Research in Transportation Business & Management xxx (2014) xxx–xxx

Contents lists available at ScienceDirect

Research in Transportation Business & Management

Intermodal chassis supply in the US — A Bayesian game model

Bruce C. Hartman [a,*], Christopher Clott [b]

[a] Intermodal Transportation Institute, University of St. Francis, Joliet, IL 60435, United States
[b] College of Business and Health Administration, University of St. Francis, Joliet, IL 60435, United States

ARTICLE INFO

Article history:
Received 29 July 2014
Received in revised form 21 September 2014
Accepted 14 October 2014
Available online xxxx

Keywords:
Game theory
Intermodal transportation
Port logistics
Container chassis
Bayesian games

ABSTRACT

A container requires a chassis for every over the road move. In North America, unlike Europe, approximately 30% of chassis have been owned by ocean carriers, who are divesting their chassis. Older chassis bring higher risk for damage or disruption on a trip, though they cost much less than new chassis. Who will provide chassis to facilitate container moves by truck for the growing amount of intermodal traffic flowing through the US? The issue is important for successful port operation, and may require at least operational improvements, and governance decisions by ports or terminal operators. We examine strategic possibilities for a trucker and shipper supplying chassis, using a Bayesian game. We find equilibrium and estimate typical values of decision parameters to make predictions about the signals shippers will send and corresponding truckers' strategy. Making truckers supply chassis may not be practical in North America, so additional specific policies and practices are needed. Inducing truckers to supply chassis under present economic conditions may require capital subsidies or higher freight costs, as well as improved operations.

© 2014 Elsevier Ltd. All rights reserved.

1. Introduction

A shipping container chassis is a complementary product; we need one with every move by truck from the port, over the road or to the rail so demand for chassis is dependent. The provider of the chassis gets to charge for it, either by embedding the charge in the rate quoted for the move, deducting it from the freight bill, or explicitly as a rental fee. There are also expenses; the chassis must be inspected for roadability, a US federal requirement, twice in each turn; and the chassis will likely require occasional maintenance and repair, though not on each trip. There is a finite probability the chassis will fail during the trip and another must be provided, resulting in a deduction from revenue. Finally, there is the capital cost of the chassis, an opportunity cost which must be deducted. The party that does not provide the chassis must pay for it or reduce payment by an amount equal to the rate for a move charged by the provider. It does not matter whether the provider charge is actually paid, or simply reflected in her need to charge the ultimate customer; it reduces her contribution margin.

Chassis availability poses serious operations issues for marine and inland ports (Mongelluzzo, 2014). Without a chassis, cargo will not move; delays in getting one will be reflected in the reliability and performance of deliveries, affecting supply chains that use the port. Some ports operate their own pools to assure they have them; others rely, at least in part, on third party pools (Bonney & Mongelluzzo, 2014). Truckers need to pick up the chassis promptly without delay; finding a suitable unit with the expectation that it is operational. They also want an easy return. Maintenance should be conducted according to good practice standards. At certain ports, such as the Ports of Los Angeles/Long Beach, disputes between maintenance unions and port operators regarding who did the maintenance also introduce delays (Gruelle, 2014). Such issues require governance activity, rules and obligations, as well as simple operational improvements. The atomic transaction, matching a chassis, trucker, and shipper for a single move, is worth understanding in detail. Game theory gives us an economically rational view of their strategic decision process. Policies or practice changes should be assessed in this light.

The primary players in this interaction are the potential providers. In the US, relatively few truckers own chassis, since their businesses usually try to reduce capital cost to the minimum. A trucker may lease or buy chassis. But she most often rents it at a daily rate from someone (a pool operator, yard, beneficial cargo owner, leasing company, shipper, or another private party). In the US, chassis interchanges are usually governed by the Uniform Intermodal Interchange and Facilities Access Agreement (UIIA) (Intermodal Interchange Executive Committee, 2013), developed and maintained by the Intermodal Association of North America (IANA) that spells out responsibilities of motor carriers and equipment providers. There may be no restriction on use of the chassis for the time rented; they may carry several containers in separate loads. However, the chassis must be returned to a specified location, and may vary, sometimes during the actual move, and result in lost time, a significant issue in contracting. Recent reports by truckers (IANA, 2013) indicate that some providers are striking out or amending their contract terms without prior consultation, indicating that there is some contention. There is also a great risk that a chassis can be idle due

* Corresponding author.
E-mail addresses: bhartman@stfrancis.edu (B.C. Hartman), cclott@stfrancis.edu (C. Clott).

http://dx.doi.org/10.1016/j.rtbm.2014.10.005
2210-5395/© 2014 Elsevier Ltd. All rights reserved.

Please cite this article as: Hartman, B.C., & Clott, C., Intermodal chassis supply in the US — A Bayesian game model, *Research in Transportation Business & Management* (2014), http://dx.doi.org/10.1016/j.rtbm.2014.10.005

to its location, thus requiring substantial repositioning cost without a backhaul and liability associated with ownership. Truckers and ocean carriers prefer that ownership lies elsewhere. Since transportation deregulation in the US, there is close to perfect competition for the transportation product and few ways to distinguish the service. Thus the chassis must be obtained as cheaply as possible with little extra risk.

Opportunities for free riding occur, by failing to provide full inspection or maintenance. Truckers can today pick up chassis owned by others at a yard; they may need to check 3 to 4 before a road-able unit is found (Transportation Research Board, 2012). And there is moral hazard; when they return the chassis later there is a possibility that they will try to return a slightly compromised unit without repair and hope it is not noticed, leaving someone else to cover the damage. Until recently, chassis were not marked or identified, and roadability checks were documented only on paper reports (Federal Register, 2008). In 2011, the US Federal Motor Carrier Safety Administration (FMCSA) found that 17% of chassis inspected had roadability issues (Berg, 2011). The introduction of electronic chassis registration by FMCSA (Federal Motor Carrier Safety Administration, 2013), and the filing of electronic maintenance and inspection reports may result in less free riding but the press of providing guaranteed service times to customers may still beg shortcuts, and it is not clear how policing would be effected if incorrect reports were submitted. If there were major damage from a chassis malfunction, reporting might allow responsible parties to be identified, but threat of a lawsuit is not necessarily a major deterrent. The FMCSA proposed a rule (Penn Intermodal Leasing, 2013) which would require reports to be filed only when the equipment was found not suitable for the road. This would reduce paperwork for truckers, but would prevent assessment of repair frequencies, and improvements in roadability.

The European model, in which truckers own the chassis (See, for example, Odyssey Logistics & Technology, 2012; Rodrigue, Zumerchick, Lanigan, & Barenberg, 2013), is feasible there because trips are mostly shorter, resulting in quicker turns and more rides per day. Europe has chassis inspection rules similar to those coming into effect in the US. In the US, as in Europe, many drivers are owner operators, working at a piecework rate, and are under-capitalized (Arruñada, González-Díaz, & Fernández, 2004). US firms with over $1 million in revenue average about 25% owner operators; in Europe the percentage is closer to 70% (Arruñada et al., 2004). Bankruptcies are common in both areas (Cassidy, 2014; James, 2009). A diversity of chassis is required in the US, since the standard domestically is 53 ft, while for international containers it is 20 ft or 40 ft, each requiring different chassis; though there are newer chassis available which will fit universally. A typical new chassis costs $15,000, and the average age of the chassis fleet in the US is about 18 years (Rodrigue et al., 2013). Only 2% of intermodal chassis are later than 2002 (DNJ, 2014). Many older chassis are outfitted with recapped tires rather than radials, and it is common for radials to be stolen from idle chassis in unprotected situations, so it is often not cost effective to upgrade the tires. IANA reports that theft of LED lights is a frequent cause of noncompliance on inspections (IANA Operations and Maintenance and Repair Committee, 2013). A used chassis from an ocean carrier fleet might cost as little as $3000 (see, e.g. Truck Paper, 2014), but would be subject to substantially higher maintenance expense and higher risk of failure en route.

Other possible providers are shippers, ocean carriers, pools, leasing companies, or terminal operators. Rodrigue et al. (2013); Rodrigue, Zumerchick, and Ogard (2012) discuss chassis availability and its impact on port performance with alternatives in different areas described. It's an important US problem, as Bonney (2011) and Bonney and Mongelluzzo (2014) indicate. Two US chassis pools are CCM, a consortium owned by 18 ocean carriers, (see Chicago and Ohio Valley Consolidated Chassis Pool (2013) for their Chicago area locations) and TRAC Intermodal (TRAC Intermodal, 2013). The home improvement chain Lowe's has begun operating its own chassis fleet (American Shipper, 2013b). The American Trucking Association has successfully petitioned the US Surface Transportation Board (American Shipper, 2013a) to operate its own pool as a non-profit on behalf of truckers. The pool is known as the North American Chassis Pool Cooperative (NACPC) and has begun operation with about 3000 chassis in the Memphis TN area (Berg, 2013). Truckers and shippers alike are concerned about how to make chassis available.

Providing a chassis for a trip is a strategic dyadic interaction between the trucker and shipper. Non-cooperative game theory is therefore ideal for examining it. In contrast, cooperative games deal with outcomes, not negotiations. “In the cooperative approach we look directly at the space of outcomes, not the nitty-gritty of how one gets there” (Aumann, 1997). Since chassis provision is part of a more comprehensive contract, studying the single interaction is appropriate. It involves asymmetric information; trucker does not know if shipper has resources to supply a chassis in case she does not. We can expect players to use their beliefs about the power of the opponent in shaping their strategy; thus an extensive Bayesian game is useful.

Bayesian games were introduced by Harsanyi (1977), extending strategic game equilibrium theory to cases of asymmetric information. Fudenberg and Tirole (1992) discuss them at length in two chapters of their text; they are applied, for instance, to Cournot competition in which one firm has private information about its cost (Fudenberg & Tirole, 1986); wars of attrition in marketing (Bishop, Cannings, & Smith, 1978); auctions (Chatterjee & Samuelson, 1983); and games of mechanism design, involving a principal and agents who have private information. Some Bayesian game modeling of individual transactions, such as terrorists selecting targets, has been done (for instance, Azaiez, 2009). Applications of Bayesian games to port economics or port operations are few. In their review Pallis, Vitsounis, De Langen, and Notteboom (2011) mention only two game theory applications, and these are not Bayesian. Also, the port literature has focused on decisions at the level of the major port actors, not specific transaction analysis. Recently, Wang and Pallis (2014) used mechanism design, a related asymmetric information game, to model moral hazard in port concession agreements. Saurí and Robusté (2012) use a principal–agent model with asymmetric information to analyze incentives in terminal concession contracting. Zheng and Negenborn (2014) use principal–agent theory and dynamic games to analyze optimal tariffs, capacities and efficiencies under centralized or decentralized port management practices. All of these model high level strategy between port authorities and terminal operators, rather than individual transactions.

Section 2 discusses the staged decision process for trucker and shipper and presents the Bayesian game. Section 3 provides some basic data for the North American market, and use the model to make predictions. Section 4 investigates sensitivity to some of the model parameters based on the earlier North American market estimates. Section 5 concludes with a summary of findings and suggestions for further investigation.

2. Bayesian game model

Consider two players, designated trucker (T) and shipper (S). Ocean carriers and terminal operators can qualify as shippers, as well as other consignors or consignees of the containers. Leasing companies are an intermediary, representing the shipper in short term leases. In making a deal for carriage, the trucker begins a two-stage process by assessing whether the shipper has access to chassis of her own, or not. There are two types of shipper; endowed (E) or weak (W). The shipper has private information about their type; their ability to provide a chassis to move the cargo if ‘push comes to shove’. The trucker does not know the shipper's type, but has a prior belief, expressed as a probability distribution on the two-point state space; $\Pr(W) = p$, and $\Pr(E) = 1 - p$.

Trucker can provide a chassis or not, strategies C or N. Trucker's strategy may depend on shipper's type. An endowed shipper has a ready source of chassis, perhaps owned or easily accessed. To calculate

Please cite this article as: Hartman, B.C., & Clott, C., Intermodal chassis supply in the US — A Bayesian game model, *Research in Transportation Business & Management* (2014), http://dx.doi.org/10.1016/j.rtbm.2014.10.005

Download English Version:

https://daneshyari.com/en/article/7410425

Download Persian Version:

https://daneshyari.com/article/7410425

Daneshyari.com