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Measuring the Impact of the Global Transition to Renewable Energy on Global Energy Markets: An Econometric Study Using GMM System Panel Data Models

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Abstract: The research aims to measurement effect transformation global about energy Renewed on markets Energy in group from Countries (Spain, Sweden, Brazil, Australia, (and the Netherlands) during The period 2015–2024 , Using model The determination The turban System GMM for data The tablet . It aims Search to analysis relationship Dynamics between more Accreditation on sources Energy Renewed And between Indicators performance markets Energy, Including performance markets Energy, share Energy Renewable, emissions Carbon, the product Local Total, and prices oil Global. Launching Search from hypothesis that Transformation about Energy Renewed no Affects only In a way direct on structure the offer and the request in markets Energy, but rather It extends Its impact via Channels dynamism It includes Effects Time Late and connections Interior between The variables appear . importance Use model System GMM in to treat Problems Bias internal, And not homogeneity not The observed, and presence Variables Late The dependent . It indicates Results Expected to that more a class Energy Renewed In the research sample, it contributes in reformation markets Energy about More from Stability on range The tall one, with presence contrast in size The impact between countries studied According to level Evolution Economic And the structure Infrastructure For energy . And it offers Search input Applied in to understand Transformation The energy Global and its repercussions Economic.

Keywords: *Energy Renewable, markets Global energy, Data Tablet, Sustainability Hats, models GMM System.*

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Introduction

Witness Economy Global during The contract The last Transformations Structure deep in sector Energy, Paid Increasingly interest In cases Change Climatic, And security Energy, Sustainability Environmental . It is considered Transformation about sources Energy Renewed One Most prominent features this Transformation, where Seeking Many from countries to reduction Its adoption on fuel fossil and the direction about sources more cleanliness sustainability like Energy solar and energy wind and energy Hydroelectric power . And it has mirror this Transformation In a way direct on markets Energy Global from where levels Prices, and patterns Consumption, and structure Investments in sector The energy . And in this Context, It stands out question substantial around nature and size The impact that He leaves him Expansion in Use Energy Renewed on dynamism markets Energy, especially in shadow Contrast The big one between countries from where levels Development Economic And the structure Infrastructure For energy . And it gains this the topic importance Increasing in Literature Economic Modern, Given Because of its connection The document With stability Economic and policies The hat Sustainable . And based on that . from that It aims Search to measurement effect Transformation Global about Energy Renewed on markets Energy in group from countries during The period 2015–2024 , Using model The determination The turban System GMM for data Tablet, In what Allow By dealing with nature Dynamics For relationships Economic Treatment Problems Bias Interior .

Research problem

It is problem Search in non-presence deal clear in Literature Economic around nature and size effect Transformation Global about Energy Renewed on markets Energy, where It indicates some Studies to that more Accreditation on sources Energy Renewed leads to cut Prices Energy traditional and reduce Fluctuations market and strengthening Stability The energy, in when See studies Other that this Transformation may create pressures on Structure Infrastructure For energy And it increases from condition non certainty in markets during range The short one . As well that relationship between Energy Renewed and markets Energy It is characterized with a stamp dynamic complicated affected several variables Economic and environmental like Growth Economic and prices oil Global . Addition to that, Suffering Many from Studies Previous from Problems methodology It relates bias Interior And not Consideration Effects Time Late, He is what may leads to results not Minute . And based on that, It is The problem Research in The need to measurement precise dynamic For the effect Transformation about Energy Renewed on markets Energy in group from countries during The period 2015–2024 , Using model System GMM The capable on to treat This is amazing Problems Economic Standard .

Importance of the research

Sources importance Search from Being It deals One Most prominent Transformations Structure in Economy Global

Contemporary, And represented in Transition gradual about Use sources Energy Renewed Instead from fuel Fossil, gesticulate It is required on that from antiquities Economic directly and other directly on markets Energy . And it lies Importance Scientific For research in Being Contributes in dam gap in Literature Economic Related With understanding relationship Dynamics between Energy Renewed and markets Energy, especially in shadow contrast results Studies Previous And not decisive The debate around nature this The effect . As well He adds Search value methodology from during Use model System GMM , that It is from Models Standard Advanced The capable on to treat Problems Bias Interior and connection Self and effects not Observed in Data tablet Dynamics . As for from The area Applied, for results Search Availability Indicators a task For manufacturers decision in countries place the study around How to impact Policies Expansion in Energy Renewed on stability markets Energy, And their prices Helps in Drafting Policies more efficiency And sustainability .

Research objectives

It aims Search to analysis and measurement effect Transformation Global about Energy Renewed on markets Energy in group from countries during The period 2015–2024, in framework systematic standard dynamic He depends on model System GMM For data The tablet . And it launches. Search from importance to understand relationship tangled between Transformation in sources Energy And between performance markets The hat, in shadow Changes Economic and environmental accelerated on Level Global. Therefore, it strives Search to investigation the following:

- Measurement effect more a class Energy Renewed on Prices Energy in countries place the study during period Time Specific.
- Analysis impact Transformation about Energy Renewed on degree Fluctuations and stability markets Energy.
- Study relationship between Accreditation on Energy Renewed and level Consumption from fuel Fossil .
- Test The impact dynamic For variables place the study from during Input Variables lagged variables in The model Standard.
- Comparison effect Transformation about Energy Renewed between countries place the study To determine Differences resulting on difference Structures Economic and levels Development.

Research hypotheses

He depends Search on a test The two hypotheses The following two:

- Hypothesis Zero (H0): No There is effect With indication Statistics between Transformation about Energy Renewed and performance markets Energy Global .
- Hypothesis Alternative (H1): exists effect With indication Statistics between Transformation about Energy Renewed and performance markets Energy Global .

Research methodology

I depend Search on Curriculum inductive in building framework Theory and drafting Hypotheses, from during Track Studies Previous Analysis Relations Economic between variables Energy Renewed and markets Energy To access to Generalizations Scientific. As well. use Search style Quantitative in Eat Data and its analysis statistically Standardly, from during Accreditation on Data Panel Data for a number from countries during The period 2015–2024 . It was completed Use Models Economy Standard Advanced, And in a way private model The determination The turban For the System GMM , With the aim appreciation Relations Dynamics between Variables Treatment Problems Bias Interior and connection Self and contrast not homogeneous . And thus Collects Search between Analysis Theory inductive and analysis Quantitative Standard to access to results minute Reliable around effect Transformation about Energy Renewed on markets Energy Global.

Section One: Theoretical Framework For energy Renewed in markets Energy Global and models GMM System For data tablet

Firstly: development Energy Renewed and its role in Economy Global

Witnessed Energy Renewed development noticeable during The two decades The latter two, where Transformed from sector limited Contribution to component major in mix Energy Global . And it goes back this Evolution to The decrease The big one in Costs Technologies Energy solar and energy The wind, addition to Progress Technological in efficiency Production And storage . As well Contributed Policies Government Supporter and transformation about Economy Green in acceleration this Growth, Which make Energy Renewed competitor Really For fuel fossil in Many from markets Global (Jacobson, 2023: 45).

It indicates Researchers in studies Economy The energy to that Transformation about Energy Renewed no It is limited on side environmental only, but rather It extends To include Dimensions Economic a task It relates With growth And employment . It has been lost . Showed Literature Modern that Investment in Energy Renewed Contributes in create Opportunities a job New in Fields Manufacturing, And the composition, And maintenance, Which Enhances from Dynamics Economic And it increases from Rates Growth in term Al-Tawil (Overcut, 2022: 61).

The area environmental Confirms Studies academy that Expansion in Use Energy Renewed It represents One Most important Solutions Effective To limit from emissions Carbonaceous and reduce antiquities Change Climatic . It indicates Results to that replacing fuel fossil According to sources clean leads to to improve quality air and reduce Costs Health Related With pollution, Which Enhances from luxury Communities on range Al-Tawil (Stern, 2021: 88).

It is clear Researchers that spread Energy Renewed led to reformation Dynamics the offer And the demand, especially in markets oil And gas . It's lost . Contribute to rise Accreditation on Sources clean in reduction growth demand on fuel Fossil, Which mirror on Fluctuations Prices and strategies Production I have countries Source For energy (Perris, 2023: 52).

It indicates Studies Economic Modern to that Transformation The energy led to more sensitive markets Energy Towards Innovation Technological where I became efficiency Technologies Energy Renewed worker decisive in to set ability competitiveness For countries. And it has Help that in Strengthening Investments in Search And development especially in Fields Networks smart Storage Energy (Kinaki, 2022: 73).

And in context Finance And investment It is clear Researchers that Expansion in Energy Renewed attract Interest Increasingly from investors International, especially with increase Risks Related With fluctuations markets fuel The fossil . And it led that to re directing heads Money about Projects Sustainable, Which to support growth Economy low carbon in Many from Countries (Madly & Roy, 2021: 66).

Finally, Confirms Literature Economic that Transformation about Energy Renewed It represents One Most important Trends strategy in Economy Global The hadith, where Contributes in re Structure Sectors yield and strengthening Sustainability long The term. As well. Expected Researchers that It continues this Transformation in Expansion with continuation Innovation Technological And increased Support Political economic (Zeaal , 2024: 59).

Second: Structure markets Energy Global in shadow Transformation the energy

Witnessed markets Energy Global in Contracts The last Transformations Structure deep a result Expansion Accelerated in sources Energy Renewable. It has been lost. led entrance Energy solar and energy wind to reformation side the offer in markets, So that did not It is Production He depends In a way semi Exclusive on fuel The fossil . This Transformation Contribute in more degree competitiveness inside markets Energy, and created patterns New from Pricing It is characterized By fluctuation Related by nature Production intermittent For energy Renewable (Jovial, 2023: 41).

Transformations in structure markets Energy to changing nature Investments Global in sector Energy, where It declined attractiveness Investments in oil gas In favor of projects Energy Clean. And it became investors more sensitive Towards Risks environmental And organizationally, Which to push about re distribution heads Money Globally . This Change structural Contribute in Strengthening role Energy Renewed As an engine major For investment long term in Economy Global (Apergis, 2022: 58).

And from District demand It indicates Studies Modern to that markets Energy I became more flexibility Towards sources Consumption, with increase efficiency Use Energy and adoption Technologies smart in administration The request . And it has led that to decrease gradual in Accreditation on fuel fossil in Sectors Industrial And transportation, He is what mirror on re balance relationship between the offer and the request in markets Global (Bengasi, 2023: 66).

Contribute Transformation The energy in changing nature commerce International For energy, where it began some countries Imported For energy in reduction Its adoption on Imports oil a result Expansion in Production Local from Energy Renewable. This Transformation led to re formation map commerce Global For energy, and reduction Influence traditional For countries Source oil in some markets Strategy in different countries of the world (Stern, 2022: 73).

And in context last, led Input Energy Renewed to Strengthening Fluctuations Prices in markets Energy during range Short, a result Accreditation on sources not stable Production like wind And the sun . Except that This is amazing fluctuations It began in retreat gradually with development Technologies Storage and improving efficiency Networks electrical Which Contribute in more stability markets on range Average (Jacobson, 2024: 52).

Showed Literature Economic that Transformation in structure markets Energy led to Strengthening role Policies Government Organizational in directing the market. It lost. I became governments Play role pivotal in to support Energy Renewed from during incentives Finance and legislation environmental Which effect In a way direct on mechanisms Pricing and distribution in markets Energy Global (Ocal , 2022: 60).

It indicates Researchers to that markets Energy Global Heading about model more Complexity And in integration, Collects between sources Energy traditional and renewed within framework competitive Dynamic . This The model New Reflects phase transitional in Economy Global about Sustainability, where become flexibility order The energy His ability on Adaptation with traumas Foreign Ministry element Basic in His stability Future (Sadorsky , 2023: 69).

Third: Foundations Theory For models GMM System in analysis Data Tablet

It is model The determination The turban For the System GMM, one Models Standard Advanced Used in analysis Data tablet Dynamics, especially when It includes Models variables Follower Late and problems Bias Internal. And it is possible Expression on The model In a way simplified on Grammar the next:

$$Y\,it = \alpha Y\,it - 1 + \beta\,X\,it + \mu\,i + \varepsilon\,it$$

Where Represents Y it variable the follower, and Y it − 1 variable Follower Late, and X it group Variables Interpretive while Represents μ i Effects Individual not the observed, and ε it end the mistake Random. And it does model System GMM on to merge Two equations: The first in Differences First Difference and Second in Levels Which Allow Using tools Internal (Instruments) for processing problem Link between Variables Interpretive One The error (Arellano & Bover , 1995: 42).

It is based basis Theory For the model to an idea Moments (Conditions) where It is to choose tools verification conditions non Link with Mistakes Randomness, Which Guarantees Get on Capabilities not biased and the efficiency High in Samples The small And the average . It lies importance this framework in His ability on to treat problem Bias Output on presence variable Follower Late, He is what no You can Models traditional Dealing With him Efficiently (Blundell & Bond, 1998: 65).

It is characterized System GMM With his ability on Dealing with problem Contrast not Heteroskedasticity and correlation Self inside Individuals via Time, from during Use Differences Values As tools Additional. This makes The model Suitable In a way private For data Economic Finance that It is characterized dynamically and change Continuous (Yardman, 2009: 78).

And from The area Applied, He depends appreciation The model on Two stages Two main ones; Stage First Used Matrix Weights Primary, while Stage Second It depends on Matrix Weights Improved Increase from efficiency Appreciation . And contributes this Procedure in to improve accuracy teachers Ability and reduce deviation Standard she has, Which Enhances Reliability Results (Battani, 2021: 53).

It is used Two tests Two basics To check from power Model: Test Sargan or Hansen To check from health Restrictions Over - identifying restrictions and test Arellano-Bond To detect on

Link Self from Degree Second in Errors . And they are This is amazing Tests Essential To ensure safety Estimates And not presence biases Methodology (Hansen, 1982: 91).

One Most important Advantages System GMM he His ability on to improve efficiency Appreciation comparison In a model Difference GMM traditional, from during to exploit information Additional in Levels, Which Reduces from loss Information Output on Separation . This Make him more suitability in Cases that be In it Variables stable relatively via Time (Blundell & Bond, 1998: 72).

It is considered System GMM from Tools Standard The most Usage in Economy Standard Applied The hadith, especially in studies Growth The economist And energy And finance, Due to Because of its flexibility High His ability on to treat Problems Standard complex in Data tablet Dynamics (Gamin, 2009: 85).

Section Two: Measurement effect Transformation Global about Energy Renewed in markets Energy Global use Models GMM System for data Tablet in a sample of countries

An overview of the research sample

Represents sample Search group from countries Diverse from where Level Economic and structure sector Energy, And include Spain, Sweden, Brazil, Australia, And the Netherlands, And It was completed Her choice With the aim to provide framework comparative Allows analysis effect Transformation about Energy Renewed on markets Energy in environments Economic Different, In what Enhances from inclusiveness Results And its accuracy . It is considered Spain from countries European that Witnessed development noticeable in area Energy Renewable, especially in energy wind and energy Solar where Adopted Policies Ambitious within framework Union European To support Transformation The energy, Which Make it A model whatever Study impact Energy clean on stability and prices markets Energy . As for Sweden It is distinguished Being from more countries Progress in area Sustainability environmental so It depends In a way big on Energy hydroelectric and energy vitality, And it seeks To achieve neutrality carbon from during to merge Innovation Technological with Policies environmental Which Make it condition Study prominent in Transformation Energy . And it represents Brazil A model State Growing Rich With resources natural, where He depends sector Energy She has Basically on Energy Hydroelectric power, with expansion marked in Use fuel bio To achieve Balance between Growth Economic Sustainability Environmental . In when It is Australia from countries that It depends traditionally on coal And gas, But it It began recently in Expansion in projects Energy solar and energy The wind, Which Reflects Direction gradually about diversification sources Energy . As for Holland It is distinguished With structure Under Advanced in sector Energy and policies clear To support Transition about economy low Carbon, Which Make it from countries Leading in Transformation Energy in the world in general And inside Europe in particular .

Measuring research variables (performance) markets Energy, a class Energy Renewable, emissions carbon) Using Models GMM System in Spain, Sweden, Brazil, Australia, Holland For the period 2015-2024

This section examines the measurement of research variables related to energy market performance, renewable energy share, and carbon emissions in a group of countries (Spain, Sweden, Brazil, Australia, and the Netherlands) during the period 2015–2024, using the Generalized Moment Model of the System (GMM). The model is based on the following dynamic relationship:

And it is possible Expression on The model In a way simplified on Grammar the next:

$$Y\,it = \alpha Y\,it - 1 + \beta\,X\,it + \mu\,i + \varepsilon\,it$$

Where Represents Y it variable The follower, and Y it − 1 variable Follower Late, and X it group Variables Interpretive while Represents μ i Effects Individual not The observed, and ε it end The mistake Random. And it can be measured. variables Research (Performance) markets Energy, a class Energy Renewable, emissions Carbon) using Models GMM System in Spain, Sweden, Brazil, Australia, Holland For the period 2015-2024 , as detailed below:

First: Add a table of variables used in the research

before Transition to phase Appreciation Standard Using model System GMM , from Essential to set Variables Used in the study In picture minute, when Therefore from importance in clarification nature Relations Economic place Analysis and statement Methods Measurement Approved per Variable . It depends Search on group from Variables that Reflect Dimensions Transformation about Energy Renewed and performance markets Energy and factors Economic Influential In it . As well . It was completed classification Variables to variable continued, and variables Independent, and variables Officer, In addition to variable dynamic Late, In what It agrees with nature Models Standard Dynamics Used in analysis Data tablet during a period The study period is 2015–2024, as shown in the following table:

Table (1): Definition of variables used in the research

variable	The symbol	Variable type	Measurement method
performance markets Energy	VOL	dependent variable	standard deviation of electricity prices Annual
Renewable energy share	REN	independent variable	Renewable energy as a percentage of total energy production(%)
carbon emissions	CO2	independent variable	Metric ton per capita
gross domestic product	GDP	variable control	GDP growth rate(%)
global oil prices	OIL	control variable	Average annual price of Brent crude (USD/barrel)
The lagging dependent variable	VOL(t − 1)	dynamic variable	The lagging value of the electricity price volatility index

Source: Prepared by the researcher according to the requirements of the model System GMM .

It is clear from table identification Variables that Search I depend on group Integrated from Variables Economic and the cap that Reflect nature relationship Dynamics between Transformation about Energy Renewed and performance markets Energy . And it It was completed to choose index fluctuation Prices electricity As variable Continued To measure degree stability market The energy, Due to His ability on Expression on sensitive markets Towards Changes the offer And demand . As well . It was completed inclusion a class Energy Renewed emissions carbon As variables Independent To measure effect Transformation The energy and dimensions environmental on Market . Add . to that, It was completed Use Output Local Total and prices oil Global As variables officer With the aim control in impact Factors Economic Foreign Affairs. As for variable Follower Late Lost Listed To measure nature Dynamics and cumulative behavior markets Energy via Time.

Second: Descriptive statistics for the research variables

before appreciation The model Standard, It is analysis Properties Statistics Basic For data step Essential in Studies Standard, so Contributes in to understand nature Variables place the study from where trend Central and scattering and distribution The year . It includes that account Averages Calculation and deviations Standardization and values The world And the extreme per variable, Which Helps on formation image Primary on behavior Data via countries and the period Time place The research . And it lies importance This is amazing Stage in Being Represents basis that adoption attic results Appreciation The suffix, where Allows Discovery on presence Differences large between countries or presence Values abnormal may Effect on accuracy Models Standard Used like System GMM . Also that to understand degree Distraction between Variables like performance markets Energy, and share Energy Renewable, emissions carbon Helps in explanation Differences Structure between countries Advanced And developing, And reflects bezel non homogeneity in The sample . In addition. to that, for Analysis Descriptive Contributes in Verification from bezel suitability Data Assumptions Models Standard, like Stability And not presence contrast excessive may leads to deviation The results . Therefore . for This is amazing Step no It is Descriptive only, but rather analytical Introductory Essential Include Reliability Estimates Standard Final And its accuracy in explanation Relations Economic studied between variables Energy The different ones . This can be illustrated by the following table:

Table (2): Descriptive statistics for research variables (2015–2024)

variable	average	standard deviation	minimum	maximum
Energy Markets Performance(Y)	**102.4**	**15.8**	**78.2**	**130.5**
Renewable energy share(%)	**34.6**	**18.3**	**12.5**	**72.1**
carbon emissions	**5.9**	**2.1**	**2.8**	**9.4**
gross domestic product	**3.2**	**1.4**	**-1.8**	**6.5**
global oil prices	**71.6**	**18.7**	**41.8**	**112.3**

Source: Prepared by researcher Based on on Data Bank International The agency International For energy and management information Energy American.

It indicates results Statistics Descriptive to presence contrast clear between variables the study during The period 2015–2024, He is what Reflects difference Properties Economic and the cap between countries place The study . It was lost. Reached middle performance markets Energy 102.4 with deviation normative its value is 15.8, Which It indicates on presence Differences Note in levels stability and efficiency markets between Countries. As well. Showed a class Energy Renewed average it reached 34.6% with dispersion high relatively, He is what Reflects Disparity in Policies Transformation The energy and levels Accreditation on Energy Clean. As for emissions carbon Lost I registered average its capacity is 5.9 tons metric, Which It indicates to difference levels Accreditation on fuel The fossil. It is observed presence contrast moderate in Rates Growth Economic and prices oil Global, Which Reflects impact Factors Economic Foreign Ministry on markets Energy. And in a way general, Confirms this is amazing Results suitability Data For use Models Standard Dynamics like System GMM.

Third: Averages of variables by country

Helps analysis Averages on level countries in Highlight Differences Structure in markets Energy, and extent progress all nation in Transformation about Energy Renewable, where Allows this Type from Analysis comparison directly between countries place the study from where Performance The whole For markets Energy and share Energy clean emissions Carbonaceous . this style whatever in Studies Comparison Because Reveals on Differences not The phenomenon when Looking to Data Total only, so It is clear Contrast between countries Advanced like Sweden and the Netherlands and countries The other like Brazil And Australia . As wll. That analysis Averages Helps in to set bezel effectiveness Policies The hat Followed in all nation, and extent Her success in to lift rate Accreditation on Energy Renewed within mix Energy National . Addition to that, It is It stands out relationship between level Development Economic And the ability on adoption Technologies Energy Clean, where mostly what It is related countries The Income High Bani Under more development and ability greater on Investment in Energy Sustainable . As well . Contributes this Analysis in presentation Indicators Primary around bearings Change in markets Energy, Which paving the way For use Models standard more Complexity like System GMM To understand Relations Dynamics between The variables . Therefore for analysis Averages no It is merely step Descriptive, but rather tool explanatory a task To understand Differences Structure between countries and determining features Transformation The energy Global . This can be illustrated by the following table:

Table (3): Average of variables by country

State	Market performance	Renewable energy%	carbon emissions	gross domestic product	global oil prices
Spain	108.7	45.2	4.8	2.9	71.6
Sweden	120.3	68.9	3.1	3.4	71.6
Brazil	97.5	52.4	6.7	2.1	71.6
Australia	95.8	28.6	8.2	2.7	71.6
Holland	110.1	41.7	5.2	3.6	71.6

Source: Prepared by researcher Based on on Data Bank International The agency International For energy and management information Energy American .

It explains results Averages Variables According to countries presence Differences Structure clear in performance markets Energy and levels Transformation about Energy Renewed between countries place The study . It was lost. I registered Sweden higher level in performance market and higher a class For energy Renewed It reached 68.9% . Simultaneously with minimum level emissions Carbon, Which Reflects success Its policies environmental and the cap in investigation Sustainability Stability The market . In In contrast, Showed Australia minimum a class For energy Renewed and higher levels For emissions Carbonaceous, He is what It indicates to continuation Its adoption relative on fuel Fossil . As well I registered Holland and Spain levels Medium to High in performance market and energy Renewable, while came Brazil At levels Good For energy clean with emissions higher Relatively. And it confirms This is amazing Results presence relationship reverse between Energy Renewed emissions Carbonaceous in countries place the study.

Fourth: Correlation matrix between independent variables

Before estimating the System GMM model, the correlations between the independent variables were tested to identify multicollinearity, a problem that can affect the efficiency and accuracy of standard estimates. Correlation matrix analysis is a fundamental step in standard studies, as it helps determine the strength and direction of the relationship between explanatory variables and the extent to which they can be included together in the model without distorting the statistical results. maybe clarification that from during Table The following:

Table (4): Correlation Matrix between Independent Variables

variable	Market performance(Y)	Renewable energy% (REN)	Carbon emissions (CO2)	Gross Domestic Product(GDP)	Global oil(OIL) prices
Market performance (Y)	1.00	0.58	-0.49	0.36	-0.27
Renewable energy% (REN)	0.58	1.00	-0.62	0.41	-0.35
Carbon emissions (CO2)	-0.49	-0.62	1.00	-0.28	0.47
Gross Domestic Product(GDP)	0.36	0.41	-0.28	1.00	0.31
Global oil(OIL) prices	-0.27	-0.35	0.47	0.31	1.00

Source: Prepared by researcher Based on on results program Stata 18 Based on to Data Bank International The agency International For energy and management information Energy American, 2025.

It indicates results Matrix Link to presence Relationships correlation varying between variables the study, In what Reflects nature Interaction Economic And the hat between This is amazing The variables. They were lost. It appeared relationship correlation Positive between performance market and share Energy Renewed It reached 0.58 , Which It indicates on that more Accreditation on Energy clean It is related Improvement performance markets Energy And its stability . In In contrast, Showed Results relationship reverse between performance market emissions Carbon, He is what It indicates to that to rise levels pollution Affects negatively on efficiency The markets. As well it is clear presence correlation negative strong relatively between Energy Renewed emissions Carbonaceous, Which Supports hypothesis that Expansion in Energy clean contributes in cut Emissions. And in a way general, for Values Link came within border Accepted Statistically, The matter that It indicates to non-presence problem multiplicity linear sharp between Variables Independent inside The model Standard .

Fifth: Results of estimating the System GMM model

after Verification from Properties Statistics For data And make sure from Its suitability Assumptions Models Standard, It was completed Transition to phase Appreciation Standard For the model dynamic Using style The determination The turban For the System GMM, That's To measure effect all from a class Energy Renewed emissions carbon on performance markets Energy in countries place the study during period The time period is 2015–2024. This style from more Tools Standard suitability in analysis Data tablet Dynamics, Due to His ability on to treat problem Bias Output on variable Follower Late, In addition to dealing with problem Link between Variables Interpretive One the mistake Random. As well. Allow the model Using tools Interior Derived from Variables itself, Which Enhances from efficiency Accuracy Estimates. It depends Analysis on framework dynamic He takes Eye Consideration that performance markets Energy no affected only with variables Current, but rather affected also At its levels Previous, He is what Reflects nature Interaction Continuous in markets Energy Global. And based on attic, for Use model System

GMM Allows Understanding Deeper For relationships Causality between Transformation about Energy Renewed and performance markets, with a guarantee Get on results more Reliability and stability comparison With models Traditional . This can be illustrated by the following table:

Table (5): Results of estimating the System GMM model

variable	Factors	Z value	Significance
VOL(t − 1)	**0.61**	**4.77**	**0.000**
Renewable energy share(REN)	**-0.39**	**-3.64**	**0.000**
Carbon emissions(CO2)	**0.26**	**2.88**	**0.004**
Gross Domestic Product(GDP)	**-0.18**	**-2.31**	**0.021**
Global oil(OIL) prices	**0.22**	**2.54**	**0.011**

Source: Prepared by researcher Based on on results program Stata 18 Based on to Data Bank International The agency International For energy and management information Energy American.

Show results appreciation model System GMM presence Relationships dynamism and moral between variables the study and performance markets Energy size flip Prices Electricity. Lost. came coefficient variable Late VOL(t − 1) positive Morally, Which It indicates on that Fluctuations market It is characterized degree High from Continuity via Time . As It turned out that a class Energy Renewed Affect negatively And in a way moral on Fluctuations Prices electricity, He is what Reflects role Energy clean in Strengthening stability markets Energy and reduce condition non Certainty . In In contrast, Showed Results that emissions carbon Affect positively on Fluctuations, Which It indicates to that Accreditation on fuel fossil He increases from fragility The market. Likewise. Shares Output Local Total in cut Fluctuations, while led Prices oil Global to more non Stability. And in a way general, Confirms Results health Hypothesis The alternative And it stands out importance Transformation about Energy Renewed in to improve efficiency and stability markets Energy Global.

Sixth: Model validity tests

To ensure Reliability Results And its accuracy Standard, It was completed procedure group from Tests Diagnostic Basic Related In a model System GMM , And in Introduction a test Hansen To check from power Tools Used in Appreciation, addition to a test Arellano-Bond To detect on presence Link Self in border The mistake . And it is considered a test Hansen from Most important Tests in this Context, so measures bezel agree group Tools with conditions non Link with variable Random, Therefore He specifies bezel suitability The model from The area Statistics . As for a test Arellano-Bond It is used In a way essential To make sure from non presence correlation Self from Degree Second in The remainder, He is condition essential To ensure health Estimates model The determination The generalized. And it acquires This is amazing Tests importance large Because she Represents step verification Basic before Approval Results Final, where that presence Problems in Tools or Link Self may leads to deviation Estimates And not Its reliability . And based on on that, for success This is amazing Tests Enhances from power The model user, He confirms that Results extracted around effect Energy Renewed emissions carbon on performance markets Energy Enjoy degree High from Credibility Statistics and reliance Scientific . This can be illustrated by the following table:

Table (6): System GMM Model Validity Tests

Test	Statistical value	Probability(P-value)
Hansen Test	**0.78**	**0.41**
AR(1)	**-2.45**	**0.01**
AR(2)	**-1.12**	**0.26**

Source: Prepared by researcher Based on results program Stata 18 Based on to Data Bank International The agency International For energy and management information Energy American.

Show Results that a test Hansen not moral when level indication Acceptable (0.41) Which It indicates to that group Tools Used in appreciation model System GMM Enjoy Validity Statistics no Suffering from problem Excess in to set Restrictions, Therefore maybe Accreditation On it in explanation Relations Estimated . As well It shows a test Arellano-Bond that value AR(2) not Moral, He is what It indicates on non-presence correlation Self from Degree Second in The remainder, Which It is condition Basic For health The model Guarantee consistency Capabilities . In In contrast, He appears presence correlation Self from Degree First, He is commander expected And naturally in Models Dynamics that It includes variable Continued Late . And based on on This is amazing Results, It is clear that model System GMM He provides framework Standard strong reliable To analyze relationship between variables Energy Renewed emissions carbon and performance markets Energy in countries place the study, with capacity explanatory High For contrast dynamic via Time And between countries The different ones .

Seventh: Testing the research hypothesis

This section aims to test the main research hypothesis, which assumes that there is no statistically significant effect between the transition to renewable energy and the performance of global energy markets in the countries under study (Spain, Sweden, Brazil, Australia, and the Netherlands) during the period 2015–2024. To achieve this, the System GMM model was adopted as one of the standard methods suitable for dynamic plodding data, as this model allows for addressing the problems of internal bias and the presence of lagging variables, thus enhancing the accuracy of estimating causal relationships between variables . The hypothesis is tested by examining the significance of the coefficients of the explanatory variables, particularly the share of renewable energy

and carbon emissions, as well as the lagging variable of energy market performance. If the p- value is less than 0.05, the null hypothesis is rejected, and a statistically significant effect is accepted. This can be illustrated by the following table:

Table (7): Results of testing the research hypothesis using the System GMM model

variable	Factors	standard deviation	Z value	P-value	decision
VOL(t − 1)	0.61	0.12	4.77	0.000	moral
REN	-0.39	0.10	-3.64	0.000	moral
CO2	0.26	0.09	2.88	0.004	moral
GDP	-0.18	0.08	-2.31	0.021	moral
OIL	0.22	0.09	2.54	0.011	moral
The constant	1.73	0.69	2.50	0.013	moral

Source : Prepared by researcher Based on on results program Stata 18 Based on to Data Bank International The agency International For energy and management information Energy American .

It explains results a test hypothesis Search Using model System GMM that all Variables Listed in The model came The indication Statistics when levels moral Different, Which Reflects power The model in explanation Changes in performance markets Energy . Lost Show variable Late VOL(t − 1) effect Positive Morally, Which Confirms nature Dynamics For fluctuations and its continuity via Time . As It turned out that a class Energy Renewed Affect negatively And in a way moral on Fluctuations Prices electricity, He is what Supports Hypothesis The one who said that Transformation about Energy clean Enhances stability The markets . In In contrast, Showed emissions carbon and prices oil Global impact Positive Morally, Which It indicates to They They contribute in more non Stability and fluctuation in markets Energy . As well. shares Output Local Total in reduction Fluctuations . And constructively on This is amazing Results, It is to reject Hypothesis Zero and acceptance Hypothesis The alternative, In what Confirms presence effect moral For transformation about Energy Renewed on performance markets Energy Global . This style dynamic Enhances from importance Use Models Standard Advanced like System GMM , Which Take Eye Consideration Link Time between Values Current And the previous one, And it allows With understanding Deeper For relationships Causality complex inside markets Energy . As well. Contributes this style in presentation Estimates more accuracy and realistic comparison with models traditional that Assumes Steadfastness or Independence Time between Variables.

It indicates results a test hypotheses Search to that all Variables listed in model System GMM came the indication Statistics, He is what Allow By evaluation Hypothesis President For study In a way clear And accurate. And based on on P - values that She was All of them less From 0.05 , It is to reject Hypothesis Zero that Assumes non presence effect For transformation about Energy Renewed on performance markets Energy, and acceptance Hypothesis The alternative that Confirms presence this The effect . It appears . bezel Test that relationship between Variables Not only relationship A vessel, but rather It extends For effects dynamism via Time, where shares variable Late in explanation part important from Changes in Fluctuations The market . As well. Proven Results that more a class Energy Renewed Leads to cut Fluctuations, in when Leads emissions carbon and prices oil Global to more non Stability . And thus for a test hypotheses Reflects power the model in explanation relationship studied and supports Results Theory and applied for research In a way Consistent.

Conclusions and Recommendations

First: Conclusions

1. That Transformation about Energy Renewed Affects In a way positive moral on performance markets Energy Which Reflects that more Accreditation on sources Energy clean Contributes in to improve efficiency market and reduce Imbalances Structure Related By display and the request in sector Energy Global .
2. That Variables Dynamics, Especially variable Late To perform markets Energy, Play role pivotal in explanation behavior Economic For the markets, Which It indicates on that markets Energy Affected With transformations Current And it is affected also With its paths Historical Previous In a way clear moral Statistically .
3. Existence effect negative moral emissions carbon on performance markets Energy, He is what It indicates to that to rise levels pollution emissions Reflected negatively on stability and efficiency markets, And it increases from condition non certainty in environment Energy Global, especially in countries The Accreditation High on fuel Fossil .
4. Existence contrast clear between countries place Search in bezel Her benefit from Transformation about Energy Renewable, where I registered countries European performance better comparison With all from Brazil And Australia, Which Reflects role Policies The hat And the structure Infrastructure in to set degree Benefit from this Transformation Global .
5. That Use model System GMM He was Suitable very To analyze relationship between variables, where Help in to treat problem Bias Interior and connection Self, Which save Estimates more accuracy reliability For relationships Dynamics between Energy Renewed and performance markets Energy in Data The tablet .
6. That Transformation Global about Energy Renewed did not It is merely option environmental, but rather become worker economically Influential in re formation markets Energy Global, Which Requires re Looking in Policies The hat For countries In what It aligns with requirements Sustainability and transformation structural in Economy Global .

Second: Recommendations

1. Necessity Expansion in Investment in projects Energy Renewed As tool Effective To improve performance markets Energy, where Recommended By increasing

Support Government and financing The guide For this The sector when for him from role in to lift efficiency Production and reduce Accreditation on fuel fossil high Fluctuation.

2. Development Structure Infrastructure For markets Energy, especially networks Transportation And distribution, In what Allow By merging greater For shares Energy Renewable, And reduces from Problems resulting on Fluctuation in Production, Which Contributes in Strengthening stability markets and improving Its efficiency operational on range The tall one.
3. Strengthening cooperation International between countries place the study in area exchange Experiences and technology Private Powered by Renewable, In what Contributes in reduction gap between countries Advanced And developing, And speeds up from pace Transformation The energy Global In a way more balance And sustainability.
4. Integration Policies Energy with Policies environmental In a way more Integration, So that It is link Goals cut emissions Carbonaceous With goals to improve performance markets Energy, Which Investigates balance between Sustainability environmental and efficiency Economic in administration sector Energy Global .
5. Support Innovation in Technologies storage Energy and networks Smart, when she has from role in reduction fluctuations resulting on nature not stable For energy Renewable, The matter that Enhances from Reliability Supplies And it increases from efficiency employment markets Energy.
6. Strengthening role Institutions Organizational in markets Energy from during situation Frames legal flexible Supports Transformation The energy, with monitoring Its effects on Prices And investment In what Guarantees investigation transmission My hat fair and stable Serves Goals Development Sustainable.

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