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Ian Ndlovu,
PhD, Faculty of Commerce,
National University of Science and Technology (Zimbabwe)
https://orcid.org/0000-0001-6323-9850

Samkelisiwe Bhebhe,
Faculty of Commerce,
National University of Science and Technology (Zimbabwe)
https://orcid.org/0009-0001-8293-0206

THE NEXUS BETWEEN BANK CREDIT AND ECONOMIC GROWTH IN THE BRICS: PANEL GRANGER CAUSALITY

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Abstract. *This study investigated the causal relationship between banking credit and economic growth within the BRICS economic bloc. The relatively superior economic growth rates of the BRICS have attracted attention from scholars and practitioners in a quest to elucidate their drivers. The indicators for banking credit were total credit to households, general government and non-financial corporations while the gross domestic product, total manufacturing production and total retail trade growth rates were the proxy for economic growth. The study spanned the period from the first quarter of 2008 to the first quarter of 2021. Pairwise panel Granger causality was investigated with respect of all variables in order to establish the direction of causality. The Dumitrescu & Hurlin (2012) model was used to test for causality in the cross-sectionally dependent heterogeneous BRICS panel data set. The results show that there is unidirectional causality from each of the three credit variables to GDP and retail trade. However, only household and government credit Granger-caused manufacturing production.*

Keywords: *banking credit, government credit, economic growth, panel Granger causality, BRICS.*

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Introduction

The relationship between bank credit and economic growth is theoretically located within the broad finance-growth nexus which has engaged theorists and empirical researchers for more than a century (Bagehot, 1873; Adusei, 2018; Fanta, 2015; Barajas et al., 2013; Stolbov, 2012). Conventional wisdom has for decades postulated that financial sector development and a sustained shift of financial structures create conditions that favor a sustained growth in national output (Hongbin, 2007; Madichie et al., 2014; Zingales, 2015; Paun et al., 2019). That operational perspective has inspired the implementation of financial sector liberalization policies and initiatives in many developing countries including some African economies (Fry, 1978; Levine and Zervos, 1998; Makina, 2005; Škare et al., 2018).

Over the past two decades, the analyses of the relationship between financial market performance indicators (including bank credit) and proxies for economic growth have yielded indeterminate results (Christopoulos and Tsianos, 2004; Levine, 2005; Afaro et al., 2006; Acaravci, et al., 2009; Ginevičius et al., 2019). Some researchers who have investigated the bank credit – economic growth nexus have employed credit-to-Gross Domestic Product (GDP), domestic credit to the private sector by banks (DCPSB) and bank deposits (BD) as proxies for bank credit

development (Belinga et al., 2016). The study by Belinga et al. (2016) relying on a Vector Error Correction model (VECM) unearthed unidirectional causality from the DCPSB and BD proxies for bank credit development to economic growth. Saeed et al. (2020) investigated 'causal and dynamic link between the banking sector and economic growth in Pakistan.' Saeed et al. (2020) employed panel unit root, panel cointegration, and panel VECM tests to analyze the data at their disposal. Their analysis revealed that "that lending capability, bank investments, and innovation have positive and statistically significant impacts on economic growth in short-run as well as in long-run dynamics (Saeed et al., 2020)." A Granger causality study by Pham and Nguyen (2020) on the nexus between domestic credit and Gross Domestic Product (GDP) in Vietnam provided evidence of bidirectional causality between credit and GDP. Ndlovu (2019) found evidence of a non-linear relationship between national output proxies and selected measures of financial intermediation among BRICS economies.

Domestic credit variables used in this study are household credit, credit to non-financial firms and credit to the general government. Household credit has risen dramatically over the years, exceeding corporate credit in some economies (Dembiermont et al., 2013).

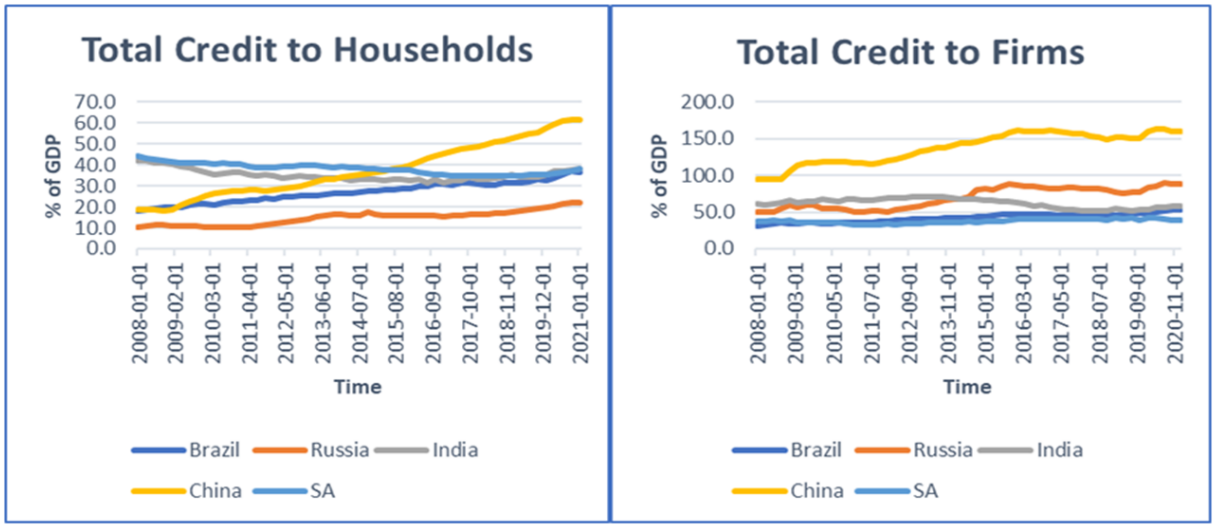

Figure 1. Credit to household and non-financial corporations

Source: calculated by the authors

Figure 1 shows that between 2008 and 2021, China exhibited a steady upward trend for both total credit to households and total credit to firms. The performance of total credit to households and total credit to firms followed a rather subdued upward trend for the Russian economy. The trend of the two economic variables for South Africa was rather flat or constant for the period 2008-2021, and this is virtually the same as the performance of Brazil's total credit to firms. However, Brazil's credit to household doubled by early 2021 from 2008 levels. The pattern for India is rather different as total credit to households followed a downward trend from 2008 to around 2010. In contrast, total credit to firms for India plateaued during the period 2009-2016, before assuming a gradual downward trend from 2015 to 2019. A number of reasons have been proffered by scholars and researchers to explain this somewhat mixed performance of total credit to households and total credit to firms for the BRICS.

The percentage of government credit to GDP in Russia is the lowest among the BRICS. China and South Africa recorded the highest growth rates between 2008 and 2021. Brazilian percentage of government credit to GDP stable and started to grow from mid-2014 as depicted in Figure 2. As at January 2021, Brazil had close to 100 percent credit to GDP ratio which makes the investigation of the causal effects of finance and economic growth imperative. The economic growth rates of some BRICS economies have been superior to those of some developed economies. It has been observed by some market watchers that the economic performance of the BRICS in the past decade has conformed to the proverbial 'Tale of Two Cities' in that the five economies fall into two distinct categories (ILO, 2018).

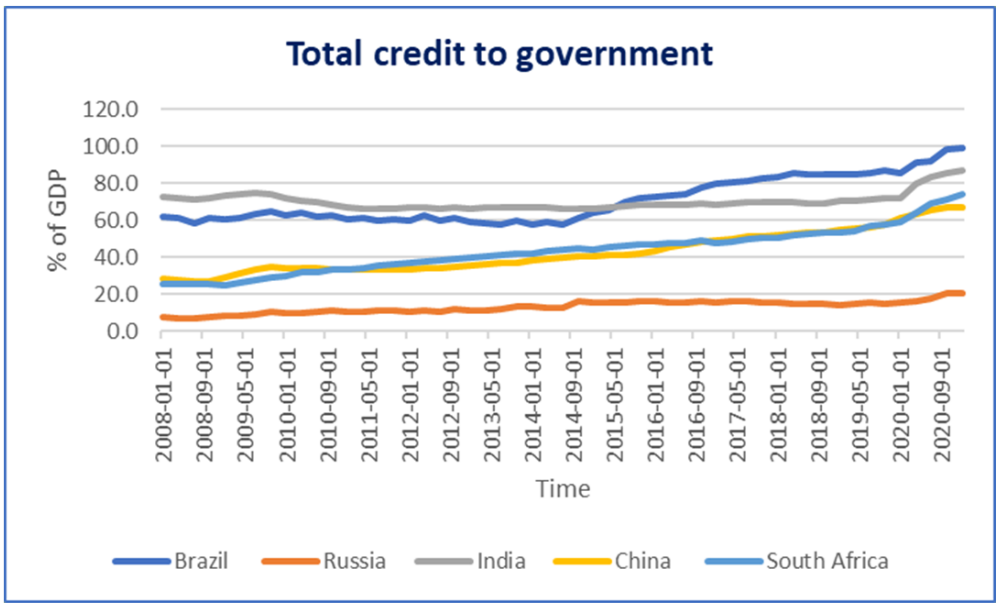

Figure 2. Credit to government

Source: calculated by the authors

The two identifiable categories in overall economic performance terms since 2010 are: China and India whose economic growth rates have trended between 7 and 8 percent, while Brazil, Russia and South Africa have been characterized by economic growth rates averaging between 1 and 2 percent (ILO, 2018). Syed and Tripathi (2020) employed the Fully Modified Ordinary Least Squares (FMOLS) method to analyse the impact of macroeconomic determinants on the non-performing loans of BRICS economies for the period 2000-2016. Their study revealed that there is a positive relationship between unemployment and non-performing loans while economic growth and financial soundness variables of a country have a negative relationship with non-performing loans (Syed and Tripathi, 2020). The same study argued for an inverse relationship between savings by households and non-performing loans (Syed and Tripathi, 2020).

This study seeks to investigate causality between bank credit variables and economic growth. The introduction of this paper is followed by the literature review, which leads to the discussion of the methodology used. That section is followed by a presentation of key results and a discussion of the same. The conclusion and an appendix for detailed results are presented at the end of the paper

Literature Review

The significant rise in total credit-to-GDP levels has made financial stability increasingly important to the global economy. Drehmann and Tsatsaronis (2014) have observed that "for a large cross section of countries and crisis episodes, the credit-to-GDP gap is a robust single indicator for the build-up of financial vulnerabilities." Thus, it can be argued that the credit-to-GDP measure been useful to the international financial system in setting countercyclical capital buffers to ameliorate the deleterious effects of financial crises whenever they occur (Drehmann and Tsatsaronis, 2014). A study by Takats and Upper (2013) revealed 'that in the aftermath of a financial crisis, declining bank credit to the private sector will not necessarily constrain the economic recovery process after output has bottomed out.' Kelly et al. (2013) have asserted that, 'the acceleration of credit in any given economy is now commonly perceived to be one of the leading indicators of financial instability.' They observed that in the aftermath of the Global Financial Crisis of 2007 to early 2009, the focus of the policy making and the scholarly communities has been on the significant deviations between the actual and log-run trends of the private sector to GDP ratio for an economy (Kelly et al., 2013).

According to the World Bank, the key indices of the credit-to-GDP ratio such as monetary sector credit (%GDP), domestic credit to the private sector by banks (%GDP) and domestic credit

provided by the financial sector (%GDP) have displayed an upward trend from 1960 to 2020 for the global economy. This upward trend in credit to GDP in general can be explained by a number of factors which include financial sector liberalization, improvements in financial technologies and the global integration of financial systems among other factors (Levine, 2005; Zingales, 2015 and Paun et al., 2019). Zharikov (2021) proposes a hypothetical model of BRICS-bonds which takes into account consensual economic policy given problems of international economic integration during a period of deglobalization. The author postulates options for automatic and state-run budget deficit services, and thus identifies the optimum taxation level and average weighted tax rate for BRICS economies (Zharikov, 2021). Over the years other researchers have demonstrated the connection between bond market performance and the behaviour of the government budget deficit variable for different economies (Christopoulos and Tsianos, 2004; Levine, 2005; Alfaro et al., 2006). In a study which employed the unrestricted Vector Autoregressive (VAR) method to model four decades of data, Shetta and Kamaly (2014) demonstrated that as the Egyptian government issued more debt instruments to finance its debt, banks shifted their portfolios away from risky private loans to relatively safe government debt instruments. Thus, the study by Shetta and Kamaly (2014) validated the oft-repeated hypothesis in the empirical literature, that government expenditure financed through budgets deficits tends to crowd out private sector investment over time, ceteris paribus.

Methods

In order to determine the direction of causality between bank credit and economic growth, the study adopted an extension of the Granger causality model proposed by Granger (1969). The Dumitrescu & Hurlin (2012) method for testing for causality in heterogeneous panel data sets was used.

The key assumption in Granger causality is that the variables are independent and not affected by the same innovations simultaneously. This necessitates the investigation of the correlations of the variables before attempting to perform the causality test. One of the prerequisites of the Dumitrescu-Hurlin panel Granger causality model is the stationarity of the panel data set. This necessitates testing for cross-section causality in order to adopt the apposite unit root test. As such, data analysis involves three steps starting with cross-section dependence testing. This is followed by unit root tests before the estimation of the panel Granger causality model.

The mere fact that the BRICS is an economic bloc suggests that there could be cross-country correlation among some of the economic variables in this study. Financial integration and international trade have been found to breed dependence among trade partners (Nazlioglu, et al. 2011). Four tests will be used to adequately test for cross-section independence where the null hypothesis states that there is no dependence.

The study closely follows Mhadhbi, et al. (2017) who used a four-test approach to determine cross-section independence. The first test used is the Lagrange Multiplier test which was developed by Breusch & Pagan (1980) and it is stated as:

$$LM = T \sum_{i=j}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij}^2 \tag{1}$$

for panel data model described as $\ln y_{i,t} = \alpha_i + \beta_i \ln x_{i,t} + \varepsilon_{i,t}$ where N represents the cross-sectional units and T represents time units.

As noted by Mhadhbi et al. (2017), one of the limitations of the LM test is that it is best suited for cases where $T > N$ by a large margin. While this condition holds sufficiently in this study, T is indeed greater than N, we proceed to perform three additional tests for good measure. Pesaran (2004) proposed a more robust technique that is not bound by the condition of the LM test. The test is defined as:

$$CD_{LM} = \sqrt{\frac{1}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} (T\hat{\rho}_{ij}^2 - 1) \tag{2}$$

Acknowledging the need for an additional test that can accurately identify dependence when $N>T$, after noting distortions in the CD_{LM} test, Perasan (2004) developed the following test:

$$CD=\sqrt{\frac{2T}{N(N-1)}}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij} \tag{3}$$

Perasan et al. (2008) proposed a bias-adjusted test to correct for the limitations of the three tests above.

$$LM_{adj}=\sqrt{\frac{2T}{N(N-1)}}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\frac{(T-K)\hat{\rho}_{ij}^{2}-\mu_{Tij}}{\sqrt{\nu_{Tij}^{2}}} \tag{4}$$

The model tests for unidirectional, bidirectional or no Granger causality in a balanced panel data set. It assumes the same lag order for all individuals in the panel. The null hypothesis asserts that there is no Granger causality for all individuals in the panel. The alternative posits that there is Granger causality for at least one of the individuals in the panel. The model runs F-tests for each of the *K* individuals and calculates the average Wald statistic as:

$$\bar{W}=\frac{1}{N}\sum_{i=1}^{N}W_{i} \tag{5}$$

From the independent and identically distributed Wald statistics the model decomposes the $\bar{Z}$ statistic to be:

$$\bar{Z}=\sqrt{\frac{N}{2K}}\cdot(\bar{W}-K) \qquad \frac{d}{T,N\to\infty} \qquad N(0,1)$$

And the $\tilde{Z}$ statistic as:

$$\tilde{Z}=\sqrt{\frac{N}{2K}\cdot\frac{T-3K-5}{T-2K-3}}\cdot\left[\frac{T-3K-3}{T-3K-1}\cdot\bar{W}-K\right] \qquad \frac{d}{N\to\infty} \qquad N(0,1)$$

The work of (Dumitrescu & Hurlin, 2012) and that of Mhadhbi et al. (2017) lend greater insight into the methodology employed in this study.

Data were obtained from different sources. Quarterly bank data were compiled by the Bank for International Settlements (BIS) and retrieved from the website of the Federal Reserve Bank of St. Louis. The BIS adjusted the data for breaks using standard econometric techniques. Household credit (HH) was proxied by total credit to households and non-profit institutions that provide credit to households. Total credit to the general government represented credit to governments (GVT). The variable firms (FIRMS) represents total credit to all non-financial corporations. The sources of credit encompass domestic and international credit providers (Dembiermont et al., 2013).

The indicators of economic growth were the gross domestic product (GDP), total manufacturing production (TMP) and total retail trade (TRT) growth rates. Each one of these output variables was tested against the set of credit variables aforementioned. Constant price GDP data was retrieved from the websites of the Organisation for Economic Co-operation and Development (OECD) and the Federal Reserve Bank of St. Louis. Total manufacturing production data were used to represent manufacturing output for Brazil, Russia, India and South Africa. Due to unavailability of manufacturing data for China, total industry production excluding construction was used instead.

Data for GDP, TMP, HH, GVT and FIRMS spanned the period 2008Q1 to 2021Q1 for all BRICS nations. Volume of total retail trade sales was used to represent retail output. However, the researchers were unable to source retail data for India. Furthermore, retail data for China and Russia was not available from 2018Q3 to 2021Q1 hence the retail panel runs from 2008Q1 to 2018Q2. Manufacturing and retail data were compiled by the Organisation for Economic Co-operation and Development (OECD) and retrieved from the website of the Federal Reserve Bank of St. Louis. The researchers encountered challenges in obtaining missing data. All data were converted to percentage changes per period and used as such (Hafer, 1982).

Results

This section is divided into three subsections starting with the presentation of descriptive statistics. The results of diagnostic tests are presented before the estimation of the panel Granger causality models.

3.1. Descriptive Statistics

In this section, comparisons among variables are made to highlight the key differences within the BRICS bloc. Figure A1 in the appendix shows the summary statistics for all variables in the panel. An analysis of the GDP growth rates is presented in Table 1 per country. China had the highest mean growth rate closely followed by India. Brazil and South Africa had similar readings albeit below a fifth of China's average.

Table 1
Descriptive Statistics for GDP

Country	Mean	Max.	Min.	Std.Dev.	Skewness	Kurtosis
Brazil	0.347	7.714	-8961	2.126	-1.007	8.531
Russia	0.245	2.653	-4.387	1.306	-1.463	3.705
India	1.618	21.176	-24.491	4.733	-1.875	23.223
China	1.864	10.7	-9.5	2.061	-1.770	24.080
S.Africa	0.326	13.893	-17.394	3.154	-1.952	25.716

Source: calculated by the authors

All economies experienced the lowest GDP growth rates in the first quarter of 2020 which coincided with the onset of the Covid-19 pandemic. Similarly, manufacturing output dipped significantly in early 2020 for South Africa, Brazil and India. However, significant recoveries ensued in the second quarter of 2020 as can be seen in Figure A1. The retail volume for China was increasing at the lowest rate since 2008 but it exceeded other economies in 2015 and continued on an upward trend until late 2017. Figure A2 shows that retail trade for Brazil, Russia and South Africa was rising albeit in a rugged manner from 2008, dropping slightly in 2015 due to the commodity crisis,

3.2. Diagnostic Tests

Firstly, correlation analysis was used to ascertain the nature and magnitude of the relationships among output and bank credit variables. Data in Tables A2 and A3, in the appendix, show that there are low positive correlation coefficients between the distinct sets of variables. Against this backdrop we conducted Granger causality analysis starting with two key diagnostic tests namely, cross section dependence and the panel unit root testing. The appropriate panel unit root test is determined by the existence of cross-section dependence within a panel data set.

3.2.1 Test Results for Cross-section Dependence

Four different tests were used to investigate the existence of dependence as outlined in Table 2.

Table 2
Cross-section dependence tests

Null hypothesis: No cross-section dependence (correlation)
Sample: 2008Q1 to 2021Q1
Periods included: 53
Cross-sections included: 5
Total panel observations: 265
Note: non-zero cross-section means detected in data
Cross-section means were removed during computation of correlations

	GDP Statistic	TMP Statistic	TRT Statistic	HH Statistic	Gvt Statistic	Firms Statistic
Breusch-Pagan LM	199.09	173.34	21.225	106.95	136.92	76.081
Pesaran scaled LM	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Bias-corrected scaled LM	42.283	36.530	4.395	21.679	28.380	14.776
Pesaran CD	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Degrees of freedom: 10 for all variables except 6 for TRT (p-values)
Source: calculated by the authors

The null hypotheses were rejected for each of the four tests in favour of the alternatives. There is cross-section dependence within the BRICS panel data hence the need to use the Perasan (2007) CIPS statistic to test for unit roots.

3.2.2 Test Results for Panel Unit Roots

Two CIPS statistics were used to test for stationary, the original CIPS and the truncated version.

Table 3
Panel unit root tests

Null hypothesis: Unit root

Statistic	GDP	TMP	TRT*	HH	Gvt	Firms
CIPS	-6.320 (<0.01)	-4.747 (<0.01)	-5.143 (<0.01)	-5.604 (<0.01)	-6.219 (<0.01)	-7.097 (<0.01)
Truncated CIPS	-5.553 (<0.01)	-4.745 (<0.01)	-5.143 (<0.01)	-5.132 (<0.01)	-5.493 (<0.01)	-5.637 (<0.01)

Note: t-statistic (p-value). *data series from 2008Q1 to 2018Q2

Source: calculated by the authors

The results in Table 3 indicate that the null hypothesis is rejected which means that all the data variables are stationary at levels.

3.3. Panel Granger Causality Results

The Dumitrescu & Hurlin (2012) model was applied to the BRICS balanced panel data to test for Granger causality. The optimal lag length was determined using the Bayesian Information Criterion (BIC) as it produced the lowest lag order. The DH model yields the most reliable results at the optimal lag orders (EViews, 2021).

Table 4
Pairwise Dumitrescu-Hurlin Panel Causality Tests (GDP)

Sample: 2008Q1 2021Q1
Lags: 1

Null Hypothesis:	W-Stat.	Zbar-Stat.	Prob.
HH does not homogeneously cause GDP	5.81513	7.00826	**2.E-12**
GDP does not homogeneously cause HH	1.41536	0.54745	0.5841
GVT does not homogeneously cause GDP	9.10786	11.8435	**0.0000**
GDP does not homogeneously cause GVT	0.54558	-0.72978	0.4655
FIRMS does not homogeneously cause GDP	4.80831	5.52981	**3.E-08**
GDP does not homogeneously cause FIRMS	0.96162	-0.11884	0.9054

Note: for all alternative hypotheses, X does Granger-cause Y for at least one country
Source: calculated by the authors

According to Table 4, there is unidirectional Granger causality from households to GDP, government to GDP and firms to GDP. There is no causality among the credit variables. Further investigation of the level of manufacturing production per country revealed that only households and government credit Granger-cause output as depicted in Table 5. There is no causality between credit to non-financial corporations and manufacturing output, in either direction, for any of the BRICS economies. A plausible reason for this result is that large corporations from the USA, for example, have operations in most BRICS nations that are financed from their home country. According to the University of Cambridge Institute for Manufacturing (2008), China attracted more FDI than the USA. Malden & Listerud (2020) show that China and India grew from the shadows from 2005 to land in the top five destinations for US multinational enterprises in 2017. The report also states that computers, semiconductors and other electronic products are the leading products manufactured by US businesses in China and India.

Financing large foreign operations from the US and other developed financial markets could prove cheaper for large US enterprises that have a good credit standing in these markets. This means that there will be no significant causality between manufacturing output and BRICS credit to firms because borrowing from BRICS banks could prove costly. Data permitting, we could test for

causality from developed financial markets to BRICS production output for selected countries and industries.

Table 5
Pairwise Dumitrescu-Hurlin Panel Causality Tests (TMP)

Pairwise Dumitrescu Hurlin Panel Causality Tests
Sample: 2008Q1 2021Q1
Lags: 1

Null Hypothesis:	W-Stat.	Zbar-Stat.	Prob.
HH does not homogeneously cause TMP	2.77268	2.54059	**0.0111**
TMP does not homogeneously cause HH	1.45593	0.60702	0.5438
GVT does not homogeneously cause TMP	5.76790	6.93891	**4.E-12**
TMP does not homogeneously cause GVT	0.98131	-0.08993	0.9283
FIRMS does not homogeneously cause TMP	2.00694	1.41615	**0.1567**
TMP does not homogeneously cause FIRMS	1.40339	0.52987	0.5962

Note: for all alternative hypotheses, X does Granger-cause Y for at least one country
Source: calculated by the authors

As shown in Table 6, credit to households, government and firms Granger-caused retail trade from 2008 to 2018. These results are comparable to the ones for GDP. However, they contradict the findings for manufacturing where credit to firms did not Granger-cause total manufacturing production. This contradiction could be explained by the type of finance under review. We could infer that retail trade is influenced by working capital finance that is obtained locally and used locally to purchase local products within the BRICS. On the other hand, fixed-term capital finance used to set up plants and factories, which is directly linked to manufacturing output, could be secured elsewhere, outside the BRICS.

Table 6
Pairwise Dumitrescu-Hurlin Panel Causality Tests (TRT – excluding India)

Pairwise Dumitrescu Hurlin Panel Causality Tests
Sample: 2008Q1 2018Q2
Lags: 1

Null Hypothesis:	W-Stat.	Zbar-Stat.	Prob.
HH does not homogeneously cause TRT	7.55966	8.35333	**0.0000**
TRT does not homogeneously cause HH	0.91418	-0.18158	0.8559
GVT does not homogeneously cause TRT	4.43522	4.34056	**1.E-05**
TRT does not homogeneously cause GVT	0.91589	-0.17937	0.8576
FIRMS does not homogeneously cause TRT	9.44175	10.7705	**0.0000**
TRT does not homogeneously cause FIRMS	1.76595	0.91238	0.3616

Note: for all alternative hypotheses, X does Granger-cause Y for at least one country
Source: calculated by the authors

Granger-causality was tested per country to show the time-dimensional causality of the variables. The results are found in the appendix in Table A4. These results mainly mimic the ones for panel tests with the exception of feedback causality between Russia's GDP and household credit. Additionally, Brazil's total credit to non-financial corporations was found to have Granger-caused total manufacturing production yet panel results indicate no causality for any of the BRICS economies.

Discussion

The fact that the total credit series include both domestic and external sources points to cross section dependence. The New Development Bank (formerly BRICS Development Bank) indirectly provides a channel through which economic shocks could be transferred from one economy to another within the bloc. The trade agreements and policy reforms also facilitate interdependence which partly explains the findings of cross-section dependence (Nazlioglu et al. 2011). Mhadhbi et al. (2017) found strong evidence of cross-section dependence among forty developing countries from different continents.

In general, the findings of this study show that bank lending, proxied by households, government and non-financial corporate credit, Granger-causes GDP. These results are fully

corroborated by those of Jotwani (2014) for India and Andersson et al. (2016) who studied China. Andersson et al. (2016) demonstrated that the total short-term loans of joint stock corporate banks and policy banks Granger-caused GDP and total factor productivity between 1997 and 2008. Lending to corporations often entails the acquisition of new capital and/or the renovation of old capital. In a manufacturing-driven economy like China, it is expected that corporate credit would have a direct and positive impact on the GDP growth rates. Much of the lending in policy banks involves infrastructural projects which may not have an effect on GDP in the short-term unlike corporate lending in joint stock banks (Andersson et al., 2016). Furthermore, it was shown that GDP Granger-caused growth in the lending activities of state-affiliated banks while feedback causality explained the relationship between policy bank lending and total factor productivity (Andersson et al., 2016). The results of Durafe & Jha (2018) and Mohanty et al. (2016) indicate bidirectional causality between economic growth and bank credit in India from 2000 to 2014.

Total manufacturing productivity was found to be Granger-caused by household and government borrowings and not by firm credit. The result contradicts the findings of Andersson et al. (2016) who showed that aggregate credit from joint stock corporate banks and policy banks in China Granger-caused growth in manufacturing production. This is in tandem with the supply-leading hypothesis were economic growth responds to the credit supply stimuli. However, in this study, the lack of causality from firm credit to manufacturing productivity implies that aggregate household expenditure financed by household debt and government expenditure financed by government credit are the main causal determinants of manufacturing production in the BRICS.

The analysis of retail trade revealed that the variable was Granger-caused by credit to households, government and corporations without feedback loops. In the mainstream extant of literature, there is scant evidence on causality among credit variables and total manufacturing production or total retail trade.

Conclusion

The study investigated the link between bank credit and economic growth within the BRICS economic bloc relying on the panel Granger causality model. The period of the study was from 2008 to 2021. The Dumitrescu & Hurlin (2012) model was used to test for causality in the cross-sectionally dependent heterogeneous BRICS panel data set. The study makes the following specific conclusions. First, it is concluded that there is unidirectional causality from each of the three credit variables proxying for bank credit to GDP and retail trade. In other words, bank credit variables Granger-cause variations in economic growth and retail trade. There is evidence of causality from finance to economic growth thus lending credence to the findings of Goldsmith (1969), McKinnon (1973), Shaw (1973) and others who found strong and positive correlations between financial market indicators and variables proxying for economic growth. Second, the study concludes that of the specified variables, only household and government credit cause or explain changes in manufacturing production. The implication is that within BRICS economies, household consumption spending financed by household credit and government expenditure financed by government credit have a significant impact on manufacturing production. This may be consistent with the relationship between household and government spending on the one side, and manufacturing on the other side as postulated by the simple Keynesian spending model. The main conclusion is that there is evidence of a causal link between bank credit and economic growth proxied by the GDP measures.

At the tail end of the time series, the Panel Granger Causality analyses included the years 2019-2021 which are generally regarded in the contemporary literature as Covid-19 years. The lockdowns of the Covid-19 pandemic that triggered the current global recession, may have introduced a structural break in the time series adopted in the analyses. Nevertheless, when the analyses was done, the likely structural breaks in time series were assumed away to avoid introducing complex assumptions into the panel Granger causality analysis.

The panel Granger causality methodology cannot be used to forecast the likely relationships between two or more variables in the future. This is one of the main limitations of the Granger

causality methodology in general. The methodology is not suitable for studying the interaction effects of two or more variables in the long-run. Other methods such as wavelet analysis are better suited for forecasting. However, the Dumitrescu-Hurlin panel causality test is sufficient in meeting the objectives of this study and provides reliable results upon which autoregressive and other forecasting models could be conducted.

This study contributes to the body of knowledge in general, and the extant literature specifically, in two ways. Firstly, the study may provide tentative evidence of a phenomenon called the "monetary veil" in monetary economics. 'Pure' monetarists and New Classicalists argue that money and money aggregates are neutral in the long-run. The study found that total manufacturing productivity was Granger-caused by household and government borrowings and not by firm credit. If total manufacturing productivity is taking as a proxy for aggregate supply (AS) in the economy, then the lack of causality between it and firm credit may be tentative evidence of the neutrality of money in BRICS economies.

Secondly, one of the oldest economic theories which was contradicted by Keynesians is Jean-Baptiste 'Say's law' that asserts that supply creates its own demand (Baumol, 1999). The fact that household and government borrowings which may be taken as proxies of aggregate demand, Granger-cause total manufacturing production [a proxy of aggregate supply], may imply an inversion of Jean-Baptiste Say's 'law'.

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Appendix A

Table A1. Panel Descriptive Statistics

	GDP	TMP	TRT	HH	GVT	FIRMS
Mean	0.8801	0.46278	1.3308	2.05791	2.36484	1.72911
Median	0.9694	0.30659	1.32075	2.69088	2.98409	2.19249
Maximum	21.176	55.6935	7.05895	23.4649	31.5789	21.0068
Minimum	-24.491	-39.119	-9.3595	-25.699	-22.945	-22.687
Std. Dev.	2.990	6.27464	2.10770	7.25517	6.84924	6.45411
Skewness	-1.785	2.29164	-0.6764	-0.7206	-0.3493	-0.6522
Kurtosis	36.353	38.3193	6.22055	4.73124	5.39367	4.88316
Jarque-Bera	12423	14005.9	85.4133	56.0262	68.6553	57.9414
Probability	0.00	0.00	0.00	0.00	0.00	0.00
Sum	233.22	122.636	223.574	545.347	626.682	458.214
Sum Sq. Dev.	2359.6	10394.0	741.878	13896.3	12384.8	10997.1
Observations	265	265	168	265	265	265

Source: calculated by the authors

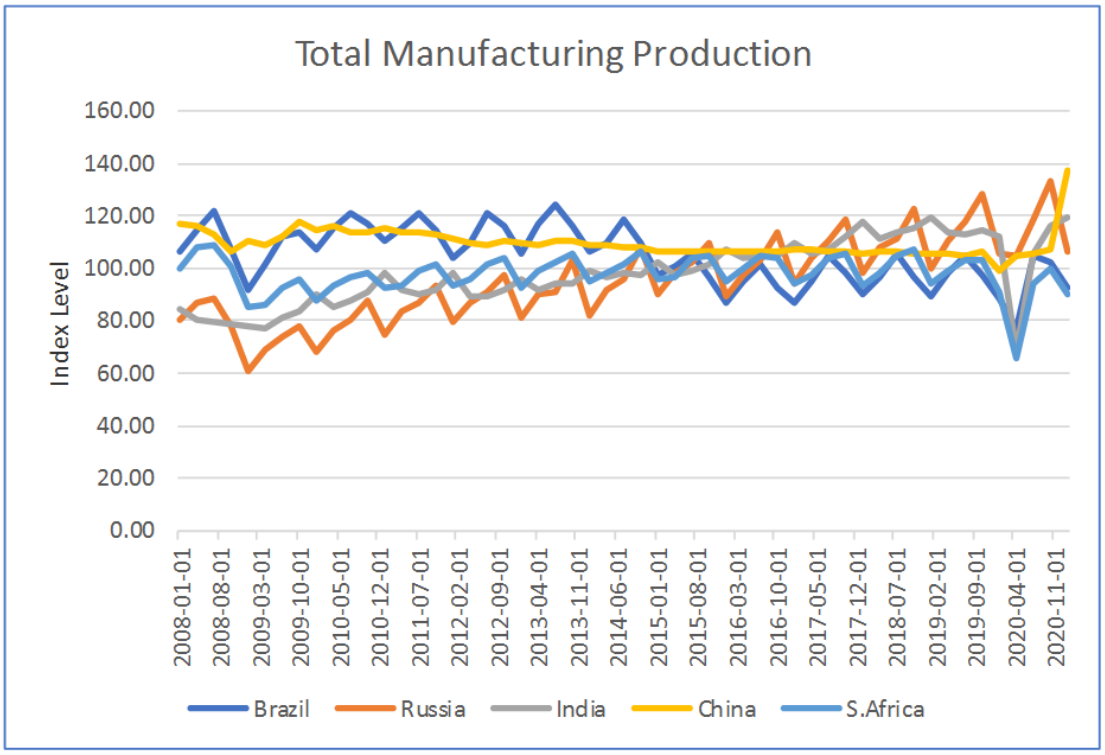

Figure A1. Total Manufacturing Production Index

Source: calculated by the authors

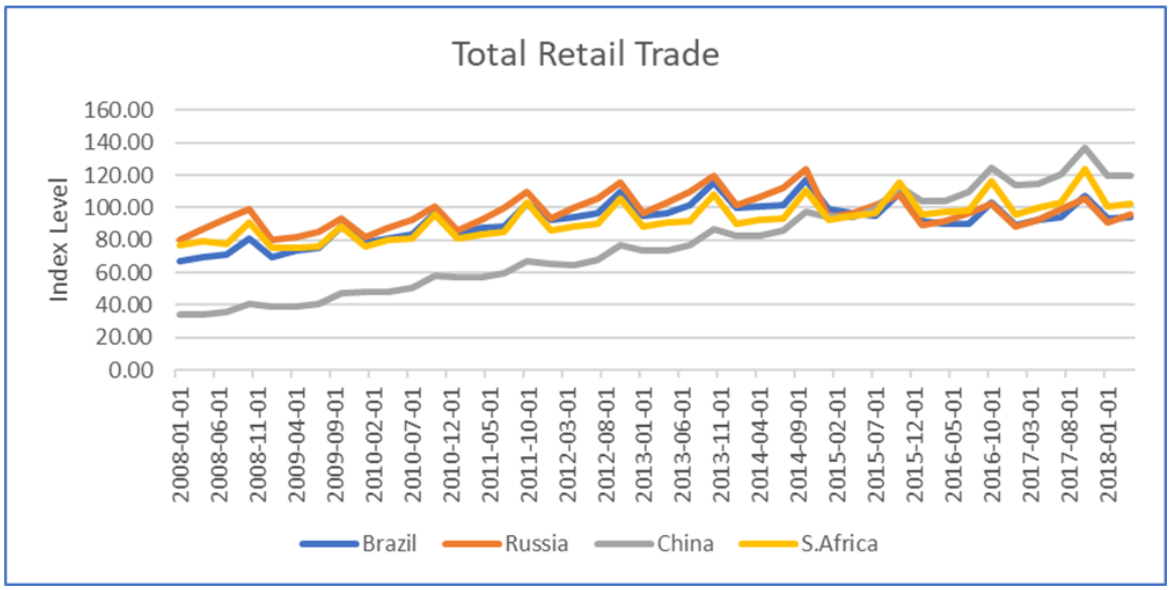

Figure A2. Total Retail Trade Index

Source: calculated by the authors

Table A2. Correlation Coefficients for GDP and TMP

Covariance Analysis: Ordinary
Date: 12/23/21 Time: 15:45
Sample: 1 265
Included observations: 265

Correlation Probability	GDP	TMP	HH	GVT	FIRMS
GDP	1.000000				

TMP	0.836903	1.000000			
	0.0000	-----			
HH	0.187719	0.143867	1.000000		
	0.0021	0.0191	-----		
GVT	0.126846	0.134098	0.878507	1.000000	
	0.0391	0.0291	0.0000	-----	
FIRMS	0.142491	0.107998	0.931911	0.853451	1.000000
	0.0203	0.0793	0.0000	0.0000	-----

Source: calculated by the authors

Table A3. Correlation Coefficients for Total Retail Trade

Covariance Analysis: Ordinary
Date: 12/23/21 Time: 15:52
Sample: 1 168
Included observations: 168

Correlation Probability	TRT	HH	GVT	FIRMS
TRT	1.000000			

HH	0.288362	1.000000		
	0.0002	-----		
GVT	0.134979	0.871520	1.000000	
	0.0811	0.0000	-----	
FIRMS	0.175891	0.942241	0.868157	1.000000
	0.0226	0.0000	0.0000	-----

Source: calculated by the authors

Table A4. Country Z-bar Granger Causality Statistics

	Brazil	Russia	India	China	S. Africa
GDP→HH	-0.21(0.83)	3.14 (0.00)	-0.52(0.60)	-0.49(0.62)	-0.45(0.66)
HH→GDP	6.41 (0.00)	6.37 (0.00)	-0.33(0.74)	-0.51(0.61)	5.54 (0.00)
GDP→GVT	0.03(0.97)	0.08 (0.94)	-0.65(0.51)	-0.36(0.72)	-0.71(0.48)
GVT→GDP	7.18 (0.00)	12.1 (0.00)	3.08 (0.00)	-0.68(0.50)	6.81 (0.00)
GDP→FIRMS	0.01 (0.99)	0.96 (0.34)	-0.56(0.57)	-0.45(0.65)	-0.09(0.93)
FIRMS→GDP	5.81 (0.00)	5.57 (0.00)	-0.26(0.79)	-0.25(0.80)	2.59 (0.01)
TMP→HH	0.13 (0.90)	1.69 (0.09)	-0.64(0.52)	0.19 (0.85)	0.25 (0.80)
HH→TMP	4.43 (0.00)	-0.34(0.74)	0.74 (0.46)	0.34 (0.73)	3.25 (0.00)
TMP→GVT	1.04 (0.30)	0.84 (0.40)	-0.70(0.48)	-0.70(0.48)	-0.55(0.58)
GVT→TMP	5.53 (0.00)	1.23 (0.22)	1.02 (0.31)	0.28 (0.78)	6.59 (0.00)
TMP→FIRMS	0.35 (0.72)	0.71 (0.48)	-0.66(0.51)	0.22 (0.83)	0.80 (0.42)
FIRMS→TMP	3.78 (0.00)	-0.07(0.94)	-0.51(0.61)	-0.47(0.64)	1.32 (0.19)
TRT→HH	-0.53(0.60)	-0.69(0.49)	-	1.13 (0.26)	-0.15(0.88)
HH→TRT	3.68 (0.00)	11.8 (0.00)		3.33 (0.00)	3.31 (0.00)
TRT→GVT	-0.25(0.81)	-0.37(0.71)	-	0.97 (0.33)	-0.59(0.56)
GVT→TRT	-0.59(0.55)	21.4 (0.00)		2.58 (0.01)	3.34 (0.00)
TRT→FIRMS	-0.59(0.55)	-0.70(0.48)	-	3.28 (0.00)	0.18 (0.85)
FIRMS→TRT	3.31 (0.00)	18.1 (0.00)		8.65 (0.00)	0.10 (0.92)

Note: Z-bar(probability)
Source: calculated by the authors