International Transport Forum

Changing Demand for Maritime Trade

Discussion Paper

178 Roundtable

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The International Transport Forum

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Introduction

The future of maritime trade demand is uncertain by nature. Foresight of what possible future maritime trade flows could look like will allow for effective planning of transport infrastructure such as ports and their connections to roads, railways and inland waterways. Due to the diversity of commodities transported at sea (oil, coal, iron ore, grain, general and containerised cargoes, etc.), each trade could be subject to a specific analysis. Such division of analysis acknowledges that maritime flows are affected by a large variety of factors, such the level of integration and of regionalisation of the global economy, prospects on world population and GDP per capita as well as the future organisation of Global Value Chains (GVCs). The diversification of energy supplies and transitions towards renewable energy will also have a significant impact on maritime trades with maritime transport still being a fossil-based industry.

The objective of this paper is to discuss these elements and to provide a holistic view on future maritime trade development. It addresses the following questions:

- How will economic globalisation evolve and translate into World population and trade outlook?
- What are the likely pathways for maritime trades?
- How will economic globalisation evolve and what does it imply for maritime trade?

The paper first sets the scene (section 1) derived from an analysis of the evolution in maritime trades during the last 50 years. It then discusses findings from studies on long-term World population and GDP per capita growth outlook, which are still the main drivers of future maritime trades (section 2). World trades are then analysed together with some maritime demand outlook (section 3) while additional drivers related, in particular, to changes in technology, Global Value Chains and regionalisation of trades are finally discussed (section 4).

Long-term changes predicted for maritime trades

The world economy has been subject to profound changes over the last century. These changes have impacted the volume, pattern and composition of maritime trades. Looking back, world trades have followed three main stages (Baldwin, 2006, 2011, 2013, 2016; Gonzales and Jouanjean 2017; WTO 2013, 2018).

The first stage of development in international trades was largely driven by falling transport costs referred as ‘first unbundling’ or ‘traditional trade’. This stage ended in the middle of the 20th century. Technological advancements made in transport, and in particular for shipping and railways, have played a major role in these trade evolutions (WTO 2018) as they enabled the separation of production and consumption across national borders. During this phase, maritime transportation experienced large growth rates, mostly supported by energy and general cargo trades.

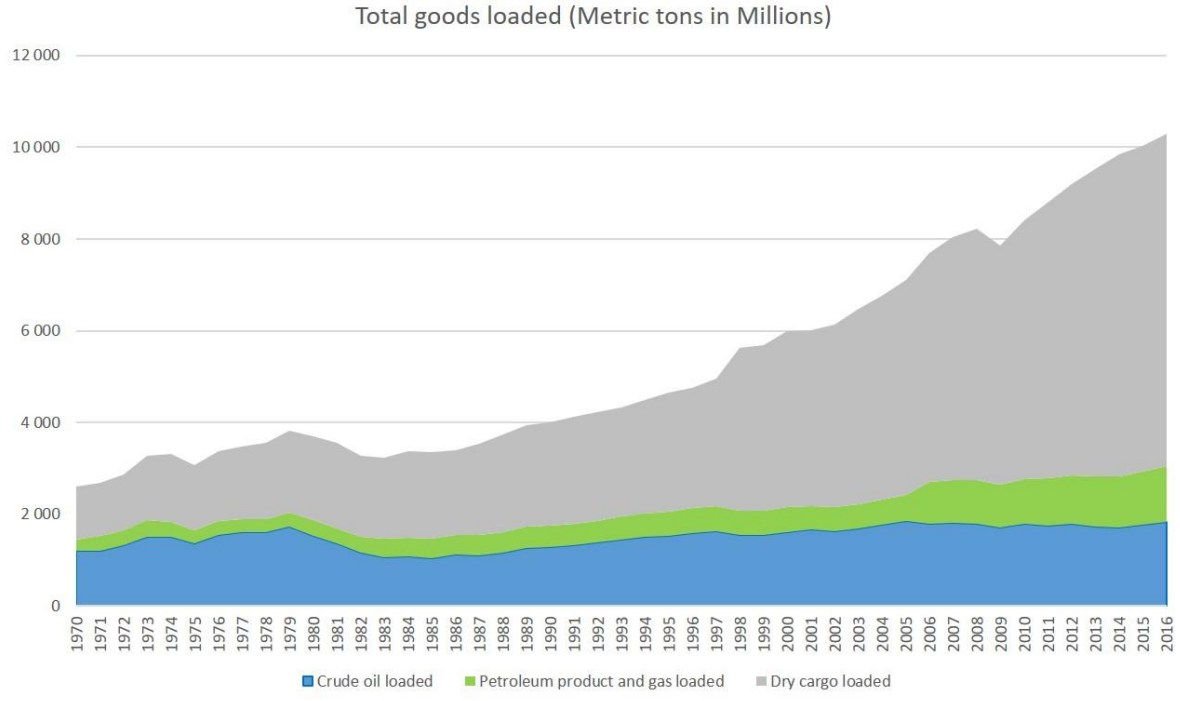
The extension of Global Value Chains (GVCs) saw a reduction in transport and in coordination costs during the second stage (1945-2000). This led to further fragmentation in the production processes across national borders. Trades in intermediate and in manufactured products flourished, and particularly in emerging economies that were the main drivers of growth (Baldwin, 2006; Baldwin, 2016). This phase was also supported by technological changes in ocean shipping (WTO, 2018) where containerisation is regularly mentioned as a major contributor to the decline in the cost of transport (Levinson, 2008; Hummels, 2007).

Digitally-enabled trade since 2000 marks the third stage of world trade. It is driven by further reductions in transport and coordination costs, that is coupled with a considerable fall in the costs through the transfer of data or information (Gonzales and Jouanjean, 2017; WTO, 2018). These elements imply that new profound changes in the world economy may emerge, that will once again impact the volume, pattern and composition of world and maritime trades. As shipping remains a derived demand (Stopford, 2009), the long-term evolution in international maritime trades is in line with changes in the world economy.

The main evolutions in maritime trades during the last 50 years (Corbett and Winebrake , 2008; UNCTAD, 2018a) can be summarised by two points (Figure 1, Tables 1-3):

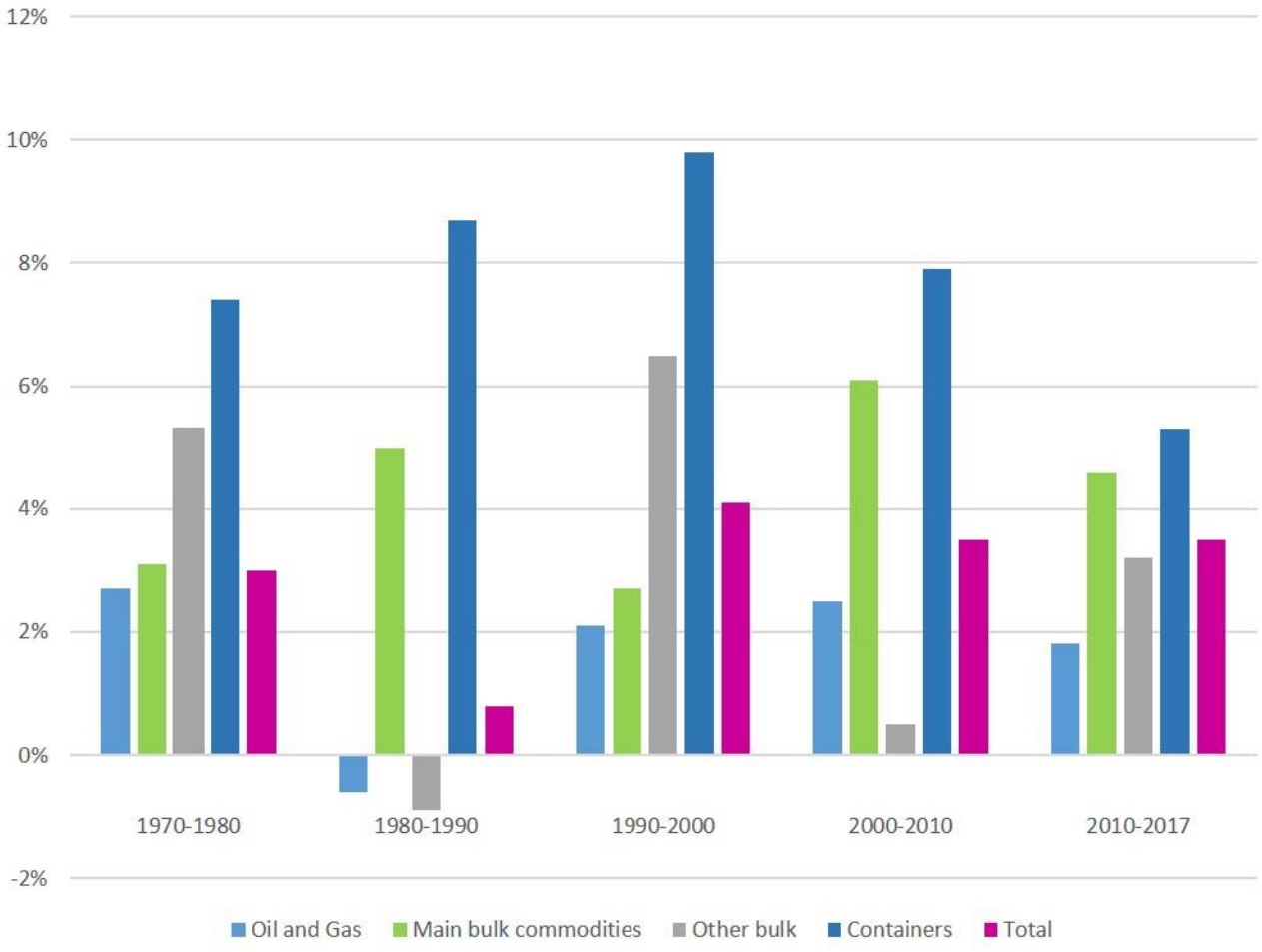
- A general increase in maritime transport volume and tonnes per-mile of approximatively 3.1%-3.8% per year from 1970 to 2017, mostly supported by developments in dry bulk and container trades. During this period, the share of dry bulk commodities has increased from 43% to 54% and from 2% to 17% for containers, while the share of oil trades decreased from 55% in 1970 to 29% of maritime trades in 2017, although still growing at 1.5%-2% per year.
- Since the 90s, even more since 2000, an increase in maritime trades of developing countries (increasing its share from 51% in 2000 to 59% in 2017) drives the growth of international maritime trades.

Figure 1. World seaborne trade by cargo type, 1970-2017 (in Metric ton in millions)



Source: Author's elaboration based on UNCTAD (2000-2018).

Figure 2. Growth rates of world seaborne trade by cargo type, 1970-2017



Source: Author's elaboration based on UNCTAD (2000-2018).

Table 1. World seaborne trade by types of cargo, 1970-2017 (in Metric ton in millions)

	1970	Share	1970-1980*	1980	Share	1980-1990*	1990	Share	1990-2000*
Oil and Gas	1440	55%	2.7%	1871	51%	-0.6%	1755	44%	2.1%
Main Bulk Commodities	448	17%	3.1%	608	16%	5.0%	988	25%	2.7%
Other Bulk Commodities	667	26%	5.3%	1123	30%	-0.9%	1031	26%	6.5%
Containers	50**	2%	7.4%	102	3%	8.7%	234	6%	9.8%
Total Goods	2605	100%	3.6%	3704	100%	0.8%	4008	100%	4.1%
	2000	Share	2000-2010*	2010	Share	2010-2017*	2017	Share	1970-2017*
Oil and Gas	2163	36%	2.5%	2772	33%	1.8%	3146	29%	1.7%
Main Bulk Commodities	1295	22%	6.1%	2335	28%	4.6%	3196	30%	4.4%
Other Bulk Commodities	1928	32%	0.5%	2022	24%	3.2%	2526	24%	2.9%
Containers	598	10%	7.9%	1280	15%	5.3%	1834	17%	8.1%
Total Goods	5984	100%	3.5%	8409	100%	3.5%	10702	100%	3.1%

Notes: * Annual Average Growth Rate. ** Estimated in 1970.

Source: Author's elaboration based on UNCTAD (2000-2018).

Table 2. World seaborne trade by types of cargo, 1970-2017 (in billions of tons-miles)

	1970	Share	1970-1980*	1980	Share	1980-1990*	1990	Share	1990-2000*
Oil and Gas	6 487	61%	3.8%	9 405	56%	-1.8%	7 821	46%	3.3%
Main Bulk Commodities	2 049	19%	5.9%	3 652	22%	3.0%	4 900	29%	2.9%
Other Bulk Commodities	2 118	20%	5.8%	3 720	22%	1.8%	4 440	26%	9.4%
Containers	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Goods	10 654	100%	4.6%	16 777	100%	0,2%	17 161	100%	6,2%
	2000	**Share**	**2000-2010***	**2010**	**Share**	**2010-2017***	**2017**	**Share**	**1970-2017***
Oil and Gas	10 778	34%	2.1%	13 251	30%	2.6%	15 869	27%	2.0%
Main Bulk Commodities	6 509	21%	6.6%	12 336	28%	4.9%	17 217	29%	4.7%
Other Bulk Commodities	10 871	35%	1.3%	12 428	28%	4.1%	16 464	28%	4.6%
Containers	3 111	10%	7.8%	6 588	15%	5.4%	9 535	16%	NA
Total Goods	31 269	100%	3.6%	44 603	100%	4.1%	59 085	100%	3.8%

Note: * Annual Average Growth Rate

Source: Author's elaboration based on UNCTAD (2000-2018).

Table 3. World seaborne trade by group of economies, 1970-2017 (in Metric ton in millions)

	1970	Share	1970-1980*	1980	Share	1980-1990*	1990	Share	1990-2000*
Developed economies	781	30%	5.8%	1 370	37%	2.5%	1 756	44%	4.1%
Transition economies	154	6%	4.9%	248	7%	1.2%	281	7%	2.0%
Developing economies	1 670	64%	2.2%	2 085	56%	-0.6%	1 972	49%	4.4%
World	2 605	100%	3.6%	3 704	100%	0.8%	4 008	100%	4.1%
	2000	**Share**	**2000-2010***	**2010**	**Share**	**2010-2017***	**2017**	**Share**	**1970-2017***
Developed economies	2 621	44%	0.9%	2 865	34%	2.5%	3 675	34%	3.4%
Transition economies	341	6%	4.2%	516	6%	2.6%	664	6%	3.2%
Developing economies	3 022	51%	5.2%	5 028	60%	2.4%	6 363	59%	3.0%
World	5 984	100%	3.5%	8 409	100%	2.4%	10 702	100%	3.1%

Note: * Annual Average Growth Rate

Source: Author's elaboration based on UNCTAD (2000-2018).

This initial analysis raises two important questions:

- First, is the decrease of energy trades in total maritime transportation (from roughly 60% in 1970 to 30% in 2017) likely to continue?
- Second, is the rise in dry bulk cargoes and container trades, the main driver of shipping markets over the last 50 years and the rise in developing countries since 2000, going to continue in the future?

The first bullet importantly asks, whether these trades, which have still been increasing in absolute value since 1970 (+1.5 to 2% on a yearly basis) are going to decrease? And what will be the new composition of energy trades, considering the new environment towards decarbonisation? The second point addresses the general reduction in international trades mostly explained by a slowdown of developing countries (around 2.5% per year from 2010 to 2017). All questions apply to a large range of products, from crude oil, oil products, dry cargoes (iron ore, coal, grain…) to manufactured products (electronics and textiles).

This paper focuses on a more holistic approach and focuses on the main drivers of future maritime trades. It proposes that long-term maritime trades will still mostly be driven by changes in GDP per capita and its associated effects such as the need for industrial production. Although many studies (IMO, 2014; DNV, 2017; UNCTAD, 2018b) stress a decoupling effect with GDP per capita over the last years, and in particular for energy-related trades (CE Delft, 2019).

Table 4 and Figure 3 show the results (linear regression in log) of maritime trade forecasts as a function of GDP per capita. There is still a strong relationship between GDP per capita and maritime trades with a R2 of 0.97 for Total goods, 0.92 for Petroleum Product and Gas and 0.99 for Dry cargo. This differs to crude oil trades, where geopolitical events and future energy transition pathways have a strong impact that explains significant deviation (R2=0.62) from GDP-based evolutions[1]. In the long run, the total maritime trade-GDP per capita elasticity is at around 2 and is higher, as expected, for dry cargo (2.74) that includes containerised cargoes. These results confirm that future maritime trades should still be mostly driven by outlooks based on world population and GDP per capita (excluding crude oil trade) that will be the focus of Section 2. The Section 3 will then discuss the implications for future maritime demand (Section 3) while additional future drivers are presented in a last section (Section 4).

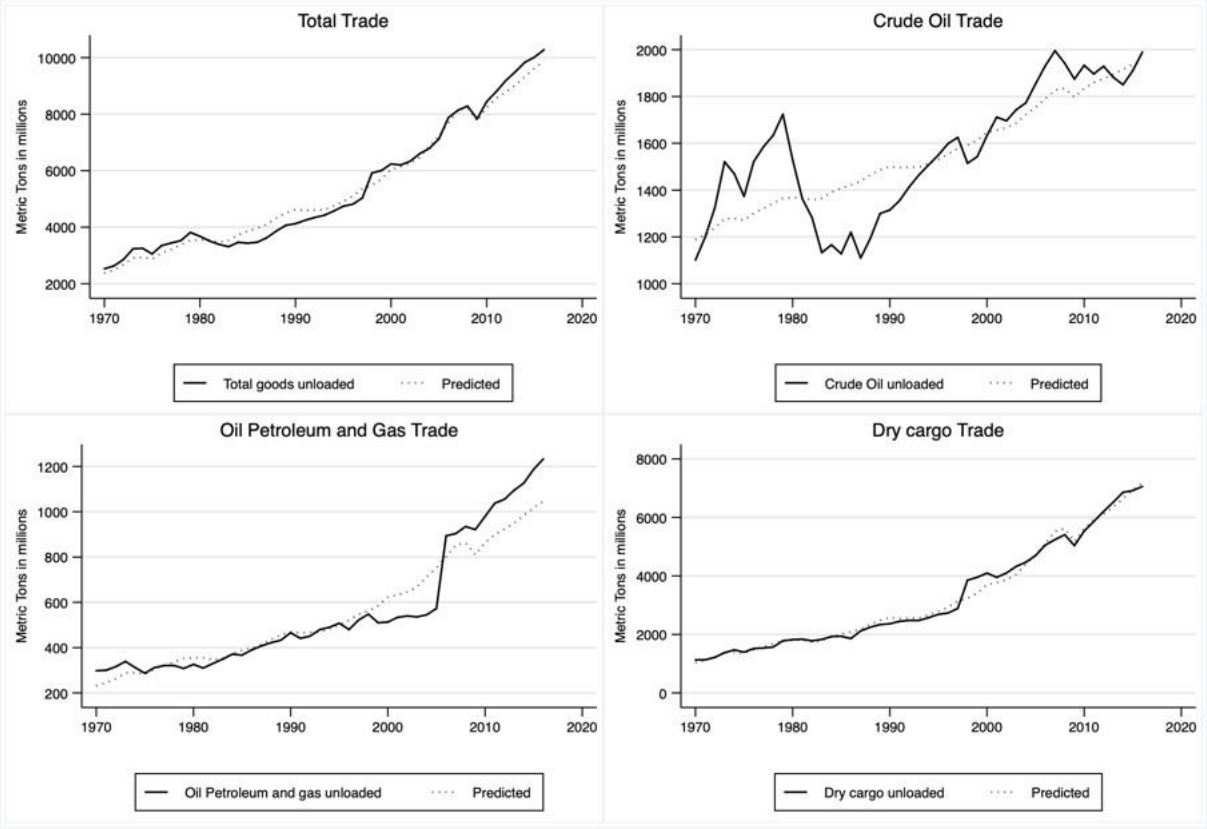
Table 4. Estimates of the log Maritime trades (unloaded) as a function of log GDP per capita (1970-2016)

Variables	Total goods	Crude oil	Petroleum Product and Gas	Dry cargo
GDP per Capita	2.027***	0.708***	2.142***	2.744***
	(41.94)	(8.60)	(22.77)	(65.64)
Constant	-9.546***	1.033	-12.851***	-16.492***
	(-22.17)	(1.41)	(-15.34)	(-44.29)
Observations	47	47	47	47
R-squared	0.975	0.622	0.920	0.990

Notes: *** Significance levels are 1%. ** Significance levels are 5%. * Significance levels are 10%

Source: Cariou (2019) based on data from UNCTAD (2018a). Initial Trade data in Metric tons in Million and Gross Domestic Product (GDP) per capita in constant (2010) prices, annual, 1970-2016.

Figure 3. Predicted versus actual maritime trades as a function of GDP per capita



Source: Cariou (2019) based on UNCTAD (2000-18).

World population and GDP per capita outlooks

World population and GDP per capita growth are the main drivers of trades. Long-term evolutions for these two variables are subject to particular attention by two main streams of research.

- Those devoted to assess the contribution of international trades to climate change and future greenhouse gas (GHG) emissions (for instance IPCC 2000; IMO 2014; CE Delft 2019).
- Those devoted to predict future world trades (for instance WTO, 2018), or to change in GVCs supply chains (for instance McKinsey Global Institute 2019; Deutsche Post, 2012).

These two streams are based on alternative futures and share common drivers such as world population, GDP future development and their respective locations. The first stream of research, initiated by the International Panel on Climate Change (IPCC, 2000) is built upon the definition of storylines. Each storyline is based on different assumptions on demographic changes, economic developments and technological changes, which can be summarised as follows:

- The first storyline describes a future world of very rapid economic growth, global population that peaks in mid-century. This is the A1 scenario. It splits into three groups according to hypothesis on fossil intensity and balance across fossil or non-fossil sources. Major underlying themes are convergence among regions, capacity building, and increased cultural and social interactions, with a substantial reduction in regional differences in per capita income.
- The second storyline (the A2 scenario) describes a heterogeneous world. Fertility patterns across regions converge very slowly, which results in a continuously increasing global population while economic development is primarily regionally oriented. Per capita economic growth and technological change are slower than in other storylines.
- The third storyline and scenario family (B1) describes a convergent world with the same global population pattern as the A1 storyline, but with rapid changes in economic structures toward a service and information economy. It leads to the introduction of clean and resource-efficient technologies and an emphasis on global solutions to sustainable economic, social, and environmental challenges.
- The fourth storyline and scenario family (B2) describes a world with local solutions to sustainable economic, social, and environmental issues. Global population growths at a rate lower than A2. While the scenario is also oriented toward environmental protection and social equity, it focuses on local and regional levels.

These model-based scenarios lead to 26 different sub-scenarios that explore the possible environmental trends in relation to population and income development, technology development, lifestyle change and evolving production and consumption patterns (Van Vurren et al. 2017). A new set of five scenarios (Van Vurren et al., 2014) or Shared Socio-economic Pathways (SSPs) serve as a basis for most estimations on future transport demand and GHG emissions since 2006. See for instance in the 2014 IMO study on GHG. These five scenarios are based on the following narratives:

- SSP 1. *Sustainable development.* This proceeds at a reasonably high pace, inequalities are lessened, technological change is rapid and directed toward environmentally-friendly processes, including use of lower carbon energy sources and high productivity of land.
- SSP 2 *Moderate.* An intermediate case between SSP1 and SSP3 or middle of the road scenario.
- SSP 3 *High for mitigation and adaptation.* Unmitigated emissions are high due to moderate economic growth, a rapidly growing population, and slow technological change in the energy sector, making mitigation difficult. Inequality is high, and a regionalised world leads to reduced trade flows.
- SSP 4 *High for adaptation, low for mitigation.* A mixed world, with relatively rapid technological development in low-carbon energy sources in key emitting regions, leading to relatively large mitigative capacity in places where it mattered most to global emissions. This highly unequal world leads to a large number of poor people across countries that face high adaptation challenges.
- SSP 5 *High for mitigation, low for adaptation.* In the absence of climate policies, energy demand is high and most of this demand is met with carbon-based fuels. Investments in alternative energy technologies are low, and there are few readily available options for mitigation. SSP 5 or ‘‘fossil-fuelled development’’ characterises a growth-oriented world that uses conventional technologies (in particular fossil fuel-based energy conversion technologies) and therefore faces high mitigation challenges.

From these five scenarios, two recent studies by Samir and Lutz (2017) and Leimbach et al. (2017) shed light on the underlying assumptions regarding future changes in world population and GDP per capita.

World population outlook

For world population future annual growth rates (Samir and Lutz, 2017), the five SSP assumptions range from 0.5% in 2010 to 0.9% in 2050 and from -0.4% in 2050 to 0.5% in 2100 (Table 5). Under these different assumptions, the world population would increase from 6.8 billion in 2010 to 8.4 (SSP1) or 9.9 (SSP3) in 2050 and then stabilise or slightly decrease up to 2100 (except for SSP3 which predicts 12.6 billion by 2100).

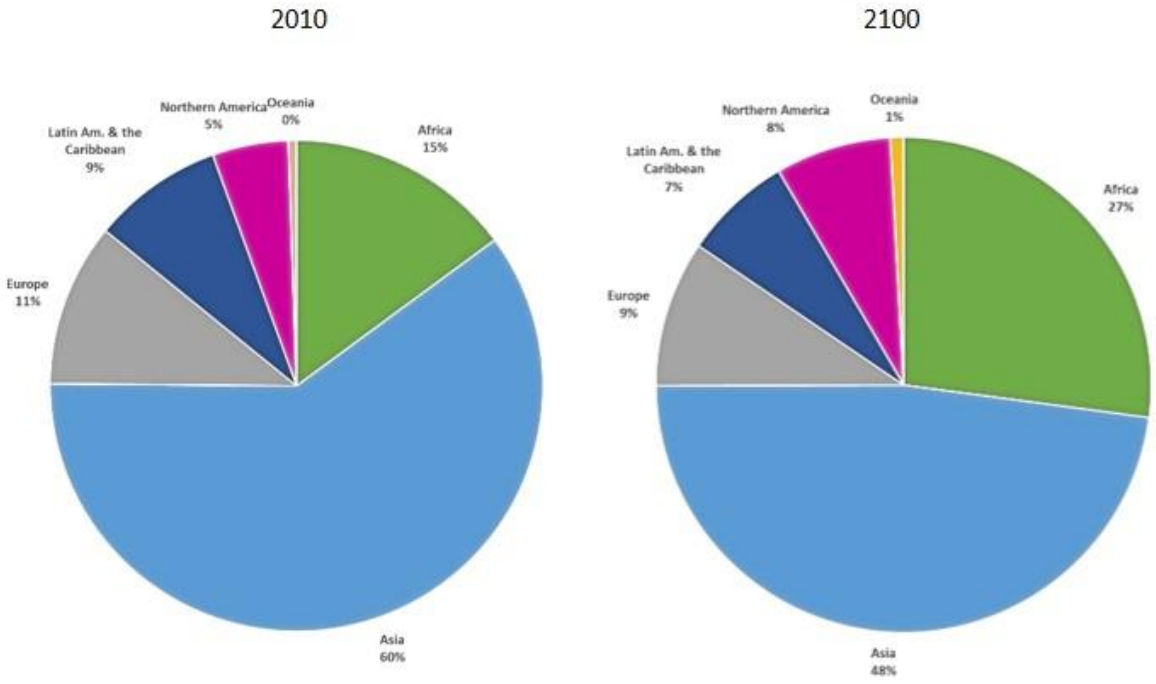
Table 5. World population outlook 2010-2100 in billion and Annual Growth Rate*

	SSP1	SSP2	SSP3	SSP4	SSP5
2010	6 871	6 871	6 871	6 871	6 871
2050	8 461	9 166	9 951	9 122	8 559
2100	6 881	9 000	12 627	9 267	7 363
2010-2050*	0.5%	0.7%	0.9%	0.7%	0.6%
2050-2100*	-0.4%	0.0%	0.5%	0.0%	-0.3%

Source: Author's elaboration based on Samir and Lutz (2017).

The share of Asia in world population is similar whatever the SSP assumptions, although differences in regional growth rates exist. Asia displays a decrease in population from 60% in 2010 to approximatively 55% by 2050. The share of African populations increases by 5% to reach approximatively 20%-25% of the world population in 2050 (Figure 4 for SSP1), while the share of the other main regions remains fairly constant. In 2100, the share of Asia is 44%-53% against 25%-39% for Africa.

Figure 4. World population by region share in 2010 and 2100 (SSP1)



Source: Author's elaboration based on Samir and Lutz (2017).

The International Energy Agency (IEA) (2019) forecasts consider an increase in world population of 0.9% per year from 2107 to 2040, in-line with SSP3. The world population is estimated at 9.1 billion by 2040, with 50% in Asia and 22% in Africa being the two largest shares. Fontagné and Fouré (2013) scenarios are based on fertility and account for the potential, but limited effects of migrations that could mostly take place in Europe and North America. Furthermore, the impact on population growth remains affected by an ageing population for which a general decline in the share of working population in total population is expected. Table 6 shows the result for a selection of 20 countries, and depicts a rise in the share of population aged more than 65 years from 20% in 2011 to 46% in 2060 compared to the 15-64 year-old groups.

Table 6. Share of population older than 65 as a share of population aged 15-64

	2011	2030	2060		2011	2030	2060
Argentina	16.5	20.8	35.9	India	7.7	12.2	25.4
Australia	20.3	31.5	42.8	Indonesia	8.3	15.1	36.1
Brazil	10.6	20.0	43.6	Italy	30.9	41.1	56.7
Canada	20.8	37.8	44.9	Japan	36.9	52.9	68.6
Chile	13.8	26.5	47.0	Korea	15.9	37.3	64.3
China	11.5	23.9	51.8	Russia	17.7	29.4	42.4
Denmark	25.7	37.0	43.5	South Africa	7.3	11.6	18.7
France	25.9	39.1	46.6	Spain	25.2	35.5	56.4
Germany	31.2	47.2	59.9	United Kingdom	25.2	34.8	42.1
Greece	28.9	37.7	56.7	United States	20.0	32.7	36.8
All 20 countries	**20.0**	**31.2**	**46.0**				

Source: Author's elaboration based on Johansson et al. (2012).

World GDP outlook

Gross domestic product (GDP) per capita outlook accounts for previous projections of world population and are adjusted according to the SSP1-SSP5 scenarios. Leimbach et al. (2017) summarise the main implications for High-, Middle- and Low-income countries in Table 7. Depending on the scenarios the Compound Annual Growth Rate World income over 2010-2040 would increase by 3% in the SSP1-secnario and by 1.9% in the SSP2-scenario, while projected growth over 2040-2100 would range between 2.2% for the SSP1-scenario to 0.5% in the SSP3-scenario. The most striking element, common in most long-term forecasts, is a convergence over time of populations amongst higher, middle and lower countries.

Out of the five scenarios, SSP3 is the closest to the latest projections by Guillemette and Turner(2018) of the OECD. Previous OECD forecasts from Johansson et al. (2012) are reported in Table 8 and conclude that the growth rate of non-OECD countries should continue to outpace that for OECD countries, but with the difference narrowing over the coming decades. Non-OECD country growth will decline from over 7% per year over the last decade, to around 5% in the 2020s and to about half that by the 2050s (2.5% from 2050). For OECD countries, the average GDP growth is estimated at 1.75% to 2.25% per year. This convergence is reinforced by the fact that determinants such as the aging of populations is likely to lower the GDP per capita growth rate despite an expected increase in the overall world population. Cross-country differences in living standards is expected to persist by 2060 despite a faster growth for low-income and emerging countries. Finally, IEA (2019) prospects on future GDP growth are more optimistic, with a prediction of 3.4% growth per year from 2017 to 2040, mostly supported by China and Southeast Asia (approximately 4.5%).

Table 7. Annual average GDP per capita growth rates per Shared Socio-economic Pathways

	SSP1				SSP2			SSP3	
	2010–2040	2040–2100	2010–2100	2010–2040	2040–2100	2010–2100	2010–2040	2040–2100	2010–2100
High income countries	1.3%	0.9%	1.0%	1.4%	0.9%	1.1%	1.1%	0.4%	0.6%
Middle income countries	4.4%	1.9%	2.8%	4.0%	1.9%	2.7%	3.4%	0.9%	1.8%
Low income countries	4.2%	3.9%	4.1%	3.7%	3.3%	3.5%	2.7%	1.0%	1.6%
World	**3.0%**	**1.8%**	**2.2%**	**2.7%**	**1.7%**	**2.0%**	**1.9%**	**0.5%**	**1.0%**
	SSP4			SSP5					
	2010–2040	2040–2100	2010–2100	2010–2040	2040–2100	2010–2100			
High income countries	1.5%	0.9%	1.1%	1.5%	1.7%	1.6%			
Middle income countries	4.3%	1.8%	2.7%	4.5%	2.6%	3.3%			
Low income countries	3.3%	1.8%	2.3%	4.0%	4.5%	4.4%			
World	**2.7%**	**1.1%**	**1.7%**	**3.1%**	**2.5%**	**2.8%**			

Source: Author's elaboration based on Leimbach et al. (2017).

Table 8. Projected GDP per capita annual growth rate in OECD, non-OECD and selected countries

	1995-2011	2011-2030	2030-2060	2011-2060		1995-2011	2011-2030	2030-2060	2011-2060
Argentina	2.6	2.9	1.9	2.3	Italy	0.6	0.9	1.5	1.3
Australia	1.9	3.0	1.7	1.8	Japan	0.8	1.4	1.9	1.7
Brazil	2.1	3.4	2.1	2.6	Korea	4.0	2.5	1.4	1.8
Canada	1.6	1.3	1.8	1.6	Russia	5.4	3.2	1.7	2.3
Chile	2.8	3.4	2.0	2.5	South Africa	2.1	3.4	2.3	2.7
China	9.3	6.4	2.8	4.2	Spain	1.9	1.6	1.3	1.4
Denmark	1.1	1.0	2.0	1.6	United Kingdom	1.9	1.3	1.8	1.6
France	1.1	1.6	1.2	1.3	United States	1.5	1.5	1.5	1.5
Germany	1.4	1.5	1.5	1.5					
Greece	1.9	1.7	1.3	1.4	World	2.5	3.1	2.3	2.6
India	5.8	5.6	3.6	4.4	OECD	1.5	1.7	1.7	1.7
Indonesia	3.1	4.5	3.3	3.8	Non-OECD	5.6	5.2	2.7	3.7

Source: Author's elaboration based on Johansson et al. (2012)

World and maritime trade outlooks

World trade outlook

The strength of the relationships between world population, GDP growth and international trade has changed over time, and is likely to be subject to further changes in the future. The strength of these relationships is weaker for specific trades, such as for energy trades that are still representing a significant share of maritime transport demand.

For fossil-based trades, the general rise in awareness towards global warming has put these energy markets under scrutiny. This impacts demand for liquid bulk and a large share of dry bulk cargoes (coal) for which pathways to energy transition will guide future trade volumes. According to the International Energy Agency (IEA, 2019), medium- to long-term energy projections based on the World Energy Model (WEM) are leading to the following conclusions. Oil demand remains highly dependent on the future outlook of developing countries and is not as favourable as during the last 30 years. This is relevant despite the United States increasingly leading the expansion in global oil supplies, and even if geopolitical will still play a critical role on the oil/energy markets. The incorporation of policy ambition toward the energy sector as well as of various Sustainable Development Scenarios (SDS) are likely to lead to profound changes in global energy trades and in the composition of such trades. This is reflected by the two IEA scenarios:

- The New Policies Scenario (NPS) that incorporates existing energy policies as well as an assessment of the results likely to stem from the implementation of announced policy intentions.
- The Sustainable Development Scenario (SDS) that outlines an integrated approach to achieving internationally-agreed objectives on climate change, air quality and universal access to modern energy.

Table 9 reports IEA estimates on world Total Primary Energy Demand (TPED) up to 2040, under the two scenarios. Estimates stress an average annual growth rate from 2017 to 2040 at 1.0% under the NPS and -0.1% under SDS, against 2.0% for the 2000-17 period. The decline in demand is the largest for coal (from 0.1% to -3.6%) and oil (from 0.4% to -1.5%) which remain the two main energy-related maritime markets.

Table 9. Forecasted Total Primary Energy Demand (Mtoe)

	2000	2017	2040 (NPS)	2040 (SDS)	AAGR 2000-17	AAGR 2017-40 (NPS)	AAGR 2017-40 (SDS)
Oil	3 665	4 435	4 894	3 156	1.1%	0.4%	-1.5%
Coal	2 308	3 750	3 808	1 597	2.9%	0.1%	-3.6%
Natural Gas	2 071	3 107	4 435	3 437	2.4%	1.6%	0.4%
Bioenergy	1 022	1 385	1 850	1 503	1.8%	1.3%	0.4%
Nuclear	675	687	971	1 292	0.1%	1.5%	2.8%
Hydro	225	353	531	601	2.7%	1.8%	2.3%
Oher Renewable	60	253	1 222	2 131	8.8%	7.1%	9.7%
Total	**10 026**	**13 970**	**17 711**	**13 717**	**2.0%**	**1.0%**	**-0.1%**

Source: IEA (2019).

Fontagné and Fouré (2013) studied the long-term perspectives of the World trade for commodities which are more dependent on the long-term trade to GDP relationship such as for other dry bulk (iron ore, grain, sugar, etc.), general and containerised cargoes (Table 10). Their study shows the development of trade/GDP elasticities since 1950, which peaked during the 1990s, when the indicator reached 2.82. This element is also underlined by UNCTAD (2017) that mentions a trade-GDP elasticity at 1.3 in 1970-1985, 2.2 in 1986-2000, 1.3 in the 2000s and 0.7 in 2008-2013.

Table 10. World trade to income elasticity (goods)

1950-59	1960-69	1970-79	1980-89	1990-99	2000-09	1950-2009
1.62	1.54	1.31	1.19	2.82	1.42	1.64

Source: Fontagné and Fouré (2013).

Fontagné and Fouré (2013) forecasts are based on a high and low simulation, from a combination of changes in GDP, comparative advantage and trade costs. In the 'high sim' scenario, the expected elasticity is at 1.49 from 2012 to 2035, at a level far below the 1990-99 period (2.82) and similar to when many global value chains were not established (1960-69). Under the 'low sim' scenario, the forecast for 2012-2035 is of a lower elasticity (0.69). Finally, for developed countries, the future trade to income elasticity ranges from 1.00 (Low Sim) to 1.78 (High Sim), while for developing countries, the respective elasticities are from 0.38 to 1.19.

The low scenario estimates a 1.1% average annual growth rate of world exports up to 2035 for developing countries and 1.8% for developed countries. This is between 8.5% and 4.5% respectively in the high scenario (WTO, 2013). These estimates are formed by combining macroeconomics and trade scenarios. Furthermore, the rise of developing countries is bound to continue as well as intra-regional trades. This is in line with other studies that predict a general long-term slowdown of global trade due to aging populations, to a decline in GDP growth, and to a decrease of income elasticity and in particular for primary goods and investment goods (UNCTAD, 2017).

Maritime trades outlook

Future maritime demand is directly impacted by world trade outlook. IMO (2014) estimates are in line with the IPCC approach. Shipping projection scenarios are based on Representative Concentration Pathways (RCPs) for future demand of coal and oil transport and on Shared Socioeconomic Pathways (SSPs) for future economic growth. This leads to the development of four main scenarios of maritime transport demand called Business-As-Usual Scenarios (BAU). For each BAU, three policy scenarios are set, with an increased action on energy efficiency, on emissions or on both.

Historical and projected data on consumption of coal and oil are used to build future trends for energy related trades. Changes in demand for these commodities are not directly related to GDP, contrary to non-coal dry bulk and container trades. The four estimates on future transport work (tonne-miles) are of an annual growth rate ranging from approximatively 1.3% to -1.2% for oil and from 2.7% to -1.7% for coal. For dry bulk cargoes (except coal), the expected growth is from 3.2% to 5.7% per year while for other dry cargoes, estimates are from 1.9% to 4.5% to 2050.

DNV (2017) forecasts provide a comprehensive analysis of future maritime trades with an expected 35% rise in seaborne trade to 2030 and an additional 12% growth thereafter (Table 11). The global annual increase in tonne-miles is 2.2% over the period 2015-2030 and 0.8% per year from 2030 to 2040. The increase in seaborne transportation occurs for all trade segments, except crude oil and oil products which peak around 2030. This reflects the major transition in the world energy system. Trade in individual energy commodities will decline with coal first, crude oil and then oil products. Natural gas – as liquefied natural gas (LNG) and liquid petroleum gas (LPG) - will experience sustained growth, as gas takes over as the largest energy source.

Bulk trades are expected to rise. Estimates are of an average growth in bulk of 1.8% per year in tonne-miles to 2030, and 0.5%-0.7% per year thereafter, driven by strong increases in grain, moderate rises in ore and other minor bulk, and a decline in coal. The increase in non-coal bulk trades (mostly iron ore and grain) in the Asian regions compensates the reduction in coal transportation.

Table 11. DNV forecasts to 2050

	Million tonnes per year				Annual Average Growth Rate		
	2015	2030	2040	2050	2015-2030	2030-2040	2040-2050
Crude oil	1 870	2 250	1 990	1 540	1.2%	-1.2%	-2.5%
Oil products	1 020	1 330	1 220	1 030	1.8%	-0.9%	-1.7%
Natural Gas	330	640	700	770	4.5%	0.9%	1.0%
Bulk	4 820	6 080	6 330	6 640	1.6%	0.4%	0.5%
Container	1 660	2 660	3 390	4 040	3.2%	2.5%	1.8%
Other Cargo	1 120	1 650	1 940	2 260	2.6%	1.6%	1.5%
Total	10 820	14 610	15570	16 280	2.0%	0.6%	0.4%
	Billion tonne-miles/year				Annual Average Growth Rate		
Crude oil	8 990	11 240	9 880	7 500	1.5%	-1.3%	-2.7%
Oil products	2 910	3 910	3 560	3 000	2.0%	-0.9%	-1.7%
Natural Gas	1 420	2 900	3 210	3 570	4.9%	1.0%	1.1%
Bulk	26 620	34 690	37 130	39 100	1.8%	0.7%	0.5%
Container	8 290	13 290	16 910	20 100	3.2%	2.4%	1.7%
Other Cargo	5 090	7 600	8 950	10 370	2.7%	1.6%	1.5%
Total	53 320	73 630	79 640	83 640	2.2%	0.8%	0.5%

Source: DNV (2017).

Container growth is high according to DNV (2017), and follows GDP growth. The trade will experience the strongest growth of all segments, as measured by tonne-miles, with 3.2% per year on average to 2030. It will thereafter decline to average 2.1% per year. Over the entire forecasting period to 2050, the annual growth will average 2.6% for container tonne-miles and 2.4% for global GDP or a container trade-GDP multiplier (trade growth relative to GDP growth) at 1.1. DNV (2017) also projects that container growth is imminent for all regions, and the Indian Subcontinent is subject to the strongest growth, followed by China, South East Asia and Sub-Saharan Africa.

Drivers of future maritime trade

Future maritime predictions will be impacted by drivers that mostly relate to energy use, emissions, transport and technology development (ITF, 2019). The ITF Transport Outlook (2019) investigates how socio-economic changes (population, GDP trade and transport policies) affect transport demand in general, and includes an analysis on the impacts for maritime demand. It concludes that freight growth will triple by 2050, and that maritime transportation will continue to dominate freight (70% of total freight with 120 000 billion tonne-km by 2030 and 250 000 by 2050) under the current situation. The growth will be mostly supported by traffic related to Asia, Africa and the trades in the Indian and Pacific oceans. The implementation of New Policies Scenario (IEA, 2019) should lead to a decrease of oil and coal demand by 33% and 50% respectively by 2035. Current and future disruptions related to logistics efficiency and technology (e-commerce, 3D printing, new trade routes, energy transition) could lower maritime demand to 160 000 tonne-km by 2050 (instead of 250 000 under current situation). Under such scenarios, maritime demand would stabilise from 2019 to 2030, and the increase in maritime demand from 2019 to 2050 would be at approximatively 2.3% per year compared to 3.8% for the last 50 years.

DNV (2017) states that particular attention should be given to decarbonisation and to environmental awareness that could lead to a further decline in trade for oil and coal. This would create the likely advantage for biomass/biofuel and hydrogen trades. The development of the circular economy could also represent a major game changer as it will impact the volume and type of cargos transported at sea. Grain that accounts for approximatively 10% of bulk trade could experience some major changes, mostly dependent on assumptions on world population. Future trade volume, pattern and modal shifts could also be significantly impacted by the development of new routes, such as the One Belt One Road for rail or by the opening of Arctic shipping.

Technological developments will also affect the future of maritime trade. McKinsey Global Institute (2018) states for instance that the adoption of electric vehicles could disrupt automotive value chains and trade as battery-powered electric vehicles have only 20 to 30 moving parts in their drivetrains, compared to 130 to 170 moving parts in an internal combustion engine. Additive manufacturing and 3D printing can reduce the need for long-distance trades as on-demand production near the consumer replaces the global distribution of mass-produced goods. The increased use of robotics could enable reshoring of production for developed countries, shortening global value chains, and potentially reducing demand for seaborne transport.

The digitalisation and innovation of the shipping industry are further factors that will affect future trade. Steamships and containerisation were crucial and initial drivers of world trade development. Digitalisation and innovation (big data and artificial intelligence (AI)) could further reduce maritime transportation and coordination costs; reinforcing competitiveness in the shipping industry and therefore change the general outlook. This is suggested by the Danish Ship Finance (2017) analysis on future maritime outlooks. They predict long-term growth in seaborne trade volumes, averaging about 1% per annum until 2030 which is about half of DNV forecasts for 2015-2030. This is because global consumer patterns are being redirected towards activities that are not as trade- and energy-intensive as in the past and that are often domestically produced (e.g. health care, leisure spending). A shift towards different vessel types, smaller parcel sizes and in some segments even fewer cargoes shipped are expected, due to the combined effects of the fourth industrial revolution (e.g. artificial intelligence, robotics, the internet of things, 3D printing and digitalisation) and the ageing consumer base. This means that the trade dynamics are expected to be

redefined. Trade volumes may stagnate, travel distances may shorten and the efficiency of the world fleet could improve considerably.

These changes are largely dependent on strategies put in place by global value chains (GVCs) (McKinsey Global Institute, 2019) and have been subject to five major structural shifts since 2000.

1. goods-producing value chains have grown less trade-intensive
2. services play a growing and undervalued role in global value chains
3. trade based on labour-cost arbitrage is declining in some value chains
4. global value chains are growing more knowledge-intensive
5. value chains are becoming more regional and less global.

These changes are particularly important for containerised shipping markets which heavily rely on goods-producing GVCs. Table 12 reports the list of the top-15 US importers/exporters in 2017 as well as their respective shares in the top-100 importers/exporters. Almost 50% of the top-100 US container imports are done by companies belonging to the retail sector (49.7%), where Walmart (12.9%), Target (8.7%), and Home Depot (5.7%) account for 37%. On the export side (around 50% less than imports), the paper/recycling/packaging sector is the largest industry using containers, with around 30% of all exports.

Table 12. Top-15 importers/exporters in 2017 in thousands of Twenty Equivalent Unit (TEU)

Rank	Top 15 – US Importer	TEU	Share	Sector
1	Walmart	874.8	12.9%	Retail
2	Target	590.3	8.7%	Retail
3	Home Depot	388	5.7%	Retail
4	Lowe's	287.5	4.3%	Retail
5	Dole Food	220.2	3.3%	Fruit and vegetables
6	Samsung America	184.8	2.7%	Conglomerate
7	Family Dollar Stores/Dollar Tree	168.4	2.5%	Retail
8	LG Group	161.6	2.4%	Conglomerate
9	Philips Electronics North America	142.9	2.1%	Electronics
10	IKEA International	120.5	1.8%	Retail
11	Chiquita Brands International	117.5	1.7%	Fresh fruit and vegetables
12	Nike	116.3	1.7%	Footwear and apparel
13	Newell Brands	115.4	1.7%	Outdoor and home goods
14	Costco Wholesale	111.7	1.7%	Retail
15	Sears Holdings	103.2	1.5%	Retail-consumer goods
Rank	**Top 15 – US Exporters**	**TEU**	**Share**	**Sector**
1	America Chung Nam	284.5	7.5%	Paper and plastics recyclables
2	International Paper	248.4	6.5%	Paper/packaging
3	Ralison International	130.1	3.4%	Paper/recyclables

4	Koch Industries	120.8	3.2%	Conglomerate
5	International Forest Products	109.4	2.9%	Packaging/paper products/pulp/recyclables
6	DeLong	106.6	2.8%	Animal feed/grain
7	WM Recycle America	75.3	2.0%	Diversified/recyclables
8	Shintech	73.8	1.9%	Chemicals
9	Louis Dreyfus Commodities	68.2	1.8%	Cotton/diversified
10	WestRock	66.3	1.7%	Paper/packaging
11	JBS USA	65.4	1.7%	Refrigerated meats/poultry
12	ExxonMobil Chemical	63.4	1.7%	Chemicals
13	Newport CH International	62.1	1.6%	Paper/metals/plastics recyclables
14	BMW of North America	61.6	1,6%	Automotive goods
15	Cargill	57.5	1.5%	Conglomerate

Source: Author's elaboration based on Journal of Commerce (2018)

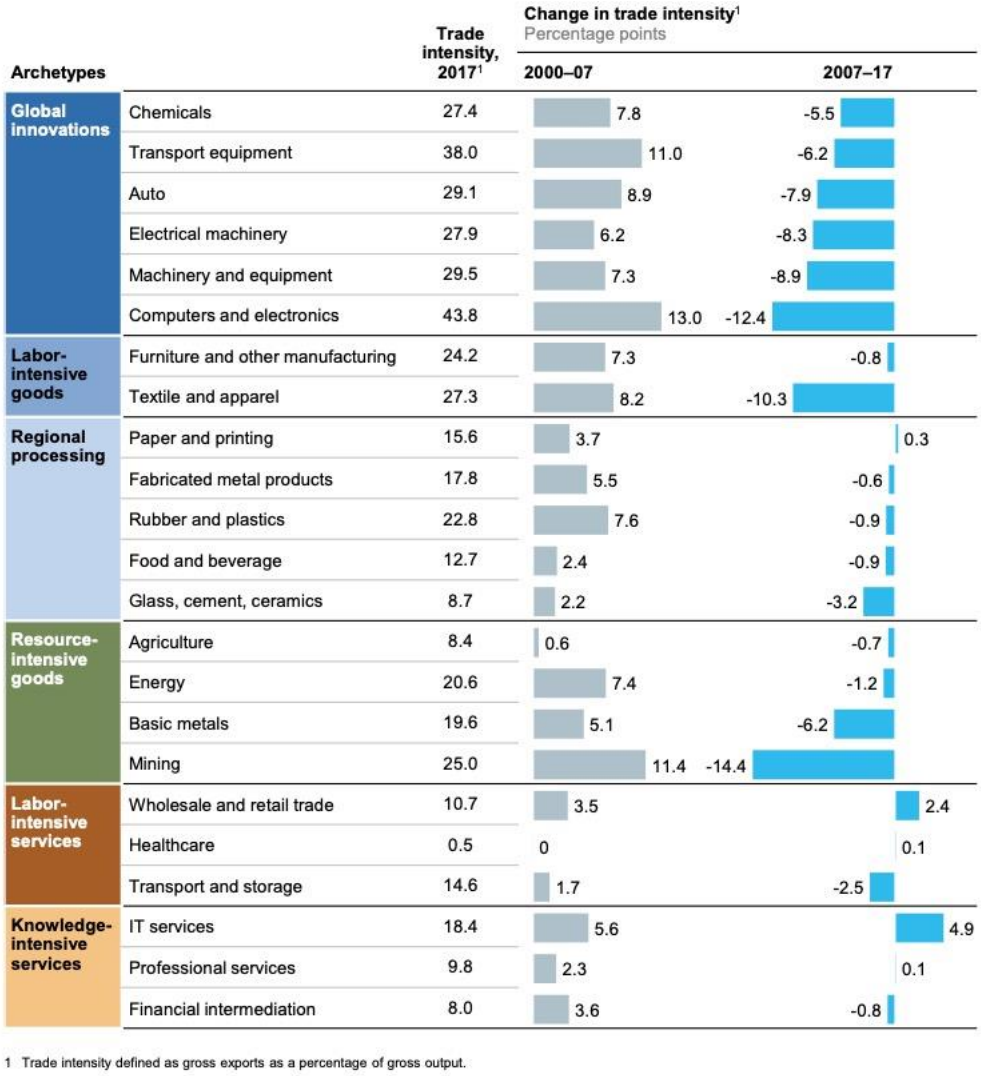
These imports and exports are subject to a decrease in trade intensity, measured as gross exports as a share of gross outputs. For instance, (Figure 5), the share of export in production declined by 12.4 percentage points in 2007-17 compared to 2000-07 for computers and electronics and -10.3% for textile and apparel.

McKinsey Global Institute (2019) states three main factors that explain these changes in trade intensity:

- growing demand in China and the rest of the developing world, which enables these countries to consume more of what they produce
- the development of more comprehensive domestic supply chains in those countries, reducing their imports of intermediate goods
- and the growing impact of new technologies (for instance, automation in production reduces the value of labour-cost arbitrage and enables location decisions based on proximity to customers).

It therefore means that regionalisation is occurring and could accelerate with automation. Automation reduces the importance of labour costs and with the increase in services goods that increase the importance of speed to market. Transport costs account for around 37% for goods flows, but falls to 17% for services flows (WTO, 2018). Information and transaction costs (around 20% for goods and 30% for services), borders and trade policy barriers costs (around 15% for each) and logistics cost (around 10% each), are now taking an increase share in total trade costs. This suggests that maritime trade's ability to provide lower transportation costs may no longer be the main driver to explain the price to move cargo from origin to destination.

Figure 5. Changes in global value chain trade intensity



Source: McKinsey Global Institute (2019).

Costs related to time delays and uncertainty, for which shipping is far less competitive, will increase. The Hummels and Schaur (2013) study shows that the most time-sensitive trade flows involve the parts and components trade, which has a time sensitivity 60% higher than other goods and in particular office equipment, electric power machinery and photographic equipment (Hummels 2001). The Djankov, Freund and Pham (2010) study on the cost of time delay in trade find that each additional day of delay reduces trade by at least 1% and by 7% for agricultural goods while Cariou (2011) and Maloni Paul and Gligor (2013) have shown how liner shipping strategies such as slow steaming impact shippers. Furthermore, the development of strategic alliances has reduced the differentiation amongst liner shipping services and are also impacting shippers (ITF, 2018).

Value chains are emerging that are less trade-intensive and less based on cost-labour arbitrage. In addition to the need for time-to-market with more intra-regional trades, this could lead to a profound move toward back-shoring or reshoring (Kinkel 2012, 2014). The Kinkel (2014) analysis of German data from the European Manufacturing Survey (EMS) stresses that around 400 to 700 German companies would back-

shore production capacities per year. The cost-based advantage from relocation to low-wage countries seem to diminish more and more, while market-related expansion investments in emerging markets are gaining significance.

The Tate (2014) survey of 320 companies indicated that 40% of these companies perceived a trend toward reshoring to the United States. The 2008 recession in the United States provided the motivation for companies to re-evaluate their global supply-chain strategies (Ellram Tate and Feitzinger, 2013; Ellram, Tate and Petterden, 2013). Simultaneously, the rising cost of labour in developing countries, high oil prices, increased transportation costs and a growing awareness of global supply chain risk have contributed to make the United States a more attractive location.

Gadde and Jonsson (2019) investigate the 2025 outlook for the Swedish textile industry in offshoring and reshoring. The analysis of 119 Swedish buyers of textiles and apparels shows that Swedish textile firms are increasingly sourcing from Europe to enhance supply chain responsiveness through nearshoring in relation to customers. Strategies in Asia represent another pattern. If China still accounts for more than half of the total sourcing volume, while Bangladesh, India, and Vietnam represent about 10% each, more than one-third of the Swedish firms expect their sourcing in China to decrease. Part of this change reflects the movement of sourcing to Europe to enhance geographical proximity, while other Swedish firms forecast increasing sourcing in Bangladesh to benefit from low cost, which is a sign of extended offshoring. These elements reinforce the idea that the intraregional share of global goods trade should continue to increase. This is supported by the WTO (2018) who lists an increase by 2.7 percentage points since 2013, in particular in Asia and Europe.

Conclusions

The objective of this report was to provide a long-term view on future maritime demand. The main conclusions are as follows:

- Shipping remains a derived demand and maritime demand will continue to largely depend on the future changes in the world economy, world population and in GDP. The substantial growth rates in maritime trades, that were explained by the process of globalisation and by the increase in developing countries GDP per capita, are not likely to continue.
- A general convergence should take place between GDP per capita growth rates amongst developing and developed countries in the long run. In a world where demand is increasingly for services rather than for goods, the globalisation process based on low labour-cost differentials and on a massive outsourcing of production that stimulated trades has reached its limit.
- The general trend towards a decarbonisation of the world economy is impacting the two largest commodities transported at sea: crude oil and coal. This trend is not new. The share of energy-trades in total maritime trades has already declined in the last 50 years. But in the near future, we could expect that these commodities will be subject to a decrease in the volume of trade.
- The new demand for smaller and low-value packages of physical goods, where goods are increasingly bundled with services and require faster transit time, will induce a new type of

maritime demand. The development of maritime trades is questionable based on the cost advantage of shipping compared to other means of transport for this new type of demand. The relocation of production to be nearer to consumption centres could also reduce the mean distance to travel, and the competitiveness of shipping towards other means of transport.

- Core services in traditional maritime business models will be lose their value in a digital world. Vessels will still be needed to perform the task of moving cargo from port to port, but it is the data this generates rather than the cargo itself that will start to be monetised. This is not only from port to port but through the entire value chain, from origin to destination.
- Advancements of digital technologies brings new opportunities. Digitalisation is likely to boost trades but considered goods and service trade policies will play an important role in achieving this.

Innovations in the shipping industry, first steamships and then containerisation, were the main drivers of the first and the second phase of development of world trades during the last century. Now, the critical question is whether or not new maritime innovations will take place to tackle the challenges of the new era of digitally-enabled trade?

Notes

1 The study by CE Delft (2019) uses oil and coal world consumption instead of world GDP for trends in energy-related maritime trade demand as well as non-linear projection methods to account for future decelerated growth.

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International Transport Forum

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