Chapter 2

The Effect of Bank Credits and Innovation on Economic Growth in BRICS Countries

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Abstract

In many economies, private sector credit plays a critical role by productively allocating resources for investment and is considered the engine of economic growth. Bank credit to the private sector promotes economic growth through capital accumulation and technological progress by mobilizing savings, increasing production and optimizing capital allocation. In this respect, it is expected that the determination of the relationship between bank credits and economic growth will shed light on policy makers. The aim of this study is to examine the effect of bank credit and innovation on economic growth in BRICS countries. In the study, which deals with the period of 2001-2020, the analysis was carried out with Westerlund panel cointegration analysis. As a result of the analysis, it has been determined that there is no cointegration relationship between GDP and domestic credits from banks to the private sector and innovation in BRICS countries and the supply-side hypothesis that bank credit causes economic growth in BRICS countries is not valid.

1. Introduction

Economic growth is one of the main goals of macroeconomic policies. In addition to raising living standards, it is the most important way to ensure economic development. Within the scope of economic policies, money supply in the credit channel is expected to affect real variables through credit availability. In this context, it is thought that the development of the financial sector plays a major role in economic development.

Deposit banks provide economic development in every economy through their intermediary roles. Credit can be defined as the total amount of funds

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provided by deposit banks to individuals, businesses and the government for consumption and investment purposes. Bank lending to the private sector promotes economic growth through capital accumulation and technological progress by mobilizing savings, increasing production and optimizing capital allocation.

Since credit feeds the economy, it is considered the key to economic growth, especially in developing countries. In many economies, private sector credit plays a critical role by efficiently allocating resources for investment and is considered the engine of economic growth. In this respect, it is expected that the determination of the relationship between bank loans, innovation and economic growth will shed light on policy makers. Therefore, the role of bank credit in economic growth has been recognized by many researchers, as various economic units can invest in various investment opportunities.

Based on the fact that the development of the financial sector plays a major role in economic development and that loans affect real variables The effect of credit on economic growth should be considered for high-speed developing countries with different financial characteristics such as Brazil, Russia, India, China and South Africa. In this study, the effect of bank credit on economic growth in BRICS countries consisting of Brazil, Russia, India, China and South Africa was examined. In the study, which deals with the period of 2001-2020, the examination was carried out with panel cointegration analysis. The study consists of four parts. The study is organized as follows after the introduction. In the second part, literature studies examining the effects of banking sector loans and innovation on economic growth are examined. In the third chapter, the analysis method and data set discussed within the scope of the analysis are explained and the findings are been given. In the fourth and last section, the results are included.

2. Literature Review

There are national and international studies in the literature examining the effects of banking sector loans, financial development and innovation on economic growth. These studies differ in terms of both the country constituting the study area, the analysis period and the analysis method. Some of these studies, especially the cointegration analysis, have been examined here, these studies are included in Table 1.

Tablo 1. Literature Studies

Author (Year)	Country	Period	Subject of Analysis
Nazlıoğlu et al. (2009)	Turkey	1987-2007	causality between investment and financial development.
Hasan & Tucci (2010)	58 countries	1980–2003	the importance of innovation on economic growth.
Adamopoulos (2010)	Ireland	1965-2007	relationship between financial development and economic growth.
Esso (2010)	Ecowas countries	1960-2005	the cointegrating and causal relationship between financial development and economic growth.
Kar et al. (2011)	Middle East and North African countries	1980-2007	causality between financial development and economic growth.
Akujuobi & Chima (2012)	Nigeria	1960-2008	the effects of loans given by banks to the manufacturing sector on economic growth.
Bittencourt (2012)	four Latin American countries	1980-2007	the role of financial development, or more widespread access to finance, in generating economic growth.
Timsina (2014)	Nepal	1975-2013	the effect of commercial bank loans given to the private sector on economic growth.
Pradhan et al. (2014)	34 OECD countries	1960-2011	real relationship between banking sector development, economic growth and inflation.
Meierrieks (2014)	51 countries	1993-2008	the effect of financial development on innovation.
Tang (2015)	Malaysia, Singapore, Indonesia, Thailand and Philippines	1990-1996	causality between bank loans and economic growth.
Mushtaq (2016)	Pakistan	1961-2012	the effects of deposits and loans on economic growth.
Işık (2017)	G-20 countries	1995-2015	cointegration bank loans given to the private sector and innovation - economic growth and innovation.
Kılınç et al. (2020)	24 European Union member countries and Turkey	2001-2017	the effects of loans given to the private sector on innovation.
Zhou et al. (2020)	China	2007-2017	the impact of regional credit and technological innovation on regional economic growth.
Kesbiç & Şimşek (2020)	33 OECD countries	2000-2018	the effect of innovation on economic growth.

3. Dataset, Methods and Findings

When empirical analysis is considered in general it has been observed that, variables such as the ratio of loans given to the private sector to gross domestic product and commercial loans, representing bank funds; R&D expenditures and patent numbers are generally considered for innovation. It has been accepted that the economies of countries that can realize innovation are also strengthened, and within the framework of the Schumpeterian tradition, whether banking contributes to innovation-based economic growth has begun to be the subject of research.

The principal changes in a dynamic economy are due to technical innovations in the production process. Credit expansion affects the distribution of income and capital formation. Bank credit detaches productive resources to new productive combinations and innovations (Schumpeter, 1934). Schumpeter (1911) also stated that the banking sector is the capitalist of productive investments and causes an increase in the rate of economic growth. Schumpeter is also first researcher to place innovation at center of economic growth, as well as banking sector (Işık, 2017, p.54).

It is important for the banking sector to finance innovations that will provide an advantage in economic growth, as financing innovations through bank loans allows the financial sector to create a bridge to the production-oriented real sector.

In this study, which examines the effect of bank loans on economic growth, BRICS countries (Brazil, Russia, India, China and South Africa) are included in the scope of the study. The data on the banking systems and economies of these countries are discussed in terms of 20-year observation numbers for the 2001-2020 period. The aspect of the study that differs from the existing literature and its contribution to the literature is that it deals with the effects of both innovation and bank credits on economic growth and differentiates the country group discussed from the literature. The data for the analysis were obtained from the World Bank website. The dependent and independent variable information, which is handled within the scope of the analysis, is given in Table 2.

Tablo 2. Defining Variables

Type	Variable Name	Code
Dependent	Growth	GDP
Independent	Domestic credit from banks to private sector	CrBank
Independent	Patent	Innov

As can be seen in Table 2, in order to measure the effect of loans on growth, GDP was taken as the dependent variable, and private sector loan as the representative of bank loan and patent were taken as the independent variable due to the fact that the loans given to the private sector to support economic growth among the loans offered by banks were evaluated more effectively.

The analysis was made with the panel cointegration test, the processes related to the process are explained below.

In the study, the homogeneity / heterogeneity of the slope coefficients in the series were examined with the $\tilde{\Delta}$ and $\tilde{\Delta}adj$ tests developed by Pesaran & Yagamata (2008). $\tilde{\Delta}$ and $\tilde{\Delta}adj$ test statistics are calculated by equations (1) and (2) (Pesaran & Yamagata, 2008, p.8).

$$\tilde{\Delta} = \sqrt{N}\left(\frac{N^{-1}\tilde{S} - k}{\sqrt{2K}}\right) \tag{1}$$

$$\tilde{\Delta}_{adj} = \sqrt{N}\left(\frac{N^{-1}\tilde{S} - E(\tilde{z}_{it})}{\sqrt{Var(\tilde{z}_{it})}}\right) \tag{2}$$

$$E(\tilde{z}_{iT}) = k,\ Var(\tilde{z}_{iT}) = \frac{2k(T-k-1)}{T+1}$$

The homogeneity test results are given in Table 3, and the hypotheses for the delta test are formed as follows.

H_0: The slope coefficient is homogeneous.

H_1: The slope coefficient is not homogeneous.

Tablo 3. Homogeneity Test Results

	Statistic	**Probability**
Delta	9,543	0,000
adj	10,670	0,000

According to the homogeneity test results, it is seen that the probability values are 0,000 and accordingly the H_0 hypothesis has been rejected. Accordingly, it can be said that the slope coefficients for the variables are heterogeneous.

Whether there is a cross-section dependency in the series, unit root tests to be applied in the analysis, and cointegration tests may vary. As a result, it is necessary to test the cross-section dependence first in panel data analysis. Pesaran (2004) CD test was used in the study to determine the cross-sectional dependence in the series of the variables. CD test turns out to be remarkably robust to major departures from normal errors, particularly for T ≥ 10 (Pesaran, 2004, p.2). Pesaran (2004) CD test is calculated with the help of equation (3) (Pesaran, 2004, p.5).

$$CD_{LM} = \sqrt{\frac{1}{N(N-1)}} \left(\sum_{i=1}^{N-1} \sum_{j=i+1}^{N} (T \hat{p}_{ij}^2 - 1) \right) \qquad N(0,1) \qquad (3)$$

Pesaran CD results are given in Table 4. The hypotheses are as follows.

H_0: There is no cross-section dependency.

H_1: There is cross-section dependency.

Tablo 4. Cross Section Dependency Test Results

Variables	**Pesaran CD**	
	Statistic	Probability
GDP	11,33	0,000
CrBank	11,24	0,000
Innov	7,59	0,000

According to the results given in Table 4, the probability values are less than 0.01 ($p<0.01$), and the H_0 hypothesis has been rejected. Accordingly, there is a cross-sectional dependence between domestic loans from banks to the private sector, innovation and GDP variables.

In the Levin-Lin-Chu (LLC) unit root test, it is assumed that all individuals in the panel have the same first-order partial autocorrelation, and all other parameters in the error process are allowed to vary freely among individuals (Levin et. al., 2002, p.4). For stationarity tests, first and the second generation LLC test was used (Yerdelen Tatoğlu, 2020, p.68; Şahin, 2022, p.80-81). One of the following models can be created (Levin et. al., 2002, p.4).

Model 1: $$\Delta y_{it} = \delta y_{it-1} + \zeta_{it} \qquad (4)$$

Model 2: $$\Delta y_{it} = \alpha_{0i} + \delta y_{it-1} + \zeta_{it} \qquad (5)$$

Model 3: $$\Delta y_{it} = \alpha_{0i} + \alpha_{1i} t + \delta y_{it-1} + \zeta_{it} \qquad (6)$$

Here, $-2 < \delta \leq 0$ i=1, …, N

In the test, the error process is independently distributed among the individuals and is modeled as in equation (7) (Levin et. al., 2002, p.4).

$$\zeta_{it} = \sum_{j=1}^{\infty} \theta_{ij} \zeta_{it-j} + \varepsilon_{it} \qquad (7)$$

Levin et. al., 2002 tests consist of three steps (Levin et. al., 2002, p.5).

1) A separate Augmented Dickey Fuller (ADF) regression is applied for all cross sections. The ADF regression model is created as in equation (8).

$$\Delta y_{it} = \delta_i y_{it-1} + \sum_{L=1}^{p_i} \theta_{iL} \Delta y_{it-L} + \alpha_{mi} d_{mt} + \varepsilon_{it} \qquad \text{m=1,2,3} \qquad (8)$$

The lag order p_i is permitted to vary across individuals

2) An estimation is made from the long-term standard deviations to the short-term standard deviations.

3) Calculations of panel test statistics are made.

The results of the LLC unit root test are given in Table 5, and the hypotheses regarding the unit root test are as follows.

H_0: Panels contain unit root.

H_1: Panels are stationary.

According to Table 5, the GDP variable was found to be significant at 10% significance levels in the fixed and trend model, and accordingly, the H_0 hypothesis, which states that the relevant series is not stationary, was rejected. On the other hand, the CrBank and Innov variables were not found to be significant at any significance level, and the H_0 hypothesis was accepted. In the first difference of the CrBank and Innov variable, the probability values were found to be significant, respectively at the 1% and 10% significance level ($p<0.01$) in the fixed and trend model, so the H_0 hypothesis, which states that the series is not stationary (contains a unit root) for all series, has been rejected.

Table 5. Levin-Lin-Chu Unit Root Test Results

Variables	No Fixed-Trendless		Fixed		Fixed-Trend	
	Statistic	Probability	Statistic	Probability	Statistic	Probability
GDP	-1,7768	0,2249	0,7197	0,9743	-4,5297	0,0658*
CrBank	-0,2376	0,8556	5,5586	1,0000	-2,2598	0,2141
Innov	-2,2584	0,1777	0,9108	0,9861	-4,7641	0,1029
Δ(GDP)	-1,1198	0,4548	0,7214	0,9809	-4,6363	0,0370**
Δ(CrBank)	-0,8573	0,6422	3,0846	1,0000	-4,4081	0,0040***
Δ(Innov)	-3,0579	0,0513*	-0,2272	0,9391	-4,6130	0,0867*

*%10 significance level, ** %5 significance level, *** %1 significance level, Δ: first difference of the series

According to the stationarity test results given in Table 5, it is understood that GDP variable is stationary at its level, the CrBank and Innov variables have a unit root at its level and they are stationary at first difference (Δ).

The existence of long-term relationships between series that are stationary at difference is determined. In determining the long-term relationship between growth and domestic loans from banks, innovation to the private sector in the BRICS countries, 2nd generation cointegration tests will be used since the correlation between units is determined.

Equation (9) can be used to generate test statistics (Westerlund, 2007, p.715).

$$\Delta y_{it} = \hat{\delta}_i^{'} d_t + \hat{\alpha}_i y_{it-1} + \hat{\lambda}_i^{'} x_{it-1} + \sum_{j=1}^{p_i} \hat{\alpha}_{ij} \Delta y_{it-j} + \sum_{j=0}^{p_i} \hat{\gamma}_{ij} \Delta x_{it-j} + \hat{e}_{it} \qquad (9)$$

Here $d_t = (1,t)^{'}$ is the deterministic components and $\delta_i = (\delta_{1i}, \delta_{2i})^{'}$ is the associated vector of the parameters.

The hypotheses for cointegration tests are as follows.

H_0: No cointegration.

H_1: All panels are cointegrated.

Westerlund test results are given in Table 6.

Table 6: Westerlund Cointegration Test Results

Variables	Statistic	Probability
CrBank	-0,2790	0,3901
Innov	-0.8498	0,1977

In order to determine whether there is a cointegration relationship between GDP and domestic loans from banks to the private sector, innovation cointegration test statistics and their probability values are given.

According to the results in Table 6, probability values greater than 0,10. Accordingly, the H_0 hypothesis, which claims that there is no cointegrated course of action among the variables in the models, has been accepted, and there is no relationship between the variables with the panel and time dimension, and there is no cointegrated course of action. Accordingly, it has been determined that there is no cointegration relationship between GDP and domestic loans from banks to the private sector in BRICS countries, and the supply-side hypothesis (Timsina, 2014: 12) that bank loans cause economic growth in BRICS countries is not valid. Moreover there is no cointegration relationship between GDP and innovation in BRICS countries.

4. Conclusions

In the BRICS countries consisting of Brazil, Russia, India, China and South Africa, the effect of bank loans and innovation on economic growth was examined for the period 2001-2020. The analysis was carried out with panel cointegration analysis. In the analysis, economic growth is represented by the GDP dependent variable, bank loans are represented by the domestic loans from banks to the private sector (CrBank) and patent (Innov) independent variable. Cointegration analysis was carried out as a result of homogeneity test, cross-section dependency test, unit root test analysis.

Homogeneity was tested with the Delta test developed by Pesaran and Yamagata (2008), and as a result of the test, it was determined that the slope coefficients for the variables were heterogeneous. Pesaran (2004) CD test was used in the study to determine the cross-sectional dependence in the series of the variables. According to the results of cross-section dependency test, there is a cross-section dependency in domestic loans from banks to the private sector, innovation and GDP variables. According to the results of the unit root test, it is understood that the GDP variable is stationary at its level and first difference, the CrBank and the Innov variable has a unit root at its level and it is stationary at first difference.

The existence of long-term relationships between the series that are stationary at difference is determined. In the determination of the long-term relationship between growth in the BRICS countries and domestic loans from banks to the private sector and innovation 2nd generation cointegration tests should be used, since the correlation between units is determined. In this context, according to the results of the Westerlund test, there is no

relationship with panel and time dimension between the variables, and there is no cointegrating style of action.

As a result of the analysis, it has been determined that there is no cointegration relationship between GDP and domestic credits from banks to the private sector in BRICS countries, and the supply-side hypothesis that bank credit causes economic growth in BRICS countries is not valid. Moreover it has been determined that there is no cointegration relationship between GDP and innovation in BRICS countries.

As a result of the analysis, it can be said that the banking sector is not the determinant of economic growth in the BRICS countries and the relevant period, the banking sector may not be used as an effective tool in economic growth, and the banks do not contribute to the economic development of the BRICS countries in terms of lending. In other words, the result shows that the monetary policy implementation aimed to expanding the bank loan volume in the BRICS countries is not determinative within the framework of the growth target. Therefore, it should make policies considering the fact that lending has no effect on GDP growth for banks in these countries. At this point, it is important to determine the activities that affect the economic growth in the BRICS countries more than the domestic loans given by the banks to the private sector. On the other hand because of the bank lending to the private sector has not performed well in terms of contribution to BRICS economic development and therefore there should be a critical monitoring of the facilities.

Innovation, which is one of the dynamics of growth, has no effect on growth. For a sustainable economic growth, it is necessary to determine the areas with strong innovation capacity and which will bring superiority in international competition. For this reason, in terms of the effect of innovation on growth, innovation policies should be reviewed, and the right projects and R&D expenditures should be directed.

The study has similar features with Kar et al (2011), Akujuobi & Chima (2012) Mustaq (2016) in terms of analysis results. In this direction, in future studies, determining the factors that determine growth in BRICS countries and / or other economies can be considered at the point of determining the effective factors for growth within the framework of the economic growth target.

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