International Transport Forum

Future Maritime Trade Flows

Summary and Conclusions

178 Roundtable

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The International Transport Forum

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International Transport Forum
2 rue André Pascal
F-75775 Paris Cedex 16
contact@itf-oecd.org
www.itf-oecd.org

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Executive summary

What we did

This report addresses uncertainty related to future maritime trade flows. It provides a synthesis of discussions at the Roundtable on Future Maritime Trade Flows, organised by the International Transport Forum in April 2019 in Paris, France. The Roundtable brought together experts from academia, consultancy and international organisations, as well as representatives from the shipping sector, ports, terminals and governments. The discussions focused on five themes that form the framework of this report, four of which are treated more in-depth in discussion papers written for the Roundtable. Two of the themes are related to the demand-side: one is directly on the demand for maritime trade; the other on the impact that environmental regulation for shipping could have on maritime transport costs and – via these costs – on demand for maritime trade. The three other themes are more related to the supply side and look into maritime business strategies, the Belt and Road Initiative and Arctic shipping.

What we found

Economic development and population growth will continue to drive future demand for maritime trade. However, the transition to non-fossil fuels and the regionalisation of trade patterns will likely have a substantial impact.

The cost of maritime transport will increase as a result of expected regulations to decarbonise shipping. However, these cost increases will be small in relation to the value of traded goods and the impact on global trade may be marginal. Trade routes to and from less-developed countries at the end of poorly serviced transport chains may feel significant repercussions, but affected countries could be compensated for some of the adverse effects on trade.

Increased ship size and industry consolidation, as well as other developments in liner shipping, have changed maritime trade patterns by reducing the number of calls to secondary ports. However, the trend towards marginalisation of secondary ports may have come to an end, as both industry consolidation and the movement of ever-larger ships seem to have run their course.

China's Belt and Road Initiative (BRI) will likely have a significant impact on maritime trade flows if fully implemented. The maritime part of the initiative has a stronger potential to impact overall trade than the terrestrial investments, focussed on railway links and pipelines. Investment in the ports connecting China with other parts of the world could cut maritime trade costs, thereby reducing trade costs and increasing imports and exports.

Modelling projections suggest that the share of global trade using the Northern Sea Route by the next century will be fairly small, at less than 5%, even in extreme climate change scenarios. Interest in developing relevant infrastructure in the Arctic Seas continues despite uncertainties, however. If a Central Arctic passage became feasible, it could trigger a considerable change in the configuration of maritime trade flows.

What we recommend

Protection of the environment and promotion of efficiency through competition are the underlying objectives of policy towards maritime shipping and trade. The recommendations address policy in each of these areas as well as how strategic planning in the maritime sector should take them into account.

Ensure strategic planning for port development accounts for the key drivers of trade

Maritime transport activity is driven primarily by growth in GDP and by costs. While climate change mitigation policies and the impact of climate change on sea ice will affect costs, their impact has less potential to affect overall cost than changes in competition and business organisation in the maritime logistics industry. Government intervention in the port sector, including the People's Republic of China's Belt and Road Initiative, can also have a significant impact on the cost of trade. Each of these factors needs to be given appropriate weight in strategic planning and modelling of maritime trade.

Support policy for decarbonisation of maritime transport with carbon pricing

Carbon pricing can help to create demand for low- and zero-carbon fuels, which is needed to scale up the production of alternative fuels and renewable energy sources for producing fuels. A carbon price to the order of USD 50-100/ton CO_2 would be needed to generate sufficient uptake of alternative fuels or renewable energy sources in the pathway towards decarbonisation of maritime transport. Revenues from a carbon pricing mechanism could be used in part to compensate affected countries for adverse trade impacts of decarbonisation of maritime transport, as could support via capacity building and technical assistance to develop green shipping.

Prevent aid to maritime shipping from eroding competition in maritime logistics services

Regulators should consider taking action when carriers – which receive state aid – compete with other parts of the transport chain that do not receive state aid, such as terminal operators and freight forwarders. Government policies that have actually stimulated vertical integration under such conditions, for example allowing tonnage taxes to cover terminal operations, should be reconsidered.

Improve maritime logistics via new performance metrics

New performance indicators need to be developed for value-added shipping to capture customer expectations in relation to this new trend in the organisation of the sector. Better indicators would improve dialogue between carriers and shippers on how to improve maritime logistics and drive efficiency through changes to the processing of cargos. For example, certain cargoes could be prioritised to ensure they are the first to unload when the ship arrives at its destination.

Guarantee open standards when digitalising maritime logistics

Open and harmonised standards and interoperability of systems should be adopted to counter the risk of "lock-in" effects that tie customers to carriers because of large switching costs. Regulators should monitor such inter-operability and open standards, and take appropriate action when needed.

Fine-tune maritime transport modelling

The modelling of maritime trade flows needs to go beyond simple extrapolation of trends and take into explicit account the implications of the Paris Agreement and the measures promoted under the International Maritime Organization's (IMO) Initial IMO Strategy. As distributive effects and the potential for economic disruption are key international policy concerns, models to examine maritime transport and climate change policies should also focus on these issues.

Introduction

Global maritime transport is at a crossroads. Demand growth can no longer be taken for granted. The dominant business strategy has reached its limit and the sector has to find answers to deal with its largest challenge: how to decarbonise. At the same time, new trade routes are being promoted, creating more uncertainty as to where maritime transport will go. The Future Maritime Trade Flows Roundtable assessed, analysed and qualified how changing demand for maritime shipping, decarbonisation, maritime business strategies, China's Belt and Road Initiative and Arctic shipping may modify trade flows to come. This report summarises those reflections and aims to provide clarity for policy makers, investors and trade flow modellers. It provides a framework with determinants to maritime trade flows that can be used by countries to evaluate impacts on their transportation systems.

Expectations about future trade flows inform investment decisions for ships, ports, terminals, logistics facilities, road, rail and inland waterway infrastructures, in both the private and public sectors. Underestimating trade flows could lead to under-investment, which could constrain potential trade; overestimating trade flows could lead to over-investment and value destruction. Assessing possible scenarios for maritime trade flows also informs policy makers on the appropriateness of their policy and regulatory frameworks. As such, the report not only formulates recommendations on the modelling of global maritime trade flows, but also on the strategic policy areas covered in the Roundtable discussions.

The future is – by definition – uncertain. Despite increased sophistication of analytical tools, the chances of predicting the future accurately remain fairly modest. That does not mean that forward-looking scenarios are useless. Projecting future scenarios helps policy-making account for uncertainty: it gauges the probabilities of certain outcomes based on current knowledge and information.

This report builds on discussions and input papers from the Roundtable, but also on a large variety of ITF work. Modelling of freight transport flows has been developed, expanded and fine-tuned in successive ITF Transport Outlooks (ITF 2015a, 2017, 2019a). In this on-going modelling exercise, OECD trade projections are linked to a transport model that covers production and consumption centres and takes into account transport infrastructure capacity constraints and transport costs. The ITF model has many possible applications relevant to maritime transport, e.g. in estimating needs for new port capacity (ITF, 2016) and possible pathways for zero-carbon shipping (ITF, 2018a). The Roundtable also builds on various ITF studies on the state of the shipping industry, e.g. with regards to ship size (ITF, 2015), industry consolidation (ITF, 2018b, 2019b) and digitalisation (ITF, 2018c).

Demand for maritime trade

Demand for maritime transport is essentially a derived demand. Shipping innovations in the past – such as steam shipping and container shipping – stimulated new trade and thus induced demand. But there is broad consensus that this is no longer the case. Maritime transport costs are very low. Further reduction would not create significantly more demand for maritime trade. The main patterns in demand for shipping are driven by the demand for goods that are shipped. This might seem a triviality, but it is not often reflected in practice, as fleet order books are often only slightly related to global trade projections. Nevertheless, changes in the time taken to ship goods to market through the opening of new maritime routes can make a difference to the nature of demand and intermodal competition. This potential is examined in this report together with expected overall growth of trade, impacts of the energy transition and regionalisation of trade and a number of other potential future drivers of change.

Growth as driver of maritime trade

There is a strong correlation between population and gross domestic product (GDP) growth on the one hand and maritime trade growth on the other. Population is projected to rise considerably, but a slowdown in population growth is projected to occur after 2050. Underlying this trend are changing patterns in the composition of population: many developed countries but also economies such as China will be confronted with ageing populations, which could mean shifts in consumption patterns – for example, from goods to services. Total GDP is projected to increase but at a lower level than before. In the long run, there is a convergence in growth rates between developed and developing countries. The globalisation process based on labour-cost differentials and massive outsourcing of production that has driven maritime trade has likely reached its limits. Trade projection models should also include the distribution of GDP.

The trade intensity of the global economy has declined. Current trade-to-GDP-growth predictions assume a multiplier of just above one, as opposed to previous multipliers of three. This is related to various developments taking place at the same time. Most importantly, there seems to be a change in the configuration of global value chains. China's economic development model is no longer focused predominantly on exports but relies increasingly on domestic consumption. This means that the China-dominated trade flows have seen a relative decrease in intensity. Other developments include the emergence of 3D printing, miniaturisation and dematerialisation. Dematerialisation refers to the consumption of goods that no longer need a physical form; for example, streaming music rather than buying CDs. All of these developments could mean a decline in cargo volumes, resulting in a weakening of the link between GDP growth and trade growth.

Energy transition

Energy commodities such as oil and coal have traditionally formed a large part of maritime shipping volumes. Their share has decreased, however, over recent decades, falling from 60% of tonnes shipped in

1970 to 30% in 2017. As countries align with the parameters of the Paris Agreement, shipping volumes of fossil fuels will fall further in the long term. Trade in energy commodities is expected to peak by 2030, and will then decline, with coal first, then crude oil and oil products. For various ports, especially those specialised in coal and oil products, this will mean a decline in volumes. In the short and medium term, natural gas – as liquefied natural gas (LNG) and liquefied petroleum gas (LPG) – is expected to experience sustained growth, at some point to be replaced by more sustainable energy sources. The economic development pathways in most shipping models will need to be aligned with the Paris Agreement and the energy transition that will be needed to achieve its targets.

The energy transition will also impact the cost structures of industries. For example, carbon pricing is intended to monetarily internalise the negative externalities of using fossil fuels. Introducing carbon pricing might tilt the comparative advantage of countries, as some countries may be more endowed with renewable energy sources. This might change global economic specialisation patterns that future economic models should take into account. It will also influence global maritime trade flows. Increasing fuel prices will likely have a minimal effect on the demand for shipping: the likely impact of decarbonisation of maritime transport on import prices is less than 1%.

Regionalisation of trade

Evidence is emerging of a rise in nearshoring, suggesting at least a partial reversal of global outsourcing. Production is becoming more regionalised: half of world trade is now intra-Asia trade. This might be explained by the changing nature of global value chains – less trade-intensive and less based on labour cost arbitrage – in combination with a stronger focus on time-to-market that might require more intra-regional trades. Population and income levels are rising, as is the use of automation and robotisation, which diminish labour costs.

Regionalisation of trade has consequences for maritime transport. First of all, it means that regional trade growth translates into less growth of maritime transport activity than before. Secondly, smaller distances require smaller ships: the largest ships are generally used for trade between large centres that are far removed from each other. The use of large ships does not make sense for smaller distances, as they take more time to handle. Were they used for shorter distances, they would spend too much time in ports and not enough at sea. Trade regionalisation calls into question the race towards ever-bigger ships. Finding the optimal ship size for each individual trade is more relevant than ever. Regionalisation of trade should also translate into different performance metrics. The sector is traditionally focused on volumes, such as tonnes or twenty-foot equivalent units (TEUs). With changing trade patterns, a focus on tonne-kilometres, TEU-kilometres or trade value transported would better reflect the actual performance of the sector.

Additional future drivers

There is a range of other possible drivers of future trade flows. Climate change could be a disruptor for shipping: if extreme weather events make shipping riskier – thus more expensive – demand for maritime trade may suffer. Changes in production technologies in different industries may also impact maritime trade flows. For example, a combustion engine in a conventional car consists of 130-170 parts, but motors for electric cars are made of only 20-30 parts. A move to electric cars will inevitably change supply and transport chains for the automotive industry. Global trade is also dependent on politics. Protectionism, political instability, civil unrest, war or domestic or international conflicts can all have negative implications for maritime trade. But maritime trade projections do not seem to be taking them into account.

Decarbonising maritime shipping

One of the main challenges for shipping is decarbonisation. The extensive changes that would be required to reduce emissions in the shipping industry would come at considerable costs. Other environmental regulations – such as those related to ballast water and sulphur emissions – represent challenges that are similar in outlook, but not of the same order. Although the costs of the global sulphur cap that will be in place from 2020 are substantial, the expectation is that these will be absorbed in the price of traded goods without much effect on global maritime trade flows (ITF, 2016b). In contrast, decarbonisation could be considered a game-changer for shipping.

Decarbonising shipping

The evident reference for how the shipping sector will decarbonise is the Initial IMO Strategy on reduction of greenhouse gas (GHG) emissions of ships of the International Maritime Organisation (IMO), as agreed by its member countries in 2018 (IMO, 2018). This strategy sets out a vision, targets and possible measures to decarbonise international shipping. The vision expressed in the Initial IMO Strategy is to phase out GHG emissions from international shipping "as soon as possible in this century". The Initial IMO Strategy formulates targets on three different levels: a carbon intensity target per ship, a carbon intensity target for the shipping sector as a whole and an absolute emission reduction target for the sector as a whole. Following the strategy, the sector needs to reduce carbon intensity by at least 40% by 2030, pursuing efforts towards 70% by 2050, compared to 2008. The absolute target for the sector entails reducing total annual emissions by at least 50% by 2050 compared to 2008 (IMO, 2018). Discussions are currently ongoing as to which of the identified candidate measures could be agreed upon and applied to achieve these targets. The Initial IMO Strategy underlines the importance of agreement on measures that could be applied immediately so to ensure that emissions start to decline as soon as possible. A revised IMO strategy on GHG emissions of ships is foreseen by 2023.

The relevance of decarbonisation of shipping has only increased since the Initial IMO Strategy was established. At the end of 2018, the Intergovernmental Panel on Climate Change released a report on a 1.5-degree temperature increase scenario. It showed that the time horizon for mitigating catastrophic temperature rises and climate change is closing in. Recent school strikes for the climate and protest movements such as the "yellow vests" in France have increased the political momentum for change, but also highlighted the societal opposition if solutions are not perceived as equitable.

How to decarbonise shipping?

There is a large divergence in expectations on the feasibility of rapidly decarbonising shipping. On the one hand, there are many promising initiatives from shipping companies. Some are experimenting with alternative fuels – hydrogen, biofuels, green ammonia – electric ships and alternative sources of propulsion, such as wind and solar energy. Maersk, the world's largest container line, has announced the target of zero-carbon shipping by 2050. On the other hand, many shipping firms seem to be sceptical about the possibilities of rapid progress, as there is not yet a universally available and accepted solution.

Considering the long average lifetime of ships – around 25 years – many of the ships that will be ordered now will still be in service in 2030, and some of them even in 2050. Ship ordering choices that do not take the Initial IMO Strategy targets into account and ignore the alternative options that are already available will likely contribute to carbon intensities or emission levels well above the set targets.

Global measures implemented so far have focused on the energy efficiency of ships. This has taken the form of targets for new ships that become stricter over time, via the Energy Efficiency Design Index (EEDI). The Initial IMO Strategy intends to accelerate the stringency of these measures. Although there still is room to improve the energy efficiency of ships, this is not the area with the largest emission reduction potential.

Slow steaming, or speed reductions, provides a promising possibility for the short term. Considering the non-linear relation between speed and fuel consumption – and emissions – speed reductions can lead to disproportionally large emission reductions. This can be an interesting measure for shipping sectors with fleet overcapacity, as speed reductions absorb overcapacity: by going slower, ships take longer to arrive, which means more ships are needed for the same weekly service frequency. Current proposals include the introduction of a mandatory speed limit for ships, but are far from universally accepted. Opponents point out concerns related to complications for time-sensitive cargo, such as refrigerated cargo, and for regular liner services that would require more ships to maintain current service frequencies.

The most important part of the decarbonisation of shipping would need to come from alternative fuels. Two key questions arise: What is the price of alternative fuel? What is the capacity to produce such alternative fuels on a large scale, with a small environmental footprint? These questions are related, as the price of alternative fuels can drop if there is a large production capacity. Research seems to indicate that there is no problem of scalability for hydrogen and ammonia by early 2030. Hydrogen needs a lot of energy to be produced, so its production ultimately depends on the availability of renewable energy sources to produce it. Its uptake will depend on pricing. Some countries, like Chile and Australia, already have very low price levels, but this is not the case overall. Governments could support decarbonisation of maritime transport with carbon pricing. In order to make alternative fuels attractive options for shipping, a transition path of a carbon price in the order of USD 50-100/ton CO_2 would be needed to generate sufficient uptake towards decarbonisation of maritime transport (Smith, 2019).

Considering ships' long lifetimes, most would need to be retrofitted to achieve rapid emission reductions. Many could be for the use of alternative fuels. For example, around 3 000 ship engines could be modified for propulsion by ammonia. Such alterations make commercial sense if there is carbon pricing or if subsidies are provided (Smith, 2019).

Various shipping companies and governments have recently shown enthusiasm for liquefied natural gas (LNG) as ship fuel, mostly in reaction to regulations on sulphur dioxide emissions for shipping. Although LNG can indeed help to drastically reduce these emissions, its effects on GHG emissions is much more mixed: it can help reduce CO_2 emissions by around 20% while increasing the risks of methane leaks. At best, LNG could play a role as a transition fuel, but it will clearly not help to reduce GHG emissions towards zero. In that light, LNG-fuelled ships risk becoming stranded assets. As financial institutions start to take these risks into account, shipping companies that are heavily investing in LNG-propulsion systems could become exposed to that risk.

Maritime trade costs and trade flows

Although decarbonisation of maritime transport will bring additional costs for the sector, these will likely be small in relation to the value of the goods that are transported. Maritime trade costs form only a small

part of the total goods value of traded goods. These shares differ, of course, per product and per country pair. In general, maritime trade costs take up the largest share of export price for low-value goods on thin and poorly connected trade routes. An overview of the literature on the subject shows that the likely changes of decarbonisation of maritime transport on import prices are less than 1%. The price elasticity of maritime transport is very low: the volume of maritime trade is unrelated to price increases or decreases. It is likely that the costs for decarbonisation of maritime transport can be passed on to final customers via price or be absorbed by shipping business profit. The overall level of maritime trade is not likely to be affected. Modal shifts due to the costs of decarbonising maritime transport are not very likely, in part because other transport modes will also incur additional costs related to their decarbonisation efforts. However, there might possibly be some adverse effects on the trade potential of certain specific states.

Impacts on states

One of the crucial concerns highlighted in the Initial IMO Strategy is the economic impact on states due to decarbonisation of maritime transport. The Strategy mentions: "disproportionally negative impacts should be assessed and addressed, as appropriate" (IMO, 2018). The Initial IMO Strategy also includes a list of possible impacts on states that should be taken into account.

This concern comes from fundamentally different visions of which principles should lead discussions on GHG mitigation in shipping. The principle leading international regulation for shipping – IMO regulations in general – is the "no more favourable treatment" (NMFT) principle: that all ships should be treated equally. At the same time, central to global climate change mitigation discussions in the United Nations Framework Convention on Climate Change (UNFCCC) is the Common but Differentiated Responsibilities and Respective Capabilities (CBDR-RC) principle: that less-developed nations carry less of the solutions' cost burden (UN, 1992). The Initial IMO Strategy takes into account both principles, which will present complications for agreement on ambitious measures.

One of the possible effects of increases in maritime transport costs is the substitution effect. This could take different forms: traded goods could be substituted by 1) domestic goods or 2) traded goods from another closer country with lower associated maritime trade costs. Both effects have been found in the literature, but they have been fairly moderate. Generally, the largest effects are found for poor countries at the end of poorly serviced transport chains.

There are different ways to compensate affected countries for the adverse trade effects. Exempting certain countries from certain measures seems difficult to justify considering the IMO's NMFT principle. However, other forms of compensation seem compatible with both NMFT and CBDR-RC. Revenues from a carbon pricing mechanism could be used in part to compensate affected countries for adverse trade impacts, as could support via capacity building and technical assistance to develop green shipping.

Maritime business strategies

Although maritime trade flows are, to a large extent, determined by demand factors, strategies of shipping companies themselves also impact the extent and configuration of these flows. A crucial question in that respect is whether the dominant maritime business strategy – economies of scale – is going to continue in the future.

Economies of scale

Chasing economies of scale has undoubtedly been the dominant business strategy in shipping. This has taken the form of a focus on cost minimisation rather than revenue maximisation, price more than service differentiation, and commoditisation of the more dominant outcome than of market segmentation. Whereas bulk shipping was always more oriented towards cost minimisation – considering the more commoditised nature of bulk cargo – this orientation has spilled over to the general cargo sector, in particular since the emergence of containerisation in the 1960s. Main elements in this strategy include increases in ship size, industry consolidation and collaboration among competitors.

Ships have become bigger over the last decades, with few exceptions. Increases in ship size are noticeable for almost all ship types but are most considerable for container ships. Over the last decade alone, the carrying capacity of a new container ship has more than doubled. The length of the first containership – Ideal X – was 160 metres; the biggest containerships today have a length of 400 metres. The only ship type where size increases seem to have halted is the tanker, where the maximum size was reached with the super-tankers in the 1970s, for which there turned out to be limited demand.

Increased ship size impacts transport chains throughout the world. The biggest containerships are deployed on the Asia-Europe trade lane, but the upsizing of containerships cascades down to all trade lanes: ships used on Asia-Europe trade lanes will now be used on other lanes (e.g. Transpacific), where similar cascading effects will take place. Ports must adapt to the new requirements imposed by the larger ships, including water depth, quay length and yard space. Bigger containerships require bigger container ports. The orientation of maritime business strategies constrains the room for ports to focus on anything other than upsizing.

Obsession with size has also driven industry consolidation. Deploying ever-larger vessels on a global scale can only be achieved by shipping firms with the capacity to attract finance and cargo. Over the last decades, several waves of mergers and acquisitions have left the liner industry much more concentrated. As of the writing of this report, the top four carriers have a market share of almost 60%. It was less than 25% in 2000. Since then, 60 out of 100 carriers have disappeared. Most of the consolidation happened via mergers and acquisitions, some of it via organic growth of certain carriers. As a result, the liner shipping industry can now be described as oligopolistic. Traditionally, oligopolies are associated with monopoly rents. These do not seem to have materialised in container shipping yet, but there lies the risk of this happening in the future.

Scale-oriented business strategies have been facilitated by co-operative agreements between shipping companies. Various jurisdictions allow shipping conferences: in essence, price-fixing cartels of liner

shipping companies. In jurisdictions where conferences have been prohibited, such as the European Union since 2008, other co-operative arrangements, consortia, have taken their place. A special place among these co-operative arrangements is taken by global alliances, which are far-reaching forms of co-operative arrangements between liner companies on a global scale. Since 2015, three such global alliances have covered almost all of the East-West containerised maritime transport. The co-ordination via such alliances can be far-reaching and includes not only vessel sharing and operational planning, but also information exchange and – in some cases – joint negotiation with port service providers (ITF, 2018b and 2019b).

The predominant focus on vessel upsizing has resulted in overcapacity. As bigger ships were considered the main tool to reduce unit costs, the decision by one line to upsize was followed by other lines that did not want to become disadvantaged. The result of this massive ordering of new big ships was overcapacity: more ships were ordered than the demand for containerised transport. An effective decoupling of demand and supply took place. Although part of the overcapacity was absorbed through slow-steaming, scores of older vessels and idle ships were demolished.

The "economies of scale" strategy was facilitated by government policies. The United States has actively stimulated open shipping registries, also called "flags of convenience", as a way to solve policy challenges, in particular the lagging cost competitiveness of US shipping companies. The rise of open registries has resulted in two policy reactions in other developed countries: the creation of second shipping registries and the expansion of maritime subsidies. Second registries, also called international registries, generally provide more attractive conditions than the national registries and are created with the aim of attracting shipping companies that left national registries. In Europe, the expansion of maritime subsidies has taken the form of favourable tax treatment of shipping companies, e.g. tax exemptions for seafarers and tonnage taxes that replace the regular corporate income taxes and result in much lower tax payments for shipping companies than would otherwise have been the case. Government policies have also been favourable to the "economies of scale" strategy by allowing for co-operative arrangements between shipping companies, for which many countries have developed exemptions from the regular anti-trust laws, e.g. the Consortia Block Exemption Regulation in the European Union (ITF, 2018b and 2019b).

The business strategy of economies of scale may have reached its limits. It does not make much economic sense for carriers to order even bigger ships. The cost savings related to lower unit costs are becoming smaller as ships become larger and have flattened out. Moreover, many of these cost savings are outweighed by additional costs related to larger ship size. The most recent increases in container ship capacity have been realised by increasing the width of ships, not the length. This means that it is not possible to deploy more quay cranes on the larger ships; as a consequence, these ships have relatively longer port stays. In order to compensate for this time loss, larger ships have to increase their sailing speed to maintain a similar service level as smaller ships. Higher speed means disproportionally more fuel consumption and, thus, higher costs. A similar tendency of diminishing returns to scale is visible with respect to the consolidation of shipping firms: the synergy effects from mergers tend to decrease with the size of companies. The inflection point has been reached and the economic rationale for larger ships has run its course.

Vertical integration

One of the consequences of focusing on economies of scale is the commoditisation of maritime transport. All the large carriers operate in three global alliances. These alliances have removed the possibility for differentiation on the maritime leg. Carriers in alliances have no incentive to provide better service, as competitors within the alliance would profit freely from those efforts. As a result, there is hardly any

difference between services offered by different carriers: transit times, pricing and reliability are roughly the same. Whatever differentiation existed has converged due to alliances (ITF, 2018b).

Vertical integration is one of the few options left for carriers to differentiate. Vertical integration in container shipping refers to carriers becoming active in other parts of the containerised maritime transport chain, such as terminal operations, port services, hinterland transport and logistics. Over the last decade, carriers have become more vertically integrated in different ways. The share of carrier-controlled terminal operators has increased from 18% in 2002 to almost 40% in 2016. Carriers have become more active in feeder operations and have reduced the share of non-operating ship-owners (ITF, 2019b). Various container carriers have expressed the ambition to transform into the integrators of global container transport and some, such as CMA CGM, have acquired logistics companies to achieve that ambition.

Although vertical integration could bring more differentiation, it might also lead to "lock-in" effects. Carriers with stakes in terminals will want to direct their ships to these terminals in order to guarantee decent rates of return on investment. They might do this irrespective of whether it adds the most value for their customers. In some cases, it might also lead to maritime network configurations with longer distances and lead times than necessary. It may also lead to competition issues in that carriers – which receive state aid – compete with other parts of the transport chain that do not receive state aid, such as terminal operators and freight forwarders. Government policies seem to have largely ignored this challenge. In some cases, it could be argued that government policies have actually stimulated vertical integration: for example, the decisions of the European Commission that allow tonnage taxes to cover terminal operations (ITF, 2019c). Governments could prevent aid to maritime shipping from eroding competition in maritime logistics services.

Towards value-added shipping

There is substantial demand for more value-added shipping services. Research carried out by container carrier Hapag Lloyd (Hapag Lloyd, 2019) shows that more than half of carriers' customers are interested in service-oriented and value-added container shipping; less than half of the customers are exclusively focused on price. This seems to dispel often-repeated notions that customers do not want to pay for better service by carriers. Instead, what seems to be at play is a lack of confidence that carriers will fulfil their promises. Value-added shipping could focus on more "supply chain speed", reliability and flexibility, in addition to the current focus on costs.

New performance indicators need to be developed to capture customer expectations in relation to this new trend in the organisation of the sector. Performance data for maritime logistics is currently rudimentary, fragmented and opaque. Better indicators could contribute to improved dialogue between carriers and shippers on how to improve maritime logistics and drive efficiency through changes to the processing of cargos. For example, certain cargoes could be prioritised to ensure they are the first to unload when the ship arrives at its destination.

Digitalisation

Digitalisation could be a tool to achieve more value-added shipping. The maritime logistics chain is the interplay of four different flows: cargo, information, documents and cash flows. Digitalisation could help to streamline document flows, whereas innovations like blockchain could help to improve cash flows.

Digitalisation could create new “lock-in” effects, meaning that customers get tied to certain carriers due to large switching costs. Open and harmonised standards and interoperability of systems should be adopted to counter the risk of “lock-in” effects that tie customers to carriers because of large switching costs. Regulators should monitor such inter-operability and open standards, and take appropriate action when needed.

New infrastructure: Belt and Road

Transport infrastructure can have a trade-inducing effect. It can expand markets, for example, by increasing the potential for economic specialisation and thereby the possibilities for trade. A classic example is railway infrastructure in the United States. Various maritime infrastructure projects, such as the Suez and Panama canals, have had similar effects. New infrastructure, in particular projects proposed within the framework of China's Belt and Road Initiative (BRI), might have similar effects.

The Belt and Road Initiative is not exclusively an infrastructure programme. It has multiple facets and objectives, which explains the challenge the European Union, for example, faces to find a common vision on what it is and how to deal with it. The present report analyses what the initiative might mean for corridors and for global maritime trade flows.

Belt and Road infrastructure and corridors

The Belt and Road Initiative includes a terrestrial part (Belt) and a maritime part (Road). The terrestrial part includes railway links, pipelines and other sorts of infrastructure. The maritime part refers to maritime routes connecting China with other parts of the world via ports. The terrestrial part is comparatively more ambitious, the maritime part builds largely on already existing facilities.

The maritime BRI projects build on a dual approach: better control of existing corridors and development of alternative corridors that could circumvent the existing ones. Existing maritime corridors are mostly determined by maritime chokepoints: the Malacca Straits, Suez Canal, the Gibraltar Straits and the Panama Canal. Part of the BRI aims at strengthening Chinese interests in these chokepoints. The alternative maritime corridors aim at relieving pressure and dependence on the existing chokepoints, in particular the Malacca Straits. This is to be achieved through the development of the Kyaukpyu port and investment in the China-Pakistan Economic Corridor and potential excavation of the Kra Canal in Thailand and the Nicaragua Canal. In addition, there are port projects related to areas with mineral reserves, e.g. in Africa.

If the BRI projects materialise, they will likely have an impact on maritime trade flows. The BRI increases trade flows among participating countries by up to 4.1%. These effects would be three times as large on average if trade reforms complemented the upgrading in transport infrastructure (Baniya, Rocha and Ruta, 2019). Other studies suggest that BRI co-operation could cut the costs of global trade by 1.1 to 2.2% (De Soyres et al., 2018). The way in which these investments will have an impact on trade flows differs: investments along existing maritime trade lanes will likely have little impact, projects related to alternative routes will change trade flow configurations and possibly stimulate trade if the ports have more functions than simply transhipment. Port projects in commodity-rich areas might reduce maritime transport costs and thus stimulate maritime trade flows. Important indications for increases in future flows could come from places where port investment is "paired" to other investments, for example, in logistics parks and hinterland infrastructure such as railroads.

Feasibility of BRI projects

Since the inception of BRI in 2013, China has participated in the construction and operation of 42 ports in 34 countries, including in the ports of Piraeus, Greece; Hambantota, Sri Lanka; Gwadar, Pakistan; and Djibouti. The number of BRI-related ports is expected to increase in the coming years, despite a decrease in China's outward investment since 2016. For example, China is interested in taking a stake in Italian ports, in particular the ports of Trieste and Genoa.

The success of BRI port projects has so far been mixed. Some projects can clearly be considered commercial success stories. The port of Piraeus has become one of the largest European container ports thanks to investments by Cosco. Other projects have seen little or no traffic and provoked local opposition. Local resistance has, for example, stalled development in Hambantota for years and resulted in a renegotiation of the agreement in 2017. The port does not handle much cargo yet. Another project that has not yet attracted cargo is Gwadar in Pakistan.

The most successful projects seem to be in ports that already existed but needed additional investments, like Piraeus. Completely new ports are more difficult to develop, especially in sensitive political contexts such as Pakistan and Myanmar.

It is difficult to predict if alternatives for the current maritime corridors will ever be realised. The two main potential projects are the Kra Canal – bypassing the Malacca Straits – and the Nicaragua Canal – bypassing the Panama Canal. Both projects have been discussed for centuries, are highly expensive and have provoked opposition of different sorts. In the case of the Kra Canal through Thailand, there is not a strong interest from the government. As for the Nicaragua Canal, there is strong government support, but opposition from environmental NGOs. Although there could be a business case for the project, especially for larger ships that cannot transit the Panama Canal, the project would likely only achieve a return on investment after an extremely long period.

New routes: Arctic shipping

The melting ice in the Arctic seas has increased the prospects of Arctic shipping. At the moment, Arctic shipping activity is marginal. In 2018, there were 28 Asia-Europe transits via the Northern Sea Route, which is less than a tenth of a percentage point of the transits via the Suez Canal. However, for a significant part of the Asia-Europe maritime traffic, using Arctic sea routes could reduce distances by 40%, thus reducing transit times. Will Arctic shipping in the future become an attractive option and will it imply a diversion of current maritime trade flows? Despite considerable constraints, continued investments in Arctic shipping and economic development projects suggest a perception of a large potential for market opportunities.

Constraints

An important constraint is cost. Despite shorter distances, almost all relevant cost factors for shipping would increase. Capital costs would increase by 20%, as ships would need to be more resistant to ice and cold weather conditions; fuel costs would rise, as ice-breaking would make the route more energy–intensive; shipping companies would have to pay icebreaker escort fees; staff costs would rise, as additional safety precautions would require larger crews; and insurance rates would rise. Business cases are often based on the assumption of connecting a port in Asia to one in Europe, whereas most of the current Asia-Europe services include a range of ports along the route. This is very relevant to the revenue potential of the Northern route. Even if shipping costs decrease with melting of the Arctic ice, the business case for Arctic shipping may well remain negative, exacerbated by limited navigability of the Northern Sea Route through the current century.

Even in scenarios with rapid temperature rises, there will be considerable periods of the year that the Northern Sea Route will not be navigable because it will not be ice-free. The parts of the Northern Sea Route that are most attractive for shipping are also the shallowest. For this reason, under the most extreme climate scenario, the transit of ships of less than 50 000 tonnes via the Northern Sea Route start to become profitable after 2035 (Van Hussen et al., 2019). However, for several decades these volumes will change only marginally compared to using the southern sea routes via the Suez Canal. In the extreme climate change scenario, substantial bulk volumes will only take off around 2070 and may take even more than a century in more moderate climate change scenarios. Even in the most extreme climate change scenario, the share of global trade using the Northern Sea Route by 2200 will still be less than 5%.

Opportunities

Despite the constraints, considerable investments related to Arctic shipping are taking place. These are investments in icebreakers, industrial projects, ports and related infrastructure. There are now 55 icebreakers operational, 13 are under construction and another 13 are planned. Russia is constructing three new nuclear icebreakers that will be delivered in the next three years. Various industrial groups, often state-backed, have developed industrial projects related to gas, oil, coal and nickel, which need new ports to serve these investments with ancillary development of maritime observatories and stations for service drones.

A possible route envisaged by China is the Central Arctic passage. The passage, which could become ice-free as soon as 2035-2050, would serve as a maritime connection between the Bering Straits and the Atlantic Ocean. Various actors from China, Russia and Germany have started to invest in ports on both sides. Although such a model would not minimise the number of cargo moves to keep maritime transport costs low, the interest from market parties seems to suggest that they have incentives to make such a system work. If this were to become feasible, it could present a considerable change in the configuration of maritime trade flows. The economic development projects related to the new ports could also generate new cargo flows.

Implications for maritime trade modelling

The modelling of possible future developments is not only an analytical economic tool but an instrument for strategic decision-making, as it makes alternative pathways explicit and visible. The modeller bears a heavy responsibility. Modelled scenarios can become references that could direct behaviour and, as such, become self-fulfilling. It is important, then, that transport models explicitly account for the implementation of the Paris Agreement in the scenarios they develop. For shipping, this would translate into a reduction of transported fossil fuels. Modelling maritime trade flows also needs to take into account the implications of the Initial IMO Strategy and the candidate measures promoted in it. As distributive effects and the potential for economic disruption are key international policy concerns, models to examine maritime transport and climate change policies should also focus on these issues.

Most predictive models extrapolate current trends and miss out on disruptive developments such as innovation. The challenge for a modeller is to somehow account for these possibilities of radical change. Obviously, modelling disruption is inherently impossible and also risks simply reflecting the subjective views of the modeller. One way to objectivise possible disruptions could be to more rigorously test them in expert workshops. The ITF Roundtable on Future Maritime Trade Flows attempted to bring clarity and consistency to modelling assumptions, but it is recommended to arrange similar exercises for updates and extensions of the ITF Freight model. Roundtable exchanges led to the following conclusions relevant to modelling future maritime trade flows:

- GDP and population growth will continue to drive future demand for maritime trade but maritime trade will likely be substantially impacted by transitions to non-fossil fuels and regionalisation of trade patterns.
- Expected regulation to decarbonise shipping will increase maritime transport costs, but the increase will likely be small in relation to the total goods value of traded goods, so the impacts on global trade fairly marginal. There could, however, be significant impacts on trade routes to and from poor countries at the end of poorly serviced transport chains, but affected countries could be compensated for some of these adverse effects on trade.
- Increased ship size and industry consolidation, as well as other developments in liner shipping, have changed maritime trade patterns by reducing the number of calls to secondary ports. However, the trend towards marginalisation of secondary ports may have come to an end, as both industry consolidation and the movement of ever-larger ships seem to have run their course.
- The Belt and Road Initiative – if fully materialised – will likely have a significant impact on maritime trade flows. It has the potential to cut maritime trade costs, thereby reducing trade costs and increasing imports and exports.
- Even in extreme climate change scenarios, the share of global trade using the Northern Sea Route by 2200 will be fairly small (less than 5%). However, despite uncertainty, there is considerable interest from parties in the market to develop relevant infrastructure in the Arctic Seas. If a Central Arctic passage were to become feasible, it could present a considerable change in the configuration of maritime trade flows.

Each of these factors needs to be given appropriate weight in strategic planning and modelling of maritime trade.

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Annex A. List of Roundtable participants

Angela Stefania BERGANTINO (Chair), Full Professor, University of Bari, Italy

Michele ACCIARO, Director and Associate Professor, Kühne Logistics University, Germany

Maximilian BAUERNFEIND, Expert and Deputy Head of Unit, Federal Ministry of Transport, Innovation and Technology, Austria

Mia BENNETT, Assistant Professor, University of Hong Kong, Hong Kong, China

Pierre CARIOU, Professor, Kedge Business School, France

Yungsok CHOE, Director/Senior Researcher, Korea Maritime Institute, South Korea

Laurent DANIEL, Head of Unit Shipbuilding, Organisation for Economic Co-operation and Development (OECD)

Thomas EDER, Research Associate, Mercator Institute for China Studies (MERICS), Germany

Neil DAVIDSON, Senior Analyst, Drewry Maritime Research, United Kingdom

Francisco FURTADO, Modeller/Analyst, International Transport Forum (ITF)

Seng Lee GOH, Assistant Vice President (Group Commercial), PSA International, Singapore

Hercules HARALAMBIDES, Professor, Erasmus University Rotterdam, the Netherlands

Andreas HOLLMANN, Managing Director Operations, HHLA Container Terminal Buchardkai, Germany

Lamia KERDJOUDJ-BELKAID, Secretary General, Federation of European Private Port Operators, Belgium

Lucie KIRSTEIN, Junior Policy Analyst, ITF

John KOK, Advisor, PSA International, Hong Kong, China

Gunnar LINDBERG, Director, Institute of Transport Economics, Norway

Iurii MELENAS, Permanent Representative, Mission of the Russian Federation to the International Maritime Organisation

Mikaa MERED, Professor, ILERI School of International Relations, France

Olaf MERK, Administrator, ITF

Alan MURPHY, CEO and Partner, Sea Intelligence, Denmark

Pino MUSOLINO, President, North Adriatic Sea Port Authority, Italy

Pieter PARMENTIER, Consultant, OECD

Harilaos PSARAFTIS, Professor, Technical University of Denmark

Jean-Paul RODRIGUE, Professor, Hofstra University, United States

Rodolfo SABONGE, Researcher, University of Panama

Peter SAND, Chief Shipping Analyst, BIMCO, Denmark

Iris SCHEEL, Member of Management Board and Head of Strategy, Hamburg Port Authority, Germany

Tristan SMITH, Associate Professor, University College London, United Kingdom

Pyers TUCKER, Head of Strategy Corporate Development, Hapag Lloyd, Germany

Marten VAN DEN BOSSCHE, Director, Ecorys Consulting, the Netherlands

Martijn VEN DER HORST, Researcher, KIM Netherlands Institute for Transport Policy Analysis

Rasmus WITH, Special Advisor, Danish Maritime Authority, Denmark

Katsuhiro YAMAGUCHI, Visiting Researcher, University of Tokyo, Japan

International Transport Forum

Future Maritime Trade Flows

This report reviews possible determinants of global maritime goods transport over the coming decades. It addresses the uncertainties that surround the future of maritime trade flows such as the development of demand, the costs of environmental regulation, maritime business strategies, the Belt and Road Initiative, and Arctic shipping. The report summarises discussions of an ITF Roundtable held in Paris, France in April 2019.

All resources from the Roundtable on Future Maritime Trade Flows are available at: https://www.itf-oecd.org/future-maritime-trade-flows-roundtable.

International Transport Forum
2 rue André Pascal
F-75775 Paris Cedex 16
+33 (0)1 73 31 25 00
contact@itf-oecd.org
www.itf-oecd.org

OECD

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