Melting Ice Caps: Trade implications for the North Western Route and the Panama Canal

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April 2014

Abstract

Arctic ice caps have been melting at an increased pace and projected climate changes imply that in the near future the extension of the Arctic ice caps will be greatly reduced. This climatic phenomenon will open up shipping routes in the Arctic. Until now media and academic attention has centered on the use of the Northern Sea Route (NSR) that will connect Northeast Asia with Northwestern Europe and affect the traffic through the Suez Canal (cf. Francois and Rojas-Romagosa, 2014). However, melting arctic ice caps will also make the North West Route (NWR) a feasible trade route for high volume commercial traffic. This route will reduce the shipping distances between Northeast Asia (i.e. China, Korea, Japan) with the East Coast of the United States and Canada. In this paper we analyze the commercial feasibility of the NWR and the economic impact of reducing the trade distances between Asia and North America. In particular, we expect that the NWR will become a direct competitor with the Panama Canal for certain trade routes and this will have significant geopolitical implications linked to both a drop in traffic through the Panama Canal as well as changes in the global supply chains that currently link East Asia and North America, as well as possible diversion of trade within NAFTA.

Keywords: North Western Route, trade forecasting, gravity model, CGE models, trade and emissions
JEL Classification: R4, F17, C2, D58, F18

1 Introduction

Arctic ice caps have been melting as a result of global warming (Kay et al., 2011; Day et al., 2012). The steady reduction of the Arctic sea ice has been well documented (Rodrigues, 2008; Kinnard et al., 2011; Comiso, 2012), and there is broad

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*Corresponding author; e-mail: h.rojas-romagosa@cpb.nl agreement on continued ice reductions through this century (Wang and Overland, 2009; Vavrus et al., 2012).[1] Recent satellite observations, furthermore, suggest that the climate model simulations may be underestimating the melting rate (Kattsov et al., 2010; Rampal et al., 2011). This implies that in the recent future the extension of the Arctic ice caps will be greatly reduced and even completely ice-free during the summer.

Besides the environmental effects, another consequence of this climatic phenomenon is the possibility of opening up shipping routes in the Arctic. Until now media and academic attention has centered on the use of the Northern Sea Route (NSR) that will connect Northeast Asia with Northwestern Europe and affect the traffic through the Suez Canal (cf. Francois and Rojas-Romagosa, 2014). However, melting arctic ice caps will also make the North West Route (NWR) a feasible trade route for high volume commercial traffic. This route will reduce the shipping distances between Northeast Asia (i.e. China, Korea, Japan) with the East Coast of the United States and Canada.

In this paper we analyze the commercial feasibility of the NWR and the economic impact of reducing the trade distances between Asia and North America. In particular, we expect that the NWR will become a direct competitor with the Panama Canal for certain trade routes and this will have significant geopolitical implications linked to both a drop in traffic through the Panama Canal as well as changes in the global supply chains that currently link East Asia and North America, as well as possible diversion of trade within NAFTA.

Until 2011, there was still controversy about the feasibility of the commercial use of the Arctic routes. However, the ever-quicker melting pace found in several studies (Shepherd *et al.*, 2012; Kerr, 2012; Stroeve et al., 2012; Slezak, 2013) has broadened the consensus in favor of its likely commercial use in the near future. A growing number of papers find that this shipping route could be fully operational for several months or all-year round at different points in the future (cf. Verny and Grigentin, 2009; Liu and Kronbak, 2010; Khon et al., 2010; Stephenson et al., 2013).[2]

Given the current uncertainties regarding the relation between the icecap melting pace and the transport logistic barriers associated with the NSR and the NWR, it is hard to predict the year when these new shipping routes will become fully operational. Throughout our study we use a what-if approach where we assume that by the year 2050 the icecaps have melted far enough and logistics issues related to navigating the Arctic have been resolved, so the NWR is fully operationally all year round.[3] In practical terms, this also implies that we use an "upper bound" scenario

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[1] The ice caps in Greenland and Antarctica have also been melting at an ever-quicker pace since 1992 (Shepherd *et al.*, 2012; Kerr, 2012).

[2] The differences on the approximate year and the yearly extent for which the Arctic routes will be fully operational varies much between papers, depending on different assumptions and estimations regarding the pace of the ice caps melting and developments in the shipping industry with respect to the new route.

[3] The use of 2050 as our benchmark year is mainly for illustration purposes and the use of another year does not affect our main economic results. For instance, we ran simulations using 2015 and 2030 as our benchmark year, and our results remain robust to these changes in the benchmark year.

that assumes that the NWR becomes a perfect substitute for Panama Canal, and as such, all commercial shipping between North East Asia and East coast of North America will use the shorter and cheaper NWR instead of the Panama Canal route. Furthermore, since the opening of the NWR will be a gradual process that will take a number of years, the economic adjustment pattern we describe in our analysis will also be gradual.

Stephenson et al. (2013) estimate that the NWR has a substantial lower prospect of full-year navigation than the NSR. Khon et al. (2010) find that: "The models predict prolongation of the season with a free passage from 3 to 6 months for the NSR and from 2 to 4 months for the NWR by the end of twenty-first century according to A1B scenario of the IPCC". So the NWR will be one-third less navigable during the year than the NSR.

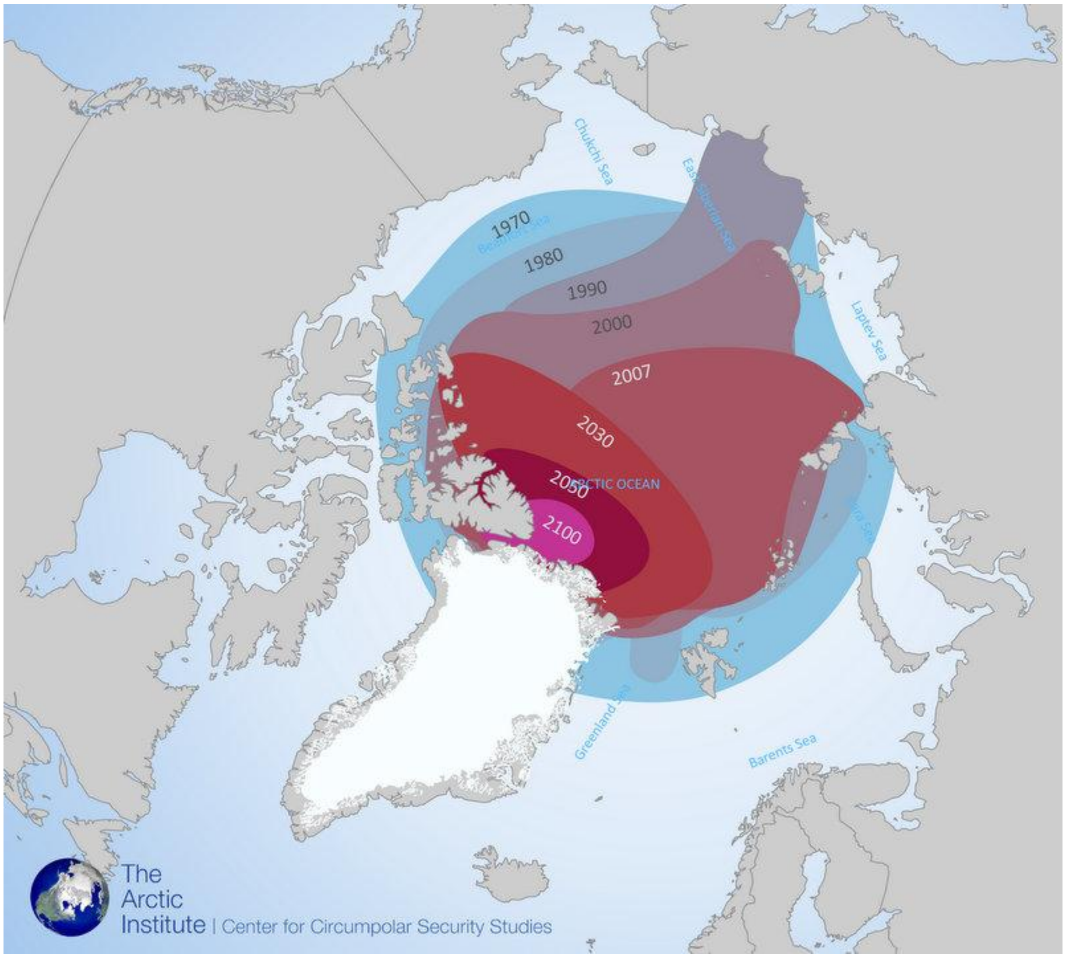
Our economic analysis follows a three-step process. In the first step we estimate the physical distances between East Asia and the US to account for water-transportation shipping routes using both the NWR and the Panama Canal. The second step employs a regression-based gravity model of trade to map the new distance calculations –for both the NWR and the Panama Canal route– into estimations of the bilateral trade cost reductions between trading partners at the industry level. In the third step we integrate our trade cost reduction estimates into a computable general equilibrium (CGE) model of the global economy to simulate the effect of the commercial opening of the NWR on bilateral trade flows, macroeconomic outcomes and the total amount of CO2 emissions.

The paper is organized as follows. In Section 2 we analyse the logistic issues and projections for commercially using the NSR in the future. We then explain how we estimate the new water-transportation distances in Section 3 and then use these new distance measures to run the gravity model of trade in Section 4. The CGE simulations and macroeconomic results are presented in Section 5. Section **??** concludes by summarizing our main results.

2 The commercial feasibility of the North Western Route

There are two elements that condition the Arctic routes –NSR and NWR– can become fully viable commercial substitutes of the current routes (SSR and Panama Canal). The first is the ice levels in the Arctic, which is the main barrier to the commercial use of the NSR and NWR. As mentioned before, there is ample scientific evidence of the melting of the Arctic ice cap (Rodrigues, 2008; Kinnard et al., 2011; Comiso, 2012), that it will continue melting in the future (Wang and Overland, 2009; Vavrus et al., 2012), and other studies even suggest that the melting process may acelerate in the future as well (Kattsov et al., 2010; Rampal et al., 2011). These elements will make the commercial use of the NWR more likely in the near future. Figure 1 further illustrates the current degree of ice cap melting (until 2007) and the forecasts produced by the GFDL model of the National Oceanic and Atmospheric Administration (NOAA). From this figure one can observe that by 2030 the ice cap will have melted enough to make the NSR ice-free, although it is not clear if this will be the prevalent condition year-round by then.

Figure 1: Arctic Sea Ice Extent observation (1970 to 2007) and forecast (2030 to 2100)



Source: NOAA GFDL model reproduced in Humpert and Raspotnik (2012) by The Arctic Institute.

The second barrier to the NSR and NWR is the transport logistic issues associated with the opening of a new commercial shipping route in a region with extreme weather conditions. Even though a number of ships have already used the NSR during summer months[4], significant logistical obstacles remain.

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[4] Most of them with assistance from Atomflot, the operator of Russia's nuclear icebreaker fleet.

3 Estimating US intra-State trade distance reductions using the Northern Western Route

As the first step of our analysis, we estimate the precise distance reductions for bilateral trade flows associated with the NWR. To do so we first need to include shipping routes in the estimation of the distance between two trading partners. Currently, the econometric literature on the gravity model of bilateral trade relies on measures of physical distances between national capitals as a measure of distance, known as the CEPII database (Mayer and Zignago, 2011).[5] However, these measures use the shortest physical distance and thus, are not appropriate for the present exercise. Shipping routes are usually longer than the shortest physical distance, and melting sea ice will not change the physical distance between Tokyo and London, for example.

Rather we need a more precise measure of actual shipping distances. To this end, we first build a new measure of distance between trading countries. Given the importance of ocean transport for global trade we wanted to take water distances between trading partners into account. Globally, 90 percent of world trade –and the overwhelming majority of trade between non-neighboring countries– is carried by ship (OECD, 2011). The rest moves primarily by land. Very few exceptions use air transportation, which mainly applies for high-value commodities that need to reach the final destination in a short time (e.g. fish and flowers). For the country pairs and trade flows we focus on here, water transportation, or multi-modal transport (water and land) accounts for essentially all trade.

Therefore, to obtain more accurate measures of trade distance, we work with shipping industry data on the physical distance of shipping routes between ports in combination with land-transport distances. We continue to use CEPII's bilateral distances to represent land routes (and so the land component of combined land-water routes), while the water routes were provided by AtoBviaC.[6] As water routes we define the shortest water distances between two major ports. For each country we choose one major port. As a country's major port we define the largest and/or most significant port in terms of tons of cargo per year from ocean-going ships –except for Australia, Canada, Spain, France, Great Britain, India, Russia, United States, and South Africa, where due to the large size of these countries and their multiple accesses to water we picked two or, in the case of the US, three major ports. In the case of two trading partners with access to water, distance is calculated as the shortest land and water distance between these countries' capitals using their major ports.

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[5] In particular, CEPII's GeoDist database (www.cepii.fr) estimates geodesic distances, which are calculated using the geographic coordinates of the capital cities. A simple measure is the distance between countries' capitals on the surface of a sphere (i.e. the great-circle formula). A more recent and sophisticated approach is to measure distance between two countries using the population weighted average index created by (Head and Mayer, 2010; de Sousa et al., 2012). This last measure also incorporates the internal distances of a country.

[6] This is a commercial company that offers sea distances to the maritime industry (www.atobviaonline.com/public/default.aspx). In particular, they provided us with port-to-port water distances.

For example we estimate the trade distance between China and The Netherlands as the land distance from Beijing (capital city) to Shanghai (main seaport), plus the water distance from Shanghai to Rotterdam using either the SSR or the NSR, plus the land distance between Rotterdam (main seaport) and Amsterdam (capital city). For landlocked countries[7] we assume that a port in a neighboring country is used, so distance between a landlocked country and a trading partner with access to water is obtained by combining the landlocked country's land distance (from CEPII) to the next major port in a neighboring country and water distances from that port to different trading partners (from AtoBviaC). For example distance between Austria and Nepal is obtained as a combination of land distance from Austria to Germany, water distance from Germany to India, and land distance from India to Nepal.

4 Gravity model of trade: Estimated linkage between shorter shipping distances and trade cost reductions

The second step in our analysis is to use the gravity model of trade to estimate the trade cost reductions associated with shorter shipping distances. We estimate trade price and distance elasticities structurally, based on the underlying theoretical structure of the trade equations in our computational model. The computational model includes CES based demand for intermediate and final goods differentiated either by firm or country. This depends on whether the sector is modeled with Armington preferences, or with monopolistic competition. In both cases, trade flows can be represented as a log-linear function defined over relevant arguments. Using this functional form as our estimating equation is consistent with both the structure of the computational model, and with the recent gravity literature.[8] The gravity model is a standard and well-known empirical workhorse in international trade. An econometrically estimated gravity model provides estimates of how much physical and socio-economic distance between partners, as well as policy, determines bilateral trade flows. Importer and exporter fixed effects are used to capture structural determinants of trade that are country specific (Anderson and Yotov, 2012). Controlling for country-specific structural features of the gravity model, estimates of pairwise coefficients provide measures of the impact that distance between two trading partners has in terms of *trade costs* between the two countries. In the present context, when we substitute the current shipping distances using the SSR with the new NSR

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[7] These are countries that do not have direct access to an ocean or an ocean-accessible water way, and thus must rely upon neighboring countries for access to seaports. Landlocked countries in our dataset are Afghanistan, Andorra, Armenia, Austria, Azerbaijan, Belarus, Bhutan, Bolivia, Botswana, Burkina Faso, Burundi, Central African Republic, Chad, Czech Republic, Ethiopia, Hungary, Kazakhstan, Kyrgyzstan, Kosovo, Laos, Lesotho, Liechtenstein, Luxembourg, Republic of Macedonia, Malawi, Mali, Moldova, Mongolia, Nepal, Niger, Paraguay, Rwanda, San Marino, Serbia, Slovakia, Swaziland, Switzerland, Tajikistan, Turkmenistan, Uganda, Uzbekistan, Vatican City, Zambia, Zimbabwe.

[8] See for example Anderson and van Wincoop (2003), Baldwin and Taglioni (2006), Francois and Woerz (2009), Egger et al. (2011) and Anderson and Yotov (2012).

distances, we obtain a measure of how much current trade costs will be reduced by the shorter physical shipping distances associated with the NSR.

The basic estimating equation takes the following form:

$$v_{jsd} = e^{D_{js}+D_{jd}+\sum_{i}\beta_{ji}X_{isd}+\eta_{jsd}} \tag{1}$$

where the term v_{jsd} is the value of bilateral imports in sector j originating in source country s and exported to destination country d. In addition to a vector of pairwise variables X_{isd} –where i is a sector different from j– the importer and exporter fixed effects D capture country specific (i.e. not varying by partner) structural properties (Anderson and Yotov, 2012). The vector of β_{ji} coefficients apply to our pairwise variables and η_{jsd} are the error terms.

Our trade, distance, and socio-economic data for estimating equation (1) represent bilateral trade between 107 countries. Trade data are taken from COMTRADE. Data for tariffs come from the World Bank/UNCTAD WITS database. Regarding tariffs, importer fixed effects capture the most favored nation (i.e. MFN or non-preferential) tariff, while the log difference between the MFN rate $ln(1+t_{MFN})$ and the preferential tariff (where there is a free trade agreement or customs union) is included as a pairwise tariff variable. In addition to the shipping distances discussed above, socio-economic data are from Dür et al. (2014), the CEPII database (Mayer and Zignago, 2011), and the Quality of Governance (QoG) expert survey dataset (Teorell et al., 2011).[9] The coefficient on the tariff term is known as the trade or price elasticity. In CES based trade models, it has varying interpretations, though in the present context it serves in our structural model as an estimate of the trade substitution elasticity. Distance data, as discussed above, are based on the length of shipping routes. Following Santos Silva and Tenreyro (2006, 2011), we estimate equation (1) with a Poisson pseudo-maximum likelihood (PPML) estimator, both for total goods trade, and for trade for each sector in the computational model.

Working from our data on shipping distance changes as discussed above, combined with the distance and tariff elasticities in Table **??**, we can assess how much the decrease in shipping distance translates into effective trade cost reductions. The basic calculation is the following:

$$\Delta\text{cost}_{jsd} = \frac{\beta_{j,\text{distance}}}{\beta_{j,\text{tariff}}}\Delta\ln\left(\text{distance}_{sd}\right) \tag{2}$$

where Δcost_{sd} is the change in the total cost of goods sold as a share of the value of trade. They are defined for each sector j and for bilateral trade flowing

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[9] Following Egger et al. (2011), we instrument preferential trade agreements by a set of political economy variables from Teorell et al. (2011). We include polity, functioning of government, corruption, and civil liberties measures, as well as lagged trade network embeddedness (Easley and Kleinberg, 2010; De Benedictis and Tajoli, 2011; Zhou, 2011), distance, common border, common language, former colonial ties, population and GDP. Preferential trade agreements are free trade agreements and customs unions that have been agreed at least four years previously (Dür et al., 2014). The political economy variables also include pairwise measures of similarity, reflecting evidence that homophily is important in explaining direct economic and political linkages (De Benedictis and Tajoli, 2011).

from country s to country d. Our estimates of Δcost_{jsd} are summarized in Table **??** below. Note that these total trade costs are sector-specific and are not symmetrical for country pairs. For instance, the trade costs from China to Belgium are different than from Belgium to China.

We then allocate these total cost reductions over actual shipping services costs and the remainder as iceberg trade costs. We first estimate the shipping services costs reduction by multiplying the trade margins (i.e. the wedge between the *fob* and *cif* trade values in the data) by the percentage distance reduction associated with the NSR (see Table **??**). The iceberg trade costs are then calculated as the difference between the total trade costs in equation (2) and the shipping service cost reductions. These iceberg trade costs account for several costs that hinder international trade, such as time, coordination, and other non-shipping service costs (cf. Hummels and Schaur, 2012).

5 CGE analysis of trade and macroeconomic outcomes

In the third and last step we integrate the trade cost reduction estimations into a computable general equilibrium (CGE) model of the global economy. Since the opening of the NWR is a global phenomenon that affects several countries at once, it will create inter-related shocks between different trading economies. Trade facilitation through the NWR will not only affect bilateral trade, but also sectoral production and consumption patterns, relative domestic and international prices and the way production factors (i.e. labour, capital) are used in different countries. CGE models are routinely used in the fields of international trade, economic integration and climate change to analyse such global issues.[10] In this context, our CGE model can analyse how macroeconomic variables change with respect to a benchmark global economy projection in the year 2030. The model provides information on the impact on bilateral trade flows, socioeconomic indicators, transport related pollution levels, and overall CO2 emissions.

Moreover, CGE models are the standard economic tool to analyse global trade issues. They are built upon neoclassical theory, have strong micro-foundations and explicitly determine simultaneous equilibrium for a large number of markets. They provide an explicit and detailed treatment of international trade and transport margins, while bilateral trade is handled via CES (constant elasticity of substitution) preferences for intermediate and final goods.[11] They are developed for the analysis of medium and long-term questions that involve inter-regional and inter-sectoral

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[10] See for instance, Schmalensee et al. (1998), Elliott et al. (2010), Peng (2011); Beckman et al. (2011); Boehringer et al. (2011); Böhringer et al. (2012); Auffhammer and Steinhauser (2012); Dixon and Jorgenson (2013).

[11] This assumption is generic to most CGE models as it is a simple device to account for "cross-hauling" of trade (i.e. the empirical observation that countries often simultaneously import and export goods in the same product category). However, since the main driving force in our bilateral trade results is a reduction on the trading distance between partners that follows from the gravity model of trade, it is expected that similar bilateral trade results will be found using a wider set of trade models (e.g. the Eaton-Kortum model), although the production and welfare implications can

effects, and thus, CGE models are designed to assess the likely macroeconomic consequences of policy changes that affect more than one country at the same time, and can have varying effects on different economic sectors.

The opening of the NWR, therefore, fits within the analytical scope of CGE models since it implies a very sizable shock to the world trade system that will affect a large set of countries simultaneously.[12]

The particular model we use is a modified version of a standard GTAP-class CGE model[13] However, our specific CGE model incorporates monopolistic competition instead of perfect competition with constant returns to scale (Francois et al., 2013), and CO2 emissions linked to production, consumption and trade.[14]

To assess the global general equilibrium effects of the commercial use of the Northern Sea Route, we work with the GTAP8 database, projected along the medium or SSP2 (Shared Socioeconomic Pathway) from the most recent SSPs and related Integrated Assessment scenarios (IIASA, 2012; O'Neill et al., 2012). In the paper, we focus on the year 2030 from this baseline.[15] Our model allows us to analyse both the trade and macroeconomic implications associated with the NWR, as well as changes in CO2 emissions from production and international transport.[16] We aggregate the 57 GTAP sectors into 23 sectors, and the 129 regions into 39 country/regions (see Table 1 and Table 2 in the Appendix).

Working from the 2030 projection along the baseline SSP, our main CGE results are the differences between the baseline values in 2030 (i.e. the business-as-usual scenario with no NWR shipping) compared with the counterfactual scenario where we allow bilateral trade to move through the NWR. In this counterfactual scenario,

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be different between both sets of models. See Francois et al. (2013) for a more technical discussion of demand systems and different market structures.

[12] It is important to note that recent quantitative trade models –summarized by Costinot and Rodríguez-Clare (2013)– are not able to handle the current exercise. These micro-theory based econometric models are highly stylized quantification methods, that however, are not capable of dealing with detailed analysis of global trade issues. Thus, even though these models are well grounded in recent micro-economic theory, their scope is very limited in terms of actual analysis. In particular, these models simply cannot be used to address the current exercise, since these models are not able to deal with intermediate linkages associated with global supply chains and their associated carbon emissions; on how emissions are linked to country- and sector-specific transport activities; and on how to separate actual transport costs from time related costs that are sector-specific in nature. These are issues central to the evaluation of the economic and environmental effects of the NWR that can only be tackled using a CGE model.

[13] The main characteristics and references to the standard GTAP model can be found at: www.gtap.agecon.purdue.edu/models/current.asp. Also see Hertel (2013) and Rutherford and Paltsev (2000) for a more detailed discussion.

[14] The model is implemented in GEMPACK under OSX and the model code is available upon request, as well as an executable version of the model.

[15] As a robustness analysis –besides our benchmark case for 2030– we use different years for which the NWR is fully operational. In general, the main results found for 2030 do not change significantly. The main difference between using different benchmark cases (for instance 2015 and 2040) are related to the relative size of the trade effects, which are dependent on the projected GDP values. In particular, the trade effects of China are the most sensitive results.

[16] GTAP is the standard basic data used in most CGE models. See Narayanan et al. (2012) for documentation on the GTAP 8 database, and Hertel (2013) on the full database project.

we include both the transport and trade cost reductions as discussed above into our CGE model to assess the impact on bilateral trade flows, sectoral output, and other macroeconomic variables.[17] It is important to note that our CGE models explicitly takes into account the input-output relationships within countries and sectors embodied in global value chains (GVC). Thus we can also assess how these GVC are adjusting to the new shipping distances. We also look into the social costs of these trade changes in terms of overall welfare, and employment/wage changes. Finally, we also analyse the changes that shorter shipping routes have on transport related pollution levels, which account for both shorter distances but also on potentially larger trade volumes.

Furthermore, the use of a particular benchmark year –in this case 2030– does not affect the main qualitative results presented below. As a robustness analysis we also ran the CGE simulations using 2015 and 2040 as benchmark years. Using these alternative years we find that the size of the trade effects varies, but the trade patterns remain unchanged. The main difference between the results using different years can be explained by the GDP projections used in the baseline. Choosing later years (e.g. 2040) will reflect higher GDP values for some countries that are projected to grow faster than the average. In particular, the growth path of China is an important determinant in the size of the trade changes. In 2015 the relative size of China, measured by GDP, is smaller than in 2040, and this implies that the trade volumes are larger for 2040 than for 2015. Nevertheless, the overall trade patterns remain the same when using different benchmark years – i.e. 2015, 2030 and 2040.[18]

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[17] As explained in Section 4, technically this is done through a mix of both technical efficiency in shipping and iceberg trade costs, where in total these are equivalent to estimated reductions in total trade costs.

[18] These results are available upon request.

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A Appendix

Table 1: Sectoral description and aggregation

Code	Sector description	Aggregated GTAP sectors
S01	Agricultural products	OSD (oil seeds), C_B (sugar cane), PFB (plant-based fibbers), CTL (cattle), OAP (animal prods nec), RMK (raw milk), WOL (wool)
S02	Motor vehicles	MVH (motor vehicles and parts)
S03	Beverages and tobacco	B_T (beverages & tobacco products)
S04	Chemicals	CRP (Chemical, rubber and plastic products)
S05	Clothing	WAP (wearing apparel)
S06	Plant products	OCR (crops nec)
S07	Fisheries	FSH (fishing)
S08	Processed foods	PDR (paddy rice), WHT (wheat), GRO (cereal grains nec), V_F (vegetables & fruits), CMT (bovine meat prods), OMT (Meat prods nec), VOL (vegetable oils), MIL (diary prod), PCR (processed rice), SGR (sugar), OFD (food products nec)
S09	Leather products	LEA (leather products)
S10	Forestry	FRS (forestry)
S11	Metals	I_S (ferrous metals), NFM (metals nec), FMP (metal products)
S12	Office machinery	ELE (electronic equipment)
S13	Other machinery	OME (machinery and equipment nec
S14	Other manufactures	NMM (mineral products nec), OMF (manufactures nec)
S15	Petrochemicals and gas	P_C (Petroleum and coal products), GDT (gas manufacture and distribution)
S16	Mining and extraction	COA (coal), OIL (oil), GAS (gas), OMN (Minerals nec)
S17	Textiles	TEX (textiles)
S18	Transport equipment	OTN (transport equipment nec)
S19	Paper products and publishing	PPP (paper products and publishing)
S20	Wood products	LUM (wood products)
S21	Transport services	OTP (transport nec), WTP (water transport), ATP (air transport)
S22	Commercial services	WTR (water), CNS (construction), TRD (trade), CMN (communication), OFI (financial services nec), ISR (insurance), OBS (Business services nec)
S23	Public and consumer services	ELY (electricity), ROS (recreational and other services), OSG (Public Administration, Defence, Education, Health), DWE (dwellings)

Table 2: Regional aggregation

	Code	Country / Region		Code	Country / Region
1	AUT	Austria	21	SVK	Slovakia
2	BEL	Belgium	22	SVN	Slovenia
3	CYP	Cyprus	23	ESP	Spain
4	CZE	Czech Republic	24	SWE	Sweden
5	DNK	Denmark	25	GBR	United Kingdom
6	EST	Estonia	26	BGR	Bulgaria
7	FIN	Finland	27	ROU	Romania
8	FRA	France	28	NOR	Norway
9	DEU	Germany	29	CHN	China
10	GRC	Greece	30	HKG	Hong Kong
11	HUN	Hungary	31	JPN	Japan
12	IRL	Ireland	32	KOR	South Korea
13	ITA	Italy	33	PHL	Philippines
14	LVA	Latvia	34	PNG	Other Asia Pacific
15	LTU	Lithuania	35	TWN	Taiwan
16	LUX	Luxembourg	36	USA	United States
17	MLT	Malta	37	OCD	Other OECD
18	NLD	Netherlands	38	SSA	Sub-Sahara Africa excl. ZAF
19	POL	Poland	39	ROW	Rest of the World
20	PRT	Portugal			