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IMPACT OF MONETARY POLICY, OIL AND GOLD PRICES ON THE STOCK MARKET: EVIDENCE FROM A DEVELOPED AND A DEVELOPING ECONOMY

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Abstract

The main aim of this study is to examine the impact of the US monetary policy, oil prices and gold prices on the stock markets in a developed and a developing economy. Upon structuring the necessary data using valid and reliable sources, the data is plugged into a statistics package EViews and processed to determine the relationship between the variables. Descriptive statistics is delivered using Excel, while EViews is used to conduct unit root tests, model diagnostics and Ordinary least squares regression analysis. A lot of similar studies have been done but none test for a relationship that is significant between the US monetary policy, gold prices and oil prices and the stock market of Germany (DAX index) and Bosnia and Herzegovina (SASX 10 index), which are in the focus of this study. The results show that VIX has statistically significant negative impact on DAX index, while it has no statistically significant impact on SASX 10 index. All other variables did not show any significant impact on the two observed stock market indices. This study helps in better understanding of the movements of the stock market and potentially helps investors make

better decisions. There are some limitations of this study and the main being that there are other factors that potentially affect the stock market indices, which could be included in future research studies.

Keywords: Stock market, Monetary policy, Gold, Oil, Germany, B&H

INTRODUCTION

Due to the impact of globalization within diverse business environments, the global economy has become remarkably interconnected. Observable is the phenomenon where events in specific countries wield substantial influence over the economies of nations across the world. The monetary policies of leading global economies, such as the United States, can exert a profound impact on the broader international economic landscape (Miranda-Agrippino & Rey, 2020). The Federal Reserve, as the central bank of the United States, puts together monetary policies using various instruments, including the establishment of interest rates. Alterations in these interest rates by the Federal Reserve can significantly influence the stock market.

Should the Federal Reserve choose to raise interest rates, it could render borrowing more expensive for both businesses and consumers. Consequently, this might lead to a reduction in demand for goods and services, ultimately resulting in a deceleration of economic growth. Such economic conditions could prompt a decline in stock prices as investors adopt a less optimistic outlook regarding the future prospects of the economy and companies. Conversely, a lowering of interest rates by the Federal Reserve could render borrowing more affordable, stimulating economic growth. This, in turn, could lead to an upswing in stock prices as investors adopt a more optimistic perspective on the future prospects of the economy and companies.

It is imperative to acknowledge that the stock market is subject to a myriad of influences, encompassing economic indicators, company-specific developments, global events, and investor sentiment. The impact of monetary policy on the stock market can fluctuate contingent on these factors.

Gold and crude oil are two commodities that wield influence over the stock market, albeit within a complex and variable relationship dependent on numerous factors. Gold is often perceived as a safe haven asset, performing well during periods of economic uncertainty or market volatility. An increase in the price of gold may signal market uncertainty, potentially resulting in a decline in stock prices. Conversely, crude oil, a critical input in the production of

various goods and a key determinant of global economic health, can impact businesses' production costs and profitability, influencing stock prices.

The intricate relationships between gold and crude oil prices and their impact on the stock market underscore the complexity of these dynamics, with various other factors also contributing to stock price fluctuations. Investors may opt to include these commodities in their portfolios to diversify risk, while others may concentrate on alternative asset classes. Prudent consideration of investment strategy, coupled with consultation with financial professionals, is recommended before making any investment decisions.

Gold prices have been intertwined with interest rates and the value of money since the advent of fiat currency, making an exploration of their effect on the stock market particularly intriguing. Additionally, the petroleum industry, often referred to as "black gold," is a primary driver of our economy and has demonstrated vulnerability, as witnessed during the COVID-19 pandemic.

The amalgamation of these three factors—monetary policy, oil prices, and gold prices—undoubtedly exerts an impact on the stock market. However, a crucial question remains: which factor carries the most significant influence? This study seeks to compare their impact on both a developed and a less developed economy.

Germany, recognized for possessing one of the most developed economies in Europe (Siebert, H. 2005), serves as a case study to ascertain the extent to which the US monetary policy, oil prices, and gold prices affect its stock market. The primary index on the German stock exchange, the DAX, comprises the 40 major German blue-chip companies that are traded on the Frankfurt Stock Exchange. In contrast, Bosnia and Herzegovina, characterized by a developing economy in Europe, provides a contrasting perspective. This paper aims to investigate whether the economic development status influences the impact of changes in monetary policy, oil prices, and gold prices on the stock market. The Sarajevo Stock Exchange features the SASX 10, an index reflecting the price movements of the top 10 issuers on the market.

The research study is driven by three overarching objectives: firstly, to ascertain if the US monetary policy, oil prices, and gold prices have any discernible effect on the market; secondly, to determine the extent of their impact on the stock market; and thirdly, to draw parallels between their effects on a developed economy and those on a developing economy. This paper is crafted with the aspiration that it will contribute to a deeper understanding of stock market behavior, potentially unveiling new strategies to foster its growth and benefit the global economy.

LITERATURE REVIEW

The existing literature provides insightful perspectives on the interplay among the variables under investigation in this study, namely the US monetary policy, gold prices, oil prices, and the stock market, as well as the relationship between stock market indices and Chicago Board Options Exchange's CBOE Volatility Index (VIX).

Monetary Policy and Stock Market

Ansari & Sensarma (2019) explored the impact of the US monetary policy on the stock indices of BRICS markets. Notably, they found an insignificant effect on the indices, except for the Bombay Sensex, representing the Indian stock market. In a similar vein, Kontonikas et al. (2013) delved into the relationship between the US stock market and the FFR, discerning a positive reaction to unexpected cuts in the FFR, particularly outside the 2007 crisis.

Narayan & Narayan (2012), in a study spanning seven Asian countries, investigated the influence of US macroeconomic conditions on stock markets. The results of the study suggested that interest rates had a statistically insignificant effect on returns for most countries, in the short run. The only exception were the Philippines during the crisis. Additionally, the long-run relationship between variables weakened post the 2007 financial crisis, signifying a diminished link between stock prices and the US macroeconomic conditions.

Gold Prices and Stock Market

In a study conducted by Zeinedini et al. (2022) on the Iranian stock market during COVID-19, gold prices were found to exert a significant impact. Similarly, Ansari & Sensarma (2019) explored the effect of gold prices on BRICS stock markets, revealing a notable impact on indices, excluding the Bombay Sensex. Furthermore, El Hedi Arouri et al. (2015) established a relationship between gold prices and the China stock market, affirming the influence of gold prices.

Oil Prices and Stock Market

Examining the Iranian stock market during COVID-19, Zeinedini et al. (2022) found that oil prices have a discernible effect on stock prices. Consistently, Ansari & Sensarma (2019) investigated the effect of oil prices on BRICS stock markets, mirroring the impact observed with gold prices. Jones and Kaul (1996) offered theoretical insights, identifying potential negative effects of higher oil prices on production costs and inflation expectations, with potential positive effects on a booming economy.

Additionally, Cheng et al. (2017) suggested a positive correlation between oil price volatility and stock market momentum, attributing it to time-varying investor sentiment. However, Apergis & Miller (2009) found that changes in oil prices did not elicit significant responses in stock markets across eight countries (Japan, Italy, France, Australia, Canada, the United Kingdom, and the United States, Germany).

Furthermore, Smyth & Narayan (2018) conducted a survey exploring the impact of oil prices on stock returns, providing a broader overview of research on this relationship.

VIX - Chicago Board Options Exchange's CBOE Volatility Index

The CBOE Volatility Index (hereafter, VIX index) is introduced as a control variable in this study. "It is built upon the Standard & Poor's 500 (S&P500) index option and representing the 30-day forecast volatility of the S&P500 index is an indicator introduced by the Chicago Board Options Exchange to measure the volatility risk of the futures market. The VIX index captures investors' fear of security investment. When the VIX index increases, the stock market tends to adjust downward because of the high turbulence in the US stock market. In other words, an increase in the VIX index shows a decreased trend in the returns of the US stock market" (Vuong et. al, 2022).

Prior studies have demonstrated the negative relationship that exists between the change in the VIX index and the returns in the US stock market (Vuong et. al, 2022). Gürsoy (2020) emphasized the significance of the VIX as a volatility index derived from the S&P 500 index, monitored globally since 1993. Investigating developing countries (BRICS), the study found bilateral causality between the VIX and Russian/South African stock markets, while unilateral causality existed in India and China. No causality relationship was identified with the Brazilian stock market. Similarly, Tekin & Hatipoğlu (2017) examined the effect of oil prices, the US Dollar rate, and the VIX on Borsa Istanbul, revealing a significant impact of the volatility index on the BIST index. Furthermore, it is mentioned by Vuong et. al, (2022) that the VIX does have the ability to predict the stock market returns in the Europe back in the 2008 global financial crisis.

Lastly, as a summary of this section mentioned is a similar study, that encompasses most of the variables used in the study. It is a study conducted by Mensi et al. (2014). In this study the author used quantile regression to investigate the dependence structure between BRICS stock markets and global factors, including oil and gold prices, the S&P index, and the CBOE volatility index. They found asymmetrical dependence affected by the 2007 global financial crisis, while no impact of US economic policy uncertainty on BRICS stock markets has been found.

In conclusion, all abovementioned studies collectively contribute to a nuanced understanding of the intricate relationships between monetary policy, gold prices, oil prices, VIX and the stock market, providing valuable insights for the current study. It can be concluded that the results are mixed.

METHODOLOGY

For this study, secondary data will be employed. This study relies on the closing prices of indices representing national stock markets and relevant commodities. Specifically, the DAX index comprises 40 major German blue-chip companies that are being traded on the Frankfurt exchange, while the SASX 10 represents the Sarajevo Stock Exchange. The study will also consider oil and gold prices, with a particular focus on the Federal Reserve rate in terms of the US monetary policy. Furthermore, as a control variable in the model introduced is VIX - Chicago Board Options Exchange's CBOE Volatility Index.

Historical data for the DAX index, as well as gold and oil prices, are sourced from the Yahoo Finance, while data for the SASX 10 index is obtained from the official Sarajevo Stock Exchange Market website. The data for the FFR is collected from the website of the Federal Reserve Bank of St. Louis. The data span will cover a period of 10 years, from December 2012 to February 2023, of daily closing prices of DAX, SASX 10, FFR, oil, gold and VIX.

Despite the availability of various software for data analysis, in this study utilized is Eviews, a statistical package for Windows predominantly employed for time-series-oriented econometric analysis.

The applied methodology involves gathering data for the DAX and SASX 10 indices, comparing the movement of their prices with fluctuations in oil and gold prices, and monitoring changes in the US monetary policy, as well as the VIX. Following data collection and comparison, Ordinary least squares regression analysis is conducted. Subsequently, thorough analysis and comparison will be undertaken to confidently draw conclusions and elucidate the underlying rationale. The presentation of collected data will take the form of line charts, illustrating the movement of relevant elements.

Constructing the econometric equations involved specifying the relationship between the dependent variable (in this case, the stock market indices) and the independent variables (oil price, gold price, US Monetary policy and VIX). The econometric equation can be written as follows: $Yt = \beta 0 + \beta 1X1t + \beta 2X2t + \beta 3X3t + \beta 4X4t + \varepsilon t$

Here, the subscripts t represents time, and the terms have the following meanings:

- Yt : Stock market at time t.
- $X1t$: Oil price at time t.

- $X2t$: Gold price at time t.
- $X3t$: US Monetary policy at time t.
- $X4t$: VIX variable at time t .
- β 0 : Intercept (constant term).
- β 1,β2,β3,β4 : Coefficients of the respective independent variables.
- εt : Error term.

RESULTS

Descriptive statistics

Table 1 presents a comprehensive overview of the key descriptive statistics for the variables under consideration. During the data analysis the movement of variables were analyzed and displayed in a graph to visualize the movement of the variables used in the study.

Table 1 Descriptive statistics

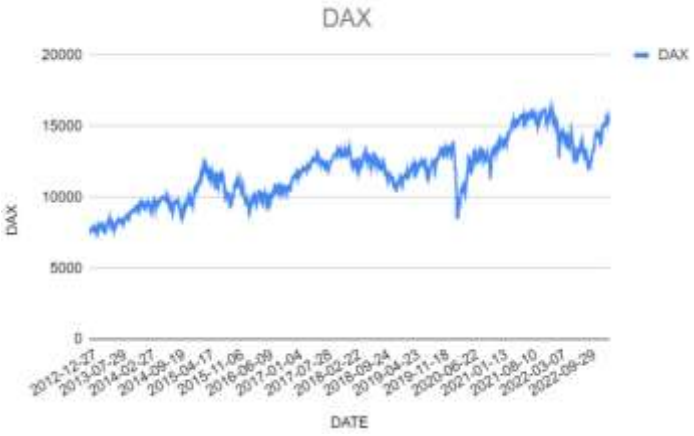
	VIX	SASX	OIL	GOLD	FFR	DAX
Mean	17.92444	759.0242	65.97586	1444.955	0.838868	11776.02
Median	15.77500	717.9300	59.95500	1320.300	0.330000	11980.83
Maximum	82.69000	1187.700	123.7000	2051.500	4.580000	16271.75
Minimum	9.140000	562.4900	-37.63000	1050.800	0.040000	7459.960
Std. Dev.	7.366153	125.9935	22.49782	260.1190	1.025625	2095.189
Skewness	2.685730	1.147317	0.379580	0.602525	1.468119	0.055294
Kurtosis	16.23905	3.578410	2.312181	1.869281	4.756374	2.331116
Jarque-Bera	20514.58	562.7899	105.4666	274.4324	1176.488	46.19331
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	43233.74	1830766	159133.8	3485231	2023.350	28403750
Sum Sq Dev.	130821.4	38273083	1220332	1.69E+08	2536.146	1.06E+10
Observations	2412	2412	2412	2412	2412	2412

The graph complements the table's statistics, offering a visual representation of the FFR variable's distribution and trends.

Figure 1 Movement of the FFR over time

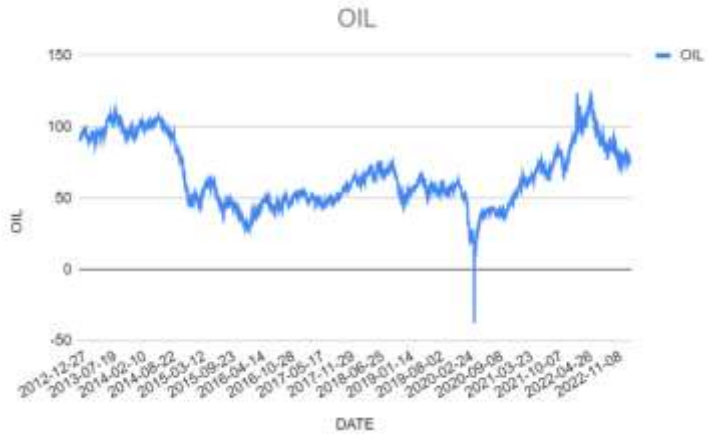
The graph complements the table's statistics, offering a visual representation of the SASX 10 variable's distribution and trends.

Figure 2 Movement of the SASX 10 index over time



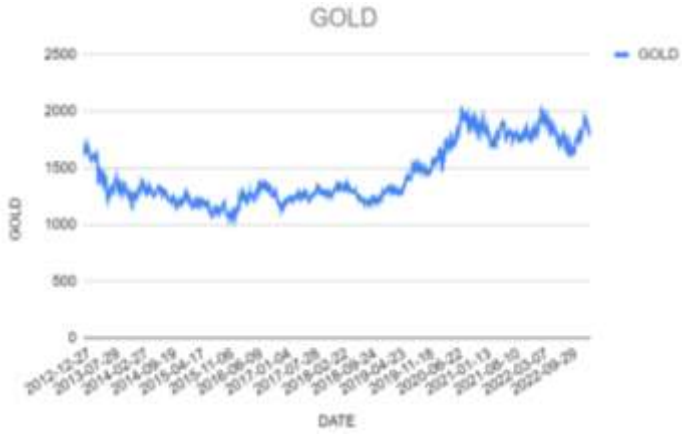
The graph complements the table's statistics, offering a visual representation of the DAX variable's distribution and trends.

Figure 3 Movement of the DAX index over time



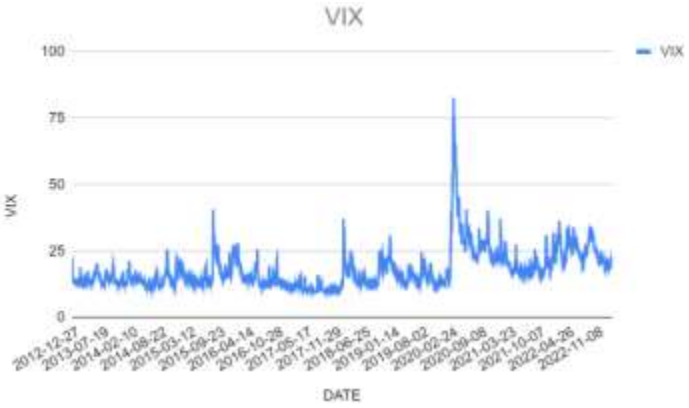
The graph complements the table's statistics, offering a visual representation of the OIL variable's distribution and trends.

Figure 4 Movement of the OIL price over time



The graph complements the table's statistics, offering a visual representation of the GOLD variable's distribution and trends.

Figure 5 Movement of the GOLD price over time



The graph complements the table's statistics, offering a visual representation of the VIX variable's distribution and trends.

Figure 6 Movement of the VIX index over time

Unit root tests

In Table 2, presented are the results of the Augmented Dickey-Fuller unit root tests.

Table 2 Unit root test of all variables

Variable	P-value
FFR	0.9998
D(FFR)	0.0001*
SASX	0.9158
D(SASX)	0.0001*
DAX	0.3549
D(DAX)	0.0001*
OIL	0.3105
D(OIL)	0.0000*
GOLD	0.6863
D(GOLD)	0.0001*
VIX	0.0000

*Note: * stationary at the first difference*

Starting off the analysis of the date an Augmented Dickey-Fuller unit root test was made on all of our variables and where the probability failed to be below 0.05 a first difference test was conducted. DAX unit root test returned a probability of 0.3549 so to satisfy the null hypothesis a first difference test was conducted, and it returned a probability of 0.0001. A similar procedure was implemented for almost all the other variables. SASX originally had a probability of 0.9158 and the first difference variable of SASX had a probability of 0.0001. OIL initially had a probability of 0.3105 and a first difference analysis returned a probability of 0.0000. Gold had a probability of 0.6863 and a first difference variable had a probability of 0.0001. Testing the VIX variable we get a probability of 0.0000 off the bat (Table 2).

Regression analysis and model diagnostics for SASX

Ordinary least squares regression (OLS) was used in order to analyze the effects of four independent variables that might exert an effect on the stock market index, namely SASX 10. Variables in the model are first transformed into the logarithmic form, and then differencing was applied in order to fulfill the requirement of stationarity. In Table 3, presented are the results for SASX 10.

Table 3 Results of the regression analysis for SASX 10

Dep. variable DLNSASX				
Method: Least Squares				
Observations: 2409 after adjustments				
Var.	Coeff.	S. Error	t-Stat.	Prob.
DLNFFR	-0.002677	0.001847	-1.453871	0.1461
DLNOIL	-3.70E-05	0.006097	-0.006074	0.9952
DLNGOLD	-0.028228	0.017153	-1.645686	0.1000
DLNVIX	-0.001925	0.002184	-0.881432	0.3782
C	0.000141	0.000173	0.814939	0.4152

Note: Confidence interval 95%, all data used in the OLS regression analysis are stationary according to the ADF Unit root test

Regression analysis does not show a statistically significant effect of any of the independent variables on the SASX 10, since the p-values are greater than 0.05.

In order to check if the model is fulfilling the diagnostics criteria, tests for normality of the residuals, autocorrelation (serial correlation) test and heteroscedasticity tests were applied.

In order to address the potential heteroscedasticity issue that is common in time series a Breusch-Pagan-Godfrey test is run. The results of the test are presented in Table 4. The null hypothesis assumes homoskedasticity. The results are mixed, but majority of the criteria

indicates that we fail to reject the null hypothesis which suggests that there is no evidence of heteroscedasticity.

Table 4 SASX 10 Heteroskedasticity test

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	1.384446	P. F(4,2404)	0.2368
Obs*R-squared	5.536546	P. Chi-Sq.(4)	0.2365
Scaled explained SS	26.39928	P. Chi-Sq.(4)	0

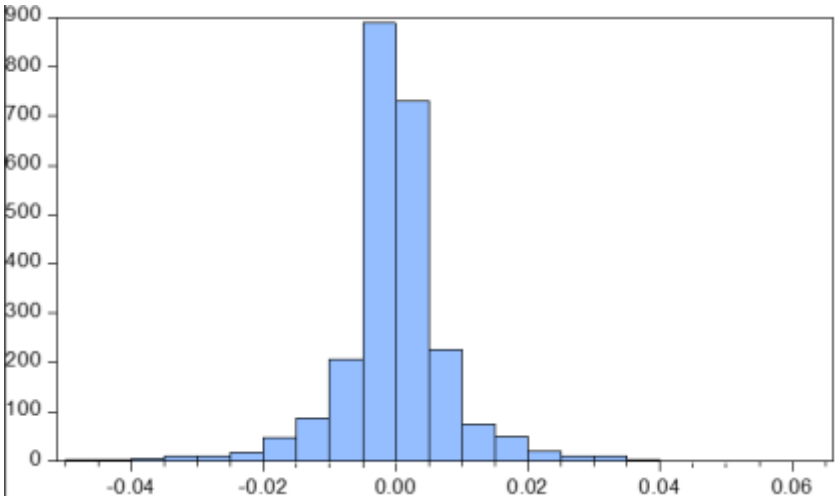


Figure 7 SASX 10 normality test

Furthermore, Figure 7 presents the results of the normality test. The model estimation shows a Jarque-Bera statistic of 5772.205, accompanied by a probability of 0.000. This result leads to the inference that, at any conventional significance level, we can reject the null hypothesis regarding the normality of the distribution of relationship errors. However, Brooks (2008) state that "for the sample sizes that are sufficiently large, violation of the normality assumption is virtually inconsequential. Appealing to a central limit theorem, the test statistics will asymptotically follow the appropriate distributions even in the absence of error normality."

The examination of autocorrelation was conducted using the Breusch-Godfrey LM test for autocorrelation, as detailed in Table 5. At a 5% significance level, we do not find sufficient evidence to reject the null hypothesis, indicating the absence of autocorrelation in the model.

Table 5 SASX 10 Breusch-Godfrey LM test for autocorrelation

Breusch-Godfrey Serial Correlation LM Test:			
F-stat.	0.064571	P. F(2,2402)	0.9375
Obs*R-sq.	0.129511	P. Chi-Sq.(2)	0.9373

Regression analysis and model diagnostics for DAX

Ordinary least squares regression (OLS) was used to analyze the effects of four independent variables that might exert an effect on the stock market index, namely DAX. Variables in the model are first transformed into the logarithmic form, and then differencing was applied in order to fulfill the requirement of stationarity. DAX index is transformed to the first difference.

Since in the process of the analysis it was not possible to arrange the model to fulfill the requirement of homoscedasticity. So heteroscedasticity-consistent standard error and covariance estimates were used, for the Ordinary least squares regression analysis (Table 6).

Table 6 Results of regression analysis for DAX

Dep. Variable: DDAX				
Method: Least Squares	Observations: 2409 after adjustments			
White-Hinkley (HC1) heteroscedasticity consistent standard errors and covariance				
Var.	Coeff.	S. Error	t-Stat.	Prob.
DLNFFR	104.7134	107.5058	-0.974025	0.3301
DLNOIL	3.786752	3.604677	1.050511	0.2936
DLNGOLD	-0.48418	0.363221	-1.3226600	0.1861
DLNVIX	-2.356839	0.928982	-2.537011	0.0112
C	45.68697	15.35481	2.95418	0.0030

Note: Confidence interval 95%, all data used in the OLS regression analysis are stationary according to the ADF Unit root test

The results of the regression analysis in the Table 6 show that VIX has a statistically significant negative impact on the DAX index at 5% significance level. Other variables do not show statistically significant impact on the DAX index at the 5% significance level.

In order to check if the model is fulfilling diagnostics criteria other than homoscedasticity, tests for normality of the residuals and autocorrelation (serial correlation) test were employed.

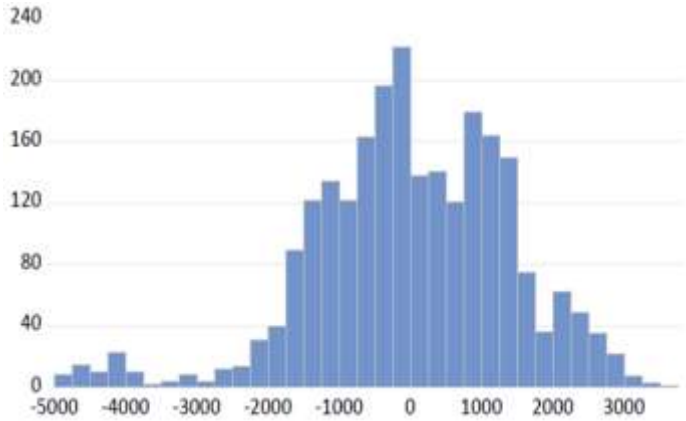


Figure 8 DAX normality test

The assessment of distribution normality employed the Jarque-Bera test, as depicted in Figure 8. The model estimation yielded a Jarque-Bera statistic of 233.5622, accompanied by a probability of 0.0000. This outcome indicates that, at any standard significance level, we reject the null hypothesis concerning the normality of the distribution of relationship errors. However, Brooks (2008) states that "for the sample sizes that are sufficiently large, violation of the normality assumption is virtually inconsequential. Appealing to a central limit theorem, the test statistics will asymptotically follow the appropriate distributions even in the absence of error normality."

The examination for autocorrelation (serial correlation) utilized the Breusch-Godfrey LM test, and the results are presented in Table 7. At a significance level of 5%, we do not find enough evidence to reject the null hypothesis, suggesting there is no presence of autocorrelation in the model.

Table 7 DAX Breusch-Godfrey LM test for autocorrelation

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	1.609643	Prob. F(2,2402)	0.2002
Obs*R-sq.	3.224341	Prob. Chi-Sq.(2)	0.1995

DISCUSSION

Upon meticulous examination of the outcomes derived from the comprehensive data analysis, several discernible conclusions come to the fore. Specifically, in relation to the SASX 10 dependent variable, emblematic of an economy in the early stages of development, it is noteworthy that no discernible reactivity was observed in response to alterations in any of the independent variables at a 5% significance level.

The congruity in the results obtained for both dependent variables, DAX and SASX 10, is conspicuous. Neither appears to be significantly influenced by fluctuations in any of the independent variables. Exceptionally, a notable exception arises where a significant relationship is identified between the DAX and the volatility index. This observation may be attributed to the heightened digitization and sensitivity inherent in the more advanced German economy, rendering it more susceptible to volatility.

The results of the empirical analysis related to the relationship between the US monetary policy and stock market inidces are in line with the studies of Ansari & Sensarma (2019) and Narayan & Narayan (2012). Ansari & Sensarma (2019) found an insignificant effect on the BRICS countries indices, except for the Bombay Sensex, representing the Indian stock market.

Narayan & Narayan (2012), in a study spanning seven Asian countries found that, in the short run, the US interest rates had a statistically insignificant effect on returns for most countries, except the Philippines during the crisis.

The results of the analysis related to the impact of gold prices on stock market indices are in line with the result found by Ansari & Sensarma (2019) who explored the effect of gold prices on BRICS stock markets, where gold prices did not have statistically significant impact on the Bombay Sensex (Indian stock market). However, there was found a statistically significant impact from gold prices on the stock markets of other BRICS countries.

The results related to the oil prices impact on the stock market indices of Germany and BiH are in line with Apergis & Miller (2009) who found that changes in oil prices did not elicit significant responses in stock markets across eight countries (Japan, Italy, France, Australia, Canada, the United Kingdom, and the United States, Germany).

Lastly, the results of the analysis related to the impact of VIX on the stock market indices showed that there is a statistically significant negative impact of VIX on DAX index (Germany), while there is no statistically significant impact on SASX 10 (BiH). The results are mixed, which is also in line with the results of the previous studies. For example, Vuong et. al (2022) suggested that prior studies have demonstrated the negative relationship that exists between the change in the VIX index and the returns in the US stock market. This is in line with the results related to DAX index. However, Gürsoy (2020) did not find a a causal relationship between Brazilian stock market and the VIX.

The variance in results may stem from idiosyncrasies in the contextual parameters and economic dynamics, thus underscoring the nuanced nature of the interplay between variables in distinct economic environments.

CONCLUSION

The aim of this study was to examine if the US monetary policy, oil prices and gold prices exert an impact on the stock market indices of a developed and a developing economy. As a reference for a developing economy, the study observed Bosnia and Herzegovina, more precisely SASX 10 index, and as a developed one, the study observed Germany, more precisely DAX index. Ordinary least squares method (OLS) was used for the analysis. All required diagnostics tests were employed.

At a 5% significance level it was found that neither gold prices, oil prices or the US monetary policy exerted a significant effect on the SASX 10 index representing stock market of Bosnia and Herzegovina or DAX index, representing stock market of Germany. However, it can

be highlighted that the results show that control variable VIX has a statistically significant negative impact on DAX index.

The results of the study contribute to the existing empirical literature, especially related to the Bosnian and Herzegovinian context, which represented a stock market of a developing economy. Furthermore, these results could be valuable for the potential investors, and their investment and diversification decisions. Results of the study also offer a comparative perspective of the relationships found in a stock market of a developed and a developing economy.

The main limitation of this study is that only two indices were taken as a sample, one representing developed and the other representing a developing economy. Future studies should include various indices from different geographical regions, representing developed and developing economies, which could lead to a more comprehensive results and conclusions.

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