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Stock Market Volatility in ASEAN Plus Three Countries during Geopolitical Crisis

Imania Fatikasari[1], Robiyanto[2], Petrus Wijayanto[3]

Fakultas Ekonomika dan Bisnis, Universitas Kristen Satya Wacana, Indonesia
*Correspondence: E-mail: robiyanto.robiyanto@uksw.edu

ABSTRACT

The purpose of this study is to examine the effect of stock market volatility in ASEAN Plus Three Economic Relation toward gold prices and the value of the US Dollar Index during geopolitical crisis. The technique used in this study is Generalized Autoregressive Conditional Heteroskedasticity (GARCH) or GARCH. This study found that the volatility of PSEi, STI, and KOSPI effect the gold price positively. The same finding also applies on the US Dollar Index, where the volatility of the VN30 and KOSPI proved to have a positive effect. Therefore, that increased stock market volatility encourages investors to seek alternative investments such as Gold and the US Dollar Index.

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1. INTRODUCTION

Geopolitical tensions have again reached a breaking point after a series of events, from the conflict between Russia and Ukraine to the clash between Israel and Hamas. On February 28, 2022, President Vladimir Putin officially announced the implementation of military operations to invade Ukraine. The invasion was a significant escalation of Russia's act of annexation of Ukrainian territory triggered by Ukraine's desire to join NATO. Russia considers that the presence of NATO forces in Eastern Europe will hamper Russia's efforts to restore its former glory, advance itself, and protect its interests (Guild & Groenendijk, 2023). Turning from other geopolitical issues, in 2023 there was a significant change in the conflict between Israel and Palestine. The conflict began to heat up when Israel launched massive attacks aimed at civilians and military installations. From this attack, a group of Palestinian defense activists known as Hamas emerged, which seeks to destroy the Jewish nation and return the territory currently under Israeli sovereignty to Palestinian hands.

The conflict continues to affect the global economy, causing losses in financial markets. As a result, investor sentiment in various countries has become volatile, and the volatility of financial asset prices has increased significantly (Mu et al., 2022). Volatility measures the statistical spread of returns on a particular market or stock index that becomes risky when it increases. Market instability can affect the value of volatility. This instability will affect changes in gold prices and the US Dollar Index.

Gold is a valuable commodity and has a high economic value. Gold is considered a global currency because it has an intrinsic value that is fixed and standardized and can be traded in various places. In addition, gold can be used as a hedging tool and an alternative investment when the stock market is experiencing instability (Tran & Nguyen, 2022). Nonetheless, changes in the value of gold can hurt financial markets. This is due to the increase in gold price fluctuations associated with risky investment situations, while the decrease is associated with safer investment situations (Xiaozhong et al., 2022).

The US dollar is the currency that is the main component of the United States financial markets and plays a dominant role globally. Its significant influence can be seen in its movements in the foreign exchange market (Liu et al., 2023). The US dollar is one of the reserve currency options used by more than 60% of central banks, and many commodity sectors have used it as a reference in setting prices. Thus, fluctuations in the dollar index have a significant impact on the global economy, especially in the stock market.

Tensions between Russia and Ukraine have impacted several regions of the world, including countries in the ASEAN region and beyond. The Russia-Ukraine conflict impacted global financial markets, causing financial asset price volatility to increase significantly (Mu et al., 2022). Beraich et al. (2022) said that the conflict between Russia and Ukraine is affecting financial market volatility. Yang et al. (2021) suggests that geopolitical tensions are affecting China's stock market volatility. Alam et al. (2022) stated that the tensions linked the gold commodity and financial markets. If financial market volatility increases, it will lead to uncertainty at the global level which will result in a rise in the gold commodity. As financial markets globalize through international trade, high volatility is expected to impact foreign exchange and commodity markets.

Thus, it is necessary to study the impact of stock market volatility on changes in gold and US dollar prices during the geopolitical crisis. Since the previous research still focuses on the Russia-Ukraine war situation, this research will add a new geopolitical issue, namely the conflict between Hamas and Israel. This study will examine the impact of gold price movements and the US Dollar Index on stock market volatility in ASEAN Plus Three Economic. ASEAN Plus Three Economic is a partnership with strong economic, political, and technological ties to compete and gain regional influence (Kim et al., 2023). Therefore, this study aims to prove whether stock market volatility in the ASEAN Plus Three Economic affects changes in gold prices and the value of the US Dollar Index. By conducting this research, it is hoped that investors and capital market practitioners can better understand the factors that affect stock market volatility. This research is also expected to provide additional insight into the impact of volatility on gold prices and the US Dollar Index so that investment decisions can be made more precisely and risks can be minimized.

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2. METHODOLOGY

Type and Source of Data

The data that is the focus of this research includes daily data from gold prices, the US Dollar Index, and indices on ASEAN countries and three other countries namely China, South Korea, and Japan. The research data can be accessed through the website www.investing.com and related exchange sites. Data collection was carried out from 2021 to 2024 during the geopolitical crisis. These geopolitical crises cover the period before the Ukraine-Russia war, during the Ukraine-Russia war, and the Hamas-Israel crisis.

Definition of Operational Variables

In this research, there are several independent variables and dependent variables. The independent variables used are the volatility of PSEi, LSX, JKSE, KLSE, STI, SETI, VN 30, Nikkei, KOSPI, and SSEC. Meanwhile, the dependent variables are the price of gold and the US Dollar Index. The stock market volatility is represented by the conditional variance of the stock market returns. While in determining the stock return rate to calculate volatility, the following formula is used:

$$R_{m_{(it)}} = \left[\frac{m_{(t)} - m_{(t-1)}}{m_{(t-1)}}\right]$$

Keterangan :

R_m : Stock Market Return

$m_{(t)}$: Closing Stock Index $Day_{(t)}$

$m_{(t-1)}$: Closing Stock Index $Day_{(t-1)}$

i : The i-th exchange

t : $Period_t$

Analysis Technique

The data in this study was processed using the GARCH analysis technique. Before GARCH testing, a stationary test using Augmented Dickey-Fuller and a normality test using Jarque-Bera value are conducted. Khan et al. (2023) stated that GARCH can account for changes in volatility dynamically. GARCH can estimate future volatility values based on historical volatility through the concept of autoregression and describe volatility probabilities through the concept of heteroscedasticity (Xiao et al., 2020). The respective stock market volatility can be calculated using the following equation:

$$h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i e_{t-1}^2 + \sum_{j=i}^{p} \beta_j \sigma_{t-j}^2$$

Where :

h_t : Volatility

$\alpha_i e_{t-1}^2$: Volatility of ARCH component

$\beta_j \sigma_{t-j}^2$: Volatility of GARCH component

Since this study has several dependent variables, the GARCH model equation used is as follows:

$$R_{Gold_t} = \beta_0 + \beta_1 h_{m_{it}} + \sigma_t^2 + \varepsilon_t$$
$$R_{DXY_t} = \beta_0 + \beta_1 h_{m_{it}} + \sigma_t^2 + \varepsilon_t$$

Where :

R_{Gold_t} : Gold Price Return in period t

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R_{DXY_t} : Dollar Index Return in period t
$h_{m_{it}}$: Market Volatility of Stock i in period t
With :

$$\varepsilon_t = \Phi_1 \varepsilon_{t-1} + \eta_{t-p}$$
$$\eta_{t-p} = \sigma_t \epsilon_t$$
$$\sigma_t^2 = \alpha_0 + \alpha_1 \eta_{t-1}^2 + \ldots + \alpha_p \eta_{t-1}^2 + \beta_1 \sigma_{t-1}^2 + \ldots + \beta_q \sigma_{t-q}^2$$

3. RESULTS AND DISCUSSION

Results

Stationarity Test

Data stationarity is tested using the Augmented Dickey-Fuller Test. The results of stationary testing using the Augmented Dickey-Fuller Test are presented in Table 1., which show that the probability value of the variables in each period is lower than the significance level of 1%. So that the data is considered stationary and can be used for further research.

Table 1
Results of Stationary Test

Period	Variable	t-statistic	Prob.
Pre Russia-Ukraine War	R XAU	-11.03548	0.0000***
	R DXY	-11.91777	0.0000***
	V JKSE	-12.47346	0.0000***
	V KLSE	-12.60381	0.0000***
	V PSEi	-11.78239	0.0000***
	V STI	-11.15352	0.0000***
	V SETI	-14.72121	0.0000***
	V VN30	-13.10605	0.0000***
	V LSX	-11.28824	0.0000***
	V Nikkei	-11.05977	0.0000***
	V Kospi	-12.67307	0.0000***
	V SSEC	-12.98191	0.0000***
During Russia-Ukraine War	R XAU	-16.65325	0.0000***
	R DXY	-15.29973	0.0000***
	V JKSE	-13.77224	0.0000***
	V KLSE	-12.12513	0.0000***
	V PSEi	-14.86113	0.0000***
	V STI	-15.12499	0.0000***
	V SETI	-14.09769	0.0000***
	V VN30	-12.84392	0.0000***
	V LSX	-13.04797	0.0000***
	V Nikkei	-14.49183	0.0000***
	V Kospi	-12.79336	0.0000***
	V SSEC	-14.29732	0.0000***
During Hamas-Israel Conflict	R XAU	-8.068382	0.0000***
	R DXY	-8.829935	0.0000***

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	V JKSE	-7.394588	0.0000***
	V KLSE	-8.434338	0.0000***
	V PSEi	-9.866435	0.0000***
	V STI	-8.257727	0.0000***
	V SETI	-9.350214	0.0000***
	V VN30	-12.17075	0.0000***
	V LSX	-10.27092	0.0000***
	V Nikkei	-12.09551	0.0000***
	V Kospi	-7.554403	0.0000***
	V SSEC	-10.96351	0.0000***
All Period	R XAU	-18.60406	0.0000***
	R DXY	-18.20487	0.0000***
	V JKSE	-17.83296	0.0000***
	V KLSE	-17.54183	0.0000***
	V PSEi	-20.71597	0.0000***
	V STI	-18.34374	0.0000***
	V SETI	-17.30339	0.0000***
	V VN30	-19.89793	0.0000***
	V LSX	-18.90098	0.0000***
	V Nikkei	-17.95747	0.0000***
	V Kospi	-19.97101	0.0000***
	V SSEC	-17.89209	0.0000***

*** Significant at 1% level

Normality Test

In order to determining whether the data is normally distributed, the normality test can also be used to determine the GARCH model to be applied. The GARCH volatility model consists of several models, including Student-t, Generalized Error Distribution (GED), and Normal Gaussian (Adubisi et al., 2023). If the data is normally distributed, the GARCH model is Normal Gaussian. However, if the data is not normally distributed, the model used is Generalized Error Distribution (GED). In this study, the normality test was carried out by applying the Jarque Bera value. The results of the normality test using the Jarque Bera value are listed in Table 2. The table shows that the probability value of the variables in each period is lower than the significance level. Thus, it can be said that the data is not normally distributed, and the GARCH model used for further testing is the Generalized Error Distribution (GED).

Table 2
Results of Normality Test

Pre Russia-Ukraine War	Jarque-Bera	Prob.	Model
R XAU to V JKSE	57.92902	0.0000	GED
R XAU to V KLSE	52.75937	0.0000	GED
R XAU to V PSEi	56.79076	0.0000	GED
R XAU to V STI	57.74675	0.0000	GED
R XAU to V SETI	56.73282	0.0000	GED
R XAU to V VN30	57.12873	0.0000	GED
R XAU to V LSX	50.45520	0.0000	GED
R XAU to V Nikkei	57.60386	0.0000	GED
R XAU to V Kospi	56.69101	0.0000	GED

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R XAU to V SSEC	53.84792	0.0000	GED
R DXY to V JKSE	50.15919	0.0000	GED
R DXY to V KLSE	71.77257	0.0000	GED
R DXY to V PSEi	85.72262	0.0000	GED
R DXY to V STI	30.73514	0.0000	GED
R DXY to V SETI	47.24103	0.0000	GED
R DXY to V VN30	80.92270	0.0000	GED
R DXY to V LSX	83.60832	0.0000	GED
R DXY to V Nikkei	49.27255	0.0000	GED
R DXY to V Kospi	59.49530	0.0000	GED
R DXY to V SSEC	54.01321	0.0000	GED
During Russia-Ukraine War	**Jarque-Bera**	**Prob.**	**Model**
R XAU to V JKSE	20.30976	0.0000	GED
R XAU to V KLSE	19.30308	0.0001	GED
R XAU to V PSEi	21.86189	0.0000	GED
R XAU to V STI	24.38700	0.0000	GED
R XAU to V SETI	21.82829	0.0000	GED
R XAU to V VN30	24.52903	0.0000	GED
R XAU to V LSX	15.60584	0.0004	GED
R XAU to V Nikkei	23.39937	0.0000	GED
R XAU to V Kospi	21.39442	0.0000	GED
R XAU to V SSEC	22.24005	0.0000	GED
R DXY to V JKSE	24.24458	0.0000	GED
R DXY to V KLSE	13.02286	0.0015	GED
R DXY to V PSEi	22.16161	0.0000	GED
R DXY to V STI	18.17554	0.0001	GED
R DXY to V SETI	18.38645	0.0001	GED
R DXY to V VN30	24.54598	0.0000	GED
R DXY to V LSX	21.90163	0.0000	GED
R DXY to V Nikkei	21.70320	0.0000	GED
R DXY to V Kospi	17.81468	0.0001	GED
R DXY to V SSEC	21.75964	0.0000	GED
During Hamas-Israel Conflict	**Jarque-Bera**	**Prob.**	**Model**
R XAU to V JKSE	110.34500	0.0000	GED
R XAU to V KLSE	109.80840	0.0000	GED
R XAU to V PSEi	77.73817	0.0000	GED
R XAU to V STI	109.98860	0.0000	GED
R XAU to V SETI	57.51811	0.0000	GED
R XAU to V VN30	113.80550	0.0000	GED
R XAU to V LSX	74.04591	0.0000	GED
R XAU to V Nikkei	94.28037	0.0000	GED
R XAU to V Kospi	94.01787	0.0000	GED
R XAU to V SSEC	107.12760	0.0000	GED
R DXY to V JKSE	20.17894	0.0000	GED
R DXY to V KLSE	25.91552	0.0000	GED
R DXY to V PSEi	36.16575	0.0000	GED
R DXY to V STI	29.82524	0.0000	GED

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R DXY to V SETI	37.26904	0.0000	GED
R DXY to V VN30	41.79642	0.0000	GED
R DXY to V LSX	35.37340	0.0000	GED
R DXY to V Nikkei	36.89711	0.0000	GED
R DXY to V Kospi	23.36064	0.0000	GED
R DXY to V SSEC	30.39812	0.0000	GED
All Period	**Jarque-Bera**	**Prob.**	**Model**
R XAU to V JKSE	139.90550	0.0000	GED
R XAU to V KLSE	146.45490	0.0000	GED
R XAU to V PSEi	136.84690	0.0000	GED
R XAU to V STI	151.29170	0.0000	GED
R XAU to V SETI	131.91550	0.0000	GED
R XAU to V VN30	145.84600	0.0000	GED
R XAU to V LSX	135.98100	0.0000	GED
R XAU to V Nikkei	144.72310	0.0000	GED
R XAU to V Kospi	136.34710	0.0000	GED
R XAU to V SSEC	133.94790	0.0000	GED
R DXY to V JKSE	115.09510	0.0000	GED
R DXY to V KLSE	88.51715	0.0000	GED
R DXY to V PSEi	127.28110	0.0000	GED
R DXY to V STI	91.37453	0.0000	GED
R DXY to V SETI	100.44510	0.0000	GED
R DXY to V VN30	135.95490	0.0000	GED
R DXY to V LSX	122.98200	0.0000	GED
R DXY to V Nikkei	110.25560	0.0000	GED
R DXY to V Kospi	97.93579	0.0000	GED
R DXY to V SSEC	112.54670	0.0000	GED

In recent years, the use of GARCH models in the financial sector has increased as they are considered capable of efficiently predicting the volatility of financial data (Mahajan et al., 2022). Table 3 shows the results of the GARCH (1.1) test that examines the effect of stock market volatility on gold prices before the Russian-Ukrainian war. The test results show that each variable follows the GARCH pattern because the probability value of GARCH for each variable is significant at the 1% level. However, stock market volatility has not been proven to affect gold prices. This is because the probability value of each variable exceeds the specified significance level.

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Table 3
The Impact of Stock Market Volatility on Gold Prices Before the Russia-Ukraine War

Pre Russia-Ukraine War							
Independent Variable		Mean Equation		Variance Equation			GED Parameter
		C	Independent Variable (Volatility)	C	Resid	GARCH	
JKSE	Coefficient	0.0009	-0.0001	0.0000	0.0660	0.6741	0.9234
	z-statistic	1.9777**	-0.1748	1.2593	0.7143	2.9162***	6.6641***
	Prob.	0.0480	0.8612	0.2079	0.4751	0.0035	0.0000
KLSE	Coefficient	0.0008	0.0000	0.0000	0.0649	0.6753	0.9291
	z-statistic	1.9094*	0.0184	1.2653	0.7132	2.9458***	6.6603***
	Prob.	0.0562	0.9853	0.2058	0.4757	0.0032	0.0000
PSEi	Coefficient	0.0009	-0.0001	0.0000	0.0662	0.6739	0.9249
	z-statistic	1.9953**	-0.2744	1.2559	0.7189	2.9124***	6.6358***
	Prob.	0.0460	0.7838	0.2092	0.4722	0.0036	0.0000
STI	Coefficient	0.0008	0.0000	0.0000	0.0650	0.6755	0.9286
	z-statistic	1.9486*	0.0534	1.2630	0.7142	2.9445***	6.6597***
	Prob.	0.0513	0.9574	0.2066	0.4751	0.0032	0.0000
SETI	Coefficient	0.0008	0.0000	0.0000	0.0652	0.6749	0.9293
	z-statistic	1.9253*	0.0452	1.2665	0.7161	2.9420***	6.5939***
	Prob.	0.0542	0.9640	0.2053	0.4739	0.0033	0.0000
VN 30	Coefficient	0.0009	-0.0006	0.0000	0.0694	0.6527	0.9364
	z-statistic	2.0158**	-1.4853	1.3222	0.7213	2.7669***	6.7237***
	Prob.	0.0438	0.1375	0.1861	0.4707	0.0057	0.0000
LSX	Coefficient	0.0008	-0.0006	0.0000	0.0733	0.6693	0.8799
	z-statistic	2.0147**	-1.3608	1.2145	0.7366	2.7672***	6.7464***
	Prob.	0.0439	0.1736	0.2246	0.4613	0.0057	0.0000
Nikkei	Coefficient	0.0008	0.0000	0.0000	0.0658	0.6701	0.9292
	z-statistic	1.9538*	0.0975	1.2731	0.7138	2.8969***	6.6535***
	Prob.	0.0507	0.9223	0.2030	0.4753	0.0038	0.0000
Kospi	Coefficient	0.0008	0.0000	0.0000	0.0653	0.6748	0.9293
	z-statistic	1.9193*	-0.0600	1.2653	0.7151	2.9398***	6.6494***
	Prob.	0.0549	0.9521	0.2058	0.4745	0.0033	0.0000
SSEC	Coefficient	0.0007	0.0004	0.0000	0.0599	0.6881	0.9611
	z-statistic	1.6497*	0.8682	1.2730	0.7256	3.1315***	6.5454***
	Prob.	0.0990	0.3853	0.2030	0.4681	0.0017	0.0000

*** Significant at 1% level
** Significant at 5% level
* Significant at 10% level

The GARCH (1.1) test of the effect of stock market volatility on gold prices during the Russia-Ukraine war period is listed in Table 4. The test results indicate that not all variables follow the GARCH pattern. Some variables that follow the GARCH pattern include PSEi, STI, LSX, Nikkei, and Kospi, which are significant at 10% and 1% significance levels. The PSEi was shown to positively influence gold prices at the 1% significance level. In addition, the STI and Kospi were also shown

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to positively influence gold prices at the 10% significance level.

Table 4
The Impact of Stock Market Volatility on Gold Prices During The Russia-Ukraine War

During Russia-Ukraine War							
Independent Variable		Mean Equation		Variance Equation			GED Parameter
		C	Independent Variable (Volatility)	C	Resid	GARCH	
JKSE	Coefficient	0.0010	-0.0005	0.0000	-0.0565	0.5888	1.2712
	z-statistic	1.9120*	-0.9783	1.0129	-3.6150***	1.3211	8.2625***
	Prob.	0.0559	0.3279	0.3111	0.0003	0.1865	0.0000
KLSE	Coefficient	0.0010	0.0000	0.0001	-0.0607	0.5930	1.2834
	z-statistic	1.7156*	0.0468	1.1033	-8.2350***	1.4298	7.9788***
	Prob.	0.0862	0.9627	0.2699	0.0000	0.1528	0.0000
PSEi	Coefficient	-0.0001	0.0016	0.0000	0.0285	0.9587	1.2636
	z-statistic	-0.1339	3.0511***	0.2567	1.2483	19.9801***	8.4962***
	Prob.	0.8935	0.0023	0.7974	0.2119	0.0000	0.0000
STI	Coefficient	0.0006	0.0009	0.0000	-0.0535	0.5895	1.4770
	z-statistic	1.4262	1.9213*	1.4265	-2.7693***	1.8518*	9.3057***
	Prob.	0.1538	0.0547	0.1537	0.0056	0.0641	0.0000
SETI	Coefficient	0.0008	-0.0002	0.0000	-0.0581	0.5875	1.2866
	z-statistic	1.4753	-0.4200	1.1160	-7.6669***	1.4237	8.3344***
	Prob.	0.1401	0.6745	0.2644	0.0000	0.1545	0.0000
VN 30	Coefficient	0.0005	-0.0003	0.0001	-0.0608	0.5853	1.3271
	z-statistic	0.9817	-0.5714	1.1488	-4.5124***	1.4515	8.3076***
	Prob.	0.3262	0.5677	0.2506	0.0000	0.1466	0.0000
LSX	Coefficient	0.0009	-0.0005	0.0000	-0.0612	0.5875	1.3562
	z-statistic	1.6444	-1.0724	1.3835	-9.6492***	1.7170*	8.1863***
	Prob.	0.1001	0.2835	0.1665	0.0000	0.0860	0.0000
Nikkei	Coefficient	-0.0001	-0.0002	0.0000	0.0366	0.9644	1.2755
	z-statistic	-0.2427	-0.3396	-0.1577	1.6659*	28.2488***	8.7823***
	Prob.	0.8082	0.7342	0.8747	0.0957	0.0000	0.0000
Kospi	Coefficient	0.0001	0.0009	0.0000	0.0371	0.9613	1.2484
	z-statistic	0.1366	1.6957*	-0.0404	1.5838	26.3709***	8.5483***
	Prob.	0.8914	0.0899	0.9678	0.1132	0.0000	0.0000
SSEC	Coefficient	0.0010	0.0000	0.0001	-0.0591	0.5822	1.2883
	z-statistic	1.7874*	-0.0422	1.0234	-3.4960***	1.3008	8.1834***
	Prob.	0.0739	0.9664	0.3061	0.0005	0.1933	0.0000

*** Significant at 1% level
** Significant at 5% level
* Significant at 10% level

Table 5 shows the results of the GARCH (1,1) test, which examines the effect of stock market volatility on gold prices during the Hamas-Israel conflict. The test results show that the GARCH probability value for each variable is lower than the 1% significance level, indicating that each

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variable follows the GARCH pattern. KLSE is considered to affect gold prices during the Hamas-Israel conflict because its probability value is lower than the 10% significance level and has a negative coefficient value.

Table 5
The Impact of Stock Market Volatility on Gold Prices During The Hamas-Israel Conflict Period During Hamas-Israel Conflict

Independent Variable		Mean Equation		Variance Equation			GED Parameter
		C	Independent Variable (Volatility)	C	Resid	GARCH	
JKSE	Coefficient	0.0024	0.0005	0.0000	-0.0410	0.8203	1.2485
	z-statistic	2.5946***	0.5141	1.6061	-0.8850	6.9020***	4.7894***
	Prob.	0.0095	0.6072	0.1083	0.3762	0.0000	0.0000
KLSE	Coefficient	0.0026	-0.0016	0.0000	-0.0601	0.8182	1.3987
	z-statistic	2.7523***	-1.8248*	1.9044*	-1.1124	7.2050***	3.9223***
	Prob.	0.0059	0.0680	0.0569	0.2660	0.0000	0.0001
PSEi	Coefficient	0.0021	0.0006	0.0000	-0.0376	0.8211	1.3126
	z-statistic	2.1864**	0.4683	1.5910	-0.8280	7.1734***	4.8833***
	Prob.	0.0288	0.6396	0.1116	0.4077	0.0000	0.0000
STI	Coefficient	0.0022	-0.0009	0.0000	-0.0426	0.8099	1.3275
	z-statistic	2.4355**	-1.0303	1.7124*	-1.1005	7.0392***	5.0231***
	Prob.	0.0149	0.3029	0.0868	0.2711	0.0000	0.0000
SETI	Coefficient	0.0022	0.0003	0.0000	-0.0406	0.8208	1.3047
	z-statistic	2.4070**	0.2819	1.5499	-0.9059	6.7167***	4.8742***
	Prob.	0.0161	0.7780	0.1212	0.3650	0.0000	0.0000
VN 30	Coefficient	0.0022	-0.0004	0.0000	-0.0400	0.8020	1.3209
	z-statistic	2.3456**	-0.4746	1.6772*	-0.7987	6.4939***	4.8151***
	Prob.	0.0190	0.6351	0.0935	0.4245	0.0000	0.0000
LSX	Coefficient	0.0023	-0.0011	0.0000	-0.0436	0.8293	1.3463
	z-statistic	2.4345**	-1.0000	1.6478*	-0.9882	7.5870***	4.5709***
	Prob.	0.0149	0.3173	0.0994	0.3231	0.0000	0.0000
Nikkei	Coefficient	0.0023	-0.0011	0.0000	-0.0371	0.8006	1.2552
	z-statistic	2.5301**	-1.2845	1.5769	-0.9313	6.3217***	5.1077***
	Prob.	0.0114	0.1990	0.1148	0.3517	0.0000	0.0000
Kospi	Coefficient	0.0022	-0.0003	0.0000	-0.0407	0.8039	1.3124
	z-statistic	2.3904**	-0.4351	1.6793*	-0.8743	6.6266***	4.9552***
	Prob.	0.0168	0.6635	0.0931	0.3820	0.0000	0.0000
SSEC	Coefficient	0.0022	-0.0003	0.0000	-0.0394	0.8098	1.2943
	z-statistic	2.3810**	-0.3503	1.6466*	-0.8474	6.7217***	4.8961***
	Prob.	0.0173	0.7261	0.0996	0.3968	0.0000	0.0000

*** Significant at 1% level
** Significant at 5% level
* Significant at 10% level

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To determine the impact of stock market volatility on gold prices as a whole, GARCH (1,1) testing was conducted for the entire period. The results of the test are listed in Table 6. Over the entire period, it can be seen that almost every variable follows the GARCH pattern. However, one variable does not follow the GARCH pattern, namely VN 30 where the probability value exceeds the 10% significance level. In addition, only PSEi is proven to positively influence gold prices.

Table 6
The Impact of Stock Market Volatility on Gold Prices in All Periods

All Period							
Independent Variable		Mean Equation		Variance Equation			GED Parameter
		C	Independent Variable (Volatility)	C	Resid	GARCH	
JKSE	Coefficient	0.0005	-0.0002	0.0000	0.0235	0.7191	1.1050
	z-statistic	1.3813	-0.4645	1.3942	0.6517	3.6910***	12.5505***
	Prob.	0.1672	0.6423	0.1633	0.5146	0.0002	0.0000
KLSE	Coefficient	0.0005	0.0003	0.0000	0.0271	0.7163	1.1035
	z-statistic	1.5662	0.8325	1.4312	0.7235	3.7538***	12.6356***
	Prob.	0.1173	0.4052	0.1524	0.4694	0.0002	0.0000
PSEi	Coefficient	0.0005	0.0007	0.0000	0.0216	0.7206	1.1217
	z-statistic	1.6201	2.1726**	1.4706	0.6261	3.9266***	12.5881***
	Prob.	0.1052	0.0298	0.1414	0.5312	0.0001	0.0000
STI	Coefficient	0.0004	0.0003	0.0000	0.0228	0.7207	1.1166
	z-statistic	1.1958	0.8610	1.4368	0.6464	3.8290***	12.6022***
	Prob.	0.2318	0.3892	0.1508	0.5180	0.0001	0.0000
SETI	Coefficient	0.0004	0.0003	0.0000	0.0266	0.7155	1.1108
	z-statistic	1.1321	0.9547	1.4232	0.7177	3.7246***	12.5583***
	Prob.	0.2576	0.3397	0.1547	0.4730	0.0002	0.0000
VN 30	Coefficient	0.0003	-0.0002	0.0001	0.1500	0.6000	2.0000
	z-statistic	0.2673	-0.1731	0.9307	0.8426	1.4628	6.4640***
	Prob.	0.7893	0.8625	0.3520	0.3995	0.1435	0.0000
LSX	Coefficient	0.0005	-0.0004	0.0000	0.0270	0.7203	1.0965
	z-statistic	1.4539	-1.3170	1.3838	0.7238	3.7049***	12.5047***
	Prob.	0.1460	0.1879	0.1664	0.4692	0.0002	0.0000
Nikkei	Coefficient	0.0004	-0.0001	0.0000	0.0235	0.7151	1.1073
	z-statistic	1.2562	-0.3497	1.4042	0.6506	3.6460***	12.6209***
	Prob.	0.2090	0.7266	0.1602	0.5153	0.0003	0.0000
Kospi	Coefficient	0.0005	0.0004	0.0000	0.0262	0.7199	1.1063
	z-statistic	1.4909	1.2520	1.4141	0.7095	3.7781***	12.5260***
	Prob.	0.1360	0.2106	0.1573	0.4780	0.0002	0.0000
SSEC	Coefficient	0.0005	0.0005	0.0000	0.0259	0.7234	1.1099
	z-statistic	1.4516	1.4834	1.3735	0.7132	3.7280***	12.5769***
	Prob.	0.1466	0.1380	0.1696	0.4757	0.0002	0.0000

*** Significant at 1% level
** Significant at 5% level
* Significant at 10% level

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Table 7
The Impact of Stock Market Volatility on the US Dollar Index
In the Period Before the Russia-Ukraine War

Pre Russia-Ukraine War							
Independent Variable		Mean Equation		Variance Equation			GED Parameter
		C	Independent Variable (Volatility)	C	Resid	GARCH	
JKSE	Coefficient	0.0003	-0.0003	0.0000	-0.0503	1.0310	1.4427
	z-statistic	1.4153	-1.1921	1.3451	-2.5095**	5767.70***	7.2752***
	Prob.	0.1570	0.2332	0.1786	0.0121	0.0000	0.0000
KLSE	Coefficient	0.0003	-0.0002	0.0000	-0.0515	1.0328	1.4454
	z-statistic	1.2625	-0.8196	1.9765**	-3.6881***	8711.99***	7.1635***
	Prob.	0.2068	0.4124	0.0481	0.0002	0.0000	0.0000
PSEi	Coefficient	0.0003	0.0002	0.0000	-0.0489	1.0313	1.4794
	z-statistic	1.3568	0.8253	1.3648	-2.5484**	5568.68***	7.2979***
	Prob.	0.1748	0.4092	0.1723	0.0108	0.0000	0.0000
STI	Coefficient	0.0003	-0.0001	0.0000	-0.0498	1.0300	1.4706
	z-statistic	1.3604	-0.6062	1.2308	-2.3283**	4744.35***	7.1861***
	Prob.	0.1737	0.5444	0.2184	0.0199	0.0000	0.0000
SETI	Coefficient	0.0003	-0.0004	0.0000	-0.0570	1.0303	1.4867
	z-statistic	1.3181	-1.6441	1.8871*	-3.0339***	6133.48***	7.1193***
	Prob.	0.1875	0.1002	0.0591	0.0024	0.0000	0.0000
VN 30	Coefficient	0.0003	0.0002	0.0000	-0.0508	1.0292	1.4308
	z-statistic	1.3708	0.8645	1.4522	-2.5152**	4136.97***	7.3282***
	Prob.	0.1704	0.3873	0.1464	0.0119	0.0000	0.0000
LSX	Coefficient	0.0003	-0.0001	0.0000	-0.0186	-0.9593	1.3130
	z-statistic	1.2503	-0.3730	7.9281***	-1.4043	-15.4876***	7.9845***
	Prob.	0.2112	0.7091	0.0000	0.1602	0.0000	0.0000
Nikkei	Coefficient	0.0003	-0.0006	0.0000	-0.0538	1.0317	1.4635
	z-statistic	1.2175	-2.4555**	1.4500	-3.1624***	9497.62***	7.2138***
	Prob.	0.2234	0.0141	0.1470	0.0016	0.0000	0.0000
Kospi	Coefficient	0.0003	-0.0004	0.0000	-0.0565	1.0299	1.5236
	z-statistic	1.3567	-1.5315	1.5921	-2.8221***	6830.81***	7.1663***
	Prob.	0.1749	0.1256	0.1114	0.0048	0.0000	0.0000
SSEC	Coefficient	0.0004	-0.0003	0.0000	-0.0515	1.0302	1.5121
	z-statistic	1.4983	-1.1791	1.2736	-2.4286**	5583.33***	7.1751***
	Prob.	0.1341	0.2383	0.2028	0.0152	0.0000	0.0000

*** Significant at 1% level
** Significant at 5% level
* Significant at 10% level

Table 7 shows the results of the GARCH (1,1) test, which analyzes the effect of stock market volatility on the US Dollar Index in the period before the Russia-Ukraine war. The test results show that each variable follows the GARCH pattern. In addition, only the Nikkei variable

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influences the US Dollar Index because its probability value is lower than the significance level of 5%. Nikkei itself has a negative effect on the US Dollar Index.

Table 8
The Impact of Stock Market Volatility on the US Dollar Index During the Russia-Ukraine War

During Russia-Ukraine War							
Independent Variable		Mean Equation		Variance Equation			GED Parameter
		C	Independent Variable (Volatility)	C	Resid	GARCH	
JKSE	Coefficient	0.0005	-0.0006	0.0000	0.1502	0.5790	1.4672
	z-statistic	1.5741	-1.8356*	1.4592	1.4331	2.3246**	9.0102***
	Prob.	0.1155	0.0664	0.1445	0.1518	0.0201	0.0000
KLSE	Coefficient	0.0005	-0.0010	0.0000	0.1649	0.5076	1.5571
	z-statistic	1.4483	-3.0487***	1.4490	1.4853	1.7491*	8.5138***
	Prob.	0.1475	0.0023	0.1474	0.1375	0.0803	0.0000
PSEi	Coefficient	0.0005	0.0000	0.0000	0.1476	0.5863	1.4250
	z-statistic	1.5419	-0.0342	1.4052	1.4079	2.3067**	9.0120***
	Prob.	0.1231	0.9727	0.1599	0.1592	0.0211	0.0000
STI	Coefficient	0.0006	-0.0010	0.0000	0.1664	0.5837	1.4240
	z-statistic	1.9294*	-3.4358***	1.4165	1.5441	2.3986**	8.3046***
	Prob.	0.0537	0.0006	0.1566	0.1226	0.0165	0.0000
SETI	Coefficient	0.0005	-0.0012	0.0000	0.2401	0.4169	1.6160
	z-statistic	1.6441	-4.2722***	1.7640*	1.9002*	1.6734*	8.3255***
	Prob.	0.1001	0.0000	0.0777	0.0574	0.0943	0.0000
VN 30	Coefficient	0.0005	0.0002	0.0000	0.1304	0.6195	1.4090
	z-statistic	1.5454	0.6863	1.2980	1.3048	2.4260**	9.1519***
	Prob.	0.1223	0.4925	0.1943	0.1919	0.0153	0.0000
LSX	Coefficient	0.0004	0.0005	0.0000	0.1242	0.6342	1.4025
	z-statistic	1.3211	1.6056	1.2465	1.3167	2.4702**	9.0811***
	Prob.	0.1865	0.1084	0.2126	0.1879	0.0135	0.0000
Nikkei	Coefficient	0.0005	-0.0007	0.0000	0.0995	0.6811	1.4433
	z-statistic	1.5904	-2.3449**	1.1065	1.1694	2.6582***	9.2622***
	Prob.	0.1117	0.0190	0.2685	0.2422	0.0079	0.0000
Kospi	Coefficient	0.0005	-0.0010	0.0000	0.1218	0.5852	1.4438
	z-statistic	1.5306	-3.1834***	1.1490	1.2385	1.8276*	8.7121***
	Prob.	0.1259	0.0015	0.2505	0.2155	0.0676	0.0000
SSEC	Coefficient	0.0005	-0.0010	0.0000	0.2066	0.4961	1.4960
	z-statistic	1.6538	-3.0081***	1.6659*	1.7353*	1.9896**	8.5277***
	Prob.	0.0982*	0.0026	0.0957	0.0827	0.0466	0.0000

*** Significant at 1% level
** Significant at 5% level
* Significant at 10% level

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Furthermore, GARCH (1.1) testing was conducted in the Russia-Ukraine war period to determine the effect of stock market volatility on the US Dollar Index, presented in Table 8. The test results prove that all variables follow the GARCH. The test shows that KLSE, STI, SETI, Kospi, and SSEC negatively affect the US Dollar Index at a 1% significance level. In addition, Nikkei and JKSE also negatively affect the US Dollar Index with a significance level of 5% and 10% respectively.

Table 9 results from the GARCH (1,1) test that analyzes the effect of stock market volatility on the US Dollar Index during the Hamas-Israel conflict. The table shows that each variable follows the GARCH pattern. In this period, only VN 30 and Kospi are proven to positively influence the US Dollar Index.

Table 9
The Impact of Stock Market Volatility on the US Dollar Index During the Hamas-Israel Conflict Period

During Hamas-Israel Conflict							
Independent Variable		Mean Equation		Variance Equation			GED Parameter
		C	Independent Variable (Volatility)	C	Resid	GARCH	
JKSE	Coefficient	5.4E-06	-0.0004	8.0E-08	-0.0881	1.0701	1.3874
	z-statistic	0.0140	-0.7662	0.1323	-3.4488***	3063.24***	3.6720***
	Prob.	0.9888	0.4435	0.8948	0.0006	0.0000	0.0002
KLSE	Coefficient	-4.1E-06	0.0004	3.3E-08	-0.0789	1.0722	1.3347
	z-statistic	-0.0112	1.0310	0.0573	-3.2667***	3218.26***	3.7392***
	Prob.	0.9911	0.3025	0.9543	0.0011	0.0000	0.0002
PSEi	Coefficient	8.9E-05	-5.4E-05	7.7E-08	-0.0954	1.0789	1.3603
	z-statistic	0.2456	-0.1100	0.4170	-51.5956***	5221.40***	3.9048***
	Prob.	0.8060	0.9124	0.6767	0.0000	0.0000	0.0001
STI	Coefficient	8.1E-05	0.0004	-2.8E-07	-0.0605	1.0646	1.2129
	z-statistic	0.2334	1.2152	-0.4251	-2.3586**	2623.56***	3.8875***
	Prob.	0.8155	0.2243	0.6707	0.0183	0.0000	0.0001
SETI	Coefficient	0.0001	-0.0001	9.0E-08	-0.0843	1.0652	1.3007
	z-statistic	0.3701	-0.3248	0.1614	-3.0909***	2519.30***	3.6052***
	Prob.	0.7113	0.7453	0.8718	0.0020	0.0000	0.0003
VN 30	Coefficient	0.0003	0.0009	-2.5E-07	-0.0619	1.0623	1.2347
	z-statistic	0.7877	2.4833**	-0.3636	-2.3136**	2798.39***	3.5557***
	Prob.	0.4309	0.0130	0.7161	0.0207	0.0000	0.0004
LSX	Coefficient	4.8E-05	0.0004	1.4E-07	-0.0905	1.0673	1.4047
	z-statistic	0.1277	0.8659	0.2550	-3.9202***	2778.23***	3.6535***
	Prob.	0.8984	0.3866	0.7987	0.0001	0.0000	0.0003
Nikkei	Coefficient	0.0001	0.0002	-1.3E-07	-0.0683	1.0677	1.2922
	z-statistic	0.3747	0.7419	-0.2135	-2.6399***	2777.01***	3.6756***
	Prob.	0.7079	0.4582	0.8309	0.0083	0.0000	0.0002
Kospi	Coefficient	0.0001	0.0005	-2.2E-07	-0.0661	1.0793	1.3045
	z-statistic	0.3344	2.5115**	-0.9255	-12.5550***	4709.83***	4.0338***

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	Prob.	0.7381	0.0120	0.3547	0.0000	0.0000	0.0001
SSEC	Coefficient	6.1E-05	-0.0003	2.0E-07	-0.1091	1.0821	1.3174
	z-statistic	0.1766	-1.1248	1.4267	-287.72***	5729.48***	4.0538***
	Prob.	0.8598	0.2607	0.1537	0.0000	0.0000	0.0001

*** Significant at 1% level
** Significant at 5% level
* Significant at 10% level

Table 10 shows the analysis of the effect of stock market volatility on the US Dollar Index using the GARCH (1,1) test for the whole period. Over the period, each variable follows the GARCH pattern. JKSE, STI, SETI, and Nikkei have a negative influence on the US Dollar Index at the 5% significance level. Meanwhile, SSEC negatively influences the US Dollar Index at the 1% significance level.

Table 10
The Impact of Stock Market Volatility on the US Dollar Index in All Periods

All Period							
Independent Variable		Mean Equation		Variance Equation			GED Parameter
		C	Independent Variable (Volatility)	C	Resid	GARCH	
JKSE	Coefficient	0.0003	-0.0004	3.2E-07	0.0349	0.9531	1.2605
	z-statistic	1.7720*	-2.1037**	1.2206	1.8670*	40.0477***	12.6753***
	Prob.	0.0764	0.0354	0.2222	0.0619	0.0000	0.0000
KLSE	Coefficient	0.0003	-0.0003	3.2E-07	0.0329	0.9550	1.2651
	z-statistic	1.7024*	-1.4980	1.2747	1.8462*	41.6955***	12.9655***
	Prob.	0.0887	0.1341	0.2024	0.0649	0.0000	0.0000
PSEi	Coefficient	0.0003	0.0002	3.4E-07	0.0343	0.9528	1.2383
	z-statistic	1.7836*	0.9308	1.3029	1.8781*	40.4917***	13.0767***
	Prob.	0.0745	0.3520	0.1926	0.0604	0.0000	0.0000
STI	Coefficient	0.0003	-0.0004	3.2E-07	0.0350	0.9528	1.2793
	z-statistic	1.7340*	-2.3767**	1.1889	1.8632*	39.3139***	12.6698***
	Prob.	0.0829	0.0175	0.2345	0.0624	0.0000	0.0000
SETI	Coefficient	0.0003	-0.0003	3.6E-07	0.0348	0.9514	1.2715
	z-statistic	1.7505***	-2.1154**	1.3070	1.8443*	38.6474***	12.8137***
	Prob.	0.0800	0.0344	0.1912	0.0651	0.0000	0.0000
VN 30	Coefficient	0.0003	0.0002	3.3E-07	0.0326	0.9552	1.2228
	z-statistic	2.0069**	1.3261	1.2841	1.8322*	41.6924***	13.0694***
	Prob.	0.0448	0.1848	0.1991	0.0669	0.0000	0.0000
LSX	Coefficient	0.0003	0.0003	3.7E-07	0.0344	0.9520	1.2237
	z-statistic	1.6936*	1.5998	1.3058	1.8207*	39.1596***	12.8991***
	Prob.	0.0903	0.1096	0.1916	0.0687	0.0000	0.0000
Nikkei	Coefficient	0.0003	-0.0004	2.9E-07	0.0324	0.9564	1.2702
	z-statistic	1.8296*	-2.4630**	1.1967	1.8359*	41.8374***	13.1625***
	Prob.	0.0673	0.0138	0.2314	0.0664	0.0000	0.0000
Kospi	Coefficient	0.0003	-0.0004	3.0E-07	0.0312	0.9574	1.2807

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	z-statistic	1.6039	-2.3922**	1.2252	1.8134***	42.7265***	13.2075***
	Prob.	0.1087	0.0167	0.2205	0.0698	0.0000	0.0000
	Coefficient	0.0003	-0.0005	3.3E-07	0.0352	0.9521	1.2928
SSEC	z-statistic	1.7864*	-2.9242***	1.2275	1.8785*	38.9251***	13.0435***
	Prob.	0.0740	0.0035	0.2196	0.0603	0.0000	0.0000

*** Significant at 1% level
** Significant at 5% level
* Significant at 10% level

Discussion

The GARCH model is a volatility analysis technique that is an advanced form of development of the ARCH model. GARCH is more favorable than ARCH because it uses fewer parameters and performs better (Mofema & Mah, 2021). Based on the results of data testing using the GARCH model, stock volatility had no influence on gold prices before the Russian-Ukrainian war. In addition, the Russia-Ukraine war period shows that the volatility of PSEi, STI, and KOSPI positively influences gold prices. During the whole period, PSEi volatility also positively affected gold prices. This is in line with the research of (Yamaka & Maneejuk, 2020), which suggests that stock price volatility positively impacts gold prices.

Gold is considered a safe asset to allocate funds as a precious metal with consumption value (Wang et al., 2024). If volatility increases, market uncertainty also increases, which will encourage investors to divert their funds to gold commodities, ultimately leading to an increase in gold prices. In the Hamas-Israel conflict period, the test results show that KLSE volatility has a negative impact on stock prices. The test results are supported by the research (Mensi et al., 2022), which says there is a negative correlation between stock market volatility and gold.

The study also revealed the influence of stock market volatility on the US Dollar Index. The analysis shows that the volatility of the VN 30 and Kospi positively influences the US Dollar Index. In other words, it can be concluded that the US Dollar Index increases when volatility increases. This research is supported by Mensi et al. (2023) dan Lian et al. (2022) which suggest that stock market volatility is positively correlated with the US Dollar Index. So, it can be said that an increase in stock market uncertainty will strengthen the value of the US Dollar against other major currencies. Then, in the period before the Russia-Ukraine war, during the Russia-Ukraine war, and the whole period, the volatility of the JKSE, KLSE, STI, SETI, Nikkei, Kospi, and SSEC had a negative impact on the US Dollar Index.

This indicates that when the volatility of the relevant stock markets increases, it will decrease the value of the US Dollar Index. Increased uncertainty due to volatility will encourage investors to reduce risky assets such as the US Dollar. Supporting this, Ma et al. (2020) mentioned that the US Dollar is not a haven for the Chinese stock market as it is subject to extreme risk spillover from the global financial crisis. Yun et al. (2023) stated that if the interest in the US Dollar decreases, it will cause a decrease in the value of the US Dollar Index and vice versa.

4. CONCLUSIONS AND SUGGESTIONS

This study was conducted to determine the impact of stock market volatility on gold prices and the US Dollar Index. The GARCH test results show that several volatility variables influence gold prices and the US Dollar Index. PSEi volatility is proven to positively affect gold prices during

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the Russia-Ukraine war and the entire period. In addition, the STI and Kospi variables positively affect gold prices in the Russia-Ukraine war period. In the US Dollar Index, the volatility of VN 30 and Kospi positively impacted the Hamas-Israel conflict period.

Both stock prices and the US Dollar Index can be used as a hedging tool or investment alternative when the stock market experiences increased volatility. Gold is often considered stable and appealing as a store of value asset in the global economy. On the other hand, the US Dollar plays a significant role as the world's primary reserve currency and has gained global trust. These findings can be a guide in making investment decisions to reduce the risks that may arise. But of course, it is necessary to do an in-depth analysis before deciding to invest.

Future study can be conducted by extending the period as this research only extends to the ongoing Hamas-Israel conflict. In addition, the research can also be expanded by adding a period that includes future issues. To maximize the test results obtained, conducting tests using more sophisticated and complex analysis methods.

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