When Competitors Agree to Cooperate: the Case of
Transshipment in Supply Chains*

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June, 2005

1 Extended abstract

Even the fiercest competitors find it to their advantage to occasionally cooperate with each other.

One example is the technology service company “Covisint”, jointly owned by DaimlerChrysler, Ford, General Motors and Renault-Nissan; it provides online auto parts and information exchange services for the auto-makers. Another example, of direct interest to this paper, is cooperation within a competitive supply chain through transshipment. Competitors might freely enter into an agreement in advance to transship surplus product to a competitor who is suffering a shortage of an identical or substitutable product. For example, the independent car dealers of Ford Motor and Honda Motor have developed an Internal Information System (IIS), providing each dealer with complete visibility of other dealers’ inventories throughout the system. When a dealer is unable to satisfy customer’s demand directly from his own inventory, he can check the availability at other

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dealers and transship if it is available. On the other hand, without transshipment, a portion of the unsatisfied customers at the competitors might switch to him, enabling him to sell cars at a full price. Many Internet third party services providers (TSP) have begun to offer search facilities to help customers to search, and dealers can subscribe by paying a fee. Examples of this kind of service are: AutoByTel or GMBuyPower (Anupindi and Bassok, 1999).

The key question we address in this paper is: how do the two operations differ? is it better for retailers to contract in advance to transship surplus inventories to those in shortage? Or should they ensure that their inventories are at a competitive level and let the customers move? In other words, which mode of operation is better, moving the inventories or moving the customers? In the context of our car dealer example, does developing IIS with other dealers work better than joining the search facilities offered by the TSP? Other questions flow naturally from this key one: How does the choice depend on market or firm parameters? Which strategy does the supplier prefer the retailers to adopt?

To make a theoretical evaluation that is tractable, we propose a stylized model designed to capture the essence of the trade-offs involved, rather than to focus on the richness which emerges in the many arrangements and deals made in practical supply chains. We hope, however, to be able to use this simplified model to sift out the key features which might repay consideration by a finer grained analysis. The first simplification is that we assume a single period environment, perhaps reflecting a highly perishable product. We take only two retailers selling highly substitutable products supplied by a common independent supplier. This is the most parsimonious model that still allows us to analyze the effect of competition. Customer demand is modeled in three ways: without retail price setting, with price sensitive demand, and with price competitive demand.

We base our answers to the above research questions by studying two games under each of the three demand models: the Transshipment game and the Inventory Competition game.
In each section, we first derive the existence and uniqueness of a Nash equilibrium. Then we compare how the two operations differ. Under a fixed transshipment price, retailers tend to set lower service levels and retail prices than they would do under inventory competition. If the transshipment price is the retail price of the one who has surplus inventory (sender’s retail price), then the retailers will provide more safety stock and charge a higher retail price under transshipment than under inventory competition; the opposite is true if the transshipment price is the retail price of the one who has surplus demand (receiver’s retail price). The origin of these results are the effects of externalities introduced by transshipment and inventory competition, which we explain in detail later.

We compare the profitability of the two games through empirical evaluation. With a fixed transshipment price, the summary results are the following. The degree of price competition influences the retailers’ decisions on transshipping or competing; this effect is most apparent under certain transshipment prices and profit margins. Retailers are unlikely to sign a transshipment contract when they are involved in fierce price competition. This is in contrast to the results obtained from price taking or price sensitive models. So in a market with fierce price competition and sufficiently high consumer switching, cooperating to transship may not be the appropriate strategy.

The supplier usually prefers not to transship when the transshipment price is fixed, however the supplier would always prefer independent retailers to transship at the receiver’s retail price. The retailers agree with this if not involved in price competition, but are opposed if they are price competitive. The externality brought about by price competition interacts with the externalities of transshipment and inventory competition in an interesting way, causing the above observations.

As a ‘risk pooling’ tool, it has been taken for granted that transshipment is beneficial. It is intuitive to conclude that under competition, transshipment is even more desirable, since transshipment may buffer fierce competition and help both parties. However, this paper argues that this intuition
is actually wrong. The insight for inventory managers is that caution is needed when signing a transshipment contract, especially when the products are highly substitutable and customers have full information to compare prices and are able to switch after a stock out.

The literature on inventory competition starts with Parlar (1988), where two competing newsvendors make simultaneous ordering decisions. Lippman and McCardle (1997) study a more general version of the inventory competition game between newsvendors. Mahajan and van Ryzin (1999) consider inventory competition among N firms that provide substitutable products and where consumers choose firms dynamically based on availability. Netessine and Rudi (2003) also study the case with N products and assume that consumers substitute with a fixed probability. Anupindi and Bassok (1999) study the effect of stock centralization (pooling) on both manufacturer and retailers when consumers can search. They find that the retailers always benefit from centralization but the manufacturer may lose.

Literature in the field of transshipment can be divided into two groups. The first was started by Krishnan and Rao (1965). Most models assume a centralized monopoly, and both the inventory and transshipment decisions of all retailers are made to maximize total profits; examples are Lee (1987), Jonsson and Silver (1987), Robinson (1990), Archibald et al. (1997). Recently, game theoretic tools have been applied; for example, Rudi et al. (2001) study the transshipment between two independent retailers (although no competition is involved). Their primary concern was to compare inventory levels set by independent decision makers with that set by a monopoly. Anupindi et al. (2001) explore a ‘coopetition’ business world. Multiple retailers cooperatively agree on an allocation rule to share transshipment profit, but then competitively decide on individual inventory levels. Dong and Rudi (2001) study a transshipment setting with one manufacturer and N retailers jointly owned. They find that the manufacturer can extract most of the benefit from transshipment and that (numerically) retailers are even worse off under transshipment when the manufacturer is
a wholesale price setter.

These recent examples on transshipment relax the monopoly assumption and analyze the transshipment problem from a game theoretic view. However, none of them really incorporates competition at the retailer level. Is transshipment preferred by competitive retailers? This is the theme of our paper.