# PortReport

a PortEconomics Series

No 4 - 2020

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# Changing demand for maritime trades

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**PortReport No 4**
**May, 2020**

Effective planning for transport infrastructure such as ports and their connections to roads, railways and inland waterways, requires foresight of what possible future maritime trade flows could look like. The future of maritime trade demand remains by nature uncertain. Due to the diversity in commodities transported at sea (oil, coal, iron ore, grain, general and containerized cargoes…), each trade could be subject to a specific analysis as maritime flows are affected by a large variety of factors, such the level of integration and of regionalization of the global economy, prospects on World population and GDP per capita as well as the future organization of Global Value Chains (GVCs). For maritime transportation, which is still a fossil-based industry, the diversification of energy supplies and transitions towards renewable energy will also have a significant impact on maritime trades.

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

- How will economic globalisation evolve and how will these evolutions translate into World population and trade outlook?
- What are the likely pathways for maritime trades?
- What other additional drivers should be considered to understand future maritime trades?

To do so, 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 regionalization of trades are finally discussed (section 4).

## 1. SETTING THE SCENE: LONG-TERM CHANGES IN MARITIME TRADES

The world economy has been subject over the last century to profound changes. 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 et al. 2017; WTO 2013, 2018).

During the first stage that went up to the mid-20th century, referred as 'first unbundling' or 'traditional trade', the development in international trades was mostly driven by falling transport costs. Technology evolutions in transport, and in particular for shipping and railways, have played a major role in these evolutions (WTO 2018) as they have enabled the separation of production and consumption across national borders. During this phase, maritime transportation was experiencing large growth rates, mostly supported by energy and general cargo trades.

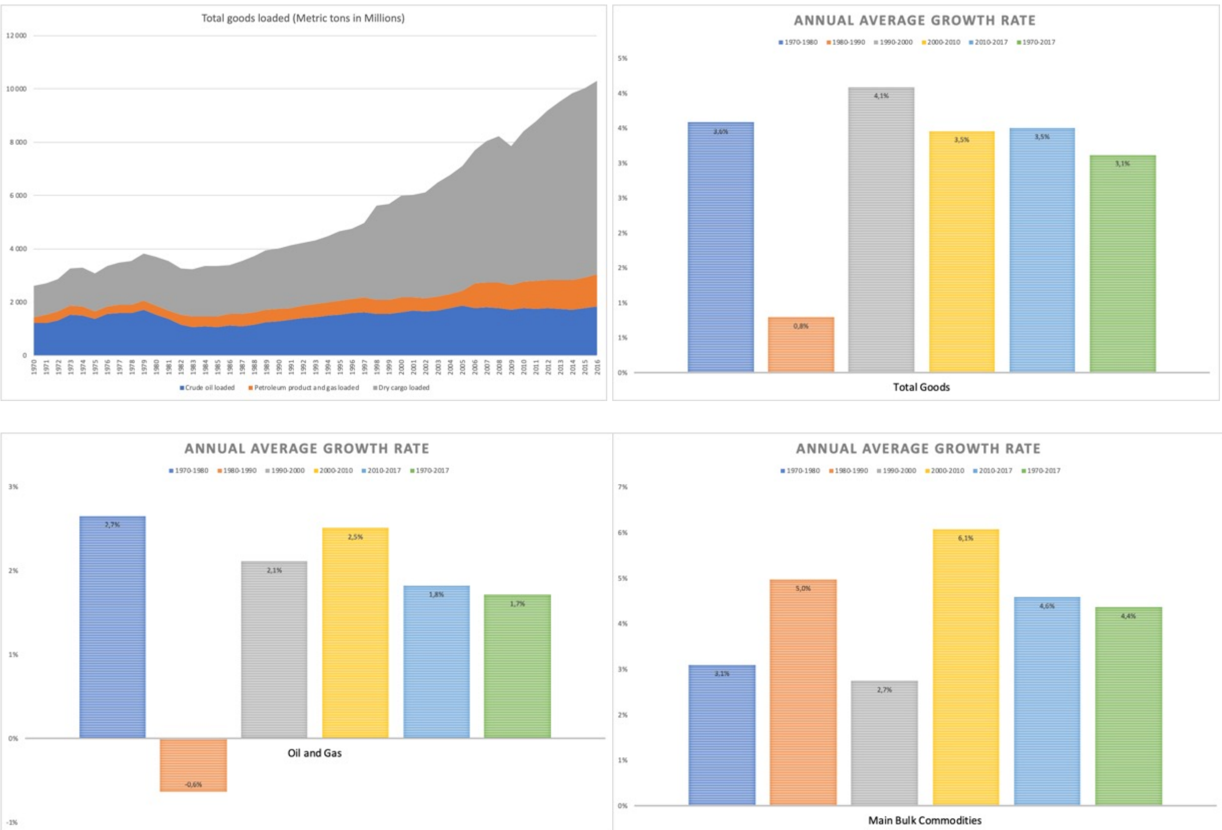
During the second stage (1945-2000), related to the extension of GVCs, the reductions in transport and in coordination costs have led to a further fragmentation in the production processes across national borders. Trades in intermediate and in manufactured products flourished, and particularly towards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

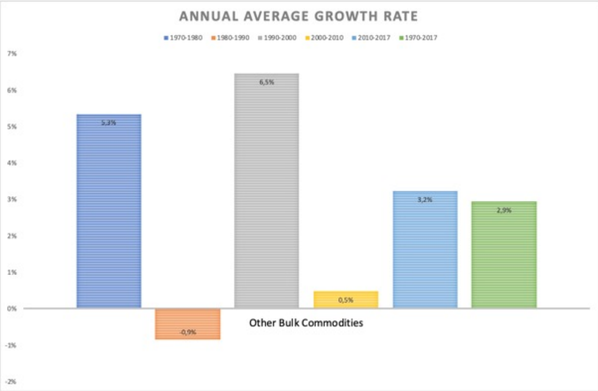
Since 2000 we are entering into a third stage, regularly referred as the age of digitally enabled trade, driven by further reductions in transport and coordination costs, that is coupled with a considerable fall in the costs through the transfer of data or information (Gonzales et al., 2017; WTO, 2018). These elements induce 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 et al. 2008; UNCTAD 2018) can be summarized by two main points (Figure 1, Table 1-3):

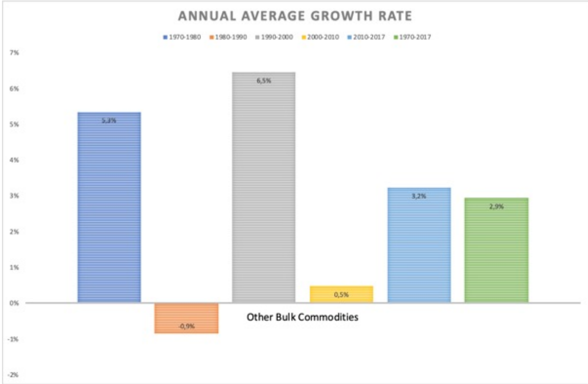
- First, a general increase in volume and in tonne-miles of approximatively 3.1-3.8% per year from 1970 to 2017, mostly supported by developments in dry bulk and container trades. During this period, the share of dry bulk commodities has increased from 43 to 54% and from 2% to 17% for containers, while 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.

- Secondly, since the 90ies and even more since 2000, an increase in maritime trades (around 4% per year) and in the share of developing countries (from 51% in 2000 to 59% in 2017) that are the main drivers of international maritime trades.

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






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% |

* 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% |

* 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% |

* Annual Average Growth Rate

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

From this initial analysis, two main questions can be raised:

- First, is the decrease of energy trades in total maritime transportation (from roughly 60% in 1970 to 30% in 2017) likely to continue? Are these trades, which were still increasing in absolute value since 1970 (+1.5 to 2% on a yearly basis), going to decrease? What will the new composition of energy trades be, considering the new environment towards decarbonization?

- Second, is the rise in dry bulk cargoes and container trades, the main drivers of shipping markets over the last 50 years and the rise in developing countries since 2000, going to continue in the future? Indeed, the latest period (2010-2107) stresses a general reduction in international trades mostly explained by a slowdown of developing countries (around 2.5% per year from 2010 to 2017).

These questions apply to a large range of products, from crude oil, oil products, dry cargoes (iron ore, coal, grain…) to manufactured products (electronics, textiles….). In this report, we focused on a more holistic approach that led us to focus on the main drivers of future maritime trades. Although many studies (IMO 2014, DNV 2017, UNCTAD 2018) stress a decoupling effect with GDP per capita over the last years, and in particular for energy-related trades (CE Delft 2019), we consider 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.

Table 4 and Figure 2 show the results (linear regression in log) of maritime trades forecasts as a function of GDP per capita. Apart from crude oil trades, where geopolitical events and future energy transition pathways have a strong impact that explains significant deviation ($R^2$=0.62) from GDP-based evolutions*, there is still, in general, a strong relationship between GDP per capita and maritime trades with a $R^2$ of 0.97 for Total goods, 0.92 for Petroleum Product and Gas and 0.99 for Dry cargo. 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 containerized cargoes.

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

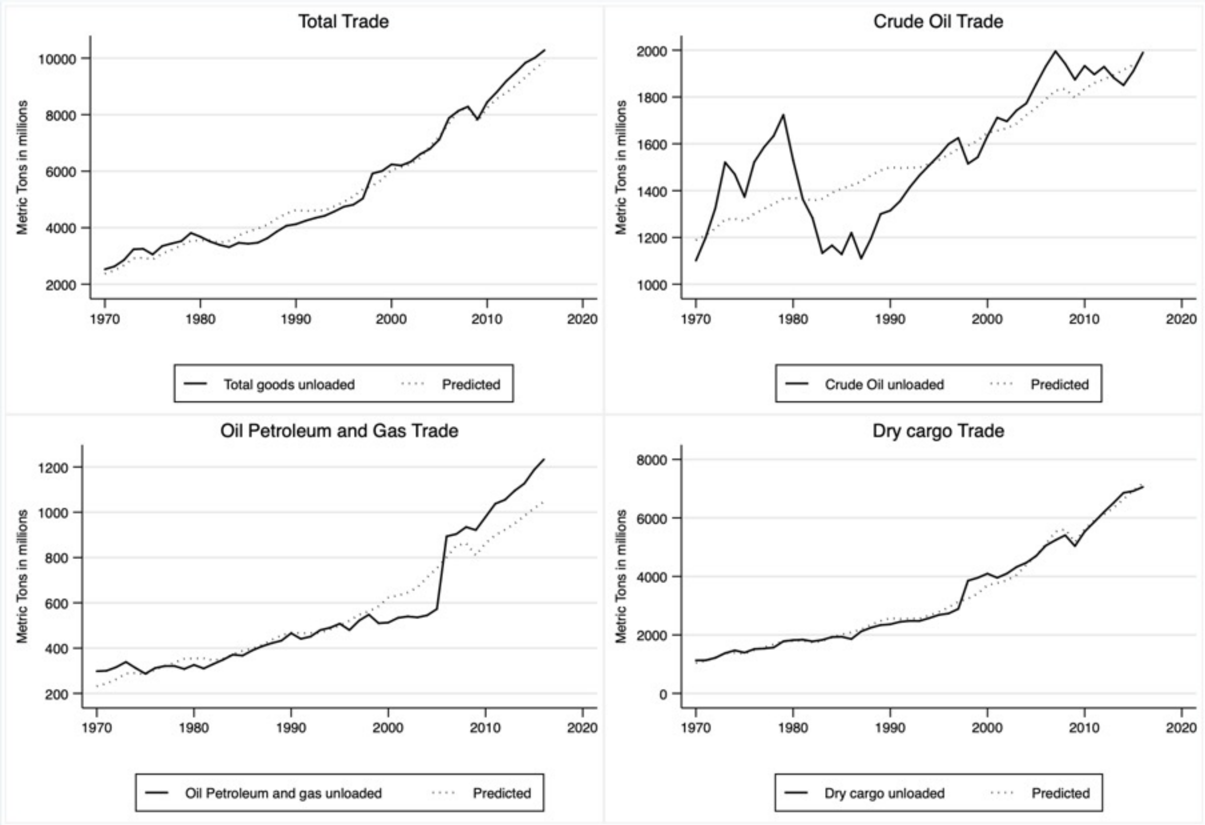
| Variables | Total goods | Crude oil | Petroleum Product and Gas | Dry cargo |
|---|---|---|---|---|
| GDP per Capita | 2.027*** | 0.708*** | 2.142*** | 2.744*** |
| | (41.94) | (8.60) | (22.77) | (65.64) |
| Constant | -9.546*** | 1.033 | -12.851*** | -16.492*** |
| | (-22.17) | (1.41) | (-15.34) |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

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

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

* 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.

Figure 2. Predicted versus actual maritime trades as a function of GDP per capita




Source: Cariou (2019) based on UNCTAD (2000-2018)

Former results confirm that apart from crude oil, future maritime trades should still be mostly driven by future outlooks in world population and GDP per capita 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).

## 2. WORLD POPULATION AND GDP PER CAPITA OUTLOOK

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 GHG emissions (for instance IPCC 2000; IMO 2014; CE Delft 2019);
- and those devoted to predict future world trades (for instance WTO 2018), or to change in GVCs supply chains (for instance McKinsey 2018; Deutsche Post 2012).

These two streams are based on the definition of alternative futures and share common drivers, mostly related to World population, GDP future development and on 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 summarized as follows:

- The first storyline (the A1 scenario that then splits into 3 groups according to hypothesis on fossil intensity and balance across fossil or non-fossil sources) describes a future world of very rapid economic growth, global population that peaks in mid-century. 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 very heterogeneous world. Fertility patterns across regions converge very slowly, which results in 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 (BI) describes a convergent world with the same global population pattern than in the Al 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 economic, social, and environmental sustainability challenges.

- The fourth storyline and scenario family (B2) describes a world with local solutions to economic, social, and environmental sustainability 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). Since 2006, a new set of 5 scenarios (Van Vurren et al. 2014) or Shared Socio-economic Pathways (SSPs) serve as a basis for most estimations on future transport demand and Greenhouse Gases emissions (see for instance in the 2014 IMO study on GHG). These 5 scenarios are based on the following narratives:

- SSP 1. *Sustainable development* proceeds at a reasonably high pace, inequalities are lessened, technological change is rapid and directed toward environmentally friendly processes, including lower carbon energy sources and high productivity of land.

- SSP2 *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 regionalized 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. SSP5 or ''Fossil-fueled development'' characterizes 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 et al. (2017) and Leimbach et al. (2017) shed light on the underlying assumptions regarding future changes in world population and GDP per capita.

### 2.1. World population outlook

For World population future annual growth rates (Samir et al., 2017), the five SSP assumptions range from 0.5 to 0.9% from 2010 to 2050 and from -0.4 to 0.5% from 2050 to 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 stabilize or slightly decreases up to 2100 (except for SSP3 with 12.6 billion by 2100).

Table 5 . World Population outlook 2010-2100 in Billion and Annual Growth Rate*

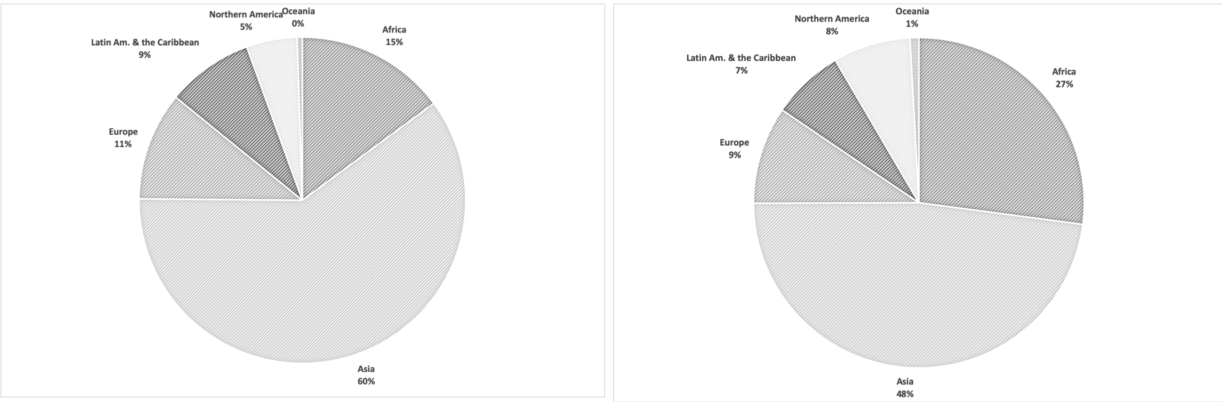
| | SSP1 | SSP2 | SSP3 | SSP4 | SSP5 |
|---|---|---|---|---|---|
| 2010 | 6 871 | 6 871 | 6 871 | 6 871 | 6 871 |
| 2050 | 8 461 | 9 166 | 9 951 | 9 122 | 8 559 |
| 2100 | 6 881 | 9 000 | 12 627 | 9 267 | 7 363 |
| 2010-2050* | 0.5% | 0.7% | 0.9% | 0.7% | 0.6% |
| 2050-2100* | -0.4% | 0.0% | 0.5% | 0.0%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

Source: Author’s elaboration based on Samir et al. (2017)

Although differences in regional growth rates exist, the share of Asia in World population is fairly similar whatever the SSP assumptions, with a decrease from 60% in 2010 to approximatively 55% by 2050. The share of Africa increases by 5% to reach approximatively 20-25% of the world population in 2050 (Figure 3 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 3. Share of regions in World population by 2010 and 2100 (SSP1)

2010 2100




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

The International Energy Agency (2019) forecasts, used to estimate to future energy trades, is of 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 population by 2040, with 50% in Asia and for 22% in Africa. Fontagné and Fouré (2013) scenarios are based on fertility and account for the potential effects of migrations, despite a limited effect that could mostly take place in Europe and North America. Furthermore, the impact from population growth remains largely impacted by population ageing 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 (Johansson et al. 2012), and stresses a rise from 20% to 46% from 2011 to 2060 in the share of population aged more than 65 years old compared to 15-64 years old is expected to.

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 |
| **Sample (20 countries)** | **2011** | | | **2030** | **2060** | | |
| Share of 65+ | 20.0 | | | 31.2 | 46.0 | | |

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

## 2.2. World GDP outlook

GDP per capita outlook accounts for previous prospects on World population and are adjusted according to the SSP1-SSP5 scenarios. Leimbach et al. (2017) summary on the main implications for High-, Middle- and Low-income countries is reported in Table 7. From 2010 to 2040, the Compound Annual Growth Rate World income would increase from 3% (SSP1) to 1.9% (SSP2), while from 2040 to 2100, the GDP per capita would increase from 2.2% (SSP1) to 0.5% (SSP3). The most sticking element, common in most long-term forecasts, is a convergence over time amongst higher, middle and lower countries.

Out of the 5 scenarios, SSP3 is the closest to the latest OECD projections (2018). OECD former forecasts from Johansson et al. (2012) are reported in Table 7 and conclude that the growth of non-OECD countries should continue to outpace the OECD countries growth rate, but that the difference narrowing over the coming decades. From over 7% per year over the last decade, non-OECD growth will decline 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 despite an expected increase in the World population, other determinants such as the aging of population is likely to lower the GDP per capita growth rate. Finally, despite a faster growth for low-income and emerging countries, cross-country differences in living standards is expected to persist by 2060. Finally, IEA (2019) prospects on future GDP growth are more optimistic, with a prediction of 3.4% per year from 2017 to 2040, mostly supported by China and Southeast Asia (approximatively 4.5%).

Table 7. Annual average GDP per capita growth rates

| | 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

| | 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)

# 3. WORLD AND MARITIME TRADES OUTLOOK

## 3.1. World trade outlook

The strength of the relationships between World population, GDP growth and international trades have change over time, and is likely to be subject to further changes in the future. As mentioned earlier, 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 liquid bulk and for a large share of dry bulk cargoes (coal) demand 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. Although the United States is increasingly leading the expansion in global oil supplies, and even if geopolitical will still play a critical role on the oil/energy markets, oil demand remains highly dependent on the future outlook of developing countries which is not as favorable than during the last 30 years. The incorporation of policy ambition toward the energy sector as well as of various Sustainable Development Scenarios 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 2000-2017 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 | 13717 | 2.0% | 1.0% | -0.1% |

Source: IEA (2019)

For commodities which are more dependent on the long-term trade to GDP relationship such as for other dry bulk (iron ore, grain, sugar…), general and containerized cargoes, Fontagné and Fouré (2013) study on the long-term perspectives of the World trade for goods stresses a structural change (Table 10). Since 1950, if trade increased faster than industrial or agricultural production, and even more than GDP, illustrated by a long-term elasticity with respect to GDP at 1.64 over the period 1950-2009, the latest period shows a reduction from 2.82 in 1990-1999 to 1.42 in 2000-2009. 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 | 1990-09 | 2000-09 | 1950-2009 |
|---|---|---|---|---|---|---|
| 1.62 | 1.54 | 1.31 | 1.19 | 2.82 | 1.42 | 1.64 |

Source: Fontagné et Fouré (2013)

Fontagné et 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.

When combined with macroeconomics and trade scenarios (WTO 2013), estimates are of an average annual growth rate of world exports up to 2035 of around 1.1% for developing countries and 1.8% for developed countries in the low scenario and between 8.5% and 4.5% in the high scenario. Furthermore, the rise of developing countries is bound to continue as well as intra-regional trades.

To conclude, although, most studies predict a general long-term slowdown due to aging population, to a decline in GDP growth, and to a decrease of income elasticity and in particular for primary goods and investment goods (UNCTAD, 2017), results also stress that world exports are likely to be much more volatile than GDP in the future and that developed countries have more to gain from a strong economic and open trade environment in the future than developing countries.

### 3.2. Maritime trades outlook

The factors discussed earlier have a direct impact on future maritime demand. 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 4 main scenarios of maritime transport demand (called BAU or Business-As-Usual Scenarios). For each BAU, three policy scenarios are set, with an increased action on energy efficiency, on emissions or on both.

To build future trends for energy related trades, historical and projected data on consumption of coal and oil are used as 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 forecasts (2017) provides 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.

For bulk trades, the increase in non-coal bulk trades (mostly iron ore and grain) in the Asian regions compensates the reduction in coal transportation. Estimates are of an average growth in bulk of 1.8% per year in tonne-miles to 2030, and 05-0.7% per year thereafter, driven by strong increases in grain, moderate rises in ore and other minor bulk, and a decline in coal.

Table 11. DNV Forecasts to 2050

| | Million tonnes per year | | | | AAGR | | |
|---|---|---|---|---|---|---|---|
| | 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 | | | | AAGR | | |
| 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. Finally, according to DNV (2017), container growth is projected for all regions, and the Indian Subcontinent is subject to the strongest growth, followed by China, South East Asia and Sub-Saharan Africa.

## 4. FUTURE DRIVERS

Predictions are impacted by additional 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 under current situation 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). The growth will be mostly supported by Asia, Africa, Indian and pacific oceans. However, 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 while 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 stabilize 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.

For DNV (201), particular attention should be given to decarbonization and to the environmental awareness, that could lead to a further decline in trade for oil and coal, to the likely advantage of 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.

Technology development are also to factor in. McKinsey (2018) stresses 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 robots could enable relocation of production back to developed countries, shortening global value chains, and potentially reducing demand for seaborne transport.

The dynamic of the shipping industry towards digitalization and innovation is another important factor. As stated at the beginning of this report, shipping through steamships and containerization has always been a key initial driver of world trade development. The ability of digitalization and innovation (big data, artificial intelligence…) to further reduce maritime transportation and coordination costs could reinforce the shipping industry competitivity and therefore changes the general outlook. This is suggested by the Danish Ship Finance (2017) analysis on future maritime outlooks. Owing that 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), they predict a long-term growth in seaborne trade volumes averaging about 1% per annum until 2030 which is about half of DNV forecasts for 2015-2030. A shift towards different vessel types, smaller parcel sizes and in some segments even fewer cargoes shipped is 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 GVCs (McKinsey 2019) and that are subject since 2000 to five major structural shifts.

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 labor-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 containerized shipping markets which heavily rely on goods-producing GVCs. Table 12 reports the list of the US top-15 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 |

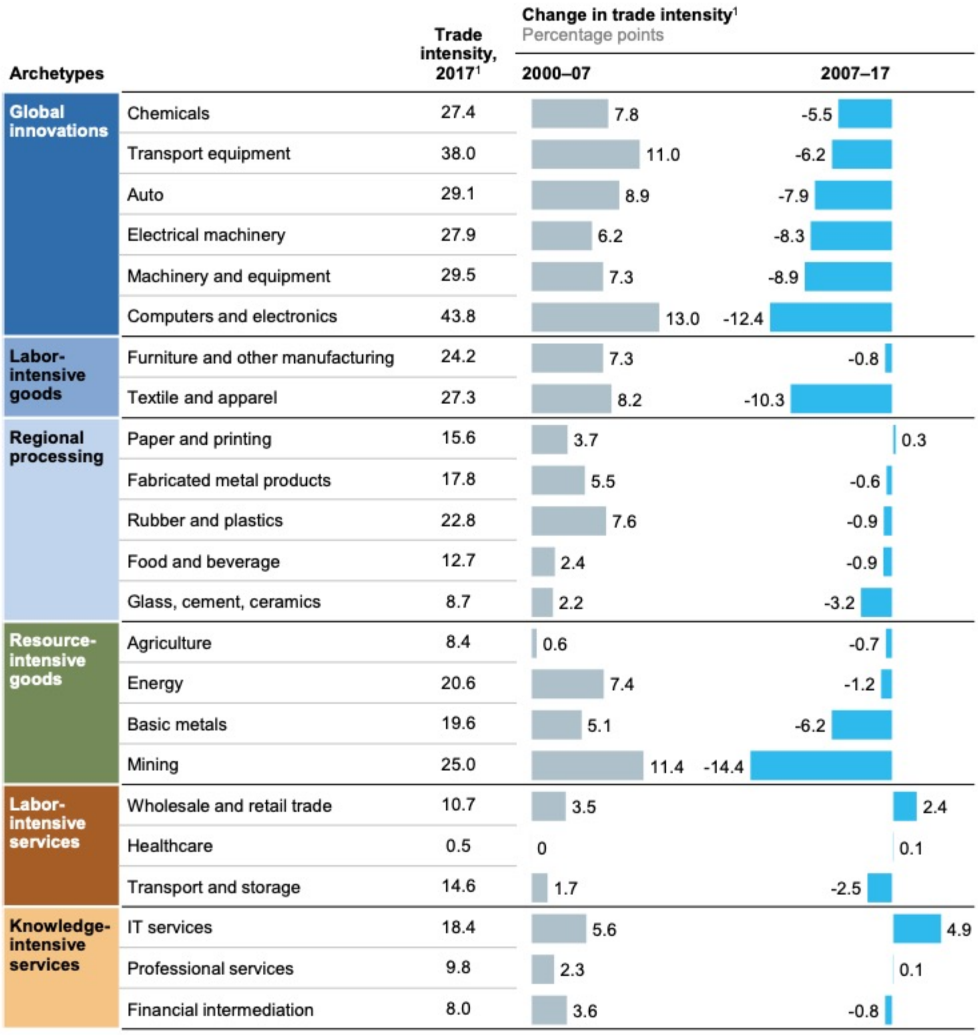
| | | | | |
|---|---|---|---|---|
| 6 | Samsung America | 184.8 | 2.7% | Conglomerate |
| 7 | Family Dollar Stores/Dollar Tree | 168.4 | 2.5% | Retail |
| 8 | LG Group | 161.6 | 2.4% | Conglomerate |
| 9 | Philips Electronics North America | 142.9 | 2.1% | Electronics |
| 10 | IKEA International | 120.5 | 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)

All 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 4), the share of export in production declined by 12.4 percentage point in 2007-17 compared to 2000-07 for computers and electronics and -10.3% for textile and apparel.

Figure 4. Changes in GVCs trade intensity




1 Trade intensity defined as gross exports as a percentage of gross output.

SOURCE: World Input-Output Database; McKinsey Global Institute analysis

Three main factors (McKinsey 2019) 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 labor-cost arbitrage and enables location decisions based on proximity to customers).

It therefore means that regionalization is most apparent and could accelerate with automation that reduces the importance of labor costs and with the increase in services goods that increase the importance of speed to market. While transport costs account for around 37 per cent for goods flows, it falls to 17 per cent 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 the main comparative advantage of maritime trade, its ability to provide lower transportation costs, might not any longer be the main drivers to explain the price to move cargo from origin to destination.

Costs related to time delays and uncertainty, for which shipping is far less competitive, will increase. Hummels and Schaur (2013) study show that the most time-sensitive trade flows involve the parts and components trade, which has a time sensitivity 60 per cent higher than other goods and in particular office equipment, electric power machinery and photographic equipment (Hummels 2001). Djankov et al. (2010) study on the cost of time delay in trade find that each additional day of delay reduces trade by at least 1 per cent and by 7% for agricultural goods while Cariou (2011) and Maloni et al. (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 (Merk, 2019).

The combination of value chains which are less trade-intensive, less based on cost-labor arbitrage and the need for time-to-market with more intra-regional trades could lead to a profound move toward back-shoring or re-shoring (Kinkel 2012, 2104). 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. To this end, 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.

Tate (2014) survey of 320 companies indicated that forty percent of these companies perceived a trend toward reshoring to the United States. The 2008 recession in the U.S. provided the motivation for companies to re-evaluate their global supply chain strategies (Ellram et al., 2013a, 2013b) while the rising cost of labor in developing countries, high oil prices, increased transportation costs and a growing awareness of global supply chain risk have contributed to make the U.S. a more attractive location. The reduction in the length of the supply chain is also mentioned (Nelson, 2013) and executives stress the excessive amounts of working capital tied up in inventory that was trapped in the new world of "slow-steaming" transport and in safety stock.

Gadde et al. (2019) tend to point into a similar direction. Investigating the 2025 outlook for the Swedish textile industry in offshoring and reshoring, the analysis of a sample 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, however, more than one-third of the firms expect their sourcing in China to decrease. Part of this change reflects movement of sourcing to Europe to enhance geographical proximity, while other 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, as suggested by WTO (2018) that stresses an increase by 2.7 percentage points since 2013 (WTO, 2018), in particular in Asia and Europe.

## 5. 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 future maritime demand will still continue to largely depend on the future changes in the world economy, in world population and in GDP. The substantial growth rates in maritime trades, that were explained by the process of globalization and by the increase in developing countries GDP per capita, are not likely to continue.

In the long run, a general convergence should take place between GDP per capita growth rates amongst developing and developed countries. In a world where more and more demand is for services rather than for goods, the globalization process based on low labor-cost differentials and on a massive outsourcing of production that stimulated trades has reached its limit.

Other factors tend to provide a different picture in the future. First, the general trend towards a decarbonization of the world economy is impacting the two largest commodities transported at sea: crude oil and coal. This trend is not new, as the share of energy-trades in total maritime trades already declined during 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.

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

This element is echoed in a report by Danish Shipping Finance and Rainmaking (2018), when stressing that the core services in traditional maritime business models will be losing 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 monetized, not only from port to port but through the entire value chain, from origin to destination. The advance of digital technologies brings new opportunities. Some quantitative projections (WTO 2018) on changes in the size and patterns of international trade by 2030 stresses for instance that digitalization is likely to boost trades but that to this end, both goods and services trade policies will play an important role.

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

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