Analysis of the Choice Behavior for Container Transport Services in the Maritime Hinterland

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Abstract. The handling of the growing container volume is facilitated by standardization and digitalization. This, in turn, makes container transport services offered by actors of the maritime transport chain hard to differentiate. Additionally, ports are faced with fierce competition and the connectivity to the hinterland becomes crucial for their competiveness. Hence, for ports it is necessary to understand the choice behavior of decision-makers in the maritime hinterland to remain competitive. Therefore, a discrete choice model is developed to investigate the preferences of shippers and forwarders for transport services in the maritime hinterland. Transport services are evaluated regarding transport costs, transit time, frequency and IT services by shippers and forwarders operating in South-West Germany. Unsurprisingly, the results reveal that costs, time and frequency are highly important for both decision-makers. However, IT services require a differentiated consideration. Shippers prefer tracking and tracing, whereas forwarders prefer no IT services and reject the introduction of an eMarketplace, which indicates the perceived threat to their business model.

Keywords: Choice behavior · Container transport · Port · Hinterland
IT services

1 Introduction and Research Background

The worldwide container port throughput increased from 88 million TEU in 1990 to approximately 691 million TEU in 2016 (Notteboom et al. 2017). Hence, in maritime transportation effective and efficient processes are needed to deal with the enormous amount of containers. From a technological perspective, continuous improvements in automatization and digitalization enhance container handling. Port authorities, terminal operators and carriers are investing in information technology (IT) (e.g. port community systems, automated guided vehicles) to prevent congestion and improve services. However, in the maritime hinterland the progress of digitalization is lagging behind (Harris et al. 2015). The challenges and reasons for the slow progress are: low degree of horizontal cooperation due to fierce competition, complex operative coordination due to uncertainties in the transport process and small investment potential due to low margins (Van der Horst and Van der Lugt 2011). Since the hinterland connectivity becomes crucial for the port competitiveness, actors (e.g. port authorities) intensify investments into the hinterland to increase market shares and differentiate services

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(Acciaro and McKinnon 2013). Thus, the knowledge about the choice behavior of shippers and forwarders in the hinterland can generate competitive advantages for ports.

Research on the port choice behavior is mainly conducted by using surveys or case studies (Flodén et al. 2017). Besides transport costs and transit time, the hinterland connectivity (De Langen 2007) and IT services (Yuen et al. 2012) are ranked as highly important. A second stream in research is the application of discrete choice models (DCM) using selected factors to derive utility values from the stated preferences. In a systematic literature review Culliane and Toy (2000) define the most relevant factors of transport services: transport costs, transit time, frequency, punctuality and additional transport services. Especially the first four are applied in various research studies using DCM (Feo et al. 2011; Arencibia et al. 2015). However, the influence of IT services as additional transport service on the choice behavior remains a research gap.

The research aim of the paper at hand is to analyze, if IT services influence the choice behavior of shippers and forwarders for container transport services in the maritime hinterland. Therefore, a DCM is developed and sent to shippers and forwarders organizing hinterland transportation in South-West Germany. This region is selected because of the high yearly container volume and export quotas (ISL 2015). Additionally, the port choice behavior is not clearly predetermined by distance as it is in e.g. North-East Germany, where ports of northern Germany are clearly favored because of lower lead times and costs. The remainder of the paper is structured as follows. In the next section the research design is described. Then the results are presented. Subsequently, the paper ends with the conclusions.

2 Research Design

In accordance to the approach of Arencibia et al. (2015) the scenario, attributes and levels of the DCM were discussed and validated in face-to-face interviews with managers from a port and an intermodal operator responsible for hinterland connections in South-West Germany. The DCM starts with a short description of the methodology and scenario as well as the definition of the attributes and levels (see Table 1). In the scenario the transport source is defined in the center of the considered region, 50 km away from the next trimodal hinterland terminal and, in turn, 600 km away from the port. The intermodal operator provided data regarding transport costs, transit times and frequencies for the considered region and distances to derive the levels of the attributes. The transport costs (in €/shipment) contain hinterland transport, storage and transshipment costs. The levels are average values for transport sources in South-West Germany using intermodal transport (barge and rail) to the four biggest ports of the north range (Rotterdam, Hamburg, Antwerp and Bremerhaven). The same applies to transit time containing average values of short (15 h) and long (20 h) rail and average barge (40 h) transports. For the attribute frequency the levels comprise the number of weekly rail and barge departures from hinterland terminals considering low (2 times/week), average (3 times/week) and high frequented (5 times/week) relations. The first level of IT services contains no additional service. Level two and three are selected based on the categorization of Harris et al. (2015) using eMarketplace (an integrated booking platform

aligning transport supply and demand) and tracking and tracing (an application for location and status information of containers).

Table 1. Attributes and levels of the DCM

Attributes	Levels		
Transport costs	450 €	480 €	550 €
Transit time	15 h	20 h	40 h
Frequency	2 times/week	3 times/week	5 times/week
IT services	none	eMarketplace	Tracking and tracing

For the DCM the software QuestionPro and a stepwise disclosure format is chosen. The DCM is based on a multi-nominal logit model, which is the mostly used model due to simplicity and robustness (Street et al. 2005). Generally, DCM is chosen to interpret utility of key factors on aggregated level (whereas conjoint analysis allows interpretation on individual level). To estimate the main effects a fractional factorial design is used considering level balance, orthogonality and minimal overlapping. Thus, to keep cognitive stress low and still retrieve reliable results (fatigue vs. learning effects) nine choice tasks with two options are defined. The DCM ends with some general questions, e.g. group of decision-makers, quantity of TEU/year. The survey period was from July to September 2017. The decision-makers were contacted via e-mail with an online link to the DCM. 125 received, 65 started and 44 respondents completed the DCM. Here only the answers of shippers (14) and forwarders (18) are considered. The average time spent with the DCM is 4 min. The results were again discussed and validated in face-to-face interviews with managers from the port and the intermodal operator.

3 Results

For shippers (see Table 2) the most important attribute is transport costs followed by transit time and frequency, which have the same relative importance. The utility value of these levels are not surprising (the lower the costs or time the better; the higher the frequency the better). The IT services are least important. However, no IT service has a negative and tracking and tracing the highest positive utility value. The best option consists of 450 €, 15 h, 5 times/week and tracking and tracing; the worst option 550 €, 40 h, 2times/week and no IT service.

For forwarders (see Table 3) the transport costs are even more important, also followed by the transit time and frequency. Hereby transit time is more important than frequency. IT services are also the least important. However, looking at the mean utility value of the levels the results reveal that no IT service has the highest positive utility value. Tracking and tracing has also a positive utility value but eMarketplace has a high negative utility value. The best option therefore contains no IT services and the worst option the eMarketplace.

Table 2. Shippers

Attributes	Relative importance of attributes	Levels	Mean utility value of levels
Transport costs (in €/shipment)	38 %	450 €	0.94
		480 €	0.11
		550 €	-1.06
Transit time (in hours)	27 %	15 hours	0.55
		20 hours	0.29
		40 hours	-0.85
Frequency (no. of weekly departures)	27 %	2-times/week	-0.61
		3 times/week	-0.18
		5 times/week	0.79
IT services (additional service provided)	8 %	none	-0.24
		eMarketplace	0.04
		tracking and tracing	0.2

Table 3. Forwarders

Attributes	Relative importance of attributes	Levels	Mean utility value of levels
Transport costs (in €/shipment)	43 %	450 €	1.28
		480 €	0.13
		550 €	-1.41
Transit time (in hours)	26 %	15 hours	0.69
		20 hours	0.24
		40 hours	-0.93
Frequency (no. of weekly departures)	18 %	2-times/week	-0.56
		3 times/week	-0.03
		5 times/week	0.59
IT services (additional services provided)	12 %	none	0.27
		eMarketplace	-0.51
		tracking and tracing	0.24

4 Conclusions

The investigation confirms that transport costs, transit time and frequency have a high influence on the choice behavior of shippers and forwarders for container transport services in the maritime hinterland. The importance of IT services could not be specified in prior research. In this case, the choice behavior of shippers and forwarders is influenced by IT services. However, the impact depends on the decision-maker and the characteristic of the IT service. Shippers prefer tracking and tracing, while forwarders prefer no additional IT service and eMarketplace even has a negative utility value. This might

indicate the perceived threat of these platforms to their business models. Ports should therefore evaluate the effects of different IT service in order to strengthen transport chain competitiveness. A limitation of this research is the quantity of respondents. To analyze variations and significance of the results further respondents are required. Moreover, the level selection determines the results and other levels might generate different findings. Therefore, further research is needed to obtain generalization.

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