

INFLATION, GOLD PRICES, AND INTEREST RATES: A MULTIVARIATE ARCH ANALYSIS OF WORLD OIL PRICE VOLATILITY

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Abstract

Fluctuation price world oil is issue important in global economy because influence inflation, investment, activity production, and financial market stability. Research This aim analyze influence inflation, prices gold, and tribes flower to volatility price world oil uses approach *Multivariate Autoregressive Conditional Heteroskedasticity* (M-ARCH). The data used in the form of monthly data period January 1990 to December 2025 obtained from the World Bank, *Federal Reserve Economic Data* (FRED), and Eco3M. Analysis done through statistics descriptive, Augmented Dickey-Fuller (ADF) test, ARCH-LM test, and M-ARCH model estimation. Research results show that inflation and interest rates flower influential significant to volatility price world oil, while price gold No influential significant. Besides that is, the ARCH(1) coefficient is significant show existence persistence volatility, which means volatility price oil moment This affected by shocks in the period previously Findings This confirm that stability macroeconomics own role important in guard stability of the global energy market as well as reduce uncertainty in the world oil market.

Keywords : Volatility price oil ; inflation ; gold prices ; interest rates flower ; M-ARCH

INTRODUCTION

Oil raw is one of the commodities strategic which becomes bone back global economy because play a role as source energy main for sector transportation, industry manufacturing, petrochemicals, and trading international (International Energy Agency, 2024). Until moment this, oil earth Still donate around one third consumption world's primary energy so that its existence still become factor important in support activity global economy (International Energy Agency, 2025). High dependence to oil cause change price oil can influence cost production, level inflation, investment and growth economy a country (Hamilton, 2009). Besides that, fluctuation price oil also has an impact to financial market and trade stability international through mechanism transmission risks and changes expectation global market players (Xu *et al.*, 2024).

In a number of year Lastly, the world oil market is facing various challenges that increase uncertainty and volatility price. Recovery economy post- COVID-19 pandemic pushes improvement request global energy, while conflict geopolitics and disruption supply energy cause pressure on the side supply (World Bank, 2025). On the other hand, the policy production of OPEC member countries also influence world oil market balance through adjustment level production For guard stability price (International Energy Agency, 2024). In addition that, transition going to more energy friendly environment start change pattern consumption global energy, although oil earth Still become source energy dominant in term short until medium (International Energy Agency, 2024). Conditions the cause price world oil moves in a way dynamic and difficult predicted so that increase energy market uncertainty as well as risk to stability global economy (He *et al.*, 2024; Tlili *et al.*, 2024). Increasing

energy market uncertainty is also reflected from the more strong transmission volatility between commodity markets and global financial markets during period crisis and post-crisis (Guan *et al.*, 2024). Fluctuation price world oil shows that the global energy market is very sensitive to change condition economics, politics and finance international. According to Baumeister and Kilian (2016), changes market expectations, disruption supply energy, as well as uncertainty economy is factor main influencing factors volatility price oil. For describe phenomenon mentioned, Figure 1 presents development price world Brent oil during period 1990–2025.



Source : World Bank, 2025

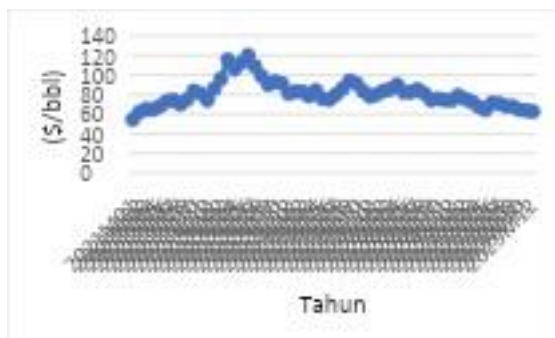
Figure 1

Oil Price Development (Brent) 1990-2025

Based on Figure 1, the price Brent oil shows quite a fluctuation tall during period 1990–2025. Increase significant price occurred in the period 2000–2008 along with increasing request global energy, whereas decline sharp happened at the time crisis global finance in 2008, excess supply oil in the 2014–2016 period, and the COVID-19 pandemic in 2020 (Hamilton, 2009). After pandemic subside, prices oil return increase consequence recovery activity global economy and increasing uncertainty geopolitics that influence world energy market expectations (Maitra, 2023; Mignon & Saadaoui, 2023). Condition the show that price world oil has

characteristics high volatility and sensitivity to various shock economy and non- economic (Baumeister & Kilian, 2016).

Although Figure 1 shows trend price world oil in term length , development price oil in the period latest need observed in a way more details Because reflect current global energy market conditions this. The period 2021–2025 becomes phase important marked by recovery economy post-pandemic, conflict geopolitics that influence supply global energy, as well as change policy monetary policy in various countries (Baumeister, 2023; Mignon & Saadaoui , 2023). Therefore that, Figure 2 presents development price Brent oil in general monthly during January 2021 to December 2025.



Source : World Bank, 2025

Figure 2

Oil Price Development (Brent) Month January 2021-December 2025

Based on Figure 2, the price Brent oil experienced quite an improvement sharp throughout 2021 to reach peak in 2022 before return experience decline in a way gradually until end 2025. Fluctuations the reflect market response to recovery post-pandemic global economy, uncertainty geopolitics, as well as change policy monetary influences supply and demand world energy. The findings in Figure 1 and Figure 2 show that volatility price world oil is still become relevant issues For reviewed. A number of study show that volatility price oil influenced by factors global supply and demand, energy market uncertainty (Baumeister & Kilian,

2016), and various form uncertainty economics and policies that influence dynamics of global energy markets (He *et al.* , 2024). Understanding about factors the required For support taking decision investment , management risk and formulation policy more energy adaptive to change global conditions (Ponomareva *et al.* , 2024).

Although volatility price world oil has become attention main in various research, factors that influence volatility the Still become debate in literature empirical . Debate the appear Because connection intervariable macroeconomics and commodity markets tend changed follow condition economics, geopolitics, and regime varying volatility (Wang *et al.*, 2024). Various studies show that variables macroeconomics like inflation, prices gold, and tribes flower own relatedness with dynamics price oil, however results obtained Still Not yet consistent (H. Zhang *et al.* , 2024). Some study find existence significant influence, whereas study other show weak relationship or even No significant Because influence factor macroeconomics to the oil market tend changed according to market conditions and resources the shock that occurred (Musa, 2023). The difference findings the show that mechanism influence variables macroeconomics to volatility price world oil is still need study more further , especially in face change condition the increasingly global economy complex (Albrizio *et al.* , 2024).

Volatility price oil is indicator important that reflects level uncertainty in the global energy market (Engle, 1982). In energy market literature, volatility is also used as indicator risks that can occur influence investor behavior, hedging strategies value, and efficiency of commodity markets (Guan *et al.* , 2024). According to theory supply and demand movement price oil affected by changes balance between supply and demand world energy (Hamilton, 2009). However, developments in global financial markets indicate that volatility

price oil No only influenced by fundamental energy factors, but also by various factor macroeconomics and finance that influence market expectations as well as decision investment in commodity markets (Tang & Xiong , 2010).

In context said, inflation, price gold, and tribes flower is frequent variables associated with dynamics price world oil Besides that, inflation and interest rates flowers are also indicator macroeconomics used For reflect conditions and risks economy Because can influence activity investment, consumption, and expectation market players towards condition future economic conditions(Idialis & Anggraini , 2025). Inflation can influence cost production and market expectations so that contribute to change price as well as volatility commodities energy (Batten *et al.* , 2024; Gagliardone & Gertler, 2023). In addition that, pressure rising inflation can change perception risk market players so that strengthen transmission volatility in energy and commodity markets strategic others (Cevik *et al.* , 2025). Gold prices often used as asset protected values (safe haven) and indicators uncertainty global economy so that its movement often associated with commodity market dynamics, including oil (Foroutan & Lahmir, 2024). The relationship between gold and oil tend the more strong in the period crisis because investors make gold as instrument protection to uncertainty economic and commodity market volatility (Wang *et al.* , 2024). Meanwhile, that, tribe flower influence cost financing, cash flow investment and activities the economy that ultimately impact on demand global energy (Narayan, 2022). Uncertainty related policy ethnic group interest is also proven capable increase volatility price oil through change market expectations regarding condition global economy and liquidity (Qadan & Cohen, 2024).

Various study previously show that inflation own relatedness with

movement price and volatility oil (Cevik *et al.*, 2025). Relationship between price gold and price oil was also found the more strong in the period uncertainty economy and global crisis (Alzate-ortega *et al.*,2024; He *et al.*,2024). Besides that, change ethnic group interest and uncertainty policy monetary proven influence commodity market volatility energy (Ayoub & Qadan , 2024; Qadan & Cohen, 2024). Although Thus the results study previously Still show diverse findings and some big use VAR, ARDL, GARCH, spillover analysis, and connectedness analysis approaches (Foroutan & Lahmiri, 2024). Most of them study latest more focus on analysis spillover and connectedness between markets, while studies that are special estimate volatility together a number of variables macroeconomics use approach multivariate Still relatively limited (Singh, 2025). In addition that, research that tests in a way simultaneous influence inflation, prices gold, and tribes flower to volatility price world oil is still relatively limited, especially with use Multivariate Autoregressive Conditional Heteroskedasticity (M-ARCH) approach

Based on condition said, research This offer contribution with applying the M-ARCH model to analyze influence inflation, prices gold, and tribes flower to volatility price world oil uses monthly data period January 1990 to December 2025. Period long observation allows study This catch various incident important factors that influence the global energy market, such as crisis global finance 2008, decline price oil the 2014–2016 period, the COVID-19 pandemic, and energy market dynamics post-pandemic. With Thus, research This expected can give proof more empirical comprehensive about factors macroeconomics that influence volatility price world oil at once enrich literature regarding energy markets and volatility global commodities .

METHODOLOGY

Research Design

Study This use approach quantitative with utilizing series data time For study influence inflation, prices gold, and tribes flower to volatility price global oil analysis This using the Multivariate Autoregressive Conditional Heteroskedasticity (M-ARCH) model, which is capable of catch changing volatility along time and heteroscedasticity conditions that are generally observed in financial and commodity markets (Fülle *et al.* , 2024; Kim & Bera , 2023). Monthly data covering period January 1990 to December 2025 used For give understanding comprehensive about volatility price oil below various condition global economy .

Data and Variables

Study This using secondary data monthly income earned from a recognized database in a way international. Inflation data represented by the US Consumer Price Index (CPI) obtained from Eco3M. Gold price measured using Gold Price (USD per troy ounce) from Eco3M. flower represented by the Federal Funds Interest Rate (FEDFUNDS) earned from the Federal Reserve Economic Data (FRED). Global oil prices are represented by the price oil Brent crude (US\$/ barrel) obtained from World Bank Commodity Markets Outlook Historical Data.

Table 1

Definition Operational Variables

Variable	Symbol	Type	Measurement
Brent Oil Price	OIL	Dependent	US\$/barrel
Gold Price	GOLD	Independent	USD/Troy Ounce
Inflation	INF	Independent	Percentage (%)
Interest Rate	FED	Independent	Percentage (%)

Before the estimation process, all variables changed to form difference First If required For reach stationarity and avoidance results misleading regression .

Model Specifications

For analyze influence inflation, prices gold, and tribes flower to price world oil the following average equation This estimated :

$$\Delta OIL_t = \beta_0 + \beta_1 \Delta GOLD_t + \beta_2 \Delta INF_t + \beta_3 \Delta FED_t + \varepsilon_t(1)$$

where ΔOIL_t show change price oil, $\Delta GOLD_t$ represent change price gol, ΔINF_t show change inflation, ΔFED_t represent change ethnic group interest β_0 is constants (intercepts), β_1, β_2 , and β_3 is coefficient regression, while ε_t is an error term .

For catch dynamics volatility, equation variance conditional variance equation is formulated as following :

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \delta_1 \Delta GOLD_t + \delta_2 \Delta INF_t + \delta_3 \Delta FED_t(2)$$

Where h_t show variance conditional variance, α_0 is constant variance, α_1 represent ARCH coefficient, ε_{t-1}^2 is the squared residual in the period previously, while δ_1, δ_2 , and δ_3 measure influence price gold, inflation, and interest rates flower to volatility price oil in a way in a ro.

Data Analysis Techniques

Data analysis was performed use device Stata 17 software via a number of stages. First analysis statistics descriptive used For describe characteristics variables study through average (*mean*), minimum, maximum and standard values deviation . Second the Augmented Dickey-Fuller (ADF) test was conducted to test data stationarity. Variables that have not been stationary at the transformed level level to in form *first difference* until fulfil condition stationary.

Thir, it is done estimate mean equation using method Ordinary Least Squares (OLS) regression. Fourth, the ARCH-LM test was conducted to identify

existence ARCH effect on model residuals. If found ARCH effect, then analysis to be continued with Multivariate Autoregressive Conditional Heteroskedasticity (MARCH) model estimation .

Stage final is testing hypothesis For evaluate influence inflation , prices gold and tribes flower to volatility price world oil . Testing significance statistics done at the level significance by 5 percent ($\alpha = 0.05$).

RESULTS AND DISCUSSION

Results

Table 2. Statistical Results Descriptive Variables Study

Variable	Obs	Mean	Std. dev.	Min	Max
doil	431	.2544181	9.315297	-51.14319	43.26332
dgold	431	.5457282	3.495566	-12.47978	16.01439
dinf	431	.2182328	.2678493	-1.786423	1.367474
dfed	431	-.010464	.1818747	-.96	.7

Based on Table 2, all variables study own amount observation as many as 431 data after transformed to in form *first difference* . Variable change price world oil (Δ OIL) has mark standard deviation highest compared to variables others , which shows that the world oil market is experiencing more fluctuations big compared to price gold inflation, and interest rates flower during period observation. Sufficient range wide between minimum and maximum values of a variable change price oil the more confirm existence high volatility in the world oil market.

Temporary that, variable inflation (Δ INF) and interest rates interest (Δ FED) has mark standard relative deviation more low, which indicates more movement stable throughout period research. Findings beginning This show that price world oil has dynamics more volatility strong compared to variables others, so that support use of the Multivariate Autoregressive Conditional Heteroskedasticity (M-ARCH) model in study This.

Stationary Test

Table 3. Augmented Dickey-Fuller

(ADF) Test Results

Variables	ADF Value	Critical 5%	Probability	Information
DOIL	-15,584	-2,873	0.0000	Stationary
DGO LD	-17,415	-2,873	0.0000	Stationary
DINF	-12,513	-2,873	0.0000	Stationary
DFED	-9,733	-2,873	0.0000	Stationary

The ADF test results show that all over variables study has stationary at level *first difference*. The ADF statistical value of each variable more small than mark critical at the level significance of 5 percent, while all over mark probability is below 0.05. With Thus, the hypothesis zero which states existence unit root can rejected. This result confirm that all over variables has fulfil assumptions stationarity and feasibility used For sequential data analysis time (*time series*) at the stage furthermore.

Estimate Mean Equation

Table 4. Estimates Mean Equation

Variables	Coefficient	Std. Error	t-Statistic	Prob.
DOIL	0.119	0.110	1.09	0.278
DGOLD	17,000	1,464	11.61	0.000***
DINF	7,290	2,128	3.42	0.001***
DFED	-3,444	0.495	-6.95	0.000***

Note : *** significant at $\alpha = 1\%$.

Model Statistics

Variables	Coefficient
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Amount Observation	431
F- statistic	60.39
Prob>F	0.0000
R ²	0.2979
Adjusted R ²	0.2930
Root MSE	7,8329

Estimation results show that inflation and interest rates flower influential significant to change price world oil , indicated by value probability both of them are more small of 0.05. On the other hand, the price gold No influential significant to movement price world oil because own mark greater probability big from level 5 percent significance. Besides that, value coefficient determination (R²) shows that around 29.79 percent variation change price world oil can explained by the variables independent entered to in the model. While that is, around 70.21 percent the rest influenced by other factors outside the research model that are not observed in analysis This.

ARCH-LM Test

Table 5. Augmented Dickey-Fuller (ADF) Test Results

LM test for autoregressive conditional heteroskedasticity (ARCH)

>		
lags(p)	chi2	
df		
>		Prob > chi2
>		
1	19.614	
1		
>		0.0000
>		
H0: no ARCH effects		vs. H
> 1: ARCH(p) disturbance		

The ARCH-LM test results showed mark greater probability small of 0.05, which indicates existence ARCH effect on model residuals. Findings This confirm existence heteroscedasticity conditional heteroskedasticity in the

data . Therefore Therefore, the use of the Multivariate Autoregressive Conditional Heteroskedasticity (M-ARCH) model was assessed. precise and relevant For estimate volatility price world oil .

M-ARCH Model Estimation Results

Table 6. M-ARCH Model Estimation Results

Variable s	Corfficient	Std. Error	z-Statistic s	Prob.
Equation (DOIL)				
Constant	0.888	0.398	2.23	0.026**
Equality Variance (HET)				
DGOLD	0.009	0.027	0.33	0.745
DINF	-0.990	0.394	-2.51	0.012**
DFED	-0.959	0.394	-2.43	0.015**
Constant	4,070	0.111	36.78	0.000***
ARCH(1)	0.389	0.086	4.51	0.000***

Information :

*** significant at $\alpha = 1\%$

** significant at $\alpha = 5\%$

Model Statistics

Variables	Corfficient
Period Observation	1990M1 – 2025M12
Amount Observation	431
Log Likelihood	-1525,591

estimation results of the M-ARCH model show that inflation and interest rates flower influential significant to volatility price world oil, while price gold No show significant influence in a way

statistics. findings This indicates that factors macroeconomics certain, especially inflation and interest rates flowers, have role important in explain change volatility in the world oil market .

Besides that is, the ARCH (1) coefficient has a value positive and significant, which indicates that volatility price world oil in the period moment This influenced by shocks that occur during *the* period previously . The results confirm existence characteristics volatility of a nature persistent, where the period with volatility tall tend followed by a period volatility high at the time next .

Testing Hypothesis

Testing hypothesis done based on results M-ARCH model estimation with level significance by 5 percent ($\alpha = 0.05$). Summary results testing hypothesis can seen in table 4.6 below.

Table 7 Summary of Test Results Hypothesis

Hypothesis	Statement Hypothesis	Results
H1	Inflation influential significant to volatility price world oil	Accepted
H2	Gold price influential significant to volatility price world oil	Rejected
H3	Ethnic group flower influential significant to volatility price world oil	Accepted
H4	Inflation , prices gold , and tribes flower in a	Accepted

	way simultaneous influential to volatility price world oil	
H5	World oil prices experienced high volatility during period study	Accepted

Based on results testing, hypothesis First accepted Because variables inflation own mark probability by 0.012 which is more small of 0.05. The results show that inflation influential significant to volatility price world oil .

Hypothesis second rejected Because variables price gold own mark probability by 0.745 which is more big from 0.05. With Thus, the price gold No influential significant to volatility price world oil during period study .

Hypothesis third accepted Because variables ethnic group flower own mark probability by 0.015 which is more small of 0.05. This result show that change ethnic group Federal Funds Rate interest rate has an effect significant to volatility price world oil .

Hypothesis fourth accepted based on simultaneous test results on the mean equation showing Prob value > F is 0.0000 and is accepted Because results estimate show that variables macroeconomics used in the capable model explain change volatility price world oil in general overall. Meanwhile that, hypothesis the fifth is also accepted Because results estimate show existence significant ARCH effect, which is indicated by the ARCH (1) coefficient of 0.3884 with mark probability 0.000. Findings the indicates that price world oil is experiencing real volatility during period study .

Discussions

Influence Inflation to Global Oil Price Volatility

Estimation results show that inflation influential significant to volatility price world oil. Discovery This indicates that change level price in a way general contribute to improvement uncertainty in the global energy market (Cevik *et al.*, 2025). Increase inflation can increase cost production and distribution so that push adjustment prices on various commodities strategic, including oil earth (Le *et al.*, 2024). The relationship This is also reflected in the existence of integration volatility between global inflation and prices oil raw which shows that change condition price can influence energy market dynamics international (Vijayakumar & Karthikeyan, 2024). Findings This in line with research that shows that dynamics price global oil prices are affected by shocks macroeconomics and transmission policy monetary work through request aggregate, value exchange, and global market conditions that are mutually integrated (Miyamoto *et al.*, 2024). In a way theoretical, relationship between inflation and volatility price oil can explained through mechanism transmission costs and market expectations. When inflation increased company face increase production input costs that ultimately push adjustment prices in various sector economy, including sector energy (Anderl & Caporale, 2023). Changes level inflation can also influence expectation market players towards prospects growth economy so that impact on decisions investment and trade commodities energy (He *et al.*, 2024). In addition that, increasing uncertainty economy consequence pressure inflation can enlarge market risks and strengthen fluctuations price world oil (Ayoub & Qadan, 2024). Conditions the show that inflation No only reflect stability macroeconomics, but also plays a role in form level uncertainty in the global energy market (Ponomareva *et al.*, 2024). Research result This in line with various studies empirical findings that variables macroeconomics own role important in explain energy market

dynamics. Pressure inflation proven own ability predictive to change price oil real through change condition monetary and expectations economy (Cevik *et al.*, 2025). Uncertainty an improving economy can also enlarge volatility of global commodity markets and its impact stability price energy (Fu *et al.*, 2024). Findings similar acquired by Gunwant *et al.* (2024) shows that shock macroeconomics contribute to improvement energy market volatility. In addition that, indicator macroeconomics like inflation proven be one of relevant factors in explain variation volatility price oil in term length (Le *et al.*, 2024).

Although Thus, the relationship between inflation and volatility price oil No always nature constant at every period observation. Strength connection the can changed follow condition global economy, change regime policies, as well as characteristics the crisis that occurred (Wang *et al.*, 2024). Uncertainty related policy ethnic group flowers can also influence response price oil to change condition economy through change perception market risks and expectations (Qadan & Cohen, 2024). In addition that, the shock finance No always transmitted in a way symmetrical to the oil market so that produce response different volatility in each period (Singh, 2025). Factors structural like limitations storage and changes balance supply-demand can also be strengthen uncertainty price oil in the global market (Oglend & Kleppe, 2025).

In a way overall, results study This confirm that inflation is one of the determinant important volatility price world oil. Discovery the show that stability price own role strategic in guard energy market stability and reducing risk fluctuations price excessive commodities (Aladwani, 2024). The relationship between condition global macroeconomics and commodity markets also show that management inflation need considered as part from effort guard stability sector energy (Boakye *et al.*, 2024). Besides

that, the increase uncertainty economy can enlarge risk volatility price oil so that need response adaptive and credible policies (Ponomareva *et al.*, 2024). Therefore that, control inflation and management market expectations become aspect important in reduce uncertainty that can trigger improvement volatility price world oil (Ayoub & Qadan, 2024).

The Influence of Gold Prices to Global Oil Price Volatility

Research result show that price gold No influential significant to volatility price world oil. Discovery This indicates that movement price gold No always capable explain change volatility that occurs in the global oil market. Although both of them is traded commodities in a way international, the fundamental characteristics that underlie formation price gold and oil tend different (Foroutan & Lahmiri, 2024). Oil prices more Lots affected by changes supply and demand energy, condition geopolitics, as well as policy production of producing countries oil (Alzate-ortega *et al.*, 2024). On the contrary, price gold generally move follow perception risk and uncertainty global economy that influences investor preferences towards asset protected value (Feder - Sempach *et al.*, 2024).

In a way theoretical, gold often viewed as safe haven assets that investors use to protect mark riches when happen turmoil economics and finance. In condition high uncertainty, investors tend to divert his portfolio to gold so that request to metal glorious the increased (Feder - Sempach *et al.*, 2024). However, the increase request gold No always followed by a directional change in the oil market Because second commodities the own different market determinants (Sahoo, 2024). The relationship between gold and oil are also dynamic as well as can changed follow phase cycle current global economic and market conditions ongoing (Wang *et al.*, 2024). Therefore that, the relationship between second commodities the No always Enough

strong For produce significant influence to volatility price world oil.

Research result This in line with various studies empirical evidence that shows that connection between price gold and price oil No always nature permanent. Foroutan and Lahmiri (2024) found that pattern relatedness between oil raw and metal glorious changed according to market conditions and approach analysis used Research Alzate -Ortega *et al.* (2024) also showed that spillover volatility between the energy and gold markets tend heterogeneous so that strength the transmission different in each period. Findings similar reported by Zou *et al.* (2024) who found that connection risk between oil and gold time-varying and influenced by changes condition economy and finance. With so, no significance influence price gold in study This can reflect weakness transmission information from the gold market to the oil market during period observation.

Although thus, some study show that connection between gold and oil can strengthened in the period certain, especially when happen crisis economy or turmoil global geopolitics. Wang *et al.* (2024) found that dependence between the gold and oil markets increase during period global crisis compared normal conditions. Research about volatility energy and metal also show that connectedness both markets tend to increase when level uncertainty the global economy is experiencing increase sharp (Cunado *et al.*, 2024). In addition that, study in Barunik *et al.* (2015) found that correlation between gold and oil more Lots appear in term short compared to connection term stable length. Findings the explain Why influence price gold to volatility oil No always consistent in various study empirical.

In a way overall, results study This show that price gold No is determinant main volatility price world oil during period observation. Findings This indicates that oil market volatility more Lots influenced by fundamental factors of the sector energy compared to

movement price metal noble (Alzate-ortega *et al.* , 2024). The role of gold as safe haven assets also cause the response to shock economy different with mechanisms that occur in the oil market (Feder - Sempach *et al.* , 2024). Therefore that, the use of price gold as indicator single For predict volatility price world oil needs done in a way be careful and considerate current market conditions ongoing (Sahoo, 2024).

Influence Interest Rate on Global Oil Price Volatility

Research result show that ethnic group flower influential significant to volatility price world oil. Discovery This indicates that policy monetary own role important in form dynamics of the global energy market. Changes ethnic group flower influence cost funding and decisions investment so that can change activity economy as well as request energy in a way overall (Qadan & Cohen, 2024). When the tribe flower increased, costs loan become more expensive so consumption and investment tend slow down, which in the end pressing request world oil (Ayoub & Qadan, 2024). On the other hand, the decline ethnic group flower can push expansion economy and improve need energy For activity production and consumption. Relationship the show that the oil market No only influenced by fundamental energy factors but also by conditions monetary that forms expectation market players (Akadiri *et al.* , 2025).

In a way theoretical, change ethnic group flower can transmitted to the oil market through various track economy One of the mechanism main is through change expectation to growth economy and demand energy in the future (Kilian & Zhou, 2019). Uncertainty about direction policy monetary can increase market uncertainty so that influence decision investment in commodity markets energy (Qadan & Cohen, 2024). In addition that change ethnic group flower often affects mark swap United States dollar which is major currencies in trading oil international (Chen *et al.* , 2024). Strengthening

dollar consequence increase ethnic group flower can pressing request oil from importing countries Because cost purchase oil become more expensive (Louka & Michail , 2024). With Thus, the policy monetary own impact No direct to movement and volatility price oil through channel mark exchange , investment , and market expectations (Ayoub & Qadan , 2024).

Research result This in line with various studies empirical evidence that shows that uncertainty policy monetary and interest rates flower own close relationship with the oil market. Qadan and Cohen (2024) found that uncertainty ethnic group flower capable predicting returns and volatility price oil in term short . Ayoub and Qadan (2024) showed that ambiguity financial increase volatility oil through change perception investor risk to condition global economy. Akadiri *et al.* (2025) found that various form uncertainty policy economy own connection causal two direction with oil market shocks so that strengthen transmission risk between sector energy and economy. Findings the support results study this is what shows that change ethnic group flower is relevant factors in explain volatility price world oil.

Although Thus, the influence ethnic group flower to price oil No always nature constant throughout time. The size influence can changed in accordance with condition global economy, level inflation, and market expectations regarding central bank policy. In the period high uncertainty, oil market response to change ethnic group flower tend become more strong Because more market players sensitive to related information with prospects economy (Ayoub & Qadan , 2024). On the other hand in conditions relative economy stable influence ethnic group flower to volatility oil can become more limited because the market is bigger Lots influenced by fundamental factors such as production, consumption and conditions geopolitics (Akadiri *et al.* , 2025). Conditions This explain Why connection between ethnic group interest and price oil often shows

different intensities at different times period observation.

In a way overall results study This show that ethnic group flower is one of the variables macroeconomics plays a role important in explain volatility price world oil Changes ethnic group flower No only influence activity economy real but also form Investor expectations and behavior in commodity markets energy (Qadan & Cohen, 2024). Findings This indicates that policy monetary need considered as one of the factor main in analysis volatility of the global energy market. Therefore that understanding about connection between ethnic group interest and price oil become important for maker policy and market players in anticipate change condition global economy.

Dynamics Volatility and Implications Study

Significant ARCH(1) coefficients confirm existence The phenomenon of volatility clustering in the global oil market. This show that period with volatility tall tend followed by a period volatility tall others, while period with volatility low also tends to be followed by low volatility (Engle, 1982) . Findings the indicates that the shock that occurred in the oil market No nature while, but rather can influence behavior volatility in the period next Characteristics persistence volatility This is one of the characteristics main commodity markets vulnerable energy to change condition economics, geopolitics , and global finance (He *et al.* , 2024). Research the latest also shows that volatility price oil own complex patterns and influenced by factors macroeconomics, uncertainty policies , as well as risk geopolitics that can extend impact something shock on the energy market (Le *et al.* , 2024). Findings study this also shows that volatility price oil own characteristic persistent so that information that appears during the period previously Still influence market behavior during the period next. Condition the in line with findings that the energy market No always move going to balance in a way

fast, but rather undergo a gradual adjustment process after happen shock economy and non- economic. Characteristics the show existence persistence volatility that causes impact something shock can endure in term relative time long-term effects on the energy market (Q. Zhang *et al.* , 2024). Research Alzate -Ortega *et al.* (2024) showed that the oil market own connectedness strong volatility with energy and asset markets finance other so that something shock can transmitted to various markets in simultaneously. Similar results were also found by Paientko and Amakude (2024) who showed that spillover volatility between commodity and energy markets cause impact something shock become more persistent compared to that predicted by conventional linear models.

The existence of volatility clustering in research This indicates that use of ordinary linear regression models not enough adequate For analyze behavior volatility price world oil. The ARCH model and its development designed For catch change variance that is not constant from time to time so that more in accordance used in financial and commodity market analysis that has level uncertainty high (Chalissery *et al.* 2022). Le *et al.*'s (2024) research shows that the GARCH-MIDAS approach is capable of explain dynamics volatility oil with more Good through combination factor term short and long term long Besides that Ozkan *et al.* (2024) found that the DCC-GARCH model is effective in catch relatedness volatility between energy markets fossil, energy net, and assets finance main so that give greater understanding comprehensive about transmission risk between markets.

Research novelty This lies in the application of the Multivariate Autoregressive Conditional Heteroskedasticity (M-ARCH) model to analyze in a way simultaneous influence inflation, prices gold and tribes flower to volatility price world oil uses monthly data during period 1990-2025. Different with study previously

generally focus on relationships two variables or use approach univariate research. This integrates a number of determinant macroeconomics to in One framework mutual volatility interact. Approach multivariate allows identification deeper relationship complex between variables economy and volatility price oil so that produce a clearer picture comprehensive about sources energy market uncertainty. Findings this is also in line with development literature the latest that is increasingly emphasize importance approach multivariate in analysis volatility of global energy and commodity markets (Paientko & Amakude, 2024).

In a way implications, results study This show that volatility price world oil does not only influenced by fundamental energy factors, but also by dynamics variables macroeconomic and market uncertainty are interrelated interact. Therefore that, maker policy need consider factor inflation, interest rates interest rates and financial market developments in formulate related policies with stability energy and economy. For investors, the findings This give information that change condition macroeconomics can become indicator important in anticipate risk oil market volatility. From the side academic, research This strengthen proof empirical about relevance of volatility models multivariate in explain the increasingly dynamic global energy market complex and integrated.

CONCLUSION

Study This aim For analyze influence inflation prices gold and tribes flower to volatility price world oil prices using the Multivariate Autoregressive Conditional Heteroskedasticity (M-ARCH) model with monthly data period January 1990 to December 2025. Research results show that inflation and interest rates flower influential significant to volatility price world oil, while price gold No show significant influence. Findings the indicates that

factors macroeconomics, in particular inflation and policy ethnic group flowers, have role important in form global energy market dynamics.

Besides that is, the ARCH(1) coefficient is positive and significant show existence persistence volatility (volatility clustering), which means volatility price oil in the period moment This affected by shocks in the period previously. Condition the confirm that the world oil market has level high uncertainty and sensitivity to change condition global economy as well as policy monetary.

Study This give contribution empirical to literature energy market volatility through use M-ARCH approach to analyze connection simultaneous between variables macroeconomics and volatility price world oil in period observation term long. In terms of implications, results study show importance guard stability inflation and policy credible monetary use reduce uncertainty in global energy markets.

Study furthermore recommended For add other variables such as mark exchange, risk geopolitics, growth economy, and stock market indexes, as well as use approach other volatility such as GARCH, DCC-GARCH, or BEKK-GARCH to be able to give more analysis comprehensive about dynamics volatility price world oil.

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