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The Impact of the Interaction of Financial Investment Instruments on Financial Market

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Abstract

Since there are many factors influencing financial markets, investors and finance professionals need a broad perspective and careful monitoring of market trends. This study aims to examine the causality relationships among gold, oil, exchange rate, interest rate, and the volatility index known as the Fear Index (VIX). For this purpose, data from January 2012 to January 2022 were analyzed for gold prices, US crude oil (WTI) prices, EUR/USD parity, 10-year US Treasury bond interest rates, and VIX index variables. A logarithmic transformation was applied to the data. Unit root tests and Granger causality tests were performed in the study. According to the results, it was observed that oil prices cause gold prices. Additionally, it was concluded that gold prices, oil prices, and volatility are the causes of the exchange rate. This study makes a significant contribution to understanding the interaction among financial investment instruments and their potential effects on financial markets.

Key Words: Gold, Oil, Exchange Rate, 10-year US Treasury Bond Interest Rate, VIX Volatility Index

Finansal Yatırım Araçlarının Etkileşiminin Finansal Piyasalara Etkisi

Öz

Finansal piyasalara etki eden birçok faktör olduğundan, yatırımcılar ve finans profesyonelleri geniş bir bakış açısına ve piyasa trendlerini dikkatlice takip etmeye ihtiyaç duymaktadırlar. Bu çalışmanın amacı, altın, petrol, döviz kuru, faiz ve korku endeksi olarak anılan volatilite endeksi (VIX) arasındaki nedensellik ilişkilerinin incelenmesidir. Bu amaçla çalışmada, altın fiyatları, Amerikan ham petrol (WTI) fiyatları, EUR/USD paritesi, Amerikan hazine 10 yıllık gösterge tahvil faiz oranları ve VIX endeksi değişkenlerine ait Ocak 2012-Ocak 2022 dönemi verileri analiz edilmiştir. Verilere logaritmik dönüşüm uygulanmıştır. Çalışmada birim kök testleri ve nedensellik testi yapılmıştır. Analiz sonuçlarına göre petrol fiyatlarının altın fiyatlarının nedeni olduğu görülmüştür. Ayrıca, altın fiyatlarının, petrol fiyatlarının ve volatilitenin; döviz kurunun nedeni olduğu sonucuna ulaşılmıştır. Bu çalışma, finansal yatırım araçları arasındaki etkileşimin ve bu etkileşimin finansal piyasalara olan muhtemel etkilerinin anlaşılmasına yönelik önemli bir katkı sağlamaktadır.

Anahtar Kelimeler: Altın, Petrol, Döviz Kuru, 10 Yıllık ABD Hazine Bonosu Faiz Oranı, VIX Volatilite Endeksi

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Introduction

In recent years, new financial investment instruments have been rapidly diversifying, and access to these instruments has become easier with globalization. However, the extent to which investors prefer these instruments depends largely on their risk perception. Most investors turn to assets such as gold, which is considered a haven, especially in uncertain periods. The novelty of this study is that it comprehensively analyses the causality correlation between key investment instruments in financial markets such as gold, oil, exchange rates, interest rates, and volatility index (VIX). Analyzing the interactions between these instruments allows for a better understanding of investors' decision processes and portfolio strategies in the face of uncertainties in financial markets. Such analyses are available in the literature. This study contributes to the literature by examining the dynamics of the markets in more depth through addressing the relationship of basic commodities such as gold and oil with the VIX along with the macroeconomic indicators of the USA particularly between 2012 and 2022.

Securities' yields act in a financial market depending on global and regional economic variables; therefore, macroeconomic variables directing operators of financial market in countries and acting on capital market are followed closely. Ups and downs in macroeconomic variables affect the profits of investors significantly. Differentiation on variables plays a major role on through affecting liquidity viability Mashayekhi et, all., 2013:123).

The price relation between gold and oil is right proportioned most of the time. Increase on gold prices cause increases oil prices. Similarly, a decline in gold prices is accepted as a precursor of the negative trend on oil prices. Analyses made by various researchers have demonstrated a positive correlation between gold and oil prices (Simakova, 2011: 651-652). Fluctuations in gold and oil prices affect countries' economies through the exchange rate in general. Since value of gold and oil is specified based on US Dollar, fluctuations in exchange rates change gold and oil prices. Moreover, gold and oil prices have an effect on macroeconomic variables like foreign trade, manufacturing, and investment (Partalidou et al., 2016: 77).

Volatility (VIX) Index is calculated by using implied volatilities of written on the S&P 500 stock market index, that have trading options with an expiry of more than 23 days and less than 37 days. If the investors forecast a higher mobility and head towards options in order to protect their positions, premiums of options and the implied volatilities that are calculated based on premiums, increase. That's why, VIX Index is called as fear index, known as weighted average of implied volatilities (Whaley, 2000: 12).

VIX Index is one of the most important parameters that are followed by investors for market expectation. When VIX index is high, this means negative expectations and higher risks. Since the implied volatility reflects only predictions of option prices, it should be taken into account that movements in the market would be different than VIX Index or predictions.

Purpose of this study is to investigate both causality (if any) and the correlation between VIX Fear Index which helps to forecast of future of the markets and Gold, Oil, Exchange Rate, US Treasury 10-year benchmark bond interest rates. The correlation between Gold, Oil, EUR/USD exchange rate, US Treasury 10-year benchmark bond interest rates and VIX Index is analyzed in this study using Granger causality test in US Dollar terms. The study consists of five sections. The second chapter of this study includes a short literature review and the third chapter includes data set, methodology, findings and analysis. Fourth and the last chapters assess the results of this study. Such studies will help to better understand the dynamics of financial markets so that investors and policymakers can act more consciously in the processes of risk management, portfolio diversification, and strategic decision-making. Therefore, the study provides valuable findings for both theoretical knowledge and practical applications.

Literature

In the literature, there are many applied studies investigating correlation of stock market index with oil, gold, exchange rate, and interest rate. These studies have revealed that how change in stock market rate, oil, gold, exchange rate and interest rate affect each other depending on the results of them with a possible reaction.

Sjaastad (2008) states that US Dollar rate has an effect on gold prices with respect to the evaluation of the relationship between gold prices and dollar exchange rates. Also, the floating rate is the cause of the price instability.

Misha et al., (2010) investigated the causality relationship between domestic gold prices and stock market returns (BSE 100 index) with respect to Granger Causality and vector error correction model and reported that there was a two-sided Granger cause. They also concluded that increases and decreases on gold prices had an effect on stock market.

Zhang and Wei (2010) investigated the relationship between oil prices and gold prices between January 2000 and March 2008. The results of their study indicated that gold prices were correlated with oil prices. Also, fluctuations in oil prices were twice as much as those in gold price. Likewise, the effect on gold prices was five times greater than that on the oil.

Walid et al., (2011), examined the interaction between stock market returns and exchange rates in developing countries such as Mexico, Malaysia, Singapore and Hong-Kong between 1994 and 2009. Based on findings from GARCH, floating in exchange rate has an asymmetric relation with stock market returns and this situation affects the politicians' exchange rate regime significantly.

Wang and Chueh (2013) examined long- and short-term interaction of gold prices, oil prices, US Dollars and interest rate between January 2, 1989 and December 20, 2007. The findings of the study indicated that while oil prices had a positive effect on gold prices, interest rates and US Dollar had a negative effect on gold prices.

In their study, Ji and Fan (2016) analyzed the correlation between oil prices and VIX. According to the findings of their study, they concluded that there was a significant causality between oil prices and VIX changes.

Gökmenoğlu and Fazlollahi (2015) investigated the impact of oil and gold prices on stock markets and found that oil and gold volatility had long-term impacts on the S&P 500 stock price index.

Kumar (2017) analyzed the causality relationship between oil and gold prices in India. In their study, they revealed that oil prices affected gold prices in the short and long terms, especially positive shocks in oil prices had more significant impacts on gold prices, and there was a linear correlation between oil and gold.

Kim and Jung (2018) investigated the relationship between the USA interest rate, exchange rate and crude oil data belonging to the period of 1998-2017. In their study, it was found the relationship between crude oil and USA interest rate was two-sided, volatility spillovers from crude oil to exchange rate was one-sided, there was volatility dependence between markets and finally innovations in the crude oil market would affect the future volatility of foreign exchange markets.

On the other hand, Hanif (2020) examined the impacts of oil, gold, and foreign exchange prices on stock returns in Pakistani markets. The results indicated that oil prices had a positive impact on PSX (Pakistan Stock Exchange), while gold and foreign exchange prices had more negative impacts. These findings emphasized the sensitivity of investors to global market variables.

Zhang and He (2021) analyzed the spillover impacts between gold, oil, and stock markets and identified a unidirectional impact of gold on stock volatility. Crude oil stood out as the most highly correlated with stock markets.

In the study by Güneş (2022), the causality relationship correlation between the VIX and the 10-year US treasury bond interest rate was analyzed. The results of the study revealed that the VIX was the cause of the 10-year US treasury bond interest rate and there was a unidirectional correlation between them.

In their study, Kılıç and Özyürek (2022) examined the correlations between the VIX and BIST 30 and gold futures and concluded that VIX had a positive impact on BIST 30 futures.

Mishra et al., (2022) examined the causal relationship between oil and gold prices in Indian markets and concluded that the impact of positive shocks on gold and oil prices was stronger than negative shocks.

Pata et al., (2023) examined the time-varying impacts of oil and gold prices on stock returns and volatility in the Turkish stock market. The findings of the study revealed that oil prices had a stronger impact on returns, while gold prices had a stronger impact on volatility.

Li and Du (2024) investigated the impacts of financial market volatility on the correlation between oil and gold prices. They emphasized that oil volatility had significant impacts on gold prices, especially in the Chinese context, and this impact varied according to market conditions.

On the other hand, Kocaarslan and Soytas (2024) analyzed the relationship of COVID-19 and other global crises with uncertainty in the US dollar, gold, foreign exchange, and stock markets. These studies emphasized the importance of asset interactions during periods of macroeconomic uncertainty.

The literature review underlined the important effects of the complex interactions between critical financial assets such as gold, oil, exchange rates, and VIX. While the correlation between gold and oil prices has become more pronounced, especially during periods of economic uncertainty and crisis, the impacts of exchange rates on securities market indices have also been frequently analyzed. The VIX, as an indicator of market fear, plays a decisive role on the prices of other assets. The findings suggested a strong correlation between gold and oil prices and the impacts of exchange rates on stock market returns. The studies identified short- and long-term causality relationships between these variables and revealed that market volatility was affected by macroeconomic factors. Generally, the existing literature emphasizes the importance for investors to formulate their strategies by taking these interactions into account and suggests that the increased hedging function of safe haven assets during periods of uncertainty provides critical information for strategic decisions.

Data Set and Methodology

Data was provided from investing.com for time period of January 2012 and January 2022 in order to investigate the causality relationship between gold, Euro/US Dollar parity, US 10-year bond yield, oil prices, and fear index. The analysis of the data involved applying a logarithmic transformation as the time series method. Unit root tests and causality tests used in the study were conducted through the Eviews 11 program. The table of variables used in the study is presented in Table 1.

Table 1. *Definitions of the Variables*

Variable	Definition
ONS	Price of 1 ons gold in US Dollars
EUROUSD	Price of 1 Euro in US Dollars
PETROL	American Crude Oil (WTI)
BONDUSA	10-year US Treasury Bond
VIX	Volatility Index

Time series are a powerful tool used to analyze the changes in a specific variable over time. Such data can provide important insights into trends, seasonality, periodic effects, and random fluctuations. Time series analysis has numerous applications, including predicting future trends, understanding market trends, and examining past performance. These analyses are typically conducted using statistical methods and mathematical models. Time series find applications in econometrics, finance, meteorology, ecology, and many other scientific fields. Accurate understanding and interpretation of this data play a significant role in strategic planning and decision-making processes.

Time series analysis is an effective method for predicting future trends based on past data. This analytical approach provides businesses, economists, and planners with important advantages in making strategic decisions and responding quickly to evolving situations. Understanding the causes and magnitudes of random fluctuations is crucial for assessing the stability of a specific variable. In financial markets, time series analysis plays a vital role in risk management, price forecasting, and portfolio optimization. Businesses can use this analysis method for strategic planning, supporting decision-making in areas such as demand forecasting, inventory management, financial planning, and marketing strategies. Time series analysis helps businesses or organizations detect rapid changes in situations and trends, enabling them to respond quickly and gain a competitive advantage. This is a critical factor for staying competitive and achieving successful performance in a dynamic market.

The most basic concept of time series analysis is stationarity. Stationarity refers to the condition in which a series fluctuates around a certain mean with a certain variance. In other words, the stationarity of

a time series means that its statistical properties, especially its elements such as mean, variance, and autocorrelation, do not change over time. Stationarity is analyzed at three different levels: weak stationarity, strong stationarity, and trend stationarity. Weak stationarity is the case where the mean and variance of the series are constant, on the other hand, the autocorrelation depends only on the distance between time points. Strong stationarity is the case where the probability distribution of the series does not change over time, while trend stationarity is the case where the series fluctuates around a trend and becomes stationary when this trend component is removed. Stationarity is critical for accurate model fitting and reliable predictions. Non-stationarity series can lead to misleading conclusions and negatively affect model performance. When stationarity is achieved, it becomes more reliable to predict the future behavior of the time series and use it in financial modelling. Therefore, stationarity is a key feature that improves the quality of findings obtained through time series analysis. The most common method for testing the stationarity of series is the ADF unit root test. The ADF unit root test tests the null hypothesis (H0) that "the series has a unit root" as the main hypothesis. In order to achieve stationarity, the null hypothesis must be rejected. In the ADF unit root test, there are 3 different models: the model with constant, the model with constant and trend, and the model without constant and trend.

$$\Delta Y = (\rho - 1)Y_{t-1} + u_t$$

$$\Delta Y = \beta_0 + (\rho - 1)Y_{t-1} + u_t$$

$$\Delta Y = \beta_0 + \beta_1 + (\rho - 1)Y_{t-1} + u_t$$

The stationarity of the series was tested for all three models.

Results

In this study, to analyze the causality relationship between gold, oil, exchange rates, and the VIX index in financial markets, the stationarity of the series was first tested using the ADF unit root test. In the ADF unit root test of the series, the first step was to conduct the constant model test. The ADF unit root test results for the constant model are presented in Table 2.

Table 2. *Results of ADF Unit Root Test for the Model with Constant*

	Level		First-Order Difference	
Variable Name	**Test Statistics**	**Probability***	**Test Statistics**	**Probability***
LGOLD	-1.690	0.434	-9.908	0.000
LEUROUSD	-1.142	0.698	-9.749	0.000
LPETROL	-0.270	0.925	-8.895	0.000
LBOND	-2.113	0.240	-10.916	0.000
LVIX	-3.132	0.027	-11.504	0.000

According to the model with constant, the null hypothesis (implying that the series are not stationary at the level) could not be rejected at the significance level of 1% for any of the series, so the series were not stationary at the level. The null hypothesis, implying that the series are not first-order difference stationary, was rejected at all the traditional significance levels for all series. As a result, according to the model with constant, all the series were first-order difference stationary. Table 3 shows results of ADF unit root test for the model with constant and trend.

Table 2. *Results of ADF Test for the Model with Constant and Trend*

	Level		First-Order Difference	
Variable Name	**Test Statistics**	**Probability***	**Test Statistics**	**Probability***
LGOLD	-1.119	0.921	-10.084	0.000
LEUROUSD	-1.697	0.747	-9.708	0.000
LPETROL	-1.324	0.877	-9.028	0.000
LBOND	-2.273	0.445	-10.873	0.000
LVIX	-3.127	0.105	-11.481	0.000

According to the model with constant and trend, the null hypothesis for any of the series (implying that the series are not stationary at the level) was not rejected at any of the traditional significance levels, so the series were not stationary at the level. The null hypothesis, implying that the series are not first-order difference stationary, was rejected at all the traditional significance levels for all series. As a result, according to the model with constant and trend, all the series were first-order difference stationary. Table 4 shows results of ADF unit root test for the model without constant and trend.

Table 3. *Results of ADF Test for the Model Without Constant and Trend*

	Level		First-Order Difference	
Variable Name	**Test Statistics**	**Probability***	**Test Statistics**	**Probability***
LGOLD	-0.348	0.558	-9.945	0.000
LEUROUSD	0.250	0.757	-9.748	0.000
LPETROL	-0.588	0.461	-8.969	0.000
LBOND	-1.203	0.209	-10.960	0.000
LVIX	-0.269	0.587	-11.553	0.000

According to the model without constant and trend, the null hypothesis for any of the series implying that the series are not stationary at level could not be rejected at any of the traditional significance levels, so the series were not stationary at the level. The null hypothesis, implying that the series are not first-order difference stationary, was rejected at all the traditional significance levels for all series. As a result, according to the model without constant and trend, all the series were first-order difference stationary.

According to the test results for all three models of the ADF test, all the series were first-order difference stationary. Then, the appropriate lag length for the appropriate VAR model must be determined. After that the Granger Causality Test - assessing whether or not changes in one variable are affected by changes in another variable in the past - can be applied to examine the causality relationship between the series. If the lagged values of the explanatory variable increase the predictive performance of the current period value of the dependent variable, this variable is the Granger cause of the dependent variable. In the Granger causality test, lag length is one of the most critical components of the test. The lag length determines how many periods ago (e.g., days, months, years) values of one variable were used to predict the value of another variable in the current period. The choice of the correct lag length is crucial for the reliability of the test results. If the lag length is chosen too short, key information may be ignored, while if it is chosen too long, the model becomes complex, reducing the power of the test. This makes it difficult to detect real correlations between variables. Moreover, an excessively long lag may adversely affect the predictive ability of the model, leading to less reliable results. Therefore, setting the appropriate lag length plays a critical role in the validity of the analyses.

Different methods are used to set the lag length. These include information criteria such as Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC or BIC), and Hannan-Quinn Criterion (HQ). These criteria provide a balance between the number of explanatory variables in the model and the accuracy of the model and help to choose the optimal lag length. When the correct lag length is chosen, the Granger causality test better reflects the effect of the past values of one variable on the other variable, providing more accurate predictability and causality relationship. Table 5 shows model selection criteria.

Table 4. *Model Selection Criteria*

Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	270.7266	NA	4.15e-09	-5.110126	-4.982992	-5.058620
1	750.4204	904.0384	6.62e-13	-13.85424	-13.09143*	-13.54520*
2	776.7663	47.11865*	6.48e-13*	-13.88012*	-12.48165	-13.31356
3	791.5145	24.95836	7.95e-13	-13.68297	-11.64882	-12.85888
4	812.6739	33.77375	8.70e-13	-13.60911	-10.93930	-12.52749
5	833.7685	31.64194	9.62e-13	-13.53401	-10.22852	-12.19486
6	851.9861	25.57463	1.14e-12	-13.40358	-9.462419	-11.80690
7	867.3728	20.12108	1.45e-12	-13.21871	-8.641877	-11.36450
8	891.7509	29.53507	1.58e-12	-13.20675	-7.994248	-11.09501

When looking at Table 5, it was determined that the appropriate delay number was 2 according to the FPE and AIC criteria and the VAR model was estimated. For the Granger Causality test to work properly, this predicted VAR model should have no autocorrelation. Table 6 shows the result of the autocorrelation test.

Table 5. *Autocorrelation Test for VAR Model*

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	24.61602	25	0.4840	0.986490	(25, 358.1)	0.4846
2	23.68979	25	0.5374	0.948170	(25, 358.1)	0.5378
3	34.63016	25	0.0951	1.406991	(25, 358.1)	0.0954

When looking at Table 6, it was determined that there was no autocorrelation problem in the 2-lag model.

The Granger causality test, an important tool in time series analysis, is frequently used in econometric modelling and forecasting analyses as a statistical method that questions whether or not the past values of one variable predict the future values of another variable and allows for the identification of a predictable correlation between two variables. The Granger causality test contributes to the understanding of financial markets, macroeconomic analysis, and policy impacts by examining short- and long-term correlations, but while it determines whether or not there is a statistical correlation between two or more variables, it does not explain the causal link that underlies this correlation and therefore does not imply true economic causality. This is due to the fact that the test only looks at the time-ordered correlation between variables and ignores third factors that may affect this correlation. For example, the exchange rate and the inflation rate may be affected by oil prices, but the Granger causality test ignores such external factors. Also, the fact that one variable precedes another does not necessarily imply that it is the cause; a timing difference may not imply true causality. The accuracy of the test depends on the appropriateness of the model and lag structure used. Errors in the model may lead to incorrect results. True economic causality requires a direct and structural correlation. The Granger test does not examine these structural links. Therefore, while we can establish a predictive link between the tested variables, deeper and more comprehensive structural analyses are required to understand economic causality. The Granger Causality Test was performed and the test results are given in Table 7.

Table 6. *Granger Causality Results*

Dependent variable: LALTIN			
Excluded	Chi-sq	df	Prob.
LEUROUSD	0.738635	2	0.6912
LPETROL	5.185519	2	0.0748*
LBONDUSA	4.201195	2	0.1224
LVIX	0.256356	2	0.8797
All	9.911247	8	0.2713
Dependent variable: LEUROUSD			
Excluded	Chi-sq	df	Prob.
LGOLD	11.03556	2	0.0040*
LPETROL	17.43094	2	0.0002*
LBONDUSA	0.609884	2	0.7372
LVIX	11.09921	2	0.0039*
All	38.30190	8	0.0000
Dependent variable: LPETROL			
Excluded	Chi-sq	df	Prob.
LGOLD	0.684152	2	0.7103
LEUROUSD	3.237469	2	0.1981
LBONDUSA	4.213909	2	0.1216
LVIX	1.322926	2	0.5161
All	13.94499	8	0.0832
Dependent variable: LTAHVILUSA			
Excluded	Chi-sq	df	Prob.
LGOLD	3.050186	2	0.2176
LEUROUSD	4.361375	2	0.1130
LPETROL	0.524427	2	0.7693
LVIX	0.172422	2	0.9174
All	8.413104	8	0.3942
Dependent variable: LVIX			
Excluded	Chi-sq	df	Prob.
LGOLD	1.123075	2	0.5703
LEUROUSD	0.040450	2	0.9800
LPETROL	0.928164	2	0.6287
LBONDUSA	2.813291	2	0.2450
All	16.33523	8	0.0378

When examining Table 7, the null hypothesis implying that there is no causality relationship from oil to gold was rejected at significance level of 10%; in other words, oil prices were the cause of gold prices. The null hypothesis, implying that there is no causality relationship from gold to euro-dollar parity, was rejected at all the traditional significance levels; in other words, gold prices were the cause of euro-dollar parity. The null hypothesis implying that there is no causality relationship from oil prices to Euro-dollar

parity was rejected at all the traditional significance levels; in other words, oil prices were the cause of Euro-dollar parity. The null hypothesis, implying that there is no causality relationship from volatility to Euro-dollar parity, was rejected at all the traditional significance levels; in other words, volatility was the cause of Euro-dollar parity.

In the study, it was found that oil prices had a significant causal impact on gold prices. This provides important clues for investors about the impacts of oil market fluctuations on the gold market. Moreover, gold prices had a causal impact on the Euro/Dollar parity. This finding suggests that gold serves as a safe haven in the foreign exchange market and can provide protection against fluctuations in the parity.

The impact of the Euro/Dollar parity on oil prices is also a striking outcome. This suggests that movements in exchange rates are reflected on the oil market, and investors should take oil prices into account when assessing risks in foreign exchange markets. Moreover, the significant effect of the volatility index on the Euro/Dollar parity suggests that market fear and uncertainty can lead to significant changes in exchange rates. This suggests that foreign exchange markets may be more volatile during uncertain periods.

The impact of oil prices on gold prices shows how movements in the energy market are reflected on financial markets. In particular, the increase in oil prices raises energy costs, which in turn increases inflation expectations. This, in turn, may lead investors to turn to gold; thus, raising gold prices. This causality relationship provides a critical reference point for understanding how global macroeconomic shocks affect asset prices.

In times of uncertainty or crisis in the markets, investors' preference for gold as a safe asset can lead to significant changes in exchange rates. While this can lead to increased volatility in foreign exchange markets, it also illustrates how gold, as a store of value, provides protection against currency fluctuations. Finally, the impact of the Euro/Dollar parity on oil prices explains how fluctuations in foreign exchange markets spill over into the energy market. This correlation between exchange rates and oil prices is an important factor affecting cost and pricing mechanisms, especially in the energy sector where global trade flows are concentrated.

Conclusion and Recommendations

Globalization has increased interaction between countries because it is easy to access more products from anywhere on Earth. In the global financial system, gold is generally accepted as an important hedge product but oil prices are accepted as a high-risk product especially in high-risk markets. There is a dominant opinion that gold is a good investment tool in order to protect from the risks caused by excessive movements in oil prices in the market.

In this study, the causality relationship between gold price, exchange rate, oil price, US 10-year bond interest, and volatility index was examined. According to the results of the Granger causality test, oil prices were the cause of gold prices. In addition, gold prices, oil prices and volatility were the cause of the exchange rate. Financial market investors can use oil prices as an indicator in case they use gold as an investment instrument. Moreover, financial market investors who will invest in foreign currency can utilize gold prices, oil prices and volatility as leading indicators.

The results of the study revealed that oil prices have a significant impact on gold prices. The study by Li and Du (2024) supported this study with their results that examined the impact of oil volatility on gold prices. These findings help investors understand how oil price fluctuations affect the gold market. Moreover, it appears that gold prices also have a causal impact on the Euro/Dollar parity. This also emphasizes the importance of gold's role in foreign exchange markets. The study by Tanin et al., (2021) examined the impact of exchange rate fluctuations on gold prices and achieved similar results. The impact of the Euro/Dollar parity on oil prices is also a notable finding. In their study, Hameed et al., (2021) similarly determined the impact of movements in foreign exchange markets on oil prices. These results suggested that there was a strong causality correlation between the variables used in the study.

According to the findings of the study, investors can formulate portfolio strategies by evaluating the relationships between gold and oil prices. Businesses that may be affected by exchange rate fluctuations can revise their risk management strategies by monitoring the trends of gold, oil, and volatility. Institutions operating in financial markets can continuously update their analysis of gold, oil, and volatility to

understand the factors influencing exchange rate values. These recommendations may be beneficial for investors and businesses aiming to make effective decisions and minimize risks in financial markets.

Further analyses can be done with larger data sets by taking into account the economic conditions and market dynamics of different countries in future studies. Similar analyses, especially in developing markets, may support the current findings and contribute to a better understanding of market dynamics. Investors should diversify their portfolios by taking into account safe-haven assets such as gold and oil, as well as exchange rate fluctuations. While regular monitoring of the correlations between these assets is important for risk management, gold can be considered a safe haven against fluctuations in oil prices. Investors may make more informed decisions against uncertainties by monitoring indicators such as the VIX and may revise their strategies by taking into account the impact of 5-year US bond interest rates on exchange rates and gold prices.

Understanding the interactions between financial markets allows investors and policymakers to manage market risks more effectively and make informed decisions. Such studies provide a strategic advantage against fluctuations in foreign exchange and commodity prices and are thought to help investors optimise their portfolios. Moreover, the interactions between these assets at the macroeconomic level are important for examining the impacts of the interest rate policies of central banks on global markets. In this context, the findings will make an important contribution to the literature by supporting policymakers to take more deliberate steps to maintain market stability.

Statement of Research and Publication Ethics

During the writing process of the study titled *"The Impact of the Interaction of Financial Investment Instruments on Financial Markets,"* scientific rules, ethical guidelines, and citation standards have been adhered to. No manipulation has been made on the collected data, and this study has not been submitted for evaluation to any other academic publication. The study does not require ethical approval.

Conflict of Interest Statement

There is no potential conflict of interest in this study.

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EXTENDED ABSTRACT

Financial markets and the relationships between investment instruments are complex and multifaceted. These relationships can be influenced by economic factors, global events, political developments, and many other variables. The expanding range of products in financial markets has brought forth specific financial assets that capture the interest of investors. Among these assets, gold stands out prominently. Gold is often seen as a safe haven during periods of global uncertainty. Similarly, another indispensable financial asset for investors is oil. Oil prices can fluctuate based on changes in energy demand and supply. Increases in oil prices can often lead to the depreciation of the local currencies of countries dependent on oil imports, impacting financial markets. The EUR/USD pair, which has the highest trading volume in financial markets, is known as a currency pair representing the value of the Euro against the US Dollar. This pair is closely monitored by investors and financial professionals worldwide. The EUR/USD pair reflects the relationships between the economic conditions of the Eurozone and the performance of the U.S. economy, showing sensitivity to global market developments. Exchange rates are often influenced by factors such as international trade, investment, and economic stability. The EUR/USD pair, representing the fluctuations in the value of the Euro against the US Dollar, can have broad implications in global financial markets. Therefore, investors and analysts carefully monitor the EUR/USD pair to assess economic trends and determine trading strategies. The relationship between exchange rates and gold prices can be particularly influential during economic uncertainties and periods of currency depreciation. The exchange rate of a country affects its exports and imports. If the exchange rate is low, a country's exports generally increase, but imports can become more costly. The impact of exchange rate fluctuations on financial markets is complex and multifaceted. As a result, investors, companies, and central banks closely monitor exchange rate movements and make strategic decisions to adapt to these changes. The U.S. Treasury bond yield is a significant indicator reflecting general interest rates in the economy and interest rate movements in financial markets. Changes in the 10-year Treasury bond yield of the U.S. Treasury can have various effects on financial markets. The Volatility Index (VIX) is an indicator that

measures uncertainty in the markets. High volatility often leads to declines in stocks because investors may shift to safer assets. Elevated VIX values typically indicate increased uncertainty and the potential for higher volatility in the markets. This suggests that investors are concerned or uncertain about future price movements. High volatility can often result in the depreciation of risky assets such as stocks, as investors may opt for safer havens like government bonds or gold. A low VIX, on the other hand, generally indicates low uncertainty in the markets, and investors may be more willing to take on additional risks. In such cases, stocks and other risky assets tend to appreciate. Therefore, monitoring VIX values can be a crucial tool for investors to understand market sensitivity and potential risks. This study aims to examine the causality relationships among gold, oil, exchange rate, interest rates, and the volatility index (VIX) that interact in financial markets. The analysis, conducted using data from January 2012 to January 2022 for gold prices, West Texas Intermediate (WTI) crude oil prices, EUR/USD exchange rate, U.S. Treasury 10-year benchmark bond yields, and VIX index, involves applying logarithmic transformation to the data. The results obtained through unit root tests and causality tests in the study indicate that oil prices influence gold prices and, simultaneously, gold prices, oil prices, and volatility impact the exchange rate. One of the primary focuses of the study is the impact of oil prices on gold prices. The analysis results show that oil prices are a significant factor affecting gold prices. Additionally, the study examines the effects of gold prices, oil prices, and volatility on the exchange rate, determining causality relationships among these factors. The significance of this study lies in understanding the complexity of interactions among financial investment instruments and evaluating the potential impacts of these interactions on financial markets. The results suggest that investors should consider the relationships between gold and oil prices when forming portfolio strategies, businesses should revise their risk management strategies, and organizations operating in financial markets should continuously update the factors influencing exchange rates. This study can be a valuable resource for professionals and researchers aiming to make effective decisions and minimize risks in financial markets. According to the Granger causality test results used in the analysis, it is observed that oil prices influence gold prices. Additionally, it is concluded that gold prices, oil prices, and volatility affect the exchange rate. Financial market investors can use oil prices as an indicator when considering gold as an investment instrument. Furthermore, financial market investors planning to invest in foreign exchange can use gold prices, oil prices, and volatility as leading indicators. Based on the results of the study, it is evident that oil prices influence gold prices, and similarly, gold prices, oil prices, and volatility affect the exchange rate. These findings can provide valuable insights and guidance for strategic decision-making for investors, businesses, and finance professionals. Additionally, the study contributes to the financial literature by offering a new perspective on understanding the complex relationships among gold, oil, exchange rates, and volatility.