Chapter 12

Opportunities and challenges of the opening of the Arctic Ocean for Norway

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1 Introduction

The Arctic Ocean is considered a semienclosed sea that is surrounded by the following five coastal states: Canada, Denmark (Greenland), Norway (Svalbard), Russia, and the United States. In addition, Finland, Iceland, and Sweden are also generally considered to be Arctic states (Potts and Schofield, 2008). There has been a drastic change in the Arctic environment, as evidenced by the fact that, over the past 50 years, the Arctic has warmed more than twice as quickly as the rest of the world. It is expected that, by the late 2030s, the Arctic Ocean could be largely free of sea ice during summers (AMAP, 2017). As a result, navigating the Arctic is becoming commercially viable during part of the year (Zhang et al., 2019), especially during September when the level of shipping activity is highest because of the reduced ice coverage (Eguíluz et al., 2016).

There has been a tremendous increase in the number of vessels navigating the Arctic during the summer since 2005 (Lasserre and Alexeeva, 2015; Lasserre et al., 2016). The three main trans-Arctic sea routes are the Arctic Northwest Passage, the Northern Sea Route, and the Transpolar Sea Route (Stevenson et al., 2019).

It is expected that shipping through the Arctic will divert global shipping traffic (Eguíluz et al., 2016). For instance, new seaports along the Arctic coastline will handle more traffic due to increased Arctic shipping. On the other hand, transit seaports (such as Singapore) along the traditional southern routes through the Suez Canal or around the Cape of Good Hope will lose traffic, especially during the northern hemispheric summer season (Zhang et al., 2019). This trend will also increase shipping traffic in Norway, especially Northern Norway, which would become a focal point for port- and shipping-related activities.

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In addition to the increase in shipping traffic, the opening up of Arctic sea routes also brings a number of opportunities in areas such as oil and gas activities, mining, tourism, fisheries, and economic development (AMAP, 2017). However, there are also certain challenges, which cover aspects such as environmental pollution, ecological damage due to oil and gas transportation/extraction, and geopolitical risks associated with new resources and trade opportunities. To fully utilize the benefits of the opening of the Arctic Ocean, it is essential that the various stakeholders involved are able to manage the challenges associated with the opening of the Arctic Ocean.

This chapter analyzes the potential benefits and challenges associated with the opening of the Arctic Ocean and discusses policies that could be considered to minimize the risks. We have taken Norway as a case study. The rest of the chapter is organized as follows: the second section describes a general overview of benefits and risks associated with the opening of the Arctic Ocean, the third section discusses benefits and risks with Norway as a case study, and the final section concludes this chapter.

2 Benefits and risks of the opening of the Arctic Ocean

Based on a literature review, Tables 1 and 2 provide an overview of benefits and risks associated with the opening of the Arctic Ocean. The benefits are broadly divided into the following four categories: reduction in shipping distance, economic benefits, changes in wildlife and ecosystems, and effects on the environment. The risks are generally divided into the following nine categories: access and transportation within the Arctic region; Arctic communities; wildlife, sea species, and ecosystems; environmental effects; vessels/ships; Arctic ice and weather; infrastructure; political disputes; and impacts on regions outside the Arctic.

It is not currently possible to conduct a cost-benefit analysis by simultaneously considering all the factors listed in Tables 1 and 2. A detailed risk assessment of the Arctic passage is at an early stage (Zhang et al., 2019) and the analysis of some aspects of benefits and risks of the Arctic requires either a very large amount of data or data that is scarce (see, for example, Schøyen and Bråthen, 2011; Zhang et al., 2019). However, based on the factors listed in Tables 1 and 2, we might conclude that the number of factors reflecting the risks is more than factors showing benefits. Measuring the strength of these factors to decide whether the benefits outweigh the risks or vice versa is complicated and beyond the scope of this study.

In this chapter, we analyze the benefits and risks of the functioning of the Arctic Ocean by focusing only on Norway. Norway is a part of the European Arctic, which Hønneland (2003, p. 141) defined as "the parts of Norway, Sweden, Finland, and European Russia that are located north of the Arctic Circle, plus the Barents Sea, the Svalbard Archipelago and the Russian archipelagos of Novaya Zemlya and Franz Josef Land". Åtland (2007) identified the

TABLE 1 Benefits of the opening of the Arctic Ocean.

Category	Description
Reduction in shipping distance	The use of the Arctic Northeast Passage instead of the present route via the Suez Canal reduces navigational distance between East Asia and Europe by 30%–40%; similarly, it reduces the distance by 40%–50% compared to the Panama Canal route and by 50%–60% compared to the route around the Cape of Good Hope (Lasserre and Pelletier, 2011; Zhang et al., 2019)
Economic benefits	The Arctic Ocean is creating more opportunities for marine shipping and tourism. The Arctic could become a potential future source of freshwater and hydropower for southern areas. It may facilitate access to oil, valuable minerals (like nickel, cobalt, palladium, and platinum are found in Russia, Alaska, Canada, and Greenland), gas, and other resources (Lindholt, 2006; Potts and Schofield, 2008; Rhéaume and Caron-Vuatari, 2013; AMAP, 2017) There is also a trend to shifting of some fish species (for example, mackerel recently migrated into waters around Svalbard and Greenland) and there is a potential for 17 species to migrate into the Arctic (AMAP, 2017; The Norwegian Polar Institute, 2015), which will promote fisheries. The shippers and carriers can achieve benefits of economies of scale by utilizing mega vessels because, as Zhang et al. (2019) explained, the mega vessels are unable to pass through the Suez Canal and must navigate around the Cape of Good Hope. There are no canal fees for Arctic navigation routes and, by avoiding politically unstable regions and the piracy affected regions in traditional routes, the cost of insurance for transportation can be reduced (Zhang et al., 2019). Changing climate and rising temperature may benefit agriculture and aquaculture in Northern Norway (The Norwegian Polar Institute, 2015)
Changes in wildlife and ecosystems	The growth of marine phytoplankton and creation of more habitats for open-water species (AMAP, 2017)
Effects on the environment	Ships navigating via the Arctic Northeast Passage could reduce carbon dioxide emissions by 49%–78% compared to traditional southern routes (Schøyen and Bråthen, 2011)

following five attributes of the European Arctic: it is a region (1) of peripheries, (2) that is rich in natural resources, (3) that has unresolved legal issues, (4) that is strategically significant, and (5) of transnational cooperation.

In the next section, we discuss some of the benefits and risks listed in Tables 1 and 2 that are most relevant to the Norwegian context.

TABLE 2 Risks of the opening of the Arctic Ocean.

Category	Description
Access and transportation within the Arctic region	Ice roads are affected because of the decrease in the thickness of lake and river ice and changes in permafrost. Because of the shorter snow cover season, it has become difficult for some northern communities to obtain wild sources of food and access to resources. There are also risks to food and water security (AMAP, 2017)
Arctic communities	The safety and, in some cases, the very existence of coastal communities are under threat because of coastal erosion and flooding resulting from melting of coastal sea ice. There is an increase in severe wildfires in the Arctic areas of North America and Eurasia. Thawing permafrost is affecting the communities and infrastructure built on frozen soils, especially in Siberia. There is also a probability of health risks to people such as increased incidence of West Nile fever. Climate change will also negatively affect Sámi culture (AMAP, 2017; The Norwegian Polar Institute, 2015)
Wildlife, sea species, and ecosystems	There is a change in the availability of habitat for microorganisms, plants, animals, and birds. Vegetation can be damaged, which affects the conditions for grazing animals such as caribou, reindeer, and musk ox. Loss of ice-associated algal species disturbing the feeding platforms and life cycles of seals, polar bears, and, in some areas, walrus and finally affecting the food web (AMAP, 2017; The Norwegian Polar Institute, 2015). There is a possibility that Arctic species like North East Arctic Cod, which are generally slow-growing due to their cold environment, will be especially vulnerable to overfishing (Barber et al., 2005; Potts and Schofield, 2008)
Environmental effects	More greenhouse gas emissions because of extraction of oil and gas and acidification of the ocean by carbon dioxide (AMAP, 2017; The Norwegian Polar Institute, 2015). Ship accidents may increase oil spills and other types of contamination of the Arctic environment (Zhang et al., 2019). Pollution threats from economic activities such as mining, heavy industry, tourism, mineral resource development, and military activities (Potts and Schofield, 2008)
Vessels' operation	Possibility of the vessels being trapped in the Arctic ice and ship damage and accidents (Liu and Kronbak, 2010; Lasserre and Pelletier, 2011; Kum and Sahin, 2015; Goerlandt et al., 2016; Zhang et al., 2017, 2019), higher building costs for ice-classed ships, ice-breaking fees, and other additional costs such as route recommendation, communication service, special vessel steerage, bunker-filling fee, and supply of fresh water (Liu and Kronbak, 2010; Aksenov et al., 2017); the increased consumption when plowing ice packs; no precise opening and closing date of Arctic sea routes and the cost of operating an ice-class vessel in non-Arctic waters (Lasserre et al., 2016)

TABLE 2 Risks of the opening of the Arctic Ocean.—cont'd

Category	Description
Arctic ice and weather	Arctic ice specified by shipping lines in various forms such as drifting ice, growlers, icebergs, ice ridges, and multiyear ice; and the Arctic weather (coldness, icing, and fog) (Lasserre et al., 2016)
Infrastructure	Poor infrastructure of existing Arctic ports and inadequate support facilities for commercial shipping such as deep-water access, places of refuge, marine salvage, port reception facilities for ship-generated waste, and towing services.[a] Existing transport infrastructure and municipal utilities like water mains and drains, and buildings are exposed to floods (The Norwegian Polar Institute, 2015)
Political dispute	The possibility of the opening up of Northwest Passage led to the re-emergence of the dispute between Canada and the US over the legal status of the waterway (Byers and Lalonde, 2006; Kraska, 2007). Conflict between Norway and Russia in the Barents Sea (Potts and Schofield, 2008)
Impacts on outside regions	A potential rise in sea level by 0.6 m by 2099 can have a negative effect on low-lying areas and islands of countries such as Bangladesh, the Netherlands, and the Maldives (Miller, 2007)

[a] *See http://www.chnl.no/publish_files/Future_of_Arctic_Shipping_Routes.pdf (Accessed 29 April 2019).*

3 Benefits and risks of the opening of the Arctic Ocean related to Norway

In this section we discuss certain risks and benefits by focusing only on Norway. We divide these risks and benefits into two broad groups. The first group includes the benefits of "reduction in shipping distance" and the risks related to "vessels' operation" in the Arctic. There are two reasons for addressing these two themes together: first, both themes are related to shipping; second, the risks associated with vessel operation can outweigh the benefits achieved from the reduction in shipping distance. The second group consists of "economic benefits" (see Table 1) and specific risks that can outweigh benefits such as poor infrastructure, overfishing, and political disputes (see Table 2).

3.1 Reduction in shipping distance and vessels' operation

A significant decrease in shipping distance can be utilized by selecting the Arctic routes instead of traditional current sea routes. For instance, selecting the Arctic Northeast Passage instead of the present route via the Suez Canal reduces

navigational distance between East Asia and Europe by 30%–40%; similarly, it reduces the distance by 40%–50% compared to the Panama Canal route and by 50%–60% compared to the route around the Cape of Good Hope (Lasserre and Pelletier, 2011; Zhang et al., 2019). This reduction in sea distance means it is expected that more vessels will use the Arctic Ocean routes. However, as mentioned by Liu and Kronbak (2010), a reduction in distance does not necessarily mean a corresponding decrease in cost. This is because there are number of other cost-related factors, such as higher building costs for ice-classed ships, ice-breaking fees, additional charges such as route recommendation, communication service, specialized vessel steerage, bunker-filling fee, supply of fresh water (Liu and Kronbak, 2010; Aksenov et al., 2017) and the increased consumption when plowing ice packs, and the cost of operating an ice-class vessel in non-Arctic waters (Lasserre et al., 2016).

Arctic shipping can be broadly classified into two categories. The first is Intra-Arctic transport, which includes a voyage or marine activity that remains within the general Arctic region and links two or more Arctic states. Examples of Intra-Arctic transport include marine route between the port of Churchill, Manitoba, Canada on Hudson Bay and Murmansk, Russia, known as an "Arctic-bridge" between the two continents; and an Icelandic fishing vessel working in Greenlandic waters, and tug-barge traffic operating between Canada's Northwest Territories and the US Beaufort Sea off the Alaskan coast. The second category is trans-Arctic transport, which is taken across the Arctic Ocean from the Pacific to the Atlantic Oceans, or vice versa. These are full voyages that connect the North Pacific and North Atlantic Oceans through the Arctic (AMSA, 2009). Three main trans-Arctic routes are the Arctic Northwest Passage, the Northern Sea Route, and the Transpolar Sea Route (Stevenson et al., 2019).

Regarding the trans-Arctic shipping, Norway's Statoil does not consider it very attractive, after sending several tankers, including cargoes of naphtha and LNG, to Japan in previous years (Lasserre et al., 2016).

> *"Statoil has not used the Northern route since 2013 and we currently have no plans to use it." "The attractiveness of a route depends on direct costs, and sailing time as well as the market characteristics of the respective commodities at the time of sailing."*
>
> (Statements by a company spokeswoman, quoted in Pettersen, 2016)

In order to acquire updated information, we conducted a telephonic interview in June 2019 with a concerned person in Equinor[a] (Statoil), who confirmed that Statoil still does not use the Northern Sea Route to deliver cargo to countries outside the Arctic region.

Similarly, according to the Norwegian Shipowners' Association (2014, p. 3):

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a. In May 2018 Statoil changed its name to Equinor. See https://www.gasworld.com/statoil-changes-name-to-equinor/2014750 (Accessed 19 June 2019).

Transit through the northern sea routes will gain in importance but will remain limited in volume in the next few years.

As in the previous case, we conducted a telephonic interview in June 2019 with a concerned person at the Norwegian Shipowners' Association, who mentioned that the situation is the same as stated in 2014 report that the transit through the Northern Sea Route will remain limited in volume in the next few years. This is mainly because of the shallow water near Russia, the expense of building specialized ships, and the regulations set by the Russian government that shipping lines must adhere to.

These findings are consistent with those obtained by Lasserre and Alexeeva (2015) and Lasserre et al. (2016), which explained that trans-Arctic (transit) traffic in the Northwest Passage (NWP) and the Northeast Passage (NEP) remains low. For their study, the transit data for the NEP was provided by the center for High North Logistics (CHNL) located in Kirkenes, Norway, with a branch in Murmansk, Russia. Thus, we may conclude that, even for Norway, as explained by Lasserre et al. (2016), the benefits realized from a reduction in costs because of shorter shipping distance and the technical feasibility are not currently sufficient to select the Arctic Sea routes for transit. In this situation, environmental benefits—reducing carbon dioxide emissions by 49%–78% by choosing the Arctic Northeast Passage instead of traditional southern routes, as described by Schøyen and Bråthen (2011)—are not currently being realized (see Table 1).

Norway has taken several measures to overcome the risks associated with vessel operation in the Arctic Ocean, including the provision of specialized vessels, as explained by the Norwegian Shipowners' Association (2014, p. 5):

A number of shipping companies have under construction, or already in service, specialised ships and rigs adapted to working in extreme climatic conditions.

To provide adequate protection in the case of accidents at sea, Norway has joined the international regulatory framework that consists of the International Convention on Oil Pollution Preparedness, Response and Cooperation, and also the International Oil Pollution Compensation Funds, including the Supplementary Fund. From these frameworks, Norway has total available compensation equal to 750 million Special Drawing Rights (SDR) (approx. NOK 7.5 billion). There is a very low possibility that a claim for compensation following an accident off the Norwegian coast would exceed this amount. By introducing an excellent compensation scheme, Norway has protected itself from compensation issues being put forward as an argument against increased oil transport along the Norwegian coast (Norwegian Shipowners' Association, 2014).

In addition to compensation for accidents at sea, there is compensation claim for the discharge of bunker oil from ships not transporting oil as cargo. This scheme was set by the 2001 International Convention on Civil Liability for Bunker Oil Pollution Damage, which entered into force on November 21, 2008. The convention was accompanied by a resolution encouraging all states to ratify or accede to the 1996 Protocol to the 1976 Convention on Limitation of

Liability for Maritime Claims (LLMC, 1976). Consequently, Member States are given the option to set higher national rates instead of the standard international rates. Among the Arctic states, the Russian Federation, Denmark, Finland, and Norway follow LLMC 1976 (AMSA, 2009). Norway is one of the countries that has selected this option and has recently adopted a further increase to ensure that the compensation amount is available to cover most accidents, including the largest scale ones (Norwegian Shipowners' Association, 2014).

3.2 Economic benefits, sea species, infrastructure, and political dispute

In terms of economic benefits, Norway has the potential to utilize several resources from the Arctic region. Norway's sea area is six times larger than its land area and most of the sea area lies in the High North[b] (Norwegian Shipowners' Association, 2014). The Barents Sea off the coast of Norway and Russia in the Arctic region is recognized as the area with the highest potential in both fishing and petroleum. Svalbard in Norway and Franz Josef Land in Russia are considered significant protected land and sea areas in the region (Eliasson et al., 2017).

From the perspective of Norway's maritime industry, the three main areas of interest in the Arctic region are offshore energy extraction, intraregional transport, and trans-Arctic transport. The most important area is offshore energy extraction, and intraregional transport provides a support activity for the offshore energy extraction (Norwegian Shipowners' Association, 2014), while Arctic transit transport is limited, as discussed in the previous section.

Oil and gas extractions have already started in High North Norway. Norway has one of the most advanced maritime industries and, as mentioned by the Norwegian Shipowners' Association (2014, p. 16):

> *Offshore activities are not new to the High North and, with the world's most modern fleet, we have demonstrated that we can solve the challenges within the defined frameworks.*

Statoil made significant investments in North Norway in 2018. As a part of this investment, Aker Solutions will connect a total of 30 wells on the oil field in the Barents Sea. Six of the subsea templates will be delivered in 2019, and four in 2020. In addition, Aker Solutions, Sandnessjøen has a contract for developing the subsea template and suction anchor for Snefrid Nord, a gas discovery 12 kilometers from the Aasta Hansteen field in the north of the Norwegian Sea. Snefrid Nord is expected to be in operation in the fourth quarter of 2019[c] and will generate employment opportunities in the region, as described by the managing director of the supplier network for petroleum activities in the North, Petro Arctic:[c]

b. The Norwegian Shipowners' Association defines the High North as the entire circumpolar Arctic, including the Barents region and the Barents Sea area.
c. See https://www.equinor.com/en/news/13apr2018-investments-north.html (Accessed 1 May 2019).

This will generate employment and add value at Helgeland for many years to come.

In addition to the two above-mentioned projects, Statoil and its partners also invested about NOK five billion in Askeladd, which is the second part of the phased development plan of the Snøhvit field in the Barents Sea. It is expected that, as an outcome of this project, Askeladd will deliver 21 billion cubic meters of gas and two million cubic meters of condensate to Hammerfest LNG.[c]

The Norwegian Arctic has some of the largest and most valuable fishing stocks in the world, such as the northeast Arctic cod and the Norwegian spring spawning herring (DNV GL, 2019). There is also a trend in shifting of some fish species; for example, mackerel recently migrated into waters around Svalbard and Greenland (AMAP, 2017; The Norwegian Polar Institute, 2015). Southern and pseudo-oceanic temperate fish species stocks are migrating toward North Norway (Barents and Bering Seas), which could result in unprecedented harvest levels and, thus, promote commercial fisheries (Hunt Jr. et al., 2013; Christiansen et al., 2014; Falk-Petersen et al., 2015).

According to the report by the Ministry of Local Government and Modernisation: Regionale utviklingstrekk (2018), fisheries and aquaculture contributed to the economy in 2015 as follows: The two industries combined represented 7.0% of the gross domestic product of Nordland (county in Norway) and 6.1% in Tromso (a municipality in Norway) and Finnmark (county in Norway), contributing to annual growth of 2.8% and 2.6% in the period 2010–15. The fishing industry has traditionally been labor-intensive and because of technology development and economies of scale, efficiency in the industry has increased significantly (DNV GL, 2019).

The opening of the Arctic Ocean has generated significant maritime traffic in the Norwegian Arctic. The large tankers that are used for oil and gas extraction in Russia and Finnmark are sailing outside the coast in traffic separation lanes; bulkers and deep-sea vessels are calling at Norwegian ports such as Narvik and Mo i Rana; coastal traffic including cruise and passenger ships are operating throughout the fairways; fishing vessels are operating on the fishing grounds; and the offshore service vessels are serving the oil fields at Haltenbanken and the Barents Sea. Fishing vessels and cruise traffic are common in the sea area between mainland and Svalbard (DNV GL, 2019). The majority of this maritime traffic falls into the category of intra-Arctic transport. Finally, changing climate and rising temperature may benefit agriculture and aquaculture in Northern Norway (The Norwegian Polar Institute, 2015).

In addition to economic benefits there are some challenges, and one of the main challenges in North Norway is the poor infrastructure, which includes roads and streets, airports, harbors (lighthouses, navigation aids, etc.), railways, energy supply, telecommunications (including broadband), buildings, water and sewage, and waste management. Norwegian officials have already started to work on this issue. For instance, the Norwegian Government has set out infrastructure in the High North as one of the five priority areas in its Arctic policy.

In the National Transport Plan 2018–29, priority is given to several major infrastructure investment projects in the North, which will shorten travel times significantly. The Barents Euro-Arctic Transport Plan, which focuses on better connectivity between Sweden, Finland, Russia, and Norway, is of great benefit to national and regional transport planning of Norway. Norway carried out the follow-up work on the Joint Barents Transport Plan at the national level through planning processes and budget priorities. To improve the port facilities and to handle the increasing number of cruise ships, as well as other types of vessels, the Norwegian Coastal Administration recommends building a new floating dock with a terminal building in Svalbard. The government has allocated 300 million NOK to finance this project.[d]

Regarding fisheries, the biggest challenge is the fact that Arctic species such as North East Arctic cod, which are generally slow-growing due to their cold environment, are probably especially vulnerable to overfishing (Barber et al., 2005; Potts and Schofield, 2008). To overcome this challenge and to achieve economic benefits from fisheries, overfishing should be avoided under yet insufficient Arctic fisheries biological data (Christiansen et al., 2014).

Another challenge is the dispute between Norway and Russia in the Barents Sea, mainly over oil and gas and fishing resources. To overcome this dispute Norway and Russia signed a maritime boundary agreement on 11 July 2007, which was intended to clarify, update, and reconfirm an agreement dating from 1957 and extend it into the southern Barents Sea (Potts and Schofield, 2008). Despite this agreement, the tension remains because of the two countries' overlapping claims further north in the Barents Sea and their conflict over Norway's maritime claims from Spitsbergen (Svalbard).[e]

However, the Norwegian Shipowners' Association (2014) considers the agreement between the two countries to be a positive step in the political stability of the region:

> *It is important to point out that a stable region characterised by low levels of tension and by international cooperation would form the basis for all maritime activity in the High North. In this context, the Norwegian Shipowners' Association finds the Norwegian authorities' foreign and security policies in the High North to be stable and sound. The five Arctic coastal states share the view that maritime law must govern the resolution of outstanding issues concerning control of sea areas, and that generally accepted principles for resource management shall also apply in the Arctic. We believe that such an approach is beneficial for all stakeholders in the High North and the Arctic.*
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> (Norwegian Shipowners' Association, 2014, p. 7)

d. See https://www.regjeringen.no/contentassets/7c52fd2938ca42209e4286fe86bb28bd/en-gb/pdfs/stm201620170033000engpdfs.pdf (Accessed 15 June 2019).
e. See http://www.regjeringen.no/en/dep/ud/Press-Contacts/News/2007/Agreement-signed-between-Norway-and-Russ.html?id=476347 (Accessed 15 May 2019).

4 Conclusion

It is generally expected, and also highlighted in the media, that the opening of the Arctic Ocean will bring a lot of opportunities, not only for the Arctic states but also for the rest of the world. However, there are several risks that also emerge with the melting of polar ice. In this chapter, based on a literature review, we have identified potential benefits and risks associated with the warming of the climate in the Arctic region. It is difficult to conduct a cost-benefit analysis by considering all the factors related to benefits and risks because this requires data that is either scarce or required on a large scale. However, based on the listed factors, we can conclude that there are more risk factors than benefit factors.

We conducted a detailed analysis of certain benefits and risks that are relevant to Norway, with the help of the literature review and case studies. We divided the relevant factors into two broad groups. The first group considers the benefits of reduction in shipping distance by selecting the Arctic route for Norway. In the same group, we also analyzed certain risks factors that are related to vessels' operation in the Arctic Ocean and can challenge or offset the benefits of reduction in shipping distance. The second category includes the economic benefits and specific risks that can outweigh the economic benefits.

Our analysis shows that, for Norway, trans-Arctic (transit) shipping is currently not attractive. As a result, it is not desirable for the cargo owners and shipping companies to gain the benefits of reduction in cost by selecting Arctic routes instead of traditional routes. The analysis also revealed that the strong and advanced maritime industry of Norway is capable of overcoming the risks related to vessels operation by investing in specialized vessels that can handle the harsh weather and ice. Moreover, the Norwegian Government has developed a substantial compensation scheme for ship accidents and the discharge of bunker oil in the Arctic Ocean. In its Arctic policy and its National Transport Plan 2018–29, the Norwegian government has prioritized the development of infrastructure in High North. The government has allocated NOK 300 million to improve the port facilities in Svalbard.

This study shows that Norway has the potential to utilize the abundant opportunities emerging from climate change, such as oil and gas extraction and commercial fishing in the Barents Sea. The analysis indicates that despite the reduction in oil prices, investment in oil and gas sector by Statoil is increasing and will also generate employment opportunities in Northern Norway. There is also a potential for growth in other sectors such as agriculture, aquaculture, and fishing in High North, although fishing is also subject to the risks of overfishing. The best strategy to overcome this risk is to avoid overfishing, which is challenging and difficult because it requires data related to the amount of fishing.

Finally, with the emergence of abundant natural resources in the Barents Sea, the tension between Norway and Russia has increased over the sea boundary. However, both countries' governments have attempted to overcome this dispute

by signing a maritime boundary agreement. The Norwegian Shipowners' Association considers this as a good step for regional stability and maritime-related activities in the Barents Sea.

The study shows that although Norway is a small and open economy compared to the other Arctic states, its strong maritime industry, along with support from the government, is well prepared to achieve the benefits and to overcome certain risks related to the melting of ice in Arctic Ocean.

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