chain to alter their decision-making based on material payoff calculations as well as social considerations, we modified the Beer Distribution Game in three ways. Firstly, we added prices and costs to the cases of beer in order to facilitate payoff calculation. Secondly, we changed the objective for the players from global costs minimization to local profit maximization. Thirdly, the players in the modified version of

the game possess complete information about the payoffs of the players positioned directly upstream and directly downstream from them to allow the players to calculate their social utility. Based on both, their social utility and their material payoff-induced utility, the players can then choose between three discrete options in the upstream direction via price setting and in the downstream direction by adjusting their order quantity. The three options comprise, from the perspective of the affected player, a favorable, a neutral, and an unfavorable option. Concerning the decision-making in the downstream direction, the players are designed to use an ordering mechanism that is based on a decision-making heuristic developed by Sterman (1989).

To test the effect of social considerations on the dynamics of the supply chain, we ran three simulation runs with varying degrees of relative importance of the players' social considerations in their decision-making, which is captured by the reciprocity parameter. The three simulation runs correspond to a first scenario with no social considerations at play, a second scenario with, in relation to the effect of material incentives, weak reciprocal considerations, and a third scenario, defined by relatively strong reciprocal concerns. The set up for our simulation runs was, concerning initial stock values and delay values, very similar to the traditional set up for the unmodified Beer Distribution Game.

We find that the players generally demonstrate inequity averse behavior, which leads to a relatively equitable profit distribution in the model supply chain. If this finding persists in the dynamics of actual supply chains, it could explain a greater level of channel harmony in supply chains that are strongly affected by social considerations. Moreover, we find that the bullwhip effect, which describes a common problem of supply chains, also persists in reciprocal supply chains. However, our results indicate that relatively weak reciprocal considerations seem to have a negative effect on supply chain performance, while relatively strong reciprocal considerations have the converse effect. A somewhat ambiguous effect of social preferences is in line with related theoretical research work (Cui et al., 2007) (Du et al., 2014). Future research efforts could focus on comparing the results of the modified Beer Distribution Game to the performance measures of actual supply chains. Potential overlaps or discrepancies could help to better estimate the parameters in the modified Beer Distribution Game and could help to ameliorate the understanding of the impact of reciprocity in these settings.

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