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# Sourcing truckload capacity in the transportation spot market: A framework for third party providers

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## ABSTRACT

Due to uncertainty in supply chains and carrier networks stretched thin by demand, it is sometimes necessary for shippers to procure capacity for shipments on the transportation spot market. The transportation spot market is a mechanism by which unfulfilled and urgent demand is satisfied. Shipments are tendered one at a time on a load-by-load basis. Because of the often severe shortage of spot market capacity and its relatively high and volatile prices, shippers must *actively* as opposed to *passively* seek carrier capacity. Often, they turn to third parties. This research considers third party brokers (3PL, or non-asset carriers) operating in the spot market. On behalf of shippers, these brokers take responsibility for shipments and secure capacity for them. The paper proposes a behaviourally-based conceptual framework that uses 3PL broker data to improve the search for capacity on the spot market. It seeks to improve the effectiveness of the search process by combining (1) broker data on the availability of carrier capacity, (2) a priori information on a particular carrier's likely response to various prices to service a load (the reservation price), and (3) the ability to source multiple loads simultaneously (bundling). These components are incorporated into a framework that enables brokers to better prioritize the carriers they contact, thereby improving outcomes in terms of lower carrier costs and reduced search effort.

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## 1. Introduction

The transportation spot market is an important component of the U.S. motor carrier industry that exists to serve urgent or unfulfilled demand. It consists of shipments handled on a one time load-by-load basis (Tibben-Lembke and Rogers, 2006). Residual demand results from supply chain uncertainty and shipper-carrier contracts for dedicated services that are often structured to allow carriers to refuse loads for which they do not have capacity. Because of supply chain uncertainty, shippers are often faced with unexpected shipments that their dedicated carriers have no capacity to serve. In this situation, they are forced to grant those shipments to any available carrier (Caplice and Sheffi, 2006). Because of this, shipper-carrier contracts are designed to guarantee to the carrier volume commitments in relative (percentages) rather than absolute terms. Carriers, in turn, generally have the right to refuse an agreed upon percentage of a shipper's service requests.

Therefore, the spot market represents shipper and carrier efforts to mitigate supply chain uncertainty. It is an integral part of the logistics industry, representing approximately one-fifth of for-hire trucking movements valued at more than \$10 bil-

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lion in annual billings (Transcore Freight Solutions, 2011). However, the spot market itself can be highly dynamic, and subject to considerable uncertainty in availability and/or pricing, making it difficult for shippers to utilize. Because of occasional severe shortages of spot market capacity, especially in certain lanes, and its relatively high and volatile prices, shippers must actively as opposed to passively (i.e. conduct traditional transportation auctions) seek capacity. Often, they engage the help of third party brokers. On behalf of a shipper, third party logistics (3PL) brokers will take responsibility for securing capacity for a shipment.

This research considers third party brokers operating in the spot market. It proposes a behaviourally-based conceptual framework that uses 3PL broker and third-party data to improve the search for capacity on the spot market and potentially reduce costs of completed transactions. The framework is predicated on the notion that the search process could be improved if the broker has knowledge of: (1) the availability of carrier capacity and (2) the compensation a particular carrier is likely to require in order to service a load – the reservation price. The search process could be further improved if (3) the broker can source multiple loads simultaneously – bundling. Offering bundled shipments in hope of securing capacity for those shipments more quickly and at better rates is a common practice.

These components are incorporated into a framework that enables brokers to better prioritize the carriers they contact, thereby improving outcomes in terms of lower carrier costs and reduced search effort. An important behavioural element is introduced into spot market transactions via reservation prices due to the speculative and dynamic nature of the marketplace. Though aspects of sourcing spot market capacity have been explored in the logistics literature, this research contributes to that body of work by devising and applying a methodological framework to effectively utilize information on reservation prices and available capacity.

## 2. Background

Sourcing refers to the securing of capacity for shipments. In the 3PL literature, there are two perspectives from which the sourcing problem is viewed: the spot market and the dedicated services market. In the spot market, carriers are awarded shipments on a load-by-load basis, whereas the dedicated services market awards traffic lanes (distinctive delivery routes with different origins and destinations). The dedicated services literature on sourcing strategies, which predates the spot market literature, prominently features auctions as central methodological components (Foster and Strasser, 1991; Ledyard et al., 2002; Caplice, 1996; Song and Regan, 2003; Sheffi, 2004). These strategies, in turn, influenced early spot market strategies as they also were auction-based (Figliozzi et al., 2003, 2004, 2005; Garrido, 2007). Gradually, spot market sourcing strategies progressed to feature alternative methodologies such as real options (Tibben-Lembke and Rogers, 2006; Tsai et al., 2011), social network theory (Huang et al., 2011), and discrete choice (Lindsey et al., 2014; Lindsey and Mahmassani, 2015). A brief review of the spot market literature is provided in Section 2.1.

The specific entity within the spot market on which this research focuses are 3PL brokers. In the context of this work, the primary service provided by brokers is the securing of capacity for shipments in the transportation spot market. This differs from fourth-party logistics (4PL) or lead logistics provider (LLP) services in that the 3PL broker is not the orchestrator of the shipper's supply chain (Fulconis et al., 2006; Zacharia et al., 2011). Increasingly, 4PLs and LLPs coordinate the activities of carriers, storage operators, subcontractors, and other elements of the supply chain as a value-added service to shippers. While 3PL brokerages may exist within 4PLs or LLPs, the service offerings are distinct.

### 2.1. Review of spot market sourcing strategies

Though the market for spot contracts is inherently different from the one for long-term contracts, the use of auctions as a methodological tool for sourcing is still a popular approach with researchers. Figliozzi et al. (2003, 2004, 2005) modeled the spot market as a series of sequential auctions where either a shipper or a set of shippers offered shipments to a set of carriers. The carriers then bid on the shipments. The bidding problem was formulated as an equilibrium and decision theory problem. This series of studies conducted simulations to investigate the effect of the auction format, levels of sophistication for carriers, various routing technologies employed and learning capabilities of the carrier.

Garrido (2007) modeled the freight spot market using a double-auction scheme. In a double-auction, shippers first act as auctioneers soliciting bids from carriers for available shipments. Once the initial round of shipments is awarded, the tables are then turned as carriers begin to offer capacity at bargain prices in order to generate demand for backhaul movements. Thus, shippers are now bidders for the available capacity offered at discounted prices. In order to exemplify the benefits of the double-auction format, Garrido designed a simulation experiment that consisted of a single O-D network for which a series of shipments is sequentially auctioned. Carriers bid on the shipments according to a set of behavioural rules and are awarded shipments according to price. Garrido's experiment showed that a double-auction scheme could result in system-wide cost reductions of at least 14%.

Other researchers abandoned the auction-based strategies to spot market sourcing in favor of alternative approaches. A particularly interesting thread in the literature uses concepts from the theory of Real Options to envision truckload spot market contracts as financial derivatives, called truckload options. Tibben-Lembke and Rogers (2006) first presented a general framework for using options in the logistics industry. As applied to the spot market, a shipper would buy a transportation option from a carrier, or a carrier's agent, which would give the shipper the right to send a shipment in a given freight lane at

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