Shipping Dynamics of an Emerging Arctic

WORKING PAPER

Joseph M. Klein

Claremont Graduate University
91711 Claremont, California, United States
joseph.klein@cgu.edu

Abstract. The Arctic Passage has long been idealized as the Holy Grail of global commerce and navigation. As the Arctic sea ice continues to recede into the mid twenty-first century, trans-polar shipping is becoming an enticing economic opportunity. Theoretically, an ice-free *Northern Sea Route*, (NSR) North of Russia offers significantly decreased travel distance between Asia, Europe, and North America in comparison to the existing Suez and Panama Canal Routes and thus, decreased fuel costs. Nevertheless, political, economic, and climatological factors inhibit its growth as a major trade route, and the leading subject-matter experts are divided regarding the extant of increased traffic along the NSR and how much traffic will be diverted from Suez and Panama. Scholars such as Lasserre et. al have identified notable increases in commercial Shipping in the Arctic and forecast the sector to continue to grow based on the leading climate models predicting a continued decrease in the extant of Ice in the foreseeable future. Others, such as L. Brigham from the University of Alaska Fairbanks, forecast much more moderate growth due to size constraints on a vessel owing to shallow waters and the ever-present ice in the winter months. Alternatively, C. Ø. Hansen et. al approached the issue from a system of equations approach to the problem, with variables such as number of ice-free days, the price of oil, and tonnage capacity of a vessel, to identify the values of key variables that would lead to increases in Arctic Shipping. Their model indicated that fuel price as well as temperature were key indicators of whether or not a voyage through the Arctic rather than the canal would be financially feasible. This paper expands upon this work of C. Ø. Hansen et. al, modeling their innovative system of equations model as a comprehensive systems dynamics model examining under what conditions and to what extant the Northern Sea Route could develop into an alternative to the existing Suez and Panama Canal Routes. Using the system of equations of Hansen et. al. as a base, our model includes many similar variables such as a company's investment in a vessel with an ice-reinforced hull, Arctic temperature, oil price, potential tonnage shipped via the Arctic route compared to the Canal Route. Unique to our model, however, is the presence of feedback loops in the form of fees and cost of operation in the competing Canal Route, ice-breaker availability, and political regulations serving as negative feedback loops. We are confident that a systems dynamics

model is uniquely suited to the question of the Growth of commercial Arctic Shipping because it allows us to observe any non-linear relationships between our model parameters and the model outputs such as the price of oil and total tonnage shipped. Likewise, a system dynamics modeling approach is not bound by the restrictions of ordinary least squares, and can effectively manage endogeneity that we suspect is present in some of our variables. Additionally, system dynamics models are robust even in data-poor fields such as Arctic shipping, and we are confident that our model will allow us to make precise forecasts even with limited inputs. Moreover, a system dynamics approach also allows us to frame the question of the growth of Arctic shipping within a complex adaptive systems framework in which we can observe how global warming may positively affect certain aspects of Arctic shipping, while having adverse indirect effects in other domains. Currently, we are wrangling the real-world data to calibrate the model inputs and to perform sensitivity analysis. Likewise, we are consulting the subject matter experts in the fields of climatology and maritime shipping as we continue to validate our model's theoretical premises and fine-tune model behaviors and the relationships between our variables. Our preliminary results suggest that investment in a vessel with a reinforced hull is positively associated with crude oil consumption and the yearly days of navigation determined by the Arctic temperature, while the availability of icebreakers for escort and Russian tariffs play a significant role as well. Ultimately, our introductory analysis suggests that despite global warming increasing operational costs along the Northern Sea Route slightly, the decision to use the Arctic as a shipping lane is positively associated with global warming.

Bibliography

Affairs, M. (2021). The Norwegian Government's Arctic Policy. Retrieved March 24, 2021, from https://www.regjeringen.no/en/dokumenter/arctic_policy/id2830120/

Azzara, A. (n.d.). (2013). Arctic sea shipping: Emissions matter more than you might think. Retrieved May 03, 2020, from https://theicct.org/blog/staff/Arctic-sea-shipping-emissions-matter-more-you-might-think

CONTINENTAL SHELF - GENERAL DESCRIPTION. (n.d.). Retrieved May 03, 2020, from https://www.un.org/Depts/los/clcs_new/continental_shelf_description.htm

Eiterjord, T. (2019, September 05). Checking in on China's Nuclear Icebreaker. Retrieved May 03, 2020, from https://thediplomat.com/2019/09/checking-in-on-chinas-nuclear-icebreaker/

Hansen, C. Ø., Grønsedt, P., Lindstrøm Graversen, C., & Hendriksen, C. (2016). Arctic Shipping: Commercial Opportunities and Challenges. Frederiksberg : CBS Maritime.

Khon, Vyacheslav & Mokhov, I. & Latif, M. & Semenov, V. & Park, W.. (2010). Perspectives of Northern Sea Route and Northwest Passage in the twenty-first century. Climatic Change. 100. 757-768. 10.1007/s10584-009-9683-2.

Markowitz, Jonathan N.. Perils of Plenty : Arctic Resource Competition and the Return of the Great Game, Oxford University Press USA - OSO, 2020. ProQuest Ebook Central, http://ebookcentral.proquest.com/lib/claremont/detail.action?docID=6141276.

Meng, Qiang & Zhou, Chuanbei & Têtu, Pierre-Louis & Alexeeva, Olga & Lasserre, Frédéric. (2019). Compared Transit Traffic Analysis along the NSR and the NWP. 10.4324/9781351037464-6.

NPD increases estimate of Barents Sea resources. (2017). Retrieved May 03, 2020, from https://www.offshore-mag.com/regional-reports/article/16801335/npd-increases-estimate-of-barents-sea-resources

Nilsen, T. (2017). Kommersant: Russia lists Norway's Svalbard policy as potential risk of war. Retrieved May 03, 2020, from https://thebarentsobserver.com/en/security/2017/10/kommersant-Russia-lists-Norways-svalbard-policy-potential-risk-war

PAME. (2020, March 31). Arctic Shipping Status Report. Retrieved March 18, 2021, from https://www.pame.is/projects/Arctic-marine-shipping/Arctic-shipping-status-reports

Pizzolato, L., Howell, S. E., L., Derksen, C., Dawson, J., & Copland, L. (2014). Changing sea ice conditions and marine transportation activity in canadian arctic waters between 1990 and 2012. Climatic Change, 123(2), 161-173. doi:http://dx.doi.org.ccl.idm.oclc.org/10.1007/s10584-013-1038-3

Russia submits revised claims for extending Arctic shelf to UN. (2016). Retrieved May 03, 2020, from https://www.rt.com/news/332089-Russia-Arctic-claim-un/

Sevunts, L. (2016, May 18). Canada to submit its Arctic continental shelf claim in 2018. Re-trieved May 03, 2020, from https://www.rcinet.ca/en/2016/05/03/Canada-to-submit-its-Arctic-continental-shelf-claim-in-2018

Spitzbergen. (2020, May 18). Retrieved March 21, 2021, from https://www.vulkankultour.de/touren/spitzbergen/

Stroeve, J. C., Kattsov, V., Barrett, A., Serreze, M., Pavlova, T., Holland, M., and Meier, W. N. (2012), Trends in Arctic sea ice extent from CMIP5, CMIP3 and observations, Geophys. Res. Lett., 39, L16502,

The Arctic of the Future: Strategic Pursuit or Great Power Miscalculation? (2018). - Panel I. (n.d.). Retrieved May 03, 2020, from https://www.csis.org/analysis/Arctic-future-strategic-pursuit-or-great-power-miscalculation-panel-i

Wang, M., & Overland, J. E. (n.d.). (2009). A sea ice free summer Arctic within 30 years? Retrieved May 03, 2020, from https://www.pmel.noaa.gov/pubs/outstand/wang3261/wang3261.shtm