Assessing the Impact of International Sanctions on Russian Oil Exports

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We use a unique high-frequency Russian customs dataset to evaluate the impact of international sanctions on Russia – focusing on Russian crude oil and oil products exports, as they are the key sources of export earnings and government revenues. We study the effects of two focal sanctions measures – the EU embargo and G7 price cap on Russian seaborne crude oil, which both took effect on December 5, 2022. We find that Russia was able to redirect crude oil exports from Europe to alternative markets such as India, China, and Turkey but that export earnings were curbed substantially by the sizable discounts that Russian exporters had to accept in market segments where the impeding EU embargo lowered demand, e.g., exports from Baltic Sea ports – a dynamic that only became more pronounced after the embargo and price cap's taking effect. However, we do not find crude oil discounts as large as those reflected in Urals prices towards the end of 2022. In particular, prices in market segments that are unaffected by lower European demand, e.g., exports from Russia's Pacific Ocean ports, have not dropped in a meaningful way and shipments do not appear to comply with the price cap. What the EU embargo and G7 price cap have, thus, triggered is a fundamental fragmentation of the market for Russian crude oil. Based on our analysis, we conclude that a central focus of policy going forward should be the enforcement of existing sanctions on Russian oil – along with the lowering of the oil price cap. As far as oil products are concerned, we show that it is significantly less feasible to redirect exports away from the European market. This suggests that the EU embargo on oil products, which took effect on February 5, 2023, will prove to be a powerful additional tool to further curb Russian export earnings and fiscal revenues.

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I. Introduction

We use a unique high-frequency dataset[2] to evaluate the impact of international sanctions on Russia—specifically measures targeting Russian crude oil and oil products exports, as they are the key drivers of the country's external accounts, its economy, and government finances—including funding of Russia's war of aggression in Ukraine. In this paper, we focus on two focal sanctions measures: the European Union's (EU) embargo on seaborne crude oil and the Group of Seven's (G7) price cap mechanism, which both took effect on December 5, 2022.

Our key findings are as follows:

- As sanctions on Russian energy were only implemented towards the end of 2022—and as global prices for oil and gas soared—Russia's goods exports reached a record $532 billion in 2022, resulting in an all-time high trade surplus of $316 billion.
- Russia was able to redirect crude oil exports from Europe to alternative markets such as India, China, and Turkey with no loss of volumes, albeit at the cost of accepting discounts in a *subset* of markets where the EU embargo has dramatically lowered demand (i.e., shipments from Baltic and Black Sea ports). This suggests that Russia, at least initially, chose to not reduce volumes in the face of downward pressure on prices.
- **Surprisingly, we do not find crude oil discounts as large as those reflected in Urals prices: in the post-embargo/price cap period, the average export price for Russian crude oil stood at around $74/barrel based on our data—compared to Urals at $52/barrel.**
- In particular, we find that Russian oil exports from Pacific Ocean ports, which are critical for trade with China, do not comply with the G7 price cap—with average prices in the post-embargo/price cap period around $82/barrel. While around 50% of the oil is transported via *Sovcomflot* or the *shadow fleet*[3]—and are, thus, not sanctionable—, the remaining shipments should still be subject to the cap as they involve Western shipping services.

Our policy recommendations are as follows:

- **Our findings do not imply that the sanctions on Russian oil exports should be abolished. Indeed, our data shows that the EU embargo on Russian oil played a key role in driving the deep discounts on Russian oil. Most importantly, our findings suggest that going forward, the enforcement of sanctions on Russian oil exports is critical—including ensuring compliance with price cap-related restrictions on shipping, maritime insurance, and other services.** This is of particular importance as sales to non-sanctions coalition countries now dominate Russia's oil trade.
- **Moreover, our surprising finding of a significant share of Russian crude oil being sold well-above the price cap level of $60/barrel urgently calls for further investigation of these transactions and reinforces the need for stepped-up enforcement.** Key elements

[2] We rely on Russian customs data on goods exports and imports for the period January 2019-December 2022 at the ten-digit HS (Harmonized System) level of classification. More information on the dataset as well as data validation and data limitations can be found in Appendix 1.

[3] See *The Kozmino Mystery* by Craig Kennedy (forthcoming) at https://navigatingrussia.substack.com/.

of this would be risk-based audits of attestations regarding price cap compliance, increased transparency of transactions with non-G7 shipping service providers, and strengthening of capacities for sanctions enforcement, especially in the EU.

- We further believe that the price caps on crude oil should be lowered as soon as possible. While we appreciate concerns regarding market stability and rising oil prices, the post-embargo period demonstrates that Russia is willing to accept lower prices on some of its shipments and is unlikely to cut volumes as long as the price cap level remains above production costs. And—as our analysis suggests—a lower cap could significantly impact Russia's earnings from crude oil exports. Thus, we support the International Working Group on Russian Sanctions' recent call for a $35/barrel cap[4] and propose a similarly aggressive approach as far as price caps on oil products are concerned.[5]

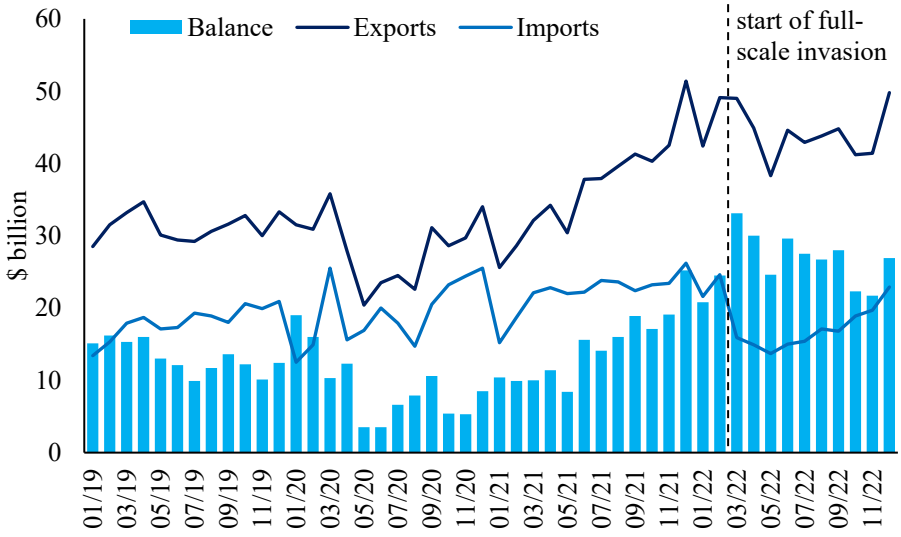
[4] See *Working Group Paper #10: Implementation of the Oil Price Cap* at https://fsi.stanford.edu/working-group-sanctions.
[5] See *The International Working Group on Russian Sanctions Calls For Introducing a Low Price Cap on Russian Oil Products* at https://fsi.stanford.edu/working-group-sanctions.

II. Russian Trade in 2022: Record-High Surplus

Russia recorded a record-high trade surplus of $316 billion in 2022. According to our data, goods exports reached $532 billion last year—an increase of 21% compared to 2021 and the highest ever. At the same time, goods imports dropped sharply to $217 billion—18% lower than in the previous year. These numbers are broadly consistent with the Bank of Russia's recent release of data on the country's external accounts—showing a goods and services surplus of $282 billion and an overall current account balance of $227 billion—as well as official comments by Russia's Federal Customs Service.[6] [7] [8]

Extremely high energy prices and a collapse in imports were the key drivers. Russia's external environment has always been determined by the country's exports of oil and natural gas, with global energy prices being the driving force behind swings in the trade balance—and last year was no different. Exports of oil and gas reached $333 billion in 2022—representing 63% of total goods exports—, with crude oil accounting for $142 billion, oil products for $83 billion, and natural gas for $108 billion. Russia's ability to redirect crude shipments from Western countries—which undertook considerable efforts to reduce their dependence on Russian oil— was critical for keeping up volumes, while elevated global oil prices drove up the value of exports. In the area of naturals gas, soaring prices more than offset sharp volumes declines as a result of Russia's weaponizing of energy and Europe's decisive moving away from Russian supply, and lead to all-time high export earnings. The overall trade surplus was also driven by a sharp drop in imports into Russia in the immediate aftermath of the invasion.

Figure 1: Summary of Russian Trade



Source: Federal Customs Service, authors' calculations

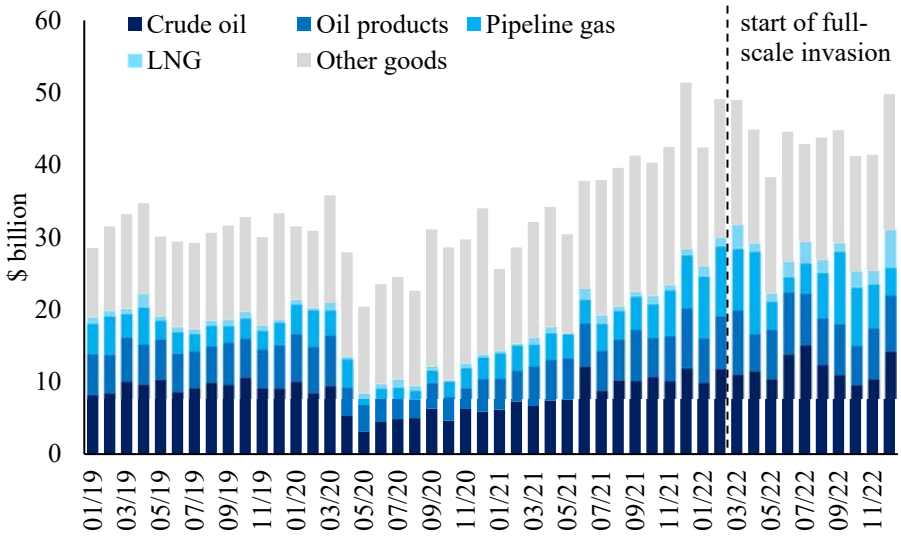
[6] See https://tass.ru/ekonomika/16842409.

[7] See https://www.rbc.ru/economics/10/02/2023/63e2411a9a794730042580a5?from=from_main_1.

[8] Since the beginning of the full-scale invasion of Ukraine, the *Bank of Russia (CBR)* no longer reports goods and services exports and imports separately. However, it publishes regular estimates of the balance of payments' broad parameters. See https://www.cbr.ru/Collection/Collection/File/43710/Balance_of_Payments_2022-4_13_e.pdf.

Full-year numbers conceal that the external environment is worsening rapidly. Russia's trade surplus soared from an average $22.7 billion per month in January-February 2022 to $33.1 billion in March on the back of robust energy export volumes and significantly elevated prices—before falling to a monthly average of $23.6 billion in 2022Q4 (see Figure 1).[9] While oil exports remained robust—at around $55-60 billion per quarter—Russia's drastic reduction of natural gas deliveries to Europe, together with prices returning to pre-invasion levels, weighed on total exports in the second half of the year (see Figure 2). More importantly, however, imports bounced back strongly from their collapse in March-June, when they had fallen by more than one-third. In December, $22.9 billion in imports essentially means a return to pre-invasion (January-February) numbers. In line with our results, the CBR reported a sharp fall in the current account surplus—from an all-time high of $78.5 billion in Q2 to $48.0 billion in Q3 and $31.4 billion in Q4. December was particularly weak with a surplus of only $4.1 billion, the lowest monthly reading since the pandemic year of 2020.[10] While Russian authorities no longer publish details on goods trade, official statistics capture similar changes to the external environment.

Figure 2: Composition of Russian Goods Exports



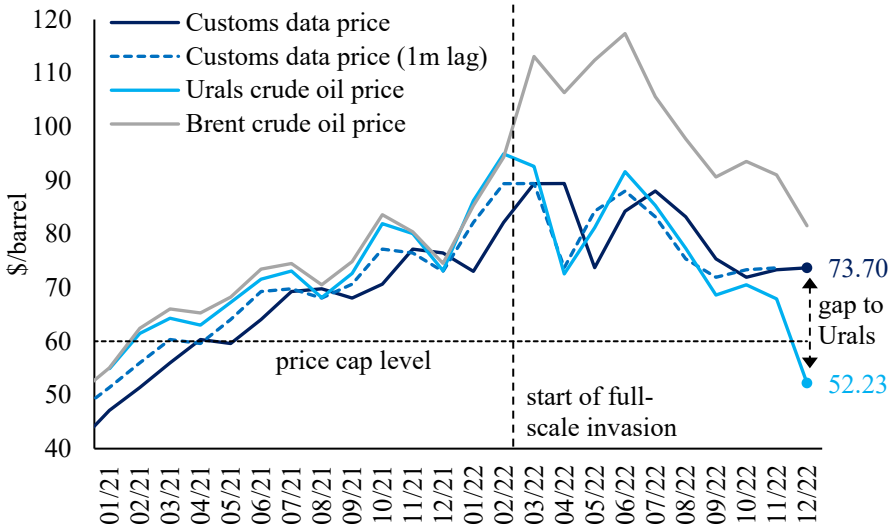
Source: Federal Customs Service, authors' calculations

Prices for Russia's oil exports have been subject to much speculation in the absence of reliable, comprehensive data: our dataset provides a unique glimpse into the prices that Russia is charging for its oil and oil product exports. For crude oil, we find that export prices calculated based on our customs data, when lagged by one month, track historical prices for Urals well, where Urals is the most common export grade of crude oil from Russia (see "Customs data price (1 m lag)" vs "Urals crude oil price" in Figure 3). Discrepancies of this kind are to be expected in our view because actual shipments (which our data captures) take place after the signing of a contract (which forms the basis of market price estimates).

[9] We observe some volatility in the data, especially with respect to trade flows that are continuous in nature but reported to authorities in larger quantities at certain intervals. This is most notable for crude oil and natural gas shipments via pipeline and creates discrepancies with other sources that record physical flows instead.

[10] The *CBR* reported an increase to $8 billion for January 2023. However, this still shows a significant worsening of the external environment compared to most of 2022. See https://www.cbr.ru/eng/statistics/macro_itm/svs/bop-eval/.

Figure 3: Crude Oil Prices



Source: Bloomberg, Federal Customs Service, authors' calculations

In the current context of adjustments to Russian exports following the taking effect of the EU crude oil embargo and G7 crude price cap on December 5, 2022, this time dimension is of critical importance. For instance, **for December, we find an average (volume-weighted)[11] price of around $74/barrel, broadly unchanged from November, while the reported Urals price—the number the press focuses on due to its availability—declined by 23% month-over-month to $52/barrel**. Differences between Urals prices and our estimates are likely a result of several factors: *One*, since the beginning of the full-scale invasion of Ukraine, Russia has been significantly less transparent about its energy trade—in particular, contractual details—and reported prices are often based on trader surveys. *Two*, while our data covers the entire universe of Russia crude oil exports, Urals prices have historically been based to a large extent on contracts for shipments to Europe and, despite efforts to incorporate the fundamental changes the market for Russian crude oil is undergoing, may not fully reflect shipments to buyers like China and India.[12]

Our estimated average oil prices could indicate that Russia is selling crude oil substantially *above* the G7 price cap of $60/barrel and that the discount vs. Brent *narrowed* towards the end of the year (to around $7/barrel). We think this is plausible considering Russia's ability to export certain quantities without reliance on G7 shipping services and incentives for the Russian government to under-report actual prices paid.[13] Moreover, our oil price numbers are in line with recent estimates by Russian oil and gas analysts.[14] This is an important finding and—if confirmed by other research—would have important implications for the assessment of the oil price cap's impact that is currently underway.

[11] Our data includes values and volumes for all crude oil transactions.

[12] Crude oil exports to China via pipeline are elevated in December 2022 due to the fact that customs data captures the date of a transaction's submission to authorities and not the actual shipment. This has some effect on the average price. We estimate December prices of $73-74/barrel if pipeline volumes are adjusted to reflect pipeline capacities.

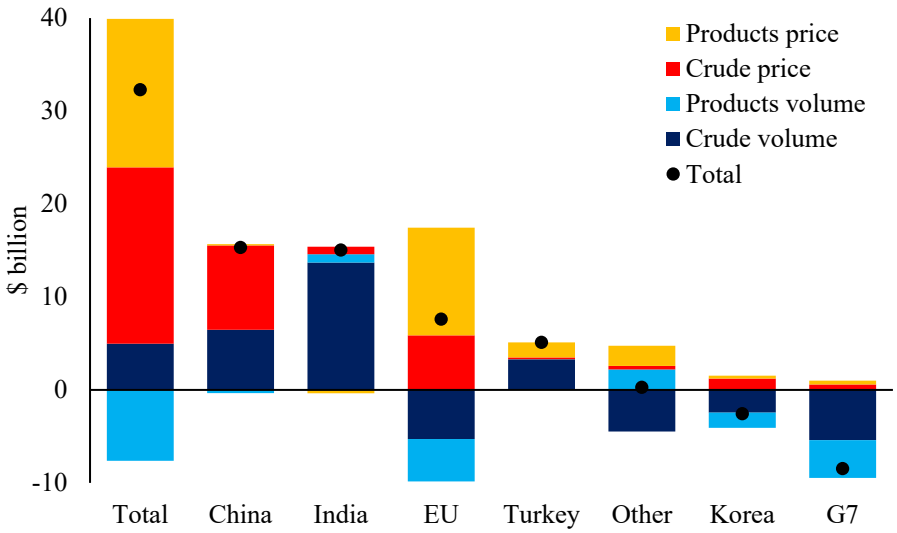
[13] See https://www.belfercenter.org/publication/instituting-price-cap-russias-oil-q-professor-catherine-wolfram.

[14] See https://svakulenko.substack.com/p/the-cap-of-smoke-and-mirrors

It is an open question whether prices for Russian crude exports will deteriorate in the coming months; future iterations of this paper will zoom in on this question. However, our findings with respect to the time lag between movements in reported Urals prices and customs data-based export prices provide support for the hypothesis that shipments should reflect downward pressure on prices as documented by oil market observers in the coming months. That is not to say that Russian attempts to circumvent the price cap do not introduce considerable uncertainty.

Soaring oil prices and the redirection of crude exports more than offset the reduced reliance on Russian oil in sanctions coalition countries. We estimate that higher prices drove up Russian oil exports by around $35 billion in the post-invasion period (March-December 2022) compared to the corresponding period in 2021—of which $19 billion can be assigned to crude oil prices and $16 billion to oil product prices (see Figure 4, which decomposes changes in Russia's oil exports into price and volume effects for both crude oil and oil products). The total effect from volume changes was slightly negative with the increase in crude oil volumes almost offsetting the decrease in oil product volumes. Specifically, we find a positive contribution from crude volumes as exports were redirected to China, India, and Turkey. Oil product volumes fell due to G7 countries' reduction of purchases in the absence of significant additional sales to alternative markets. As far as individual buyers of Russian oil are concerned, this analysis shows that sharply higher prices offset volume reductions for both crude oil and oil products in the case of EU countries, leading to payments to Russia $7.6 billion higher than in March-December 2021.

Figure 4: Contributions to Change in Oil Payments



Source: Federal Customs Service, authors' calculations

What should not be overlooked, however, is that the sizable discount on Russian crude oil during most of 2022 reduced the country's export earnings considerably. Although the EU embargo and G7 price cap were not implemented until December, Russia had to accept significantly lower prices to maintain export volumes. We estimate that the widening spread between Russian export prices and Brent crude, which soared to above $30/barrel in April-May (see Figure 3), shaved off more than $30 billion—or above $3 billion per month from crude oil exports compared to a scenario in which Russia received close to market prices.

III. Crude Oil Exports Under International Sanctions: New Buyers and Market Fragmentation

Sanctions Did Not Begin in Earnest Until December of 2022

International sanctions are of critical importance for the analysis of Russian oil exports. Several events are key to the understanding of oil export dynamics, with the timeline illustrating that meaningful sanctions did not begin in earnest until December of 2022:

(1) The European Union decided to place Russian oil and oil product exports under a comprehensive embargo as part of its sixth sanctions package in June—with crude restrictions taking effect on December 5, 2022, and oil products on February 5, 2023. While the embargo only includes seaborne oil and, thus, does not affect deliveries via the important Druzhba pipeline, Germany and Poland committed to ending such flows by the end of 2022. This, effectively, leaves only deliveries to the Czech Republic, Hungary, and the Slovak Republic through Druzhba's southern branch—a relatively small share of total Russian crude exports to the EU (14% in 2022).

(2) Other members of the sanctions coalition imposed restrictions on Russian oil and oil products much earlier; however, they also accounted for a significantly smaller share of Russia's exports. The U.S. banned the import of all Russian energy products in March-April, first, through presidential executive order and, later, the Ending Importation of Russian Oil Act. Australia and Canada also placed Russian energy exports under embargo, both in March, and the United Kingdom decided to do so in June, with this measure legally binding on December 31, 2022. Finally, Switzerland's ban on crude oil took effect in June. As we will show in more detail below, these countries' crude and product imports from Russia essentially came to a halt by July 2022.

(3) Coinciding with the EU embargo on crude oil, the G7 oil price cap also took effect on December 5. Here, countries under whose jurisdiction a significant number of oil tankers and the overwhelming share of maritime insurance companies operate, mandated that any crude oil exports from Russia must be conducted under a price cap of, initially $60/barrel, to be able to rely on such shipping and insurance services provided by EU/G7 companies.

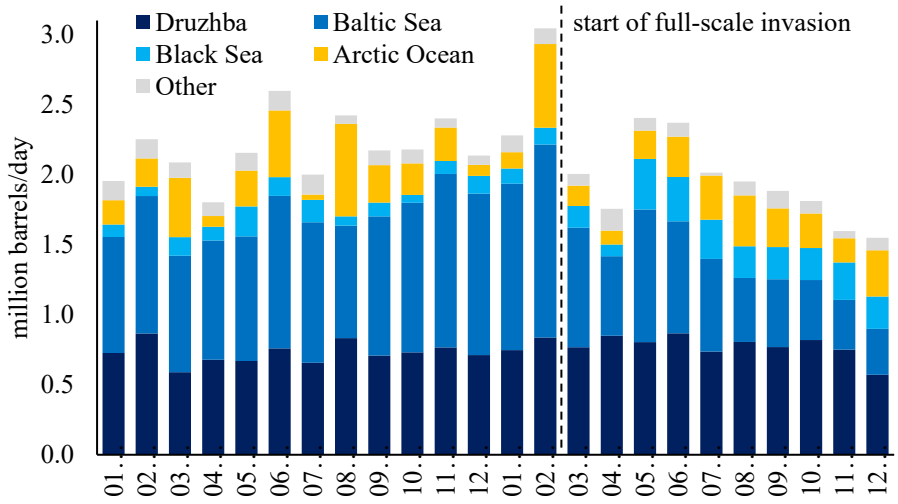
(4) While sanctions on Russian oil exports are fairly comprehensive, especially since the taking-effect of the EU embargoes, several important buyers have not implemented any restrictions—in fact, they have significantly stepped-up purchases. Among them are China, India, and Turkey, which are responsible for a substantial share of Russian crude oil exports, as well as Singapore and the UAE, which imported meaningful quantities of oil products. Japan, while aligned with international sanctions on Russia in many areas, has not implemented any restrictions on Russian oil and gas.

The partial sanctions regime outlined here means that important changes to the pattern of Russian oil exports took place in 2022, which we analyze in this paper next.

Crude Oil: Volumes Recovered as New Buyers Stepped In

EU imports of Russian crude oil have been falling since the embargo decision in June. We identify several key developments that can be placed in the context of the war and international sanctions (see Figure 5). *First*, import volumes fell sharply in March-April following Russia's full-scale invasion of Ukraine. *Second*, volumes recovered in May and June as energy markets adjusted to the ongoing war and, likely, as discussions regarding an embargo gained traction. *Third*, since the EU's decision on its sixth sanctions package, volumes have fallen every month, reaching 64% of the May level by December. *Fourth*, despite the taking effect of the embargo on December 5, customs data registers shipments for the rest of December as existing contracts were executed. *Finally*, import dynamics have changed with respect to the channels through which EU countries receive Russian crude oil. Specifically, deliveries via the Druzhba pipeline, which are exempted from the embargo, remained relatively stable throughout the year, while seaborne oil from Russian ports in the Baltic Sea, by far the most important channel in the past, fell sharply. These developments have important implications for the overall market for Russian crude oil.

Figure 5: EU Imports of Russian Crude Oil from Russia[15]

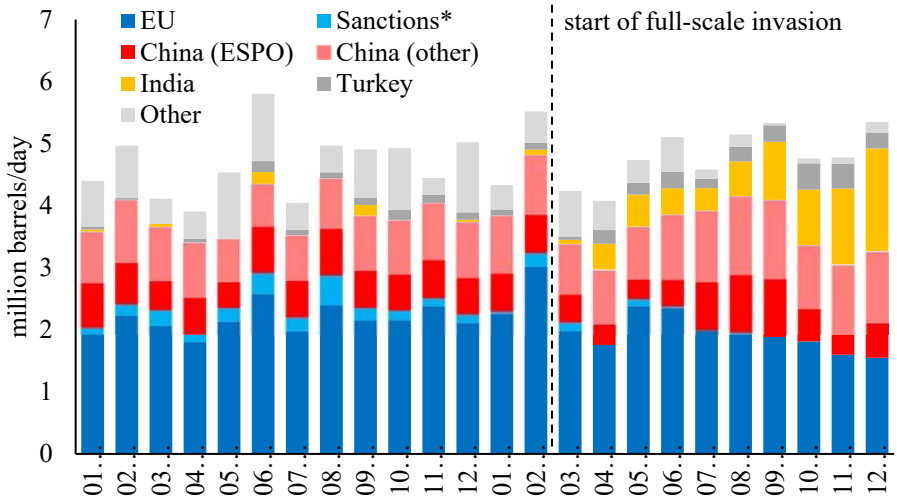


Source: Federal Customs Service, authors' calculations

China and India have replaced the EU as Russia's most important export market. As mentioned above, other members of the sanctions coalition also imposed restrictions on Russian crude oil and exports to these countries which, while small to begin with, fell to zero over the course of 2022H2 (see Figure 6). At the same time, China continued to purchase significant quantities from Russia and India increased its own dramatically. In the fourth quarter, the two countries, together with Turkey, accounted for two-thirds of total Russian crude oil exports, as compared to roughly 30% in the first quarter of last year.[16]

[15] Crude oil volumes are converted from tons (in source data) to barrels using a factor of 7.33 throughout the paper.
[16] In our data, we find a sharp increase in pipeline oil exports to China in December. This is a result of a small number (23) of contracts between *China National Petroleum Corporation (CNPC)* and Russia's *Rosneft* (plus one contract with *Transneft*). In total, these contracts for *ESPO* deliveries account for 5.6 million tons of crude oil (or

Figure 6: Imports of Russian Crude Oil from Russia[17]



*Source: Federal Customs Service, authors' calculations *AU/CA/CH/UK/US*

Significant changes to trade patterns have led to fragmentation in the market for Russian crude oil. Through which channels different countries acquire crude from Russia is of critical importance for market conditions and, thus, price dynamics. To look at such issues in more detail, we break up 2022 in four time periods: the pre-invasion period (calendar weeks 1 to 7; Russia started its full-scale war in week 8), the time from the invasion to the decision on the EU embargo as part of the sixth sanctions package (calendar weeks 9 to 22), the time between this decision and the EU embargo's implementation on December 5, 2022 (calendar weeks 23 to 48), and the post-embargo period (calendar weeks 49 to 52).

First, we look at Russia's export channel independent of a shipment's destination (see Figure 7). We find that exports via the Druzhba pipeline and Baltic Sea ports declined significantly, especially in the post-embargo period as Europe reduced its reliance on Russian crude. At the same time, shipments from Black Sea, Arctic Ocean, and Pacific Ocean ports remained broadly stable, while exports through other channels that we are not able to assign geographically increased.[18]

Second, we combine the geographical location of a shipment with its ultimate destination (see Figure 8). This analysis shows that EU imports from Russian Baltic Sea ports have essentially come to an end by January 1, 2023—a development in line with the EU embargo and of critical importance for Russia as such shipments had made up close to 30% of all Russian crude exports in the pre-invasion period. What remains from the perspective of the EU, and sanctions coalition

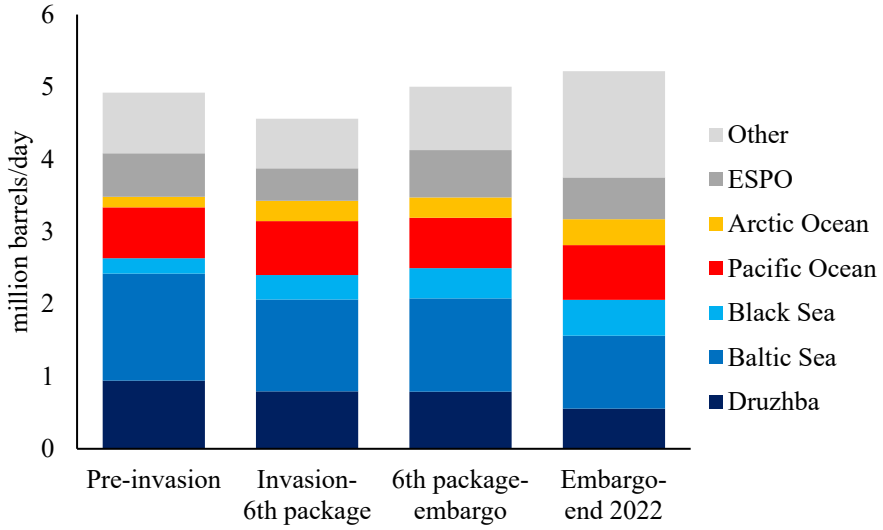
50% of all Chinese imports of Russian crude in December). While they were reported to Russia's *Federal Customs Service* on only four dates—December 9, 13, 20, and 22—actual shipments are most likely stretched out over a longer period of time. This notion is also supported by the fact that significant month-to-month fluctuations can be observed in the past. For instance, October and November of 2022 only show deliveries of 1.1 and 0.6 million tons, respectively. In December, *CNPC* paid between $78/bbl and $84/bbl for Russian crude, with an average of $81/bbl.

[17] For our analysis of export volumes, we use three-month moving averages for crude oil shipments to China via pipeline to account for the customs data accounting issue outlined above.

[18] The latter includes shipments with missing data as well as those with locations that cannot be assigned to export channels such as ports in receiving countries.

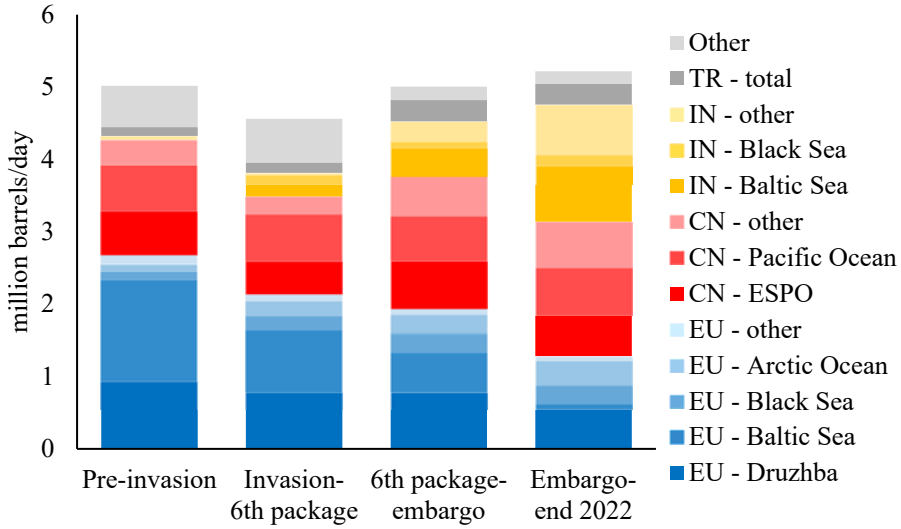
countries per se, is seaborne oil from Black Sea and Arctic Ocean ports as existing contracts are executed. Importantly, our data shows that pipeline flows via Druzhba, which are exempt from the embargo, have not changed materially.

Figure 7: Crude Oil Exports by Period[19]



Source: Federal Customs Service, authors' calculations

Figure 8: Crude Oil Exports by Period



Source: Federal Customs Service, authors' calculations

[19] For our analysis of export volumes, we use twelve-week moving averages for crude oil shipments to China via pipeline to account for the customs data accounting issue outlined above.

Pipeline oil to Europe consists of 60% flows through Druzhba's northern branch (to Germany and Poland) and 40% through its southern branch (to the Czech Republic, Hungary, and the Slovak Republic). As Germany and Poland committed to ending pipeline oil imports from Russia by the end of 2022 and seaborne oil is fully banned, we expect that future crude exports to the EU will likely fall to around 200-250 thousand barrels/day—a roughly 90% decline compared to the pre-invasion period.

Attempts to redirect exports encounter infrastructure constraints. Not surprisingly, Russia is attempting to route deliveries in a way that minimizes shipment times and, thus, costs. This is reflected in the maximizing of pipeline flows to China (largely via the *Eastern Siberia-Pacific Ocean Pipeline* or *ESPO*)—here, the capacity lies around 900 thousand barrels/day. Together with another pipeline through Kazakhstan, *ESPO* allows Russia to route around 15-20% of its crude oil exports through channels that cannot be reached by international sanctions (for details, also see *Section IV*, below).

Russia has attempted to route larger quantities through its Russian Pacific Ocean port at *Kozmino*. But as we see with *ESPO*—which also supplies crude oil to *Kozmino*—Russia's ability to redirect exports is limited by the existing infrastructure. Ports close to China and India are reaching capacity limits while those freed-up by the loss of the European market (in the Baltic Sea) are located far away—increasing not only delivery times (to around a month) and costs, but also requiring a much larger number of ships. Nonetheless, we find that Russia is shipping crude oil to India from the Baltic Sea and Black Sea, to maintain export volumes (see Figure 8).

Price Dynamics: Crude Oil Market Fragmentation

Oil market fragmentation has led to diverging prices for Russian crude oil. Due to these developments, the Russian oil export market saw increasing fragmentation during 2022. This becomes clear when looking at oil price dynamics (see Figure 9).[20] Until Russia's full-scale invasion of Ukraine, prices for Russian crude did not differ significantly depending on the specific export channel—this has changed dramatically. The key driver here are fundamental changes in demand from different buyers in the context of oil infrastructure geared toward traditional export partners such as Europe and geographically set up for this purpose.

We find that, essentially, two different markets have emerged for Russian crude oil:

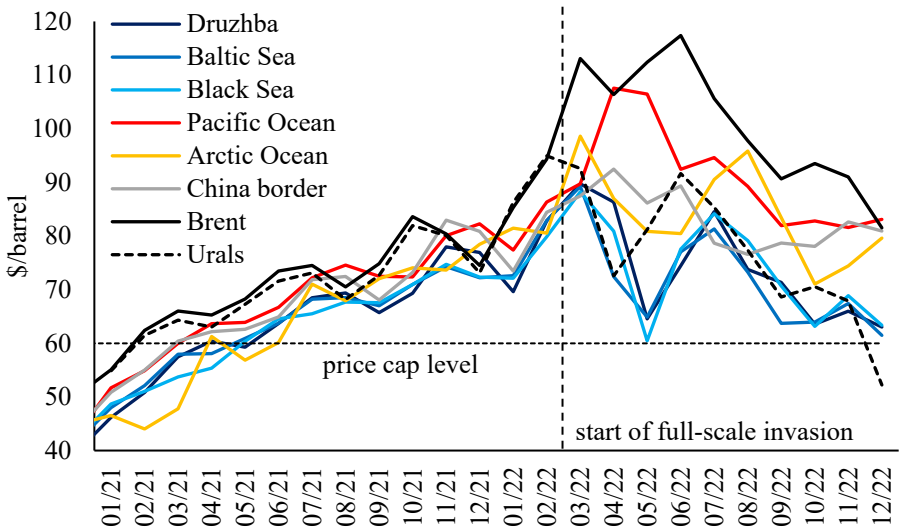
(1) Where European demand has fallen sharply and alternative buyers are impossible (e.g., via *Druzhba*) or hard to find and service (e.g., Baltic Sea and Black Sea ports), prices have fallen significantly—to around $60/barrel, or $20/barrel below Brent in December 2022. Weekly data shows that prices weakened in particular after the taking effect of the EU embargo, as well as the G7 price cap, on December 5 (see Figure 10).

(2) Where Europe's moving-away from Russian crude does not matter (e.g., Pacific Ocean ports and pipelines to China), demand conditions did not change materially (see Figure 9). As a result, Russia did not have to offer any discounts to alternative buyers—and prices

[20] We recognize that different contractual terms could compromise the comparability of transactions. However, we find that the seaborne crude oil exports documented here almost exclusively take place under FOB ("free on board") or FCA ("free carrier") terms, which assign the responsibility for the carriage and transportation costs to the buyer. Thus, transportation costs should ***not*** be influencing the relative prices that we calculate.

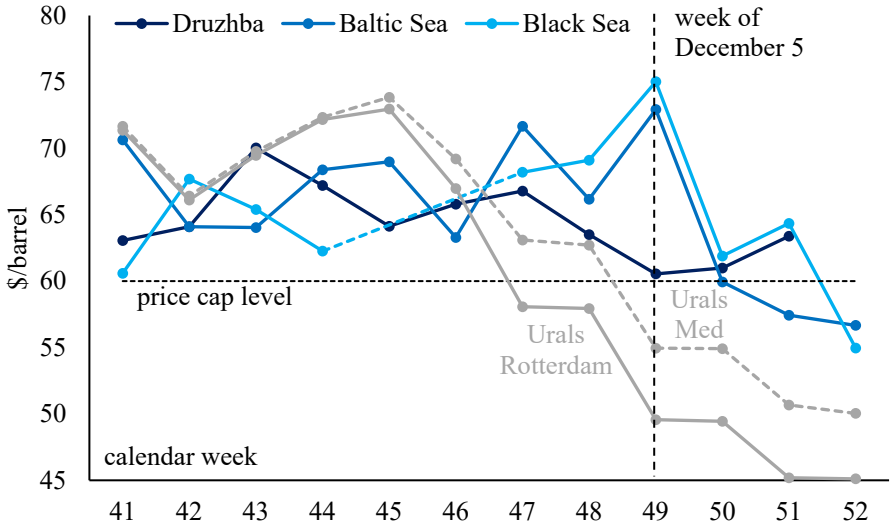
did not decline much at all in 2022Q4. In fact, Russian crude delivered via pipeline to China, or from its Pacific Ocean port of *Kozmino* port, costs roughly $20/barrel more than Baltic and Black Sea oil, with essentially no discount vs. Brent. Shipments from Arctic Ocean ports have always been much smaller in size and, thus, display more volatile price dynamics due to the outsized effect of individual transactions. However, as European customers did not play a major role here, market conditions have not changed materially and discounts not materialized.

Figure 9: Crude Oil Price by Export Channel



Source: Bloomberg, Federal Customs Service, authors' calculations

Figure 10: Crude Oil Price by Export Channel



Source: Bloomberg, Federal Customs Service, authors' calculations

Russia is offering steep discounts to some trading partners, particularly India, to be able to export sufficient volumes—specifically from ports that have lost European business. To investigate this further, we focus on the post-embargo period and, again, break up exports by channel and ultimate destination (see Table 1). The data shows again how extensively Russia is relying on shipping crude oil to India from Baltic Sea ports (800 thousand barrels/day), thereby accepting the longest possible shipping route and being forced to lower prices. India is paying $22/barrel below Brent for shipments from the Baltic Sea—and China $16/barrel below with volumes much smaller (150 thousand barrels/day).

However, Table 1 also reinforces our earlier point that those segments of the Russian oil market that are not much affected by the EU embargo, such as crude oil shipped from Pacific Ocean ports, do not display similar dynamics. **Despite popular beliefs that China is getting large discounts on its purchases of Russian crude oil, this appears to be incorrect.** In fact, we calculate an average price of $84/barrel based on transactions reported to Russia's customs service—with pipeline oil slightly cheaper at $81/barrel vs. seaborne crude from *Kozmino* at $84/barrel. While India receives a discount for Pacific Ocean shipments—as Russia is trying to gain alternative customers through all available export channels—it is significantly smaller (by $10-11/barrel) than the one we documented above for Baltic Sea shipments.

Table 1: Post-Embargo Exports of Russian Crude Oil[21] [22] [23] [24] [25]

	Total	EU	China	India	Turkey	Total	EU	China	India	Turkey
	Average price, $/barrel					*Volume, million barrels/day*				
Total	**73.70**	**69.79**	**81.86**	**64.00**	**68.87**	**6.1**	**1.3**	**2.8**	**1.6**	**0.3**
Baltic Sea ports	**59.86**	75.41	63.96	58.03	55.71	**1.0**	0.1	0.1	0.8	0.0
Black Sea ports	**63.34**	68.06	…	58.23	58.44	**0.5**	0.3	…	0.1	0.1
Pacific Ocean ports	**82.24**	…	84.28	69.62	…	**0.8**	…	0.7	0.1	…
Arctic Ocean ports	**79.31**	79.79	…	…	…	**0.4**	0.3	…	…	…
Druzhba	**62.98**	62.98	…	…	…	**0.6**	0.6	…	…	…
China via pipeline	**80.91**	…	80.91	…	…	**1.5**	…	1.5	…	…
Destination reported	**74.49**	…	88.12	69.94	67.90	**0.9**	…	0.2	0.5	0.1
Other/unassigned	**77.93**	77.03	84.57	87.72	92.83	**0.6**	0.1	0.3	0.1	0.1

Source: Federal Customs Service, authors' calculations

[21] Table does not show separately 175k barrels/day to other destinations; category "destination reported" consists of shipments for which customs data provides the destination instead of the port of origin; category "other/unassigned" includes shipments with missing data as well as those with locations that cannot be clearly assigned.

[22] Prices for categories "destination reported" and "other/unassigned" are not directly comparable to other export channel prices as they consist of transactions that are partially or largely conducted under contractual terms which assign the responsibility for the carriage and transportation costs to the *seller*, e.g., CFR ("cost and freight") or CIF ("cost, insurance and freight"). Price differences can also not be interpreted as indicative of transportation costs as the customs data does not specify the export location and, thus, does not allow to determine the exact shipping route.

[23] Volume for crude oil exports to China via pipeline reflects data as reported to customs.

[24] We find that exports classified in customs data as crude oil (HS code 2709) could contain some oil products, which would have implications for prices in Table 1. It may also indicate that Russia's officially reported balance of payments statistics are distorted. We will investigate this issue further in future iterations of this paper.

[25] For the time period shown in the table (calendar weeks 49 to 52), average prices for Urals Rotterdam and Urals Med were $47.3/barrel and $52.6/barrel, respectively.

Russia does not appear to be selling under the price cap from *Kozmino*. One of the key questions that has emerged post-December 5 is whether Russia is selling crude under the price cap or not. While detailed contractual terms may not be accurately represented in this data, we find that Russia is *not* selling its oil from the *Kozmino* port under the oil cap prices of $60/barrel—out of 83 total transactions during calendar weeks 49 to 52, 65 fell into a range of $80-90/barrel. **Russian companies were largely selling to traders in the UAE and East Asia with almost all shipments—85% in volume terms—destined for China.**[26] All contracts are under FOB terms, which means that the buyer is responsible for the cost of carriage from the sending to the receiving port. As mentioned before, it may take time for discounts observed in Urals prices to become evident in customs data—thus, our findings are preliminary.

Key Drivers: Embargo vs. Price Cap

The effectiveness of the G7 price cap on Russian crude oil is much debated. As the introduction of the cap coincides with the taking effect of the EU embargo, it is somewhat difficult to distinguish between effects of the two. Most observers seem to believe that the embargo is the primary driver behind current oil market developments—and we tend to agree.

The key argument is the time dimension. The fragmentation of the market for Russian crude oil—and resulting price dynamics—is a development that began in the spring of last year and continued throughout 2022 as decisions on sanctions, including the embargo, were made and implemented. This is significantly before any debate on a price cap mechanism began or any details on the specifics of the proposal, including the cap's level, emerged. This is not to say that we do not believe that the price cap has an impact or is an important policy instrument.

While some oil market analysts have presented evidence in recent weeks that Russia has opted for higher crude export volumes out of *Kozmino* and accepted usage of Western-owned and Western-insured ships—and, thus, sales under the price cap—, we find export prices significantly above the $60/barrel level in December. It is important to recognize that such transactions may not be reflected in our data due to the shortness of the post-cap period. Future iterations of this paper will zoom in on developments in January-February.

[26] For more details on post-embargo crude oil contracts at *Kozmino*, please see Appendix 2.

IV. Counterfactuals: Impact of Hypothetical Earlier Restrictions on Russian Crude Oil

In this section, we try to estimate how Russia's crude oil exports would have performed in several hypothetical scenarios with respect to sanctions on Russian oil—counterfactuals—and what takeaways there may be in terms of future sanctions measures. While we recognize that stricter (and earlier) measures on Russian oil exports would have been extremely challenging for the countries imposing them at the time, we want to show how much money was left on the table for Russia—and what kind of impact could be achieved now as further sanctions decisions loom.

We focus on two types of scenarios: (i) an earlier implementation of the EU embargo on crude oil, and (ii) an earlier implementation of the G7 price cap.[27]

Scenario I: Earlier Crude Oil Embargo

To illustrate the impact that an earlier implementation of the EU's embargo on Russian crude oil would have had, we report the monthly change in Russia's oil exports should imports have been reduced to zero by the EU (see Table 2). In our calculations, we also include several other countries that either introduced embargoes or aligned their measures with those of the EU. The main driver of our findings, however, are shipments to the EU.

As EU reliance on Russian crude declined in the aftermath of the EU embargo decision in June, the potential impact of an embargo does so as well. **We find that a complete stop in the immediate aftermath of the invasion would have reduced Russian crude oil exports by $46 billion, or roughly one-third.** Had the embargo taken effect after the EU's sixth sanctions package was agreed upon (in July), the decline would have been around $25 billion.

Table 2: Change in Russian Crude Oil Earnings

	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
$ billion										
Monthly impact	-6.0	-4.5	-5.3	-5.5	-5.3	-5.0	-4.1	-3.7	-3.3	-3.3
Cumulative impact	-45.9	-39.9	-35.4	-30.1	-24.6	-19.3	-14.3	-10.3	-6.6	-3.3

Source: Federal Customs Service, authors' calculations

We recognize that these numbers likely overestimate the impact as Russia has been able to redirect crude exports to other buyers since European countries began to move away from Russia's supplies. On the other hand, our analysis shows that the loss of a substantial share of demand has weighed heavily on prices of crude oil shipped from ports geared toward exports to Europe. With an earlier embargo, this dynamic would have also materialized earlier.

Overall, embargo scenarios are somewhat problematic as they cannot fully account for effects on the volume of exports to other markets as well as the impact on prices. Thus, we look at price cap counterfactuals where volumes are not the main lever and where price changes should not affect total exports as long as the cap remains above Russian oil production costs.

[27] Under all scenarios, unless specifically stated, we assume perfect implementation and enforcement.

Scenario II: Earlier Crude Oil Price Cap

As far as the price cap is concerned, we believe that three dimensions are critical for its impact and should be reflected in our analysis. For these, we simulate the following scenarios:

(1) *Time of the price cap's taking effect:* March 2022 in the immediate aftermath of the invasion; July 2022 as the first month after the EU embargo decision; and October 2022 as the first month after Russia's annexation of Ukrainian territory.

(2) *Level of the price cap:* $60/barrel (as ultimately chosen), $50/barrel, and $40/barrel.

(3) *Effectiveness of the price cap/compliance rate:* Here, we incorporate several assumptions with respect to the G7's ability to implement such a measure, specifically, that any price cap would be 100% effective for crude exports to countries of the "price cap coalition" (G7, EU, and Australia) and that it would be 0% effective for pipeline oil flows to China. For the remaining shipments, we model levels of 100%, 50%, and 0%, with the remaining volumes sold at the realized prices.

Our findings are summarized in Table 3. We find that results differ—by around $50 billion between the most and least impactful scenarios. **Assuming a price cap of $40/barrel, introduced in March 2022 with a 100% compliance rate, Russian export earnings would have declined by close to $50 billion.** For reference, actual earnings for the full-year came in at $142 billion, meaning that this scenario would have resulted in a roughly one-third reduction.

Table 3: Change in Russian Crude Oil Earnings by Scenario

Price cap level	**$60/barrel**			**$50/barrel**			**$40/barrel**		
Compliance rate	**100%**	**50%**	**0%**	**100%**	**50%**	**0%**	**100%**	**50%**	**0%**
Start date	***Impact, $ billion***								
March 2022	-23.9	-17.1	-10.4	-36.4	-26.4	-16.5	-48.9	-35.7	-22.6
2022Q3	-12.3	-8.5	-4.8	-19.8	-13.9	-8.1	-27.3	-19.3	-11.4
2022Q4	-4.6	-2.9	-1.1	-8.6	-5.6	-2.7	-12.6	-8.4	-4.2

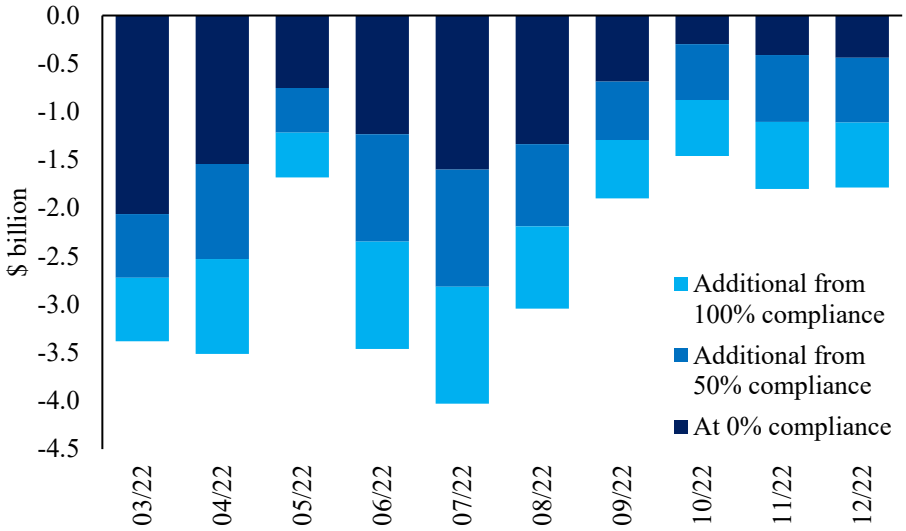
Source: Federal Customs Service, authors' calculations

At the other end of the spectrum—a $60/barrel cap that, effectively, only applies to exports to the EU/G7—earnings would not have changed in any meaningful way (-$1.1 billion). Two important dynamics should be emphasized: with EU/G7 imports of Russian crude oil declining markedly over 2022H2, these represent a less-and-less effective lever. And, with pipeline oil exports to China growing, shipments that cannot be reached via the cap are gaining in importance.

What this analysis shows, however, is that **Russian oil exports could have been reduced in a meaningful way—even with a cap that is only partially effective**. A $40/barrel cap—which most analysts see as substantially above Russian crude production costs and, thus, would not have prompted the country to stop supplying oil to the market—could have cost Russia more than $35 billion if applied in March and even if only complied with at a 50% rate.

While our analysis illustrates that a price cap can have an important impact, time—and leverage—has been lost. With EU/G7 imports of Russian crude approaching negligible levels in the aftermath of the embargo's taking effect in December and Chinese pipeline imports growing in importance, any cap's effect is increasingly dependent on the ability to enforce it (see Figure 11).

Figure 11: Change in Russian Crude Oil Earnings by Scenario



Source: Federal Customs Service, authors' calculations

V. Oil Product Exports Under International Sanctions: Embargo Impact Yet to Be Seen

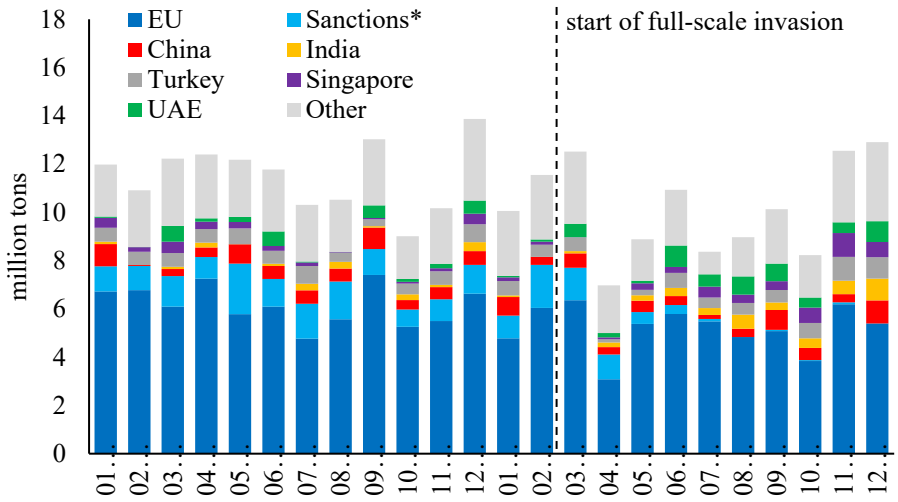
Oil Products Exports: A More Complex Market

The market for oil products is fundamentally different from crude in several ways. First, outside of exports to the EU, which accounted for 50% of total Russian product exports in 2022, oil product market is much more fragmented, with China, India, and Turkey—the most important buyers of Russian crude oil after lower European demand—playing a much smaller role, and many smaller export partners making up the remaining share (see Figure 12).

Some dynamics with respect to oil products are similar to the ones we observed for crude oil above, including the disappearance of exports to non-EU countries that imposed sanctions, e.g., the U.S. and United Kingdom. Exports to China, India, and Turkey have also grown but substantially less so than in the case of crude oil as these countries have their own refining industries and are, thus, not interested in additional supply from Russia.

A key difference to crude oil is that EU imports of Russian oil products have not reacted as much to the EU June's decision to impose an oil embargo—potentially a reflection of the fact that restrictions on oil products take an effect several months after the crude oil embargo.

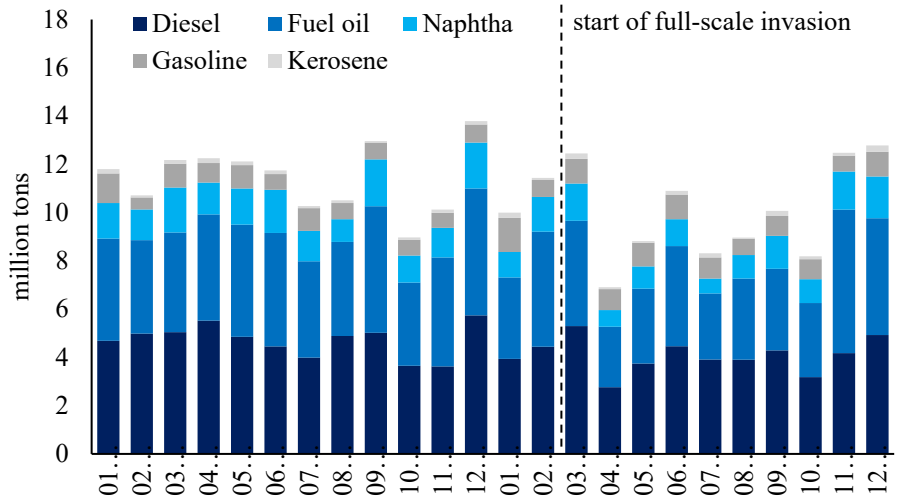
Figure 12: Imports of Oil Products from Russia



Source: Federal Customs Service, authors' calculations

The second major difference to crude oil is that, when we talk about the oil products market, we are effectively discussing several separate markets for individual types of refined oil (see Figure 13). Diesel is, by far, the most important item for Russian exports, accounting for roughly 50% of total product exports in 2022, but fuel oils (25%), gasoline (10%), and naphtha (10%) also play an economically meaningful role. Importantly, different countries import these products to varying degrees; therefore, a comprehensive analysis of product exports requires looking at them individually (Table 4).

Figure 13: Russian Exports of Oil Products by Category



Source: Federal Customs Service, authors' calculations

Table 4: Geographical Distribution of Oil Product Exports

	EU	Turkey	Sanctions*	China	UAE	Singapore	India
Volume (2022), thousand tons							
Diesel	30,062	4,298	1,725	210	297	395	1,571
Fuel oil	19,391	1,545	3,726	2,235	4,512	3,436	2,309
Naphtha	7,925	196	112	1,356	616	375	60
Gasoline	4,209	11	438	2,070	8	93	37
Share of total by product (2022), %							
Diesel	61.4%	8.8%	3.5%	0.4%	0.6%	0.8%	3.2%
Fuel oil	42.5%	3.4%	8.2%	4.9%	9.9%	7.5%	5.1%
Naphtha	56.5%	1.4%	0.8%	9.7%	4.4%	2.7%	0.4%
Gasoline	38.7%	0.1%	4.0%	19.0%	0.1%	0.9%	0.3%

*Source: Federal Customs Service, authors' calculations *AU/CA/UK/US*

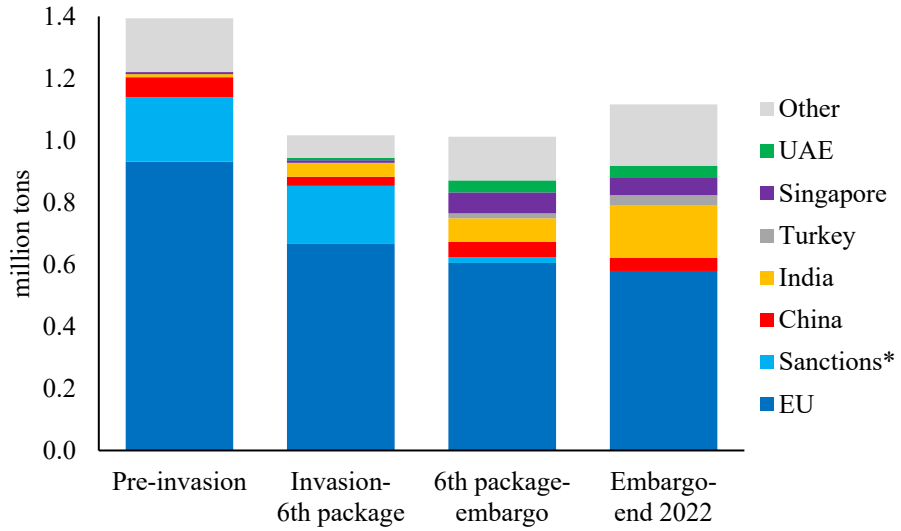
Price Dynamics: Evidence for Discounts Emerges

Some dynamics observed for crude are also playing a role for product exports. For instance, EU imports of Russian oil products from Baltic ports have fallen by roughly one-third in the final weeks of last year compared to the pre-invasion period. And Russia appears to be using the freed-up capacity for shipments to destinations located father away such as India (see Figure 14). Thus, we would expect similar discounts to the ones provided for crude oil.

We find much larger divergence between prices of different oil products compared to the pre-invasion period. Aside from fuel oils, key Russian products such as diesel, gasoline, kerosene, and naphtha had displayed relatively stable—and small—price differences. This is no longer the case (see Figure 15). In the case of diesel, several developments have led to rising prices, including rebounding demand in the post-pandemic period and refinery closures due to a muted macroeconomic outlook as well as labor disputes in some countries (e.g., France). In addition, the

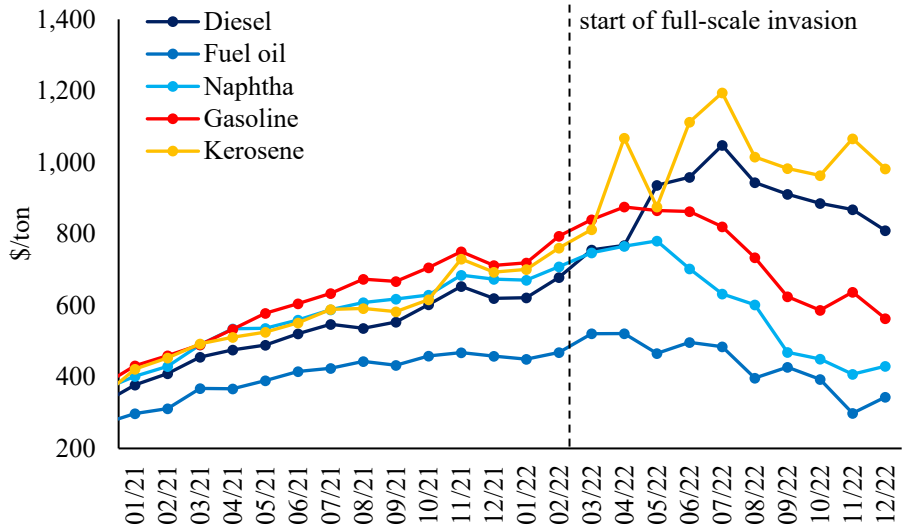
production of diesel (and kerosene, for that matter) requires natural gas, the prices for which soared for extended periods of time in 2022. On the other end of the price spectrum, naphtha, which is largely used in the petrochemical industry, tends to reflect overall economic conditions—and cheapened as the global outlook weakened.

Figure 14: Average Weekly Oil Product Exports from Baltic Sea Ports



*Source: Federal Customs Service, authors' calculations *AU/CA/UK/US*

Figure 15: Prices for Oil Products



Source: Federal Customs Service, authors' calculations

Russia appears to be providing discounts to keep up export volumes. As neither the EU's embargo on oil products nor the price caps took full effect during the period covered by our data, we cannot analyze detailed price dynamics in the same way we did for crude. However, we find that Russia appears to be providing "new" customers such as India with substantial discounts, especially on diesel and fuel oils, to keep export volumes from dropping too much (see Figure 20).

While this is important from the perspective of Russia's external balance and its fiscal revenues, it is also needed for the functioning of the oil products industry itself. In the process of producing distillates for the domestic market, Russian refineries generate additional oil products for which there is no demand within the country. If these substantial quantities cannot be exported, the lack of sufficient storage space will eventually require reducing refinery runs—leading to shortages with respect to certain fuels and weighing on economic activity overall.

As the full redirection of oil product exports to alternative markets away from the EU is unlikely to be possible to the same extent that Russia realized for crude, the problem will grow now that the EU embargo on oil products is in force. We expect to see both an overall reduction in volumes and downward pressure on prices.

Table 5: Post-Embargo Oil Product Exports[28]

	EU	China	India	Turkey	UAE
Volume, thousand tons					
Diesel	2,615	…	307	544	42
Fuel oil	1,123	62	435	56	238
Naphtha	236	81	59	35	190
Gasoline	141	147	37	11	…
Price, $/ton					
Diesel	847	…	245	881	701
Fuel oil	337	328	191	540	371
Naphtha	432	471	350	391	389
Gasoline	595	579	480	670	…

Source: Federal Customs Service, authors' calculations

[28] To allow for a comparison of prices, table only displays transactions in FOB ("free on board") terms.

VI. Conclusions and Policy Recommendations: Focus on Enforcement

Key Findings

- **Our data represents an important addition to other publicly-available information on Russia's post-full-scale invasion/post-sanctions trade**—providing supportive evidence for already-known facts and allowing for a more comprehensive analysis of exports and imports. In this paper, we focus on crude oil and oil product exports and, specifically, changes to export markets and emerging price dynamics.
- **Sanctions on Russian hydrocarbon exports did not begin in earnest until the EU crude oil embargo took effect on December 5, 2022.** However, with the EU embargo on oil products in place as well since February 5, 2023, a significant share of oil exports is now sanctioned—51% of crude oil and 64% of oil products, both in 2021 volume terms. In addition, price caps have been imposed on crude and products.
- **While volumes of energy imports from Russia by Ukraine's allies fell markedly during the second half of last year—including a dramatic moving away from Russian gas—, soaring prices supported overall Russian energy earnings** and led to record-high goods exports of $532 billion, an increase of 21% over 2021. At the same time, imports fell significantly in 2022Q2 and—while they essentially recovered fully from their post-invasion collapse toward the end of the year—reached $217 billion, a minus of 18%, in 2022. The result was an all-time high trade surplus of $316 billion.
- **A second key to Russia's elevated energy earnings was its ability to redirect crude oil to alternative markets**, including China, which continued to buy large quantities, and India, which emerged as the most important new destination. The two countries, together with Turkey, have replaced the EU as the most important buyer of Russian crude oil, accounting for two-thirds of exports in 2022Q4 (vs. less than one-third in 2022Q1). As a result, Russia was able to maintain pre-war oil production levels in 2022.
- **These substantial changes to Russia's oil trade relationships had implications for a subset of prices, however.** The loss of the country's most-important export market for crude—Europe—freed up capacities at ports, primarily in the Baltic Sea, whose geographic location is not suited for exports to "new" customers such as India. To support export volumes, we find that Russia appears to be providing steep discounts in this market; for instance, in the post-embargo period, Indian buyers paid around $17/barrel less for Baltic Sea crude shipments than Europeans. As demand via other export channels did not change materially (e.g., in the Pacific Ocean) leading to much-higher prices, what we see is essentially a fragmentation of the market for Russian oil. Given that overall volumes of Russian crude oil exports did not decline in 2022, it appears that Russia chose to not reduce volumes in the fact of price discounts on some of its shipments, at least initially.[29]

[29] In February 2023, Russian authorities announced a 500k barrels/day cut to crude oil production (~5%) in response to international sanctions. See https://www.ft.com/content/dc898690-653a-47f1-af56-b0216abd7dcd.

- **For overall prices, however, we find smaller discounts than reported in other sources and export prices did not drop in line with Urals crude.** From Pacific Ocean ports, Russia appears to not export under the price cap, with average prices around $82/barrel. While the lag in customs data-based prices vs. market survey-based ones may play a role, these high prices also indicate Russia's ability to circumvent the price cap: while around 50% of crude oil is transported via the *shadow fleet*—and are, thus, not sanctionable—, the remaining shipments should still be subject to the cap as they involve Western shipping services. Additional research, including analysis of data for the first months of 2023, is needed to determine the effectiveness of the price cap mechanism.
- **While it is difficult to disentangle the effects of the EU crude oil embargo and G7 price cap, the timeline points toward the embargo as the main driver for current price dynamics.** The aforementioned market fragmentation began in the spring of 2022 and continued throughout the year as decisions on sanctions, including the embargo, were made and implemented. This is significantly before any debate on the price cap began.
- **We find that an earlier embargo or earlier crude oil price cap could have reduced Russian earnings from crude oil exports significantly last year** and, in turn, weighed on Russian fiscal revenues and the overall economy. More importantly, as sanctions coalition countries' oil imports from Russia reached negligible levels, the enforcement of the price cap is a critical factor.
- **In the area of oil products, any redirection of exports in the aftermath of the EU embargo, which took effect on February 5, 2023, could be a challenge.** The countries that now account for a dominant share of Russian crude oil exports, e.g., China, India, and Turkey, play a much smaller role with regard to oil products as they all have their own developed refining sectors. With Russia's ability to export certain products soon to be limited, there may be spill-overs into the domestic refining industry.
- **We find that there is some evidence for discounts being provided to alternative buyers to keep up oil product exports volumes**, especially on shipments from ports where capacities opened up due to the loss of the European market. However, the market for oil products is more complex than for crude oil, with countries relying on different products from Russia to varying degrees. As our data only extends to the end of 2022, it does not capture any effects of the EU embargo as well as the G7 price caps on oil products.
- **It appears that countries which banned Russian oil products are increasingly acquiring these goods via places such as India and Turkey**, which stepped up imports of Russian crude oil for this purpose. While this does not mean that sanctions are circumvented—it effectively removes profits from Russia's refining industry and may force painful reductions in refining activities—it is an important finding and should be considered as additional decisions on oil sanctions loom.
- **We also find that a significant shift seems to be under way in terms of specific companies that engage in oil-related transactions with Russia.** While further analysis of individual invoices needs to be undertaken, new players—largely located in the Middle East (e.g., UAE) and East Asia (e.g., Hong Kong, Singapore)—are responsible for an

increasing share of exports, in particular those to China and India. Some entities may, in fact, be connected to Russian energy companies, which represents a key challenge for the implementation and enforcement of international sanctions.

Policy Recommendations

- **While we advocate for significantly lower price caps on Russian crude oil and oil products exports, we also believe that stepped-up enforcement of existing sanctions is of critical importance.** The specific design of sanctions—including decision on price cap levels—matters little if restrictions are not adhered to. Our surprising and striking finding of export prices for Russian crude oil significantly above $60/bbl alone demonstrates that investigating compliance with *existing* sanctions should be front and center.

- **The first key component is risk-based audits of attestations regarding compliance with the price cap.** These attestations, which are required from EU/G7 shipping service providers, currently only consist of generalized assurances that transactions are conducted under the cap.[30] However, companies are not required to submit any documentary evidence unless and until this is requested by authorities. Regular audits are not only critical to determine compliance with EU/G7 policies, but also to understand market dynamics and Russian attempts to circumvent sanctions.

- **A second element concerns non-EU/G7 shipping service providers, which are not required to provide any assurances or evidence.** Measures to increase the transparency of all transactions related to Russian oil exports are critical. For instance, schemes to circumvent the price cap may include ship-to-ship transfers or the re-export of Russian crude oil and/or oil products from third countries—all of which are difficult to identify and address in the absence of sufficient information.

- **Finally, countries imposing comprehensive sanctions on Russia must develop administrative capacities to implement and enforce such measures.** Bans on Russian oil exports and, especially, the price cap mechanism represent the farthest-reaching intervention in the global oil market in history. Not only is Russia a far bigger oil producer compared to, for instance, Iran, Iraq, or Venezuela, but current measures are also dramatically more complex than those in the past which consisted of full embargoes or trade schemes such as Iraq's *Oil-for-Food Programme*. The EU/G7 price cap requires the cooperation from many market participants.

  In the U.S., the *Treasury Department*'s *Office of Foreign Assets Control (OFAC)* has a track record of effectively enforcing sanctions—as does *OFSI* in the United Kingdom. In the EU, however, it is primarily the member states that are responsible for the implementation of sanctions, including those imposed by the Union as a whole. Thus, a unified enforcement structure is largely missing. With the Russia sanctions regime, in all likelihood, remaining in place for a considerable amount of time, we see the development of such a capacity as critical for its ultimate success.

[30] For the EU's official guidance on the price cap mechanism, including its documentation requirements, see https://finance.ec.europa.eu/publications/oil-price-cap_en.

Data Limitations

We recognize that important limitations apply to our dataset. *First*, customs data only includes invoices—and invoiced prices and volumes, but no information about the timing of payments. For instance, invoices may have been prepaid at an earlier point in time—or they may include payments for future deliveries. Thus, we may over- or underestimate cash inflows from exports, as far as their exact timing is concerned. *Second*, invoices reflect different contractual arrangements (*International Commercial Terms* or *Incoterms*), which differ in their assignment of responsibilities—and costs—for specific elements of the transaction (e.g., loading, carriage, customs fees, insurance) to buyer or seller. While the issue of shipping costs is of particular importance for the interpretation of export prices, we find that buyers are almost always responsible for transportation as far as oil transactions in our data is concerned. *Third*, there are questions surrounding the temporal allocation of actual deliveries, in particular in the case of pipeline flows; however, we are confident that total values and volumes are not affected.[31] *Fourth*, we find that exports classified in customs data as crude oil (HS code 2709) may contain some oil products, which would have implications for prices.[32] We will explore these issues in future publications.

[31] Data validation exercises (see Appendix 1) show that discrepancies are larger where pipeline exports play a significant role (e.g., crude oil) than where they do not (e.g., oil products).

[32] However, as our data aligns well with official statistics (see Appendix 1), it would mean that Russia's balance of payments has historically misreported crude oil and oil product data.

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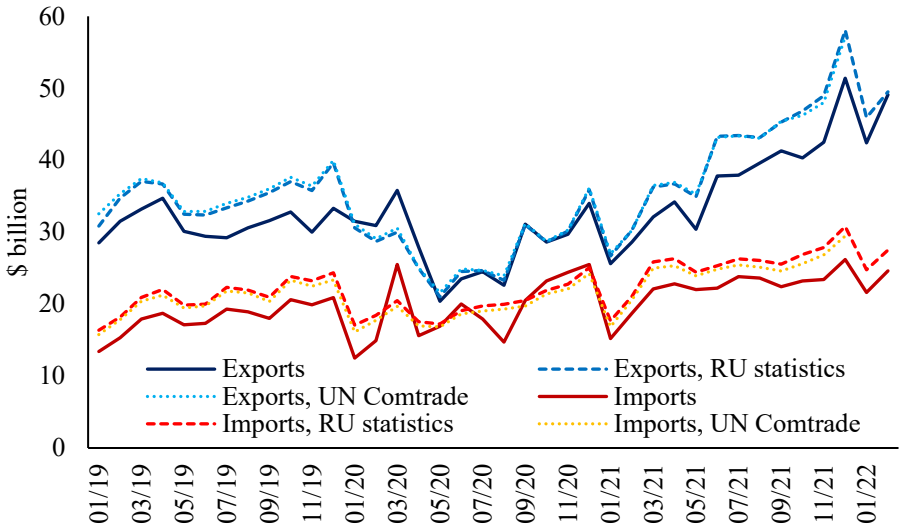
Appendix 1: Data Validation

In this paper, we rely on a comprehensive Russian customs dataset at an extraordinary level of detail. It consists of over 50 million entries for Russian goods exports and imports, spanning a period of 48 months—from January 2019 to December 2022. For each transaction—or invoice reported to Russia's *Federal Customs Service*—the dataset captures around 90 variables, including the name and geographic location of seller and buyer, the good's description and HS code at the ten-digit level, value and volume of the transaction, and information about the location of the customs declaration filing (e.g., the port from which a shipment originates).[33]

We have undertaken extensive efforts to validate the customs data by comparing values and volumes to statistics by Russian authorities as well as international organizations such as the *International Monetary Fund* and *UN Comtrade*. For total goods exports and imports, we find that our micro-level data matches other sources quite well (see Appendix Figure 1). Some discrepancies are to be expected due to the inherent characteristics of customs data—namely that transactions are recorded at the time of an invoice's reporting to authorities. Official trade statistics often reflect certain efforts at reconciling such temporal effects.[34]

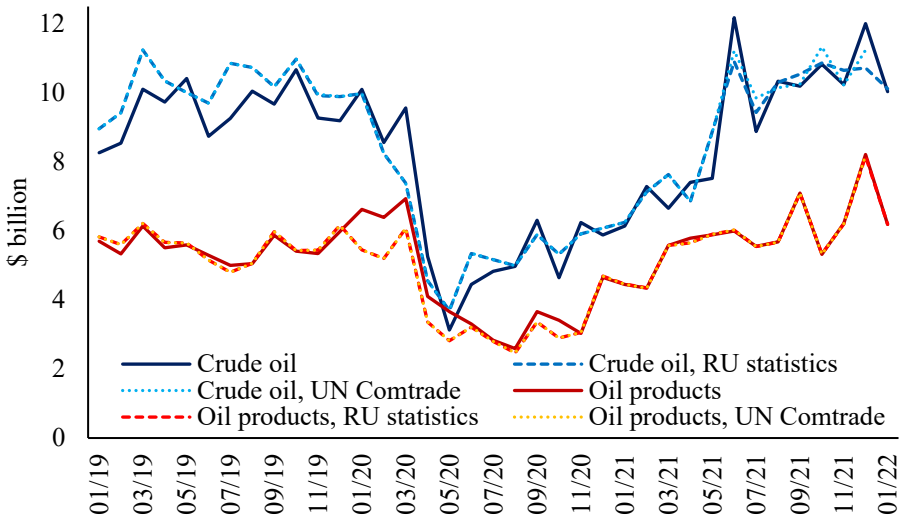
Appendix Figure 1: Total Goods Exports and Imports



Due to this paper's focus on Russian exports of crude oil and oil products, we also looked at alternative data sources for these specific series. In a first step, we estimate export values by aggregating transactions reported under HS codes 2709 (crude oil) and 2710 (oil products). The series constructed in this way fit data by Russian authorities and *UN Comtrade* extremely well (see Appendix Figure 2), with discrepancies somewhat more prevalent in the case of crude oil due to the role played by pipeline deliveries which are continuous in nature but reported to customs as part of a relatively small number of bigger transactions. In a second step, we estimate export volumes following the same methodology, and calculate export prices for both crude oil and oil products—with comparison, again, delivering encouraging results (see Appendix Figure 3).

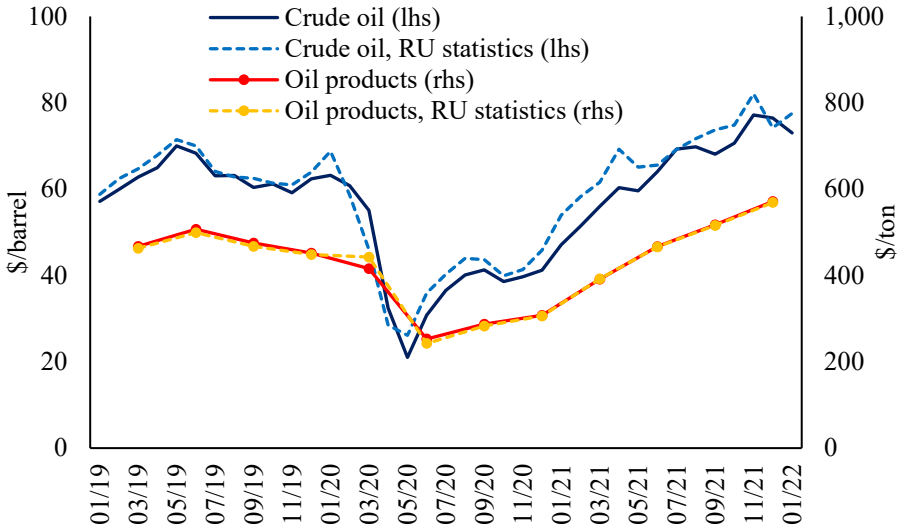
[33] Substituting reported trade values in U.S. dollar with market exchange rate-based numbers shows less accurate results.
[34] See the *World Customs Organization*'s database at https://www.wcotradetools.org/en/harmonized-system.

Appendix Figure 2: Crude Oil and Oil Products Exports



Source: Federal Customs Service, UN Comtrade, authors' calculations

Appendix Figure 3: Crude Oil and Oil Products Export Prices[35]



Source: Federal Customs Service, authors' calculations

Based on these data validation exercises, we are confident that our dataset can be relied upon for the analysis of Russian oil exports in the post-invasion period when authorities stopped publishing any detailed information on Russian goods trade—and other components of the country's balance of payments. If anything, our data seems to somewhat underestimate crude oil export prices in 2020-21—an important finding considering that the prices we calculate for the post-invasion period are *higher* than what has reported by others.

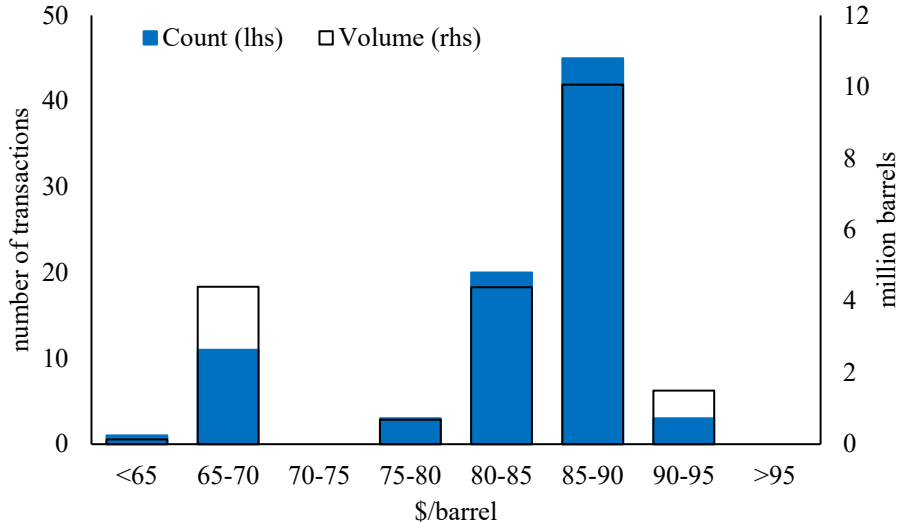
[35] Oil product export volumes are only released at quarterly frequency.

Appendix 2: Additional Analysis of Shipments from Kozmino

Russia's Pacific Ocean port of *Kozmino* is of particular importance as it represents the key channel through which the country exports seaborne crude oil to destinations such as China and India—with the key question being if it does so under the G7 price cap or not.

As we noted above, we find an average export price of significantly above $60/barrel in the post-embargo/price cap period of calendar weeks 49-52. Appendix Figure 4 shows the distribution of contracts during this time—with almost 80% of contracts, and close to 70% of involved volumes, falling into a range of $80-90/barrel and an average of around $82/barrel.

Appendix Figure 4: Distribution of Post-Embargo Crude Oil Transactions at Kozmino



Source: Federal Customs Service, authors' calculations

Appendix Table 1: Distribution of Post-Embargo Crude Oil Transactions at Kozmino

Seller	Buyer	Volume, mbbl	Share of total	Price, $/bbl
Rosneft	Nord Axis Limited (Hong Kong)	5.1	24.3%	77.83
Lukoil	Lukoil Asia Pacific (Singapore)	4.5	21.0%	84.13
INK	Concept Oil Services (Hong Kong)	3.2	15.2%	85.00
Rosneft	Terjarineft (UAE)	2.3	11.0%	74.65
Initiativa	Demex Trading Limited (UAE)	1.8	8.7%	85.16
Surgutneftegas	QR Trading DMCC (UAE)	1.1	5.3%	87.86
Surgutneftegas	Unipec Asia Limited (Hong Kong)	0.8	3.8%	87.70
RNG	Concept Oil Services (Hong Kong)	0.7	3.5%	84.46
Surgutneftegas	Litasco Middle East DMCC (UAE)	0.5	2.4%	88.07
Surgutneftegas	Coral Energy DMCC (UAE)	0.3	1.6%	87.73
Yargeo	Novatek Gas and Power (RU)	0.3	1.6%	82.60
Novatek	Novatek Gas and Power (RU)	0.2	0.9%	82.60

Source: Federal Customs Service, authors' calculations

We appreciate that our date, which extends to the end of 2022, may not capture the most-recent developments in this market that others have documented.[36] However, we believe that a certain lag between reported prices, which are based on the analysis of contracts, and customs data invoices, which are largely based on the time of shipment, is to be expected.

Finally, *Kozmino* is also of importance for the analysis of the sanctions regime as our data provides insight into entities that Russia is conducting its crude oil export business with—and how they may differ from the pre-embargo/price cap period. As we document in Appendix Table 1, buyers are located in the Middle East (e.g., UAE) and East Asia (e.g., Hong Kong, Singapore). Specific corporate relationships warrant further analysis in the future.

[36] See *The Kozmino Mystery* by Craig Kennedy (forthcoming) at https://navigatingrussia.substack.com/.