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RESEARCH PAPER

The causal relationship between financial development and economic growth: an experience with BRICS economies

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Abstract
In recent years, the emerging economies of the world, particularly those of the BRICS countries, have attracted increasing attention for their contribution to the growth of the global economy. These countries have initiated significant reforms within financial institutions and financial markets that are vital to the expansion of the financial sector and thus to the countries' economic growth. In this context, this study aims to determine whether the development of the financial system in these economies is the cause for their growth. To measure the financial system development, the study constructs three broad-based indices—the financial institution development index, financial market development index, and financial system development index—for each economy using principal component analysis, with the factors of depth, efficiency, and stability of financial institutions and financial markets as variables. In addition, we use the Toda–Yamamoto causality test to conduct this exercise for the period 1996–2016. The results of the study reveal that there is no uniformity in finance and growth causality among the BRICS countries.

Keywords BRICS · Financial system · Toda–Yamamoto Granger causality · Economic growth

JEL Classification C38 · G2 · O5

Introduction

Economic growth is the ultimate objective of every country's economic policy, to enhance the well-being of its people. Among the numerous factors influencing a country's economic growth, the most important determinant is investment or capital. Several economic theories have suggested that investment accelerates the process of economic growth. In all economies, the financial system plays an intermediary role in generating these required

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investments through the mobilization of a country's capital. Thus, an efficient financial system is necessary for channeling resources to productive sectors. The financial system also aids entrepreneurs in financing their investment projects through the transfer of funds from surplus spending units or agents. Without a good financial system, entrepreneurs will lack information regarding those agents who are willing to lend, and at the same time the agents will have no means of knowing who is in need of their surplus funds. Financial systems consist of financial institutions and markets that foster economic growth by reducing transaction costs, thereby facilitating the allocation of resources. Financial development promotes a country's economic growth in two ways. One is through the accumulation of capital, which is quantitative, and the other is total factor productivity (TFP), which is qualitative. The former mobilizes surplus funds to finance investment projects, thus leading to higher economic growth. The latter allocates resources efficiently by reducing the asymmetries in information through innovation in financial technologies. An efficient financial system helps to enhance productivity through the adoption of new technologies (Ang 2008). Also, a well-developed financial system is essential for any country, as it enhances its well-being and reduces poverty.[1] The forces of liberalization and globalization among the world economies since the 1980s have resulted in the integration of financial markets, which has paved the way for foreign capital to flow from developed to developing and emerging economies. In the emerging economies in particular, the financial reforms initiated have enabled the system to function more effectively and efficiently. Several studies have been taken up to examine the finance–growth causation paradigm with respect to developed, developing, or emerging economies. Most of these studies (e.g. King and Levine 1993a, b; Demirguc and Levine 1999; Kar et al. 2011; Sehrawat and Giri 2015) used only the *depth* factor of financial institutions and financial markets as a variable to measure financial development. However, financial development is multidimensional in nature, and hence the depth factor alone may not adequately represent all the characteristics of a financial system. In the literature, there are studies which considered a financial development index to denote the financial system. However, this index is constructed using only depth variables, which include *liquid liabilities to GDP*, *private sector credit to GDP*, and *stock market capitalization to GDP*. No study to date has used all factors—depth, efficiency, access, and stability—to construct a broad-based index for both institutions and markets. On the other hand, there is no uniformity across studies in establishing the finance–growth causation. In this context, Patrick (1966) framed two important hypotheses[2] regarding patterns of financial growth. The first is a finance–growth causation paradigm, while the second is growth–finance causation. More recently, based on study findings, two additional hypotheses have been identified: the feedback (mutual causation) and neutrality (no causation) hypotheses. In the first, the expansion of the financial sector drives real sector growth through diversification and pooling of risk, accumulation of physical capital, mobilization of surplus funds, and enhanced levels of productivity and technology. The notion of finance-led growth is supported by a number of studies, including Levine (1991), Pagano (1993), Thornton (1994), Levine and Zervos (1996, 1998), Bekaert, Campbell and Christian (2001), Agbetsiaga (2004), McCaig and Stengos (2005), Luintel et al. (2008), Ang (2008), Bojanic (2012), Siva Kiran Guptha and Prabhakar Rao (2014), and Akel and Talip (2017). The second hypothesis, which maintains that improved standards of living demand

[1] World Bank.

[2] Jung (1986).

expanded financial services, is supported in theoretical studies by Robinson (1952) and[3] Stern (1989), along with empirical studies such as those of Al-Yousif (2002), Handa and Khan (2008), Panopoulou (2009), Paramati and Gupta (2011), and Pradhan et al. (2013a). The notion of two-way causation between finance and economic growth has been argued by Fritz (1984), Akinboade (1998), Ahmed and Ansari (1998), Craigwell and Downes (2001), Unalmis (2002), Apergis et al. (2007), Chow and Fung (2011), Jun (2012), Pradhan et al. (2014), and Lebe (2016). The fourth paradigm suggests the absence of finance and economic growth causation, with some studies (see Lucas 1988; Singh 1997; Naceur and Ghazouani 2007; Majid 2008; Marques et al. 2013; Haque 2013; Grassa and Gazdar 2014; Mhadhbi 2014; Ductor and Grechyna 2015; Akbas 2015) rejecting the existence of a relationship between finance and growth.

O'Neill (2001) of Goldman Sachs[4] analyzed the growth patterns of G7 nations and a few of the world's larger emerging economies. He found that four emerging economies had the potential to outperform the G7 countries in terms of the size of their economies. These countries were Brazil, Russia, India, and China, for which he coined the acronym BRIC in 2001. When South Africa joined the group in 2010, the new economic order BRICS was established. These BRICS countries, with a combined population of 3.1 billion, comprising 42% of the world's population, have thus been gaining importance on a global level. In 2017, these economies together contributed about 23.3% of global GDP, with a volume of US $18.8 trillion and collective GDP (purchasing power parity; PPP) of US $40.5 trillion, which is around 32% of global GDP (PPP). Also, with regard to the BRICS financial sector, the reforms that began in the 1980s and 1990s have helped financial institutions and markets experience a steady increase in size and volume. Financial development indicators have improved considerably, with combined domestic bank credit of US $22 trillion (22% of the world's domestic bank credit) and US $13 trillion in stock market capitalization (17% of the world's market capitalization) in 2017. In light of the changing financial scenario in BRICS economies with the expansion of banks and markets, this study aims to examine finance–growth causation in these economies. To this end, we have constructed three broad-based indices (see Svirydzenka 2016), namely the financial institution development index (FIDI), financial market development index (FMDI), and the financial system development index (FSDI, which combines institutions and markets), using financial system depth, efficiency, and stability factors for the period from 1996 through 2016.

The remainder of the paper is organized as follows: A literature review is presented in section 2, followed by a description of the data and methodology in the third section. In section 4 we present the findings of this study. Section 5 concludes the paper with a summary and conclusions.

Literature review

Many researchers have undertaken both theoretical and empirical studies to ascertain finance–growth causation. The first theoretical study by Bagehot (1873) underscored the need for financial systems in mobilizing capital for industrialization. Following this seminal study, a number of development economists, from Schumpeter (1911) to McKinnon

[3] "Where enterprise leads, finance follows".

[4] Building Better Global Economic BRICs.

(1973), Shaw (1973), and others, have highlighted the role of finance in economic growth. Until the 1990s, the financial sector was always represented by financial intermediaries such as banks. The seminal study by Atje and Jovanovic (1993), which considered financial markets as well as institutions, found that the stock market contributed positively to economic growth. Later studies by Levine and Zervos (1996, 1998), Levine (1997), and others have included both banks and stock markets in a unified framework to understand finance–growth causation.

In addition to theoretical studies, the literature includes empirical research such as cross-sectional studies by Goldsmith (1969), Odedokun (1996b), Harris (1997), Levine (1999), Ram (1999), Khan and Senhadji (2000), Graff (2002), Jalilian and Kirkpatrick (2002), and Levine (2002). Time-series studies which are relevant in this context are those of Gupta (1984), Odedokun (1996a), Hansson and Jonung (1997), Ghali (1999), Choe and Moosa (1999), Xu (2000), Ang (2008), Siva Kiran Guptha and Prabhakar Rao (2011, 2014), Sahoo (2014), Joshi (2016), and Sehrawat and Giri (2015, 2016, 2017). Major contributions in studies using panel data have been made by De Gregorio and Guidotti (1995), Benhabib and Spiegel (2000), Henry (2000), Nazmi (2005), Yu et al. (2012), Pradhan et al. (2013a), and Mariusz and Wasiak (2016).

A few studies have considered particular groups of countries, including the Organisation for Economic Co-operation and Development (OECD) and EU (Mariusz and Wasiak 2016), Association of Southeast Asian Nations (ASEAN) (Pradhan et al. 2014), the Middle East and North Africa (MENA) (Naceur and Ghazouani 2007; Suleiman and Aamer 2008; Kar et al. 2011), and BRICS economies (Pradhan et al. 2013b, Mercan and Ismet 2013, Wait et al. 2017). Similarly, Peia and Kasper (2015) examined finance–growth directional causation for 22 advanced economies, while Menyah et al. (2014) and Jagadish (2018) sought to identify finance–growth directional causation in African countries.

With respect to each of the BRICS countries, various time-series studies have been conducted to determine the finance–growth direction. Carneiro de Matos (2002) found that banking sector development in Brazil drove its economic growth. In another study investigating the relationship, Stefani (2007) used a cointegrated vector autoregressive (VAR) model and found that finance was the driving force for Brazil's economic growth. Using a spatial-autoregressive disturbance model, da Silva (2015) showed a positive association between finance and growth in Brazil. Nyasha and Odhiambo (2017) used a nonlinear autoregressive distributed lag (ARDL) approach to study the roles of the banking sector and markets in driving Brazil's growth, and observed that growth was driven by the stock markets rather than the banking sector. Along similar lines, a study by Moyo et al. (2018) on the association between bank and market indicators and growth showed that stock markets were responsible for driving Brazilian economic growth. In the case of finance–growth causation in Russia, studies are sparse. Ono (2012) used a cointegration method to show that the supply of money to GDP promoted Russian economic growth. Another study by Ono (2017) observed a demand-following economic growth response to money supply and bank lending in Russia. With reference to India, studies by Demetriades and Luintel (1996, 1997) found that financial repression[5] hampered financial stability and economic growth during the pre-reform period, thus supporting financial liberalization in India. A finance–growth nexus was observed in the studies of Biswal and Kamiah (2001), Bhattacharya and Sivasubramanian (2003), Singh (2008), Chakraborty (2010), Fulford

[5] Is a government measure to reduce the debt burden by keeping the interest rate below inflation levels.

(2013), Srinivasan (2014), Tripathy and Pradhan (2014), Satyanarayana Murthy et al. (2014), Siva Kiran Guptha and Prabhakar Rao (2011, 2014), Sahoo (2014), Joshi (2016), and Sehrawat and Giri (2015, 2016, 2017), while growth-led financial development was found by Chakraborty (2008) and Satyanarayana Murthy and Amresh (2014), and absence of a causation pattern was reported by Nain and Kamaiah (2014). As regards China, Hasan et al. (2009) have argued that capital markets are beneficial to growth in China, while the banking sector is detrimental to growth. Other studies in the case of China include Liang and Teng (2006), Liu and Sinclair (2008), Jalil and Feridun (2010), Cheng and Degryse (2010), Ho and Odhiambo (2011), Zhang et al. (2012), Xu (2016), Chow et al. (2018), and Pan and Mishra (2018). As for finance–growth directional causality in South Africa, empirical studies by Agbetsiaga (2004) pointed to finance-led growth, while Sunde (2012) reported that economic growth led financial sector development in South Africa. Similar results were noted by Odhiambo (2004, 2010), where economic growth was found to drive growth in South Africa's financial sector.

Data and methodology

Data and variables

This study utilizes annual time-series data from 1996 through 2016. The data for all the variables are taken from the World Bank and the Global Financial Development Database (GFDD, 2018).

PCAPGR: Growth rate of real GDP per capita $\left(\frac{\mathrm{PCAP}_t - \mathrm{PCAP}_{t-1}}{\mathrm{PCAP}_{t-1}}\right) \times 100$ is used to denote economic growth. Here, PCAP_t is the per capita GDP at time t.

The definition and notation for the variables used to construct the financial institution development index (FIDI), financial market development index (FMDI), and financial system development index (FSDI) are given in Table 1.

Principal component analysis (PCA)

Principal component analysis is a multivariate statistical technique that converts correlated variables into uncorrelated variables without losing the information in the large set. These uncorrelated variables which are extracted from the original set of variables using their correlation matrix are called principal components. We employ PCA for the construction of financial development indices by using a set of variables to measure three factors—depth, efficiency, and stability—of banks and financial markets.

Let $X_i (i = 1, 2, 3, \ldots, n)$ be the set of set of n variables that are transformed to a new set of m variables $P_j (j = 1, 2, 3, \ldots, , m)$ $(m \ll n)$ are called principal components (PCs). These PCs are linear combinations of the Xs and are represented mathematically as

$$PC_k = a_{k1}X_1 + a_{k2}X_2 + \cdots + a_{kn}X_n \tag{1}$$

where PC_k is the kth principal component, $X_1, X_2, \ldots X_n$ are the original set of variables, and $a_{k1}, a_{k2}, \ldots a_{kn}$ are loadings or scores of respective X_i in the kth principal component.

Here, the variance contribution of PCs to variables is the weights which are the component loadings. Among the PCs, the first principal component PC_1 is the linear combination of X_1, X_2,… X_n, accounting for maximum variance. The remaining variance of the total variance is explained by the second principal component PC_2, which is uncorrelated with

Table 1 List of variables considered for the analysis, along with their notation

Factor	Variable	Notation
Financial institution development index (FIDI)		
Depth	Private sector credit to GDP	DCPS
Efficiency	Net interest margin	NIM
	Overhead costs to total assets	OHC
Stability	Bank credit to bank deposits (%)	BCBD
Financial market development index (FMDI)		
Depth	Stock market capitalization to GDP	MCAP
	Stocks traded to GDP	TVTR
Efficiency	Stock market turnover ratio	TURNR
Stability	Stock price volatility	VOL
Financial system development index (FSDI)		
Depth	Private sector credit to GDP	DCPS
	Stock market capitalization to GDP	MCAP
	Stocks traded to GDP	TVTR
Efficiency	Net interest margin	NIM
	Overhead costs to total assets	OHC
	Stock market turnover ratio	TURNR
Stability	Bank credit to bank deposits (%)	BCBD
	Stock price volatility	VOL

Source: IMF database

DCPS : $\frac{\text{private sector credit}}{\text{GDP}} \times 100$

NIM : $\frac{\text{Bank interest income} - \text{interest expenses}}{\text{total assets}}$

OHC : $\frac{\text{Overhead costs}}{\text{Total bank assets}}$

BCBD : $\frac{\text{Bank credit}}{\text{Bank deposit}} \times 100$

MCAP : $\frac{\text{Stock market capitalization}}{\text{GDP}} \times 100$

TVTR : $\frac{\text{Total value of shares traded}}{\text{GDP}} \times 100$

TURNR : $\frac{\text{Total value of shares traded}}{\text{Stock market capitalization}}$

VOL: The mean value of 360-day volatility in stock prices

the first principal component PC_1. Here we extract the principal components whose eigenvalues are greater than 1. The details of the principal components are discussed in several books on multivariate analysis, such as Johnson and Wichern (1999).

Toda–Yamamoto Granger causality test

This test was proposed by Toda and Yamamoto (1995) and is an improved causality test under the VAR framework for the variables of different orders of integration. Like the Granger causality test, this test is a two-step procedure with consideration of extra lags of maximum order of integration.

Step 1 We perform the augmented Dickey–Fuller (1979) test to check stationarity and identify the maximum order of integration ($d_{\max}$) using the following equation.

$$\Delta y_t = (\emptyset - 1) y_{t-1} + \sum_{i=1}^{j} \delta_i \Delta y_{t-i} + \varepsilon_t \tag{2}$$

where $\varepsilon_t \sim N(0, \sigma^2)$.

Step 2 Then, using the optimal lag length (k) selected by the Akaike information criterion/Schwartz information criterion (AIC/SIC), a VAR model is considered in its level form by means of $(k + d_{\max})$ lags. Suppose that $k = 1$, and two variables y_t, x_t are stationary at levels, first difference, and second difference, so that $d_{\max} = 1$. Then, one extra lag is added to each variable. Thus, the following is a VAR model with two lags.

$$\begin{bmatrix} y_t \\ x_t \end{bmatrix} = \begin{bmatrix} \beta_{10} \\ \beta_{20} \end{bmatrix} + \begin{bmatrix} \beta_{11} & \beta_{12} \\ \beta_{21} & \beta_{22} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ x_{t-1} \end{bmatrix} + \begin{bmatrix} \beta_{11} & \beta_{12} \\ \beta_{21} & \beta_{22} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ x_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix} \tag{3}$$

A Wald test which follows asymptotic χ^2 distribution is applied to determine the relationship between any two variables.

Empirical analysis

Construction of financial institution, market, and financial system development indices

In order to ascertain the directional causality from institutions (banks), markets (stock markets), and overall financial development to economic growth, we construct financial institution, financial market, and financial system development indices using the PCA. The factors considered for the indices are depth, efficiency, and stability. Due to the lack of available data on access[6] (indicator for measuring financial inclusion) for all the BRICS countries, the access factor is excluded from the analysis. Here we have taken principal components with a cumulative variation of up to 95% (see Satyanarayana Murthy and Amresh 2014) as corresponding weights to construct the indices. The factor loadings in each PC of the FIDI, FMDI, and FSDI for all the BRICS countries are provided in the Appendix (Tables 4–18).

Unit root test results

Before undertaking any econometric analysis, it is important to test the variable for stationarity in order to avoid wrong inferences. Therefore, the augmented Dickey–Fuller (1979) and Phillips–Perron (1988) tests are used for stationarity by taking optimal lag lengths based on the AIC. The unit root test results are presented in Table 2.

The augmented Dickey–Fuller and Phillips–Perron unit root test results show that the per capita growth rates of Russia and India and the FMDI of South Africa are stationary at levels. All other variables are stationary at first difference, with the exception of the FIDI of India and China, which is stationary at second difference.

Toda–Yamamoto Granger causality test results

As the variables considered for the study are stationary at different orders of integration, we performed the Toda–Yamamoto Granger causality test to identify causation between the three

[6] Global Partnership for Financial Inclusion (GPFI) 2011.

Table 2 Unit root test results

Country	Variable	ADF test			PP test		
		I(0)	I(1)	I(2)	I(0)	I(1)	I(2)
Brazil	PCAPGR		−7.26*			−13.80*	
	FIDI		−5.44*			−5.56*	
	FMDI		−3.87**			−3.87**	
	FSDI		−6.20*			−6.22*	
Russia	PCAPGR	−3.30***			−3.29***		
	FIDI		−4.09**			−4.52*	
	FMDI		−4.16**			−4.16*	
	FSDI		−5.14*			−5.08*	
India	PCAPGR	−3.95**			−3.94**		
	FIDI			−5.39*			−5.44*
	FMDI		−7.32*			−7.32*	
	FSDI		6.44*			−6.60*	
China	PCAPGR		−4.16*			−5.80*	
	FIDI			−3.32***			−3.29***
	FMDI		−5.51*			−5.51*	
	FSDI		−6.41*			−6.48*	
South Africa	PCAPGR		−4.86*			−10.45*	
	FIDI		−6.17*			−10.08*	
	FMDI	−3.33***			−3.33***		
	FSDI		−4.84*			−5.33*	

*, **, *** denote level of statistical significance at 1%, 5%, and 10%

ADF augmented Dickey–Fuller, *PP* Phillips–Perron

indices and per capita income among the BRICS countries. The appropriate lag length of 2 is used from the AIC for the VAR model. The causality results are reported in Table 3.

The causality results show that FIDI causes for economic growth in Brazil, Russia, India, and China support the financial institution-led growth paradigm, while the FMDI causes for economic growth in Brazil, Russia, and China support the financial market-led growth hypothesis. However, for India, we find that growth drives the financial markets. The results also reveal two-way causation from the FSDI to economic growth in Brazil, Russia, and India, but unidirectional causation for China. On the other hand, the neutrality hypothesis is found in the case of South Africa, implying the absence of finance–growth causation. In the case of Brazil, Russia, India, and China, the results are consistent with the findings of Stefani (2007), Ono (2012), Sahoo (2014), and Jalil and Feridun (2010), who argued for finance–growth causation. With regard to the economic growth to FMDI causation for India, our findings are contrary to the findings of Biswal and Kamiah (2001) and Srinivasan (2014), which revealed market-led growth.

Table 3 Results of Toda–Yamamoto Granger causality/block exogeneity Wald tests

Country	Null hypothesis	Wald statistics (Toda–Yamamoto)
Brazil	FIDI does not cause PCAPGR	11.64 (0.003)*
	PCAPGR does not cause FIDI	4.500 (0.105)
	FMDI does not cause PCAPGR	10.021 (0.006)*
	PCAPGR does not cause FMDI	2.475 (0.290)
	FSDI does not cause PCAPGR	14.644 (0.000)*
	PCAPGR does not cause FSDI	11.250 (0.003)*
Russia	FIDI does not cause PCAPGR	7.774 (0.020)**
	PCAPGR does not cause FIDI	4.006 (0.134)
	FMDI does not cause PCAPGR	14.824 (0.000)*
	PCAPGR does not cause FMDI	4.034 (0.133)
	FSDI does not cause PCAPGR	19.722 (0.000)*
	PCAPGR does not cause FSDI	5.229 (0.007)*
India	FIDI does not cause PCAPGR	9.496 (0.008)*
	PCAPGR does not cause FIDI	1.264 (0.531)
	FMDI does not cause PCAPGR	5.360 (0.068)
	PCAPGR does not cause FMDI	13.985 (0.000)*
	FSDI does not cause PCAPGR	8.443 (0.014)*
	PCAPGR does not cause FSDI	6.300 (0.042)**
China	FIDI does not cause PCAPGR	7.015 (0.030)**
	PCAPGR does not cause FIDI	1.611 (0.446)
	FMDI does not cause PCAPGR	7.529 (0.023)**
	PCAPGR does not cause FMDI	0.056 (0.971)
	FSDI does not cause PCAPGR	5.912 (0.052)**
	PCAPGR does not cause FSDI	0.074 (0.963)
South Africa	FIDI does not cause PCAPGR	0.252 (0.881)
	PCAPGR does not cause FIDI	1.458 (0.482)
	FMDI does not cause PCAPGR	0.461 (0.794)
	PCAPGR does not cause FMDI	0.281 (0.868)
	FSDI does not cause PCAPGR	0.495 (0.780)
	PCAPGR does not cause FSDI	0.617 (0.734)

*, **, *** denote level of statistical significance at 1%, 5%, and 10%

Summary and conclusions

Financial systems play a vital role in generating investments that are crucial for economic growth through mobilization of surplus funds. Although there exist several empirical studies examining finance–growth causation, no consensus has been achieved. Studies using cross-sectional, panel, and time-series data have found four paradigms, namely finance–growth causation, growth–finance causation, finance–growth mutual causation, and no causation. There have also been studies carried out in the context of groups of countries, including the OECD, EU, ASEAN, BRICS, and MENA. As far as measures of financial development are concerned, most studies have considered only depth factors for financial sector development. Thus, in this study, we constructed a broad-based index using three factors—depth, efficiency, and stability—for both financial institutions and stock markets separately. In order to evaluate overall financial system development causality, we also constructed a financial system development index. All indices were constructed using annual data for the period 1996–2016.

The Toda–Yamamoto causality results reveal that the FIDI exhibits unidirectional causation, with economic growth in all economies except South Africa. This indicates that financial institutions or banks accelerate investment and promote growth. With regard to the FMDI and economic growth causation, the causality test results display a finance–growth pattern in Brazil, Russia, and China, and a growth–finance pattern in India, while South Africa conforms to the neutrality hypothesis. In the case of the FSDI and economic growth, the results indicate that Brazil, Russia, and India follow the feedback hypothesis, and China and South Africa follow the supply-leading and neutrality hypotheses, respectively.

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Appendix

See Tables 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, and 18.

Table 4 Principal components for the financial institution development index (FIDI) of Brazil

Variables	PC 1	PC 2	PC 3	PC 4
DCPS	−0.551	0.203	0.573	0.570
NIM	0.515	0.307	0.724	−0.338
OHC	0.507	0.532	−0.304	0.605
BCBD	−0.415	0.761	−0.232	−0.439
Eigenvalues	2.78	0.85	0.34	0.033
(Author’s calculation)				

As the first three PCs (i.e. PCs 1, 2, and 3) cumulatively account for 99% of total variation, we use their values as weights (Eq. 1) to construct the financial institution development index (FIDI)

Table 5 Principal components for financial market development index (FMDI) of Brazil

Variables	PC 1	PC 2	PC 3	PC 4
MCAP	0.690	−0.253	0.256	0.626
TVTR	0.672	0.373	0.099	−0.631
TURNR	−0.027	0.870	−0.181	0.456
VOL	−0.263	0.196	0.944	−0.016
Eigenvalues	1.78	1.28	0.93	0.0249
(Author’s calculation)				

As the first three PCs cumulatively account for 99% of total variation, we use their values as weights (Eq. 1) to construct the financial market development index (FMDI)

Table 6 Principal components for the financial system development index (FSDI) of Brazil

Variables	PC 1	PC 2	PC 3	PC 4	PC 5	PC 6	PC 7	PC 8
DCPS	0.487	0.109	−0.021	0.266	0.285	0.412	0.650	0.061
NIM	−0.422	0.207	0.206	0.436	−0.204	0.671	−0.228	0.017
OHC	−0.430	−0.140	0.283	0.449	−0.115	−0.459	0.525	−0.108
BCBD	0.366	−0.260	0.249	0.577	0.341	−0.204	−0.486	0.074
MCAP	−0.038	0.694	0.160	0.002	0.118	−0.276	−0.019	0.632
TVTR	0.272	0.499	0.440	−0.079	−0.106	−0.103	−0.064	−0.670
TURNR	0.365	−0.262	0.442	−0.114	−0.677	0.055	0.060	0.351
VOL	−0.233	−0.238	0.631	−0.427	0.512	0.186	0.061	0.076
Eigenvalues	3.62	1.96	1.16	0.78	0.31	0.13	0.03	0.01
(Author’s calculation)								

As the first five PCs cumulatively account for 97.89% of total variation, we use their values as weights (Eq. 1) to construct the financial system development index (FSDI)

Table 7 Principal components for the financial institution development index (FIDI) of Russia

Variables	PC 1	PC 2	PC 3	PC 4
DCPS	0.601	−0.111	0.211	0.762
NIM	−0.471	0.430	0.734	0.230
OHC	0.309	0.895	−0.318	−0.024
BCBD	0.565	−0.013	0.561	−0.604
Eigenvalues	2.44	0.89	0.53	0.14
(Author’s calculation)				

As the first three PCs cumulatively account for 96% of total variation, we use their values as weights (Eq. 1) to construct the financial institution development index (FIDI)

Table 8 Principal components for the financial market development index (FMDI) of Russia

Variables	PC 1	PC 2	PC 3	PC 4
MCAP	0.524	−0.510	0.413	0.541
TVTR	0.658	0.127	0.239	−0.701
TURNR	0.427	0.745	−0.223	0.459
VOL	−0.329	0.408	0.849	0.055
Eigenvalues	2.11	1.02	0.83	0.04
(Author’s calculation)				

As the first three PCs cumulatively account for 99% of total variation, we use their values as weights (Eq. 1) to construct the financial market development index (FMDI)

Table 9 Principal components for the financial system development index (FSDI) of Russia

Variables	PC 1	PC 2	PC 3	PC 4	PC 5	PC 6	PC 7	PC 8
DCPS	0.448	−0.391	0.021	−0.053	0.097	0.332	0.658	0.299
NIM	−0.268	0.499	−0.048	−0.191	0.695	0.358	0.149	0.072
OHC	0.185	−0.047	0.801	0.270	0.400	−0.289	−0.060	−0.024
BCBD	0.506	−0.059	−0.026	0.046	0.098	0.582	−0.555	−0.282
MCAP	0.297	0.445	0.281	−0.477	−0.328	−0.013	−0.166	0.519
TVTR	0.386	0.534	−0.030	0.075	−0.176	−0.137	0.419	−0.575
TURNR	0.288	0.260	−0.403	0.631	0.147	−0.198	−0.109	0.462
VOL	−0.339	0.195	0.334	0.502	−0.419	0.529	0.127	0.097
Eigenvalues	3.50	1.47	1.06	1.02	0.66	0.17	0.10	0.02
(Author's calculation)								

As the first five PCs cumulatively account for 96.40% of total variation, we use their values as weights (Eq. 1) to construct the financial system development index (FSDI)

Table 10 Principal components for the financial institution development index (FIDI) of India

Variables	PC 1	PC 2	PC 3	PC 4
DCPS	0.528	0.222	−0.428	0.698
NIM	−0.450	0.763	−0.430	−0.166
OHC	−0.532	0.114	0.500	0.673
BCBD	0.483	0.594	0.617	−0.177
Eigenvalues	3.421	0.502	0.05	0.01
(Author's calculation)				

As the first two PCs cumulatively account for 98% of total variation, we use their values as weights (Eq. 1) to construct the financial institution development index (FIDI)

Table 11 Principal components for the financial market development index (FMDI) of India

Variables	PC 1	PC 2	PC 3	PC 4
MCAP	0.490	−0.629	0.202	0.567
TVTR	0.692	−0.125	−0.098	−0.703
TURNR	0.440	0.533	−0.587	0.420
VOL	0.292	0.550	0.777	0.080
Eigenvalues	2.0	1.2	0.8	0.02
(Author's calculation)				

As the first three PCs cumulatively account for 99% of total variation, we use their values as weights (Eq. 1) to construct the financial market development index (FMDI)

Table 12 Principal components for the financial system development index (FSDI) of India

Variables	PC 1	PC 2	PC 3	PC 4	PC 5	PC 6	PC 7	PC 8
DCPS	0.472	−0.072	−0.024	−0.105	0.297	−0.380	0.194	0.698
NIM	−0.367	0.014	0.649	0.108	0.446	−0.424	0.147	−0.173
OHC	−0.457	0.131	0.259	0.084	−0.015	0.528	−0.030	0.647
BCBD	0.440	−0.155	0.195	0.023	0.590	0.582	−0.118	−0.204
MCAP	0.386	0.175	0.382	0.422	−0.427	0.130	0.539	−0.062
TVTR	0.281	0.560	0.305	0.024	−0.135	−0.151	−0.685	0.047
TURNR	−0.010	0.596	−0.019	−0.668	0.109	0.128	0.392	−0.117
VOL	−0.101	0.502	−0.481	0.585	0.388	−0.029	0.104	−0.018
Eigenvalues	4.24	1.82	0.85	0.77	0.23	0.05	0.01	0.009
(Author’s calculation)								

As the first four PCs cumulatively account for 96% of total variation, we use their values as weights (Eq. 1) to construct the financial system development index (FSDI)

Table 13 Principal components for the financial institution development index (FIDI) of China

Variables	PC 1	PC 2	PC 3	PC 4
DCPS	−0.331	0.863	0.081	0.372
NIM	0.488	0.445	−0.583	−0.470
OHC	0.680	−0.048	−0.053	0.728
BCBD	0.433	0.232	0.806	−0.329
Eigenvalues	1.93	1.02	0.87	0.19
(Author’s calculation)				

As the first three PCs cumulatively account for 95.33% of total variation, we use their values as weights (Eq. 1) to construct the financial institution development index (FIDI)

Table 14 Principal components for the financial market development index (FMDI) of China

Variables	PC 1	PC 2	PC 3	PC 4
MCAP	0.480	−0.459	0.647	0.371
TVTR	0.632	−0.161	−0.160	−0.739
TURNR	0.567	0.253	−0.557	0.550
VOL	0.215	0.835	0.494	−0.106
Eigenvalues	2.4	1.1	0.52	0.02
(Author’s calculation)				

As the first three PCs cumulatively account for 99% of total variation, we use their values as weights (Eq. 1) to construct the financial market development index (FMDI)

Table 15 Principal components for the financial system development index (FSDI) of China

Variables	PC 1	PC 2	PC 3	PC 4	PC 5	PC 6	PC 7	PC 8
DCPS	0.427	−0.216	0.329	0.399	−0.002	0.686	−0.118	0.132
NIM	0.177	0.435	−0.452	0.394	−0.399	0.116	0.484	−0.106
OHC	−0.158	0.544	−0.271	0.260	0.306	0.102	−0.626	0.199
BCBD	−0.076	0.432	0.602	0.234	0.446	−0.155	0.399	−0.079
MCAP	0.445	−0.115	−0.410	−0.180	0.622	−0.023	0.296	0.335
TVTR	0.574	0.087	−0.012	−0.035	0.106	−0.213	−0.290	−0.720
TURNR	0.475	0.255	0.272	−0.122	−0.381	−0.404	−0.149	0.535
VOL	0.031	0.439	0.089	−0.716	−0.059	0.519	0.068	−0.078
Eigenvalues	2.87	2.28	1.06	0.95	0.46	0.21	0.16	0.01
(Author's calculation)								

As the first five PCs cumulatively account for 95% of total variation, we use their values as weights (Eq. 1) to construct the financial system development index (FSDI)

Table 16 Principal components for the financial institution development index (FIDI) of South Africa

Variables	PC 1	PC 2	PC 3	PC 4
DCPS	−0.229	0.669	0.704	−0.049
NIM	0.688	−0.016	0.190	−0.699
OHC	0.681	0.141	0.136	0.704
BCBD	−0.093	−0.729	0.669	0.107
Eigenvalues	2.01	1.38	0.56	0.056
(Author's calculation)				

As the first three PCs cumulatively account for 98% of total variation, we use their values as weights (Eq. 1) to construct the financial institution development index (FIDI)

Table 17 Principal components for the financial market development index (FMDI) of South Africa

Variables	PC 1	PC 2	PC 3	PC 4
MCAP	0.497	−0.522	0.457	0.519
TVTR	0.634	−0.204	−0.082	−0.740
TURNR	0.524	0.352	−0.649	0.424
VOL	0.273	0.748	0.602	−0.039
Eigenvalues	2.32	1.14	0.51	0.026
(Author's calculation)				

As the first three PCs cumulatively account for 99% of total variation, we use their values as weights (Eq. 1) to construct the financial development market index (FMDI)

Table 18 Principal components for the financial system development index (FSDI) of South Africa

Variables	PC 1	PC 2	PC 3	PC 4	PC 5	PC 6	PC 7	PC 8
DCPS	0.440	0.134	−0.044	0.542	0.405	−0.536	−0.103	−0.170
NIM	−0.265	0.531	0.336	0.006	0.199	0.152	−0.681	0.073
OHC	−0.206	0.608	0.243	0.010	0.152	−0.044	0.708	−0.013
BCBD	−0.281	−0.429	0.247	0.525	0.423	0.442	0.132	0.075
MCAP	0.457	0.264	−0.121	0.333	−0.282	0.374	0.038	0.610
TVTR	0.507	0.104	0.134	−0.133	0.067	0.543	0.022	−0.628
TURNR	0.372	−0.196	0.398	−0.510	0.455	−0.095	0.051	0.430
VOL	0.089	−0.156	0.756	0.200	−0.549	−0.216	0.000	−0.079
Eigenvalues	3.38	1.99	1.36	0.61	0.37	0.23	0.053	0.009
(Author's calculation)								

As the first five PCs cumulatively account for 96.37% of total variation, we use their values as weights (Eq. 1) to construct the financial system development index (FSDI)

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