Determinants of Economic Growth in BRICS Countries: A Panel Data Analysis Approach

Mohamed Khaled Al-Jafari

Department of Accounting and Finance, College of Business Administration

Prince Mohammad Bin Fahd University, Al Khobar, Kingdom of Saudi Arabia

E-mail: aljafarimohamedkhaled@yahoo.com

Abstract

This study investigates the driving forces of economic growth in BRICS (Brazil, Russia, India, China, and South Africa) countries. Therefore, explanatory variables including foreign direct investment, investment in information and technology, inflation rate, economic size and domestic credit provided to private sectors are utilized. In addition, unit root tests and the error correction model are employed on a data collected from 2000 till 2014. Results indicate that variables are stationary and integrated at the first order. On the other hand, foreign direct investment found to have a positive and significant effect on economic growth in the long-run. In contrary, investment in information and technology, inflation rate and economic size exhibited a negative and significant effect on economic growth. The short-run results show that the economic size variable has a negative and significant effect on economic growth, while the rest of the other variables found to be insignificant. The findings are consistent with previous literatures suggesting that BRICS policymakers must encourage foreign direct investments and eliminate any obstacles in order to achieve a high and sustainable economic growth.

Keywords: Economic growth, Foreign direct investment, BRICS, Panel data, Unit root test, Error correction model

JEL Classification: C23, O40, O57, P52

1. Introduction

Economic growth of countries is a very controversial and debatable subject that has been investigated thoroughly in the literature. Some believe that economic growth is detrimental to the environment and it will increase pollution and global warming. Furthermore, it will not

benefit the needy segment of society and ultimately increasing the crime rate and reducing the standard of living. On the other hand, proponents of economic growth believe strongly that it will lead to reduction in unemployment and ultimately reducing poverty. Moreover, governments accounting books will look better and they can spend more money on governments programs such as education and health care. This at the end will uplift from the standard of living of society. Regardless of the different points of view, most economists believe that economic growth will prosper societies and increase their standard of living. Accordingly, extensive empirical studies related to economic growth theories and issues are taken place such as in Solo (1956), Feder (1983), Barro (1991, 1997), Mankiw, et al., (1992), Squire (1993), Kim and Lau (1994), Bloom and Finlay (2009), Aghion and Howitt (2009), Altaee et al., (2015, 2016) and others. However, this study selected BRICS countries for several positive reasons: i- they constitute a large part of the globe in terms of land and population (approximately half of the world population); ii- they are rich in human and natural resources; and iii- they have good and developed educational systems that will provide a skilled labor force; iv- they constitute one fourth of the world gross domestic product which make them a huge economic power that can be reckoned with. This could give them comparative advantages in many ways in comparison with the European Union and the United States. Moreover, the world was baffled as a result of the economic growth that each of China and India were achieving during the financial crisis of 2008 while the rest of the industrialized economies went to a deep recession.

Therefore, the objective of this study is to examine the determinants of economic growth in BRICS countries utilizing unit root test and error correction model. This paper is unique from previous empirical studies in several ways. Empirical studies that investigated the determinants of economic growth in BRICS economies are rare. In addition, this study includes some variables that have not been tested before such as the variable of investment in information and technology and the variable of domestic credit to the private sector. Moreover, data utilized in this paper are more recent and updated and it includes all member countries.

The paper is organized into five sections as follows: Section 2 displays previous empirical studies. On the other hand, data and research methods are discussed in section 3. Section 4 discusses the empirical findings and results, while the concluding remarks are presented in section 5.

2. Literature Review

There are plenty of articles that discussed the determinants of economic growth on most countries around the globe. However, there is a lack of research conducted on BRICS countries as an important economic bloc that can influence the world economy. Therefore, this section will briefly shed the light on researches related to the determinants of economic growth for countries of the BRICS individually and collectively.

Starting with a recent study by Sinha and Sen (2016), where the generalized method of moments (GMM) is utilized to investigate the causal association between economic growth, CO_2 emission, trade volume, and human development for BRIC countries. Their findings show bidirectional causality between CO_2 emission and economic growth and unidirectional

association from trade volume to economic growth. On the other hand, Prabhakar et al., (2015) found a positive and statistically significant impact between economic growth, foreign direct investment, and trade of the BRICS countries. Similar results were obtained by Agrawal (2015) showing that foreign direct investment and economic growth are cointegrated, and there is a long-run causality relationship running from foreign direct investment to economic growth in BRICS economies. Moreover, Ozturk (2015) found that economic growth in BRICS countries leads to an increase in energy demand and environmental deregulation. By the same token, Gur (2015) found a significant negative relationship between economic growth and unemployment. He concluded that a growth in GDP will lead to a reduction in unemployment in BRIC countries. In addition, Basu, Barik and Arokiasamy (2013) explored the effect of demographic factors on economic growth in the BRICS and selected developed countries. They found that growth of productivity of workers will lead to growth rate of GDP per capita. In addition, education was found to have a significant positive impact on economic growth. Similar to the results of previous studies, Jahaveh (2012) discovered a positive and significant effect between real GDP and foreign direct investment in BRICS economies. On the other hand, Goel and Korhonen (2011) found that export and literacy rate will lead to economic growth. In addition, the study found a positive relationship between growth rate and corruption in the BRIC countries. Another study by Vijayakumar et al., (2010) obtained the same results of a positive and significant relationship between economic growth and foreign direct investment, concluding that BRICS countries must create an attractive investment environment to encourage foreign investments and sustain a good economic growth.

Investigating economic growth of Brazil was performed by Jayme Jr. (2003). His results found a positive cointegration between the growth in export and the long-term economic growth.

On the other hand and in India, Agrawal (2015) concluded that a decline in poverty comes as a result of an increase in economic growth. On the other hand, Sreelata and Anup (2014) found that domestic capital formation, employment, export, FDI and money supply have a positive effect on GDP growth. Similar results were obtained by Aamir, Saba and Tazeen (2011), they found that gross of capital formation, exports and employment have a positive and long-term impact on economic growth in India.

Moving to China, Hasan, Wachtel, and Zhou (2009) found a strong relationship between the development of financial markets, legal environment, awareness of property right and political plurism on economic growth in China. On the other hand, Liang and Teng (2006) found a unidirectional causality from economic growth to financial development. Another study by Yao (2006) found that exports and FDI have a strong and a positive effect on economic growth. However, Liu, Burridge and Sinclair (2002) found a bi-directional causality between economic growth, FDI and exports. On the other hand, the convergence hypothesis was supported by Chen and Feng (2000). They found that private and semi-private enterprise, higher education and international trade have a positive impact on economic growth.

3. Data and Research Methodology

The sample of the study consists of variables of economic growth, foreign direct investment, investment in information and technology, exchange rate, inflation rate, economic size and

domestic credit to private sector for BRICS countries from 2000 to 2014. The data were obtained from the website of the World Bank (www.worldbank.org), World Development Indicators 2015. Therefore, panel data analysis is utilized in order to deal with two dimensional of cross sectional and time series.

The unit root test and error correction model are used to capture the effect of economic variables on economic growth for BRICS countries. In addition, the error correction model used in this research expressed in the following two equations:

Long-run model

$$\Delta G_t = a_0 + \varphi_1 \ln G_{t-i} + \varphi_2 \ln DI_{t-i} + \varphi_3 \ln ICT_{t-i} + \varphi_4 \ln INFLA_{t-i}$$
$$+ \varphi_5 \ln SIZE_{t-i} \; \varphi_6 \ln CR_{t-i} + \varepsilon_t \tag{1}$$

Short-run model

$$\Delta \ln G_t = a_0 + \sum_{i=1}^{n} \beta_1 \Delta \ln G_{t-i} + \sum_{i=1}^{n} \beta_2 \Delta \ln DI_{t-i} + \sum_{i=1}^{n} \beta_{3 \Delta \ln ICT_{t-i}}$$

$$+ \sum_{i=1}^{n} \beta_4 \Delta \ln INFLA_{t-i} + \sum_{i=1}^{n} \beta_5 \Delta \ln SIZE_{t-i}$$

$$+ \sum_{i=1}^{n} \beta_6 \Delta \ln CR_{t-i} + \lambda_1 ECT_{t-1} + \varepsilon_t \tag{2}$$

Where:

G is the annual percentage growth rate of GDP at market prices based on constant local currency.

DI is the foreign direct investment refers to direct investment equity flows in the economy and measured by the natural logarithm of the FDI.

ICT is the investment in information and technology that refers to imports of information and communication technology goods measured as a proportion of total goods imports.

INFLA is the inflation rate measured by the annual growth rate of the GDP implicit deflator and shows the rate of price change in the economy as a whole.

SIZE is the economic size measured by the natural logarithm of the GDP.

CR is the domestic credit to private sector measured as a proportion of the GDP.

In addition, φ_i denotes the coefficients of variables on long-run while the β_i represents the coefficients of variables on short-run. On the other hand, ECT is the error correction term lagged one period obtained from the long-run equation. It represents the adjustment coefficient, and must be significant, negative, and less than one to prove a long-run relationship. Also, ε_t is serially uncorrelated disturbance with zero mean and constant variance.

4. Empirical Results

4.1 Descriptive Statistics

Table 1 listed below contains the summary of the descriptive results for each variable included in the study from 2000 to 2014.

Table 1. Descriptive statistics

Russia	G	DI	ICT	INFLA	SIZE	CR
Mean	4.596931	23.75091	6.969465	15.45739	27.57400	33.91355
Std. Dev.	4.285686	1.179246	1.440152	8.463752	0.762569	13.09240
Jarque-Bera	11.26793	1.793239	1.627182	3.415202	1.502110	1.194371
Probability	0.003574	0.407946	0.443263	0.181300	0.471869	0.550358
Brazil						
Mean	3.360015	24.31737	9.952739	8.067478	27.83933	43.54006
Std. Dev.	0.765655	1.012444	2.117963	1.929708	0.622959	14.37816
Jarque-Bera	0.354562	1.140769	0.636284	23.81137	1.611728	1.575108
Probability	0.837545	0.565308	0.727499	0.000007	0.446702	0.454956
India						
Mean	7.009223	23.39353	6.624836	5.608616	27.67533	42.29207
Std. Dev.	2.253577	0.944610	1.241176	2.117708	0.527959	9.200205
Jarque-Bera	1.164026	1.957277	0.520025	1.507335	1.411599	1.655929
Probability	0.558773	0.375822	0.771042	0.470637	0.493714	0.436938
China						
Mean	9.721698	25.54551	21.96324	3.876061	28.88267	120.2044
Std. Dev.	1.908028	0.699363	2.381505	2.896934	0.757123	11.18578
Jarque-Bera	2.056969	1.409637	0.836150	1.463583	1.319744	0.589754
Probability	0.357548	0.494198	0.658313	0.481046	0.516917	0.744623
South Africa						
Mean	3.214174	21.88847	9.513019	7.222106	26.25600	139.9830
Std. Dev.	1.796898	1.006356	1.522648	1.833563	0.432415	14.08600
Jarque-Bera	3.677956	1.965281	1.115427	6.220226	1.706641	1.200857
Probability	0.158980	0.374321	0.572517	0.044596	0.425998	0.548577

From the results of descriptive statistics listed in the Table 1, we can note that China has recorded the highest average economic growth between the BRICS countries, followed by India 7.01 %, Russia 4.6 %, Brazil 3.36 % and South Africa 3.21%. China also outperforms the rest of the economies of other BRICS countries in terms of foreign direct investment. The annual size of FDI measured by natural logarithm of FDI reached to 25.55 in China followed by Brazil 24.32, Russia 23.75, India 23.39 and South Africa 21.89. Moreover, China has achieved top spot of investment in information and technology amounted to an annual average of 21.96 %, while Russia and India have the lowest annual average of ICT with 6.96% and 6.62% respectively. On the other hand, Russia has highest annual average inflation rate between BRICS countries with rate of 15.46 % while China has the lowest annual average inflation rate

with 3.88%. The annual average domestic credit to private sector is the highest in South Africa with 139.98% followed by China 120.2 %, Brazil 43.5%, India 42.3% and Russia 33.9 %.

Normality test is applied on all times series variables by using Jarque-Bera test. The results show that the null hypothesis of Jarque-Bera test cannot be rejected for all the variables except for economic growth for Russia, inflation in Brazil and South Africa. Therefore, we can conclude that variables under consideration follow a normal distribution.

4.2 Correlation Analysis

The correlation matrix of variables under consideration is presented in Table 2. The correlation coefficient between foreign direct investment (FDI) and economic growth (G) is positive and significant at 1% level. Similarly, a positive and significant relationship exists between investment in information and communication technology (ICT) and economic growth (G). In addition, the correlation coefficient between economic size (SIZE) and economic growth (G) is positive and significant as well. On other hand, the relationship between economic growth (G) and each of inflation rate (INFLA) and domestic credit (CR) variable is not significant.

Table 2. Correlation matrix of variables under consideration

Correlation-Probability	G	DI	ICT	INFLA	SIZE	CR
G	1.000000					
P-value	-----					
DI	0.319494	1.000000				
P-value	0.0052	-----				
ICT	0.505660	0.500308	1.000000			
P-value	0.0000	0.0000	-----			
INFLA	0.008153	-0.197151	-0.411812	1.000000		
P-value	0.9447	0.0900	0.0002	-----		
SIZE	0.363586	0.922465	0.461001	-0.261590	1.000000	
P-value	0.0013	0.0000	0.0000	0.0234	-----	
CR	0.065608	-0.020166	0.520893	-0.413458	-0.034883	1.000000
P-value	0.5760	0.8637	0.0000	0.0002	0.7664	-----

4.3 Unit Root Test

Investigating the long-run relationship requires that all the variables included in the model must be integrated at the same order. Accordingly, the results in Table 3 and Table 4 show that

the null hypothesis of unit root test is rejected at the first difference for all variables, confirming that all times series are stationary and integrated at the first order.

Table 3. ADF-Fisher unit root test

	At level	**At the first difference**
	ADF- Fisher Chi-square	ADF- Fisher Chi-square
Economic Growth	15.1021	38.5802***
Direct Investment	6.55802	22.9307**
Investment in Technology	11.7915	34.2678***
Credit	5.24772	18.585**
Inflation	16.5994	36.0450***
Size	8.3749	21.6768**

*** show significance at 1% level, ** show significance at 5%

Table 4. Im, Pesaran and Shin W-Stat unit root test

	At level	**At the first difference**
	Statistic	Statistic
Economic Growth	-1.38916	-4.5304 ***
Direct Investment	0.36998	-2.34623 ***
Investment in Technology	-0.78519	-3.97383 ***
Credit	1.11102	-1.71721 **
Inflation	-1.55559	-3.96382 ***
Size	-0.07847	-2.32289 **

*** show significance at 1% level, ** show significance at 5%

4.4 The Error Correction Model

The findings of the error correction model and the cointegrating equation are listed in Table 5. The cointegrating equation represents the long-term effect of the investigated variables on economic growth. The results show that only foreign direct investment has a positive and significant effect on economic growth in the long-run. The other variables including the investment in Information and technology, inflation rate and economic size; all found to have negative and significant effect on economic growth in long-run. However, the domestic credit to private sector variable found to have a positive long-run effect on economic growth but statistically insignificant.

Table 5. Error correction estimates

Cointegrating Equation		Error Correction	
G(-1)	1.000000	ECT	-0.182926**
DI(-1)	13.96883***	D(G(-1))	-0.160687
ICT(-1)	-0.823505***	D(DI(-1))	0.762944
INFLA(-1)	-0.582469**	D(ICT(-1))	0.177511
		D(INFLA(-1))	-0.026956
SIZE(-1)	- 18.67664***		
CR(-1)	0.027731	D(SIZE(-1))	-10.91704***
C	189.8234	D(CR(-1))	0.016776
		C	1.059461**
		R-squared	0.334729
		Adj. R-squared	0.253029
		F-statistic	4.097054

*** show significance at 1% level, ** show significance at 5%

The short-run results of the error correction model show that only economic size affects economic growth negatively and significantly. Likewise, the inflation rate has a short-run impact on economic growth but this impact is not statistically significant. On the other hand, foreign direct investment, investment in information and technology and domestic credit to private sector variables have a short-run positive affect on economic growth but also this effect is not statistically significant.

The value of error correction term is -0.182926 and statistically significant at the 5% level. It proves the existence of long-run relationship between economic growth and economic variables. Moreover, error-correction term measures the speed of economic growth of BRICS countries to back to equilibrium status after the changing in economic variables.

The value of adjusted R-squared indicates that this model explained 25.3 percent in variations in economic growth in BRICS countries. The value of F-test indicates that value of the adjusted R-squared is significantly different from zero which means that this model is significantly explain 25.3 percent of economic growth variation in BRICS countries.

5. Conclusion

This paper explored important determinants of economic growth of BRICS countries. Therefore, a data of the selected variables were collected and spanned between the years 2000 and 2014. The unit root test and the error correction model were utilized on the selected variables. The results show that variables were stationary and integrated at the first order. On the other hand, foreign direct investment found to have a positive and significant long-run effect on economic growth. The results are consistent with the results of Prabhakar et al., (2015), Agrawal (2015), Jahaveh (2012), and Vijayakumar et al., (2010), concluding that BRICS countries must eliminate barriers that hinder foreign investment in order to achieve a high sustainable economic growth.

References

Aamir, M., Saba, S., & Tazeen, N. (2011). Determinants of Economic Growth in India. *Interdisciplinary Journal of Contemporary Research in Business, 3*(7), 1016.

Aghion, P., & Howitt, P. (2009). *Endogenous Growth Theory*. Cambridge MA: MIT Press.

Agrawal, G. (2015). Foreign Direct Investment and Economic Growth in BRICS Economies: A Panel Data Analysis. *Journal of Economics, Business and Management, 3*(4), 421-424.

Agrawal, P. (2015). Reducing Poverty in India: The Role of Economic Growth. Institute of Economic Growth Working Paper. *IEG Working Paper No. 349*. Delhi, India.

Altaee, H. H. A., & Al-Jafari, M. K. (2015). Financial Development, Trade Openness and Economic Growth: A Trilateral Analysis of Bahrain. *International Journal of Economics and Finance, 7*(1) 241-254.

Altaee, H. H. A., Al-Jafari, M. K., & Khalid, M. A. (2016). Determinants of Economic Growth in the Kingdom of Saudi Arabia: An Application of Autoregressive Distributed Lag Model. *Applied Economics and Finance, 3*(1), 83-92.

Barro, R. (1991). Economic Growth in a cross Section of Countries. *Quarterly Journal of Economics, 106*(2), 407-444.

Barro, R. (1997). *Determinants of Economic Growth: A Cross Country Empirical Study*. Cambridge, MA: MIT Press.

Basu, T., Barik, D., & Arokiasamy, P. (2013). Demographic Determinants of Economic Growth in BRICS and Selected Developed Countries. *XXVII IUSSP International Population Conference (IUSSP 2013) 26-31th August 2013*. BEXCO, Busan, Republic of Korea.

Bloom, D., & Finlay, J. (2009). Demographic Change and Economic Growth in Asia. *Asian Economic Policy Review, 4*, 45-64.

Chen, B., & Feng, Y. (2000). Determinants of Economic Growth in China: Private Enterprise, Education, and Openness. *China Economic Review, 11*(1), 1-15.

Feder, G. (1983). On Exports and Economic Growth. *Journal of Development Economics, 12*, 59-73.

Goel, R. K., & Korhonen, I. (2011). Determinants of Economic Growth in BRIC Countries. Institute of Advanced Development Studies (INESAD). Development Research Working Paper Series. *Working Paper No. 05/2011*. La Paz, Bolivia.

Gur, B. (2015). An Analysis of Unemployment Determinants in BRIC Countries. *International Journal of Business and Social science, 6*(1), 192-198.

Hasan, I., Wachtel, P., & Zhou, M. (2009). Institutional Development, Financial Deepening and Economic Growth: Evidence from China. *Journal of Banking and Finance, 33*(1), 157-170.

Jadhav, P. (2012). Determinants of Foreign Direct Investment in BRICS Economies: Analysis of Economic, Institutional and Political Factor. *Procedia-Social and Behavioral Sciences, 37*, 5-14.

Jayme, F. G. Jr. (2003). Balance-of-Payments-constrained Economic growth in Brazil.

Brazilian Journal of political Economy, 23(1), 62-84.

Kim, J.-I., & Lau, L. J. (1994).The Sources of Economic Growth of the East Asian Newly Industrialized Countries. *Journal of Japanese and International Economies, 8*, 235-271.

Liang, Q., & Teng, J.-Z. (2006). Financial Development and Economic Growth: Evidence from China. *China Economic Review, 17*(4), 395-411.

Liu, X., Burridge, & Sinclair, P. J. N. (2002). Relationship between Economic Growth, Foreign Direct Investment and Trade: Evidence from China. *Applied Economics, 34*(11), 1433-1440.

Mankiw, N., Romer, D., & Weill, D. (1992). A Contribution to Empirics of Economic Growth. *Quarterly Journal of Economics, 107*, 407-437.

Ozturk, I. (2015). Sustainability in the Food-Energy-Water Nexus: Evidence from BRICS (Brazil, the Russian Federation, India, China, and South Africa) Countries. *Energy, 93*(Part 1), 999-1010.

Prabhakar, A. C., Azam, M, Bakhtyar, B., & Ibrahim, Y. (2015). Foreign Direct Investment, Trade, and Economic Growth: A New Paradigm of BRICS. *Modern Applied Science, 9*(12), 32-42.

Sinha, A., & Sen, S. (2016). Atmospheric Consequences of Trade and Human Development: A case of BRIC Countries. *Atmospheric Pollution Research, 7*(6), 980-989.

Solo, R. M. (1956). A Contribution to the Theory of Economic Growth. *Quarterly Journal of Economics, 70*(1), 65-94.

Squire, L. (1993). Fighting Poverty. *American Economic Review, 83*(2), 377-382.

Sreelata, B., & Anup, K. S. (2014). Macroeconomic Determinants of economic Growth in India: A Time Series Analysis. *SOP Transaction on Economic Research, 1*(2), 54-72.

Vijayakumar, N., Sridharan, P., & Rao, K. C. H. (2010). Determinants of FDI in BRICS Countries: A Panel Analysis. *Int. Journal of Business Science and Applied Management, 5*(3), 2-13.

Yao, S. (2006). On Economic Growth, FDI and Export in China. *Applied Economics, 38*(3), 339-351.