

An Extended Literature Review to Analyses the Economic Impact of Global Warming on Shipping Routes of Developing Countries

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Abstract

Global warming has created potential opportunities, one of which is the opening of new shorter shipping routes as a result of melting Arctic polar ice. It is expected that by the end of the 21st century, vast areas of the Arctic will be ice-free. In view of these emerging developments, this extended literature review as part of a doctoral study attempts to anticipate the economic impact of emerging Arctic routes on developing countries such as South Africa, whose foreign trade rely heavily on viable coastal sea routes. The author firstly aims to demonstrate the limited studies conducted on the economic impact of the emerging route on developing countries and secondly the potential geopolitical challenges that could be faced. This review concludes with recommendations for further studies.

Keywords: *global warming, arctic ice, shipping routes, economic impact*

1. Extended Literature review

1.1 Impact of Global Warming on Shipping Routes

The chemistry of the global oceans is undergoing fundamental changes in response to climate change, rising atmospheric carbon dioxide, excess nutrient inputs from land and many forms of pollution (Harris, Roach and Codur,2015; Thomson et al., 2018).

While climate change and its associated impacts of warming oceans, acidification and sea-level rise fundamentally threatens the planet's oceans (Cazenave et al., 2014), in South Africa, oceans face further diversity of challenges spanning increasingly intertwined and complex socioecological systems. Offshore, new threats such as bulk sediment mining of the seabed and the unchecked expansion of fossil fuel exploration pose significant and poorly understood risks to entire ecosystems and associated industries (Duncan et al., 2016). Fossil fuels and global warming are closely associated with each other as global warming is triggered mainly due to excessive use of fossil fuels.

At the same time, there was a shift towards smaller species dominance, that is indicative of ocean warming which are likely to have a profound effect on the local climate as well as the marine and coastal ecosystems of South Africa(Department of Environmental Affairs South Africa, 2015)potentially impacting negatively on South Africa's ability to trade internationally due to reduced ocean related export production.

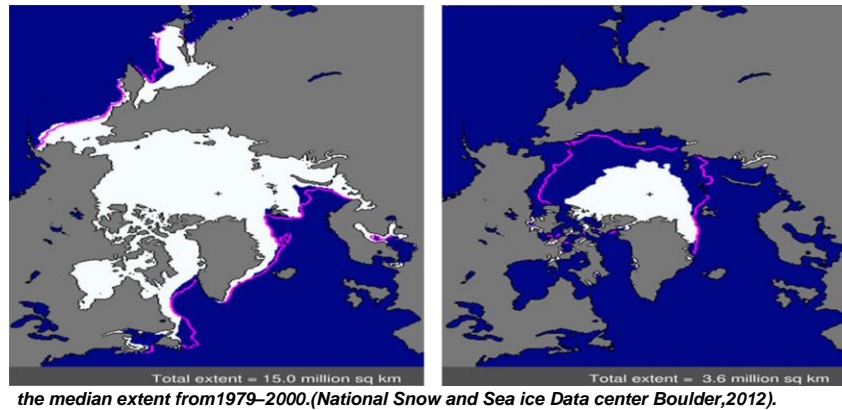
Changes in the climate system, not least sea level rise (Cazenave et al., 2014) and the increasing frequency of extreme events, may modify transport routes and infrastructures, thereby changing the accessand possibilities for the international transport of goods and services. The environmental impact of global warming includes the melting of Polar ice which could become increasingly valuable in a warming world and could potentially make the lead to new shipping routes emerging (Borgerson, 2008).

1.2 Emerging Developments in Shipping as a result of Global Warming

An increasing body of scientific evidence (Lu et al., 2014; Faury and Cariou, 2016; Yumashev et al., 2017) details the extent of climate change in the Arctic region as per figure 1.Warming caused by climatic factors and by the impact of humans on atmospheric processes from the late 1970s until early2012, has reduced the area covered by permanent ice in the Arctic by almost half (Borgerson, 2008). In Sea Ports, shipping is the main source of emission, representing about 70% of total emission. Maritime Transport CO2 emissions are projected to increase by50% to 250% in the period to 2050 which could potentially have a catastrophic impact on Arctic ice melting.

Reduced Arctic sea ice presents new opportunities for shipping (Mumby et al., 2017) and the poleward migration of various fishery stocks, such as pelagic shelf fishes and Humboldt squid along the west coast of North America will allow some jurisdictions to increase their access to stocks or lead to the emergence of entirely new fisheries.

Fig 1. Total sea ice extent in March (left) and September 2012 (right). Magenta lines represent



As it continues, this warming may create a fundamentally new situation in the Arctic and Russia's far north anticipating global implications. The prospect of increased Arctic commerce brings with it competition among countries and companies for control of the area riches, and international competition generally carries the possibility of conflicting the strive for economic sustainability.

The shrinking of Arctic ice triggers off a new round of competition and dispute in this region, among traditional Arctic states and non-Arctic actors. Like its East Asia neighbours, China sees the melting Arctic Ocean a unique opportunity for itself and international trade generally. The changing physical landscape of the Arctic region will certainly have a major impact on China's economic future which is very dependent on international shipping. The Arctic has previously been off limits to most types of shipping. With the receding ice, at least five types of shipping will benefit from using arctic waters: International shipping, shipping associated with northern resource development, fishing vessels, cruise vessels and surface naval vessels (Hong, 2012).

Shipping in the Arctic can be broken down into two categories: 'trans-Arctic' shipping, as a short cut between the Pacific and Atlantic Oceans, and 'destination' shipping, to and from destinations within the Arctic. Although trans-Arctic shipping has increased since 2007, the peak in destination shipping occurred under the Soviet Union, before the effects of climate change drastically affected the Arctic sea-ice pack on the scale seen in the last 20 years. This Soviet peak in shipping was supported with huge investments in icebreakers, ports, and infrastructure along the eastern Arctic coast (Melia, Haines and Hawkins, 2017).

When the ocean ceases to be a barrier and instead brings the world together, a state need to think about global strategy, and the important reality it exposes. Essential would be the linkage between a state's maritime security, national economy, politics and the navy's important role among these (Wei and Ahmed, 2015).

1.3 Economic Impact of Arctic ice melting on shipping routes

Studies into the economic feasibility of 21st century trans-Arctic shipping date back as early as, a year after the NSR became open to international traffic and just after the collapse of the Soviet Union. Lasserre (2014) compiled a comprehensive review of 26 such studies and finds that 13 conclude that Arctic routes can be profitable for commercial shipping, six are ambivalent or do not take a position, and seven conclude that conditions are currently too difficult to be profitable (Melia, Haines and Hawkins, 2017).

The loss of Arctic sea-ice therefore may emerge as one of the most significant events in human history, with consequences that may reverberate throughout future generations (Savitzky, 2016). Arctic ice melting also increases the possibility of shipping in the northern waters and could perhaps become the most important development for the maritime regions of the Arctic (Hong, 2012).

A look at the world map in figure 2 shows the savings in distance that can be achieved with the Arctic routes: for example, a trip between London and Yokohama through the Northwest Passage is 15,700 km and 13,841 km through the Northeast Passage, which is significantly shorter than the route through Suez (21,200 km) or Panama (23,300 km) (Lasserre and Pelletier, 2011).

Empirical studies have been conducted to analyse the potential economic impact of Arctic ice melting on shipping routes and these are their findings:

Figure 2: The Arctic Northern Sea and Southern Sea routes Source: (Bekkers, Francois and Rojas-Romagosa, 2017)



(Rahman, Saharuddin and Rasdi, 2014; Stephenson and Smith, 2015; Chou et al., 2017; (Khon, Mokhov and Semenov, 2017) concluded that the opening of the Northern Sea Route as an alternative route for transporting cargoes from the Far East and Europe will affect the maritime sector of Malaysia Economy both positively in agreeing with (Yumashev et al., (2017) and (Melia, Haines and Hawkins, 2017) that the new route may result in a shorter travel distance of up to 40% (Cho, 2012; Hong, 2012; Lu et al., 2014; Mokhov, Khon and Prokof'eva, 2016) between Asia and Europe and negatively (Zhang, Meng and Zhang, 2016) in the scope of 1) political, 2) economy, 3) social, 4) technology 5) environment and 6) legal (Savitzky, 2016) on both developed and emerging economies (Brown, 2015).

(Melia, Haines and Hawkins, 2017) suggest that trans-Arctic routes may provide a useful supplement to the traditional canal routes (Fauray and Cariou, 2016), but they will likely not replace them (Bensassi et al., 2016) even though (Bekkers, Francois and Rojas-Romagosa, 2017) arguably predict shifts in trade flows (Savitzky, 2016) between Asia and Europe with diversion of trade within Europe (Brown, 2015), heavy shipping traffic in the Arctic and a substantial drop in Suez traffic (Hong, 2012; Mokhov, Khon and Prokof'eva, 2016; Button et al., 2017; Chou et al., 2017).

(Lindstad, Bright and Strømman, 2016) concluded that the results indicate that there are no general climate benefits of utilizing the Northern Sea Route, even with cleaner fuels, since the additional impact of emissions in the Arctic more than offsets the effect of shorter voyages with the biggest economic losses set to occur in Africa (Hong, 2012) and India of CO₂ emissions due to global warming (Yumashev et al., 2017; Bekkers, Francois and Rojas-Romagosa, 2017). Countering this argument, (Cho, 2012; Chou et al., 2017) predicts decreased environmental impact due to CO₂ emissions.

Economic activity is a cause of climate change and climate change impacts economic activity. Governments, firms, and individuals are grappling with establishing policies to reduce emissions of the greenhouse gases that are causing the climate to change – referred to as the mitigation of climate change – and facing up to the need to adapt to a climate that will change quite drastically whatever mitigation actions are taken (Dobes, Jotzo and Stern, 2014).

1.4 Gaps in the prior literature

The gaps identified in the prior literature are aimed at resolving the main research statement of this study that to date, no significant model has been developed to analyse the economic impact of global warming on shipping routes of developing countries, particularly those in the Southern hemisphere such as South Africa. As a result, these countries could be unprepared to counter/predict/ react to economic losses thus leaving them vulnerable of total economic collapse as the shipping industry is at the heart of all main industries. Loss of jobs, GDP.

Sub-questions in this study that remain unanswered:

1.4.1 Research question 1: Has the Economic impact of global warming on shipping routes around SA has been examined?

(Rahman, Saharuddin and Rasdi, 2014; Lu et al., 2014; Melia, Bensassi et al., 2016; Haines and Hawkins, 2017) studies are limited to the Malaysian economy and Malacca Straits shipping route to the exclusion of developing countries i.e. South Africa. (Stephenson and Smith, 201; Mokhov, Khon and Prokof'eva, 2016; Khon, Mokhov and Semenov, 2017) total focus is on the melting of the Arctic ice without further analysis. Limited to fuel and CO2 emissions for vessel movement along the Northern Sea Route (Chou et al., 2017) excluding analysis of emerging economies coastlines.

1.4.2 Research sub-question 2.: How will the emerging route that arise as a result of global warming affect the viability of SA shipping routes?

Zhang, Meng and Zhang (2016) focused on the broader geographical and economic implications for the Adriatic region countries. Implications for Africa and other developing countries not considered (Button et al., 2017; Hong, 2012) Mentions broad impact the new Arctic route may have around Africa and Latin America without specific data input (Ha and Seo, 2014). Limited to Korean and Northern Europe Exclusion of impact on developing countries/continents e.g. Africa

1.4.3 Research sub-question 3.: Lack of the maritime economic assessment models related to global warming impedes on continuous economic improvement of SA shipping routes.

(Bekkers, Francois and Rojas-Romagosa, 2017) in their equation restricts the sample to European and East Asian countries. The quality of the transport service data is poor for many other countries – in particular, the African countries.(Yumashev et al., 2017; Lindstad, Bright and Strømman, 2016) Excluding impact analysis of trade loss and trade cost benefits related to traditional routes(Savitzky, 2016) including Africa Excluding Southern and Western African Ocean routes impact analysis. Results hold for a specific origin-destination and that uncertainty remains in sailing and economic conditions that were not considered in the model and opens avenues for further research (Fauray and Cariou, 2016).

The models do not simulate how the emerging route that arise as a result of global warming affect the economic viability of South African shipping routes and thus given the gaps identified in the above literature, researchers have opined that there is a need for further studies to solve the questions in this study.

1.5 Summary and conclusion

An extensive review of related literature shows that Ice cover in the Arctic is expected to continue diminishing throughout the 21st century with sufficient evidence suggesting that the melting is resulting in emerging and new shipping routes.

Further research to respond to the gaps identified will use a model-based approach to consider whether movement of shipping traffic on the South African coastline is economically affected by emerging routes as a result of Arctic ice melting. The purpose of the model will serve as predictability tool for economic viability of emerging economies.

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