A PROJECT REPORT

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Preface

This report on "Analysis of the relationship between GDP and Energy Consumption" is prepared under the guidance of Dr. Mohanasundari Thangavel, Assistant Professor dept. of Economics. Through this report, we have tried to give a detailed analysis on the relationship between GDP and Energy Consumption. We have tried to the best of our abilities and knowledge to explain the content in a lucid Manner.

ABSTRACT

The energy consumption of developing countries like Brazil, India, Russia, China and South Africa (BRICS) continues to give rise as the GDP increases. The point of this study is to analyze the relation between the energy consumption and economic growth (1985 to 2019) in the BRICS countries.The aim of this work is to empirically analyze the short and long runs association of these variables which are economic growth and energy consumption.In order to establish this influence, both the variables should be integrated by 1(order)). Under Johansen test , Cointegration will be performed and Vector Error Correction Model (VECM) will be applied according to the result.The output of our model shows that variables are associated throughout both long and short periods.The Granger test under VECM will next be applied equally in order to determine if there is unidirectional or bidirectional causality between the variables.

INTRODUCTION

India, We know many versions of India, as around us we see an India that is leaping up thesteps of prosperity, racing to join the developed world but behind the screens, beside the elite wall, there is another version of India which is indigent and impoverished; Oppressed and subservient for a long time but never scared of dreaming. India is the largest democracy on earth; it is one of the fastest evolving economies and ranked sixth in terms of GDP.It has got with the largest educated workforce; in the meanwhile it is also the nation with highest unemployment rate. India is leading the world in solar energy adoption; meanwhile, it is a country with 30% of households having no access to electricity supply. This list goes on. Before diving into Economic growth lets have a glance at what economics refers to in little. It has been proposed by many well-known Economists. Adam smith defined it as

"Art of creation of wealth", Marshal defined as "A subject on how wealth can be created by that, how welfare can be attained". But the most widely accepted is thus by Robbins, which is stated as, "Human behavior when he is faced with scarcity of resources, which have multiple uses". If there is no scarcity there might be no need for the concept of economics.

Anyhow, we the people, also not gifted with infinite resources and energy. Since, we are facing a shortage of resources; we have been pushed to a position where the resources and energy should be managed too wisely. Since India's economy is one of the fastest expanding economies in the world.Power consumption is among the key aspects for achieving such growth.Energy is seen as one of the major factors that drives economic growth in all economies, hence the relationship between energy consumption and economic growth has been a topic of intense study. The relationship of energy consumption with the rate of overall economic growth which is often related and measured by the GDP of the economy is justified by this fact that every sector of the economy is dependent on energy in one or some other way.

As a result the relation between energy consumption and economic growth has been the subject for much of research to determine the cause.The pioneers in the studies of energy consumption and economic growth are John Kraft and Arthur Kraft (1978).

If energy consumption supports economic expansion, a decline in energy production and consumption could lead to poor incomes, unemployment or a budget deficit. If in case the change in energy consumption policies does not affect the overall GDP much, then the ideas of energy saving practice can be put into practice.Therefore, understanding the casual relationship between these two factors is very much crucial for policy makers.

In earlier work on causality between energy consumption and economic growth, The economists and authors used several methodological procedure and approaches which is taken on different two periods of data sets for different countries. These works have involved data of several countries in cross-border contact and sometimes even a single country in studying the cause and the effect relationship among the two variables.

To attain a broader picture in the Analysis of relation between Energy consumption and GDP, we are stepping back and looking at the group of nations (includes India) which are the emerging economies of the present times.

Though their goals, values, and political preferences are not all the same, the five nations collectively referred to as the BRICS—Brazil, Russia, India, China, and South Africa—do share the interest in working with non-Western powers to limit US/Western strength and influence. Although they all exceed other developing nations in terms of population, military might, economic might, geopolitical heft, and global reach and engagement, they differ greatly from one another.

Energy is required for economic expansion, for enhancing quality of life, and for expanding development potential. About 700 million Indians utilize biomass as their main source of cooking energy, and 600 million of them don’t have access to electricity. In order to promote inclusive growth, achieve the millennium development goals, and improve India’s human development index, which currently compares poorl y to several other countries that are currently below India's level of development, it is crucial to guarantee a lifeline supply of clean energy to all.

The 2010 International Energy Outlook published by the Energy Information Administration (EIA) shows that the global use of renewable energy has been rising at a pace of 2.6% annually. About 19% of the world's energy consumption in 2008 came from renewable sources, of which 13% came from traditional biomass (primarily used for heating), 3.2% came from hydroelectricity, and the remaining 2.7% came from quickly expanding "new renewables" (such as small hydro, modern biomass, wind, solar, geothermal, and biofuels). Around 18% of the world's electricity is produced by renewable energy, with 15% coming from hydropower and 3% from new renewable energy sources.

In rural and remote places, where the transportation costs for crude oil, natural gas, and electricity are frequently prohibitively expensive, "new renewables" technologies are suitable for local electricity generation.

We still require a sizable source of 24/7 electricity to meet our energy needs, notwithstanding environmentalists' warnings that severe climate change is a real and urgent threat. In order to meet high demand for clean electricity on a worldwide scale, nuclear energy is the only practical alternative for producing electricity with no emissions of carbon dioxide or other greenhouse gasses.

Nowadays, nuclear power plants provide around 6% of the world's energy and 14% of its electricity demands. The relation between the use of renewable energy and economic growth has drawn a lot of attention from researchers in the early twenty-first century.
The forecast error variance decomposition analysis model, the bi-variate error correction model, the Toda-Yamamoto process within a framework of production function, and the multivariate error correction model within a framework of production function are some of the regularly used approaches. The relationship between the energy use and the economic growth might have varied policy consequences.

Under the idea that there is a positive correlation between economic growth and energy consumption, the existence of a one-way or two-way causal relationship between the two would indicate that energy conservation measures that lower consumption may slow down economic growth. Energy conservation initiatives, on the other hand, are likely to have less or no effect on economic growth, according to unidirectional causality from GDP to energy consumption or the absence of causality in either direction (Apergis and Payne, 2013).

In comparison to previous decades, Brazil is currently dealing with a radically different economic situation. The Real Plan, Brazil's currency stabilization strategy, was put into effect in 1994 and pushed the nation's economy to previously unknown levels of stability, greatly improving the lives of its people. Households were able to start making long-term budget decisions in light of a reasonably fixed monetary basis when runaway inflation was abruptly eliminated. This modification significantly increased societal financial stability.

With its enormous oil and natural gas resources, the Russian Federation is well recognized as a significant energy producer. However, in addition to its status as a major energy producer, Russia also consumes a significant amount of energy.

The output of primary energy in Russia is third in the world. According to BP (2010), the proven reserves of oil and natural gas make up 5.6% and 23.7% of the total, respectively, while oil and gas production make up 12.9% and 17.6% of the total.

With a proportion of 5.7%, its main energy consumption is third in the globe, only behind the US and China and larger than the Southern and Central American region(5.0%) and the African continent (3.2%) (BP, 2010).

China is a significant energy consumer, and there is a significant imbalance between supply and demand. The fact that Chinese energy efficiency is extremely low is even more serious. Thus, more energy is required for economic expansion. Construction, steel, metallurgy, equipment electro-analysis, aluminium, glass, and other high energy-consumption industries encouraged economic expansion. This is somewhat related to the stage of economic growth. But the economy and energy consumption mindsets should be altered, focusing on improving energy efficiency throughout the entire energy cycle.

Due to the extensive reform and economic transformation during the past 20 years, the globe has seen significant changes in the economic and environmental sectors in South Africa. Following the acceleration of economic growth after the apartheid era, South Africa has seen a surge in energy demand. The nation has an above-average energy intensity, meaning it takes a lot of energy to produce one unit of gross domestic product (GDP). However, South Africa's energy use is defined by a heavy reliance on cheap and widely accessible coal. While just a limited quantity of renewable energy is used, the country imports a lot of crude oil.

There are 3 primary categories into which the findings of research studies can be divided:

no causality,

unidirectional causality, and

(3) bi-directional causality

between energy use and economic growth.

Additionally, the causal relationship between economic expansion and energy use is divided into two categories:

(a) short-term causality; and

(b) long-term causality.

The structure of the economy affects how much energy is consumed in relation to economic growth.

The link between these two influences (EC &EG) helps the nation to frame its energy policy significantly. For the creation and execution of policies, convergence on the relationship and impact magnitude is crucial.

LITERATURE REVIEW

The acronym "BRICS" was created by a private sector analyst, and the grouping was not the result of diplomatic negotiations based on shared political beliefs or economic objectives. However, it functions as the primary identifier of the important rising nations.

Any attempt to define and specify the identity of "emerging powers" could quickly become esoteric, idiosyncratic, and not particularly helpful for the central issue under analysis in this paper.BRICS are among the confetti of "G" groups that dot the contemporary global political, security, and economic landscape. An easier alternative would be of listing the countries *Brazil, Russia, India, China, and South Africa* as the BRICS member countries.

In order to fix their economic woes, developing nations sought to the West for technical aid, financial transfers, and favorable economic terms since they found it convenient to attribute the majority of the blame for their economic decline to colonialism.

Contradictory advice has been given to impoverished states by wealthy countries and the international financial institutions they dominate, despite the reality that no important economy has ever effectively developed by free markets and deregulation from the start. However, Northeast Asia (Japan, Taiwan, and South Korea) has emerged as the most successful region in terms of almost all development indicators.

Northeast Asia adopted policies that were oriented inward and also outside the world, with the State setting the direction and the market following.

Their state-led industrialization began with internal land reforms and subsequently protected and supported export-oriented manufacturing companies in the domestic market to compensate for their competitive disadvantages in foreign markets.

In terms of interests and policy inclinations, BRICS are hardly strong and united. The notion is instead that they may apply more considerable leverage collectively than individually on those topics (financial norms, trade regulations, non-interference in internal affairs, etc.) when they have a common viewpoint.

They can contribute to creating a new global development agenda for economic progress, sustainable growth, and inclusive development after 2015. Additionally, they can provide attention to emerging Interests and worries of the nation over new laws governing healthcare, drugs, rights to intellectual property etc. They can exchange knowledge and experience in more pertinent development areas and benefit from China's achievements in eradicating poverty and building infrastructure for Brazil's production of renewable fuel.

ENERGY IN THE PRODUCTION STAGE

Capital, labour, and land are the three main economic concepts. materials like fuel as the primary means of production, while inputs that come in between.

The method used in growth theory concentrates on the primary inputs, capital and labor, but energy's function in the development process has not received as much attention as the explicit Energy seems to does not play a role. Among the manufacturing factors, energy , energy (fuel) cannot be renewed; yet, it is an element that can be produced again.

In consideration of this, natural scientists and ecological Economic experts have recognized the significance of the role of energy and its accessibility during the production process and economical growth (Stern and Cleveland, 2004).

GROWTH MODEL NOT INVOLVING RESOURCES

According to Solow's (1956) According to Solow's (1956) The neoclassical growth hypothesis contends that population increase the factors of capital accumulation and technological progress persistent economic growth. The Solow growth model was created based on the fundamental principles of production and the equation of capital accumulation function which is explained.

$$Y = F(K,L) = K^{\alpha} L^{I-\alpha}$$

When labour (L) and capital (K) form the basis of the production function, and Y stands for output. This production process is expected to possess qualities of constant return scale.

The model is silent on how advanced technologies are seen as external. Resources and growth are focused on conditions for sustainable growth, or at the very least non-declining utility and consumption. the scientific Circumstances consist of a mix of renewable and non-renewable resources, natural resources, and endowments, as well as the integration of inputs.

Moreover, Solow (1974) proposed that sustainability might be obtained via small amounts and natural resources that are non-renewable and have no extraction costs and capital that doesn't depreciate Capital and resources are used in production. Resources where the elasticity of substitution between the two inputs is one, and specific technical requirements are satisfied.

The body of knowledge in the discipline of energy economics, which studies the relationship between the energy usage and economic growth in national and international economies, is expanding (Ozturk 2010).

In his thorough analysis of the most advanced research on the subject, Ozturk (2010) concludes that there is no agreement on the direction of causality between energy use and economic growth.

Since the groundbreaking study by Kraft and Kraft (1978), the econometric findings that have been reported in the literature have been mixed or contradictory. The sample of nations, the period of analysis, and the estimate techniques all affect the outcomes.

While some studies (Kraft and Kraft 1978) found no evidence of a causative relationship between GDP and energy consumption, other studies (Yu and Choi 1985; Yu and Hwang 1984) discovered evidence of a reverse causal relationship between energy consumption and GDP (Lee 2005)

GROWTH MODEL INVOLVES TECHNOLOGICAL MOVEMENT AND RESOURCES

Technological advancement enables development, or at least steady consumption in the presence of a finite supply Even though sustainability's substitution elasticity is <1, increasing the total productivity factors makes it technically easier and possible to achieve.

The advancements in technology suggest that production per unit will increase in the future. Knowledge expansion increases productivity in long-run economic growth.

Because of this, the rate at which non-renewable resources are exhausted is not ideal and may vary.

Aghion and Howitt's (1998) endogenous growth model allows for modifications to one of the model's variables and encourages economic growth.

The relation between economic growth and energy usage has been the subject of numerous investigations. In general, it is believed that energy use can increase economic growth and that economic expansion has an impact on energy consumption. (Zhixin and Ren, 2011).

Aghion and Howitt's (1998) endogenous growth model allows for modifications to one of the model's variables and encourages economic growth.

Energy consumption generally rises as a result of economic growth. The substitution of energy and other inputs, technical advancements, changes in the composition of energy sources, and changes in the composition of outputs can all have an impact on the link between energy consumption and GDP (Stern and Cleveland, 2004).

According to Samuelson and Nordhaus (2010), industrialised nations' rapid and sustained economic expansion enables them to provide their inhabitants more, including better food, larger homes, more resources for health care, environmental control, etc,. both public pensions for pensioners and universal education for children.

Poveda and Martnez (2011) further suggested that the decreasing energy supply per person and increasing GDP reduce poverty and promote economic expansion.

The Kuznets and Simon (1955) work, which proposed an inverted-U shape relationship between income inequality and economic development, is where the environmental Kuznets curve (EKC) originates.

The main principle of the EKC is that as a nation's economy begins the industrialization process, resource extraction rises as income rises, increasing pollution levels. Pollutant emissions begin to fall after a certain point as people become more aware of the environment and are able to pay for the usage of cleaner energy sources like hydro, solar, and nuclear power as their wealth rises. Hence, an inverted-U form is achieved.

Grossman and Krueger's (1991) original work that proposed the EKC hypothesis' inverted-U form provided the basis for a significant amount of subsequent research on the hypothesis' applicability.

The EKC's policy implication is that promoting economic expansion will, in the long run, benefit the environment.
As a result, Beckerman (1992) contends that increasing national wealth is the greatest method to reduce the intensity of environmental pressure.

In Pao and Tsai(2010, 2011)' two analyses,

They used carbon dioxide emissions, energy consumption, and economic growth in 2010 and foreign direct investment(FDI) in 2011 as a fourth variable.

They discovered evidence for the EKC hypothesis in both of these experiments.

Carbon dioxide emissions and energy consumption were found to have a significant short-term unidirectional causal relationship with actual production by Pao and Tsai (2010).

There is a clear bidirectional causal relationship between energy consumption and carbon dioxide emissions as well as between energy consumption and actual output.

Consequently, it may be said that energy is a determinant of growth in the BRIC nations. Additionally, BRIC nations must raise their investments in energy infrastructure and promote the adoption of innovative technologies in order to reduce emissions without compromising their competitiveness.

Chang and Wolde-Rufael (2013) have applied panel causality analysis to re-examine the relation between energy consumption and the economic growth for the period 1970-2010 in view of South Africa's relatively recent admission in the BRIC group.

There is no proof of causal relationship between energy consumption and economic growth for either China or Brazil.

Unidirectional causality is discovered to exist between energy usage and economic growth in South Africa. As a result, the growth hypothesis is found to be true.
In India, on the other hand, it is discovered that unidirectional causality runs from economic growth to energy consumption. In Russia, proof of a causal relation b

etween energy use and economic growth is finally discovered.Hence, in Russia, both energy consumption and economic growth are interrelated.

With regard to the United States, Akarca and Long (1980), Yu and Hwang (1984), Yu and Choi (1985), and Yu and Jin (1992) found no correlation between total energy consumption and income

While Cheng (1995), Stern (1993), and Kraft and Kraft (1978) found a unidirectional correlation between US economic growth and energy consumption.

In 2003, Soytas and Sari looked into the relationship between GDP and energy consumption in France, West Germany, Italy, Japan, and Turkey.With the exception of South Korea, where the relationship between energy consumption and GDP is causal, their findings are in favour of growth-led energy consumption.

Masih and Masih (1996) analyse the energy-growth nexus in a multivariate framework for Asian economies such India, Pakistan, Malaysia, Singapore, Indonesia, the Philippines, Korea, and Taiwan.

India and Pakistan's and Indonesia's consumption-led growth is suggestive of a neutral nexus for Malaysia, Singapore, and the Philippines, while the opposite is true for Indonesia.

Thus, the growth-led-energy, energy-led-growth, growth-led-energy-led-growth energy, energy-led-growth-led-energy hypothesis, and neutrality hypothesis can be used to define empirical evidence on the relationship between energy and economic growth.

There is a general consensus regarding the energy-GDP link in India, where the energy led growth hypothesis is developed.The planning and management of energy production in Brazil, according to a major Brazilian electricity utility, depends significantly on understanding electricity demand because it affects decisions made by electricity companies in the following areas:long-term generation expansion plans, transmission and distribution infrastructure projects, investment planning of these companies, system operations planning, investment plans, and wholesale energy.

Payne (2009) found that no evidence of a causal relationship between total renewable and non-renewable energy consumption and real GDP using the Toda-Yamamo to procedure within a production function framework;

Payne (2011b) provided a disaggregated analysis of the causal relationship between fossil fuel (coal, natural gas, and petroleum) consumption and real GDP, and their results showed that different energy consumption items have different effects on real GDP.

Inconsistent results were discovered by Bowden and Payne (2010) who looked at the causal relationship between renewable and the non-renewable energy consumption by sector (commercial, industrial, and residential) and real GDP in the US.
Payne (2011a) found unidirectional causality from biomass energy use to real GDP.

Brazil's overall primary energy needs have increased about twice since 1990. The nation's economy has grown as a result of the country's expanding hydroelectric power expansion (Clottey et al. 2018).

It is recommended that the countries that rely on imported energy put up long-term income and energy strategies to encourage the growth of nuclear energy in their nations. However, no studies have examined the relationship between the use of renewable power (such as nuclear, hydroelectric, and new renewables) and non-clean energy (such as fossil fuels) and economic growth in developing nations like Brazil.

Although there is no steady or average relationship between them, Russia's energy consumption and economic growth are cointegrated throughout time. Consequently, it is inappropriate to simply present the connection in an average way.

The stability of Russia's energy consumption and economic growth appears to be the lowest among the BRIC nations.

This highlights the difficulty of Russia's energy-growth nexus and energy-saving policy formulation.

Economic expansion causes energy consumption, and as the economy grows, so does the demand for energy from many sectors of the economy, according to a unidirectional causality (Wolde-Rufael, 2006; Yoo, 2006; Mozumder and Marathe, 2007).,which refers to "conservation hypothesis"

In this situation, a nation's economic growth is not totally dependent on energy, making it possible to execute energy conservation measures without significantly harming the economy.

It is believed that energy consumption is what drives economic growth, which according to economic theory implies that there is a single causal link between energy consumption and GDP (Narayan and Singh, 2007; Odhiambo, 2009).This theory is known as the "growth Hypothesis" because it suggests that economic growth is dependent on energy consumption.

The third finding assumes that both energy consumption and GDP are causally related, proving that there is two-way causal relationship between the two (Glasure and Lee, 1997; Soytas and Sari, 2003; Paul and Bhattacharya, 2004). As a result, it's also known as the "feedback Hypothesis."

The final finding, known as the "neutrality hypothesis," maintains that there is no causal link between energy consumption and economic growth in any way. Accordingly, measures promoting energy conservation have little to no impact on economic growth (Cheng, 1997; Asafu-Adjaye, 2000; Paul and Bhattacharya, 2004; Wolde-Rufael, 2006; Odhiambo, 2009); likewise, a shift in the economy may not have an impact on how much energy is consumed.

Between 1978 and 2009, China's economic growth and changes in energy usage have been closely correlated. China saw its industrialization process advance at rapid rates, resulting in rapid economic expansion. Real GDP growth averaged above 9% during this time period, which was followed by an increase in total energy consumption with an average annual growth rate of 5.7%. Consumption grows at a rate that is significantly slower than the real GDP's annual growth rate.

According to the data from the China Statistical Yearbook, at the disaggregated level, consumption of coal, oil, and gas increased by an average annual growth rate of 5.5%, 4.76%, and 6.25%, respectively.

China is experiencing an increasing number of difficult issues as a result of its heavy reliance on coal, rising fuel costs, increased international pressure to cut carbon emissions and a slowing of the global warming process.

Real GDP and electricity consumption in China are cointegrated, and there is a unidirectional Granger causality running from the electricity consumption to real GDP but not vice versa, according to Alice and Pun-Lee (2004) who applied the Granger's method (1988) and an error-correction model (ECM) to examine this relationship during the period of 1971-2000.

In a multivariate regression framework, Yuan et al. (2007) used the co-integration theory and the maximum likelihood method of Johansen and Juselius (1990) is to investigate the causal relation between electricity consumption and real GDP in China from 1978 to 2004.

They discovered that China's real GDP and power consumption are cointegrated, with only a unidirectional Granger causation connecting the two variables rather than the other way around.

In a multivariate framework, Yuan et al. (2008) used a neo-classical aggregated production model where capital, labour, and energy were regarded as independent inputs. They investigated if there was a causal relationship between output growth and energy consumption in China at both aggregated and disaggregated levels, such as use of coal, oil, and electricity.They discovered a larger causation connecting oil and power use to GDP using Johansen's method, but none connecting coal and aggregated energy consumption to GDP.

Yuan et al. (2011) explored the causal relationship between energy consumption and economic growth in China during the period of 1972-2006 by combining capital and labour variables based on the neo-classical production theory within a multivariate framework. They claimed that there was both short-term and long-term causation linking energy consumption and economic growth.
The neutrality hypothesis was supported by a study conducted in China by Soytas and Sari in 2006.

There are probably no consistent conclusions on this subject from these analyses based on various approaches and data. More research on this subject is strongly encouraged.

The study by Menyah and Wolde-Rufael (2010) looked at the connection between energy use, pollution emissions, and economic growth. They used South African data for the years 1965-2006 and incorporated labour and capital to create a multivariate model.

To examine the direction of causality and long-term correlations between the variables, an updated version of Granger causality test and limits test approach to co-integration were used. Between the variables, a long-term link was established.

The Granger-causality studies revealed a one way causal relationship between economic growth and pollution emissions. It also discovered a one-way causal relationship between energy consumption and economic growth.

There haven't been many studies done about South Africa that examine the relationship between energy consumption and economic growth.

METHODOLOGY

Software:

E-views:

Co-integration

If there is no co-integration:

Estimate only the short-run model

EViews's Johansen Cointegration Test

The premise is as follows:

H0: no equation for cointegration

H1: H0 is false

At a 5% level, the null hypothesis is rejected.

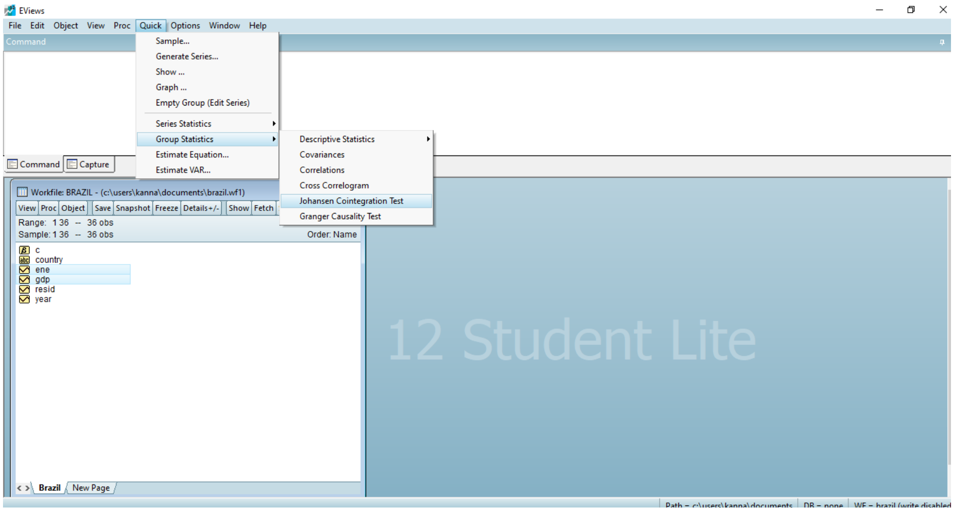
The level form of the variables should be used for the cointegration test, not their first difference. It is acceptable to additionally apply the log-transformation of the original variables.

Steps:

1. Load data into EViews

2. Open as Group data

3. Go to Quick >> Group Statistics >> Johansen Co-integration >> list the variables >> Click on OK >> Select option 3 >> Click OK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Show ...
Graph ...
Empty Group (Edit Series)
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Group Statistics
Estimate Equation...
Estimate VAR...
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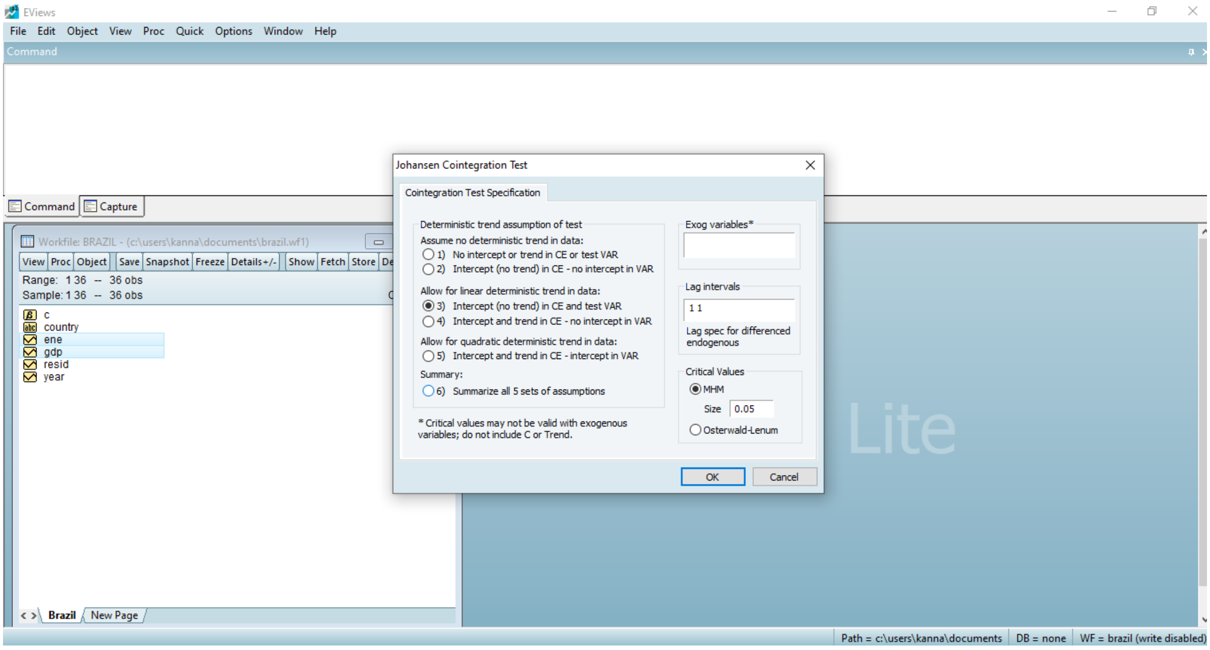
12 Student Lite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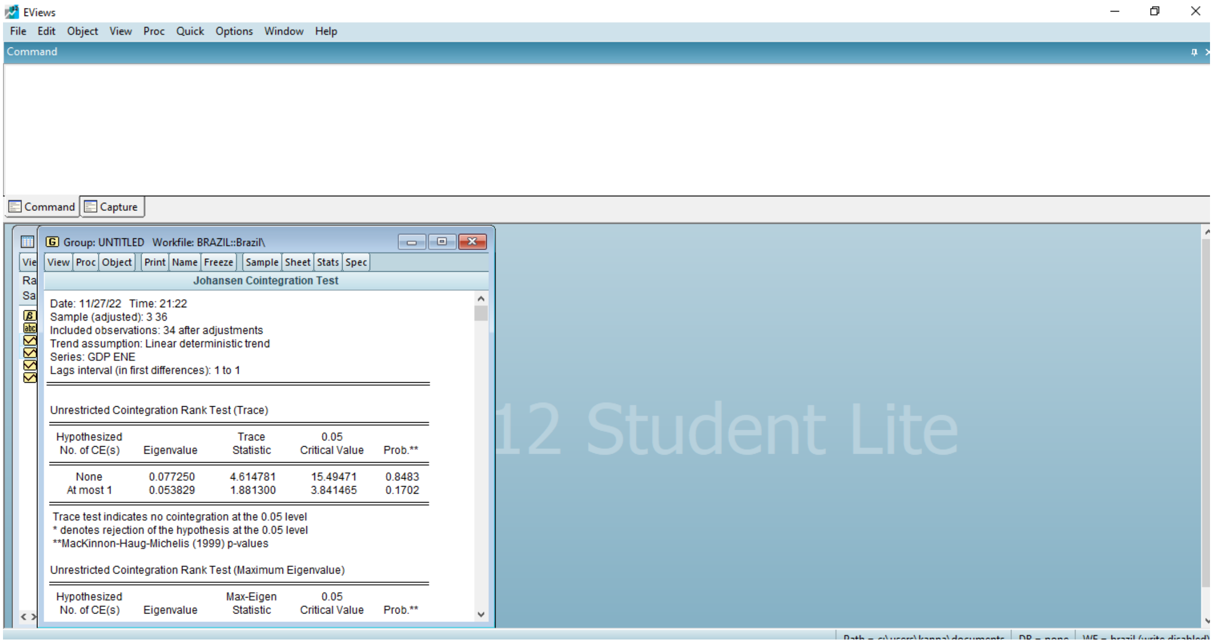
Brazil
New Page
Johansen Cointegration Test
Cointegration Test Specification
Deterministic trend assumption of test
Assume no deterministic trend in data:
1) No intercept or trend in CE or test VAR
2) Intercept (no trend) in CE - no intercept in VAR
Allow for linear deterministic trend in data:
3) Intercept (no trend) in CE and test VAR
4) Intercept and trend in CE - no intercept in VAR
Allow for quadratic deterministic trend in data:
5) Intercept and trend in CE - intercept in VAR
Summary:
6) Summarize all 5 sets of assumptions
* Critical values may not be valid with exogenous variables; do not include C or Trend.
Exog variables*
Lag intervals
1 1
Lag spec for differenced endogenous
Critical Values
MHM
Size 0.05
Osterwald-Lenum
OK
Cancel
Lite
Path = c:\users\kanna\documents
DB = none
WF = brazil (write disabled)


EViews
File Edit Object View Proc Quick Options Window Help
Command
Command Capture
Group: UNTITLED Workfile: BRAZIL::Brazil\
View Proc Object Print Name Freeze Sample Sheet Stats Spec
Johansen Cointegration Test
Date: 11/27/22 Time: 21:22
Sample (adjusted): 3 36
Included observations: 34 after adjustments
Trend assumption: Linear deterministic trend
Series: GDP ENE
Lags interval (in first differences): 1 to 1
Unrestricted Cointegration Rank Test (Trace)
Hypothesized No. of CE(s) Eigenvalue Trace Statistic 0.05 Critical Value Prob.**
None 0.077250 4.614781 15.49471 0.8483
At most 1 0.053829 1.881300 3.841465 0.1702
Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)
Hypothesized No. of CE(s) Eigenvalue Max-Eigen Statistic 0.05 Critical Value Prob.**
12 Student Lite

Johansen Cointegration Test

Date: 11/08/22 Time: 18:10
Sample (adjusted): 3 36
Included observations: 34 after adjustments
Trend assumption: Linear deterministic trend
Series: GDP ENE
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.077250	4.614781	15.49471	0.8483
At most 1	0.053829	1.881300	3.841466	0.1702

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.077250	2.733481	14.26460	0.9629
At most 1	0.053829	1.881300	3.841466	0.1702

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

GDP	ENE
-3.46E-12	0.021078
1.81E-12	-0.022722

Unrestricted Adjustment Coefficients (alpha):

D(GDP)	4.70E+10	2.52E+10
D(ENE)	2.947283	-1.980775

1 Cointegrating Equation(s): Log likelihood -1067.041

Normalized cointegrating coefficients (standard error in parentheses)

GDP	ENE
1.000000	-6.09E+09
	(1.9E+09)

Adjustment coefficients (standard error in parentheses)

D(GDP)	-0.162699
	(0.12356)
D(ENE)	-1.02E-11
	(8.4E-12)

Date: 11/08/22 Time: 18:31
Sample (adjusted): 3 36
Included observations: 34 after adjustments
Trend assumption: Linear deterministic trend
Series: ENE GDP
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.241222	11.73099	15.49471	0.1703
At most 1	0.066658	2.345449	3.841466	0.1256

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.241222	9.385545	14.26460	0.2555
At most 1	0.066658	2.345449	3.841466	0.1256

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

ENE	GDP
-0.019864	5.10E-13
0.002965	-1.60E-12

Unrestricted Adjustment Coefficients (alpha):

D(ENE)	14.18268	-0.955590
D(GDP)	9.16E+09	5.97E+10

1 Cointegrating Equation(s): Log likelihood -1096.179

Normalized cointegrating coefficients (standard error in parentheses)

ENE	GDP
1.000000	-2.57E-11
	(2.5E-11)

Adjustment coefficients (standard error in parentheses)

D(ENE)	-0.281730
	(0.09221)
D(GDP)	-1.82E+08
	(8.4E+08)

Date: 11/08/22 Time: 18:29
Sample (adjusted): 3 36
Included observations: 34 after adjustments
Trend assumption: Linear deterministic trend
Series: GDP ENE
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.290254	11.65686	15.49471	0.1741
At most 1	5.27E-07	1.79E-05	3.841466	0.9990

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.290254	11.65684	14.26460	0.1242
At most 1	5.27E-07	1.79E-05	3.841466	0.9990

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

GDP	ENE
-5.88E-12	0.058428
5.94E-12	-0.089238

Unrestricted Adjustment Coefficients (alpha):

D(GDP)	-3.38E+10	-55158287
D(ENE)	-5.789457	0.003210

1 Cointegrating Equation(s): Log likelihood -1033.146

Normalized cointegrating coefficients (standard error in parentheses)

GDP	ENE
1.000000	-9.94E+09
	(1.0E+09)

Adjustment coefficients (standard error in parentheses)

D(GDP)	0.198509
	(0.09926)
D(ENE)	3.40E-11
	(1.1E-11)

Johansen Cointegration Test

Date: 11/08/22 Time: 18:26
Sample (adjusted): 3 36
Included observations: 34 after adjustments
Trend assumption: Linear deterministic trend
Series: GDP ENE
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.758371	48.95888	15.49471	0.0000
At most 1	0.019422	0.666862	3.841466	0.4141

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.758371	48.29201	14.26460	0.0000
At most 1	0.019422	0.666862	3.841466	0.4141

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

GDP	ENE
-4.43E-13	0.000950
2.04E-12	-0.017171

Unrestricted Adjustment Coefficients (alpha):

D(GDP)	-1.66E+11	4.33E+10
D(ENE)	-49.61309	-0.578330

1 Cointegrating Equation(s): Log likelihood -1111.017

Normalized cointegrating coefficients (standard error in parentheses)

GDP	ENE
1.000000	-2.14E+09
	(6.3E+08)

Adjustment coefficients (standard error in parentheses)

D(GDP)	0.073460
	(0.02628)
D(ENE)	2.20E-11
	(2.3E-12)

Date: 11/08/22 Time: 18:33
Sample (adjusted): 3 36
Included observations: 34 after adjustments
Trend assumption: Linear deterministic trend
Series: GDP ENE
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.198639	7.580270	15.49471	0.5113
At most 1	0.001504	0.051180	3.841466	0.8210

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.198639	7.529090	14.26460	0.4286
At most 1	0.001504	0.051180	3.841466	0.8210

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

GDP	ENE
-6.54E-12	-0.134232
7.41E-12	-0.338877

Unrestricted Adjustment Coefficients (alpha):

D(GDP)	8.67E+09	7.73E+08
D(ENE)	-0.397487	0.035717

1 Cointegrating Equation(s): Log likelihood -918.8691

Normalized cointegrating coefficients (standard error in parentheses)

GDP	ENE
1.000000	2.05E+10
	(1.8E+10)

Adjustment coefficients (standard error in parentheses)

D(GDP)	-0.056662
	(0.03159)
D(ENE)	2.60E-12
	(1.5E-12)

1. Trace Statistic and Max-Eigen Statistic

are two statistics generated by the EViews output.

2. The rejection threshold is set at 0.05.

3. An asterisk

(*) denotes that the null hypothesis has been rejected.

4. If the probability value

<= 0.05, reject the null hypothesis.

5. If the Trace or Max-Eigen statistic is greater than the 0.05 threshold value, reject the null hypothesis.

If the null hypothesis cannot be proved out, it shows that there is no cointegration and no long-term relationship between the series. This suggests that the model is unlikely to converge over the long term if there are systemic shocks. Additionally, only the short run model should be evaluated if there is no cointegration.

Coefficients signs should be reversed in the normalized cointegrating equation of Johansen model which is representing the long run. GDP is the target variable. ENE has a negative and significant impact on GDP in the long run. An increase in ENE will lead to a decline in GDP.

The long run coefficient is negative and significant which shows long run causality between ENE to GDP. Coefficient should have a negative sign showing the ability to bounce back to equilibrium. The positive sign indicates movement away from equilibrium.

Results and discussions

Using johansen cointegration, which takes into consideration the co-integration relationship across nations, this study reexamines the causal relation between GDP and energy consumption in the BRICS countries for the period 1985-2020. The outcomes of this methodology imply that the existence and direction of Granger causality vary across the various BRICS nations. These findings each have significant and different recommendations for policy making.

The different time periods between the outcomes for these studies can be the cause of the variances. Causality analysis, in particular, is sensitive to the approach chosen. For groups of countries with relationships in terms of their economic policies and trends of key variables, cross-sectional dependence is taken into account and is thought to be of great relevance.

This study has investigated the causality relation between energy consumption and economic growth in

Brazil during the period of 1980-2008. Granger causality tests were used to examine the causal relationship between Variables.

Coefficient signs should be reversed in the normalized cointegrating equation of Johansen model which is representing the long run. GDP is the target variable. ENE has a negative and significant impact on GDP in the long run. An increase in ENE will lead to a decline in GDP.

The long run coefficient is negative and significant which shows long run causality between ENE to GDP. Coefficient should have a negative sign showing the ability to bounce back to equilibrium. The positive sign indicates movement away from equilibrium.

POLICY IMPLICATIONS

The empirical results of this study offer important guidelines and policy consequences.

The results showing that rapid industrialization and development had negative effects on energy consumption in Brazil and South Africa and positive ones in India, China, and Russia show that better trade and investment flows, closer social connections, and political strategies can reduce the demand for energy across economies, primarily due to increased awareness of energy-efficient technologies.

Although economic globalization is on the rise, producers in Brazil and South Africa may not employ cutting-edge production methods, which results in higher energy consumption for production activities. Natural disasters and climate change are two examples of how globalization's negative effects on energy use and the greater environmental costs that follow from increased energy consumption must be properly addressed.

The results showed that capitalization increased energy consumption in the majority of the BRICS countries when it comes to the relationship between capital and energy consumption. These nations should implement energy conservation regulations, purchase cutting-edge energy-saving equipment, and use "green" and clean technology for both production and consumption.Transferring from lower-quality to higher-quality energy sources is anticipated to reduce both total energy consumption and the impact of the energy use on the environment. The change from coal to natural gas would be a clear demonstration. Natural gas burns more cleanly than other energy sources and emits fewer carbon dioxide vapors per unit of energy producedHydro and w ind energy may also have a lesser influence on the environment. The environmental effects of energy use may also alter over time as a result of technology advancements that lower pollution emissions or other environmental effects related to a particular energy source.Furthermore, reducing energy use via changing customer behavior, i.e., by utilizing pricing and taxation to reduce Therefore, despite the strong link between energy use and economic expansion, there are number of ways to lessen the impact of growth on the environment. Additionally, if there are barriers for the adoption of renewable energy sources and the technological advancement of outdated technologies, the potential reduction in the environmental complexity of economic activity is eventually constrained.

Use of energy-intensive devices and encouraging the use of energy-conserving devices is highly desirable. To be successful, these strategies must link both suitable supply and end-use technologies. Policy agents must convert these strategies into policies. Complete hardware plus ‘software’ - policies,management, financing, training and institutions-solutions are essential for the deployment of energy as an instrument of sustainable development.

Based on the results of analysis, it is resulted out that:

1. The five BRICS countries’ economic growth is favorably and considerably impacted by the usage of fossil fuels, particularly coal.

2. The five BRICS countries’ economic growth is positively but statistically not significantly impacted by the usage of fossil fuels, particularly oil and natural gas.

3. The five BRICS countries’ economic growth is negatively impacted by the use of renewable energy.

Conclusion

Globalization plays a crucial role in connecting developing economies, but it also has an impact on environmental degradation because of the massive amount of energy used in both production and consumption in developed and developing nations.

The findings show that energy consumption, globalization, economic growth, and capital all exhibit asymmetric cointegration. The long-term effects of factors on energy usage in the BRICS were also shown to vary widely. Energy consumption in Brazil and Russia (Brazil and South Africa) dramatically fell as a result of favorable globalization impacts, and vice versa. With negative globalization shocks in Russi a and China, energy consumption fell. Globalization (including negative and positive shocks) decreased India's levels of energy usage. The analysis found that rapid economic expansion raises energy consumption in Brazil and South Africa by comparing both positive and negative shocks (Russia, India and China).