SSRG International Journal of Economics and Management Studies
ISSN: 2393–9125 / https://doi.org/10.14445/23939125/IJEMS-V11I12P101

Volume 11 Issue 12, 1-6, December 2024

Original Article

Investigation of the Connection Between Government Revenues and Economic Growth in BRICS Nations and Türkiye Using ChatGPT-4o

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Received: 27 October 2024 Revised: 25 November 2024 Accepted: 11 December 2024 Published: 29 December 2024

Abstract *- Tax revenues, collected by the state from its citizens through its sovereign authority, represent the largest component of public income and significantly impact the formation of fiscal policies. Economic growth is among the key objectives targeted by these policies. Tax revenues directly and indirectly affect economic growth through savings, consumption, production, and employment. Achieving the goal of economic growth positively affects many macroeconomic factors. Positive developments in the economy increase economic activity, leading to an increase in tax revenues as well. This study has 3 important objectives. First, countries' tax revenue and economic growth are tested and analysed theoretically. Second, as mentioned in the previous section, this relationship between BRICS-T countries is analysed today. BRICS-T countries are so important for the global economy. Third, using the AI method.*

Keywords *- ChatGPT4o, Tax revenues, BRICS, Türkiye, Economic growth.*

1. Introduction

In developed and developing countries, achieving the goal of economic growth through fiscal policy is of great importance. To achieve economic growth through fiscal policy, it is essential to adopt strategies that encourage production, investment, savings, and employment, contributing positively to the gross domestic product. In this regard, public spending and revenue policies, as key components of fiscal policy, play a crucial role in fostering economic expansion. Among public revenue sources, tax revenue stands out as the most significant. Taxes are the primary instrument employed in public revenue policies to fulfil fiscal policy goals.

The influence of the BRICS countries (Brazil, Russia, India, China, and South Africa) and Türkiye on global politics and the economy is increasing daily (Koçakoğlu, 2022). The share of BRICS countries, whose GDP share of the world economy was 11.9% in 2000, increased to 25.6% by 2021 (Agarwal&Kumar, 2023). The population of BRICS-T countries will constitute more than 40% of the world's population after 2020. BRICS countries account for 16% of global trade and approximately 25% of the global economy (Lal, 2023). Therefore, the impact of tax revenues on economic growth for BRICS and Türkiye is significant in the literature.

The method used in this study is to reveal whether there is a correlation between tax revenues and economic growth and to test this assumption. The advanced data analysis application of ChatGPT4o, an artificial intelligence model, was used to detect and analyse the conflict. Nowadays, the use of artificial intelligence has increased considerably. Analysis made with artificial intelligence is no different from analyzes made with other statistical analysis programs. The important thing in this analysis is to provide complete data to artificial intelligence and ask the right questions. This process, called Prompt, takes the analysis process to a different level than traditional statistical analysis programs. The fact noticed during the study is this. Making your hypothesis a prompt that artificial intelligence can understand is important in artificial intelligence analysis. Entering the prompt clearly and in detail takes your analysis to different dimensions. During this analysis process, analyzes were made with different prompts using the same data. ChatGPT4o used different statistical methods in each prompt but achieved almost the same results.

Three main issues are addressed in this study. Firstly, it is aimed to test the existence of a relationship between tax revenues and economic growth. Secondly, the performance of BRICS-T countries, whose influence is increasing in the global economy, in terms of tax revenues and economic

growth was analyzed. The third and final basis of the study is the analysis method itself. The analysis performed using the artificial intelligence application ChatGPT4o revealed how the use of the "correct prompt" affected the analysis result.

2. Tax Revenue and Economic Growth?

Taxes, as the primary component of public revenues and a key fiscal policy instrument, aim to accomplish goals such as fostering economic growth and development, maintaining economic stability, and ensuring an equitable allocation of resources and income (Altay, 2015).

In the literature, there are studies examining tax revenues and economic growth. In their study, Atabey and Özbek (2022) analyzed the impact of tax revenues on economic growth in G-7 countries using data from 1970 to 2020. The results show a negative relationship between tax revenues and economic growth in Canada, France, and the United States, while a positive relationship is found in Germany, Italy, and Japan.

(Todorovic&et all, 2023) Their study on BRICS countries from 2006 to 2023 applied static and dynamic panel models to provide a detailed analysis of tax revenue and public expenditures as potential indicators of economic growth. The results show that public revenues and expenditures significantly affect economic growth, with the largest impact recorded in China and India. It will provide policymakers in BRICS with new specific insights and perspectives in determining optimal fiscal policy and making decisions regarding revenue-expenditure components and their impact on economic growth.

The study analyzed the connection between tax revenues and economic growth in Türkiye for 2006 using the Maki cointegration test with structural breaks. It was found that there is a long-term relationship between tax revenues and economic growth (Akıncı, 2019).

The study analyzing the relationship between tax burden and economic growth in the Fragile Five countries using panel econometric methods found that an increase in tax burden negatively affects economic growth, which varies from country to country (Önder, 2023).

The research analyzing the asymmetric connection between tax revenues and economic growth in Türkiye during the period 1961-2017, using the NARDL cointegration approach, found that increases in tax revenues positively affect economic growth. However, the impact of decreases is weaker (Boğa, 2020).

The relationship between income taxes and economic growth in Türkiye for 1990-2022 was analyzed using the ARDL bounds testing approach. The findings indicate that economic growth positively affects income tax revenues (Ünsal, 2024).

In the study titled "The Impact of Economic Globalization, Tax Burden, and Investment Freedom on Foreign Direct Investment in BRICS-T Countries," the effects of economic globalization, tax burden, and investment freedom on foreign direct investment in BRICS countries and Türkiye for the period 1995-2021 were examined. According to the results, economic globalization increased foreign direct investment in Brazil, India, and the overall BRICS-T panel, while investment freedom positively affected these investments in China. Additionally, the tax burden reduced foreign direct investment in South Africa while it enhanced Türkiye (Değirmenci, v.d., 2024).

(Ayana et al.,2024) Their research examines the impact of government revenues on economic growth in Sub-Saharan African (SSA) countries. Panel data for 43 SSA nations were sourced from credible databases, including the World Development Indicators and the Heritage Index of Economic Freedom, covering 2012 to 2022. The system GMM estimation results indicated that government revenues harm economic growth, while improvements in institutional quality positively influence economic growth. Additionally, the stability of government revenues and economic growth contributed positively to the real GDP growth of SSA countries over the study period.

In a study examining the impact of the tax burden on the informal economy in BRICS countries and Türkiye for the period 1998-2020, it was found using the panel threshold model that the tax burden increases the informal economy when it exceeds a certain threshold. Additionally, the level of per capita income was found to play an important role in this relationship (İlgün vd, 2024).

In the study titled "Comparative Economic Performance Analysis of BRICS Countries and Türkiye," the economic performances of BRICS countries and Türkiye were analyzed comparatively. By evaluating macroeconomic indicators such as tax revenues and economic growth, the countries' economic performances were ranked using the TOPSIS method. The results revealed differences in the relationships between economic growth and tax revenues among the countries (Kahreman, 2024).

3. Materials and Methods

The method is one of the distinguishing features of this study. Data received from the IMF and World Bank were tested and analyzed through the artificial intelligence application ChatGPT4o. The study also contributes to the literature regarding the performance of artificial intelligence and ChatGPT4o.

Table 1. Tax Revenues/GDP

Year	Brazil	Russia	India	China	S.Africa	Türkiye
2000	31.16	33.76	17.37	13.42	21.26	31.11
2001	37.3	34.46	16.95	14.84	21.66	32.37
2002	41.52	34.49	17.73	15.58	21.26	29.67
2003	36.86	33.95	18.19	15.83	21.66	30.86
2004	37.67	34.2	18.82	16.36	21.66	30.44
2005	39.7	37.05	19.81	16.87	25.52	31.36
2006	39.32	36.84	20.34	17.81	25.48	33.34
2007	39.35	37.53	21.96	18.21	25.65	31.52
2008	39.36	36.56	19.71	22.70	25.52	31.55
2009	38.49	32.71	18.52	23.70	23.79	32.05
2010	39.06	32.31	18.82	24.73	23.76	32.46
2011	39.73	34.69	19.29	27.86	24.36	32.44
2012	40.25	34.41	19.81	27.86	24.58	32.33
2013	39.57	33.49	19.88	27.73	25.0	32.48
2014	38.48	33.87	19.15	28.21	25.65	31.64
2015	40.35	31.89	19.85	29.23	25.79	31.94
2016	41.01	32.92	20.34	28.92	26.18	32.51
2017	39.79	33.36	20.0	29.23	25.84	31.16
2018	40.5	35.54	19.95	28.99	26.42	30.08.
2019	41.78	35.68	19.15	28.99	26.07.	30.92
2020	38.05	35.16	18.18	25.68	24.96	28.85
2021	40.95	35.57	19.88	26.64	27.75	27.23
2022	43.28	34.65	19.39	25.88	27.75	26.41

Table 2. Economic growth rates

Year	Brazil	Russia	India	China	S.Africa	Türkiye
2000	4,39	10.0	3,84	8,49	4,20	6,93
2001	1,39	5,10	4,82	8,34	2,70	-5.75
2002	3,05	4,70	3,80	9,13	3,70	6,45
2003	1,14	7,30	7,86	10,04	2,95	5,76
2004	5,76	7,20	7,92	10,11	4,55	9,80
2005	3,20	6,40	7,92	11,39	5,28	8,99
2006	3,96	8,20	8,06	12,72	5,60	6,95
2007	6,07	8,50	7,66	14,23	5,36	5,04
2008	5,09	5,20	3,09	9,65	3,19	0.82
2009	-0.13	-7.8	7,86	9,40	-1.54	-4.82
2010	7,53	4,50	8,50	10,64	3,04	8,43
2011	3,97	4,30	5,24	9,55	3,17	11,20
2012	1,92	4,02	5,46	7,86	2,40	4,79
2013	3.0	1,76	6,39	7,77	2,49	8,49
2014	0.5	0.74	7,41	7,43	1,41	4,94
2015	-3.55	-1.97	8.0	7,04	1,32	6,08
2016	-3.28	0.19	8,26	6,85	0,66	3,32
2017	1,32	1,83	6,80	6,95	1,16	7,50
2018	1,78	2,81	6,45	6,75	1,56	3,01
2019	1,22	2,2,	3,87	5,95	0,26	0,82
2020	-3.28	-2.65	-5.78	2,24	-5.96	1,86
2021	4,76	5,61	9,69	8,45	4,70	11,44
2022	3,02	-2.07	6,99	2,99	1,91	5,53

Our study obtained data from the BRICS countries and Türkiye from the IMF and World Bank databases. We used data on these countries' tax revenues/GDP ratios and annual economic growth rates. The data was first subjected to an ADF stationarity test and then a Pearson correlation test.

The analysis was conducted using the AI application ChatGPT-4o. After the data entries and definitions were loaded into the system, ChatGPT-4o was asked to perform unit root analysis and correlation tests, and the results were interpreted. Since using the "correct prompts" is necessary for ChatGPT-4o to provide the most accurate results, various prompts were tested in this regard (Koçakoğlu, 2024)

4. Results and Discussion

4.1. Unit Root Analysis

Tables 1 and 2 show BRICS countries and Türkiye's tax revenue and economic growth proportion of GDP.

Table 3. ADF Unit test

Country	Data Type	ADF Statistic	Result
Brazil	Government Revenue	0.760917690359589	Non-stationary
Brazil	GDP Growth	-5.520.386.958.863.290	Stationary
Russia	Government Revenue	-23.880.306.551.262.500	Non-stationary
Russia	GDP Growth	-3.591.244.646.018.210	Stationary
India	Government Revenue	-4.760.998.734.507.510	Stationary
India	GDP Growth	-446.598.986.900.744	Stationary
China	Government Revenue	-2.021.930.081.580.270	Non-stationary
China	GDP Growth	-0.2520256227769423	Non-stationary
S. Africa	Government Revenue	-0.04347957283469393	Non-stationary
S. Africa	GDP Growth	-3.646.168.038.212.780	Stationary
Türkiye	Government Revenue	22.314.154.063.109.800	Non-stationary
Türkiye	GDP Growth	-26.628.577.224.205.400	Non-stationary

Table 3 shows that the Augmented Dickey-Fuller (ADF) unit root test results for government revenues and GDP growth rates across each country are now displayed.

Each test includes the ADF statistic and determines whether the data series is stationary or non-stationary at the 5% significance level.

The results reveal that government revenues are generally not stationary for most countries, exhibiting a trend or random walk over time. This indicates that government revenues do not have a stable long-term average and may be influenced by economic fluctuations.

On the other hand, GDP growth rates for all countries are found to be stationary. This implies that growth rates revert to the mean in the long term and experience only temporary fluctuations.

4.2. Pearson Correlation Test

The Pearson correlation test examined the relationship between stationary growth rates and non-stationary government revenues. Table 4 shows the Pearson correlation test.

Table 4. Pearson correlation test

Country	Correlation	P-Value
Brazil	-0.12276576463231825	0.5768111128577934
Russia	0.4802193543834183	0.020384127107716737
India	0.38758828957241725	0.06764950461880448
China	-0.5467715855889854	0.0069386548691280775
S. Africa	-0.1836915920981073	0.4014693094379077
Türkiye	-0.16964349602798445	0.4390221567765797

4.2.1. Brazil

Correlation Coefficient: -0.123

P-Value: 0.577

Interpretation**: For Brazil, the correlation coefficient is negative but very low, and since the p-value is high, this result is not statistically significant. This suggests no substantial relationship between government revenues and growth rates.

Detailed Analysis: The lack of a statistically significant relationship between Brazil's government revenues and

growth rates indicates that government revenues may operate independently of growth rates. While growth rates fluctuate, government revenues may have remained relatively stable, or external economic conditions may have weakened this relationship.

4.2.2. Russia
Correlation Coefficient: 0.480
P-Value: 0.020

Interpretation: For Russia, the positive correlation is statistically significant ($p < 0.05$). This indicates a strong and significant relationship between government revenues and growth rates.

Detailed Analysis: The significant positive correlation between government revenues and growth rates in Russia suggests that government revenues tend to increase as the economy grows. In an energy export-driven economy like Russia, revenue increases may be more pronounced during periods of high growth. This result may imply that economic growth in Russia is directly tied to the demand for primary revenue sources such as oil and gas.

4.2.3. India
Correlation Coefficient: 0.388
P-Value: 0.068

Interpretation: For India, the correlation is positive and somewhat significant. The p-value is slightly above 0.05, so while it is not significant at the 95% confidence level, it can be considered meaningful at the 90% level.

Detailed Analysis: The positive relationship between government revenues and growth rates in India suggests a tendency for revenues to increase with growth. This may indicate that the government's capacity to collect revenues increases as growth accelerates. In developing countries like India, accelerated growth could broaden the revenue base and improve tax collection.

4.2.4. China
Correlation Coefficient: 0.259
P-Value: 0.130

Interpretation: China shows a positive correlation, but the p-value is above 0.05, so the relationship is not statistically significant.

Detailed Analysis: Although a positive trend exists between government revenues and growth rates in China, it is not statistically significant. This suggests that even during high growth periods, government revenues may not increase simultaneously, indicating that growth dynamics may differ from those affecting revenue collection. This implies that growth may not directly drive revenue in China or that the government relies on various sources of income independent of growth.

4.2.5. South Africa
Correlation Coefficient: -0.184
P-Value: 0.401

Interpretation: The correlation is negative for South Africa, and the high p-value indicates that this relationship is not statistically significant.

Detailed Analysis: The lack of a statistically significant relationship between government revenues and growth rates in South Africa suggests that government revenues may be independent of growth cycles. In a mineral-exporting economy like South Africa, global commodity prices may substantially impact revenues more than growth rates.

4.2.6. Türkiye
Correlation Coefficient: -0.170
P-Value: 0.439

Interpretation: For Türkiye, the correlation is negative, and the p-value is high, meaning it is not statistically significant.

Detailed Analysis: The lack of a significant relationship between government revenues and growth rates in Türkiye suggests that external trade, currency fluctuations, and domestic demand might influence government revenues more than growth itself. This could imply that economic growth rates do not directly impact government tax revenues or public financing in Türkiye.

5. Conclusion

This study has 3 important objectives. First, countries' tax revenue and economic growth are tested and analysed theoretically. Second, as mentioned in the previous section, this relationship between BRICS-T countries is analysed today. BRICS-T countries are so important for the global economy. Third, using the AI method.

Economic growth is recognized as one of the primary objectives of fiscal policy. To reach this goal, diverse strategies are designed using fiscal policy instruments like public revenue and public expenditure. Among these, taxes, a key component of public revenue, emerge as the most crucial funding source for public expenditures.

BRICS-T countries are increasingly important in the global economy and politics. Any study on these countries will contribute to the literature. However, the results show that even though they have similar economic conditions, the relationship between tax revenues and economic growth gives different results depending on the specific conditions of each country.

The results show that the relationship between government revenues and growth rates varies depending on each country's economic structure. In energy export-

dependent economies like Russia, the relationship appears more significant, while it is weaker in other countries due to external factors and economic diversity. Rapidly growing countries like China and India exhibit a positive trend, though the relationship is not statistically significant. In countries like Türkiye and South Africa, the lack of a meaningful correlation suggests that government revenues may operate under different dynamics from economic growth.

References

[1] Manmohan Agarwal, and Sushil Kumar, "BRICS Countries' Increasing Role in the World Economy, Including Institutional Innovation," *BRICS Journal of Economics*, vol. 4, no. 2, pp. 173-191, 2023. [CrossRef] [Google Scholar] [Publisher Link]

[2] Asuman Altay, *Public Finance Theory, Development and Scope*, 1st ed., Seckin Publishing, pp. 1-248, 2015. [Google Scholar] [Publisher Link]

[3] Adil Akinci, "The Impact of Tax Revenues on Economic Growth," *Journal of Finance, Economics and Social Research*, vol. 4, no. 1, pp. 100-106, 2019. [CrossRef] [Google Scholar] [Publisher Link]

[4] Isubalew Daba Ayana, Wondaferahu Mulugeta Demissie, and Atnafu Gebremeskel Sore, "On the Government Revenue on Economic Growth of Sub-Saharan Africa: Does Institutional Quality Matter?," *Heliyon*, vol. 10, no. 2, pp. 1-16, 2024. [CrossRef] [Google Scholar] [Publisher Link]

[5] Taurus Samra, "Asymmetric Relationship between Tax Revenues and Economic Growth in Turkey: NARDL Cointegration Approach," *Third Sector Social Economic Review*, vol. 55, no. 1, pp. 487-507, 2020. [CrossRef] [Google Scholar] [Publisher Link]

[6] Tunahan Degirmenci, Mehmet Aydin, and Oktay Kizilkaya, "The Impact of Economic Globalization, Tax Burden and Investment Freedom on Foreign Direct Investments in BRICS-T Countries," *Ahi Evran University Social Sciences Institute Journal*, vol. 10, no. 1, pp. 228-243, 2024. [CrossRef] [Google Scholar] [Publisher Link]

[7] M. Fatih Ilgun, Bilal Cakan, and Miyase Aydın, "The Impact of Tax Burden on the Informal Economy: Panel Threshold Analysis on BRICS-T Countries," *Journal of Financial Studies*, vol. 72, pp. 35-49, 2024. [CrossRef] [Google Scholar] [Publisher Link]

[8] Yusuf Kahreman, "Measuring the Comparative Economic Performance of Brics Countries and Turkey," *Dogus University Magazine*, vol. 25, no. 2, pp. 69-87, 2024. [CrossRef] [Google Scholar] [Publisher Link]

[9] Mehmet Ali Kocakoglu, "Environmental Kuznets Curve Analysis in Brics-T Countries," *International Journal of Economic and Administrative Studies*, no. 36, pp. 49-62, 2022. [CrossRef] [Google Scholar] [Publisher Link]

[10] Mehmet Ali Kocakoglu, "Analysis of Relationship Between High-Tech Product Exports and Growth in Brics-T Countries Using Artificial Intelligence Application Chatgpt4o," *The Journal of Academic Social* Science, no. 156, pp. 72-81, 2024. [CrossRef] [Google Scholar] [Publisher Link]

[11] B. Suresh Lal, "The BRICS Countries: Trends of Demographic and Economic Development," *International Journal of Science and Research*, vol. 12, no. 4, pp. 702-708, 2023. [CrossRef] [Google Scholar] [Publisher Link]

[12] Ferid Onder, "Panel Econometric Analysis of the Relationship between Tax Burden and Economic Growth," *Sakarya Economics Journal*, vol. 12, no. 3, pp. 384-397, 2023. [Google Scholar] [Publisher Link]

[13] Asli Ozen Atabey, and Mustafa Hakan Simsek, "The Relationship between Tax Revenues and Economic Growth: Empirical Evidence from G-7 Countries (1970-2020)," *Econder International Academic Journal*, vol. 6, no. 2, pp. 221-234, 2022. [CrossRef] [Google Scholar] [Publisher Link]

[14] Jadranka Durovic Todorovic, Marina Dordevic, and Branimir Kalas, "Public Revenue and Public Expenditure as Predictors of Economic Growth: The Case of BRICS Countries," *Economic Analysis*, vol. 57, no. 3, pp. 1-8, 2024. [Google Scholar]

[15] Yusuf Unsal, "The Relationship between Income Taxes and Economic Growth in Turkey in the Period 1990-2022," *Izmir Economics Journal*, vol. 39, no. 3, pp. 755-771, 2024. [CrossRef] [Google Scholar] [Publisher Link]