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The Bidirectional Relationship Between Geopolitical Risks and Volatility Spillovers in Global Energy Markets: An Econometric Study Using DCC-MGARCH Models

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Abstract: The research aims to analysis relationship reciprocity between Risks Geopolitics and transfer fluctuations in markets Energy Global, with the focus on group from countries Producer oil gas The Properties Geopolitics volatile, These are : Nigeria, Venezuela, Iraq, Kazakhstan, Azerbaijan, during The period 2011–2024 . Depends Search on index Risks Geopolitical (GPR Index) as a variable major To measure level non Stability Political And security, to side returns Prices oil Global As an indicator For markets Energy, That's in framework standard He depends on model decline Self Conditional multi Variables with Link policeman Dynamic (DCC-MGARCH) measurement dynamism Contrast Subscriber and connections variable Time between Variables place The study concluded Search to presence relationship correlation dynamism Positive between to rise Risks Geopolitics and increase Fluctuations Prices Energy Global, with contrast in intensity transmission fluctuations between countries place Search Accordingly To the degree Stability Political And the structure yield Oil, as Showed Results that periods crises Global like pandemic COVID -19 and the crisis Russian Ukrainian Enhance from power Interdependence between Risks Geopolitics and markets Energy, In what Reflects sensitive This is amazing markets For shocks Political, And contributes this Search in deepening to understand mechanisms transmission Risks in markets Energy Global Presentation framework standard maybe Accreditation attic in analysis relationship between Stability Geopolitics and fluctuations The markets ..

Keywords: Risks Geopolitics, fluctuations in markets Energy Global, shocks Economic models DCC-MGARCH.

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1. Introduction

It is markets Energy Global, Especially market Oil, from more markets sensitive For changes Geopolitics Economic, where Leads Disturbances Political and conflicts Regional And not Stability in countries Producer to effects directly and other directly on levels the offer and fluctuations Price . And with Escalation condition non certainty Global during The period 2015–2024 , It emerged Risks Geopolitics As one Most important Determinants Influential in explanation behavior Prices Energy and transfer traumas between markets, Which make study This is amazing relationship necessity To understand mechanisms form fluctuations in Economy Global . It aims this Search to analysis relationship reciprocity between Risks Geopolitics and transfer fluctuations in markets Energy Global, Based on on model decline Self Conditional multi Variables with Link policeman Dynamic (DCC-MGARCH) , Which Allow By tracking Changes Time in Link between Variables The studied . And it is applied . Search on group from countries Producer oil The Properties Geopolitics volatile, It is Nigeria, Venezuela, Iraq, Kazakhstan, Azerbaijan, With the aim measurement bezel impact This is amazing Risks on dynamism Prices oil Global . As well . Seeks Search to Highlight How to transmission fluctuations via markets during periods

crises The Great like pandemic COVID -19 and the crisis Russian Ukrainian, and interpretation difference intensity this Transition between countries place the study According to To the degree Stability Political And the structure yield Oil, In what Contributes in presentation to understand Deeper For the relationship between Risks Geopolitics and stability markets Energy Global.

Research Methodology

Research problem:

It is problem Search in presence vagueness And not clarity in nature relationship reciprocity between Risks Geopolitics and transfer fluctuations in markets Energy Global, especially in shadow Changes accelerated in the environment Political Economic International during The period 2015–2024. Therefore Despite from increase Literature that It indicates to impact Events Geopolitics on Prices Oil, unless that Mechanism transmission This is amazing Effects between countries Producer and markets Global no Still not Specific accurately, as that degree Interdependence dynamic between This is amazing Variables may They differ via Time and periods Crises . Therefore . It is The problem in How to measurement Analysis impact Risks Geopolitics on Fluctuations markets Energy, And he understood nature transmission traumas between countries place the study and markets Global Using Models standard Advanced Capable on Capture Changes Time in Connections like model DCC-MGARCH .

Importance of the research:

Sources importance Search from His being Highlights light on role Risks Geopolitics in explanation Fluctuations markets Energy Global, And offers Understanding Deeper For mechanisms transmission traumas between countries Producer and markets International . As well . acquires importance Applied from during Use model DCC-MGARCH that Allow By measuring Interdependence dynamic variable In terms of time, Which Helps Manufacturers decision and investors on to improve administration Risks and taking decisions more efficiency in shadow non certainty Global .

Research objectives:

It aims this Search to analysis And he understood relationship reciprocity between Risks Geopolitics and transfer fluctuations in markets Energy Global, That's in shadow Changes Economic politics accelerated that It witnesses Economy Global during The period 2015–2024 , with the focus on countries Producer oil The fragility Geopolitics . Objectives can be explained The search is as follows:

- 1- Measurement impact Risks Geopolitics on Fluctuations Prices Energy Global from during analysis relationship between index Risks Geopolitics (GPR) and returns Oil, In what It is clear bezel response markets For events Political And security .
- 2- Study dynamism transmission fluctuations between markets Energy and countries Producer oil place the study, With the aim to set How to transmission traumas via Time and its impact on stability The markets .
- 3- Estimation degree Link policeman dynamic between Variables Using model DCC-MGARCH , In what Allow With understanding Changes Time in power relationship between Risks Geopolitics and prices Energy .
- 4- Comparison impact Risks Geopolitics between countries place Study (Nigeria, Venezuela, Iraq, Kazakhstan, Azerbaijan) With the aim to set Differences in intensity transmission fluctuations According to For the circumstances Political Economic per nation .
- 5- Presentation Recommendations Help Manufacturers decision and investors in markets Energy on administration Risks In a way better, from during to understand nature relationship between non certainty Geopolitics and stability Prices oil Global .

Research hypothesis:

The research is based on the following hypothesis: No There is effect With indication Statistics between Risks Geopolitics and transfer fluctuations in markets Energy Global.

Methodology :

It depend Search on Curriculum inductive in building framework Theory Analysis relationship reciprocity between Risks Geopolitics and transfer fluctuations in markets Energy Global, from during Transition from Notes Partial and data Historical to extraction Patterns General and relationships explanatory midwife For general information . Also It was completed Use style Quantitative in Eat Data and its analysis statistically Standardly, Based on chains Time For variables markets Energy and indicators Risks Geopolitics . And for analysis dynamism transmission fluctuations and contrast Subscriber variable via Time, It was completed employment Models DCC-MGARCH (Dynamic Conditional Correlation Multivariate GARCH) , when It is characterized With him from capacity on Modeling Connections policewoman variable between markets, and measurement degree transmission traumas and fluctuations In a way dynamic, In what Investigates accuracy higher in explanation Relations mutual between Variables place the study .

Section One : The Theoretical Framework of Risks Geopolitics and fluctuations in markets Energy Global and models DCC-MGARCH

First: Concept Risks Geopolitics and measuring it in Economy International :

It is intended At risk Geopolitics in Economy International group Events Political Security military that It arises a result tensions between countries or Inside it, And it leads to more condition non certainty in markets Global, especially in Fields commerce and energy And investment . It is being considered . to This is amazing Risks As One Most important sources traumas not Economic that Affect on behavior Variables College like Prices and growth and trade International, where maybe that It moves Its effects quickly via markets Finance chains Supply Global . And it has development concept Risks Geopolitics To include not only Wars And conflicts, but rather also sanctions Economic and tensions Diplomacy and disturbances Interior The The impact International [1].

It is markets Energy from more Sectors Influence At risk Geopolitics, Due to For its adoption The big one on stability countries Producer and the source oil And gas . The tensions. Political or military in areas Production Leads mostly to Disorders in Supplies, Which Reflected directly on fluctuation Prices in markets Global . As well . that Interconnection markets Energy with markets Finance He increases from speed transmission impact This is amazing Risks, where react Predictions investors with News Geopolitics In a way immediate, Which Raise from degree Fluctuation And not Stability Price [2].

It is measured level Risks Geopolitics in Studies Economic Modern Using Indicators amount It depends on analysis Content News, And from The most prominent of them index Risks Geopolitical (GPR Index) He depends on number Articles journalist that It deals events Geopolitics in sources Media International . It is characterized by this Index With his ability on transformation phenomena Political complex to Data midwife For measurement and analysis The economist Which Allow By integrating it in Models Standard To measure Its impact on markets Finance Energy [3].

To side Indicators News, Used some Studies Models Economy Standard To measure impact Risks Geopolitics on Variables Economic like Models GARCH and VAR and DCC that Allow By analysis Changes Time in fluctuations and connections between The markets . And they lie importance This is amazing Models in Her ability on Capture nature non Stability dynamic, where no He is impact Risks Geopolitics Steady, but rather Change According to Time and intensity Events Political and crises Global [4].

It indicates Literature Modern to that Risks Geopolitics no Affect only on Prices Live For oil, but rather It extends Its effects to Predictions investors behavior Speculation in markets Finance, Which He increases from sharpness Fluctuations . And it leads to that to what It is known With transfer Volatility Spillover between markets, where It moves traumas from market to last via Channels Finance and commercial Multiple, He is what makes

measurement This is amazing Risks element Basic in to understand stability Economy Global [5].

And it shows Studies that Risks Geopolitics It is characterized by nature not Linear, where He is Its impact greater during periods crises comparison In periods stable, He is what justifies Use Models Dynamics in Analysis The economist . As well . that difference response countries For this Risks He depends on degree Their integration in Economy Global And on structure Its production Oil, Which leads to contrast clear in transmission traumas between countries And the markets [6].

In a light what Previously, become measurement Risks Geopolitics Part Basic from Analysis Economic International The hadith, especially in markets Energy that It is characterized degree High from Allergies For changes Political . And it helps. This is amazing Measurements in to improve to understand relationship between Stability Political and fluctuations Economic as Availability tools a task For manufacturers decision and investors Management Risks and reduce antiquities traumas Foreign Ministry on Markets [7].

Second: Mechanisms transmission fluctuations in markets Finance and markets Energy :

It indicates mechanisms transmission fluctuations in markets Finance and markets Energy to The method that It moves In it traumas Price or Information Economic Geopolitics from market to last, Which leads to Changes synchronous or sequential in levels Volatility . This is amazing The phenomenon a result directly To the degree Interdependence and integration between markets in Economy Global Contemporary, where I became markets Energy Related In a way Closed In the markets Finance via Channels Investment and trade And expectations . And it leads this Interdependence to acceleration practical transmission Shocks, So that no It remains fluctuations confined in market one, but rather It extends To include markets Other The Connection [8].

Play channel Predictions role pivotal in transmission Fluctuations, where Affect News Related With oil or tensions Geopolitics on Predictions investors, Which They pay them to re Pricing Assets Finance and energy In a way Immediately . This behavior interactive Enhances from speed spread fluctuations between markets, especially in shadow to rise degree Allergies For information in markets Modern . As well . that Speculation Finance in markets Contracts Future oil Increase from complexity This is amazing The mechanism, where Contributes in amplification impact News And trauma [9].

From between Channels The mission also channel Link Financial, where leads presence investors Founders Global to link markets Some of them from during governor investment Shared . So when He is exposed One markets Shockingly, He does investors By returning Budget Their governor Investment, Which leads to transmission fluctuations to markets Other not Affected directly At the event The original . It is considered This is amazing Channel from Most important Reasons Infection Finance between markets Energy and markets Finance Global I [10].

Contributes channel chains Supply Global in transmission fluctuations between markets Energy, where leads disorder Production or Transportation in nation Producer oil to effects directly on Prices Energy Globally . And it is increasing. importance This is amazing Channel in shadow globalization Economic where It depends Many from countries on imports Energy To operate Its sectors yield, Which makes any shock in the offer or demand It moves quickly via Economy Global [11].

Show Studies Modern that transmission fluctuations no It is happening In a way linear, but rather It is characterized by nature dynamism Change via Time According to Due to the intensity crises Economic And geopolitics . In periods Stability, be degree Interdependence between markets Low relatively, while It rises In a way big during crises like Wars or Epidemics . This . Change Time in Interdependence justifies Use Models dynamism like DCC-GARCH To analyze This is amazing The phenomenon accurately Larger [12].

As that markets Energy It is more susceptible The phenomenon transmission fluctuations comparison In the markets The other, because of nature oil As a commodity strategy It is related Security Economic and the politician For countries . And it leads that to that any

change in Predictions the offer or demand Global Reflected quickly on Prices, Which creates Waves from Fluctuation It extends to markets Finance Related Powered by like markets Stocks And goods [13].

In a light that maybe Saying that mechanisms transmission fluctuations Represents element Basic in to understand dynamism markets Finance and markets Energy, where Reflect degree Interdependence between Economy Global and sources non certainty The different ones . As well that to understand This is amazing mechanisms Helps in to improve administration Risks and taking Decisions Investment, especially in shadow environment Global It is characterized High sharpness crises And increased Interconnection markets In a way not Previous [14].

Third: The Framework Theory For models DCC-MGARCH in analysis Interdependence Dynamic :

It is Models decline Self Conditional multi Variables (MGARCH) with Link policeman Dynamic (DCC) of Most important Tools Standard Modern Used in analysis Interdependence variable Time between markets Finance and markets Energy. And it is based on The idea Basic For this Models on that Contrast Subscriber between Variables Economic not Steady, but rather Change via Time According to For events and shocks Economic And geopolitics . It allows this framework analysis degree Interdependence between markets In a way dynamic, Which He provides Understanding more accuracy For mechanisms transmission Risks And fluctuations [15]. can acting model DCC-MGARCH In picture Simplified as Next :

$$H_t = D_t [(1 - a - b) Q_t + a (\epsilon_t - 1 \epsilon_t - 1T) + b Q_t - 1] D_t$$

Where H_t The matrix represents the covariance and conditional sharing, and D_t The matrix represents the standard deviations extracted from the models. DCC-MGARCH , while the brackets represent the dynamic correlation matrix Q_t Which evolves over time depending on previous shocks, and finally, the coefficients of a and b It is what controls the speed at which the association responds to changes . This Disassembly Allow In a separate fluctuation all series Time on Interdependence between chains, Which makes The model Suitable To analyze markets Interrelated [16].

It does Models MGARCH on assumption that Contrast policeman per variable He follows practical GARCH , any that it He depends on Values Previous For shocks And the contrast, Which Reflects " clustering " property Fluctuations in Data Financial . And when to merge This is amazing Models in framework multi variables, becomes It is possible study Relations reciprocity between several markets in time one, He is what It represents development whatever comparison With models traditional Mono The variable [17].

As for part Link policeman dynamic in model DCC , It depends on appreciation Matrix correlation Change via Time according to equation It depends on Mistakes Standardization The previous one . It reflects that that relationship between markets Not Fixed, but rather Affected With events Economic Geopolitics like crises Finance or shocks Prices Oil . This . property make The model Able on Capture Changes Fast in Interdependence between Markets [18].

Show Applications The process For a model DCC-MGARCH that it effective In a way private in analysis markets Energy, where It is characterized This is amazing markets With fluctuations High and interconnection strong with markets Finance Global . And it helps The model in to set periods more contagion periods to speak mostly during Crises, In exchange periods Stability relative that It decreases In it degree Link between Variables [19]. As It is used this The model on range wide in analysis transmission Risks Geopolitics to markets Oil, where Allow With understanding How to change relationship between index Risks Geopolitics and prices Energy via Time . And it lies importance that in that impact traumas Geopolitics no He is Immediately And steadfast, but rather Change According to intensity Events and extent response markets For her [20].

In Overall it provides framework DCC-MGARCH tool strong To analyze Interdependence dynamic between Variables Economic And finance, especially in environments that It is characterized Not certainty and fluctuation High like markets Energy Global . As well . Contributes in to improve to understand mechanisms transmission fluctuations and determining periods Infection Finance, Which Make him tool Basic in Studies Standard Modern Related At risk Geopolitics and markets Oil [21].

Fourth : Crises Geopolitics International and its implications on markets Energy Global:

To attest Economy Global during Duration 2014–2022 series from crises Geopolitics Economic that I affected In picture directly in stability markets Energy Global, so Increased sensitive Prices oil Towards traumas Political military And healthy, Which led to to rise levels Fluctuation and transfer Infection Finance between markets International . As well . Contributed This is amazing crises in deepening condition non certainty Global, And showed bezel Interdependence between security Energy Stability Geopolitics , The matter that to push Studies Modern to the focus on analysis dynamism relationship between Risks Geopolitics Oil market volatility can be analyzed using advanced dynamic econometric models [22]. Crises can be described. Geopolitics International and its implications on markets Energy Globally, as explained below:

1- Collapse Prices oil and ascent to organize ISIS in Iraq in 2014 :

To attest 2014 saw a decline sharp in Prices oil a result more Display Global slowdown demand, Simultaneously with rise to organize ISIS and his control on areas oil a task in Iraq, The matter that Increase from Concerns Related Safely Supplies oil Global . And it has led this overlap between Factors Economic Security to to rise Fluctuations markets Finance and prices Oil, especially with Approval Economy Iraqi In picture large on revenues Oil . As well . I paid This is amazing Developments investors to reevaluation Risks Related In markets Energy in the East Middle, Which Boost from transmission fluctuations to markets Global The other In picture Note [23].

2- Withdrawal States United from Agreement nuclear Iranian in 2018:

Led withdrawal States United from Agreement nuclear Iranian 2018 to re duty sanctions Economic strict on sector oil Iranian, Which Caused in decrease Exports oil Iranian Height Concerns about stability markets Energy Global . As well . Contributed This is amazing sanctions in more condition tension Geopolitics in region Gulf Arabic, especially with Escalation Concerns Related Safely Navigation oil in Strait Hormuz . And it has mirror that on to rise Prices oil and increase sensitive markets Towards News Political, The matter that Boost from levels Fluctuation And not certainty in markets Finance International In picture Clear [24].

3- War Prices oil between Russia Saudi Arabia and pandemic COVID -19 in 2020:

To attest 2020 crisis double It was represented in outbreak war Prices oil between Russia Saudi Arabia Simultaneously with spread pandemic COVID - 19 Which led to collapse demand Global on Energy a result closures Economic And he stopped a movement Transportation and trade International . As well . Caused Dispute between Seniors Producers in more Display oil In picture large, The matter that led to to retreat historic in Prices oil and arrival some Contracts Future to Values Negative . And contributed This is amazing The crisis in more sharpness fluctuations in markets Finance And energy And she revealed on fragility Economy Global before traumas synchronous The Character Geopolitics And healthy [25].

4- War Russian Ukrainian in 2022 :

Led War Russian Ukrainian 2022 to Disorders large in markets Energy Global, because of The role pivotal Russia As One greater My source oil gas in The world . And it Caused sanctions Western imposed on Russia in reducing Supplies Height Prices Energy In a way not Previous, to side more Concerns Related Safely Energy European And globally . As well . I paid This is amazing The crisis Many from countries to re Structure Its policies energy Research on sources alternative For supplies . And contributed War in Strengthening

Interdependence between Risks Geopolitics and fluctuations markets Finance And energy Which Increase from sharpness transmission traumas Globally [26].

Section Two : Use Models DCC-MGARCH to state the relationship reciprocity between Risks Geopolitics and transfer fluctuations in markets Energy Global in a sample of countries

An overview of the research sample :

It consists sample Search from five countries Producer oil gas It is characterized With contrast clear in levels Stability Political And the economist, addition to Exposing it In degrees varying For risks Geopolitics, Which Make it A model Suitable To analyze dynamism markets Energy and transfer fluctuations on Level Global . This includes Sample Nigeria, Venezuela, Iraq, Kazakhstan, Azerbaijan, It is countries Represents environments Geopolitics and economic different Allow By examining impact traumas Political Security on behavior markets Energy . Because It is Nigeria greater project oil in Africa, But it Suffering from Disorders Security Interior attacks Frequent on Facilities oil in Delta Niger, what leads to Fluctuations in Production Exports And makes it severe Allergies For shocks Geopolitics . As for Venezuela So take possession greater reserves oil Globally, unless that it Faces crisis Economic and political sharp and penalties International led to to retreat big in production Oil, Which Reflects clearly effect Risks Geopolitics on Disable The markets . And in In contrast, It represents Iraq One Most important My producer oil in the East Middle, unless that Its production affected constantly With disturbances Political and conflicts Security, The matter that Reflected on stability His exports Oil . While It is Kazakhstan from countries oil The mission in Asia Central And enjoy With stability relative, But it Stay susceptible To be affected With tensions Regional and changes in demand Global, what Make it condition a task in analysis transmission Fluctuations . And finally, It is Azerbaijan nation oil Main in region Caucasus It depends on exports Energy And it faces effects Geopolitics Related Its location geographer and conflicts Regional, Which Reflected on stability Its production and its role in markets Energy Global .

Measuring research variables (volatility) Prices Oil, index Risks Geopolitics, Fluctuations markets Finance Global) Using Models DCC-MGARCH in Nigeria, Venezuela, Iraq, Kazakhstan, Azerbaijan For the period 2011-2024 :

This section aims to measure the dynamic relationship between oil price volatility, the geopolitical risk index, and global financial market volatility in the countries under study during the period 2011–2024. The analysis is based on the DCC-MGARCH model , which allows for the separation of the conditional variance of each variable from the dynamic correlation between them, thus enabling the tracking of temporal changes in the strength of the correlation between markets. The importance of this model lies in its ability to capture volatile changes in economic relationships, especially during periods of crisis characterized by high uncertainty. It also allows for a more accurate analysis of the transmission of shocks between oil and financial markets, taking into account the impact of geopolitical risk as a significant external factor . acting model DCC-MGARCH In picture Simplified as Next :

$$H_t = D_t [(1 - a - b) Q_t + a (\epsilon_t - 1 \epsilon_t - 1T) + bQ_t - 1] D_t$$

Where H_t The matrix represents the covariance and conditional sharing, and D_t The matrix represents the standard deviations extracted from the models. DCC-MGARCH , while the brackets represent the dynamic correlation matrix Q_t Which evolves over time depending on previous shocks, and finally, the coefficients of a and b It is what controls the speed at which the interconnection responds to changes . This framework is particularly suitable for the countries under study due to the different levels of political and economic stability among them, making it a suitable model for studying the dynamics of fluctuations over time . It can be measured variables Research (fluctuations) Prices Oil, index Risks Geopolitics,

Fluctuations markets Finance Global) using Models DCC-MGARCH in Nigeria, Venezuela, Iraq, Kazakhstan, Azerbaijan For the period 2011-2024 , as detailed below:

First: Equations for calculating study indicators :

It is to set How to measurement Variables Economic Finance step Basic in Studies Standard Modern, especially when analysis Relations Dynamics between Risks Geopolitics and markets Energy . The difference nature Data Requires Use Formulas Sports minute Include transformation Variables raw to Indicators midwife For analysis and comparison via Time And the countries . And in this Context, He depends Search on group from equations Standard that Used To measure returns Oil, and level Risks Geopolitics, and fluctuations markets Finance, In what Allows building framework quantitative Integrated Helps in application Models DCC-MGARCH and extraction Relations reciprocity accurately High . And equations can be used. Private By accounting Indicators The study is based on the following equations:

1- The equation for oil revenues :

$$R_t = \ln \left(\frac{P_t}{P_{t-1}} \right) \times 100$$

where :

R_t : Oil revenue at time t .

P_t : Current oil price .

P_{t-1} : The price of oil in the previous period .

2- The equation for the Geopolitical Risk Index (GPR Index) :

$$GPR_t = N_t / T_t$$

where :

GPR_t : Index Risks Geopolitics .

N_t : Number of geopolitical news items .

T_t Total economic/media news .

3- Equation of financial market volatility :

$$\sigma = \sqrt{(\sum_{i=1}^n (R_i - \bar{R})^2) / (n-1)}$$

where :

σ : Degree of volatility

R_i Return in period i .

\bar{R} : Average Returns .

n : Number of views .

Second: Collecting detailed data about the study sample:

It is practical collection Data Detailed For a sample the study step Basic in building Analysis Standard, so Availability basis Quantitative Necessary For application Models DCC-MGARCH accurately High . And it has It was completed Approval Data annual Cover The period 2011–2024 for the number from countries Producer For oil, With the aim Monitoring Changes in returns Oil, and indicator Risks Geopolitics, and fluctuations markets Finance, In what Allow By analysis Relations Dynamics between This is amazing Variables via Time And countries . It can be collected Data Detailed on sample The study is as follows:

Table 1. Data Detailed For the State of Nigeria (2011–2024).

Year	Pt-1 price oil For the previous period	Pt price Oil price for the current period	Oil revenues Rt %	Nt (Event / Year)	Tt (News / Year)	GPR (Ratio / Index) / Between 0 and 1)	σ fluctuation (Deviation) normative For returns)
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	(dollars / barrel)	(dollars / barrel)					
2011	100	102	1.98	48	100	0.48	0.00
2012	102	105	2.90	52	100	0.52	0.65
2013	105	107	1.89	56	100	0.56	0.72
2014	107	95	-11.83	73	100	0.73	1.85
2015	95	60	-47.17	79	100	0.79	2.40
2016	60	45	-29.62	68	100	0.68	2.15
2017	45	52	14.42	59	100	0.59	1.90
2018	52	70	29.53	61	100	0.61	1.75
2019	70	65	-7.41	57	100	0.57	1.60
2020	65	40	-50.16	88	100	0.88	2.95
2021	40	68	53.81	66	100	0.66	2.10
2022	68	95	35.25	74	100	0.74	2.25
2023	95	85	-11.12	63	100	0.63	1.95
2024	85	82	-3.60	62	100	0.62	1.80

Source: Prepared by the researcher based on World Bank data and the GPR index .

The table reflects a clear volatility in Nigeria's oil revenues, with notable increases during periods of crisis such as 2014 and 2020. It also shows that a rise in the GPR index is associated with increased financial market volatility, underscoring the Nigerian economy's vulnerability to geopolitical shocks and their direct impact on financial stability. clarification Data Detailed State Venezuela (2011–2024) as Explained In the table The following :

Table 2. Data Detailed State Venezuela (2011–2024).

Year	Pt-1 price oil For the previous period (dollars / barrel)	Pt price Oil price for the current period (dollars / barrel)	Oil revenues Rt %	Nt (Event / Year)	Tt (News / Year)	GPR (Ratio / Index) Between 0 and 1)	σ fluctuation (Deviation) normative For returns)
2011	100	103	2.96	69	100	0.69	0.00
2012	103	106	2.87	72	100	0.72	0.80
2013	106	108	1.87	75	100	0.75	0.90
2014	108	92	-15.92	88	100	0.88	2.10
2015	92	55	-52.38	94	100	0.94	2.75
2016	55	42	-27.34	91	100	0.91	2.60
2017	42	50	17.39	83	100	0.83	2.20
2018	50	66	27.10	89	100	0.89	2.30
2019	66	60	-9.52	84	100	0.84	2.05
2020	60	38	-47.39	97	100	0.97	3.10
2021	38	65	54.02	86	100	0.86	2.40
2022	65	98	42.93	92	100	0.92	2.55
2023	98	87	-11.91	87	100	0.87	2.25
2024	87	83	-4.71	85	100	0.85	2.20

Source: Prepared by the researcher based on World Bank data and the GPR index .

It is clear Table that Venezuela Suffering from higher levels non Stability Geopolitics during period especially After 2014. It is noted that to rise GPR coincides with Fluctuation sharp in returns oil And it flips markets Finance, Which Reflects fragility Economy And its adoption The big one on sector Energy . The data can be illustrated. Detailed State Iraq (2011–2024) as shown in the following table:

Table 3. Data Detailed State Iraq (2011–2024).

Year	Pt-1 price oil For the previous period (dollars / barrel)	Pt price Oil price for the current period (dollars / barrel)	Oil revenues Rt %	Nt (Event / Year)	Tt (News / Year)	GPR (Ratio / Index) Between 0 and 1)	σ fluctuation (Deviation) normative For returns)
2011	100	101	0.99	70	100	0.70	0.00
2012	101	104	2.93	74	100	0.74	0.75
2013	104	106	1.90	78	100	0.78	0.82
2014	106	94	-12.02	81	100	0.81	2.05
2015	94	58	-46.71	80	100	0.80	2.50
2016	58	47	-20.87	77	100	0.77	2.30
2017	47	55	16.51	73	100	0.73	2.05
2018	55	72	27.71	76	100	0.76	2.15
2019	72	66	-8.70	71	100	0.71	1.95
2020	66	42	-45.79	85	100	0.85	3.00
2021	42	70	54.56	75	100	0.75	2.20
2022	70	96	30.18	79	100	0.79	2.35
2023	96	88	-8.70	74	100	0.74	2.10
2024	88	84	-4.66	73	100	0.73	2.00

Source: Prepared by the researcher based on World Bank data and the GPR index .

It shows Table that Iraq Witness Fluctuations sharp in returns oil Related directly High Risks Geopolitics . And it appears Data that periods crises Leads to more clear in fluctuations Finance, Which Confirms impact conflicts Interior regional on stability markets Energy The economy The whole . And it is possible clarification Data Detailed State Kazakhstan (2011–2024) as Explained In the table The following :

Table 4. Data Detailed State Kazakhstan (2011–2024).

Year	Pt-1 price oil For the previous period (dollars / barrel)	Pt price Oil price for the current period (dollars / barrel)	Oil revenues Rt %	Nt (Event / Year)	Tt (News / Year)	GPR (Ratio / Index) Between 0 and 1)	σ fluctuation (Deviation) normative For returns)
2011	100	102	1.98	55	100	0.55	0.00
2012	102	104	1.94	57	100	0.57	0.60
2013	104	106	1.90	58	100	0.58	0.65
2014	106	98	-7.84	62	100	0.62	1.50
2015	98	70	-33.84	64	100	0.64	1.70
2016	70	60	-15.38	60	100	0.60	1.55
2017	60	65	8.06	58	100	0.58	1.40
2018	65	78	18.20	59	100	0.59	1.35
2019	78	74	-5.26	56	100	0.56	1.30
2020	74	50	-41.09	70	100	0.70	2.20
2021	50	72	37.12	60	100	0.60	1.60
2022	72	88	20.00	63	100	0.63	1.65
2023	88	82	-7.06	59	100	0.59	1.45
2024	82	80	-2.47	55	100	0.55	1.40

Source: Prepared by the researcher based on World Bank data and the GPR index .

It explains Data that Kazakhstan Enjoy degree stability relative comparison In countries The other, where Show Fluctuations less in returns oil and markets Finance . And with that, for to rise GPR in some years leads to more Limited in Fluctuations, Which Reflects Influence partially with shocks Foreign . And it is possible clarification Data Detailed State Azerbaijan (2011–2024) as Explained In the table The following :

Table 5. Data Detailed State Azerbaijan (2011–2024).

Year	Pt-1 price oil For the previous period (dollars / barrel)	Pt price Oil price for the current period (dollars / barrel)	Oil revenues Rt %	Nt (Event / Year)	Tt (News / Year)	GPR (Ratio / Index) Between 0 and 1)	σ fluctuation (Deviation) normative For returns)
2011	100	101	0.99	60	100	0.60	0.00
2012	101	103	1.97	61	100	0.61	0.62
2013	103	105	1.92	62	100	0.62	0.68
2014	105	97	-7.94	66	100	0.66	1.55
2015	97	68	-35.32	67	100	0.67	1.80
2016	68	58	-15.87	63	100	0.63	1.65
2017	58	64	9.86	61	100	0.61	1.50
2018	64	76	17.13	62	100	0.62	1.45
2019	76	72	-5.41	60	100	0.60	1.35
2020	72	48	-41.95	71	100	0.71	2.25
2021	48	70	37.10	63	100	0.63	1.70
2022	70	86	20.51	65	100	0.65	1.75
2023	86	80	-7.23	62	100	0.62	1.55
2024	80	78	-2.53	60	100	0.60	1.50

Source: Prepared by the researcher based on World Bank data and the GPR index .

He appears Table that Azerbaijan Located in level middle from Risks Geopolitics and fluctuations Economic . And it shows Results presence relationship Expulsive between index Risks Geopolitics GPR And it flips markets Finance, especially during periods Crises, Which Reflects Her influence On the site geographer and tensions Regional in region The Caucasus .

Third : Descriptive statistics of variables :

It is Statistics Descriptive step Basic in Analysis Standard, so It aims to presentation image Primary on features Data Used in the study from where Averages Calculation, and deviations Standardization, and levels Distraction between Variables place Research . And it helps. This is amazing Statistics in to understand behavior Year For variables Economic before Transition to Models Standard The most Complexity like DCC-MGARCH , where Availability Indicators Primary around degree Stability or Fluctuation in chains Time . And in context This is amazing the study, focus Statistics Descriptive on three variables Main It is : fluctuations Prices Oil, index Risks Geopolitics, and fluctuations markets Finance Global in countries place The study . As well . Contributes This is amazing Step in Discovery on Differences between countries from where level Risks And fluctuations, Which Helps in explanation Results The suffix Related With transfer traumas and fluctuations between markets during period Time place the study Extended From 2011 to 2024. This can be illustrated by the following table :

Table 6. Mean and Standard Deviation of Variables.

State	Oil revenues (%)	GPR Index) Ratio / Index) Between 0 and 1	Financial market volatility (Deviation) normative For returns
Nigeria	1.8	0.62	1.25

Venezuela	2.1	0.85	1.47
Iraq	1.6	0.78	1.33
Kazakhstan	1.4	0.55	1.10
Azerbaijan	1.5	0.60	1.18

Source: Prepared by the researcher based on World Bank data, the GPR index , and the EViews database .

Table 6 reveals a clear disparity among the countries studied in terms of geopolitical risk levels, financial market volatility, and oil revenues. Venezuela registers the highest GPR value (0.85) , reflecting its high degree of political and economic instability. This is accompanied by the highest level of financial market volatility (1.47), indicating a strong positive correlation between geopolitical risk and volatility. In contrast, Kazakhstan exhibits the lowest risk level (0.55) and the lowest financial volatility (1.10), reflecting a higher degree of relative stability. Iraq and Nigeria are also found to be at medium to high risk levels, which is reflected in their oil price volatility. Azerbaijan occupies a middle position among the five countries. These preliminary results confirm a positive correlation between high geopolitical risk and increased volatility in financial markets and oil prices, supporting the research hypothesis regarding the impact of political instability on the dynamics of global energy markets .

Fourth : GARCH model coefficients for each country :

It is appreciation Transactions model GARCH per nation step pivotal in Analysis Standard, so It aims to measurement behavior Contrast policeman and fluctuations chains Time place the study In picture minute Reflect nature Response For shocks Economic And geopolitics . It depends this The model on Agents Basics They coefficient The shocks (α) that measures impact News or traumas New on Fluctuations, and coefficient Continuity (β) which Reflects bezel continuation impact This is amazing traumas via Time . And it lies importance This is amazing Step in that it Allows to understand nature conglomerate fluctuations in markets oil and markets Finance, and extent Their difference between countries place The study . As well . Help in explanation Differences between countries from where degree Allergies For changes Geopolitics Stability The economist where They vary This is amazing Transactions between countries Producer oil The fragility Political like Venezuela And Iraq, and countries The most stability like Kazakhstan Azerbaijan, Which He provides Basically whatever To analyze transmission fluctuations in Stages The suffix from The study . This can be illustrated by the following table :

Table 7. Conditional variance coefficients α and β .

State	α (shocks) (value Estimated Between 0 and 1	β (continuity of fluctuation) (value Estimated Between 0 and 1	$\alpha+\beta$
Nigeria	0.21	0.73	0.94
Venezuela	0.25	0.70	0.95
Iraq	0.22	0.71	0.93
Kazakhstan	0.18	0.75	0.93
Azerbaijan	0.19	0.74	0.93

Source: Prepared by the researcher based on World Bank data, the GPR index , and the EViews database .

The results in Table (7) indicate that all countries under study are characterized by a strong cluster of fluctuations, where the values of the continuity coefficient exceed β A level of 0.70 in all cases indicates that shocks in energy markets do not disappear quickly but rather persist over time. The fact that the sum of ($\alpha + \beta$) approaches one in all countries reflects a high degree of continuity in volatility, which is consistent with the characteristics of oil markets. Venezuela registers the highest value (0.95), indicating that the impact of shocks

there is more persistent compared to the other countries. The shock coefficient also shows α The figures are also higher in Venezuela, reflecting its high sensitivity to new developments. In contrast, the values are similar across Nigeria, Iraq, Azerbaijan, and Kazakhstan, with only slight differences. These results suggest that the oil markets in the countries studied not only react to shocks immediately but also retain their impact for extended periods, highlighting the importance of using dynamic models to accurately capture these characteristics .

Fifth : Dynamic conditional correlation between variables :

It is analysis Link policeman Dynamic (DCC) between Variables Economic step Basic in to understand nature Interdependence variable Time between Fluctuations Prices Oil, and indicator Risks Geopolitics, and fluctuations markets Finance Global . It depends this Analysis on Track How to change power relationship between This is amazing Variables via Time, Instead from assumption Its stability as in Models Traditional . And it lies importance this Procedure in His ability on Discovery on periods more Interdependence or what It is known With the phenomenon Infection Finance, especially during crises Economic And geopolitics . As well . Helps in to set bezel transmission traumas between markets Energy and markets Finance in countries place the study, Which He provides Understanding Deeper dynamic Risks Globally . And in this Context, Allows model DCC-MGARCH measurement This is amazing Relations In a way precise, with Consideration Changes Time in degree Link between variables, it is what Enhances from quality Analysis Economic in This is amazing the study . This can be illustrated by the following table :

Table 8. Average DCC between oil, geopolitical risks and financial markets.

State	Oil – GPR (value Standard without lonliness, ranges Between -1 and +1	Oil – Financial Markets (value Standard without lonliness, ranges Between -1 and +1
Nigeria	0.58	0.62
Venezuela	0.71	0.68
Iraq	0.66	0.64
Kazakhstan	0.49	0.55
Azerbaijan	0.52	0.57

Source: Prepared by the researcher based on World Bank data, the GPR index , and the EViews database .

Table 8 shows a positive dynamic correlation between oil prices and the geopolitical risk index in all countries, although the strength of this correlation varies. Venezuela registers the highest correlation (0.71), reflecting a high sensitivity of oil prices to political changes, followed by Iraq and then Nigeria, while Kazakhstan registers the lowest level of correlation. A positive correlation is also found between oil prices and financial markets in all countries, indicating a global interconnectedness of market movements. These results mean that shocks in energy markets do not remain local but are transmitted to financial markets through multiple channels, especially in countries with high geopolitical risks. The results also confirm that the dynamic correlation changes according to the degree of political stability, being higher in fragile states and more volatile during crises. Thus, the results support the hypothesis of transmission of volatility between oil markets, geopolitical risks, and global financial markets .

Sixth : The transmission of fluctuations during periods of crisis :

index transmission fluctuations he gauge statistical Used To determine bezel transmission traumas and changes sharp in Contrast between markets Finance or between Variables Economic via Time . And it reflects this Index degree Interdependence and impact mutual between markets, especially during periods Crises . As well . Helps in measurement size Infection Finance and extent response markets For shocks Geopolitics Economic in environment non certainty Global The increasing [increase/ growth] . analysis transmission

fluctuations during periods crises from Most important Aspects in study markets Energy, so It aims to to understand How to Double And intensify transmission traumas between Prices oil and markets Finance in shadow Events Geopolitics Economic Acute . And it depends this Analysis on comparison behavior Variables during Two periods Two basics : period Stability and period Crises, That's To measure bezel change degree Interdependence between markets when occurrence shocks not Expected . And it stands out. importance this side in His being Reveals on nature Infection Finance and extension impact crises from nation to Other And from market to last, especially in countries Producer oil The Allergies High For changes Political like Nigeria Venezuela And Iraq . As well . Contributes this Analysis in clarification The role that Play it Risks Geopolitics in amplification fluctuations during Crises, Which makes markets Energy more susceptible For lack of Stability . Therefore He provides this framework Understanding dynamically How to transmission Risks via Time And in conditions Economic Different . This can be illustrated by the following table :

Table 9. Index of volatility transmission before and during crises.

State	Before the crises (value Standard without lonliness, Between 0 and 10)	During crises (value Standard without lonliness, Between 0 and 1)
Nigeria	0.41	0.69
Venezuela	0.55	0.82
Iraq	0.48	0.77
Kazakhstan	0.35	0.58
Azerbaijan	0.38	0.61

Source: Prepared by the researcher based on World Bank data, the GPR index , and the EViews database .

Table shows that the transmission of volatility increases significantly during periods of crisis compared to periods of stability, reflecting the non-linear nature of financial and energy markets. The index in Venezuela rose sharply from 0.55 to 0.82, demonstrating the amplified impact of crises due to economic and political fragility. Iraq and Nigeria also recorded significant increases, reflecting their high vulnerability to geopolitical shocks. In contrast, although Kazakhstan and Azerbaijan register relatively lower levels, they also experience a clear increase during crises. These results confirm that periods of crisis act as a major catalyst for increased market interdependence, and that geopolitical risks play a pivotal role in amplifying financial contagion. They also indicate that the transmission of volatility is not fixed but rather varies according to economic and political conditions, thus supporting the importance of dynamic models in analyzing these phenomena and understanding market behavior amidst increasing global uncertainty .

Seventh: Testing the research hypothesis:

This section aims to test the main research hypothesis, which states that " there is no statistically significant relationship between geopolitical risks and the transmission of volatility in global energy markets . " This is achieved using appropriate standard methods based on the results of the DCC-MGARCH model , in addition to statistical significance tests for dynamic correlation coefficients and volatility transmission coefficients. Testing this hypothesis is a crucial step in verifying the assumed relationships between the variables under study. Correlation coefficients, Z- statistical values, and p-values are used to determine the significance of the relationship between geopolitical risks and oil price volatility and financial markets. This test also allows for an assessment of whether these relationships are stable over time or change during periods of crisis, reflecting the dynamic nature of global markets . The hypothesis testing process relies on analyzing the relationship between the Geopolitical Risk Index (GPR) and the transmission of volatility in energy markets. This is achieved by estimating dynamic correlation coefficients and testing their

statistical significance. A p- value less than 0.05 rejects the null hypothesis and confirms the existence of a statistically significant relationship. The DCC coefficient is also analyzed for each country individually to determine the strength of shock transmission. High correlation coefficient values indicate a greater impact of geopolitical risks on market volatility, while low values indicate a weaker impact. The Z- statistic is used to measure the significance of these relationships over time, particularly during periods of crisis when the correlation between variables is high. This analysis aims to provide clear statistical evidence for the presence or absence of a relationship between the variables under study . This can be illustrated by the following table :

Table 10. Results of the test of the relationship between geopolitical risks and the transmission of volatility (DCC-MGARCH).

State	DCC coefficient	Z-Statistic	p-value	Statistical decision
Nigeria	0.58	3.21	0.001	moral
Venezuela	0.71	4.15	0.000	moral
Iraq	0.66	3.88	0.000	moral
Kazakhstan	0.49	2.45	0.014	moral
Azerbaijan	0.52	2.98	0.003	moral

Source: Prepared by the researcher based on World Bank data and the GPR index And the SPSS-18 program .

10 shows that all the statistical values for the dynamic correlation coefficients between geopolitical risk and the transmission of volatility in global energy markets were statistically significant at the 5% significance level, with p- values ranging from 0.000 to 0.014, all less than 0.05. This leads to the rejection of the null hypothesis and acceptance of the alternative hypothesis. The high DCC values in Venezuela (0.71) and Iraq (0.66) indicate a strong influence of geopolitical risk on the transmission of volatility in these two countries, while Kazakhstan shows a relatively low value (0.49), reflecting a lower degree of sensitivity to shocks. Furthermore, the Z-statistical values , all exceeding the critical value (1.96), confirm a strong statistical relationship between the variables. Based on these results, it is clear that geopolitical risks directly and statistically significantly affect the transmission of volatility in global energy markets, which supports the results of the standard model used and confirms the importance of including geopolitical factors in the analysis of the dynamics of oil markets .

Conclusions and Recommendations

Conclusions:

- 1- Existence relationship Positive And clear between Risks Geopolitics and transfer fluctuations in markets Energy Global, where It increases power Link during periods Crises, Which Confirms that markets oil Affected In a way direct With changes Political And not Stability in countries Producer .
- 2- That Venezuela Iraq They represent higher grades Allergies For shocks Geopolitics, where It rises In them Fluctuations Prices oil In a way marked comparison With the rest countries, Which Reflects role fragility Political Economic in amplification transmission fluctuations to markets Finance Global .
- 3- That coefficient Continuity in Models GARCH high in all countries place the study, Which It indicates on that traumas in markets Energy no It disappears Quickly, but rather It continues For periods Time long, He is what Enhances phenomenon conglomerate fluctuations in markets Oil .
- 4- That periods crises Global like COVID -19 and crises Geopolitics The Great Leads to more large in Interdependence between variables, Which It is clear that transmission fluctuations He is more sharpness in environments not stable comparison At intervals Stability The economist .

5- Existence correlation positive between Prices oil and markets Finance Global, Which It indicates to that markets Energy did not It is Isolated, but rather I became Part from network Finance Global interconnected Affected quickly With events Economic Geopolitics The different ones .

6- That Kazakhstan Azerbaijan They enjoy In degrees less from Allergies Towards Risks Geopolitics comparison countries Other, Which Reflects that level Stability Political relative Reduces from sharpness transmission fluctuations And limits from impact traumas Foreign Ministry on markets Energy .

Recommendations:

1- Necessity drawers Indicators Risks Geopolitics within Models Prediction At prices Oil, because neglect This is amazing Factors leads to weakness accuracy Expectations, especially in shadow to rise degree non certainty in Economy Global And increased impact Events Political on The markets .

2- Strengthening Strategies administration Risks in markets Energy Global, from during Use tools Finance Advanced like Hedging and contracts Future, With the aim reduction effect transmission fluctuations resulting on traumas Geopolitics not Expected .

3- Strengthening cooperation International between countries Producer oil To ensure stability Supplies Oil, where that Coordination in Policies Production maybe that Reduces from sharpness fluctuations resulting on crises Political and conflicts Regional .

4- Use Models standard dynamism like DCC-MGARCH and TVP-VAR in Analysis Future, when Availability from capacity on Track Changes Time in Relations between Variables In a way more accuracy comparison With models Traditional .

5- Development Policies Economic inside countries The Risks Geopolitics High With the aim reduction fragility sector Energy, from during diversification sources Income and improving Structure Infrastructure oil To promote Stability Productive .

6- Creation systems warning early It depends on Indicators Risks Geopolitics and fluctuations Finance, So that Help Manufacturers decision and investors on anticipation periods crises and taking procedures proactive To reduce Its effects on markets Energy .

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