Sanctions against Russian oil: An empirical assessment

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TECHNICAL NOTE RUSSIA

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Content

1. Motivation

The main objective of this technical note is to preliminary assess the potential magnitude of the recent EU/G7 oil-sanctions related shock to the Russian economy via a simple quantitative model. In order to do that, we briefly discuss the fundamentals of the world oil market, the background and motivations behind the most recent oil-related sanctions by the EU and the G7, construct three scenarios of the potential sanctions implementation and estimate their effects with the usage of a simple empirical model.

2. Oil sector background and sanctions overview

In response to Russia's Ukraine invasion, the European Union has agreed to cut most of the crude oil purchases from Russia starting December 5, 2022 and to implement a ban on oil-products sea shipments from Russia on February 5, 2023. In addition to that, G7 plans to install a price cap on Russian oil sales which would go outside the EU.

Currently, Russia produces around 10.5 million b/d (barrels per day, 7.5% of the world total) and exports 7.5 million b/d (17% of world total oil exports). Sea shipments equate to around 3.9 million b/d. European Union imports of Russian shipped oil constitute around 1.3 million b/d.

One of the key specifics of the international oil market is its game-theoretical nature, rather than the usual supply and demand-driven price fluctuations. Oil prices are usually far above its marginal production costs and way below the value added created by oil utilization. This situation creates a lot of room for the possible range of prices acceptable to both producers and consumers.

It also should be noted that in volume terms, there is rather limited slackness between world total demand and world total production capabilities. Saudi Arabian oil company Saudi Aramco recently declared that it is going to increase production by 1.8 million b/d in the next 2 years. Venezuela, which used to produce 3.5 million b/d in 1998 and its current production levels of 1 mb/d potentially can increase its output by another 1 mb/d. Iran which used to produce 4.6 mb/d in the past, may add 1.3 mb/d to its current level of 3.3 mb/d. The US and Canada's unconventional oil production industry (oil sands and cracking) may add another 1 mb/d. To sum it up, in the best-case scenario, world producers have the potential to increase their capacity by a maximum of 5.1 mb/d over a horizon of 2 years, while the more likely figure will be 3-4 mb/d.

In line with this, both proposed measures (by the EU and G7) do not actually aim at any serious reduction in Russian oil exports in terms of volume, but rather at decreasing profits that Russia can get by keeping export volumes – and thus world supply – constant. As of today, even before most of the formal oil-related sanctions are enacted, Russia sells its oil at a sizable discount of 20-30% to international benchmarks (Brent). If the price-cap plan is implemented with the intended consequences, this discount may be kept in place while the oil price will go back to the pre-war levels, creating a de-facto dent in Russian oil exports.

Figure 1: Urals-Brent Differential (USD).

Source: Thomson Reuters

However, this plan relies on Russia being a rational agent in a one-shot game. The formation of a "buyers' cartel" may in turn cause retaliation on the Russian side. If Russia will be able to live for several months with severely decreased oil incomes and thus cut oil exports by 20-30%, international oil prices may rise to unprecedented levels, destroying the cartel and making Russian future oil exports de facto more profitable than before the war.[1]

The retaliation risks create a trade-off for the G7 countries: if the price cap will be too low, Russia may find retaliation in its own interest since the margin that it would need to forgo will be small enough; alternatively, if the price cap will be too high, the mechanism won't bring any discomfort for the Russian budget.

The International Working Group on Russian Sanctions (IWGRS) at Stanford University has analyzed the potential effects of different levels of the price cap and proposed 35 USD/barrel as the most efficient one.[2] Despite that, G7 decided to start with an introduction of a 60 USD/barrel cap. Tymofiy Mylovanov, one of the most prominent members of the IWGRS has argued that due to the novelty of the price cap mechanism, time will be needed for adjustments and modifications, suggesting that if the price cap will start working, the cap may be decreased in the future.

As Figure 2 shows, currently, the 60 USD/barrel cap is currently not binding, as since the beginning of the oil embargo BRENT oil prices went down and the discount on URALS actually increased.

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[1] Bloomberg, „JPMorgan Sees 'Stratospheric' $380 Oil on Worst-Case Russian Cut", https://www.bloomberg.com/news/articles/2022-07-01/jpmorgan-sees-stratospheric-380-oil-on-worst-case-russian-cut

[2] The International Working Group on Russian Sanctions, https://fsi.stanford.edu/working-group-sanctions

Figure 2: Brent and Urals oil price.
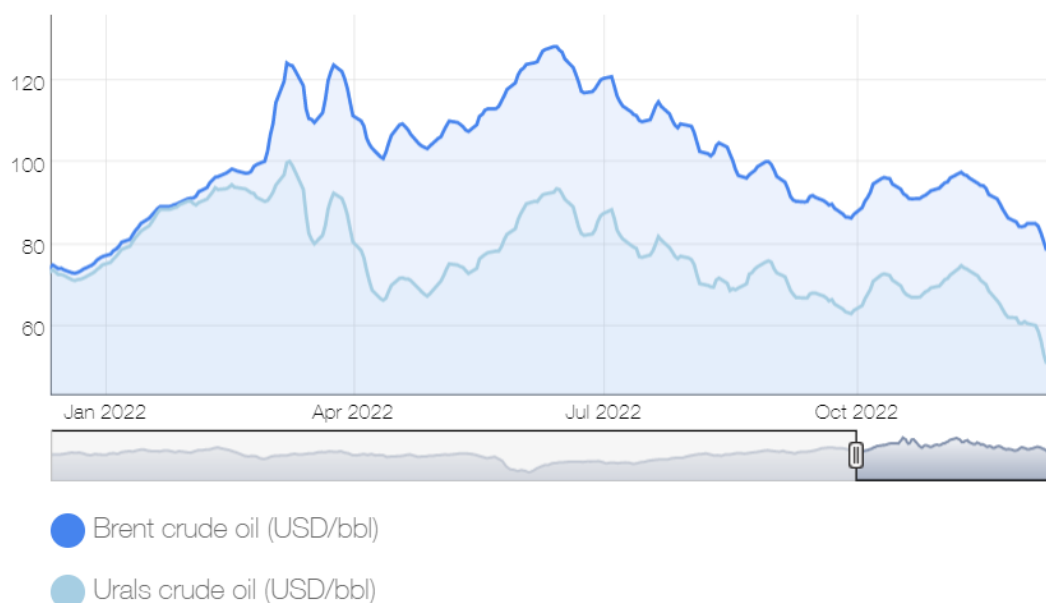
Source: Thomson Reuters

Given all of the above, the three main scenarios in our analysis are:

» Russia continues to export oil at 60 USD/barrel and successfully re-orients the oil shipments that fell under the EU ban to other markets,

» Russia continues to export oil at 60 USD /barrel but fails to find markets for around half of the oil that it used to ship to the EU,

» Russia fails to find new customers for half of the oil that it used to ship to the EU, the price cap mechanism works perfectly, and the cap is reduced to 35 USD /barrel.

These scenarios are based on several assumptions. The first assumption is that the world won't step towards a recession and the overall oil prices would be higher than the 60 USD/barrel level. Although we cannot rule out the possibility of a recession that would drive down all oil prices, the current assumption is based on the fact that at the end of 2022 Brent oil futures were trading at above 80 USD/barrel levels. Another assumption implicitly present in the best-case scenario is that the oil price cap mechanism will work at least at the current, 60 USD/barrel level. Scenarios where Russia fails to reroute half of its EU volumes to the other markets are based on the fact that logistical issues of finding enough sea ships may be a crucial barrier to Russia. For example, during the first week of EU embargo implementation, Russian seaborne exports decreased exactly by 50%.[3]

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[3] Bloomberg, "Russia's Oil Exports Collapsed Since G-7 Sanctions Began", https://www.bloomberg.com/news/articles/2022-12-20/russia-s-oil-exports-collapsed-since-g-7-sanctions-began?leadSource=uverify%20wall

3. Description of the model

In order to estimate the effects of oil-related sanctions on the Russian economy, we estimate a seasonal ARIMAX model. We use official data on real GDP and Urals oil prices in constant dollars for a time span of 2011Q1 -2022Q3. For the last quarter of 2022, the interpolation of October-November data is used. In order to account for the other effects of war on the Russian economy, we introduce a War dummy which starts to be equal to one since 2022Q2.

The best fit model for the log(RealGdp) response variable appears to be ARIMAX(0,0,1)(0,1,1)[4] with the following values of estimated parameters:

Coefficients:

mal	smal	drift	Urals	War
0.2931	-0.7811	0.0037	0.0007	-0.0536
s.e. 0.1504	0.1601	0.0005	0.0002	0.0130

sigma^2 = 0.0003124: log likelihood = 116.57

AIC=-221.14   AICc=-218.87   BIC=-210.43

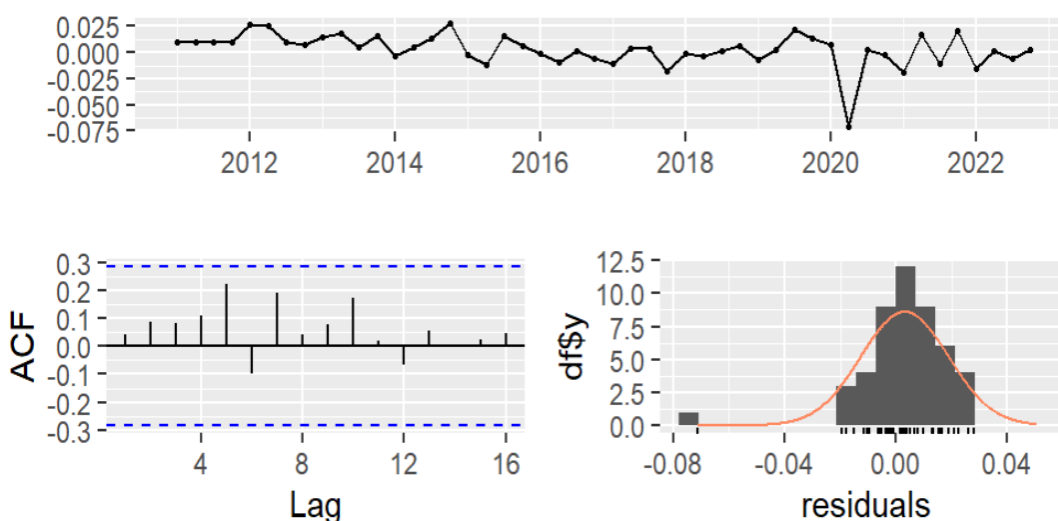The model is well-specified, with the following results of the Ljung-Box test for residuals:

Ljung-Box test

Data: Residuals from Regression with ARIMAX(0,0,1)(0,1,1)[4] errors

$Q* = 7.0586$, df = 6, p-value = 0.3155

Model df: 2.   Total lags used: 8

Figure 3: Residuals from Regression with ARIMAX (0,0,1)(0,1,1)[4].

Source: Own calculations

Residuals analysis shows the random and rather normal distribution. The largest residual outlier is seen during 2000Q2 during the COVID-19 pandemic.

Since the formal R^2 measure is not well-defined for ARIMAX models, we report the squared value of correlation between fitted and actual values: Corr(fitted, observed)^2=0.965. Such a high value means that the time series at hand is very well described by its own lags, a war dummy, and a single variable, namely the price of URALS oil. This result is not surprising and was documented previously, for example by Becker (2016)[4].

Figure 4 below demonstrates a striking link between the oil price and Russian nominal USD GDP:

Figure 4: Russian GDP and Brent oil price in current USD.
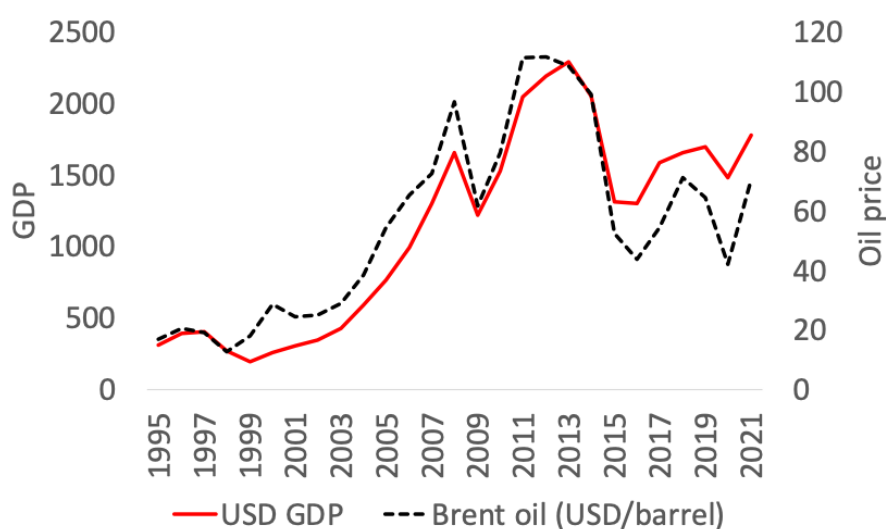
Source: calculations by Torbjorn Becker for an updated version of Becker (2016)

4. Scenario forecasts

The most optimistic for Russia scenario assumes no cut in the oil volume sold and an average price of Brent at 60 USD/barrel. Under this scenario, the price of oil equals the price cap and is higher than at the end of 2022 level.

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[4] Torbjörn Becker, Russia's Oil Dependence and the EU, Working Paper No 38, Stockholm Institute of Transition Economics,
https://swopec.hhs.se/hasite/papers/hasite0038.pdf?_ga=2.247006086.360510178.1663578861-403605704.1663578861

Figure 5: Forecasts from Regression with ARIMAX (0,0,1)(0,1,1) [4] errors.
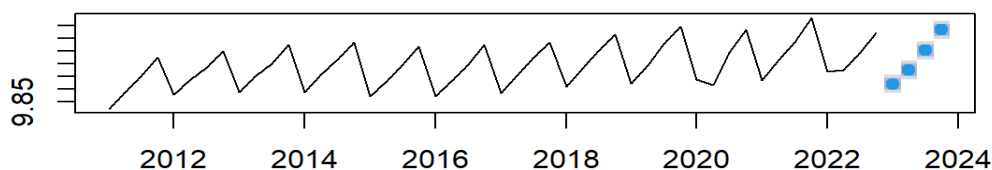
Source: Own calculations

Under this scenario, the **decrease in real GDP will be 0.6% in 2023**.

Table 1: Quarterly GDP as % of the same quarter a year ago (scenario 1)

	Q1	Q2	Q3	Q4
2022	104	96	96	94
2023	95	100	101	101

The second scenario assumes that Russia fails to reroute all EU oil shipments to new markets, while the price cap is maintained at the 60 USD/barrel level. Prior to the war, EU's share in Russian oil exports was equivalent to 20% of crude oil equivalent. Since the beginning of Russian aggression in Ukraine, Russia managed to reroute around half of this volume. According to the estimates based on the previous data, the elasticity of volume loss to the price discount for Russian oil revenues equates to 0.9. According to these assumptions, the model yields a 1.2% real GDP decline in 2023.

Table 2: Quarterly GDP as % of the same quarter a year ago (scenario 2)

	Q1	Q2	Q3	Q4
2022	104	96	96	94
2023	95	99	100	101

Finally, the most pessimistic scenario assumes that in addition to the loss of EU exports, Russia will face a working price cap at 35 USD/barrel. In such a case, the decrease in real GDP in 2023 will equate to 2.6% in 2023.

Table 3: Quarterly GDP as % of the same quarter a year ago (scenario 3)

	Q1	Q2	Q3	Q4
2022	104	96	96	94
2023	93	98	99	99

5. Conclusion

It is hard to overestimate the effects of oil exports on the Russian economy. Given that, it was natural to expect that in response to the Russian aggression in Ukraine, the EU and

major economies would at some point resort to sanctions aimed at this crucial sector for the Russian economy. The challenge of the oil-sanctions design is that the Russian share of world oil exports can hardly be replaced by the other exporters, and therefore, the risk of Russian retaliation should always be considered. Thus, the main goal of G7 sanctions is twofold: to decrease Russian oil export revenues, while keeping the incentives for Russia to supply the world market with needed volumes of oil and oil products.

We propose three scenarios to assess the sanctions implementation. The first scenario assumes that both the EU embargo and G7 price cap won't have a de-facto effect on Russian exports. In this case, Russia will still suffer a 0.6% GDP decline in 2023 due to the other sanctions and advert effects of its aggression. The second scenario assumes that Russia won't be able to fully re-rout European seaborne oil exports to other customers but will still enjoy the non-binding price cap of 60 USD/barrel. Under this scenario, the Russian GDP is expected to contract by 1.2% in 2023. Finally, we look at a scenario where Russia won't be able to fully compensate for the loss of EU customers, and in addition the price capping mechanism will appear to be efficient enough to support a 35 USD/barrel cap. In this case, we expect the Russian real GDP to decrease by another 2.6% during 2023.

Our estimates appear to be in line with the other forecasts produced by various institutions. JP Morgan[5] predicts Russian GDP to fall by 1.2% in 2023, while the IMF predicts a 2.3% decline[6]. The Russian Central Bank gives an interval prediction of a 1% to 4% decline in 2023.[7]

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[5] J.P. Morgan, "Russia: GDP bounced in 3Q", https://markets.jpmorgan.com/research/email/-4st72dk/gElUzlPPs9EBE6-bdGEYpQ/GPS-4265872-0

[6] Interfax, „IMF expects Russia's GDP to fall 3.4% in 2022 and 2.3% in 2023", https://interfax.com/newsroom/top-stories/83755/

[7]Bank of Russia, "The Bank of Russia keeps the key rate at 7.50% p.a.", https://www.cbr.ru/press/pr/?file=28102022_133000Key.htm#:~:text=%D0%92%202023%20%D0%B3%D0%BE%D0%B4%D1%83%20%D1%82%D0%B5%D0%BC%D0%BF%20%D0%BF%D1%80%D0%B8%D1%80%D0%BE%D1%81%D1%82%D0%B0,%D0%98%D0%BD%D1%84%D0%BB%D1%8F%D1%86%D0%B8%D0%BE%D0%BD%D0%BD%D1%8B%D0%B5%20%D1%80%D0%B8%D1%81%D0%BA%D0%B8