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**Article**

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# Relationship between Oil Price, Inflation, and Economic Growth in BRICS Countries: Panel Cointegration Analysis

**Aina B. Aidarova[1], Aissulu Nurmambekovna Ramashova[1], Karlygash Baisholanova[2], Galiya Jaxybekova[3], Aliy Imanbayev[4], Indira Kenzhebekova[5]*, Dinmukhamed Kelesbayev[6]**

[1]M.Auezov South Kazakhstan University, Shymkent, Kazakhstan, [2]Al-Farabi Kazakh National University, Almaty, Kazakhstan, [3]Almaty Management University, Almaty, Kazakhstan, [4]Central Asian Innovation University, Shymkent, Kazakhstan, [5]Peoples' Friendship University named after Academician A. Kuatbekov, Shymkent, Kazakhstan, [6]Khoja Akhmet Yassawi International Kazakh-Turkish University, Turkestan, Kazakhstan. *Email: kenzhebekovaindira722@gmail.com

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**ABSTRACT**

In 2001, Jim O'Neil coined the term "BRIC" to refer to the economies of Brazil, Russia, India and China. In 2011, South Africa joined the group, and it was updated to "BRICS." These countries have a significant impact on the world economy, and there are numerous studies examining their macroeconomic structures. This study focuses on the relationship between economic growth, oil revenues, and inflation levels in BRICS countries from 2000 to 2021 and uses panel cointegration analysis. Many studies showed a relationship between these variables in different countries and unions. This study aims to determine if these relationships hold for BRICS countries. The results suggest a cointegration relation and a causality relation between economic growth, inflation, and oil revenues in BRICS countries. This finding demonstrates the impact of energy, specifically oil revenues, on economic growth. However, other macro indicators also affect economic growth, as suggested by existing literature. Therefore, future studies could improve on this research by including additional social and economic variables to evaluate the impact of oil revenues on economic growth from multiple perspectives.

**Keywords:** BRICS, Oil Price, Inflation, Economic Growth, Panel Cointegration.
**JEL Classifications:** C13, C20, C22

## 1. INTRODUCTION

In 2001, Jim O'Neil introduced the term BRIC to represent the economies of Brazil, Russia, India, and China (O'Neill, 2001). This abbreviation was widely used as "BRIC," "BRIC countries," "BRIC economies" or "Big Four" (Elango, 2023). O'Neill's article "Building Better Global Economic BRICs" drew attention to these countries, leading to comprehensive research by Goldman Sachs. In their report titled "Dreaming with BRICs" published in 2003, they projected the evolution of BRIC over 50 years and estimated that by 2050, China would become the world's largest economy, followed by the USA, India, Japan, Brazil, and Russia, respectively (Wilson and Purushothaman, 2003). BRIC became an official organization in 2006, and South Africa joined in 2011 following China's proposal, resulting in the group's name changing to BRICS (Thussu, 2018). At the 6th BRICS summit held in Brazil in 2014, the group decided to establish the New Development Bank, aimed at improving the countries within the group, their region, and global development. The New Development Bank (NDB) started operating on February 27, 2016 (NDB, 2024). The inclusion of countries with the world's most populous populations, such as India and China, and countries such as Russia, which is the world's largest energy exporter and the fastest developing economy, indicates that the BRICS community will be among the world leaders of the future. The population and economic size of the BRICS countries confirm this, as they constitute 41% of the

world population, 24% of world GNP, and 16% of world trade (BRICS, 2021).

Oil, being the most important energy source in the world, has a significant impact on various economies and is a source of economic fluctuations. Since World War II, oil price shocks have had a significant impact on the global economy. For instance, the 1973-1974 oil price shock due to the Yom Kippur War and the 1979-1980 oil price shock due to the Iranian revolution were the main causes of stagflation observed around the world in the 1970s. However, since the late 1990s, the effects of similar shocks on industrialized economies have been less significant (Wong et al., 2013). Unexpected increases in oil prices caused high inflation worldwide in the 1970s. Although oil prices fell in the following decade, they temporarily increased due to the Gulf War crisis in the 1990s. Oil prices rose rapidly in 2008, but decreased significantly in 2009 due to a decline in demand. Since then, concerns have been raised about possible increases in inflation due to the high volatility in oil prices. The COVID-19 pandemic has also significantly impacted the energy market, leading to radical changes in energy markets globally (Choi et al., 2018). Although many measures have been taken globally, the energy markets of countries have changed at different levels due to the COVID-19 epidemic. For instance, energy-importing countries have become more successful than energy-exporting countries for the 1st time since World War II due to a decrease in energy demand caused by curfews. This has improved the energy trade balance in importing countries and deteriorated it in exporting countries (Nyga-Łukaszewska and Aruga, 2020). The pandemic triggered an unprecedented collapse in oil demand in March 2020, leading to an increase in oil stocks and a downward pressure on prices. As a result, demand-driven collapses in oil prices have occurred in 2020 (Wheeler et al., 2020).

Every good or service that is traded in the market has a price in a specific currency such as the Dollar, Euro, Sterling, Ruble, or Yen. And the price level is the absolute price expressed by these figures in an economy. Inflation is defined as a continuous increase in the general level of average prices, and the inflation rate indicates the effect of the last period's price level on today's level. If this rate is negative, there is deflation (Carlin and Soskice, 2005). Price levels are calculated based on an index value, and commonly used indices include the Consumer Price Index (CPI), Producer Price Index (PPI), and GDP Deflator (Stanford, 2008).

Economic growth refers to the increase in productivity factors such as labor force, natural resources, domestic capital structure, foreign trade policy, banking, and financial infrastructure, energy production and consumption, and foreign direct investment that provide a higher return from the previous year to the next year (Neelankavil et al., 2012). GDP is a well-accepted indicator of economic growth in academic and sectoral studies (Dyussembekova et al., 2023). It refers to the total value of final goods and services produced in an economy in a year. The total value calculated on the prices of final goods and services produced in that year is called Nominal GDP. The concept of economic growth gained vital significance, especially with globalization, the development of information technologies, and the disappearance of borders in access to financial markets. The change in economic growth provides information about the economic development of a country in the examined period and helps compare it with countries with similar characteristics. Therefore, it is at the center of attention of policymakers and academics (Sartbayeva et al., 2023).

The relationship between price fluctuations in the global oil market, inflation, and economic growth rates has been the focus of many academic studies (Issayeva et al., 2023; Niyetalina et al., 2023; Sultanova et al., 2024). Specifically, this study analyzed the relationship between oil price, inflation, and economic growth with the panel cointegration method for the BRICS countries.

## 2. LITERATURE REVIEW

The literature contains numerous studies that examined different aspects of the BRICS countries and their economies, individually and collectively. As it is impossible to list all in literature, this study only mentions studies related to its subject of analysis (Habanabakize and Dickason-Koekemoer, 2024).

Li and Guo (2022) analyzed the asymmetric effects of oil prices and component shocks on inflation in BRICS countries. They decomposed oil price changes into supply, demand, and risk shocks and created an empirical framework to investigate asymmetric transitions using a new multi-threshold, non-linear autoregressive distributed lag model (MTNARDL). Their research findings revealed significant asymmetries between oil prices and inflation in China, with the inflationary effect more dramatic when the oil price fell. Supply shocks had strong asymmetries in Russia, China, and South Africa, while demand and risk shocks had either zero asymmetries or a weak effect. Besides they found that demand shocks and risk shocks either have zero asymmetries or are weak; and in most cases, risk shocks have the weakest impact on inflation and their effect fades quickly.

Adhikari and Chen (2012) conducted a study to examine the long-term relationship between energy consumption and economic growth in 80 developing countries from 1990 to 2009. They employed the panel unit root test, panel cointegration test, and panel dynamic ordinary least squares (DOLS) methods. The countries were divided into three income groups: Upper middle income, lower middle income, and low income. The study found a long-term cointegrated relationship between energy consumption and economic growth for the entire country panel and each country group. There was a strong relationship from energy consumption to economic growth for upper middle-income countries and lower middle-income countries and from economic growth to energy consumption for low-income countries. The research showed that energy consumption has a positive and statistically significant impact on economic growth in the long term.

Behera (2014) conducted a study that analyzed the impact of inflation on economic growth in six South Asian countries, namely India, Bangladesh, Bhutan, Nepal, Maldives, and Sri Lanka. The researcher used annual growth and inflation data from the period of 1980-2013, sourced from the World Economic Outlook (WEO) for growth data, and published consumer prices for inflation data.

The study employed several research methods such as correlation analysis between inflation and economic growth data, determining unit roots in the series on a country basis. In the following step which employed Johansen Cointegration tests, they analyzed the causality between inflation and emission data using Granger tests. Using the Error Correction Models, they investigated whether short-term shocks were eliminated in the long term. Finally, VAR analyses were conducted to analyze the effects of a one-unit shock in inflation on growth. The study found that the relationship direction between inflation and economic growth variables is from economic growth to inflation in Bangladesh, Bhutan, and India, while it is from inflation to growth in Nepal. However, no causality relationship was detected between the two variables in Maldives and Sri Lanka.

Cho et al. (2014) analyzed the relationships between carbon dioxide emissions, energy use, and gross domestic product in 22 OECD countries from 1971 to 2000 using panel unit root and panel cointegration tests, as well as the fully corrected ordinary least squares (OLS) method. They also examined the Environmental Kuznets Curve (EKC) hypothesis using total GHGs, methane, and nitrogen monoxide to investigate these results for other direct greenhouse gases (GHGs). The results supported that energy usage still plays a significant role in explaining GHG emissions for OECD countries, and a quadratic relationship was observed in the long run regarding the EKC hypothesis.

Ji et al. (2015) conducted a study on the effects of structural oil shocks on production, exchange rate, and inflation in BRICS countries. They used the structural vector autoregression approach (SVAR). The research found that oil supply shocks had a significant effect on Russia, while other countries were mainly affected by the total demand shock. The study also revealed that oil-specific demand shocks caused by changes in expectations or speculative activities pose a stagflation risk for China and India. However, these harmful effects are mitigated by oil subsidies or price regulation measures.

Škare et al. (2020) examined the relationship between energy consumption and green GDP. The analysis used the panel cointegration method to study the long-term relationships between integrated variables. The data included 36 countries (28 European Union Members and potential member countries) from 2008 to 2016. The findings indicated that an increase in energy consumption leads to an increase in GDP, thereby boosting green GDP. However, the study also found that an increase in energy consumption in environmentally harmful sectors widened the gap between GDP and green GDP, while an increase in cleaner energy consumption narrowed this gap.

Streimikiene and Kasperowicz (2016) investigated the long-term relationship between energy consumption and real GDP, taking into account fixed capital and total employment in 18 EU countries from 1995 to 2012. The analysis included panel unit root tests, panel cointegration tests, fully adjusted least squares (FMOLS) estimator, and dynamic least squares (DOLS) estimator. The data were examined in three groups. The results showed cointegration between economic growth and the variables "energy consumption" and "gross fixed capital" for the entire country panel and two selected country groups. Additionally, the panel FMOLS and DOLS estimators indicated a positive relationship between energy consumption, gross fixed capital, and economic growth.

Lu (2017) examined the co-movement and causality relationships between greenhouse gas emissions, energy consumption, and economic growth for 16 Asian countries from 1990 to 2012. The study's findings suggest the presence of bidirectional Granger causality between energy consumption, GDP, and greenhouse gas emissions, as well as between GDP, greenhouse gas emissions, and energy consumption in the long run. The research also indicates a non-linear, quadratic relationship between greenhouse gas emissions, energy consumption, and economic growth, consistent with the environmental Kuznets curve for the 16 selected Asian countries and a subsample of Asia's new industrial economies. Short-term relationships vary regionally across the Asian continent. Concerning energy policy in Asia, various governments have noted their support for the use of low-carbon or renewable energy and reducing fossil fuel combustion to sustain economic growth.

Syzdykova et al. (2019) aimed to examine the effects of exports and imports on national income using quarterly data from Kazakhstan between 2000 and 2017. They employed the autoregressive distributed lag (ARDL) model in their research. The findings demonstrate that increasing both exports and imports in Kazakhstan leads to an increase in the country's gross domestic product (GDP). Specifically, in the long run, a 1% increase in exports corresponds to a 0.38% increase in GDP, while a 1% increase in imports results in a 0.42% GDP increase. Additionally, the long-term effect of exports was stronger than the short-term effect. Imports were observed to have a negative impact on economic growth in the short term, but a positive impact in the long term. The study also concluded that the income elasticity of imports was statistically significant and positive, indicating that a 1% increase in economic growth led to a 0.60% increase in imports.

Rasool et al. (2021) specifically analyzed the relationship between inbound tourism, financial development, and economic growth in the 1995-2015 period for BRICS countries (Brazil, Russia, India, China, and South Africa) using the ARDL cointegration test. The research findings indicated that tourism, financial development, and economic growth are cointegrated in the long term. Furthermore, the Granger causality analysis revealed that the causality between inbound tourism and economic growth is bidirectional, confirming the "feedback hypothesis" in BRICS countries. Husnain et al. (2024) investigated the impact of institutional quality, foreign direct investment (FDI), inflation, and domestic investment on the economic growth of Latin America from 1996 to 2021. The results show that institutional quality, FDI, and local investment have a significant positive impact on the economic growth of Latin America, while inflation has a negative impact.

Another study by Li et al (2021) examined the relationship between energy consumption and income for a panel that consists of Asian economies during the period from 1971 to 2018. Asian economies are a dynamic, diverse, and interesting group that

is useful for identifying trends in convergence and integration in energy consumption and usage characteristics. The analysis provided evidence of convergence in energy intensity between countries. Panel data methodologies were utilized to enhance the explanatory power of the econometric analysis. Additionally, common factors were included to account for factors beyond the bivariate relationship. The results supported a causal flow from energy consumption to income, with short-term feedback. The findings implied that current policies to reduce energy intensity and $CO_2$ emissions are not expected to significantly hinder economic growth. Moreover, the study corroborated the pioneering work of Kraft and Kraft (1978) and highlighted that the panel's long-run income elasticity estimates double when unobserved common factors are excluded.

A study by Baimaganbetov et al. (2021) analyzed the impact of real oil price shocks on food inflation in Kazakhstan using monthly data from 2004 to 2019. They used a VAR model and conducted a unit root test of Zivot and Andrews (1992) to account for breaks in the data, which are not adequately captured by standard unit root tests. Their analysis revealed that food prices were I(1) according to the Zivot and Andrews test, but I(0) according to the ADF test. They also found a bidirectional causal relationship between oil prices and food prices and used a VAR model to analyze the short-term effects of the variables, determining that crude oil prices indirectly affect food prices.

Rahman et al. (2021) examined the impact of remittance income on energy consumption and economy in the four highest-earning remittance recipient countries in South Asia from 1976 to 2019. Their detailed analysis included long-run and directional relationships, stationarity tests, panel cointegration test, DOLS, FMOLS, and Granger causality tests using VECM. The research findings showed long-term relationships between remittance income, energy consumption, GDP, and urbanization. The cointegrated regression indicated that remittance receipts, economic growth, and urbanization have a positive and significant impact on individual energy consumption in the long run. The results indicated that a 1% increase in remittance revenues led to a 0.045% increase in energy consumption. Among the studied countries, the impact of remittance income on energy consumption was found to be significantly dominant in Bangladesh and Pakistan. The statistically significant and negative value of the error correction term suggested the long-run causality of remittances, GDP, and urbanization on energy consumption. Variance decomposition analysis showed that energy usage is most affected by remittance inflows.

## 3. METHODS

In terms of econometric analysis methodology, there are three different types of data: time series, cross-sectional data, and pooled panel data consisting of the combination of the time series and the cross-sectional data (Gujarati, 2003). If cross-sectional effects, along with time-dependent changes, need to be investigated, using the appropriate panel data method is a mandatory approach.

In panel data analysis, researchers typically use balanced panel data sets with an equal number of periods for each cross-section. The panel data set consists of N cross-section units and T periods for each unit, providing a total of N × T observation units. Panel data analysis allows (i) the use of both time series and cross-sectional data, enabling researchers to benefit from a larger number of data and (ii) to analyze the effect of units on the dependent variable as cross-sectional data together with the variables observed as time series (Baltagi, 2005). Conducting analyses with only cross-sectional data or only time series data can lead to bias in the estimates, as it cannot control heterogeneity. Panel regression analysis, on the other hand, gives more reliable results by reducing the linearity between variables (Baltagi, 2008; Ibyzhanova et al., 2024).

In panel data analysis, the stationarity of the series is examined in two steps. Firstly, cross-sectional dependency is checked. Secondly, one of the first-generation or second-generation unit root test methods is applied depending on whether there is cross-section dependence or not. Cross-section dependence occurs when the number of time series periods (T) is greater than the number of cross-section units (N) (T > N). In such cases, researchers use Breusch and Pagan's (1980) LM test and Pesaran et al. (2008) *LMadj* tests. If the number of time series periods is small (T < N), researchers use Pesaran (2004) *CDLM* test. In cross-sectional dependence tests, the null hypothesis is "*H*0: There is no cross-sectional dependence." If a cross-sectional dependence is determined, first-generation panel unit root tests are applied to the analysis. If cross-sectional dependence is present, second-generation panel unit root tests are applied. These tests help determine whether the series is stationary, which is essential in panel data analysis (Baltagi, 2008; Yesbolova, et al., 2024).

In panel data analysis, first-generation unit root tests such as (Levin et al., 2002; Breitung, 2005; Hadri, 2000; Maddala and Wu, 1999; and Choi, 2001) are commonly used when there is no cross-sectional dependence. Second-generation unit root tests, such as Bai and Ng (2004), Taylor and Sarno (MADF, 1998), Breuer et al. (SURADF, 2002), Pesaran (CADF, 2006; 2007) and Carrion-i-Silvestre et al. (PANKPSS, 2005), are also widely used (Pesaran, 2006).

The panel cointegration test is used to examine the existence of a long-term relationship between series in panel data, and commonly Pedroni (2004) test is used. Pedroni's test uses seven different test statistics to examine the hypothesis of cointegration.

## 4. DATA AND FINDINGS

The impact of the union structures of BRICS member countries on macroeconomic indicators is a significant issue in the literature and for the economies of these countries. This study examines the relationship between the economic growth, oil revenues, and inflation levels of BRICS countries using panel cointegration analysis. The study uses data from the website https://ourworldindata.org/(Access date: March 02, 2024), and the research variables and brief definitions are given in Table 1. The analysis period is from 2000 to 2021.

Firstly, descriptive statistics and graphics were utilized before analyzing the data. Secondly, unit root tests were performed to determine the stationarity of the series. During this stage, cross-sectional dependency was also considered. After making the series stationary at the same level, the effect of inflation and oil revenues on economic growth was examined using the panel cointegration test.

Table 2 shows the descriptive statistics regarding the GDP variable in BRICS countries. It is observed that the People's Republic of China has the highest average GDP while Brazil and South Africa have the lowest average. Additionally, India's GDP has a skewed distribution, as evidenced by the difference between the mean and median and the skewness coefficient.

**Graph 1:** The time path graph for the gross domestic product variable

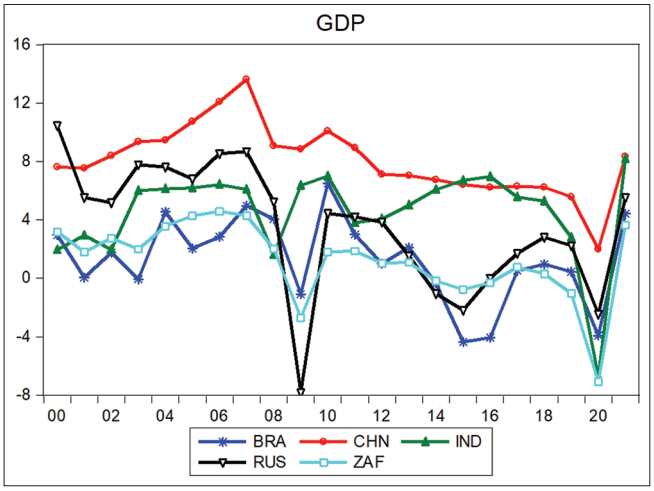



**Table 1: Research variables**

| Code | Country | Variable | Description |
|---|---|---|---|
| BRA | Brazil | GDP (DGDP) | Economic growth by year |
| CHN | China | INF (DINF) | Inflation |
| IND | India | OIL (DOIL) | Oil rents (% of GDP) |
| RUS | Russia | | |
| ZAF | South Africa | | |

GDP: Gross domestic product

The time path graph for the GDP variable in BRICS countries is depicted in Graph 1, which shows a stable structure of GDP across the countries. However, it is important to note that Russia's GDP value sharply decreased in 2009. Moreover, there was a decrease in GDP across all countries in 2020.

Table 3 displays the descriptive statistics for the inflation variable in BRICS countries. The People's Republic of China has the lowest inflation while Russia has the highest inflation. Furthermore, there is no skewed distribution in the BRICS countries, according to both the difference between the mean and median and the skewness coefficient.

Graph 2 shows the time path graph for the inflation variable in BRICS countries. The graph indicates a high level of inflation in Russia during the early 2000s and again in 2015. In Brazil, except for the high inflation rate in 2003, inflation is generally around the average value. The Republic of South Africa experienced high and low inflation fluctuations in 2002 and 2004.

Table 4 provides descriptive statistics for the oil revenue variable in BRICS countries. Based on the average value, the highest income rate is in Russia, and the lowest is in the Republic of South Africa. The skewness values suggest that oil revenue rates show a distribution close to the normal.

Graph 3 illustrates the time path graph for the oil revenue variable in BRICS countries. The graph confirms that Russia's high oil income is visible, despite a fluctuating decline from 2000 to 2021. For the other four countries, oil revenue values are around the average and close to each other, with no significant fluctuations.

Table 5 presents the cross-sectional dependence and unit root test results for the research series. The Breusch-Pagan LM test was used to examine cross-sectional dependency, and it was found that there was cross-sectional dependence for the GDP and OIL variables but not for the INF variable. Unit root tests compatible with cross-sectional dependence revealed that the GDP and OIL variable series were stationary at the first difference, while the INF variable series was stationary at the level.

**Table 2: The descriptive statistics for the GDP variable**

| CODE | Mean | Median | Maximum | Minimum | Standard deviation | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|
| BRA | 1.2968 | 1.3839 | 6.5228 | −4.3583 | 2.9252 | −0.3998 | 2.6246 |
| CHN | 8.0889 | 7.9952 | 13.6358 | 1.9956 | 2.4337 | −0.0039 | 3.9000 |
| IND | 4.5727 | 5.7924 | 8.1844 | −6.7263 | 3.1323 | −2.2144 | 8.7038 |
| RUS | 3.5804 | 4.3359 | 10.4637 | −7.8278 | 4.3693 | −0.7458 | 3.3249 |
| ZAF | 1.2295 | 1.8061 | 4.5911 | −7.1066 | 2.6680 | −1.3626 | 5.4254 |
| All | 3.7537 | 4.0613 | 13.6358 | −7.8278 | 4.0210 | −0.4007 | 3.3109 |

GDP: Gross domestic product

**Table 3: The descriptive statistics for the INF variable**

| CODE | Mean | Median | Maximum | Minimum | Standard deviation | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|
| BRA | 6.3021 | 6.2667 | 14.7149 | 3.2118 | 2.5982 | 1.4635 | 5.9826 |
| CHN | 2.1829 | 1.9608 | 5.9253 | −0.7320 | 1.7382 | 0.4866 | 2.9831 |
| IND | 6.1353 | 5.0398 | 11.9894 | 3.3282 | 2.6442 | 0.8522 | 2.4272 |
| RUS | 9.9256 | 8.7239 | 21.4770 | 2.8783 | 5.3052 | 0.6775 | 2.6561 |
| ZAF | 5.1719 | 5.2616 | 10.0746 | −0.6920 | 2.2583 | −0.1568 | 4.3307 |
| All | 5.9435 | 5.1578 | 21.4770 | −0.7320 | 3.9803 | 1.3862 | 5.8386 |

**Table 4: The descriptive statistics for the OIL variable**

| CODE | Mean | Median | Maximum | Minimum | Standard deviation | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|
| BRA | 1.7352 | 1.7808 | 2.6045 | 0.8323 | 0.4969 | −0.0250 | 2.1083 |
| CHN | 1.1216 | 1.2333 | 2.2306 | 0.1143 | 0.6905 | 0.0662 | 1.7833 |
| IND | 0.8461 | 0.8842 | 1.5850 | 0.1443 | 0.4374 | −0.1578 | 1.7217 |
| RUS | 9.7058 | 9.6632 | 15.3560 | 4.7078 | 2.6616 | −0.0859 | 2.8483 |
| ZAF | 0.6693 | 0.7004 | 1.3793 | 0.1821 | 0.3159 | 0.0879 | 2.4091 |
| All | 2.8156 | 1.2775 | 15.3560 | 0.1143 | 3.6973 | 1.7530 | 4.7213 |

**Table 5: The cross-sectional dependence and unit root test results for the research series**

| Variable | Cross-section dependence | | Level | | First diference | |
|---|---|---|---|---|---|---|
| | t-statistics | P | t-statistics | P | t-statistics | P |
| GDP1 | 84.2688 | 0.0000 | 15.4021 | 0.1181 | 57.5374 | 0.0000 |
| INF2 | 16.6803 | 0.0817 | −3.3210 | 0.0004 | −7.8796 | 0.0000 |
| OIL1 | 128.4020 | 0.0000 | 9.05158 | 0.5272 | 50.8122 | 0.0000 |

1: ADF - Fisher Chi-square, 2: Levin, Lin and Chu t

**Table 6: Panel cointegration test results**

| Pedroni cointegration test | | | | |
|---|---|---|---|---|
| Within-dimension | t-statistic | P | Weighted t-statistic | P |
| Panel v-Statistic | 0.847919 | 0.1982 | −0.15003 | 0.5596 |
| Panel rho-Statistic | −4.18431 | 0.0000 | −3.924553 | 0.0000 |
| Panel PP-Statistic | −9.96144 | 0.0000 | −12.72162 | 0.0000 |
| Panel ADF-Statistic | −6.55729 | 0.0000 | −7.212886 | 0.0000 |
| Between-dimension | t-statistic | P | | |
| Group rho-Statistic | −3.59085 | 0.0002 | | |
| Group PP-Statistic | −16.3755 | 0.0000 | | |
| Group ADF-Statistic | −7.49521 | 0.0000 | | |

| Kao cointegration test | | |
|---|---|---|
| Test results | t-statistic | P |
| ADF | −4.794435 | 0.0000 |
| Residual variance | 29.57422 | |
| HAC variance | 5.494130 | |

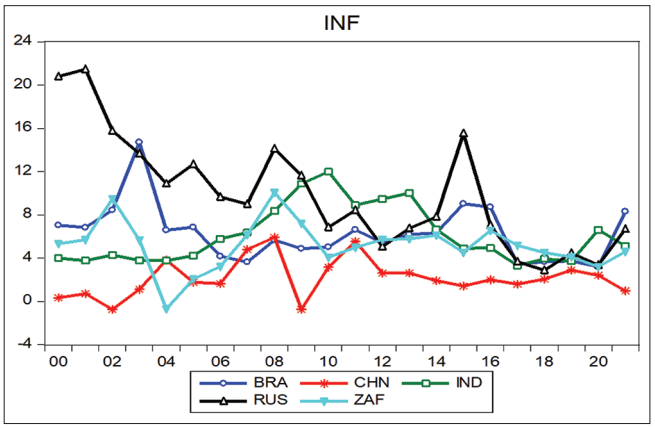
**Table 7: The results of the panel granger causality test**

| Null hypothesis | F-statistic | P |
|---|---|---|
| DINF does not Granger Cause DGDP | 3.31029 | 0.0410 |
| DGDP does not Granger Cause DINF | 1.15441 | 0.3199 |
| DOIL does not Granger Cause DGDP | 0.89389 | 0.4127 |
| DGDP does not Granger Cause DOIL | 2.96138 | 0.0568 |
| DOIL does not Granger Cause DINF | 0.11042 | 0.8956 |
| DINF does not Granger Cause DOIL | 7.27820 | 0.0012 |

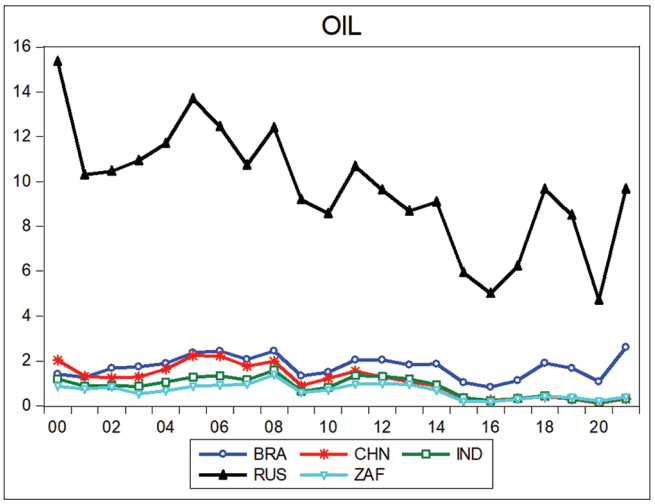
Table 6 shows the findings obtained by the Pedroni and Kao methods for the existence of cointegration for GDP, OIL, and INF variables in BRICS countries. The Pedroni method revealed that the hypothesis of panel cointegration between the series could only be accepted based on the results of the Panel v-statistic. In other tests, the null hypothesis was rejected. Based on the test findings, the panel cointegration hypothesis was accepted between the series. This means that there is a long-term relationship between oil revenues, inflation, and economic growth for BRICS countries.

Table 7 displays the results of the Panel Granger causality test. The test findings indicate that inflation has a causal effect on GDP and oil revenues at the 5% significance level, while GDP has a causal effect on oil revenues at the 10% significance level.

**Graph 2:** The time path graph for the INF variable




**Graph 3:** The time path graph for the OIL variable




## 5. CONCLUSION AND RECOMMENDATIONS

This study examined the relationship between oil revenues, inflation, and economic growth in BRICS countries using a panel cointegration analysis. Many studies have shown a link between these variables, but this study aimed to see if these relationships

hold for a specific group of countries. The results indicate a cointegration relationship, and even a causal relationship, between economic growth, inflation, and oil revenues. This is an important finding as it highlights the impact of energy, specifically oil revenues, on economic growth. However, other macro indicators also play a role in economic growth. By including other social and economic variables in the study model, the effect of oil revenues on economic growth can be assessed from a different perspective.

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