AMRO
ASEAN +3 MACROECONOMIC RESEARCH OFFICE

Analytical Note

The Great Supply Chain Disruption: What Does the Shipping Crystal Ball Foretell?[1]

Updated August 5, 2022

"The line between disorder and order lies in logistics."

~ Sun Tzu
Chinese military strategist, 496 B.C.

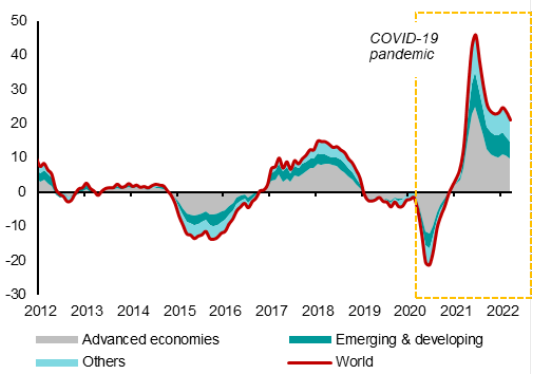
I. Introduction

1. **Maritime ports have been a major choke point of global supply chains throughout the COVID-19 pandemic.** A vital link in supply chains, shipping ports handle around 80 percent of the volume and over 70 percent of the value of goods traded internationally (UNCTAD 2018). However, the pent-up demand for merchandise goods as the economies of Europe and the United States reopened from COVID-19 lockdowns in Q2 2020 has stretched global shipping capacity, especially as it coincided with extended COVID-19 containment measures in several parts of Asia. The result has been widespread port congestion, shipment delays, and a surge in freight costs since Q3 2020 (Figures 1 and 2). The shipping bottlenecks, in addition to raw material and input shortages, have disrupted trade flows and raised production costs around the world (Figure 3).

2. **In the ASEAN+3 region, prolonged supply bottlenecks have dampened export volumes and contributed to higher producer and consumer prices.** As port congestion worsened throughout 2021, surveys of the manufacturing sector likewise indicated longer supplier delivery times. Export volumes have slowed since peaking in Q1 2021 as the delays spread across layers of the supply chain. In fact, price increases are now driving the region's buoyant export growth after gaining pace since the start of 2021 (Figure 4). The surge in freight rates since late 2020 is also consistent with faster increases in the input prices faced by manufacturers, and on a broader scale, the region's import and producer prices (Figure 5). Elevated producer prices have only been passed on partially to ASEAN+3 consumers, but have nonetheless contributed to higher inflation.

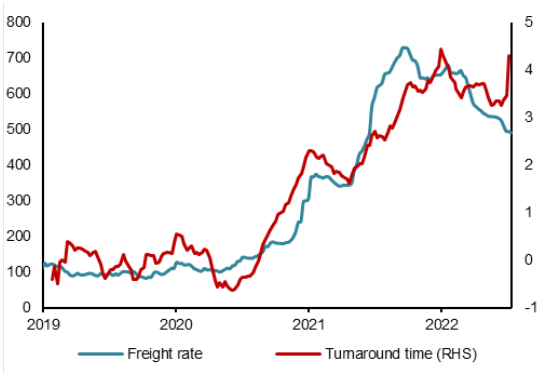
[1] Prepared by Diana del Rosario (diana.del-rosario@amro-asia.org) and Toàn Long Quách (Quach.ToanLong@amro-asia.org), with contributions from Alex Liyang Tang (Tang.Liyang@amro-asia.org) and Yin Fai Ho (ho.yinfai@amro-asia.org) (all Financial Surveillance); reviewed by Li Lian Ong (Group Head, Financial Surveillance); authorized by Hoe Ee Khor (Chief Economist). The authors would like to thank Anthony Tan and colleagues at Bangko Sentral ng Pilipinas for useful comments. The views expressed in this note are the authors' and do not necessarily represent those of the AMRO or AMRO management.

Figure 1. World: Merchandise Imports
(Percent year-over-year, 3mma)



Sources: IMF via Haver Analytics; and AMRO staff calculations.
Note: 3mma = three-month moving average.

Figure 2. World: Container Freight Rates and Turnaround Time at Ports
(Percent, 2019=100; hours, 2019=0)



Sources: Bloomberg Finance L.P.; and AMRO staff calculations.
Note: Freight rate refers to the World Container Index, a weighted average by volume of the spot freight rates of a 40-foot container box for eight major East-West trade routes. Turnaround time refers to median stay of vessels at a port, from arrival to departure, on a 4-week moving average basis. Data until July 18, 2022.

Figure 3. Purchasing Managers' Index (PMI), Selected Sub-indices
(Percentage point)

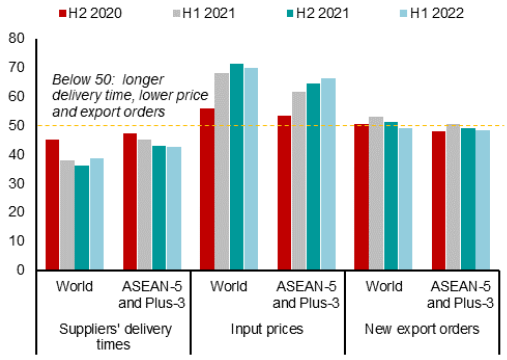


Figure 4. ASEAN-5 and Plus-3: Merchandise Exports
(Percent year-on-year, 3mma)

Sources: National authorities; S&P via Haver Analytics; and AMRO staff calculations.
Note: ASEAN-5 comprises Indonesia, Malaysia, Philippines, Thailand, and Vietnam. Plus-3 refers to China; Hong Kong, China ("Hong Kong"); Korea, and Japan. The PMI refers to the manufacturing sector and excludes Hong Kong in Plus-3 owing to data unavailability. A PMI value below (above) 50 means that a greater number of survey respondents report longer (shorter) delivery times and lower (higher) input prices.

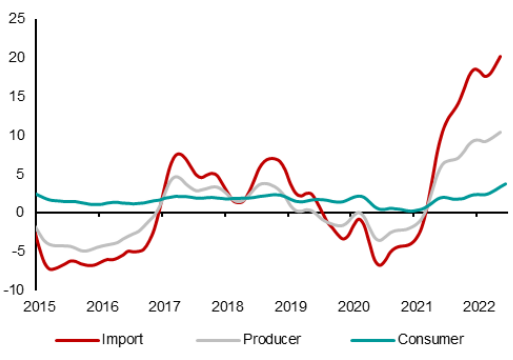
3. **But beleaguered supply chains are confronted with new challenges.** Specifically:

- Disruptions to shipping from the Russia-Ukraine war has already squeezed shipping costs. In particular, the costs of shipping dry and liquid bulk commodities have risen since late-February 2022, even as container freight rates have eased (Figure 6). These developments reflect the fact that the war in Ukraine and the resultant international sanctions on Russia involve two countries that are major energy and agricultural exporters, but have limited participation in manufacturing supply chains.[2]

[2] The standardization of shipping containers from the late 1960s has been closely associated with globalization and the growth of global supply chains (UNCTAD 2013). Containerization has led to a decline in shipping costs and an increase in port efficiency, as container boxes can be loaded and unloaded at ports by automation and transported easily using ships, railways, or trucks.

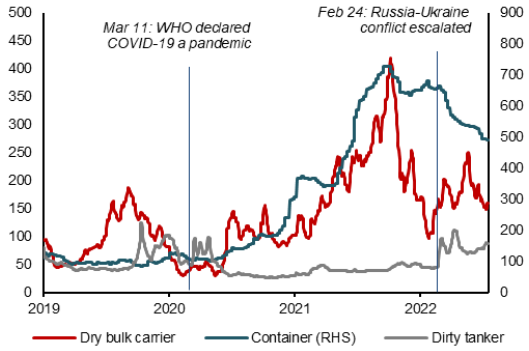
- The impact of the war is to be clearly distinguished from shocks stemming from China's dynamic zero-COVID policy. The lockdowns in China, notably those in Shenzhen and Shanghai in March–May 2022, may have also disrupted commodities trade, given that China is the world's largest importer of natural resources. At the same time, China's COVID strategy would have also affected containerized shipping in light of the country's central role in global value chains.

Figure 5. ASEAN-6 and Plus-3: Import, Producer, and Consumer Prices
(Percent year-on-year, 3mma)



Sources: National authorities; and AMRO staff calculations.
Note: ASEAN-6 comprises ASEAN-5 and Vietnam.

Figure 6. World Shipping Freight Rates by Commercial Vessel Types
(Percent, 2019=100)



Sources: Bloomberg Finance L.P.; and AMRO staff calculations.
Note: Container refers to the World Container Index. Dry bulk carrier rate refers to the Baltic Dry Index, which tracks freight rates for bulk commodities such as coal, iron ore, and grain. Dirty tanker rate refers to the Baltic Dirty Tanker Index, which tracks freight rates for crude oil. Data until July 18, 2022

4. **This note analyzes the supply chain issues confronting maritime transport since 2021, and their implications for the ASEAN+3 economies.** The analysis builds on staff's earlier work on container port congestion (del Rosario and Quách 2021), but with a broader focus to include dry and liquid bulk shipping to capture developments arising from the Russia-Ukraine war. Near real-time indicators derived from "big" shipping data, as discussed in del Rosario and Quách (2020), are applied in concert with information derived from media reports to shed light on the ongoing supply chain bottlenecks. Discussions with subject matter experts and port authorities also provide context to the strains in global shipping capacity. Given the uncertainty in the outlook, extended disruptions to global supply chains are then assessed for their impact on the ASEAN+3 economies. The note concludes with a discussion on the ongoing initiatives to strengthen resilience in global supply chains.

II. Container Shipping: Squeezed by COVID-19 Distortions

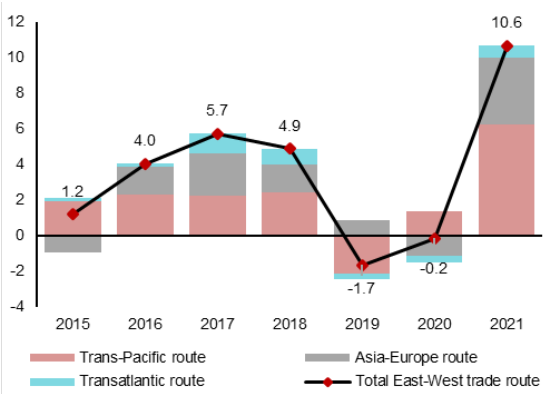
5. **World container freight rates have skyrocketed in the wake of the pandemic's recovery starting in the latter half of 2020.** The cost of shipping a 40-foot container began its steep ascent in Q4 2020 after economies globally, led by the United States and Europe, emerged from COVID-19 lockdowns. After staying flat for the most part of 2020, container freight rates surged to 3 times their 2019 levels at the end of 2020 and to 7 times at their peak in October 2021. Freight rates have eased since the beginning of 2022, but have nonetheless remained at around 5 times the pre-pandemic average (Figure 6). The sharp spike in the cost of shipping containers, especially when compared to the freight rates for bulk commodities, points to considerable pressure in container shipping capacity from the latter half of 2020.

6. **The demand-supply imbalance in container shipping is attributable to pandemic-induced disruptions and exacerbated by factors unrelated to the pandemic.** The shift in consumer spending toward goods and less on services, as the pandemic prompted movement restrictions, led to a boom in cross-border e-commerce, driving containerized trade particularly in the Trans-Pacific route linking Asia to North America (Figures 7 and 8). But, Asia grappled with a shortage of container boxes, against a pile-up of empty containers at ports in the West, to ship goods overseas (Figure 9 and Box 1). Across the Pacific, the robust rebound in US imports overwhelmed the country's aging port infrastructure and caused a shortage of warehouse space and container chassis (Figure 10). A labor crunch at ports and in related logistics services, such as trucking, also hampered productivity in several parts of the world. The accidental blockage of the Suez Canal in March 2021 and various weather-related disturbances throughout North America and Asia last year compounded the squeeze in shipping capacity.

Figure 7. Global Container Ship Traffic

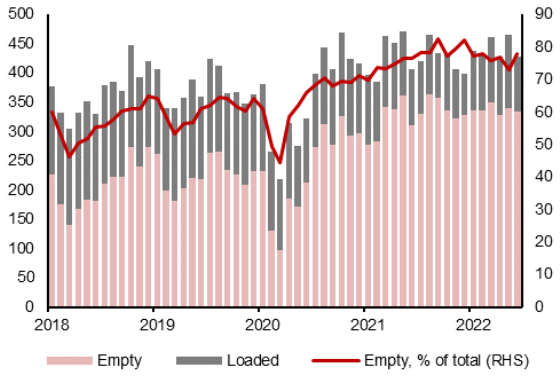
Source: MarineTraffic (https://www.marinetraffic.com/en/ais/home/centerx:162.4/centery:23.0/zoom:3).
Note: Green dots refer to container and general cargo vessels. Some general cargo vessels also container boxes, and can thus serve as container ships. Accessed on May 26, 2022.

Figure 8. Containerized Trade on Major East-West Trade Routes
(Percent year-on-year)



Sources: UNCTAD; and AMRO staff calculations.
Note: The Trans-Pacific route is dominated by the Eastbound route, from East Asia to North America. The East-West trade route represented the biggest market share in global containerized trade in 2020, equivalent to 40 percent of total world trade (UNCTAD 2021).

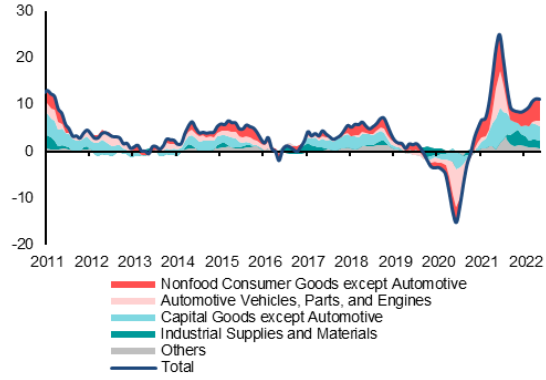
Figure 9. Port of Los Angeles: Outbound Empty Containers
(Percent of total; Thousand TEUs*)



Sources: The Port of Los Angeles; and AMRO staff calculations.
Note: TEU = twenty-foot equivalent unit.

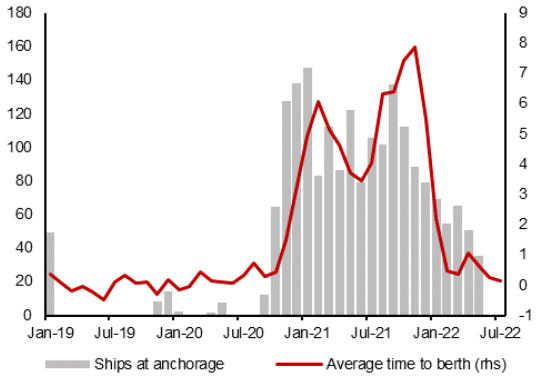
7. **Consequently, the stress in shipping capacity impaired the smooth flow of shipping containers worldwide.** Disruptions to port operations, including the struggle to find container capacity amid the rebound in trade volumes, resulted in longer port turnaround times for container ships at ports across the world. On average, container ships globally spent an additional 1–4.5 hours between arrival and departure at ports from 2021 till recently (Figure 2). But, actual shipping delays may be longer as vessels wait at anchorage until a berth becomes available. For instance, the ports of Los Angeles and Long Beach (LA/LB)—the gateway for 40 percent of US seaborne imports—saw a build-up of container ships at anchorage in 2021 and it took 3–8 days more than pre-pandemic for ships to berth (Figure 11). The delays at US ports cascaded through the entire supply chains, contributing to congestion worldwide (Appendix Figure 1).[3] And, port congestion sparked a vicious cycle, with estimates that it caused a 10–15 percent reduction in vessel capacity globally (Tirschwell 2022).

Figure 10. United States: Goods Imports Adjusted for Price Changes
(Percent year-on-year, 3mma)



Sources: US Census Bureau; and AMRO staff calculations.
Note: Others refer to foods, feeds, and beverages; other merchandise; and residual.

Figure 11. US Ports of Los Angeles and Long Beach (LA/LB): Ships at Anchorage and Time to Berth
(Unit; number of days*)



Sources: MarineTraffic; and AMRO staff estimates.
Note: *Both left-hand and right-hand side axes are expressed as 2019 average = 0. Data until July 17, 2022.

8. **The response of shipping operators to the long wait times at ports has also added to the gridlock and shipping delays.** The delays due to the bottlenecks encouraged ships to make fewer stops—a practice known as blank sailing—which then led to vessels converging around the same time at major ports (Table 1). The surge in container freight rates following the squeeze in shipping capacity, especially along the Trans-Pacific route, attracted greater vessel capacity from other regions, which then placed even greater pressure on port infrastructure and operations (Figure 12). At the same time, mounting costs from the long wait times at ports reduced the incentive to reach port sooner, prompting more ships to slow steam or sail at reduced speeds.[4] However, slow steaming also meant longer vessel transit times, as observed in 2021 and 2022 to-date (Figure 13).

[3] A weekly bivariate vector autoregression (VAR) model of cross-country port congestion levels, proxied by vessel turnaround at the port, shows that an increase in congestion in the United States can have a statistically significant impact on other countries' port congestion. Results show a positive contemporaneous impact on Malaysia's congestion, and a delayed positive effect on the Netherlands'. At the same time, an increase in Malaysia's congestion, due to factors specific to Malaysia, pushes up congestion in Singapore, and vice versa.

[4] The surge in crude oil prices may have also forced ships to slow steam to cut down on fuel consumption. In effect, slow steaming reduces greenhouse gas emissions and air pollution from shipping.

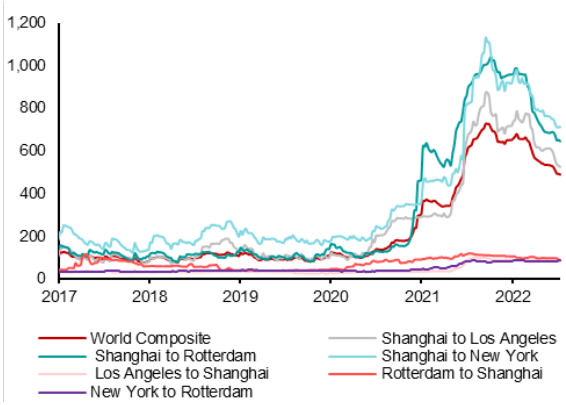
9. **Shipping constraints have eased somewhat in 2022 to-date, though China's stringent management of COVID-19 infections is obscuring the outlook.** The drop in sales and trade volumes after the Lunar New Year in early-February and the spike in inflation in the advanced economies have been attributed to the 25 percent drop in container freight rates since the start of 2022 (Figures 12 and 14). China's COVID-19 lockdowns, especially in Shanghai—a manufacturing hub and host to the world's busiest container port—in March–May 2022, reportedly helped to relieve shipping constraints and freight rates (The Maritime Executive 2022). The lower imports from China gave US ports the breathing space to clear backlogs and facilitate vessel movements (Figure 15).[5] That said, any rebound in US-bound export volumes from China could again swamp US ports and increase vessel wait times (Figure 16) (Murray, Koh, and Varley 2022).[6] China's export recovery could also lead to greater competition for container boxes and shipping capacity globally, in turn pushing up container freight rates across the board (LaRocco 2022).

Table 1. World: Average Number of Port Calls by Vessel Type
(Unit)

	2019	2020	2021	2022
Coverage: All Ports Globally				
Container	9.4	9.1	8.4	7.3
Bulk Carrier/ General Cargo	8.2	7.8	3.6	1.9
Tankers	6.4	6.0	6.1	5.5
Coverage: ASEAN+3-US Trade Routes				
Container	7.4	7.0	6.0	4.9
Bulk Carrier/ General Cargo	2.6	2.2	2.0	1.7
Tankers	3.0	2.8	2.8	2.5

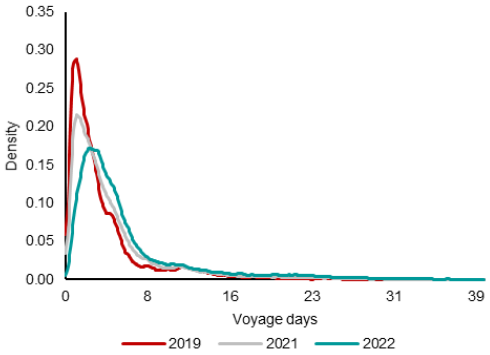
Sources: MarineTraffic; and AMRO staff estimates.
Note: Data until July 17, 2022.

Figure 12. Container Freight Rates by Specific Routes
(Percent, 2019=100)



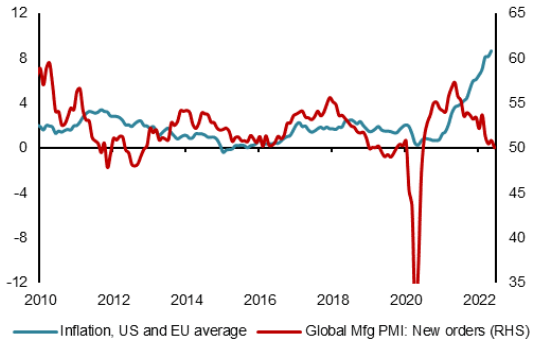
Sources: Drewry via Bloomberg Finance LP; and AMRO staff calculations.
Note: Data until July 14, 2022.

Figure 13. Travel Time Distribution for International Voyages of Container Ships



Sources: MarineTraffic; and AMRO staff calculations.
Note: Kernel density estimates are weighted by the deadweight tonnage of ships that sail between the origin and destination ports. Data until July 17, 2022.

Figure 14. Inflation and New Orders
(Percent year-on-year; percentage point)

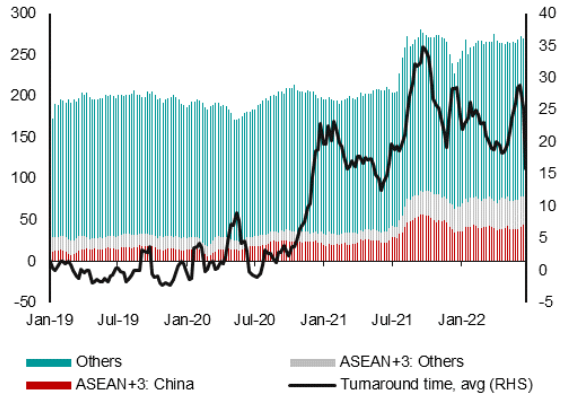


Source: National authorities and S&P, both via Haver Analytics.
Note: Mfg PMI = Manufacturing sector purchasing managers' index.

[5] Moves to increase operating hours at ports and expedite the movement of cargo out of the ports have also helped to ease port congestion in the United States (The White House 2021).

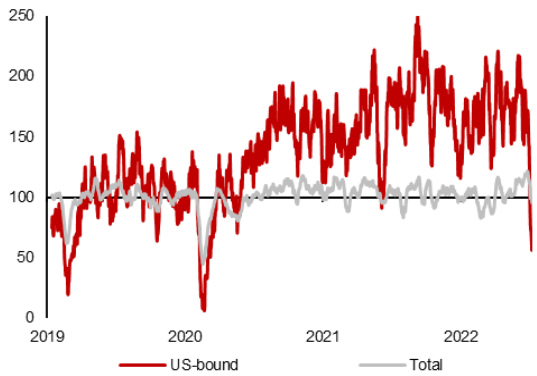
[6] It usually takes at least 16–18 days for a ship from Shanghai or Ningbo in China at arrive and unload cargo at ports in the US West Coast, although transit times increased to as much as 36 days around mid-2021 (The Maritime Executive 2021a).

Figure 15. United States: Incoming Container Ships and Turnaround Time at Ports
(Unit; number of hours*)



Sources: MarineTraffic; and AMRO staff calculations.
Note: Data until July 17, 2022.

Figure 16. Ports in China: Overseas-Bound Cargo Volume
(Percent, 2019=100)



Sources: MarineTraffic; and AMRO staff calculations.
Note: The series are presented as a two-week moving sum. Data until July 17, 2022.

10. **On the flipside, a softening in demand due to high inflation could provide time to ease the stress in shipping capacity.** Especially in the case of the United States and Europe, high inflation could weigh on demand and take some pressure off shipping capacity and freight rates around the time that China clears its production and shipping backlogs. Worse, an abrupt pullback in consumer demand globally against the strong inventory build-up over the past year—a supply glut phenomenon known as the "bullwhip effect"—could lead to a sharp correction in freight rates.[7]

11. **However, supply-side shipping constraints also remain prevalent and could take time to overcome.** For example, the US economy is facing a labor crunch in the trucking industry, which is keeping cargo idle at port terminals and weighing on port productivity (Miller and others 2022). The global imbalance in the supply of container boxes also persists, with the United States maintaining large amounts of empty containers despite some decline this year (Figure 9). Likewise, the more prevalent slow steaming becomes, amid the surge in fuel costs, the longer ships and container boxes are held up at sea, which then contributes to the shortage of available ships at ports. These supply-side issues keep shipping capacity tight and, consequently, vulnerable to any resurgence in demand.

12. **China's ongoing dynamic zero-COVID policy and the drawn-out war in Ukraine could exacerbate the supply-side constraints in container shipping.** Specifically:

- Aside from the impact on container boxes, recurring lockdowns in China could cause intermittent disruptions to domestic labor supply and hold back the flow of vessels at ports. This scenario occurred during the lockdowns in Shanghai and other cities in March–May 2022, when the shortage of truck drivers, owing to stringent inter-provincial travel measures, worsened congestion at the Port of Shanghai despite keeping port staff onsite (Pilkington and Rechtschaffen 2022).

[7] The "bullwhip effect" is a supply chain phenomenon wherein strong consumer demand leads to an even bigger inventory build-up across the manufacturing supply chain.

- The war in Ukraine could make it difficult for shipping companies to move crew in and out of Ukraine, while Western sanctions on Russia could complicate payments to Russian seafarers. Russia and Ukraine are vital to the global shipping workforce, accounting for 10.5 percent and 4 percent, respectively (ICS 2022). The lack of seafarers could drive up wages and increase vessel operating costs, especially if shipping demand is sustained.

- The sanctions on Russia have also required additional customs inspections, causing a pileup of cargo containers and worsening in vessel delays at Europe's largest seaport of Rotterdam (Koc 2022).

Box 1. Factors Driving Congestion at Container Ports since 2021

A**uthors' conversations with port authorities and shipping analysts shed light on the origin and factors behind the congestion at container ports since last year.** The key takeaways are that:

- **Congestion at US ports cascaded within the global shipping network.** The strong rebound in US demand that emerged after domestic movement restrictions were relaxed from mid-2020 strained the capacity of US ports. Outdated port infrastructure limited the ability of major container terminals, such as in Los Angeles and Long Beach, to quickly offload large volumes of cargo. As a result, ships were stuck in long queues. The congestion then spilled over to subsequent ports in the network as ships started arriving at the same time.

- **The unsynchronized economic recovery, with Asia initially lagging behind, left container boxes idle at US ports.** The United States maintains a trade deficit with Asia, and so more empty containers would be expected to return to the latter than arrive in the former. However, the structural imbalance intensified in 2021 when a greater number container boxes arriving in the United States from Asia were left empty or under-capacity on their return, amid weak demand from Asia, owing to extended mobility restrictions. The situation reduced the incentive to move container boxes to Asia. But, as manufacturing activity resumed in the region, major ports in places such as China, Malaysia, Singapore, and Thailand were subsequently faced with a shortage of container boxes, constraining their capacity to ship goods and causing long wait times before container ships were able to depart for the next port of call.

- **The sudden lockdowns had likewise left large stockpiles of container boxes at port terminals and consignment yards across the world.** In Malaysia, for example, container boxes containing auto parts were left unmoved at the port terminal or the premises of the consignee during the Movement Control Order in July 2021. Those unattended container boxes used up storage space at port terminals and contributed to the shortage of available container boxes, slowing down vessel traffic as trade activity picked up. Delays in the manufacture of new container boxes contributed to the bottlenecks. Labor shortages at the ports and ancillary logistics services, such as trucking and ship feeder services, also hindered the loading and unloading of cargo shipments.

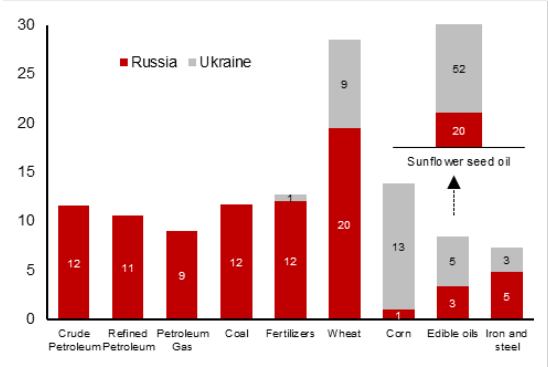
- **Increased incidences of "blank sailings" resulted in the bunching of incoming vessels at major ports.** Severe port congestions, such as those experienced in the United States and China, prompted more ships to skip particular port calls in their scheduled sailing routes—a practice known as blank sailing—to meet berth booking schedules at certain key ports. However, the greater number of blank sailings inadvertently contributed to the clogging of vessels at major ports as these ships ended up arriving at around the same time.

- **The Trans-Pacific routes have attracted greater vessel capacity amid soaring freight rates.** In an attempt to capitalize on the surge in container freight rates along the Asia-North America routes, some ships have reportedly diverted trade routes away from Africa and Latin America to the Trans-Pacific lanes (Lademan 2022). However, the increase in the number of vessels plying these routes has placed greater pressure on Asian and North American port infrastructure, further contributing to the congestion. Within Asia, more vessels were diverted to China, leaving ports such as Busan in Korea with a stack of containers waiting to be loaded onto available ships (Kang 2021; Kim 2021).

III. Commodities Shipping: Disrupted by the Russia-Ukraine War

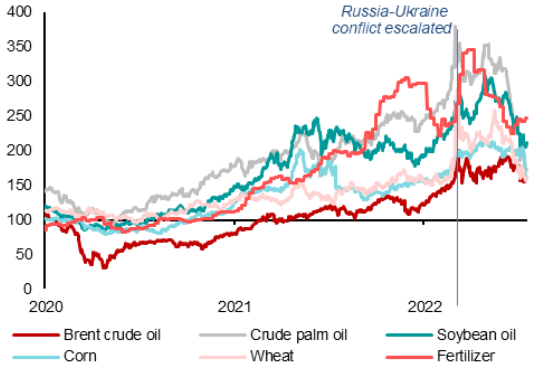
13. **The war between two major producers of key commodities, Russia and Ukraine, has sent shockwaves through global commodity markets.** Prior to the war, Russia accounted for about 10 percent of the world's oil and gas exports, 12 percent of total coal exports, and was the largest exporter of fertilizers (Figure 17). Russia and Ukraine were also the leading exporters of sunflower oil, commonly used for cooking, and wheat. Further, Ukraine accounted for over 10 percent of the world's corn exports. Corn and wheat are grains used to produce food items or as key ingredients in animal feed. Amid widespread concerns over supply disruptions, prices of energy and agricultural products—including substitutes like palm and soybean oils for sunflower oil—surged to new highs as the conflict escalated in late February 2022 (Figure 18). The prices of fertilizers and agricultural commodities have eased in recent weeks, but remain elevated—as with crude oil prices—at more than 1.5 times their 2019 levels.

Figure 17. Russia and Ukraine: Key Commodity Exports, 2020
(Percent of world total)



Source: The Observatory of Economic Complexity; S&P Global Trade Atlas; and AMRO staff calculations.

Figure 18. Global Prices of Selected Commodities
(Percent, 2019=100)



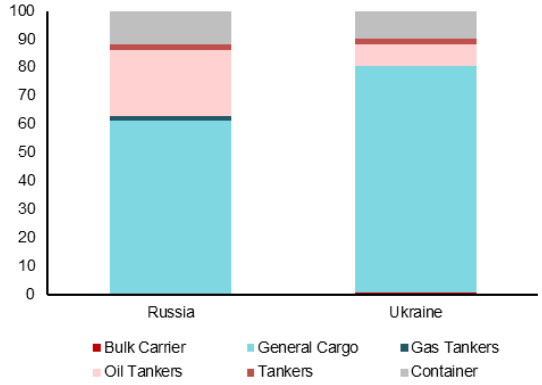
Source: Bloomberg Finance LP.
Note: Crude palm oil price refers to the Peninsular Malaysia Palm Oil Board spot price. Fertilizer prices refer to the Green Markets North America Fertilizer Price Index. Data until July 18, 2022.

14. **The disruptions to commodities trade have pushed up the costs of shipping bulk commodities.** Russia and Ukraine are key commodity exporters; thus, ships that carry dry and liquid bulk commodities commonly congregate around their ports (Figure 19). Grains, fertilizers, coal, and iron ore are moved by sea on bulk carriers or general cargo vessels, while petroleum, natural gas, and edible oils are shipped on designated tankers. However, the free flow of shipments out of Russia and Ukraine has been disrupted by the war, pushing up bulk carrier and tanker rates (Figure 20). In particular, the blockade of Ukraine's main shipping routes in the Black Sea has led to a decline in global vessel capacity, with ships taking longer routes as alternate suppliers fill the gap in the market (Figures 21 and 22).[8] War risk premia for ships plying the Mediterranean, concerns over increasing disruptions to Russian shipments as sanctions widened, as well as higher fuel prices have also contributed to the increase in shipping costs (Psaropoulos 2022; Samanta, Tan, and Sanicola 2022; Wittels 2022). Meanwhile, fears of a global economic recession

[8] Examples include Australia replacing Russia in the supply of coal to Europe, and natural gas to Japan and Korea (Toscano 2022; Gibson 2022). Separately, clean tankers used to ship chemicals have also been redeployed to carry edible oils, likely as buyers seek to find replacements for diminished supplies of sunflower oil from Russia and Ukraine (Chambers 2022).

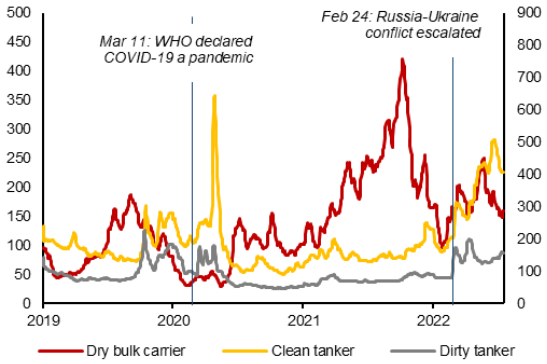
have weighed on commodity freight rates, especially bulk carrier rates, more recently (Hellenic Shipping News 2022).

Figure 19. Russia and Ukraine: Outbound Vessel Types, 2019
(Percent of total)



Sources: MarineTraffic; and AMRO staff estimates.

Figure 20. Dry Bulk and Tanker Rates
(Percent, 2019=100)

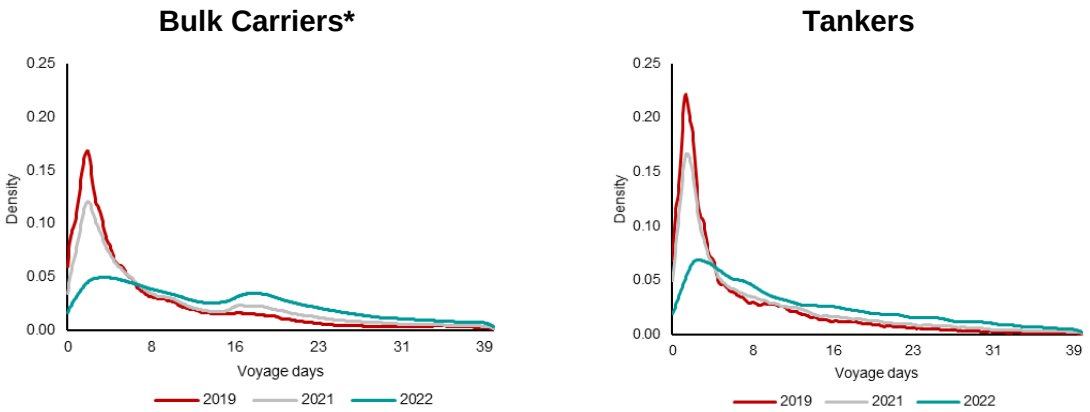


Source: Baltic Indices via Bloomberg Finance L.P.
Note: Dry bulk carrier rate refers to the freight rates for bulk commodities such as coal, iron ore, and grain. Dirty tanker rate refers to the freight rates for crude oil and high-sulfur petroleum products such as residual fuel oil. Clean tanker rate refers to the freight rates for lower-sulfur petroleum products, including refined petroleum products such as motor gasoline, diesel fuel, jet fuel, and naphtha. Data until July 18, 2022.

Figure 21. Black Sea: Commercial Ship Traffic

Source: MarineTraffic (https://www.marinetraffic.com/en/ais/home/centerx:162.4/centery:23.0/zoom:3).
Note: Green refers to bulk carrier, container, and general cargo vessels. Red refers to tankers. Dots refer to vessels at anchorage, markers with an arrow refer to vessels that are underway. Accessed on May 26, 2022.

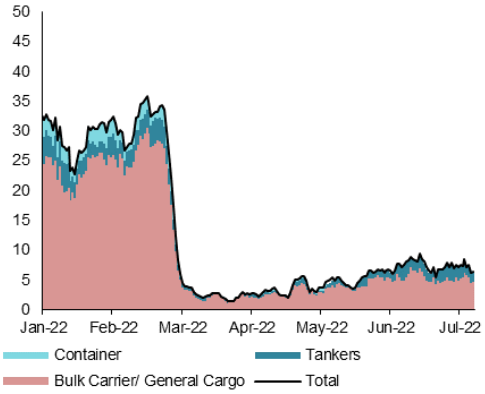
Figure 22. Travel Time Distribution for International Voyages of Commercial Vessels



Sources: MarineTraffic; and AMRO staff calculations.
Note: *General cargoes have been grouped together with bulk carriers. Kernel density estimates are weighted by the deadweight tonnage of ships that sail between the origin and destination ports. Data until July 17, 2022.

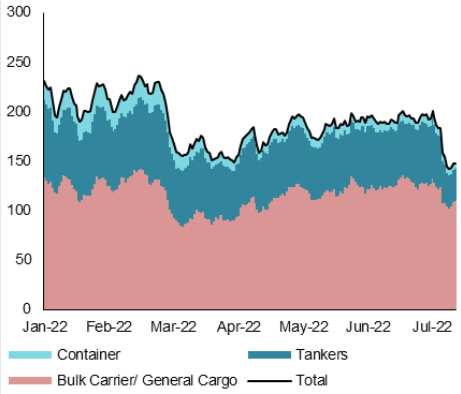
15. **Ship traffic out of Ukraine ports has collapsed while shipments coming from Russia have been curtailed.** Daily outbound merchant traffic from Ukrainian ports fell sharply from a peak daily average of 35 vessels in February 2022 to fewer than 10 by late July (Figure 23). The latter were mostly bulk carriers or general cargo vessels departing from minor ports on Ukraine's border with Romania, which have reportedly stepped up operations amid Russia's blockade of Ukrainian ports on the Black Sea (Diakun 2022) (Figure 21). Meanwhile, commercial vessel traffic out of Russian ports has dipped but remains fairly buoyant, driven by shipments of dry bulk commodities to Turkey (Figure 24). Reports indicate that Russia's shipping traffic has held up as existing contracts are being fulfilled before global sanctions on Russia take full effect in the months ahead (Swanson 2022b).

Figure 23. Ukraine: Outbound Vessels
(Unit, 7-day moving average)



Sources: MarineTraffic; and AMRO staff estimates.
Note: Data until July 17, 2022.

Figure 24. Russia: Outbound Vessels
(Unit, 7-day moving average)

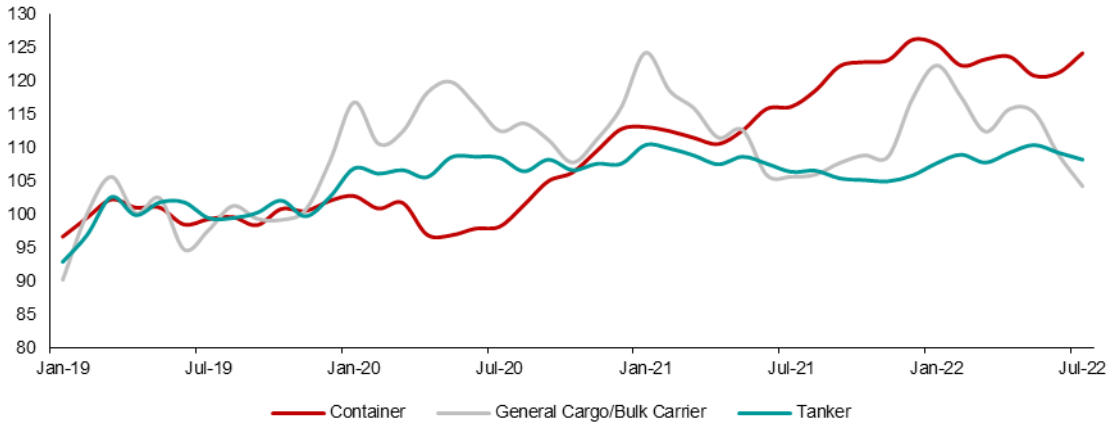


Sources: MarineTraffic; and AMRO staff estimates.
Note: Data until July 17, 2022.

16. **The realignment of trade flows due to the war in Ukraine has compounded the delays in bulk carrier and tanker shipping this year.** Bulk cargo ships experienced heightened port bottlenecks from the beginning of 2022, albeit not as severely as with container ships (Figure 25). Port bottlenecks were initially associated with Indonesia's coal export ban in January 2022, followed by China's local COVID-related lockdowns in March (Bartlett 2022). Thereafter, shifts in shipping routes and vessel repositioning arising from the Russia-Ukraine conflict, in addition to the lingering impact of China's COVID-19 clampdown, have kept bulk cargo vessel turnaround times elevated at key ports in Australia, Germany,

Malaysia, Singapore, and South Africa (Appendix Figure 2). Tanker vessel delays have not been as widespread as with bulk carriers and containers, but have also picked up at major ports in Australia, Brazil, China, Hong Kong, Indonesia, and Spain (Appendix Figure 3).

Figure 25. Global Vessel Turnaround Time at Ports, by Commercial Vessel Type
(Percent, 2019=100)



Sources: MarineTraffic; and AMRO staff calculations.
Note: Data until July 17, 2022.

17. **In addition to the squeeze in vessel capacity and the availability of seafarers, the war has also triggered protectionist measures that may be amplifying bottlenecks in shipping commodities.** Soaring food prices initially caused by droughts and COVID-19 labor restrictions, and which have been exacerbated by the war, have unleashed a wave of food protectionism across countries.[9] Sudden export bans, such as those on crude palm oil by Indonesia in April 2022 (Cabinet Secretariat of the Republic of Indonesia 2022) and wheat by India in May (Parija 2022), are disruptive of scheduled sailing routes as vessels with banned cargo are unable to sail overseas while empty vessels would have to reposition to overseas ports. The ongoing rush among importer nations to build up stock amid surging food prices may also be contributing to the pressure on shipping capacity and freight rates.

IV. Outlook and Macroeconomic Implications

18. **The mix of factors driving bottlenecks in container and bulk shipping suggests that the disruptions to global supply chains could run through 2023.** Back towards the end of 2021 through early 2022, considerable production and shipping backlogs—for example, evident in the elevated number of ships waiting at the LA/LB ports (Figure 11)—were already expected in some quarters to keep global supply chains strained at least through mid-2022 (The Maritime Executive 2021b; Cox 2021) (Figure 26). But, with the lockdowns in China and the war in Ukraine compounding the squeeze in shipping capacity in various channels, elevated freight rates and disrupted supply chains are now expected to extend into 2023 (Hand 2022; Fechner, Luman and Konings 2022). Supply chain woes could also stretch further, if investments in new ships and port facilities, warehouses, and land transportation are not realized sooner to keep up with an eventual rebound in demand (Goodman 2022). For instance, container ship orders made in 2021 are only anticipated to add to existing capacity from 2024 (Hand 2022). In the United States, despite availability of

[9] Of the 47 export curbs on food and fertilizers imposed by countries since the beginning of 2022, 43 have been put in place since Russia invaded Ukraine in late-February 2022 (Swanson 2022a).

funding, labor shortages are preventing upgrades to port and landside infrastructure from progressing as planned (The White House 2021; Wilson 2022).

19. **The near-term outlook, however, rests largely on how much inflation could dampen demand to overcome the supply-demand imbalance.** While likely to persist for some time, supply constraints could get a breather from a potential slump in global demand as heightened inflation and the sharp increases in interest rates erode purchasing power. Early signs may already be apparent in the continued easing in container freight rates despite approaching the peak season for global shipping in August to October.[10] However, the outcome for the global economy from the increased headwinds remains uncertain—a soft landing, as opposed to a hard one, could leave supply chains vulnerable, given that sustained strength in job creation (as is the case in the United States) would keep consumer demand buoyant.

20. **Against this backdrop, a large-scale macro model is employed to assess the impact of disruptions to global supply chains on the ASEAN+3 economies.** The AMRO Global Macro-Financial Model (AGMFM) is a dynamic general equilibrium model that covers 48 economies, including all 14 ASEAN+3 economies (Tang 2022). It allows for cross-country and within-country industry linkages based on information from the OECD inter-country input-output tables. In this study, shocks to the relevant economies' use of foreign water transport services as well as imported industry inputs are calibrated to follow the extent of the delays in supplier delivery time (SDT) for the global manufacturing sector, as proxy for supply chain disruptions.[11] SDT captures a wide variety of capacity constraints, such as input and labor shortages, and are able to reflect the disruptions to shipping in 2021 and 2022 to-date (Figure 27).[12]

21. **Given that SDT moves closely with output fluctuations, demand factors driving delivery times are filtered out to focus on supply-side effects.** The demand-supply decomposition of the SDT is estimated using a monthly bivariate vector autoregression (VAR) model with sign restrictions, as in Attinasi and others (2021). With the VAR, movements in SDT are controlled for fluctuations in manufacturing output and vice-versa. Shocks stemming from the demand rebound and supply chain disruptions are then identified using sign restrictions.[13] Results confirm that the capacity strains since the start of the pandemic has been unparalleled in close to two decades and a half (Figures 28 and 29). After the spike in early-2020 from the wave of lockdowns globally, supply chain disruptions re-emerged in Q3 2020 and contributed 41 percent of the recorded SDT in January

[10] Retailers typically build up inventories ahead of the holidays and shopping season in the fourth quarter.

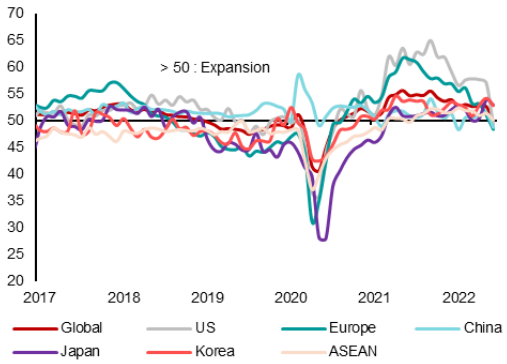
[11] In using the AGMFM for this particular scenario, an economy's imports of water transport service is shocked by the same amount as the deviation of the supply-shock component of SDT from the 2019 average. Further, the same economy's imported industry inputs are shocked by an amount that is proportional to the shock on imported water transport service.

[12] "SDT" is a sub-index of Purchasing Managers' Index (PMI) for the manufacturing sector.

[13] The sign restrictions are informed by the assumptions that supply chain disruptions increase SDT and reduce output, while the recovery in demand increases both SDT and output. The VAR has a lag order of 3, according to the Schwarz Information Criterion and Hannan-Quinn Criterion, and covers the period August 2007–May 2022. An alternative VAR of order 4, as suggested by the Akaike Information Criterion, yields similar results.

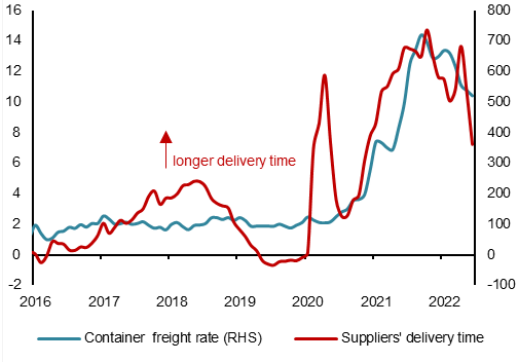
2021-March 2022. The importance of capacity constraints rose to 53 percent in April–May 2022, amid the war in Ukraine and lockdowns in China, before easing back in June.[14]

Figure 26. Global and Selected Economies: Work Backlogs, Manufacturing Sector
(Percentage point, seasonally adjusted)



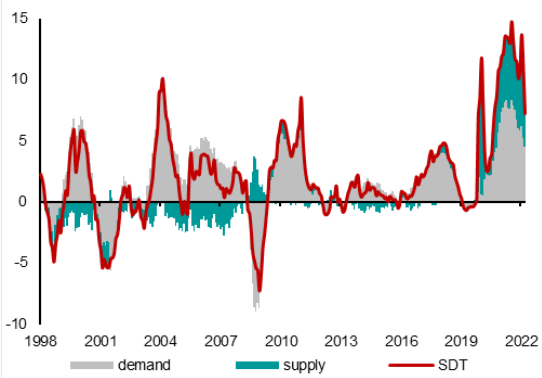
Sources: S&P Global via Haver Analytics.
Note: Based on the Purchasing Managers Survey of the manufacturing sector.

Figure 27. World: SDT, Manufacturing Sector and Container Freight Rates
(Percentage point, 2019=0; percent, 2019=100)



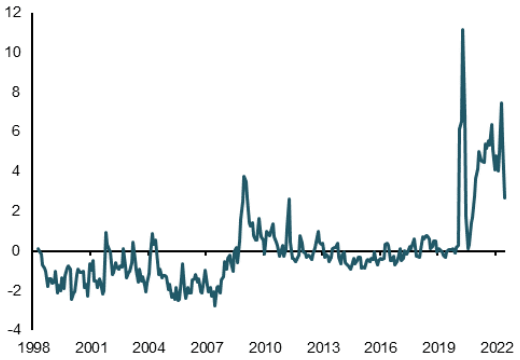
Sources: Bloomberg Finance LP; S&P Global via Haver Analytics; and AMRO staff calculations.
Note: SDT has been inverted from its original presentation to show that an increase represents lengthier delivery time.

Figure 28. World: Historical Decomposition of SDT
(Percentage point, 2019=0)



Sources: S&P Global via Haver Analytics; and AMRO staff calculations.

Figure 29. World: Actual Supply Chain Disruption without Demand Shocks
(Percentage point, 2019=0)



Sources: S&P Global via Haver Analytics; and AMRO staff calculations.

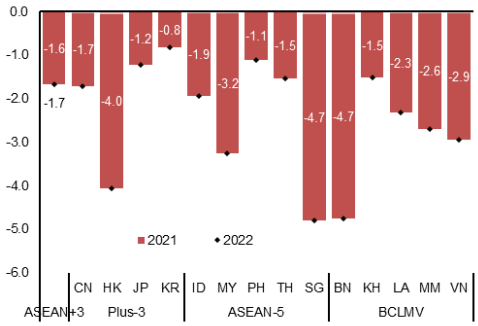
22. **The Great Supply Chain Disruption is estimated to have cut ASEAN+3 GDP by 1.6–1.7 percent from 2019 levels.** Capacity constraints in 2021 are estimated to have pulled down ASEAN+3 output by 1.6 percent relative to 2019 levels (Figure 30). Global supply disruptions particularly hit export-oriented economies with high import content, but their overall impact on GDP was mitigated by domestic sectors that were much less reliant on imports, as in the case with Indonesia, Japan, Korea, and the Philippines (Figures 31 and 32). Meanwhile, impact was greater for Hong Kong, Malaysia, and Singapore—given the relatively higher import shares in both their domestic and external sectors—and for Vietnam, given the disproportionately higher import content in its domestic demand. Supply disruptions have also affected Brunei more sharply, likely because of its greater reliance on

[14] Supply-side constraints were 5.0 percentage points and 5.1 percentage points greater in 2021 and the first six months of 2022, respectively, than in 2019. These deviations determine the amount of shock to foreign water transport service in the AGMFM.

seaborne trade despite being less import-intensive.[15] If the supply disruptions recorded in H1 2022 were to continue through the rest of 2022, ASEAN+3 GDP in 2022 would be pared down by 1.7 percent from 2019. The additional drag to growth in 2022, at nearly 0.1 percent from 2021, would be minimal given that the extent of supply disruptions would be similar.

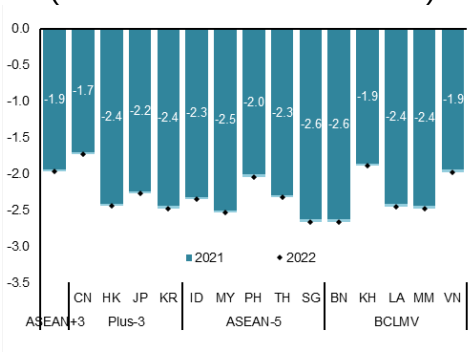
23. **At the same time, the supply chain disruptions are estimated to have pushed ASEAN+3 consumer prices 2.8 percent higher relative to 2019.** The impact estimates indicate a range of within 2.3–2.8 percent increases in ASEAN+3 consumer prices in 2021 and 2022 relative to the pre-pandemic period (Figure 33). A caveat to these impact estimates is that by scenario design, only capacity constraints emanating from shipping and seaborne imported input shortages are accounted for. Incorporating the effects of domestic labor shortages, as evident in the wage pressures faced by countries such as Malaysia and Singapore could amplify the results.

Figure 30. ASEAN+3: Impact Estimates on GDP
(Percent deviation from 2019)



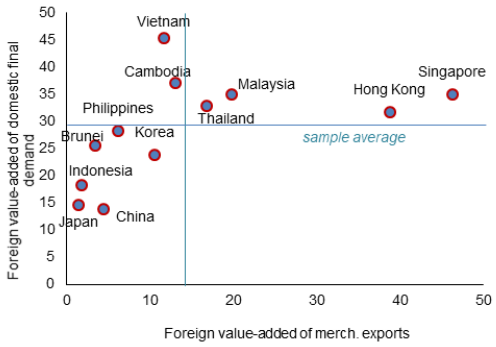
Sources: MarineTraffic; and AMRO staff estimates.
Note: CN = China; HK = Hong Kong, China; JP = Japan; KR = Korea; ID= Indonesia; MY = Malaysia; PH = Philippines; TH = Thailand; SG = Singapore; BN = Brunei; KN = Cambodia; LA = Lao PDR; MM = Myanmar; VN = Vietnam.

Figure 31. ASEAN+3: Impact Estimates on Exports
(Percent deviation from 2019)



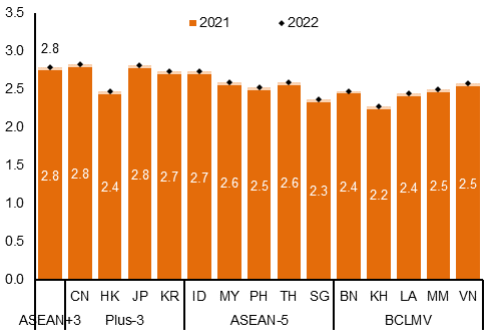
Sources: National authorities; and AMRO staff calculations.
Note: Figures refer to 2018-2021 average, except for Cambodia (2018-2019) and Myanmar (2018). Trade data are from the national income account, except for China, Lao PDR, Singapore and Vietnam, which are from the balance of payments.

Figure 32. ASEAN+3: Import Content of Domestic and External Sectors
(Percent of GDP)



Sources: National authorities; OECD; and AMRO staff calculations.
Note: Figures refer to 2016, as data by the OECD on foreign value-added content are only available up to 2016 and for the above-mentioned ASEAN+3 economies only. Data for Lao PDR and Myanmar are not available.

Figure 33. ASEAN+3: Impact Estimates on Consumer Prices
(Percent deviation from 2019)



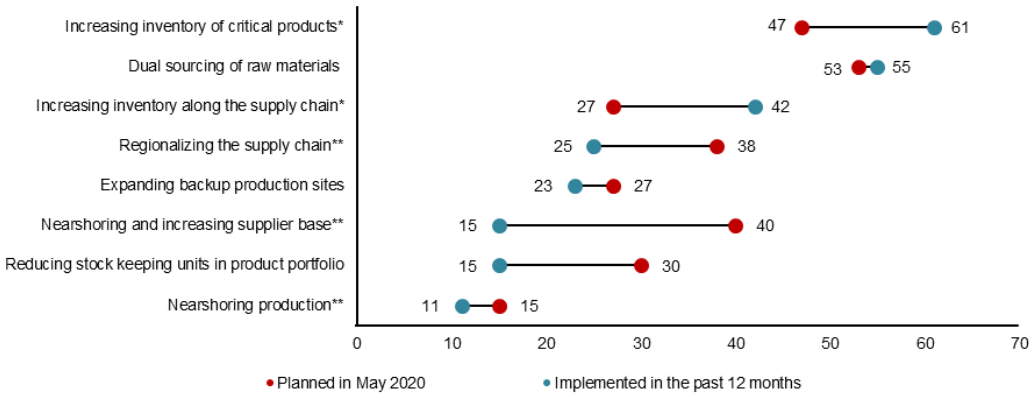
Sources: MarineTraffic; and AMRO staff estimates.
Note: CN = China; HK = Hong Kong, China; JP = Japan; KR = Korea; ID= Indonesia; MY = Malaysia; PH = Philippines; TH = Thailand; SG = Singapore; BN = Brunei; KN = Cambodia; LA = Lao PDR; MM = Myanmar; VN = Vietnam.

[15] Brunei Darussalam's seaborne imports accounted for 85 percent of the country's total imports in 2019, according to UN Comtrade. This proportion is greater than for ASEAN+3 economies with available data: Hong Kong reported 14 percent, Korea 72 percent, Malaysia 59 percent; Myanmar 83 percent, and the Philippines 73 percent, also according to UN Comtrade.

V. Conclusion

24. **The unprecedented disruption to global supply chains over the past two years has highlighted the need to balance efficiency with resilience.** Exposed to input shortages and shipping bottlenecks, businesses have been forced to rethink longstanding cost-efficient strategies of keeping inventories to a minimum and using short-term, flexible contracts (Masters and Edgecliff-Johnson 2021). A McKinsey survey of senior supply chain executives shows that a considerably greater number of respondents actually ended up increasing inventories of critical products and across the entire supply chain, than those that had intended to do so 12 months prior in May 2020 (Alicke, Barriball and Trautwein 2021) (Figure 34). Businesses are said to be shifting from a "just-in-time" to "just-in-case" approach to managing inventories, and are entering into longer contracts with key suppliers.

Figure 34. Planned and Implemented Actions by Global Supply Chain Leaders
(Percent of respondents)



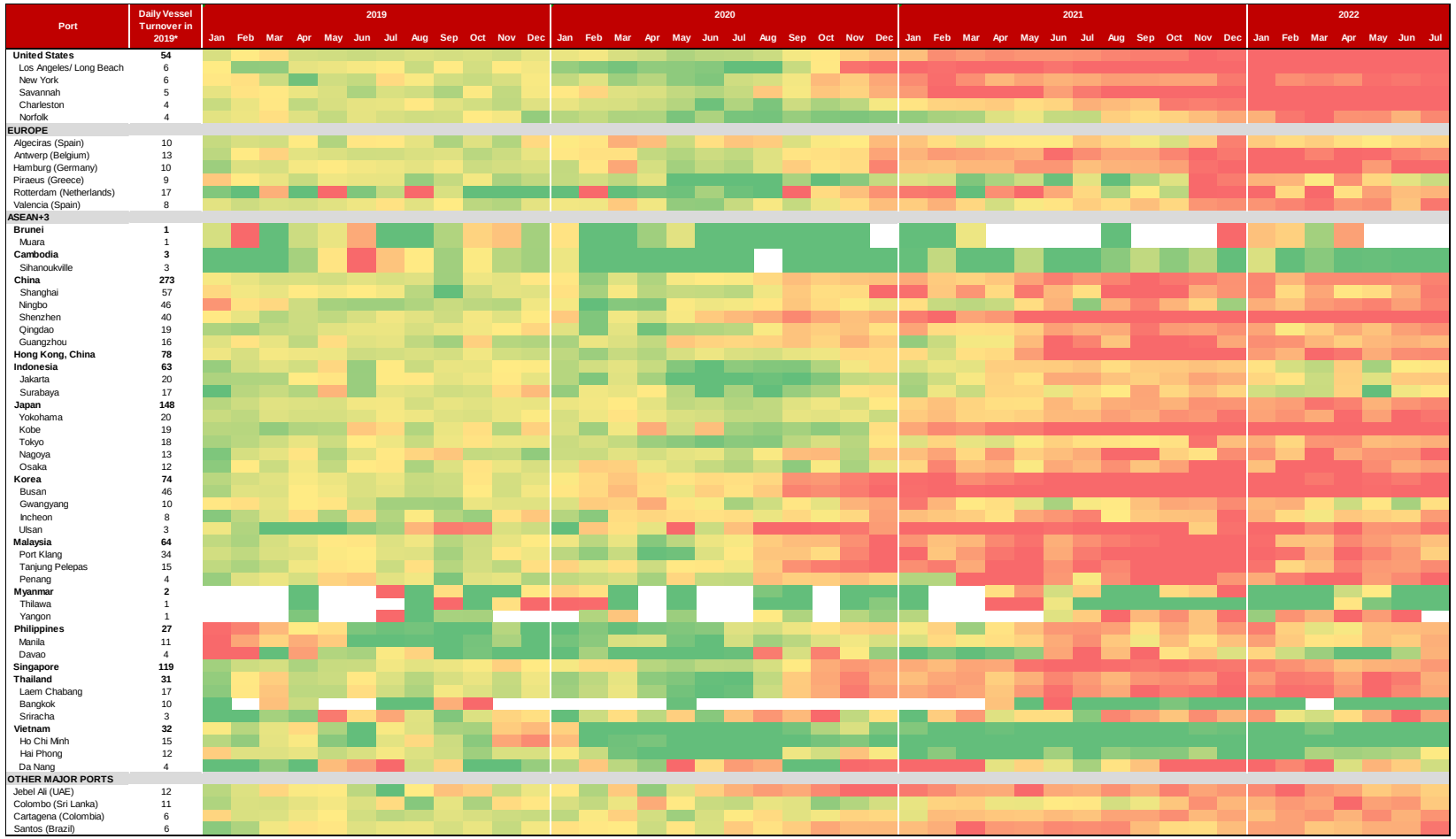
Source: McKinsey & Company.
Note: * refers to actions related to inventory; ** refers to actions related to nearshoring. A total of 71 were surveyed on May 4 – June 16, 2021.

25. **The next few years could see moves to shorten and diversify supply chains in an effort to increase resilience and agility.** The first McKinsey survey in May 2020 indicated strong intentions among businesses to implement nearshoring or regionalization strategies to make their supply chains far more flexible, agile, and resilient. While progress had been slower than anticipated, still close to 90 percent of respondents from a May 2021 survey expressed plans to pursue some degree of regionalization in the next three years (Figure 34). Multinational companies, for example, are considering creating regional hubs with local suppliers, in a move to increase visibility of their supply base across multiple layers. To diversify their supply bases, companies are also taking action to ensure multiple sources of raw materials or build back-up production sites, such as with the "Plus One" strategy. Meanwhile, the United States is pushing for "friend-shoring" to diversify supply chains with trusted partner countries (US Department of Treasury 2022).

26. **Investments in modern digital tools would be critical to strengthen the risk management processes of supply chains.** Technological advances could be harnessed to enable timely and agile responses to emerging supply chain issues. Examples of digital tools to improvement supply chain visibility are the use of track-and-trace sensors for the real-time monitoring of vessels and shipments, and the use of blockchain technology to improve traceability of materials and compliance levels (Sako 2022). The use of external data (weather patterns, port delays, and supplier issues) could also enable real-time corrective decisions, and improve supply forecasting. In this respect, governments have a crucial role to play in facilitating the free flow of data and digital technologies across borders.

Appendix I. Vessel Turnaround Time at Major Ports

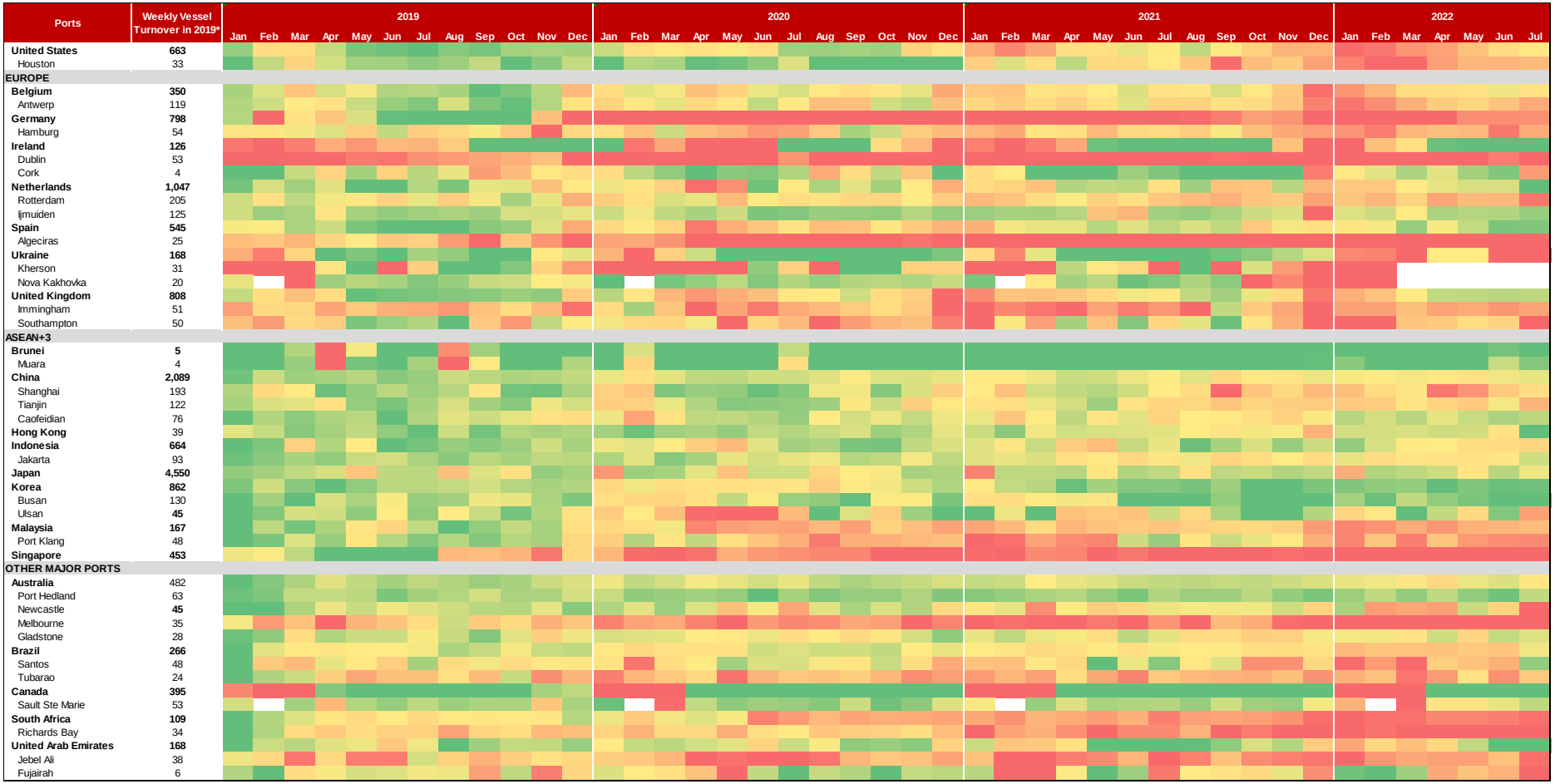
Appendix Figure 1. Vessel Turnaround Time at Major Ports: Container Ships



Sources: MarineTraffic; and AMRO staff calculations.

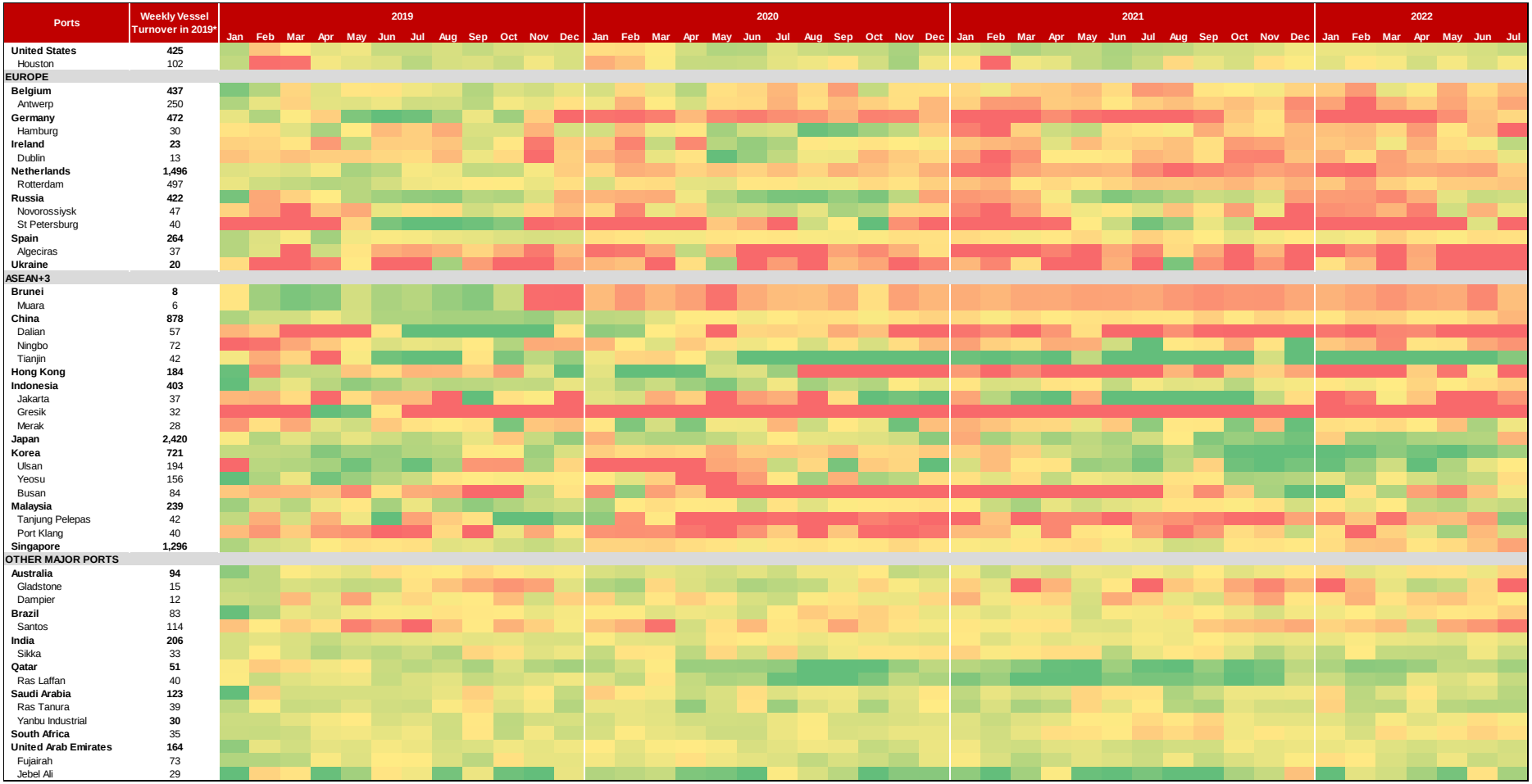
Notes: *Refers to the average number of container vessels that arrive and depart said port within a day from January–December 2019. Dashes (-) mean no container ship was recorded for the month. For the above heatmap, we have included only container ships with a carrying capacity of more than 2,000 TEUs, which tend to be involved in international trade. Red, Yellow, and Green refer to the 90th, 50th, and 10th percentiles, respectively, of the vessel turnaround time (in 2019=100) of the ports featured in the heatmap. Shenzhen (China) port comprises Da Chan Bay, Zhujian Kou, Chiwan, Shekou, and Yantian ports; Guangzhou (China) comprises Huangpu, MCID, Nansha, and Xinsha; Busan (Korea) combines both Busan and Busan New Port; and Manila (Philippines) combines both Manila and Manila South Harbor. Data until July 17, 2022.

Appendix Figure 2. Vessel Turnaround Time at Major Ports: Bulk Carriers/ General Cargo Vessels



Sources: MarineTraffic; and AMRO staff calculations.
Notes: *Refers to the average number of vessels that arrive and depart said port within a week from January–December 2019. Dashes (-) mean no container ship was recorded for the month. Red, Yellow, and Green refer to the 90th, 50th, and 10th percentiles, respectively, of the vessel turnaround time (in 2019=100) of the ports featured in the heatmap. Data until July 17, 2022.

Appendix Figure 3. Vessel Turnaround Time at Major Ports: Tankers



Sources: MarineTraffic; and AMRO staff calculations.
Notes: *Refers to the average number of vessels that arrive and depart said port within a week from January–December 2019. Dashes (-) mean no container ship was recorded for the month. Red, Yellow, and Green refer to the 90th, 50th, and 10th percentiles, respectively, of the vessel turnaround time (in 2019=100) of the ports featured in the heatmap. Data until July 17, 2022.

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