Effects of Truckload Freight Assignment Methods on Carrier Capacity and Pricing

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Summary: In this research, we investigate how carrier assignment methods impact available capacity and pricing. In the lane robustness study we examine how shipment volumes on specific lanes affect price escalation. We also study the role of brokers and asset based carriers in capacity creation process. In addition, we examine lane aggregation scenarios for different lengths of haul and analyze the optimal carrier location with regard to freight origin and destination. Finally, we suggest techniques to build additional capacity, improve service levels, and provide stable pricing.

KEY INSIGHTS

1. Building lane robustness through carrier assignment is a key factor in achieving stable pricing and high level of service. Growing a pool of available capacity slows down price escalation and reduces rejection rates.

2. Lane aggregation reduces demand variability and operational complexity. Short haul lanes can be grouped by distance in 10 mile intervals, while custom regions and city zones are most suitable for long haul moves.

3. Carrier location in relation to shipping location and freight destinations has a direct impact on pricing and available capacity for short haul shipments.

Introduction

Transportation is the movement of goods between supply chain parties. According to Standard and Poor (2012), transportation spend in the United States was $694 billion in 2010. Of this, $255 billion was spent on for-hire truckload (TL). Our study focuses solely on the for-hire TL industry where a truck moves one shipment directly from origin to destination.

Throughout our research we investigated the use of asset based carriers and brokers as unique sources of capacity on short and medium haul lanes. We examined price escalation issues in the context of load tender rejections and daily shipment volumes on a given lane. A lane robustness study guided our investigation into what factors affect ability of carriers to handle volume fluctuations. A study of brokers and asset based carriers helped us determine their roles in capacity creation depending on lane activity and daily shipment volume. We also studied effects of carrier location on and its ability to compete with regard to freight location.

The intent of our research is to study the impact of truckload assignment and provide recommendations...
on different techniques that can be used to build additional capacity, improve service levels, and provide stable pricing.

**Methodology and Data**

In this study we worked with a large beverage producer that at the time had 6 major production facilities across the US. To understand its network we investigated the different actors, production facilities, destinations, and service regions. Each was individually studied to see the underlying differences and explore various concepts for our analysis.

Relevant data used in our study:
- Transactional data (origin, destination, linehaul cost, distance, and carrier) for 12 months
- Shipment tender data (accepted and rejected tenders) for five months
- Spot market data (spot requests and carrier response) for seven months
- Interviews with asset based carriers and brokers

We used MS Access, SQL Server 2008, Excel and Google Maps to conduct our analysis. We segmented data for analysis based on:
- Distance brackets
- Carrier classification (carrier vs. broker)
- Tendering sequence
- Daily price ranking

Gathering the information and finding the right tools was a lengthy process, however, having everything organized and ready in advance, allowed us to efficiently conduct our data analysis.

**Lane Robustness Analysis**

*Price Escalation*

We defined lane robustness as an ability of the system to absorb demand fluctuations on specific lanes without impacting service levels and price. Our study looked at 41 high volume lanes across various distances. We determined that the larger the number of shipments on a lane, the higher the average price paid compared to a base or lowest rate paid. As volumes increase on robust lanes, price goes up by 6-10%, while 25-35% on non-robust lanes. Lanes between 100 and 280 miles are the most susceptible to price escalation with an average premium of 12-16.8%.

*Shipment Rejection Analysis*

We used rejection rates across all lanes to measure service level and carrier performance. Lanes between 100 and 400 miles had the highest rejection rates in contrast to almost all shipments being accepted in the range of up to 100 miles. Even though only 3.6% of total shipments have been rejected at least once, spotting lanes with service issues can improve operations and reduce extra costs. As Figure 1 shows, the higher the rejection depth, the higher the average price paid. While the first rejection carries a premium of 6%, the 10th rejection adds 26% to originally expected price.

Main reasons for shipment rejection are:
- Not enough lead-time to secure a truck
- Inconsistent lane volumes
- Shipments on not previously contracted lanes
- Long load times at origin or unload times at destination
- Originally offered rate being too low

**Sources of Capacity**

To lower the rejection rates and moderate price escalation, companies can access capacity directly from asset based carriers and indirectly by using freight brokers. For shipments up to 100 miles, utilization of brokers stays around 10%, while above 100 miles, goes up to 40%. The utilization levels are driven by carrier economics with very short haul lanes not being attractive to the non-asset based carriers. Additionally, our study showed that brokers are used especially on low volume (less than 20 shipments per year) and high volume lanes (over 1,000 shipments per year). For these two categories, utilization oscillates around 60%, while volumes in-between stay around 30%.

**The Magic Range between 100 and 300 Miles**

Our study showed that the range between 100 and 300 miles is the most volatile. It is mostly driven by carrier economics changing because beyond the 100 mile point carriers need to find backhauls to remain profitable. This specific range has the highest price escalation, rejection rates and broker utilization. Managing this specific range presents the largest opportunity for a company to mitigate risks and ensure a stable level of service.
Lane Aggregation Methodology

Lane aggregation offers operational efficiency, reduces variability, and reduces complexity of transportation networks. Companies put together lanes with similar characteristics and award them to the carriers as a single lane with a broader scope. We analyzed scenarios of aggregation for short and long haul lanes and designed a model that explains our methodology (Figure 2).

Figure 2: Circle-Satellite Aggregation Model

**Short Haul Aggregation**

Our study revealed that carriers usually do not use backhauls for shipments up to 100 miles so that they can optimize the number of loaded miles per day, given hours of service constraint. Based on the observation, we designed a model that created Short Haul Circles in 10 mile increments from the origin location (Figure 2). All shipments within a given circle would be awarded the same price regardless of direction. For one location, using this methodology would have reduced the number of lanes from almost 150 to six and improved the demand accuracy provided to the carriers by 21%. During interviews, carriers expressed interest in aggregating lanes using the Circles model and would be willing to do business that way.

**Long Haul Aggregation**

Aggregation can also be applied to lanes with longer lengths of haul. Currently, the sponsor company combines lanes using three digit zip zones. However, after investigating the geographical demand patterns, we determined that lanes can also be combined at the city or custom zone level. We analyzed two scenarios. For Columbus, OH aggregating within 20 miles of the city region would have combined volumes on three digit zip zones and improved the demand accuracy presented to the carriers by 11%. A custom zone with 20 miles radius around Baltimore, MD and Washington, DC, would have combined volumes for 8 different three digit zip zones and improved the demand accuracy by 13%.

**Implementation Notes**

Even though lane aggregation presents high potential for operational improvement, the right method needs to be chosen for a specific situation. Selecting the zones is an arbitrary process that should be based on carrier acceptance of the new process and financial impact in a given region.

**Carrier Proximity Impact**

In regions with significant volume of short haul shipments, carrier location with relation to the freight destination can have a large impact on a shipper's transportation costs. This is due to the fact that a carrier located far away from the origin and destination of freight must travel more empty miles than a carrier located near one of the two.

To determine the impact, we ran a multiple regression analysis of over 3,500 shipments with linehaul rate as our dependent variable and total empty miles and loaded miles as our independent variables.

With an adjusted $R^2$ of 94.24%, our study determined that for lanes over 40 miles, Large Co. spent about $1.64 for every empty mile driven by the carrier. We determined that for this particular dataset the empty miles that could be decreased accounted for 11% of the total distance traveled and eliminating them could reduce costs by about 17%.

**Carrier Co-Location**

Carrier co-location is the best way to reduce the number of empty miles in a round-trip shipping scenario for short-haul shipments. Carriers can locate their equipment near the shipper’s facility to increase its asset utilization and potentially gain more freight from the shipper. The shipper can receive better rates while the carrier can improves its network. By building a relationship with a carrier that is located on site or close by, creates additional capacity available to the shipper.

**Serviceable Region Map**

When co-location is not an option, we created a methodology for designing an Optimal Serviceable Region Map (Figure 3). It demonstrates how carrier assignment can be used to decrease empty miles.
Figure 3 is an example of one of these maps for a production facility in Dallas, TX. During the carrier procurement process, carriers would be invited to bid on specific lanes based on whether their origin falls within a specific region. For example, carriers 1 and 2 would both be invited to the bid for destination 1, assuming they would offer the best rates due to their close proximity to the shipping destination. Understanding how proximity affects the pricing, the shipper can also try to find other carriers that are positioned more favorable than existing vendors.

Our study has shown us that selecting carriers who are close to the freight origin (co-location) or carriers near the freight destination have the biggest impact on limiting empty miles and decreasing linehaul costs.

Conclusions

1. Minimizing price escalation and reducing rejection rates and its depth are the key factors to ensuring lane robustness. Leveraging strengths of carriers and brokers is important in building capacity that is able to respond to changing conditions and demand fluctuations.

2. Lane aggregation successfully reduces operational complexity for shippers and carriers. However, selecting the right method depends on the specifics of the destination, carrier acceptance, and cost implications.

3. Co-location is by far the best option when attempting to decrease empty miles. Carrier co-location will always result in the minimum number of empty miles. If co-location is not possible, creating a Serviceable Region Map can help guide shippers when selecting carriers during the procurement process.