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The effects of two benchmarks on Russian crude oil prices

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Abstract

This study analyzes the asymmetric effects of the price shocks of two global crude oil benchmarks (Dated Brent and Dubai) on three Russian crude oil prices: Urals, ESPO, and Sokol. The empirical evidence suggests that an increase in benchmark oil prices causes a rise in the selling prices of these Russian crude oil grades, and a drop in benchmarks decreases the prices. Russia has higher market power in North West Europe and the Mediterranean regions, while there is a more competitive market for Russian oils in Asia. Parallel to this, it is estimated that positive benchmark price shocks impact Urals crude oil grade sales prices more than negative ones in the North West Europe and Mediterranean markets. In contrast, negative benchmark price shocks impact ESPO and Sokol crude oil grade sales prices more than positive ones in the Asian markets. Russia's main aim is to secure its oil revenues; hence, Russia can secure higher revenue by increasing oil prices more in a less competitive market than in a more competitive market. Additionally, the degree of asymmetry increases as the shock size rises.

Keywords Energy economics · Oil prices · Asymmetric responses · Russian crude oil

JEL Classification O13 · Q41 · Q43

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1 Introduction

The price of crude oil is typically determined by a margin to one of a small group of specific types of crude oil that are widely and actively traded. These specific types of crude oils are called benchmarks or markers in the oil markets. These crude oil benchmarks make it easier for buyers and sellers to price the variety of crudes produced worldwide. Thus, these benchmarks are critical in defining the spot value of various crude oils in international markets, where they can be used for hedging risk and risk management (EIA, 2014). The economy of the Russian Federation depends heavily on the export revenues of mineral fuels, lubricants and related materials, which were worth about 221.7 billion US dollars in 2019, which is more than half of its total exports (UN Comtrade, 2019). Moreover, Russian crude oil production was about 9.66 million barrels per day, while exports were about 4.65 million barrels per day in 2020 (JODI Data, 2021). Along with Saudi Arabia, Russia is one of the most critical producers in OPEC+. Still, it has a different position from other OPEC+members due to the diversity of its economy and exchange rate regime. Since Russia is such an essential player in the oil markets and oil prices have a substantial effect on the Russian economy, Russian oil prices are important for both Russia and the buyers of the Russian oils. This study analyzes the effect of benchmark prices on Russian crude oil prices. Specifically, we analyze how increases versus decreases in world benchmark crude oil prices affect the prices of Russia's main crude oil blends (Urals, ESPO, and Sokol) differently.

Russia is a major player in the world oil market and the dominant player in the Mediterranean/European markets. Russia also sells a significant amount of its oil to Asian markets. Thus, understanding its pricing strategy is important. If Russian oil prices are not affected much when the world (benchmark) oil prices decrease and affected more when the world oil prices increase, then this means that the Russian economy is less vulnerable to oil price shocks. On the other hand, the buyers of Russian oil will be more vulnerable to oil price shocks.

In this study, Kilian and Vigfusson's (2011a) nonlinear model, which nests both the symmetric and asymmetric responses of Russian crude oil grades to benchmark crude oil price innovations, is employed. Their model also allows nonlinearity so that the effects of benchmark price shocks change with the size of the shocks. The paper's VAR methodology allows us to calculate the slope-based test statistics, which are more powerful and efficient for the asymmetry tests, too. Several studies have benefited from the innovative methods by Kilian and Vigfusson (2011a) when testing for asymmetry in the responses of economic activities such as Gross Domestic Product (GDP), stock returns, consumption expenditures, labor market and industrial production to oil price increases and decreases.[1] Herrera et al. (2011) investigate the asymmetric relationship between industrial production and oil prices, and they find asymmetry at least in the sectoral level. Kilian and Vigfusson (2011b)

[1] The studies that implement the test of asymmetry incorporated by Kilian and Vigfusson (2011a) include Kilian and Vigfusson (2011b, 2017), Herrera, Lagalo and Wada (2011, 2015), Alsalman and Herrera (2015), Herrera and Karaki (2015), Karaki (2017, 2018), and Alsalman and Karaki (2019).

and Karaki (2017) examine the asymmetry between oil prices and real GDP, while Karaki (2018) examines the asymmetric relationship between regional job flows and oil prices and Herrera et al. (2015) examine this relationship between industrial production and oil prices for OECD countries. They find only limited supporting evidence for asymmetry. Herrera and Karaki (2015) and Alsalman and Herrera (2015) investigate the asymmetry in stock markets with oil prices and could not find asymmetry between them. In their study, Alsalman and Karaki (2018) examine the relationship between oil prices and personal consumption and find that oil price shocks asymmetrically affect personal consumption at the aggregate level, while at the disaggregate level, there is limited evidence for the asymmetry. The abovementioned studies of the large literature on the subject has mainly found evidence for a symmetric effect between oil prices and aggregate economic activity and only some evidence against the null of symmetry using disaggregated economic variables especially after accounting for data mining. To the best of our knowledge, only the study by Kahraman et al. (2021) empirically investigates the price asymmetry of crude oil grades (three Iraqi crude oils) with their benchmark prices. Moreover, no other study examines the asymmetric effects of benchmark crude oil prices on specific crude oil prices. In general, there is a set of studies that examines the effects of crude oil prices on the prices of petroleum product prices, such as diesel and gasoline. Since Mork's (1989) study on the effects of crude oil price changes and Bacon's (1991) analysis of price asymmetry in petroleum product markets, various efforts have been made to analyze the price asymmetry concerning crude oil and petroleum product prices. These include Karrenbrock (1991), Borenstein et al. (1997), Godby et al. (2000), Bachmeier and Griffin (2003), Chen et al. (2005), Grasso and Manera (2007), Meyler (2009), Honarvar (2009), Kilian and Vigfusson (2011a), Lamotte et al.. (2013), Venditti (2013), Berument et al. (2014), Atil et al. (2014), Pal and Mitra (2015), and Alvarez-Ramirez et al. (2015).

For the analyses of the asymmetric effects of benchmark crude oil price shocks on Russian crude oil sales prices, the daily crude oil price data between 2015 and 2020 are used in this study. The impulse response analyses that use Kilian and Vigfusson's (2011a) nonlinear VAR model with standard deviation shock sizes of 1 and 2 are gathered. The empirical evidence reveals that positive and negative benchmark oil price shocks statistically significantly affect the related Russian crude oil prices in the same direction. More specifically, the empirical evidence gathered in this paper reveals that the increase in the Dated-Brent oil price, which is the benchmark price for the Urals crude oil grade, increases the price of Urals more than a decrease in Dated-Brent causes Urals crude oil sales prices to decrease. On the other hand, it reveals that a decrease in the Dubai oil price, which is the benchmark price for the ESPO and Sokol crude oil grades of Russia, decreases the price of ESPO and Sokol more than an increase in Dubai causes ESPO and Sokol crude oil sales prices to increase. Furthermore, it has been found that as benchmark oil prices increase, the impact on related crude oil sales prices becomes even greater. These findings suggest that there is asymmetry between Russian crude oil grade sales prices and their benchmarks' prices in terms of sign and size.

The main reasons for this asymmetry, which determines Russian actions in setting its crude oil sales prices, can be assessed as follows: (i) Russia is one of the major crude oil exporters having a high oil export revenue dependency as it makes up a major share of its national budget, so one of Russia's main aims is to secure its oil revenues. Thus, Russia has a incentive to ensure higher revenues by increasing oil prices more in less competitive markets than in more competitive markets. (ii) Europe and Asia have been two major areas where Russian crude oil competes against OPEC producers for its export grades, and they have been in market competition in most of the major demand locations globally. Russia's Urals crude grade is an important grade in the North West Europe and Mediterranean regions, both of which have limited domestic crude oil supplies. Thus, Russia has a dominant position in both regions with the demand for its Urals crude oil and its vast supply capacity. On the other hand, in the Asian market, China is the largest crude import market in Asia, and it has a sizable source of domestic crude oil. This gives the Asian market the advantage of being able to balance its crude oil imports with local crude oil production. This generates leverage against oil price volatilities in the Asian market, where Russia must consider its competitors' crude oil sales prices when setting its own price and strive to maintain its market share. (iii) Russia is a net exporter of petroleum products targeting mainly European refineries, against which they compete with their exported gasoil and other petroleum products. These factors drive Russia to maintain leverage when it sets prices for its crude oil as well as petroleum products. Finding any asymmetric regularity may lead other researchers to study the nexus of the Dated-Brent, Urals and petroleum product prices later. (iv) Although the crude oil benchmarks, Dated-Brent and Dubai in this study, move according to financial motives rather than the solely physical side of market pricing, it cannot be unparallel to the physical supply and demand conditions for Russian crude oil grades. While financial crude oil prices can move more freely in any direction than physical prices since physical delivery will face stiffer demand and supply conditions. Therefore, the obligations for buyers and sellers to fulfill their contractual terms can create boundaries for the lower and upper limits in pricing because physical prices will face physical limitations. According to the benchmarks, the abovementioned special conditions of Russia point out the asymmetry while determining its crude oil sales prices.

The main contribution of this study to the literature is empirically assessing the asymmetric price impacts of benchmark crude oils on Russian crude oil. An increase in the world benchmark oil prices increases Russian crude oil prices and a decrease in the world benchmark oil prices decrease Russian crude oil prices. However, the increases and decreases in observed responses of Russian crude oil prices are not at the same level as the corresponding increase and decrease in benchmark prices.

The outline of this study is as follows: Section II provides details on the Urals, ESPO, and Sokol Russian crude oil grades, while Section III discusses the data and methodology used in this study. Section IV presents the empirical evidence, and Section V is for the discussion. The last section concludes the paper.

2 Specifications of Urals, Sokol, and ESPO Russian crude oil grades

The Russian Urals, Sokol and ESPO crude oil grades can be assessed according to their properties. The Urals blend is the main Russian crude oil export grade, accounting for more than 80% of Russia's exports. Used heavily in Eastern and Central Europe and in Mediterranean markets, it is a mixture of heavy sour crude oil from the Urals-Volga region and light sweet crude oil from Western Siberia. Thus, it is a medium sour crude oil blend at 31° API, has about 1.4% sulfur content, and is usually priced against Dated-Brent. Siberian light crude oil is of higher quality and priced higher when sold separately, but it is usually blended into Urals crude oil because of its limited capacity for stand-alone marketing (Annenkova, 2012; EIA, 2017). There are two pricing factors for Urals crude and it is sold with two different contracts depending on its delivery destination: Urals North West Europe or Urals Mediterranean. The Urals North West Europe assessment of Platts in terms of CIF reflects typical Primorsk quality cargo. The daily spot assessment considers the shipments loaded from the Baltic Sea ports of Primorsk and Ust-Luga for delivery to Rotterdam/Netherlands since April 2012. Any cargo loaded from the Baltic Sea port of Butinge, the Barents Sea port of Murmansk, or Poland's Gdansk is assessed based on CIF Rotterdam/Netherlands (Platts, 2020a). The most important volumes of Urals Mediterranean originate from the port of Novorossiysk on the Black Sea. Its assessment is based on CIF Augusta, Sicily-Italy (Argus, 2020; Platts, 2020a).

The Eastern Siberia-Pacific Ocean (ESPO) blend is a mixture of crudes produced in several Siberian fields and launched in late 2009. This grade is exported to Asian countries through the ESPO pipeline to China and through the Pacific coast port of Kozmino in Russia. The ESPO blend is a medium sweet, medium-light blend with a typical 36.0° API gravity and a sulfur content of 0.47% (EIA, 2017; Argus, 2020). Moreover, Platts' daily spot assessment of crude oil from Eastern Siberian Pacific Oil (ESPO) considers the cargo loaded from Kozmino, Russia's Far East port. Published ESPO assessments reflect both a flat price and a differential versus Dated-Brent (Platts, 2020a).

The Sokol grade is a light sweet crude oil (ExxonMobil, 2019) with API gravity of 39.7° and 0.18% sulfur content and is produced at the Russian Sakhalin-1 oil field (Platts, 2020a). The Sokol blend is loaded on the south end of Sakhalin Island at the port of Prigorodnoye (EIA, 2017). Furthermore, the Sokol crude oil price assessment reflects the loading of cargo from the DeKastri terminal on Sakhalin Island in eastern Russia. Sokol is assessed at a fixed price as a differential to the Dubai and Oman average of Platts Middle Eastern crude oil benchmarks and a differential to Dated-Brent (Argus, 2020; Platts, 2020a).

3 Data and methodology

In this study, the time-series data of the most important Russian crude oil grades are considered for examining the asymmetric relationship between Russian crude oil sales prices and the prices of the benchmarks of those oil grades. Depending on their export destination, four types of Russian crude oil blends are taken into account. These are Urals for North West Europe Crude Oil Price (*URALSNWE*), Urals for Mediterranean Crude Oil Price (*URALSMED*), ESPO Crude Oil Price (*ESPO*), and Sokol Crude Oil Price (*SOKOL*). Moreover, Dated-Brent Crude Oil Price (*DATEDBRENT*) is the benchmark for the selling price of Urals Crude Oil in North West Europe and Mediterranean deliveries, whereas Dubai Crude Oil Price (*DUBAI*) is the benchmark for the selling prices of ESPO and Sokol grades of Russian crude oil in the Asian market. The study's daily crude oil price data span is between January 2, 2015 and November 16, 2020 and gathered from Thomson Reuter's Refinitiv Eikon Database. The Russian crude oil sales prices (*RP*) and related benchmark prices (*BP*) data are in United States dollars.

The methodology of Kilian and Vigfusson (2011a) is employed in this study to analyze the asymmetric effect of the related Benchmark Price (*BP*) on Russian Oil Prices (*RP*).[2] The nonlinear VAR(n) model considered in this study is as follows:

$$\mathrm{BP}_t = \alpha_{10} + \sum_{k=1}^{n} \alpha_{11,k}\mathrm{BP}_{t-k} + \sum_{k=1}^{n} \alpha_{12,k}\mathrm{RP}_{t-k} + \varepsilon_{1,t} \tag{1a}$$

$$\mathrm{RP}_t = \alpha_{20} + \sum_{k=0}^{n} \alpha_{21,k}\mathrm{BP}_{t-k} + \sum_{k=1}^{n} \alpha_{22,k}\mathrm{RP}_{t-k} + \sum_{k=0}^{n} \gamma_{21,k}\mathrm{BP}^{+}_{t-k} + \varepsilon_{2,t} \tag{1b}$$

where t = 1, 2, …, T.

In the model, n is the lag order, BP_t is the change in the related benchmark price from the previous period, RP_t is the change in the Russian crude oil blend price from the previous period considered in the study, and $\varepsilon_{1},_{t}$ and $\varepsilon_{2},_{t}$ are the mean zero independent and identically distributed Gaussian random variables. Equation (1.a) is the standard linear model, whereas Eq. (1.b) includes both BP_t and the censored variable of BP_t (BP_t^{+}). The censored variable BP_t^{+} is for the non-negative changes in benchmark prices, which can be identified as follows:

$$BP_t^{+} = \begin{cases} BP_t, & \text{if } BP_t \geq 0 \\ 0, & \text{if } BP_t < 0 \end{cases} \tag{2}$$

The orthogonalized shocks to the variables are gathered using the Cholesky Decomposition Method for identification. Later, the impulse responses are gathered by following Kilian and Vigfusson (2009; 2011a) while also combining Eq. (1.a) and Eq. (1.b).

[2] In this study, WinRATS Software is used for the econometric modelling.

In order to test the asymmetry, two types of tests are performed: the slope-based test and the impulse-response-based test. Firstly, two slope-based tests are used. Following Kilian and Vigfusson (2011a), H_0: $\gamma_{21,0} = \ldots = \gamma_{21,n} = 0$ is tested in Eq. (1.b). This process is called as Wald test and has a χ^2_{n+1} distribution. The conventional VAR Model, in which the lag order starts from *1* rather than *0* in Eq. (1.a) and Eq. (1.b), is also estimated. Then H_0: $\gamma_{21,1} = \ldots = \gamma_{21,n} = 0$ is tested and this process is called the Mork Test following Mork (1989). On the other hand, the null hypothesis for the impulse-response-based test is taken as H_0: $I_y(h, \delta) + I_y(h, -\delta) = 0$, where $I_y(h, \delta)$ and $I_y(h, -\delta)$ are the positive and negative responses of RP_t at period $h = 1, 2, \ldots, H$ to shock δ while this test has an asymptotic χ^2_{H+1} distribution that depends on the effect of the shock. The impulse responses in nonlinear VAR models are both historically dependent and vary according to the magnitude of the given shock.[3] In order to get the impulse response functions, we use 300 histories by Monte Carlo integration. The procedure is repeated 300 times to obtain the empirical distribution of the test statistics.

4 Empirical evidence

The Kilian and Vigfusson (2011a) model has been utilized for the nonlinear VAR Model to test the asymmetric relationship between benchmark prices and the sales prices of Russian crude oil grades. In this study, Schwarz Information Criterion is used for determining the lag lengths and taken as 18 for *URSALNWE*, 17 for *URALSMED*, 32 for *ESPO,* and 12 for *SOKOL*. The number of prespecified horizons for the impulse responses is taken as 90.

In Table 1, two slope-based and impulse-response-based test statistics are reported in Panels A and B, respectively. As given in Panel A of Table 1, the null hypothesis of symmetry is rejected for four types of Russian crude oil contracts according to the Wald Test and rejected for *ESPO* and *SOKOL* according to the Mork Test at the 5% significance level. The nonlinear VAR specification produces impulse responses for different sizes of shocks given to the system. Thus, two different impulse responses are reported depending on the size of the shock. Consistent with the *p*-values presented in Panel B of Table 1, the asymmetric responses of Russian crude oil prices to positive and negative benchmark oil price shocks along with sd shock sizes of 1 and 2 are given, and the ones with significance levels of 1%, 5%, and 10% are indicated. The test statistics reported as *p*-values in Panel B suggest the asymmetric effects of positive and negative benchmark oil price shocks on Russian Crude Oil prices. They are statistically significantly

[3] Kilian and Vigfusson (2009; 2011a) implement several asymmetry tests in their study and suggest that the two slope-based tests are more powerful and efficient since they do not require the complete specification of the system to be estimated or the computation of impulse responses. Furthermore, their study emphasizes that the Wald Test has a similar accurate size but may have greater power than the Mork (1989) test, making it beneficial to evaluate both of the tests.

Table 1 The asymmetry tests of the model

	Urals for North West Europe	Urals for Mediterranean	Eastern Siberia-Pacific Ocean	Sokol
Panel A: The slope-based tests				
Wald	206.703***	187.957***	421.552***	36.306***
Mork	26.978*	21.084	47.044**	22.618**

Panel B: The impulse-response-based test

Period	1-SD shock	2-SD shock	1-SD shock	2-SD shock	1-SD shock	2-SD shock	1-SD shock	2-SD shock
0	0.443	0.153	0.118	0.076*	0.060*	0.030**	0.471	0.729
9	0.987	0.408	0.977	0.373	0.633	0.008***	0.999	0.428
19	0.954	0.867	0.999	0.285	0.965	0.002***	0.981	0.015**
29	0.982	0.982	1.000	0.314	0.976	0.000***	0.915	0.171
39	0.734	0.800	0.999	0.361	0.993	0.000***	0.901	0.156
49	0.404	0.537	1.000	0.533	0.999	0.000***	0.870	0.070*
59	0.000***	0.074*	1.000	0.350	0.946	0.000***	0.818	0.032**
69	0.000***	0.000***	0.994	0.138	0.764	0.000***	0.201	0.004***
79	0.000***	0.000***	0.820	0.000***	0.000***	0.000***	0.000***	0.000***
89	0.000***	0.000***	0.081*	0.000***	0.000***	0.000***	0.000***	0.000***

(1) The findings are the *p* values for period (H): 0, …, 89 based on 1000 simulations of model χ^2_{H+1} value

(2) The *p*-values are presented in the table as per 10-period findings for convenience. The *p*-values for 90 periods are available upon request

(3) * indicates a 10% level of significance, ** indicates a 5% level of significance, *** indicates a 1% level of significance

different from each other in absolute value (the magnitude of the shocks is different) as the sd shock sizes increase. Thus, the impulse-response-based test also supports asymmetry for responses to Russian crude oil market prices.[4]

The impulse and responses are reported in Fig. 1 one as Panel A to D as positive and negative; 1 and 2 sd price shocks are given to the benchmark oil prices for observing four Russian crude oil prices' responses. The figures present the findings for 90 periods (days) where the benchmark crude oil types are taken as *DATEDBRENT* and *DUBAI,* and the Russian crude oil types are taken as *URALSNWE*, *URALSMED*, *ESPO,* and *SOKOL*. The dashed lines show negative price shock responses, whereas the solid lines show the responses of a positive price shock. The responses to the negative benchmark price shocks are reported as their mirror images to facilitate the comparison of the magnitudes.

[4] The complete findings of 1, 2, 4 and 10 standard deviation sizes for 90 periods are available upon request.

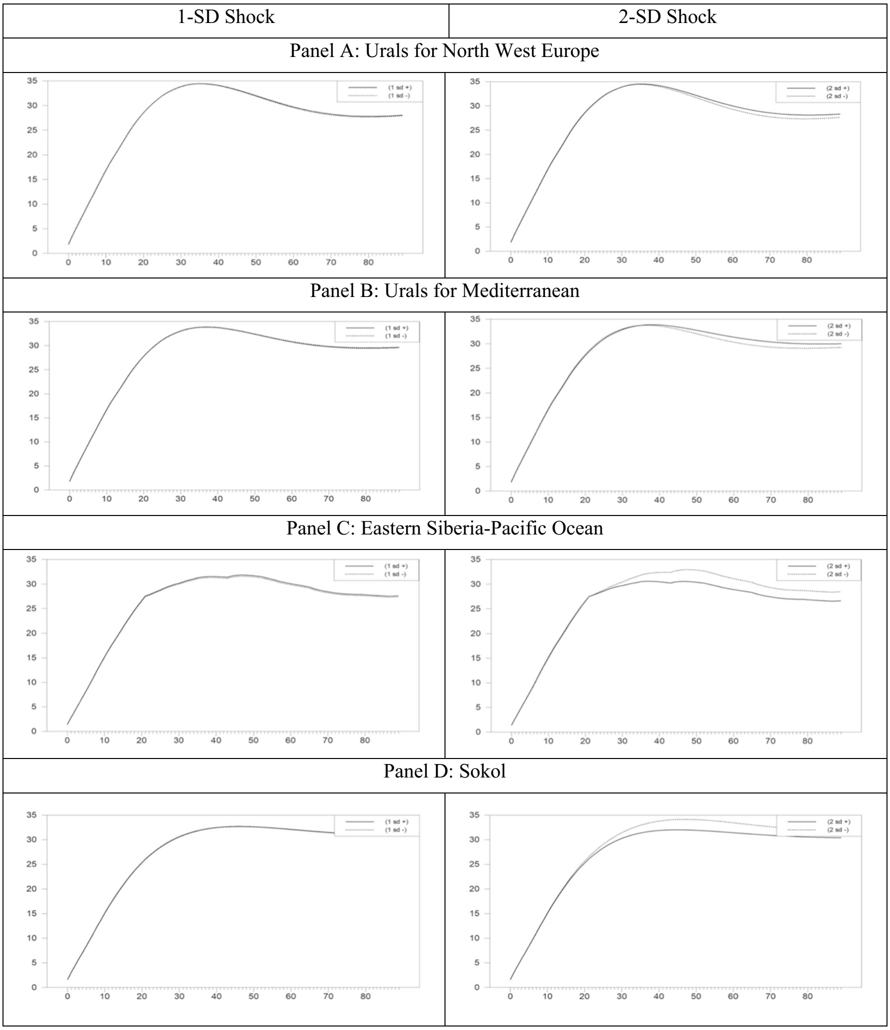

Fig. 1 The responses of Russian crude oil prices to their benchmark oil price shocks. *Note* The dashed lines show the responses of a negative price shock to the benchmark oil prices, and the solid lines show the responses of a positive price shock.

Panel A of Fig. 1 suggests that the initial negative responses of *URALSNWE* to the positive and negative price shocks of *DATEDBRENT* are higher than the positive responses. After the 30th period, the responses to the positive shocks become higher than to negative shocks. Panel B of Table 1 suggests that the difference between these shocks is statistically significant after period 58 for 1 sd and period 60 for 2 sd shocks, even though there were limited statistically significant differences on the initial ones. Additionally, the positive and negative responses to the 2 sd shocks begin to differentiate, starting around the initial period. The response of *URALSNWE* increases in an increasing fashion up to period 35 and afterward increases in a decreasing fashion. The response to a negative price shock is greater than to a positive one up to period 27; afterward, the response to the positive price shock becomes greater than the negative one. Moreover, as the sd shock size increases from 1 to 2, the difference in responses to positive and negative shocks becomes larger.

Panel B of Fig. 1 reports that the initial negative responses of *URALSMED* to the positive and negative price shocks of *DATEDBRENT* are higher than the positive responses up to around the 30th period and the responses of the positive shocks are higher than the negative shocks in the following periods. Table 1 shows that the difference between these shocks is statistically significant after period 71 for 2 sd shocks. Moreover, the positive and negative responses to the shocks begin to differentiate starting from the initial period. The response of *URALSMED* increases in an increasing fashion up to period 40 and afterward increases in a decreasing fashion. The response to a negative price shock is greater than to a positive one up to period 34, and after this period as the response to the positive price shock becomes greater than the negative one. Furthermore, the difference in responses to positive and negative shocks becomes larger as the sd shock size increases from 1 to 2.

Panel C of Fig. 1 illustrates the responses of *ESPO* to the positive and negative price shocks of *DUBAI*. Similar responses at 2 sd shocks can be seen for the positive and negative shocks. The positive and negative responses start to differentiate beginning from the initial point as the positive responses of *ESPO* are greater than the negative ones up to about the 20th period, when the negative responses become greater. Table 1 suggests that the difference between these shocks is statistically significant after period 71 for 1 sd and the initial point for 2 sd shocks. The response of *ESPO* increases in an increasing fashion up to period 20 for positive shocks and up to period 47 for negative shocks, while both increase in a decreasing fashion afterward. The responses to positive price shocks are greater than to negative ones up to the 23rd period, and the responses to the negative price shocks become greater than the positive ones in the following periods. The asymmetry in responses to the positive and negative benchmark price shocks deviates more as *ESPO*'s sd shock size increases from 1 to 2.

Panel D of Fig. 1 reports the responses of *SOKOL* to the positive and negative price shocks of *DUBAI*. A similar response pattern for both negative and positive price shocks can be seen for 2 sd shocks. The positive and negative responses begin to differentiate starting from the initial point as the positive responses of *SOKOL* are greater than to negative ones up to about the 10th period; afterward, negative responses exceed positive ones. According to Table 1, the difference between these shocks is statistically significant after period 72 for 1 sd and from period 10 up to period 27 and after period 53 for 2 sd shocks. The response of *SOKOL* increases in an increasing fashion up to period 30 for positive shocks and up to period 45 for negative shocks, while both increase in a decreasing fashion after that. The responses to positive price shocks are greater than to negative ones up to period 13, and the responses to the negative price shocks become greater than positive ones in the following periods. The asymmetry in responses of *SOKOL* to the positive and negative benchmark price shocks deviates more as the sd shock size increases from 1 to 2. To the best of our knowledge, only Kahraman et al. (2021) empirically investigate the price asymmetry of crude oil grades (three Iraqi crude oils) with their benchmark prices. They find the asymmetry, but the direction of asymmetry is reversed for two of their benchmark oil blends: Basrah Light and Kirkuk. Moreover, the evidence of asymmetry for the effects of oil price shocks on aggregate economic activity in the literature is in line with our paper's findings [see, for example, Mork (1989), Hamilton (2003), and Azad and Sertelis (2022)].

5 Discussion

Before discussing the asymmetry patterns gathered in the study, it is important to consider the characteristics of the markets in which Russian oils and their corresponding benchmarks are traded. Note that Europe and Asia have been two major points for Russian crude oil to compete against OPEC producers for its export grades. Moreover, one of the main reasons for the size asymmetry in Russian crude oil sales prices is that they react to physical market conditions that require the physical delivery of crude oil rather than only the financial (paper) markets in which benchmark prices are set. Although Dated-Brent oil is taken as a benchmark for physical market pricing, it is also a basis benchmark for the financial side of pricing and a kind of swap. On the other hand, Dubai is a benchmark oil type where financial pricing takes place directly. Additionally, crude oil benchmarks like Dated-Brent and Dubai capture the financial side of the market rather than only the physical side of the market because the impact multiplier is high as unfavorable developments in the financial market may create a panic atmosphere (Platts, 2020b). However, the crude oil prices used in this study are priced against their physical market conditions. Thus, it is expected that the pricing will tend to converge into market equilibrium rather than the mechanisms driving crude oil benchmarks in the financial markets. For any physical crude (Russian crudes in this study) pricing cannot be unparallel to the physical supply and demand conditions. The obligations of buyers and sellers to fulfill their contractual terms can create boundaries for the lower and upper limits of the pricing. This suggests that financial crude oil prices can move more freely in any direction than physical prices since physical delivery will face stiffer demand and supply conditions. Therefore, this is expected to generate another reason for the asymmetric responses of price mechanisms for physical prices against their benchmarks. It is especially important to note that most of the crude oil traded in physical markets is traded with long-term contracts with fixed terms as of the commencement of the contract, so the physical prices tend to converge into contractual terms rather than benchmark conditions (S&P, 2021).

It is also necessary to examine the reasons for the price asymmetries observed in the Russian crude oil types examined in this study. When the asymmetry is evaluated for Russia's flagship crude oil grade type Urals; firstly, Russia is a net exporter of petroleum products targeting mainly European refineries, where they compete with their exported gasoil and other petroleum products. These facts drive Russia to operate at a balanced price to sell crude oil while its buyers are at an optimized margin level, but at the same time, Russia can sell gasoil or diesel. Another asymmetry factor is that Russia's Urals crude oil blend is a benchmark grade in the North West Europe and Mediterranean regions, both of which have limited domestic crude oil supplies. Thus, with the demand for its Urals crude oil and vast supply capacity, Russia has a dominant position in both regions. This means that Russia does not have any major threat to its market share in these regions, where they are more hesitant to decrease their sales price with decreasing benchmark prices (Ayasli et al., 2023). Therefore, Russia is more resistant to declining oil prices than to increasing oil prices, and Urals crude oil sales prices will react more to price increases in the benchmark oil price than decreases. Another factor is that, essentially, the dynamics of the freight market might not directly reflect physical market conditions. Freight market supply and demand patterns are not parallel to those of the crude oil market. One reason is that the crude oil is shipped with so-called dirty tankers carrying crude oil or fuel oil, which are considered dirty fuel. This means dirty vessel market supply and demand dynamics are relevant to the crude oil and fuel oil markets. Furthermore, although the crude oil pricing mechanism has a regional rather than a global impact, pricing patterns in the shipping market may be more complex due to the more intense competition in crude oil markets. Pricing generally depends on tanker sizes, and the global supply of tankers for each tanker size class can have interconnected effects for any other regional market for that tanker size. In our case, for example, most of the Urals oil exported from the Black Sea to Mediterranean markets is shipped by Aframax size tankers. Thus, Black Sea-Mediterranean freight cost is a combination of Black Sea crude oil supply, Mediterranean crude oil demand and Aframax markets for the Black Sea, Mediterranean and globally. This creates a totally different pricing pattern for Aframax freight cost for this route; hence, the Urals Augusta CIF price is the Mediterranean benchmark for Urals crude oil. This rule is applicable for any Russian crude moving to the North West Europe and Mediterranean regions. The abovementioned terms are mostly related to the price asymmetry in Urals for the price shocks in its benchmark crude oil, Dated-Brent, where the positive benchmark price shocks have a higher impact than the negative price shocks (Ayasli et al. 2023).

On the other hand, this study suggests that ESPO and Sokol have a reverse pattern where negative benchmark price shocks have a greater impact than positive ones. This situation might also be an outcome of market share dynamics between Russia and its peers competing in the Asian market. Actually, Asian markets are different from European markets. The Chinese market, which is the largest crude import market in Asia, has a large source of domestic crude oil. This allows China to balance crude oil imports with domestic crude oil production, and this generates leverage against oil price volatilities. In other words, China has the power to increase its crude oil supply when oil prices increase so that it can lower crude oil imports. These dynamic forces all the crude oil suppliers to China to be more cautious about increasing their sales price for Chinese and Asian markets. Russia, which is in direct competition with other major producers like Saudi Arabia or Angola in the Chinese market, is forced to limit the increase in its sales prices of ESPO and Sokol grades when the Dubai benchmark increases since Asian markets are more price sensitive. When the Dubai benchmark price decreases, the physical market pays more attention to demand-side constraints, so they tend to decrease their oil prices compared to benchmark prices to become an attractive supply in a demand-driven market, Asia. These are assumed to be the main reasons for the observation that higher negative price shocks have a greater impact than the positive price shocks on ESPO and Sokol.

6 Conclusion

In this study, the aim was to analyze whether there is asymmetry in the effects of benchmark crude oil prices on the market sales prices of related Russian crude oil grades of Urals, ESPO and Sokol using a nonlinear VAR specification for the period from January 2, 2015 to November 16, 2020. The empirical evidence reveals that both sign and size asymmetries exist in the sales prices of Urals, ESPO and Sokol crude oil grades against increases or decreases in Dated-Brent and Dubai benchmarks. Thus, when a positive price shock is given to the benchmark oil, then the sales price of the related crude oil increases. On the other hand, when a negative price shock is given to the benchmark oil, then the sales price of the related crude oil decreases. However, the effects of the positive and negative price shocks are not the same in absolute values. The observed asymmetries also appear to be higher in the long-term. The asymmetry in responses to the positive and negative benchmark price shocks increases as the magnitude of the given shocks increases. In the price asymmetry of European/ Mediterranean deliveries of Urals, positive benchmark price shocks have greater impacts than negative price shocks. On the other hand, in the price asymmetry of Asian deliveries of ESPO and Sokol, the negative price shocks of their benchmark prices have greater impacts than the positive price shocks. The price asymmetries between the crude oil sales prices of Russian crude oil grades and their benchmark prices can be explained by the oil grades' distinctive characteristics, target market and competitive structure.

In general terms, there are various reasons for the asymmetry in Russian crude oil sales prices' reaction to increases and decreases in benchmark oil prices. These factors limit Russia's actions in regulating crude oil prices, so the prices appear to be asymmetric. One reason for the asymmetry in Russian crude oil sales prices is that Russia is one of the major crude oil exporters with a high oil export revenue dependency and a high national budget share. Another reason is that Russia is in a proxy agreement with OPEC producers; they have been in market competition globally in most major demand locations. In addition, the pricing of the exported crude oil by establishing a balance between crude oil income and natural gas sales also affects the crude oil sales price and its specifications. Another factor is that the crude oil benchmarks are priced on a Free on Board (FOB) basis, but the crude oil prices used in this study are on a Cost-Insurance-Freight (CIF) basis to reflect the price at the point of demand. While transportation costs are not included in FOB-based pricing, they are included in CIF-based pricing. Hence, Russia faces an extra transportation cost, an added restriction in terms of pricing. Furthermore, Russia must consider its competitors' crude oil sales prices when setting its own prices and striving to maintain its market share in terms of competition. Correspondingly, pricing for Russian crude oils in this study cannot be unparallel to the physical supply and demand conditions. Therefore, the obligations for buyers and sellers to fulfill their contractual terms can create boundaries for the lower and higher limits of pricing because physical prices are faced with physical limitations. Moreover, Russian Urals crude grade is a benchmark grade in the North West Europe and Mediterranean regions, both of which have limited domestic crude oil supply. Russia has a dominant position in both regions with the demand for its Urals crude oil and its vast supply capacity. Even though China is Asia's biggest crude oil import market, it has considerable domestic crude oil supplies to balance imports. This generates a source of leverage against oil price volatilities, which limits China's vulnerability to oil price volatilities.

The latest conflict between Russia and Europe over the war in Ukraine and sanctions imposed on Russian crude and products has shown that the dependence of Europe on Russian oil is much higher than previously estimated. It makes sense that the Russian price strategy targets benefiting more from supply shocks (translated into increasing benchmark prices, particularly Dated Brent). This study shows that, unless Russian crude export into Europe fall to zero, partial sanctions on Russian crude would be giving less than anticipated harm to Russia as Russian sales price will be even higher for European buyers.

Additionally, Russia seems to have a hybrid strategy for competing in the Asian market by using its pipeline connectivity and geological advantage. ESPO being the main grade to be supplied to the Asian markets, its direct competition against the Middle East and West African grades forces the Russians to be more flexible in their pricing strategy than in North West Europe.

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