

## General approach

calculate the share of pipeline exports to the EU using Druzhba, and the share of pipeline exports to China using OPEC Monthly Market Reports. Figure 4 is compiled from Eurostat data on trade by transport type. Figure 5 is compiled by volumes reported in OPEC Monthly Market Reports.

Figures 6 and 7 are constructed from the CREA API.

We constructed this database of crude oil (oil products are not included) using real-time data of crude oil tankers. The ship data is from Genscape and is available using the following aggregators: Bloomberg, CREA and MarineTraffic. We accessed individual ship data using Bloomberg and cross-checked this with CREA data.

We restricted our analysis to ships that were in the vicinity (within 30 km) of one of the four main Russian ports (Primorsk and Ust-Luga in the Baltic Sea, Novorossiysk in the Black Sea and Murmansk in the Arctic Sea) at any given time since January 2021. It is important to note that oil transiting through Russian ports is not exclusively Russian. Some crude oil is exported from Kazakhstan to both Novorossiysk and Ust-S<sup>h</sup> some Kazakh oil that was loaded onto ships in Russian ports. We describe our method for excluding this oil below.

When a ship enters a Russian port, we tracked it based on the data it reported several times a day. This included date, current location (latitude and longitude), listed destination, ship ID and, crucially, current draft (how full the ship is).

We combined location and draft data to determine the flows of Russian oil. We defined a ship as being loaded if its draft increased by more than 15% when in the vicinity of a Russian port. If this happened, it marked the beginning of a trip.

A trip was completed if we observed a significant decrease in the draft (by more than 15%) in our data. when this happened, we matched the location where the decrease occurred with a frequently updated list of geolocated ports to determine in what region the oil was unloaded (a ship lands in a given port if its draft decreases

We did not use the destination listed by the ships for two main reasons. The first is that a ship might unload its oil somewhere else on the way. The second is that many tankers make ship-to-ship transfers, usually at sea, in areas suitable for anchoring. Here, the listed destination (Skagen in Denmark or Port Said in Egypt are frequently listed destinations in such cases) does not truly reflect where the oil ends up. As we & ship-to-ship transfers, we listed their

If we did not observe the unloading of a ship in our dataset, we considered the trip to still be in progress. We nevertheless stored its listed destination, its current draft and coordinates. If a tracked ship significantly increased its load elsewhere (not in a Russian port), we dropped the observation.

In order to estimate the volumes of oil being shipped, we estimated oil tankers to be carrying a total load of 85% their maximum capacity. In other words, a tanker with maximum load of 100,000 tons is considered to be transporting 85,000 tons. A ship is either listed as full or empty, meaning that we did not include ships that were half full.

*Excluding Kazakh oil that transits through the Black Sea port of Novorossiysk*

An important share of the oil that is loaded in the port of Novorossiysk is not Russian but Kazakh, transported to the Black Sea through the Transneft pipeline system and loaded onto tankers from the dedicated Caspian Pipeline Consortium (CPC) Terminal. While also in the area of the city of Novorossiysk, the CPC terminal is outside the bay where the main port is located. We therefore use the coordinates of ships while they are being loaded to determine whether or not they are transporting Russian oil. Indeed, if a ship does not enter the bay when loading in the vicinity of