Mismatch between supply and demand is a prevalent problem in business. One mitigation strategy is inventory sharing, also referred to as transshipment, which is popular in multiple industries including automobiles, apparels, computers, furniture, information technology products, shoes, sporting goods, and toys. Inventory sharing is powerful, particularly when demand is difficult to predict, because it enables multiple retailers to pool demand risks. Excess supply of one retailer can be used to fulfill excess demand of another.

The literature on transshipment covers both settings with centralized and decentralized retailers (e.g. Rudi et al. 2001). In a centralized system, the main issue is how risk pooling can improve inventory management. In a decentralized system, the self-interests of different retailers need to be aligned before risk pooling can be achieved. Transfer price (i.e., the price charged by one store for transshipment goods to another) is the most studied coordinating mechanism in the literature. There are substantial gaps in the literature regarding how the transfer prices should be set. Should retailers determine the terms of inventory sharing before the need of transshipment is known (i.e., ex ante) or should they postpone the transfer price decision until afterwards (i.e., ex post)? On one hand, setting the transfer price ex post has the advantage of the ability to use the actual realized demand and inventory information to coordinate. On the other hand, setting it ex ante allows for transfer price commitment that may avoid incentive problems. Besides, should retailers pre-commit to share if they have extra inventories or should they have the right to decide whether and how much to share?

The answers to those questions are further complicated by behavioral considerations. Extensive research in psychology, sociology, and economics have documented how behavioral tendencies may influence human decision making. In recent years, operations management
research has been increasingly conducted through a behavioral lens (Donohue et al. 2017) as more and more empirical evidence emerges to demonstrate that normative theories and game-theoretic models need to be augmented by behavioral thinking to provide practical guidance.

In this study, motivated by the questions above, we consider two transfer price setting processes and two inventory sharing rules, resulting in four combinations of the transshipment setting. We refer to them, collectively, as transshipment contract processes. Each retailer sets her own transfer price either before ordering decisions are made and demands are realized, referred to as the ex-ante setting, or after the demands are realized, referred to as the ex-post setting. The two inventory sharing rules are either automatic where retailers are committed to transship if one has excess inventory and the other has excess demand and no decisions are involved once the need for transshipment arises, or voluntary where retailers can choose whether and how much to request transshipment and whether to fulfill the requests.

We first derive the Nash equilibria for the four different scenarios, as benchmarks. We find that the inventory sharing rules have no impact on expected profits, and the transfer price setting process only has a marginal effect.

We then conduct laboratory experiments to evaluate different transfer prices setting processes (i.e. ex-ante and ex-post) and inventory sharing rules (i.e. voluntary and automatic) for decentralized retailers and identify several key behavioral irregularities. Specifically, individuals set transfer prices much lower, and order much less, than what Nash equilibrium predicts. We also find substantial treatment effects where rational model predicts little (none in automatic versus voluntary, a very small difference in ex-ante versus ex-post). The magnitude of disparities relative to the Nash equilibrium prediction appears to be most substantial in the situation where transfer price is set ex ante and inventory sharing is voluntary.
Motivated by these observations, we develop a behavioral model to account for these findings. We use the QRE framework and also include two behavior factors: fairness and reference dependence. The model provides compelling explanation of the behavior observed in the data. We show that fairness concerns are present in the voluntary settings, and explains the lower transfer prices, compared to the automatic settings. In addition, we show that bounded rationality explains the lower, and more “spread-out” transfer prices in the ex-ante settings. We also find that psychological pain of excess supply is present in all inventory sharing treatments, but weakest in the Ex-Ante-Auto setting.

This study leads to three main managerial insights. First, we find inventory sharing would greatly benefit retailers than without, regardless of the transfer price setting process and inventory sharing rules that are considered in the paper. Thus, firms should actively pursue transshipment arrangements. Second, surprisingly we find that supply chain efficiency is the lowest if retailers set the transfer price up-front before the ordering decision and each party is given the freedom whether to share inventory. Therefore, in order to gain the most benefit from inventory sharing, parties should either postpone the decision of transfer price until transshipment, or pre-commit to sharing. Third, we find that order decisions indeed react to the transfer price in the case where order quantities are set after the transfer price. If a retailer chooses to pre-commit to sharing, and set the transfer price up-front, transfer price can potentially be used as a coordinating mechanism for inventory sharing.

References:
