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How will the opening of the Northern Sea Route influence the Suez Canal Route? An empirical analysis with discrete choice models

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ABSTRACT

The Arctic ice has been observed to be decreasing both in terms of extent and thickness since the 1950s in all seasons due to global warming. The retreat of the Arctic sea ice creates unprecedented opportunities to maritime shipping industry and opens the door for exploring new navigable shipping routes across the Arctic Ocean. The Northern Sea Route is of particular interest as it has the most favorable ice conditions among all transarctic routes and the Russia government has been actively encouraging international use of the sea route. This paper aims to quantitatively assess the impact of opening of the Northern Sea Route on the Suez Canal Route by means of discrete choice model. Industrial preferences and choices under different situations are gathered by a state preference survey. Logit models are then built based on choice data from the survey. Based on modeling results, scenario analyses are conducted to predict company's choices under difference cases and thus some policy insights are put forward.

1. Introduction

The Arctic ice has been observed to be decreasing both in terms of extent and thickness since the 1950s in all seasons due to global warming. The retreat of the Arctic sea ice creates unprecedented opportunities to maritime shipping industry and opens the door for exploring new navigable shipping routes across the Arctic Ocean. The transarctic shipping routes are said to provide much shorter alternatives between Europe and Asia compared to conventional routes via the Suez/Panama (Lasserre and Pelletier, 2011). The Northern Sea Route (NSR), in particular, is in the spotlight, as it has the most favorable ice conditions among all transarctic routes (Østreng et al., 2013; Protection of the Arctic Marine Environment (PAME) Working Group, the Arctic Council, 2009).

The NSR was officially opened on January 1st 1991, as an international shipping route. Russia has since encouraged international use of the sea route, unsuccessfully in the 1990s but more successfully since 2009 (Moe, 2014). In 1997, a Finnish oil tanker, Uikku, sailed the length of the NSR from Murmansk to Bering Strait, marked the first Western ship to complete the voyage. Then, after a long wait of 12 years, another two international commercial cargo vessels, Beluga Fraternity and Beluga Foresight, traveled north of Russia between Europe and Asia in 2009 (Beluga Group, 2009). Since then, transit shipping along the NSR was performed by 4, 41, 46, 71, 53, 18, and 19 ships respectively from 2010 to 2016 in the summers (NSRA, 2016; Sakhuja, 2014). However, the number of NSR transits remains meagre compared with major shipping routes and trade activities are still unstable and vulnerable (Zhang et al., 2016b).

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Numerous studies on Arctic shipping issues have sprung up in the past two decades, and they had their own exclusive aims and focuses. A number of them examined transportation feasibility of the NSR, highlighting both advantages and challenges: Protection of the Arctic Marine Environment (PAME) Working Group, the Arctic Council (2009) and Østreng et al. (2013) covered a comprehensive list of issues including Arctic marine geography, climate, sea ice, governance, and infrastructure. Buixadé Farré et al. (2014) argued that while political interest and governance has been rapidly developing, the NSR still involves many challenges in governance, routes, infrastructure, and technology. The details of the discussion on navigation feasibility can be referred to Meng et al. (2017). Also, one may wonder the opening of NSR would influence the Asia-Europe shipping trade similar to a hypothesized case of blockade of the Straits of Malacca and Singapore (Qu and Meng, 2012). Some researchers investigated the cost competitiveness of the NSR relative to conventional shipping routes. Lasserre (2014) and Meng et al. (2017) reviewed various cost models and both papers pointed out the diversity of model assumptions, cost components and thus conclusions of different studies. Thus far, the viability study of the NSR has been well-rounded.

A recent trend has been to investigate the views of ship-owners to complement the academic works. Lammers (2010) designed a questionnaire of 61 events and requested 18 experts to rate their importance for realizing the “Arctic Saga” and their probability of occurring before 2030–2040. “Reliable nautical charts available”, “Satellite navigation system available for Arctic region”, “IMO determines guidelines for arctic sailing”, and “Russia sets up emergency response system for NSR” are the most important events according to 18 experts. Lasserre and Pelletier (2011) posed two questions to shipping companies: “Are you considering developing operations in the Arctic? Why?” The second question is open-ended, and thus helps to understand shipping companies’ concerns in depth. Based on 98 compiled answers, the container industry was not interested at all in Arctic shipping. Niche markets, like supply to local communities, offered a high potential for growth. Reaction from bulk shippers was mixed. It was more likely to capture a share of the highly expanding market for transporting mining and oil-and-gas products. Lee and Song (2014) conducted a stated preference survey for forwarders and logistics companies. Scenarios of using the NSR with variables of time and cost are set up to gain the expected shares of using the SCR (Suez Canal Route) and NSR in the future. 73 respondents completed the survey and analysis indicated that the share of the NSR was expected to be about 20%, 72% and 96% if the shipping time saving through the NSR was 0, 5 and 10 days, respectively, with the same shipping costs taken for both routes. Benedyk and Peeta (2016) also initiated a stated preference survey for freight shippers and forwarding companies asking for companies’ characteristics, their awareness and expectation of the NSR, and attitude towards the NSR. 204 valid responses were collected and a binary probit model was fitted. Six operational and behavioral characteristics of shipper and forwarding companies were found to be statistically significant: indicator for respondent working in forwarding company (+ sign for parameter estimate), indicator for respondent with annual volume more than 1000 TEUs (+), indicator for respondent that has shipment from East Asian countries but have no shipment to East Asian countries (+), indicator for respondent that ships chemical commodities (+), indicator that respondent considers ‘transit time’ as non-important (−), and indicator that respondent considers ‘previous work experience’ as important (−). The first two works were qualitative in nature and helped to build understanding of shipping companies views and concerns. The latter two studies involved quantitative analysis: one considered cost and time, and the other took into account various operational and behavioral characteristics of companies. However, both quantitative studies were limited in scope and they should be integrated so that analysis incorporates factors related to alternatives (i.e. shipping route) as well as shipping companies.

This paper aims to quantify the impact of opening of the NSR on the SCR by predicting the shipping route choices by individual companies under different scenarios. The research of market perspectives on Arctic shipping is extended as follows: a carefully-designed survey with various factors related to shipping routes as well as shipping companies are sent to shipping companies; then a discrete choice model is fitted using the responses collected and results are analyzed to reveal choice behaviors. The contributions are as follows: first, it is the first paper that uses logit model to help understand the choice behavior in Arctic shipping; second, various factors related to shipping routes as well as shipping companies are incorporated in the model and backward elimination is adopted to filter out important factors that are statistically significant; third, scenario analyses are conducted to reveal insights of the choice behavior and thus policy implications are drawn.

2. Methodological approach

Discrete choice models (DCMs) are widely used in transport sector to model travel behaviors. In a discrete choice experiment, a decision-maker n chooses a single alternative from a choice set $\mathscr{C}_n$, made up of a finite number of mutually exclusive alternatives. Each alternative i in the choice set is characterized by a utility $U_{i,n}$ with the following form:

$$U_{i,n} = V_{i,n} + \epsilon_{i,n}, \tag{1}$$

where $V_{i,n}$ is the systematic utility, depending on the characteristics of the individual and the attributes of the alternative; and $\epsilon_{i,n}$ represents a perception error term accounting for omitted and incomplete information. Respondent n will choose alternative i if and only if $U_{i,n} > U_{j,n}$ for all $i \neq j$, which is called utility maximizing behavior by respondents.

In this study, for a ship owner or shipping operator (decision-maker or individual) who conducts actual shipping activities between Asia and Europe, the utility that he obtains from traversing particular shipping route depends on attributes of the shipping route (alternative) as well as attributes of the decision-maker. The attributes of the shipping route, called *alternative-specific factors*, include shipping cost, transport time and navigation risk; the attributes of the decision-maker, called *individual-specific factors*, are size of the shipping company, experience in NSR transits, etc. The linear formulation is chosen for the systematic utility $V_{i,n}$. Hence, alternative-specific factors x_i are modeled as