Analysis on shipper's port choice behavior in South Viet Nam

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Understanding about shippers' decision making in port selection is crucial for port authorities and carriers. Ports in South Viet Nam have been increasing handled container cargos, but they are also facing the transport inefficiency. We apply the multi-nominal logit model to explain the selection of a port for each shipment exported from South of Viet Nam. We choose service freight rate, transit time, service frequency, dwell-time, and carrier reliability index for each shipment on land-side and ocean-leg as the elements of utility function of shippers, and we try to shed light on the impact of each factor in shippers' decision making in this particular market.

Key Words:*shipper's behaviour, container, South Viet Nam*

1. INTRODUCTION

Since the end of year 2015, ASEAN whose members of ten territories and six million people have been unified to become a single market with free movement of goods, services, investment and skilled labor. Therefore, synchronizing and improving domestic and regional connectivity among member countries is an important issue in air, road, and maritime connectivity. Consequently, we introduce series of research projects about enforcing the development of port system in Viet Nam, a member of ASEAN, to become a powerful and efficient chain in connection with the big supply chain of ASEAN region and the global transport network.

Tran and Takebayashi (2015) concluded that in the last five years, two port clusters, Ho Chi Minh City and Cai Mep Vung Tau, are competing each other for container cargo. Viet Nam is widely known for being a large exporter of textile, garments, wooden furniture commodities to the United States, Japan, China, Korea and European (WTO, 2016): the southern part of Viet Nam contribute 48% to total national export values (during May 2015), mainly by Ho Chi Minh City (18.1%), Dong Nai (8.9%), and Binh Duong (11.4%). In this context, understanding the structure of port competition is useful for improving port management in this area: especially Vietnamese shippers' bahavior has been still unreavealed. In this paper, we aim to analyze Vietnamese shippers' behavior of port selection.

We are going to estimate the port choice model by using multinomial logit model for shippers who would like to export cargo from South Viet Nam. Currently, there are two choices available Ho Chi Minh City and Cai Mep Vung Tau.

This paper has three parts. In section 1, we explain the methodology, dataset content. In section 2, parameters result, choice probabilities, choice predictions, variables elasticities are shown. In the last section, we summarize the finding results.

2. METHODOLOGY

(1) Data

Our port choice model focuses on shipments of exports from South Viet Nam bound for US West and East Coast ports, North European ports (long-haul transport-1), and Intra-Asia destination (short-haul transport-2). It requires data from multiple sources. First, we collected individual container information (Origin port- transhippment port – final destination port, carrier, service type, port dwell time, vessels information) from major containers ports, namely Cat Lai Terminal in Ho Chi Minh City, Tan Cang International Terminal and Cai

Mep International Terminal in between April and May 2015. Second, we interview several container service providers in the local market to inquire about the average Ocean freight, local transport charge at that time. Third, we use some third party data service provider to get information about container services available from Viet Nam from MDS Transmodal. By combining several sources of information, we have disaggregated information for each container which is very useful for analyzing logit model.

Shippers identified are mainly located industrial parks, manufacturing plants in Ho Chi Minh City, Dong Nai, Binh Duong, Ba Ria Vung Tau, and some from Mekong River Delta provinces. These manufacturers choose some Inland Container Depots (ICDs) to drop off cargoes for stuffing, consolidating (see Table 1). Currently, in South Viet Nam, besides seaports, some major consolidation centers which are locating nearby the plants or the industrial zones can be named: Truong Tho ICD clusters, Song Than ICD, Long Binh, Bien Hoa ICD, Tan Tao ICD and other river ports.

Table 1 South Viet Nam shipper information

Shipper Location	Export Value Share (%)	Distance to HCMC Port (km)	Distance to Cai Mep Port (km)	Available inland means of transport	Favorable pick-up location
Binh Duong	11.4	21	71	truck, barge	ICD Song Than, Binh Duong
Dong Nai	8.9	25	61	truck, barge	ICD Bien Hoa, Dong Nai Port
Long An	2.3	45	97	truck, barge	VICT port
Tay Ninh	1.7	65	116	truck	VICT port
Tien Giang	1.2	75	130	truck, barge	VICT port, Cat Lai, all ICD
Ho Chi Minh	18.1	12	63	truck, barge	all ICD, VICT, Cat Lai
Authors composed from various sources					

Fig.1 simplifies the flow how and where one container can be moved for export purpose through the choice of two major gateway port, Cai Mep or Sai Gon New Port (in Ho Chi Minh City, written as SG). We identified 33,454 containers from SGN and 24,298 containers from Cai Mep that match our data scheme. We select out dry cargo only to study. A certain amount of container export from Cai Mep bound for Transpacific, but they transshipped via some ports. We have difficulty in identifying final port of destination, trade routes for this transshipment cargo, so we dropped about 8,436 containers from Cai Mep. From SG (also called Cat Lai terminal), there were about 972 O-D pairs, comparing to 23 O-D pairs in Cai Mep, so 28,141 containers were left out in SG. Finally, we have two datasets with disaggregated data: (1) with 15,416 containers in the long-haul service market, (2) with 5,759 containers in the Intra-Asia market.

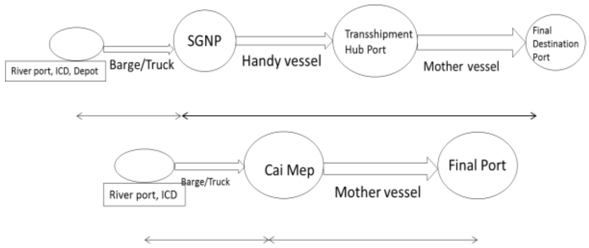

Figure 1 Export container network structure from South Viet Nam

(2). Empirical models

a) Long-haul service

The container service market in main trade routes, trans-Eurasian and transpacific, are mainly provided by mega carrier alliances namely G6, 2M, CHYKE, Ocean 3 and some independent carriers. We suggested the port-carrier alliance model, which seems to provide clearer explanation for shipper's behavior in South Viet Nam (see Fig.2). Our studied data shows that during May of 2015, G6, 2M and CHYKE accounts for 47.55%, 14.5%, and 24.2% of the market share, respectively.

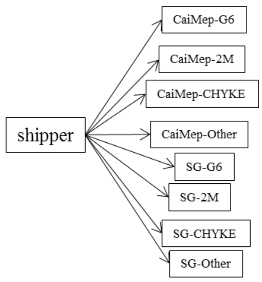

Figure 2 Port- Alliance choice tree for long-haul container service in South Viet Nam

Table 2 Variables explanation for long-haul transport port choice model

Variable	Definition	Expected sign
Vessel size (Size)	In TEUs for vessels departing from Viet Nam	+ve
Sailing time (OTime)	Time duration (in days) for container during at sea	-ve
Frequency ($Ofreq_l^j$)	Service level provided by alliance *j* on link *l* per month	-ve
On-time $Ontime_{ck}$	Reliability performance indicator of carrier *c* on route *k*(%)	+ve
Dwell- time (DwellT)	Time duration for one containers in the port (days)	-ve
Direct (DirectD)	Direct service available (dummy variable, 0 or 1)	+ve

This model did not take into account the ocean freight rate because this rate is difficult to be identified among carriers/ alliance choice, because this information is usually confidential and the market price is fluctuating over time. In stead of using ocean tariff, we introduce a new variable, i.e. reliability performance of carrier. For shippers, who are going to export high value commodities especially for the fast fashion industry, punctuality has been highly regarded as the important element for bringing value to shipper.

The discrete choice (multinomial logit) model can be described as:

$$V_k^{rs} = \alpha_1 \sum_l Size_l \delta_{rsk}^l + \alpha_2 \sum_l OTime_l \delta_{rsk}^l + \alpha_3 \sum_j \sum_l 1/Ofreq_l^j \delta_{rsk}^{jl} + \alpha_4 Ontime_{c,rsk} + \alpha_5 DwellT_k^{rs} + \alpha_6 DirectD_k^{rs}$$

where k means the route in r (origin) and s (destination) OD market; l means the link (port-to-port); h means the port for loading, transshipment, or off-loading; c,j are carrier, alliance respectively. δ_{rsk}^l is the binary variable that takes one if route k of rs includes link l; otherwise takes zero. δ_{rsk}^{jl} is also the binary variable that takes one if route k of rs includes link l operated by alliance j; otherwise takes zero. The definition for each variable was presented in Table 2.

b) Short-haul service

Due to a large number of service providers with small and scattered service for intra-Asia market, we find it difficult to simulate logit model in the port-carrier choice manner. Then, we also consider the local transport part separately. Figure 3 illustrates that from South Viet Nam there are four choices for shipper to export cargo. But, in certain inland ports, say, Binh Duong, Bien Hoa, inner city of Ho Chi Minh City, trucking is the only means of transport, which is regarded as the cause of traffic congestion, and high logistics cost.

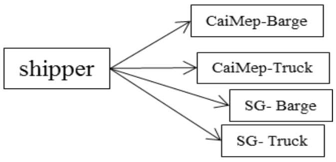

Figure 3 Short-haul transport model

Table 3 Variables explanation for short-haul transport port choice model

Variable	Definition	Expected sign
Vessel size (Size)	In TEUs for vessels departing from Viet Nam	+ve
Frequency ($Ofreq_l^j$)	Service level provided by alliance j on link l per month	-ve
Total cost (Tcost)	Average ocean freight and local transport fare (in USD)	-ve
Land time (LandT)	Local transport time (days)	+ve
Dwell- time (DwellT)	Time duration for one containers in the port (days)	-ve
Direct (DirectD)	Direct service available (dummy variable, 0 or 1)	+ve

Thus our estimated model for short-haul transport is

$$V_k^{rs} = \beta_1 \sum_l Size_l \delta_{rsk}^l + \beta_2 \sum_{l,c} \frac{1}{Ofreq_l^c} + \beta_3 Tcost_k^{rs} + \beta_4 Ltime_k^{rs} + \beta_5 DwellT_k^{rs} + \beta_6 DirectD_k^{rs}$$

Table 4 Multinomial logit results for port choice (Z-score in parenthesis)

Long-haul MNL Model (1)		Short-haul MNL Model (2)	
Vessel size	0.00016(13.18***)	Vessel size	0.0089(26.81***)
Sailing time	-0.10567(-23.69***)	Frequency	-2.3748(-5.79***)
Frequency	-1.2(-5.59***)	Total cost	-0.1587(-44.61***)
On-time	0.02258(21.2***)	Land time	-1.6(-8.83***)
Dwell time	-0.2998(-28.73***)	Dwell time	-0.0009(-0.07)
Direct	1.224(12.56***)	Direct	0.11(1.11)
-2 LL Function	13718	-2LL Function	526
Pseudo R^2	0.358	Pseudo R^2	0.05

***,**,* signicantly statistical at 99%, 95%, 90%

(3) Empirical of results

Table 4 lists the results of the multinomial logit model. As for model (1), all the signs of obtained parameters are rational. All six attributes are found significantly statistical at 99% of confidence level. The sign of parameters implies that long sailing time, so many similar services at one time, and long dwell time will give a negative effect on choice. Using larger vessels, higher service reliability, and direct service will give a positive effect on the port choice.

Comparing the observed probability of choice with computed one (see Table 5), we find that Cai Mep-G6 service for North European (Loop1 Service), Cai Mep-others for US East Coast (SVS Service), and Cai Mep-CHYKE for US West Coast (MD1 Service) shows the model's good duplication.

As for model (2), among six attributes only four are found significant; dwell-time and direct service choice does not contribute in explanation of the model. For intra-Asia destination, we found that shippers in South Viet Nam will most likely to choose Cai Mep- Barge option (66.1%), and the second preferable option is SG- Truck (31.75%). The observed values for two option are 52.6%, 39.53%, respectively. Long local transport time and high transport cost, together with many similar sailing services will reduce the choice probabilities of shippers.

Table 5 Observed and Computed choice probabilities for long-haul transport service

	North European Ports		US East Coast Ports		US West Coast Ports	
Choice	Observed	Computed	Observed	Computed	Observed	Computed
CaiMep-G6	76%	99.99%	35%	31.20%	34.90%	27.30%
CaiMep-2M	N/A	N/A	N/A	N/A	19.20%	18.80%
CaiMep-CHYKE	N/A	N/A	N/A	N/A	39.40%	53.70%
CaiMep-Others	N/A	N/A	47.80%	67.90%	N/A	N/A
SG-G6	6%	0%	5.30%	0.30%	1.70%	0.10%
SG-2M	10%	0.01%	4.20%	0.20%	1.80%	0.10%
SG-CHYKE	4%	0%	6.40%	0.30%	1.40%	0%
SG-Other	4%	0%	1.20%	0.00%	1.60%	0.10%

(4) Discussion of results

Table 6 presents the elasticities of attributes when each attribute increase by one percent, how will the shippers react. Vessel size and ocean service level are found to be relatively inelastic (less than one, bigger than zero). Sailing time (OTIME) is relatively elastic (bigger than one), in particular, 1% of time length increase will decrease the choice probability for SG-2M by 2.65%. As for reliability of service (ONTIME), shippers choice probabilities are more elastic with SG- option than they are with CaiMep- option. The implication is that if Cai Mep port and carriers aim to encourage shippers to use their port more often, Sailing time should be the first factor to reduce.

As for the short-haul service (see Table 7), Vessel size and Total cost are relatively elastic. Noticeably, 1% of ship size increase will stimulate choice probabilities for Cai Mep-Truck option by 3.27%, and Cai Mep-barge option by 1.11%. Regarding total cost, if the total cost increases by 1%, shipper will less likely to choose Cai Mep-options for probabilities of 1.13% and 6.24%. We assume that ocean freight does not vary among carriers, and port of loading Cai Mep or SG. So, the decisive factor in Total cost attributes is local transport cost which depends on the location of shipper, also the pick-up location, as well as the available means of transport available in that area. In particular, the trucking freight remains very high, and this might reduce the willingness of shipper to choose Cai Mep as port of loading.

Table 6 Elasticities of variables in long-haul service (in %)

	OTIME	ONTIME	DWELLT
CAIMEP-G6	-0.7396	0.3035	-0.136
CAIMEP-2M	-1.2272	0.6662	-0.2728
CAIMEP-CHYKE	-0.9638	0.6005	-0.2428
CAIMEP-OTHERS	-1.0352	0.5176	-0.1783
SG-G6	-2.3144	1.6873	-1.2384
SG-2M	-2.6515	1.4927	-1.5745
SG-CHYKE	-2.2126	1.1984	-1.2436
SG-OTHERS	-2.6454	1.3425	-1.1597

Table 7 Elasticities of Ship size and Total cost in short-haul service (in %)

	SIZE	TCOST
CAIMEP-BARGE	1.1139	-1.1327
CAIMEP-TRUCK	3.2796	-6.2445
SG-BARGE	1.2925	-2.6572
SG-TRUCK	0.6041	-1.3902

3.CONCLUDING REMARKS

In this paper, we use multinomial logit model to study port choice behaviors of shippers in South Viet Nam. Our main findings are as follows:

1) Model (1) brings out a good duplication of shippers' choice in the long-haul service market. Vessel size, service frequency, service reliability, ocean time, port dwell-time are found significant. CaiMep- option are elastic with sailing time only, while SG-option are more elastic when sailing time, dwell time and carrier performance change.
2) Model (2) points out that hinterland connection (in number of options, local transport fares and time) is decisive factor to port choice. Vessel size, service frequency, total transport cost, local transport time are significant attributes in the model.

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