International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2023, 13(2), 433-440.

The Impact of Energy Prices on Precious Metals: A Comparison of the SARS-COV2 Period and Prior Period

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Received: 23 December 2022 **Accepted:** 03 March 2023 **DOI:** https://doi.org/10.32479/ijeep.13968

ABSTRACT

Commodities are defined as goods that are traded. Thousands of different items are sold on international markets, but strategically important commodities such as gold, silver, and oil are used far more frequently in the real estate industry and financial markets. Oil and these metals are employed in numerous industrial applications throughout the economy, but they also draw substantial investment. The purpose of this study is to investigate the causal connections between the prices of gold and silver, two precious metals, and oil and natural gas, the two most often used energy sources. This was accomplished by comparing the weekly prices of Brent Petroleum (BRENT), Crude Oil (WTI), Natural Gas (NG), and the weekly data of Gold and Silver during and before the SARS-CoV2 epidemic. The study employed the Distributed Delayed Autoregressive Bound Test (ARDL) approach to examine the relationship between the prices of energy (natural gas, Brent oil, and crude oil) and precious metals (silver and gold). The ARDL test showed that the prices of WTI, Brent, and NG had a big effect on the prices of silver and gold during and before the SARS-COV2 pandemic.

Keywords: SARS-COV2, COVID-19, Gold, Silver, Oil, Natural Gas, Energy Prices
JEL Classification: C32, C22, C58, F30, Q43, P33

1. INTRODUCTION

The global markets are home to a wide range of goods, but the real sector and the financial markets employ strategically significant commodities like gold, silver, and oil considerably more frequently. Even though many commodities, particularly metals and oil, are used in a variety of industrial applications throughout the economy, investors' interest in these commodities has grown over time. In this regard, investors, international financial institutions, and policymakers all keep a careful eye on the ups and downs in commodity prices (Sertkaya, 2022 p. 88).

The COVID-19 pandemic is an infectious illness that first surfaced in Wuhan, China, in December 2019. It affects the respiratory system (SARS-CoV-2). On March 11, 2020, the World Health Organization (WHO) designated COVID-19 as a pandemic. According to data released by the WHO, the pandemic has resulted in more than 240 million illnesses and 4.9 million fatalities as of October 1, 2021. Over 6.5 billion doses of vaccination have been given out since the pandemic's start. Regionally, there were 6.5 million cases in the Western Pacific and Africa, 83.5 million cases in the Western Pacific and the Americas, 65 million cases in Europe, 41 million cases in South-East Asia, and 14.5 million cases in the Eastern Mediterranean. In Turkey, 5.6 million instances were found (World Health Organization, 2021). IMF estimates that aid measures will cost $3.3 trillion and subsidies $4.5 trillion to support economic growth. Additionally, the IMF forecasts that global government borrowing will rise from 3.7% of GDP in 2019 to 9.9% of GDP in 2020. According to the IMF, the ratio of the monetary balance to GDP will rise from 3.0% in 2019 to 10.7% in 2020 for developing nations and from 4.8% in 2019 to 9.1% in 2021 for advanced economies. The International Monetary Fund (IMF) has pledged 50 billion dollars in assistance for low-income nations and 10 billion dollars in quick emergency finance to address the global crisis (International Monetary Fund, 2020). The health problem develops into an economic disaster for two key reasons. The first is a decline in output and an increase in unemployment brought on by regulations and policies that restrict businesses' ability to operate because of social distance. The second is the stoppage of activity by traders and investors owing to the pandemic's spread and the uncertainty surrounding when it will cease. The pandemic has created a serious risk of a worldwide economic crisis in addition to a global health disaster. Due to the severe quarantine measures that several nations have implemented in an effort to battle the undetectable disease, economic activity has abruptly stopped. Global economic activity was slowed down at the outset of the epidemic by restrictions on international travel and later by its entire suspension.

Although the coronavirus epidemic's full impact is not yet understood, it is clear that it has a big impact on business operations. More than 100 nations across the world will have implemented partial or total lockdowns by the end of March 2020. Globally organised cultural and supporting activities have been put on hold. Countries have implemented emergency measures to manage the illness at the national level, including social isolation, curfews, testing and quarantining of suspected patients, investments in the treatment of proven cases, and testing and quarantining of suspected cases. However, these actions raised the level of economic anxiety. In addition to these worries, the central banks and finance ministries of several nations have launched assistance and incentive programmes to mitigate the economic harm (Ashraf, 2020 p. 2).

The goal of the study is to ascertain how the coronavirus, which creates extensive, major, and worldwide economic shock waves, affects gold and silver, which are viewed as safe havens in the financial markets due to their detrimental impacts on national economies, societies, and politics. The ARDL bounds test and natural logarithms will be used to analyse weekly Brent Petroleum, Crude Oil (US Texas oil), Natural Gas (NG), and Gold and Silver prices in the SARS-COV2 timeframe and prior.

2. LITERATURE REVIEW

It was found that the outbreak had a particularly large impact on the manufacturing of metal items and machinery. The industries that provide for necessary necessities and the real estate industry have been found to be the least impacted, notwithstanding the economy's stagnation.

Hammoudeh et al. (2009) compared four important commodity prices. As a result, the researchers used the ARDL limits test technique for the US economy inside the daily data for the years 1990-2006 to analyse the link between financial data and commodities, including oil, gold, silver, and copper. The research's conclusions indicate that interest rates have an impact on commodity prices and currency rates.

Şentürk et al. (2013) examined how the US dollar fluctuated in relation to gold and oil prices between 1989:01 and 2013:12. Their findings reveal that a standard error shock in the US dollar affects gold and oil prices negatively, whereas a standard error shock in gold and oil affects the US dollar positively and each other negatively.

On the other hand, in their analysis covering the years 1990-2010, Jubinski and Lipton (2013) looked at the impact of volatility on the returns of gold, silver, and oil futures. The authors provide good proof that volatility affects the returns of all three commodities futures. So, it was decided that diversifying investors' portfolios would make volatility more important and that gold and silver would make the VIX index go up and oil prices go down.

The direct and indirect impacts of oil prices on gold prices were studied by Yaprakli and Kaplan (2018). As a result, over the time period 1986:01–2017:01, there has been a negative (direct) substitution connection between Brent oil prices and gold prices.

Göçer et al. (2019) used time series analysis to examine the impact of the prices of gold, silver, oil, dollars, and natural gas on international trade for Turkey between 1997 and 2018. According to the study's findings, there is a cointegration relationship between imports and dollars but no long-term relationship in other series. It has also been found that exports interact with commodities like gold, silver, and oil over the long term but not with the dollar or natural gas, and their effects on exports are irreversible.

Çevik et al. (2020) investigated the long-term cointegration relationship between the total number of COVID-19 cases and the ounce prices of Brent oil and gold.The overall number of instances and the prices of oil and gold have been shown to be double- and triple-cointegrated, according to the research's findings.

Sari and Kartal (2020) used the ARDL Boundary Test to assess the influence of COVID-19 scenarios on gold, oil, and the VIX Index. Similar relationships were found between instances, gold prices, and the VIX Index. The number of instances and oil prices had no link.

Tuncel et al. (2021) examined, using Toda-Yamamoto causality analysis, the link between the VIX index and precious metals like gold, silver, platinum, and palladium. A direct association between the VIX index and gold, palladium, and platinum was identified in the analysis utilising daily data for the time period between 10.01.2014 and 02.01.2020; however, no causal relationship was discovered for the silver variable. On the other hand, no causal link between the precious metals examined for the investigation and the VIX index has been found.

Kuloğlu (2021) used oil prices, worldwide daily confirmed COVID-19 instances, and US dollar index variables for the Johansen cointegration test. According to the analysis, the pandemic had a modestly negative influence on oil prices during vaccination compared to shock.

The VIX index is the dependent variable in the Sertkaya (2022) research, which used weekly data from 2015:01 to 2022:02. The ARDL bounds test technique was used to assess the short- and long-term connection between the variables that were included in the investigation. The findings showed that, over the long run, there is a cointegration connection between crucial commodity variables and the VIX index.

The impacts of the oil price, gold price, and VIX index volatility on the Turkish BIST 100 index during the COVID-19 pandemic era were investigated in the Tuna (2022) research. The Toda-Yamomoto causality test revealed that there was no connection between the price of oil, gold, the VIX index, and the BIST100 index. However, the influence of the oil price, gold price, and VIX index on the BIST 100 index declines quickly, and it has been proven that the BIST 100 is announced independently in all periods based on the findings of the stimulus-response functions and variance decomposition analysis.

Kubar and Toprak (2022) used daily data from 02.01.2020 to 03.12.2021 to compare Bitcoin, Ethereum, Binance Coin, Litecoin, Chainlink, Bitcoin Cash, and Ounces of Gold, Platinum, Silver, Crude Oil, and Brent Petroleum. According to Johansen cointegration and Granger causality analyses, commodities and cryptocurrencies move together in the long run. Granger causality study found no short-term association between commodities and cryptocurrency.

Alibabalu and Sarkhanov (2023) analysed the geopolitics and geo-economy of imported gas resources in the Eastern Mediterranean and Turkey's perspective.

Muradzada's (2022) research focused on the oil and gas industries in Russia. He said that global oil prices affect Russia's core economic metrics and that the country still has the Dutch illness.

3. THE RELATIONSHIP BETWEEN ENERGY, GOLD AND SILVER

3.1. The Relationship between Oil and Gold

The first relationship between gold and oil is that producers in the Middle East sell oil for gold. In 1933, Saudi Arabia announced that it would sell oil only in exchange for gold. Today, gold and oil are traded in US dollars. Both gold and oil are important instruments in financial markets. They are also powerful enough to shape the global economy. The gold price is on the rise with the record decline in oil and growth concerns in the global economy.

Looking at the correlation between oil and gold prices, petroleum is the most traded raw material, and gold is the most traded precious metal in the markets. The effects of both on the global economy are too important to be underestimated. The first reason for the oil and gold correlation is that they are both traded in dollars. The price relationship between gold and the dollar is the opposite. Likewise, the price relationship between oil and the dollar is inverse. Therefore, an increase in the value of the dollar may cause oil and gold to enter a downward trend. Otherwise, the weakening of the dollar means an increase in the value of other instruments. As is well known, exceptional cases can occur as a result of global developments. Therefore, it would be wrong to decide on the value of one only by looking at the value of the other.

The second reason for the correlation is the effect of the crude oil price on inflation. The increase in oil prices is directly reflected in fuel prices. Therefore, it is expected to affect inflation as well. When inflation rises, gold prices are expected to increase as well. The reason for this is that investors turn to precious metals in order to protect the value of their money from inflation.

As a result, the increase in inflation caused by the increase in oil prices also raises gold prices. But this effect is not immediately reflected. That is, the reflection of this effect is delayed.

The third reason in the gold and oil correlation is related to economic growth, and the high oil prices negatively affect the economies of the countries. It creates negative effects, especially on growth. As a result, it is possible to see a decrease in stock prices. In this case, investors leave the stock market and turn to alternative assets. Since there are risks involved, it is wiser to choose safe instruments, such as gold. Therefore, with the increase in demand for gold, there is a natural increase in its price. Even if it is an indirect effect, the rise in oil prices will ultimately increase gold prices.

The fourth reason can be explained by gold mining companies. The rise in oil prices increases the costs of gold mining companies. This is because energy and oil prices affect a large portion of the costs of gold mines. Gold prices rise as a result of the increased costs of the companies. As a result, rising oil prices are reflected as an increase in gold prices in the long run.

Finally, at the beginning of the Russian army's invasion of Ukraine, oil prices rose by more than 35%. With the sudden rise in the oil price, gold has reached its peak in recent years. After the US banned oil purchases from Russia, the rise in oil, known as "black gold," caused gold to rise as well. Since the rise in oil prices will negatively affect economic growth, investors have turned to precious metals to avoid losses. In summary, when the risk arises, citizen's switch to the safe harbor, so when the price of oil rises, gold rises as well.[1]

3.2. Relationship between Energy (Oil) and Silver

Despite the climate crisis, silver prices will increase as the world's states attach more importance to renewable energy sources (Yürük, 2022: 227). In today's world, along with technological developments, the element silver has become a frequently used commodity. With the steps to be taken by the United Nations due to global climate change, it is predicted that renewable energy consumption will increase and grow in the coming years. Since solar energy causes low carbon emissions, it is supported by governments, and some countries even give incentives. The use of silver in solar panels used to benefit from solar energy has increased the demand for this commodity. In addition, the demand for and sales of hybrid and electric cars are expected to increase further in the coming years. Electric cars (EV), fully electric cars (BEV), and wired hybrid vehicles (PHEV) will use the silver element in engines, electrical accents, and battery systems, which

1 https://www.tgrthaber.com.tr/ekonomi/brent-petrol-altin-iliskisi-nedir-2817466

will be another important factor in the valuation of the commodity (Yürük, 2022: 228).

Our world is struggling with a serious climate crisis. Global targets have been set to combat the climate crisis. In line with these targets, solar energy investments, which are expected to lead the growth of renewable energy in the coming years, will increase the demand for silver. Solar silver consumption of 101 million ounces in 2020 will have more than doubled in 5 years, accounting for 11% of global demand. Solar power plant investments are expected to grow by 13% on average until 2030. This growth rate will increase the demand for silver. This increase will raise the price of silver to higher levels. At the 26th Conference of the Parties (COP26) of the United Nations Framework Convention on Climate Change, the steps taken to increase the importance given to solar energy, which is one of the renewable energy sources, are important in terms of the value of silver commodities in the coming years (Küçük, 2021).

4. DATA SET AND RESEARCH METHODOLOGY

4.1. Data Set

In the study, weekly prices of Brent Petroleum (BRENT), Crude Oil (WTI), Natural Gas (NG), and Gold and Silver were included in the analysis with weekly data in order to examine the effects of energy prices on precious metals during the COVID-19 epidemic. In addition, weekly data from March 20, 2016 to December 29, 2019, before the COVID-19 pandemic, were also included in the analysis for comparison.

Investing.com provided the weekly price data for Brent, WTI, NG, Six, and Silver used in the research. Variables were included in the analysis by taking their natural logarithms. The interaction between the data included in the analysis was estimated by the ARDL method. The data of three energy commodities Brent, WTI, and NG along with Gold and Silver are used to determine their relationship and the impact of energy prices on the metals. The prices of energy are taken as a dependent variable, and metals are an independent variable.

4.2. Research Methodology

To ascertain the cointegration connection between variables, Pesaran et al. (2001), Pesaran and Shin (1999), and the ARDL model were all used. Compared to the cointegration tests used in the literature, the ARDL approach offers a few benefits over Engle and Granger (1987), Johansen (1988), and Johansen and Juselius (1990). The ARDL test's most significant benefit is that it may be utilised regardless of whether the model's input variables are stationary at the level or stationary at the first difference. This means that before doing the limits test, it is not necessary to ascertain the degrees of stationarity of the variables. However, stationary variables in the second difference cannot be modelled using the ARDL method. Because of this, a unit root test must be performed on the variables. Second, compared to the Engle-Granger cointegration test, the adoption of the unconstrained error correction model (UECM) offers superior statistical features (Narayan and Narayan, 2005, 429). The ARDL technique also has the major benefit of being applicable to research with small sample numbers. The cointegration methods of Engle and Granger (1987) and Johansen (1988) claim that smaller sample sizes yield more trustworthy findings (Narayan and Smyth, 2005:103). The study uses the following equations to calculate the cointegration relationship with the ARDL model.

$$\Delta Y_t = \beta o + \ln(X) + \mu_t \tag{1}$$

Equation is where the study's linear estimation equation is displayed (1). Equation was used to develop the unconstained error correction model for the ARDL bounds test (2).

The model's equation may be expressed as

$$\Delta Y_t = \beta o + \sum\nolimits_{i=1}^{n} \beta_i \Delta Y_{t-1} + \sum\nolimits_{i=1}^{n} \beta_{\delta i} \Delta X_{t-1} + \varphi_1 Y_{t-1} + \varphi_2 X_{t-1} + \mu_t \tag{2}$$

The is the error term; an is the constant term; and D represents the difference operator in the equation. The Wald test is used to determine if there is a long-term association after estimating equation (2). The following are the test's hypotheses:

$$H_0 = \delta^1 = \delta^2 = 0 \tag{3}$$

$$H_0 = \delta 1 \neq \delta 2 \neq 0 \tag{4}$$

The F statistical value calculated for the analysis of the long-term relationship is compared with the significance levels derived asymptotically in the studies of Pesaran et al. (2001). Lower and upper values are presented in this research depending on whether the variables are I (0) and I (1). It is determined that there is no cointegration relationship if the F statistic is below the crucial value and that there is a cointegration relationship if it is above the critical value. It is impossible to determine if there is cointegration if the F statistical value is between the lower and upper levels (Akel and Gazel, 2014: 31).

5. RESULTS OF EMPIRICAL ANALYSIS

5.1. Unit Root Test (ADF) Results

To verify the stationarity of the model observations, a unit root test is utilised. The data unit root is examined using the most popular Augmented Dickey Fuller test (Table 1).

The model is non-stationary at level form, according to the prior COVID data, however the model data set is stationary at the first difference level.

Table 2 displays the outcomes of the unit root test following COVID-19. Model data is non-stationary at level P0.05 and becomes stationary at the first difference level, according to the results of the Augmented Dickey-Fuller test. We may use the ARDL technique to examine the short- and long-term effects of changes in oil prices on the metals (gold and silver) because all variables are stationary at the first level.

Table 1: Pre-pandemic ADF unit root test results

Variable	At level			At First difference		
	t-Statistic	Test critical values	Prob.*	t-Statistic	Test critical values	Prob.*
NG	−3.01676	−3.46358	0.0916	−13.9133	−3.46358	0.00***
WTI	−2.46624	−3.46358	0.1254	−13.2968	−3.46358	0.00***
BRENT	−2.32931	−3.46358	0.1638	−13.2603	−3.46358	0.00***
GOLD	−1.09545	−3.46358	0.7176	−13.3619	−3.46358	0.00***
SILVER	−2.2413	−3.46358	0.1925	−12.3607	−3.46358	0.00***

*** shows the level of significance at P<0.01

Table 2: Pandemic period ADF unit root test results

Variable	At level			At first difference		
	t-Statistic	Test critical values	Prob.*	t-Statistic	Test critical values	Prob.*
NG	−0.95004	−3.49844	0.7684	−10.4699	−3.49844	0.00***
WTI	−0.97057	−3.49844	0.7614	−7.3656	−3.49844	0.00***
BRENT	−1.4069	−3.49844	0.576	−3.42713	−3.49844	0.01**
GOLD	−2.72627	−3.49844	0.0731	−12.4942	−3.49844	0.00***
SILVER	−1.64766	−3.49844	0.4547	−10.546	−3.49844	0.00***

***shows the level of significance at P<0.01 and ** shows the level of significance at P=0.01

5.2. ARDL Test

The link between the dependant and independent variables is examined using the ARDL approach. We may use the ARDL approach to examine the link between metals and oil prices since all of the model variables are stationary at the initial difference. The model's outcomes are presented as.

Brent is the independent variable, while gold is the dependant variable. The ARDL model equation looks like this:

$$\Delta Gold_t = \beta o + \ln(Brent) + \mu_t$$

$$\Delta Gold_t = \beta o + \sum_{i=1}^{n} \beta_i \Delta \ln(Gold)_{t-1} + \sum_{i=1}^{n} \beta_{\delta i} \Delta \ln(Brent)_{t-1}$$
$$+\varphi_1 \ln(Gold)_{t-1} + \varphi_2 Brent_{t-1} + \mu_t$$

The pre-COVID and COVID period ARDL short run results are as follows in Table 3.

The Table 4 demonstrates that gold had no short-term effects during the pre-pandemic era, but during the pandemic period, gold was significantly impacted by the first Brent lag. In the short run, the short run gold first lag pre-pandemic and first and second lag pandemic period had a significant impact on the dependent gold prices.If the lag value increases by one percent point, the pre-pandemic gold lag coefficient increases by 0.97% point.The gold lag first period and second period lag values had a 0.66% and 0.22% point positive change in gold with the change in the first period lag and second period lag values, respectively, during the pandemic period.When Brent oil changes by one percent point, the Brent price first lags negatively by 0.05%.

The second model is considered to have a Brent-to-silver impact in the short run as well as in the long run. The ARDL model equation can be written as

$$\Delta Sliver_t = \beta o + \ln(Brent) + \mu_t$$

Table 3: Brent and gold pre-COVID ARDL test

Gold	Coefficient	Standard error	t-Statistic	Prob.*
GOLD (−1)	0.978627	0.019643	49.8216	0.00***
BRENT	0.000486	0.006553	0.074208	0.9409
C	0.153467	0.139488	1.100217	0.2726

Dependent is variable Gold and *** shows the level of significance at P<0.01

Table 4: Brent and gold pandemic period ARDL test

Variable	Coefficient	Standard error	t-Statistic	Prob.*
GOLD (−1)	0.663038	0.101945	6.503875	0.00***
GOLD (−2)	0.220894	0.098346	2.246086	0.02**
BRENT	0.051329	0.032427	1.582906	0.11
BRENT (−1)	−0.05979	0.032639	−1.83193	0.07*
C	0.90565	0.324891	2.78755	0.00***
CointEq (−1)*	−0.02137	0.013933	−1.53396	0.12

Dependent is variable Gold and *** shows the level of significance at P<0.01

$$\Delta Silver_t = \beta o + \sum_{i=1}^{n} \beta_i \Delta \ln(Silver)_{t-1} + \sum_{i=1}^{n} \beta_{\delta i} \Delta \ln(Brent)_{t-1}$$
$$+\varphi_1 \ln(Silver)_{t-1} + \varphi_2 Brent_{t-1} + \mu_t$$

Pre-pandemic silver's short run study demonstrates that Brent and silver had a large short-term influence on silver, and cointegration coefficients demonstrate that Brent had a substantial long-term impact on silver (Table 5). One percent point change in the first lag, and silver's value increased by 0.91% point.

Brent had a considerable influence on silver in the short run, according to an examination of its first and second lags, while the long run, according to cointegration coefficients, was significantly negative for silver (Table 6). Prices for silver significantly increased after its first and second post-pandemic delays, with changes of 0.75 and 0.19% points, respectively. A one percent shift in Brent prices affects the price of silver by 0.21% in the short term.

The third model considers the impact of WTI on gold.

Table 5: Brent and silver pre-pandemic ARDL test

Variable	Coefficient	Standard error	t-Statistic	Prob.*
SILVER (−1)	0.915821	0.025997	35.22806	0.00***
BRENT	−0.03136	0.012808	−2.44863	0.01**
C	0.369713	0.1119	3.303974	0.00***
CointEq (−1)*	−0.08418	0.024901	−3.3805	0.00***

Dependent is variable Silver and *** shows the level of significance at P<0.01

Table 6: Brent and silver pandemic period ARDL test

Variable	Coefficient	Standard error	t-Statistic	Prob.*
SILVER (−1)	0.75135	0.10287	7.303868	0.00***
SILVER (−2)	0.190931	0.101659	1.878147	0.06*
BRENT	0.218434	0.066331	3.293098	0.00***
BRENT (−1)	−0.07283	0.094519	−0.7705	0.44
BRENT (−2)	−0.15025	0.06587	−2.28091	0.02**
C	0.200936	0.085951	2.337809	0.02**
CointEq (−1)*	−0.05772	0.024211	−2.384	0.01**

Dependent is variable Silver and *** shows the level of significance at P<0.01

The ARDL model equation can be written as

$$\Delta Gold_t = \beta o + \ln(WTI) + \mu_t$$

$$\Delta Gold_t = \beta o + \sum_{i=1}^{n} \beta_i \Delta \ln(Gold)_{t-1} + \sum_{i=1}^{n} \beta_{\delta i} \Delta \ln(WTI)_{t-1}$$
$$+\varphi_1 \ln(Gold)_{t-1} + \varphi_2 WTI_{t-1} + \mu_t$$

The short run study of pre-pandemic reveals that WTI had a little influence on it in the long run, but cointegration coefficients reveal that gold first lag had a considerable impact on it in the short run (Table 7). Gold prices rose by 0.97% points for every one percent point increase in the first lag for gold.

The pandemic period's short run analysis reveals that WTI, Gold's first lag, second lag, and WTI's first lag all had a strong short-term impact on gold prices, while WTI's long-term influence on gold prices is shown by cointegration coefficients (Table 8). Gold prices increased by 0.66 and 0.22% points, respectively, for every 1% point increase in the first and second lags. WTI had a 0.06% point positive and negative influence on gold prices, respectively, as did WTI's initial lag.

For pre- pandemic and pandemic period scenarios, the fourth model is referred to as NG to Gold. The ARDL model equation looks like this:

$$\Delta Gold_t = \beta o + \ln(NG) + \mu_t$$

$$\Delta Gold_t = \beta o + \sum_{i=1}^{n} \beta_i \Delta \ln(Gold)_{t-1} + \sum_{i=1}^{n} \beta_{\delta i} \Delta \ln(NG)_{t-1}$$
$$+\varphi_1 \ln(Gold)_{t-1} + \varphi_2 NG_{t-1} + \mu_t$$

The pre-pandemic short run study demonstrates that in the short run Gold initial lag had a major influence on the Gold and that in the long run NG had a negligible impact on the Gold (Table 9). A one percent point increase in the gold price corresponded to a 0.96% point increase in the first lag.

Table 7: WTI and gold pre-pandemic ARDL test

Variable	Coefficient	Standard error	t-Statistic	Prob.*
GOLD (−1)	0.979489	0.01962	49.92264	0.00***
WTI	−0.0013	0.007454	−0.17439	0.8617
C	0.154442	0.139567	1.106575	0.2698
CointEq (−1)*	−0.02051	0.0133	−1.54224	0.1246

Dependent is variable Gold and *** shows the level of significance at P<0.01

Table 8: WTI and gold pandemic period ARDL test

Variable	Coefficient	Standard error	t-Statistic	Prob.*
GOLD (−1)	0.660455	0.099975	6.606221	0.00***
GOLD (−2)	0.221698	0.09678	2.290747	0.02**
WTI	0.061003	0.029932	2.038054	0.04**
WTI (−1)	−0.06824	0.030048	−2.27109	0.02*
C	0.913548	0.322521	2.832521	0.00***
CointEq (−1)*	−0.11785	0.037632	−3.13158	0.00***

Dependent is variable Gold and *** shows the level of significance at P<0.01

Table 9: NG and gold pre-pandemic ARDL test

Variable	Coefficient	Standard error	t-Statistic	Prob.*
GOLD (−1)	0.962098	0.021844	44.0432	0.00***
NG	−0.01308	0.008126	−1.60956	0.10
C	0.288309	0.161892	1.780871	0.07*
CointEq (−1)*	−0.0379	0.016957	−2.23521	0.02**

Dependent is variable Gold and *** shows the level of significance at P<0.01

The pandemic period's short run analysis reveals that Gold's first and second lags had a large influence on NG in the short run, while cointegration coefficients demonstrate that NG had a major impact on Gold in the long run (Table 10). With a one percent point shift in the first and second lags of gold prices, respectively, the gold price increased by 0.71 and 0.19% points for every percent point increase in the first and second lags.

For the pre pandemic and pandemic periods, the fifth model is taken into consideration as WTI to Silver. The ARDL model equation looks like this:

$$\Delta Silver_t = \beta o + \ln(WTI) + \mu_t$$

$$\Delta Silver_t = \beta o + \sum_{i=1}^{n} \beta_i \Delta \ln(Silver)_{t-1} + \sum_{i=1}^{n} \beta_{\delta i} \Delta \ln(WTI)_{t-1}$$
$$+\varphi_1 \ln(Gold)_{t-1} + \varphi_2 WTI_{t-1} + \mu_t$$

The pre-pandemic short run analysis demonstrates that in the short run Silver initial lag (Table 11), WTI had a large influence on the metal, and the long run cointegration coefficients demonstrate that WTI had a big impact on the metal. Short-term silver prices increased by 0.92% point for every percent point increase in the silver price's initial lag.

The pandemic period's short run analysis demonstrates that WTI, WTI first lag, and WTI second lag all significantly impacted Silver in the short run, while cointegration coefficients demonstrate that WTI also significantly impacted Silver in the long run (Table 12). First lag price changes for silver were one percent point positive, second lag price changes for silver were 0.80 and 30% point positive, and third lag price changes for silver were 0.17% point

Table 10: NG and gold pandemic period ARDL test

Variable	Coefficient	Standard error	t-Statistic	Prob.*
GOLD (−1)	0.715451	0.098754	7.244809	0.00***
GOLD (−2)	0.190697	0.097731	1.951239	0.05*
NG	−0.00699	0.007117	−0.98193	0.32
C	0.712382	0.332353	2.14345	0.03**
CointEq (−1)*	−0.09385	0.034329	−2.73385	0.00***

Dependent is variable Gold and *** shows the level of significance at P<0.01

Table 11: WTI and silver pre-pandemic ARDL test

Variable	Coefficient	Standard error	t-Statistic	Prob.*
SILVER (−1)	0.928163	0.02422	38.32293	0.00***
WTI	−0.0292	0.01359	−2.14827	0.03**
C	0.323069	0.1049	3.079792	0.00***
CointEq (−1)*	−0.07184	0.022722	−3.16161	0.00***

Dependent is variable Silver and *** shows the level of significance at P<0.01

Table 12: WTI and silver pandemic period ARDL test

Variable	Coefficient	Standard error	t-Statistic	Prob.*
SILVER (−1)	0.807076	0.097181	8.304895	0.00***
SILVER (−2)	0.300544	0.133075	2.258448	0.02**
SILVER (−3)	−0.17673	0.095545	−1.84969	0.06*
WTI	0.27242	0.062357	4.36869	0.00***
WTI (−1)	−0.26521	0.061626	−4.30352	0.00***
C	0.189174	0.084472	2.239485	0.02**
CointEq (−1)*	−0.06911	0.0303	−2.28083	0.02**

Dependent is variable Silver and *** shows the level of significance at P<0.01

negative. WTI and the first lag of WTI had a 0.27 and 0.26% point positive and negative influence on silver prices, respectively.

Sixth model consider as NG to Silver as dependent model

The ARDL model equation can be written as

$$\Delta Silver_t = \beta o + \ln(NG) + \mu_t$$

$$\Delta Silver_t = \beta o + \sum_{i=1}^{n} \beta_i \Delta \ln(Silver)_{t-1} + \sum_{i=1}^{n} \beta_{\delta i} \Delta \ln(NG)_{t-1}$$
$$+ \varphi_1 \ln(Gold)_{t-1} + \varphi_2 NG_{t-1} + \mu_t$$

The short run analysis of pre-pandemic shows that in short run Silver first lag had significant impact on the Silver and cointegration coefficients shows NG had significant impact on the Silver in the long run (Table 13). A one percent point increase in the price of natural gas first lag resulted in a 0.94% point increase in the short-term price of silver.

The short run analysis of pandemic period shows that in short run Silver first lag had significant impact on the Silver and cointegration coefficients shows NG had significant impact on the Silver in the long run (Table 14). Short-term natural gas prices increased by 0.95% point for every percentage point increase in the silver initial lag.

5.3. Diagnostic Tests

The Breusch-Godfrey serial correlation LM test result demonstrates that the data set is devoid of autocorrelation. It demonstrates that the model findings are reliable and appropriate for use in making policy recommendations (Tables 15 and 16).

Table 13: NG and silver pre-pandemic ARDL test

Variable	Coefficient	Standard error	t-Statistic	Prob.*
SILVER (−1)	0.948768	0.022033	43.06198	0.00***
NG	−0.01789	0.012104	−1.4779	0.14
C	0.165735	0.064931	2.552465	0.01**
CointEq (−1)*	−0.05123	0.018739	−2.73396	0.00***

Dependent is variable Silver and *** shows the level of significance at P<0.01

Table 14: NG and silver pandemic period ARDL test

Variable	Coefficient	Standard error	t-Statistic	Prob.*
SILVER (−1)	0.955446	0.034729	27.51144	0.00***
NG	−0.00131	0.0179	−0.07306	0.94
C	0.1427	0.099082	1.440231	0.15
CointEq (−1)*	−0.04455	0.026027	−1.71185	0.09*

Dependent is variable Silver and *** shows the level of significance at P<0.01

Table 15: Pre-pandemic analysis autocorrelation test

Breusch-godfrey serial correlation LM test			
F-statistic	0.28482	Prob. F (2,192)	0.7525
Obs*R-squared	0.582746	Prob. Chi-square (2)	0.7472

Table 16: Pandemic period analysis autocorrelation test

Breusch-Godfrey serial correlation LM test			
F-statistic	0.630083	Prob. F (2,95)	0.5348
Obs*R-squared	1.335307	Prob. Chi-square (2)	0.5129

H_o: there is no autocorrelation of any order up to p
H_1: there does

Breusch-Godfrey serial correlation's output there is no autocorrelation in the data set, according to the LM test.

H_o: there is no autocorrelation of any order up to p
H_1: there does

6. CONCLUSION

The rising need for energy supplies has increased the relevance of the interdependence felt on a global basis today (Tutar et al., 2022, p. 332). In this research, the impact of oil prices on metals has been studied. The fluctuating oil prices had an impact on gold and silver prices in both the short and long run. The unit root rest was applied to check the stationarity of the data. The data is non-stationary at level form, but at the first difference it becomes stationary. The first difference in stationary data can be used for ARDL analysis and the cointegration test. The findings of the ARDL test reveal that gold and silver lagging values have a large influence on the metals themselves as well as that oil prices have a big impact on silver and gold. The cointegration finding demonstrates that NG and Brent have a substantial long-term influence on gold. The outcome also demonstrates that NG and Brent had a substantial long-term influence on silver. Overall, the findings indicate that the model is successful in explaining variations in metal prices.

The Breusch-Godfrey serial correlation LM test findings revealed that there was no autocorrelation in the data set, proving the validity of the models' output and allowing it to be used to the formulation of policy recommendations.

REFERENCES

Akel, V., Gazel, S. (2014), Döviz kurlari ile bist sanayi endeksi arasindaki eşbütünleşme ilişkisi: Bir Ardl Sınır Testi Yaklaşımı. Erciyes Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 44, 23-41.

Alibabalu, S.S., Sarkhanov, T. (2023), Geopolitics and geoeconomics of the Eastern Mediterranean gas conflict: Analysis of Turkey's policy. Geopolitics Quarterly, 18(4), 94-115.

Ashraf, B.N. (2020), Stock markets reaction to Covid-19: Cases or fatalities? Research in International Business and Finance, 54, 101249.

Çevik, E., Yalçin, E.C., Yazgan, S.Ö. (2020), COVID-19 pandemisinin petrol ve altin fiyatlari üzerine etkisi: Parametrik olmayan eştümleşme sira testi. Gaziantep University Journal of Social Sciences, 19(COVID-19 Special Issue), 633-646.

Engle, R.F., Granger, C.W.J. (1987), Co-İntegration and error correction: Representation, estimation, and testing. Econometrica: Journal of The Econometric Society, 55(2), 251-276.

Göçer, Ş., Deniz, M.B., Bursal, M. (2019), Türkiye'de diş ticaret hadlerinin altin, gümüş, dolar, petrol, ve doğalgaz fiyatlari ile ilişkisi: Eş bütünleşme analizi. Bartın Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 10(20), 191-203.

Hammoudeh, S., Sarı, R., Ewing, B.T. (2009), Relationships among strategic commodities and with financial variables: A new look. Contemporary Economic Policy, 27(2), 251-264.

International Monetary Fund. (2020), IMF makes Available 50 Billion to help Address Coronavirus. United States: International Monetary Fund. Available from: https://www.imf.org/en/news/articles/2020/03/04/sp030420-imf-makes-available50-billion-to-help-address-coronavirus

Johansen, S. (1988), Statistical analysis of cointegration vectors. Journal of Economic Dynamics and Control, 12(2-3), 231-254.

Johansen, S., Juselius, K. (1990), Some Structural Hypotheses in a Multivariate Cointegration analysis of the Purchasing Power Parity and the Uncovered Interest Parity for UK (No. 90-05). Denmark: University of Copenhagen.

Jubinski, D., Lipton, A.F. (2013), VIX, gold, silver, and oil: How do commodities react to financial market volatility? Journal of Accounting and Finance, 13(1), 70-88.

Kubar, Y., Toprak, Y.D. (2022), COVID-19 pandemi sürecinin seçilmiş kripto paralar ve emtia fiyatlari üzerine etkisi: Ekonometrik bir analiz. Uluslararası Ekonomi ve Siyaset Bilimleri Akademik Araştırmalar Dergisi, 6(14), 21-49.

Küçük, E. (2021), Güneş "Gümüşün' Üzerinde Parlıyor. Available from: https://www.dunya.com/emtia/gunes-gumusun-uzerinde-parliyor-haberi-639526 [Last accessed on 2022 Jun 20].

Kuloğlu, A. (2021), Covıd-19 krizinin petrol fiyatlari üzerine etkisi. Ekonomi Politika ve Finans Araştırmaları Dergisi, 6(3), 710-727.

Muradzada, I. (2022), Russia to cure Dutch disease by 2024: A myth or reality. Baltic Journal of Law and Politicsa Journalof Vytautas Magnus University, 15(2), 905-9016.

Narayan, P., Smyth, R. (2005), Trade liberalization and economic growth in Fiji. An empirical assessment using the ARDL approach. Journal of Asia Pacific Economy, 10(1), 96-115.

Narayan, P.K., Narayan, S. (2005), Estimating income and price elasticities of imports for Fiji in a cointegration framework. Economic Modelling, 22(3), 423-438.

Pesaran, M.H., Shin, Y. (1999), An autoregressive distributed lag modelling approach to cointegration analysis. In: Strom, S. Econometrics and Economic Theory in the 20th Century: The Ragnar Frish Centennial Symposium. Cambridge: Cambridge University Press, pp. 371-413.

Pesaran, M.H., Yongcheol, S., Richard, J. (2001), Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics, 16(3), 289-326.

Sari, S.S., Kartal, T. (2020), COVID-19 salgininin altin fiyatlari, petrol fiyatlari ve vix endeksi ile arasindaki ilişki. Erzincan Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 13(1), 93-109.

Şentürk, M., Akbaş, Y.E., Adiguzel, U. (2013), Uluslararası ham petrol ve altın fiyatlarının Amerikan doları ile ilişkisi: Ampirik bir uygulama. Akademik Yaklaşımlar Dergisi, 4(2), 139-149.

Sertkaya, B. (2022), Katılım endeksinin döviz kuru ve altin fiyatlariyla ilişkisi: Türkiye için ARDL sinir testi yaklaşimi. Bulletin of Economic Theory and Analysis, 7(1), 173-188.

Tuna, K. (2022), Covid-19 Pandemi döneminde petrol fiyati, altin fiyati ve VIX Endeksindeki oynakliklarin türkiye BİST 100 endeksi üzerindeki etkileri. İstanbul İktisat Dergisi, 72(1), 39-54.

Tuncel, M.B., Alptürk, Y., Yılmaz, T., Bekci, İ. (2021), Korku endeksi (Vix) ile kıymetli madenler arasındaki ilişki üzerine ekonometrik bir çalışma. Atatürk Üniversitesi İktisadi ve İdari Bilimler Dergisi, 35(3), 1069-1083.

Tutar, H., Sarkhanov, T., Guliyeva, N. (2022), Eastern Mediterranean area in energy security of the European Union: from sea border ıssues to economic conflicts of ınterest. International Journal of Energy Economics and Policy, 12(1), 332-341.

World Health Organization. (2021), Covid-19 Istatistikleri. Erişim Adresi. Geneva: World Health Organization. Available from: https://www.covid19.who.int

Yaprakli, S., Kaplan, F. (2018), Petrol fiyatlarinin altin fiyatlari üzerindeki doğrudan ve dolayli etkileri: Ekonometrik bir araştirma. Ekonomi Bilimleri Dergisi, 10(1), 50-69.

Yürük, M.F. (2022), XGBOOST (Extreme Gradient Boosting) Tabanli Algoritma Ile Gümüş Fiyatlarinin Tahmin Edilmesi. In: 10th International Conference on Social Sciences and Humanities, Sivas, Turkey.