



Port and inland mode choice from the exporters' and forwarders' perspectives: Case study – Java, Indonesia



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ABSTRACT

This paper identifies the critical factors influencing the port and inland mode choice from the perspective of shippers and forwarders using data from a stated preference (SP) survey in Java, Indonesia. The best model from estimation is Mixed Nested Logit (MXNL) with the inland mode cost coefficient distributed normally and with port nests. The cost of inland modes, inland mode time, greenhouse gas (GHG) emissions and cost of ports have negative signs, whilst the number of ship calls at port and the reliability of inland modes have positive signs. Simulation results show that reducing fuel subsidies for road transport and giving incentives to reduce rail freight rates would provide the most significant encouragements to modal shift from road transport to rail transport.

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1. Introduction

This paper identifies the critical factors influencing both the port and inland mode choice from the perspective of shippers and forwarders, using data from a stated preference (SP) survey in Java, Indonesia. There has been little previous research into the joint choice of port and inland mode, although there is significant literature into each of these two areas separately. Considering firstly from the standpoint of port choice, this choice can be differentiated into three categories, i.e. based on the perspectives of shippers or freight forwarders, of carriers or shipping lines, and of port authorities or terminal operators and ship owners. Examples of previous papers from each perspective include the following:

1. Shippers' or freight forwarders' perspective (Bird & Bland, 1988; Cullinane, Teng, & Wang, 2005; De Langen, 2007; De Martino & Morvillo, 2008; Grosso & Monteiro, 2008; Murphy & Daley, 1994; Nir, Lin, & Liang, 2003; Onut, Tuzkaya, & Torun, 2011; Slack, 1985; Song & Yeo, 2004; Steven & Corsi, 2012; Tiwari, Itoh, & Doi, 2003; Tongzon, 2009; Ugboma, Ugboma, & Ogwude, 2006; Yuen, Zhang, & Cheung, 2011).
2. Shipping lines or carriers' perspective (Chang, Lee, & Tongzon, 2008; Chou, 2010; De Martino & Morvillo, 2008; Guy & Urli, 2006; Lirn, Thanopoulou, Beynon, & Beresford, 2004; Malchow & Kanafani,

2004; Panayides & Song, 2012; Saeed, 2009; Song & Yeo, 2004; Tongzon & Sawant, 2007; Wiegman, Hoest, & Notteboom, 2008; Yeo, Roe, & Dinwoodie, 2008; Yuen et al., 2011).

3. Port authorities and terminal operators' perspective (Cullinane et al., 2005; De Martino & Morvillo, 2008; Lirn et al., 2004; Onut et al., 2011; Song & Yeo, 2004).

Previous researchers have revealed that the most prominent factors influencing shippers and freight forwarders in port selection are: *port cost* (Bird & Bland, 1988; Grosso & Monteiro, 2008; Nir et al., 2003; Slack, 1985; Tongzon, 2009; Yuen et al., 2011), *ship call frequency* (Bird & Bland, 1988; De Langen, 2007; Nir et al., 2003; Slack, 1985; Tongzon, 2009; Ugboma et al., 2006), *port infrastructure* (De Langen, 2007; Song & Yeo, 2004; Tiwari et al., 2003; Tongzon, 2009), *port services* (Bird & Bland, 1988; De Langen, 2007; Song & Yeo, 2004; Ugboma et al., 2006; Yuen et al., 2011) and *port efficiency* (Grosso & Monteiro, 2008; Steven & Corsi, 2012; Tongzon, 2009; Ugboma et al., 2006). All of the researchers in the above literature used revealed preference (RP) data to examine the preferences of shippers and freight forwarders.

In the port choice area of study, some researchers have attempted to combine the port choice with other choices, such as carrier choice (Garrido & Leva, 2004; Tiwari et al., 2003). Moreover, port choice could be examined as a part of a network or chain: for instance, maritime chain choice (Zondag, Bucci, Gutzkow, & de Jong, 2010), network choice (Tang, Low, & Lam, 2011; Tavasszy, Minderhoud, Perrin, & Notteboom, 2011), maritime transport chain (Talley & Ng, 2013) and supply chain choice (Magala & Sammons, 2008). However,

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Table 1
The key factors in inland mode choice from the perspective of shippers or freight forwarders.

References (author, year)	Transport cost	Transit time	Reliability	Flexibility	Safety/security	Distance	Characteristics of goods
Jiang et al. (1999)						✓	✓
Cullinane and Toy (2000)	✓	✓	✓				✓
Shinghal and Fowkes (2002)			✓	✓			
Norojono and Young (2003)			✓	✓	✓		
Garcia-Menendez et al. (2004)	✓	✓		✓			
Beuthe and Bouffieux (2008)	✓	✓	✓				
Feo et al. (2011)	✓	✓	✓	✓			
Brooks et al. (2012)	✓	✓	✓				
Ravibabu (2013)	✓	✓					
Reis (2014)	✓	✓	✓	✓			
	7	7	7	5	1	1	2

this paper reports on the first research that has attempted to investigate the port choice and inland mode choice as a single alternative.

Secondly, many researchers have tried to investigate the behaviour of shippers or freight forwarders in terms of inland freight transport mode choice and the factors influencing such choice. Previous researchers used both revealed preference (RP) (Jiang, Johnson, & Calzada, 1999; Ravibabu, 2013) and stated preference (SP) data (Beuthe & Bouffieux, 2008; Brooks, Puckett, Hensher, & Sammons, 2012; Feo, Espino, & García, 2011; Norojono & Young, 2003; Shinghal & Fowkes, 2002) to examine such preferences of shippers or freight forwarders.

The four most important factors found to influence the decision makers on inland mode choice are: (1) *inland mode transport cost* (Beuthe & Bouffieux, 2008; Brooks et al., 2012; Cullinane & Toy, 2000; Feo et al., 2011; Garcia-Menendez, Martinez-Zarzoso, & De Miguel, 2004; Ravibabu, 2013; Reis, 2014), (2) *inland mode transit time* (Beuthe & Bouffieux, 2008; Brooks et al., 2012; Cullinane & Toy, 2000; Feo et al., 2011; Garcia-Menendez et al., 2004; Ravibabu, 2013; Reis, 2014), (3) *inland mode reliability* (Beuthe & Bouffieux, 2008; Brooks et al., 2012; Cullinane & Toy, 2000; Feo et al., 2011; Norojono & Young, 2003; Reis, 2014; Shinghal & Fowkes, 2002) and (4) *flexibility/frequency of service* (Feo et al., 2011; Garcia-Menendez et al., 2004; Norojono & Young, 2003; Reis, 2014; Shinghal & Fowkes, 2002). More details on the factors influencing the decision on inland mode choice can be seen in Table 1 below.

The main objective of this paper is to investigate the behaviour of exporters or freight forwarders in their choice of the inland modes and ports to move their export containers from their points of origin. The main contribution of this paper lies in investigating a joint model of inland mode and port choice from the shippers' or freight forwarders' perspectives. This research also examines the potential impacts of various policies that might be implemented to influence switching of users' choices from road to rail for the inland transportation leg used for such containerised export movements.

The remainder of this paper is organised as follows: Section 2.1 provides the problem statement and the experimental design for the survey, Section 2.2 presents the population and sample for the survey, and Section 3 discusses the specification of the utility functions of the models, the policies and the simulation results. Section 4 provides the discussion of the results, including the attractiveness of the alternatives, the attributes of port and inland mode choice and the market shares of the port. Section 5 gives the conclusions of the paper.

2. Stated preference survey and problem statement

A stated preference (SP) study was used to examine the preferences of exporters and freight forwarders in Java relating to port and inland mode choice. The primary reason the SP method was chosen is its capability to carry out a discrete choice experiment for accommodating non-existing alternatives (such as Cilamaya Port) and the extensive attributes of all available alternatives at different attribute levels

(Sanko, 2001). The SP survey method was also selected because of the unavailability of revealed preference (RP) data on the shippers' and freight forwarders' preferences in Java.

The SP study in this research is performed using the following steps (Louviere, Hensher, & Swait, 2000): (1) Define the study objectives; (2) Conduct a supporting qualitative study; (3) Develop and pilot the data collection instrument, partially designing the experiment; (4) Define sample characteristics; (5) Perform the main data collection; (6) Conduct model specification; and (7) Conduct policy analysis using the most satisfactory model from the previous step.

2.1. Problem statement and experimental design

Containerisation has become popular in international trade since its introduction in the 1950s, and in the Indonesian context of this paper, non-oil and mining exports are now mostly shipped using containers. Such containerised exports have been growing quickly in recent years; between 2005 and 2013 Indonesia achieved economic growth averaging some 5.9% per year, leading to export growth of on average 13.5% in weight and 12.2% in export value (WTO, 2013). Three ports on Java, namely Tanjung Priok Port in Jakarta, Tanjung Emas Port in Semarang and Tanjung Perak Port in Surabaya account for almost 70% of total container throughput in all Indonesian ports, with shares of this 70% of around 65%, 5% and 30% respectively in 2012 (see Table 2).

Tanjung Priok Port currently faces capacity problems due to the high export growth, and there is traffic congestion near the port as the road mode carries most of the containers from the regions of origin to the seaport terminal. To address these problems, the government of Indonesia plans to build a new port at Cilamaya (100 km east of Jakarta) to support Tanjung Priok Port. In addition to this new port, the authority of Tanjung Priok Port also plans to extend its current capacity by adding extra capacity of some 4.5 million TEUs/year in the first phase development plan to be completed in 2017.¹

Port throughput depends on the preferences of users – whether they choose to use a port in preference to other alternatives. This paper focuses on issues relating to port selection, not merely about port selection in itself, but also relating to the inland mode chosen to carry containers from the origin locations to the selected port. Most exporters and freight forwarders in Java choose truck as their preferred mode of delivery of containerised exports from the origin region to the three ports above. Less than 4% of the total volumes of containers from and to the three ports above are currently transported by the rail mode.

To encourage shippers and freight forwarding companies to use rail transport, the government of Indonesia needs to implement appropriate policies that will take into account the preferences of shippers and freight forwarders with respect to inland mode choice. Hence, the success of plans to shift containerised freight from road to rail will depend partly on the behaviour of the shippers and freight forwarders in choosing combinations of inland modes and ports.

¹ The details of Tanjung Priok Port's development plan can be found at <http://www.indonesiaport.co.id/newpriok/sub/development-program.html>.

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