

Does exchange rate volatility affect financial depth? Evidence from BRICS countries

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Abstract. *Deepening of financial system in emerging market economies is crucial for economic development. Financial depth enhances the ability of financial system to supply funds to private sector. In this study, the impact of exchange rate volatility on financial depth in Brazil, Russia, China and South Africa is investigated in the short and long run. In this regard, annual data belonging to 1980-2018 period is used.*

The findings obtained from empirical analyses confirm that real exchange rate is not a factor that affects financial depth and so financial development. On the other hand, financial depth is a factor affecting exchange rate volatility in Brazil, Russia, China and South Africa. These results may be a reason of relatively enough size and development of financial systems. Moreover, dominancy of public sector in financial system may be another reason.

Keywords: financial depth, exchange rate volatility, BRICS economies.

JEL Classification: E44, F31, O42.

1. Introduction

The relation with economic growth and financial system is well investigated in the literature. In Aghion et al. (1999) study, it is presented in a well-established model. Their conclusion is that economies with less developed financial systems will tend to be more volatile and to grow slowly. This explains why macroeconomic volatility tends to be larger in related economies compare to economies with developed financial systems (Aghion et al., 1999: 1363).

In the empirical literature, there are numerous studies those find evidence supporting positive relation running from development of financial system to economic growth in both developed and developing economies via different methods (Jung, 1986; Roubini and Sala-i Martin, 1992; King and Levine, 1993; Kar et al., 2008; Ghali, 1999; Kar et al., 2011; Kar and Özşahin, 2016; Puatwoe and Piabuo, 2017). This uni-directional relation is also called supply leading hypothesis by Patrick (1966). In short, a well-functioning financial system affect steady-state growth by influencing the rate of capital formation and also by altering the rate of technological innovation (Öner, 2007: 138).

On the other hand, financial system is affected by economic growth without no doubt. Robinson (1952) claims that where enterprise leads, finance follows". Patrick (1966) calls the uni-directional causality running from economic growth to financial system development as demand following hypothesis. In this type of relation, creation of modern financial institutions and related financial products are a response to the demand for these services by investors and savers in the real economy (Patrick, 1966: 174). In this regard, growing economy would need more financial services. In response, financial system would expand. The empirical literature finds evidence supporting this type of relation (Kar and Pentecost, 2000; Boulika and Trabelisi, 2002; Güryay et al., 2007). On the other hand, Levine (2004) suggests that economic growth negatively affect financial system due to increasing risk.

According to Sahay (2015), financial development has three components. They are depth, access and efficiency. While financial depth is measured via size and liquidity of financial markets, access is calculated via ability of persons to financial services. On the other hand, efficiency is more related to institutions and low costs, sustainable revenues increase efficiency of financial markets.

Among components of financial development, depth is more sensitive to economic conditions due to international financial flows in a liberalized financial structure. While access and efficiency are related to structure of the system, depth is more related to actual economic conditions. In this regard, Hajilee and Al Nasser (2017) indicate that financial depth is affected by main macroeconomic variables such as government policies, inflation rate, GDP, political stability and exchange rate.

One of the main macroeconomic indicators that affects not only financial system but also other economic variables such as inflation rate is exchange rate. A possible volatility in exchange rate affects financial system in different ways such as cost of capital imported from abroad. Also increasing exchange rate would reduce the value of domestic currency

and would induce liquidity in the banks. This might be the theoretical framework to explain why macroeconomic development have effect on financial system as Hajilee and Al Nasser (2017) explained.

The investigation of relation between financial depth and exchange rate is essential because determination of the possible relation could be useful for the choice of exchange rate strategy. According to Ehigiamusoe and Lean (2019), countries with less developed financial markets are more likely to adopt a fixed exchange rate, while countries with higher levels of financial development are more likely to adopt a flexible system. Fujiwara and Teranishi (2011) also states frictions in financial system induce responses of exchange rate persistently. All these explanations introduce that financial system's health and/or development is another important factor affecting exchange rate.

In this study, possible relation between economic growth and financial depth in Brazil, Russia, China and South Africa which are members of BRICS countries, except India between years 1994 and 2018. Although there is a vast literature investigating the interaction between exchange rate volatility and financial system/development even in BRICS economies, this study differs from them in three ways. First of them, employing financial depth instead of financial development would clarify the effect of volatility. Because by using depth only, it would possible to distill responses of financial system structure to a volatile exchange rate. Secondly, financial depth index developed by International Monetary Fund (IMF, hereafter) is employed. Lastly, advanced panel date methods are used to better understand the relation by clarifying effects of structural breaks. All these superiorities might increase possible contribution of the study to existing literature.

In the second section, a brief information about financial systems of BRICS countries. In this section, banking system and non-banking financial system will be investigated via IMF reports. In the third section international literature is investigated. In the fourth section, empirical model and analysis results will be presented. At last, results will be concluded, and policy implication will be presented.

2. Financial structure in BRICS

In the last decade of 20th century, structural changes are experienced in the world economy. Collapse of socialist system in especially Eastern Europe and liberalization of economy policies in emerging market economies have changed structure of financial systems in related economies. In this regard, Russia and China which are in a transition period from communism to capitalism and Brazil and South Africa which were subject to policy change are important actors of development in last twenty years.

In Brazil, financial system has been growing since 2012 (IMF, 2018: 5). According to IMF report (2018), although growth process, structure of the system is un-changed and the public sector is dominant in the system. While financial markets are liquid, concentration in banking system is very high and government securities play a key role in systemic

liquidity management. In the light of explanations above, there are a number of reforms in the banking system need to make in the near future in order to reduce dominance of government.

In Russia, after transition to free market economy, banking system has been experienced structural change. But, like Brazilian case, the dominance of a few federal banks is still present (Pushkareva et al., 2019: 29).

Allen et al. (2007) report that financial system of China is controlled by underdeveloped banking system and four largest of them is state controlled. Although it grows fast, two stock markets are still small compared to banking system of China. Resources are not used efficiently in the financial system. Lastly, nor banking system neither stock markets are the most effective parts of the Chinese financial system. Rather this binary, internal financing, trade credits and coalitions of various forms among firms, investors and local governments (Allen et al., 2007; 3).

In the South African case, financial sector is large and sophisticated (IMF, 2014: 10). Compare to other emerging market economies, financial system of the country is some different. Two thirds of financial assets are hold by non-banking financial institutions. Unit trusts, pension funds and insurance assets are some of products those constitute total financial assets. Banking system is dominated by only four banks. 90% of banking assets are hold by five banks. This is some similar with other BRICS economies. On the other hand, capital market is large, it is supported by non-banking financial institutions and foreign investor participation (IMF, 2014: 12).

As can be seen, financial systems of BRICS countries are similar, except South Africa. Three of four are dominated by government and although size of financial assets is big, dominance of a few large banks are the same in all of them. This situation brings a question into mind, how exchange rate fluctuations affect financial depth of these economies? As known, depth of a financial system is measured via liquidity and size, and both are enough for describing it as depth in the related countries. Moreover, dominance of public sector on banking system is might be a cause of size sufficiency, except South Africa.

In the light of explanations above, re-visiting financial depth and exchange rate fluctuations might have some important findings and conclusions. Existence of relation might give opinion what type of exchange rate strategy can be implemented in such a financial structure in the BRICS countries.

3. Literature review

In the light of theoretical explanations in the introduction section, it is possible to classify the relation in two groups. First is effect of exchange rate fluctuations on financial system and second is effect of financial system on exchange rate volatility. Moreover, parameter that used to measure financial system differentiates studies.

In the literature, stock market size, stock market price, financial depth index and various financial system indexes are employed to connote financial system development. In this regard, it is possible to classify existing literature according to different dimensions.

In one of recent studies, Ehigiamusoe and Lean (2019) investigate the relation for West African region. They employed banking data such as credit to private sector to measure financial development. According to panel data analysis results, financial development does not affect exchange rate volatility. On the other hand, increasing exchange rate volatility causes less financial growth.

Bahri and Sarmidi (2019) investigate the role of financial development in explaining how exchange rate volatility affects economic development in 41 developing countries. Authors connote financial development via domestic credit to private sector and liquid liabilities. Results imply that financial development mitigates the negative effects of exchange rate volatility on economic growth.

Martins (2015) investigates the relation between exchange rate volatility and foreign direct investments in Brazil between years 1976 and 2013. It can be thought that foreign direct investment is a measure of financial development. The author employs ARDL model to investigate the relation. According to results, real exchange rate volatility has negative impact on foreign direct investment of the Brazilian economy.

Zehan and Hamid (2017) analyze the relation in developing economies and employ capital inflows as a measure of financial system. They take 1980-2013 period into account and employ GMM estimation technique. According to results, exchange rate volatility has negative impact on capital inflows to developing countries. Agarwal (2012) analyzes Malaysian economy and investigates the effect of exchange rate on capital inflows. According to results, exchange rate volatility has an adverse effect on capital and foreign direct investment inflow in the Malaysian economy.

Hajilee and Al Nasser (2017) analyze 26 countries about possible interaction between exchange rate fluctuations and financial depth. They group the countries into three groups namely, developed, developing and emerging market economies. According to bounds test results, in 16 of 26 countries, financial depth responds to exchange rate fluctuations. More interestingly, direction of responses is different for each country.

Ergür and Özek (2020) analyze BRICS country in the context of relation between financial development and economic development. Different from this study, authors employ financial development index rather than financial depth. They use panel data approach and find that supply leading hypothesis is valid in the short run and feedback hypothesis in the long run.

In the literature, financial system and/or financial development is measured via different ways as said before. One of them is via stock market size. In earlier study of Nieh and Lee (2001), authors take stock markets as a part of financial system and exchange rate fluctuations in G-7 countries and find that there is no relation between variables. Kurihara

(2006) investigates possible effects of exchange rate on financial development in Japan by exploring the relation between exchange rate and stock prices. In the end, it is concluded that exchange rate is an effective variable on financial system. Diamandis and Drakos (2011) investigate the relation for Latin American countries and finds relation between variables in the short run. Interestingly, relation disappears in the long run in all countries. Another study which takes stock market into account to connote financial system belongs to Tsai (2012). The author analyzes six Asian economies to find possible interaction stock market and exchange rate fluctuation. Similarly, results imply no significance relation between variables.

Recent studies take capital inflows as an indicator of financial development. One of them belongs to Olusuyi (2018). Olusuyi (2018) investigates the effect of exchange rate volatility in Nigeria. The author employs GMM method and finds a possible interaction between capital inflows as a measure of financial development and exchange rate volatility. Another one belongs to Kraiche and Gaudette (2020). Different from existing studies, they investigate the effect of financial development on effect of exchange rate on foreign direct investments in 39 emerging market economies. According to results, exchange rate volatility is effective if financial development level is low and it is not effective if financial development level is high.

4. Data and empirical results

In this study, interaction between financial depth and real exchange rate in Brazilian, Chinese, Russian and South African economies is investigated. These countries are members of BRICS acronym. Because of lack of data belonging to India, Indian economy is excluded. That is why acronym is modified as BRICS. Data starts by 1994 and empirical analysis covers 1994-2018 period. In the analysis, annual data is employed. The data is obtained from International Monetary Fund's official database. In order to solve heteroscedasticity problem, natural logarithm of each variables is used in the analysis. Cross section dependency test, null hypothesis claims absence of cross section dependency and alternative one claims existence of cross section dependency.

Table 1. Cross section dependency test results

Constant	FD	REER
CD_{lm} (BP,1980)	26.608 (0.00)***	20.314 (0.00)***
CD_{lm} (Pesaran, 2004)	6.526 (0.00)***	4.132 (0.00)***
CD (Pesaran, 2004)	-3.543 (0.00)***	-3.274 (0.00)***
LM_{adj} (PUY, 2008)	5.114 (0.00)***	4.404 (0.00)***

When we take probability values into account, it is possible to conclude that alternative hypothesis which claims existence of cross section dependency is accepted. For this reason, we employ cross-sectionally augmented Dickey-Fuller (CADF, hereafter) which is among second generation unit root tests. In CADF test, null hypothesis claims series contain unit root and alternative hypothesis claims series does not contain unit root.

Table 2. *CADF unit root test results*

		Constant		Constant and Trend			Constant		Constant and Trend
	Lags	CADF-stat	Lags	CADF-stat		Lags	CADF-stat	Lags	CADF-stat
FD					REER				
Brazil	2	-2.398	2	-2.998	Brazil	1	-1.469	1	-2.455
Russia	3	-1.640	3	-0.468	Russia	1	-1.903	1	-2.095
China	1	-1.592	4	-3.122	China	1	-1.419	1	-1.457
South Africa	1	-1.310	1	-2.650	South Africa	3	-2.699	3	-5.600***
Panel CIPS		-1.735		-2.310	Panel CIPS		-1.872		-2.902**

Notes: Maximum lag length is determined as four. Optimal lag length is identified via Schwarz information criterion. CADF critical values are, in model with constant, -4.11 (%1), -3.36 (%5) and -2.97 (%10) (Pesaran, 2007, Table I(b), p. 275); in model with constant and trend, -4.67 (%1), -3.87 (%5) and -3.49 (%10) (Pesaran, 2007, Table I(c), p. 276). Critical values of panel statistics are, in model with constant, -2.57 (%1), -2.33 (%5) and -2.21 (%10) (Pesaran, 2007, Table II(b), p. 280); in model with constant and trend, -3.10 (%1), -2.86 (%5) and -2.73 (%10) (Pesaran, 2007, Table II(c), p. 281). Panel statistics are average of CADF statistics.

When test statistics are compared to critical values obtained by Pesaran (2007), it is concluded that real exchange rate series belonging to countries, except South Africa, contains unit roots in all models. In panel CIPS results, it is possible to conclude that group statistics contains unit root.

Table 3. *Cross section dependency and homogeneity test results*

Regression Model:		
$FD_{it} = \alpha_i + \beta_i REER_{it} + \varepsilon_{it}$	Statistic	p-value
Cross-section dependency tests:		
LM (BP, 1980)	37.972	0.00***
CD_{im} (Pesaran, 2004)	9.230	0.00***
CD (Pesaran, 2004)	5.393	0.00***
LM_{adj} (PUY, 2008)	11.910	0.00***
Homogeneity tests:		
$\hat{\lambda}^c$	10.314	0.00***
$\hat{\lambda}^o$	10.966	0.00***

Notes: The figures which is ***, **, * show 1%, 5% and 10% levels, respectively.

According to cross section dependency test results, it is seen that series are dependent to each other. That is why co-integration methods which take cross section dependency and heterogeneous predictive into account. In Table 4, it is seen that there is a long run co-integration relation between variables in the country group.

According both asymptotic and bootstrap probability test results, there is a co-integration relation between variables. All these positive results related to existence of co-integration allow to apply panel causality tests. In this regard, panel VECM causality method is employed.

Table 4. Panel co-integration test accounting cross section dependency

Tests	Constant			Constant and Trend		
	Statistic	Asymptotic p-value	Bootstrap p-value	Statistic	Asymptotic p-value	Bootstrap p-value
Error Correction						
Group_tau	-4.294	0.00***	0.021**	-7.429	0.00***	0.00***
Group_alpha	-7.446	0.00***	0.041**	-8.935	0.00***	0.057*
Panel_tau	-7.561	0.00***	0.00***	-9.690	0.00***	0.00***
Panel_alfa	-12.787	0.00***	0.00***	-11.316	0.00***	0.014**

Notes: The null hypothesis claims non - existence of co-integration. In error correction test, lag and antecedent are accepted as one. Bootstrap prob. value is obtained from 1.000 repeat. Asymptotic probability values are obtained from standard normal distribution. The figures which is ***, **, * show 1%, 5% and 10% levels, respectively.

In Table 5, panel vector error correction causality results are presented. According to results, there is no uni-directional causality running from real exchange rate to financial depth in the countries.

On the other hand, uni-directional causality running from financial depth to real exchange rate exists, but the significance level is low. In this regard, it is not possible to conclude that real exchange rate is not a cause of financial depthless. This causation linkage is valid in the short run.

Table 5. Panel VECM causality test results

		Short Run Causality	Long-run causality
	Δ (FD)	Δ (REER)	ECT(-1)
Δ (FD)	-	2.694 (0.097)*	-0.153540 [-1.975]**
Δ (REER)	0.036 (0.849)	-	5.833045 [0.647]

Notes: The figures which is ***, **, * show 1%, 5% and 10% levels, respectively.

In the long run, there is no causation linkage running from real exchange rate to financial depth for the panel group. But causation linkage running from financial depth to real exchange rate exists in the long run and significance level is 5%. This is consistent with short run causality findings. In this regard, neither in the short nor in the long run, real exchange rate does not affect financial depth. Interestingly, financial depth affects real exchange rate volatility in both short and long run.

Table 6. Emirmahmutoğlu and Köse (2011) panel causality test results

Country	Lag	FD#>REER	REER#>FD
Brazil	2	1.975 (0.372)	0.034 (0.983)
Russia	1	1.335 (0.247)	0.000 (0.986)
China	1	1.233 (0.266)	0.240 (0.623)
South Africa	2	8.269 (0.016)**	1.591 (0.451)
Fisher Stat.		15.677 (0.047)**	2.596 (0.957)

Notes: The figures which is ***, **, * show 1%, 5% and 10% levels, respectively.

Panel causality test method developed by Emirmahmutoğlu and Köse (2011) permits country-based causality analysis, besides group results. According to results, there is no causation linkage running from real exchange rate to financial depth in any country. Financial depth affects real exchange rate only in South Africa and significance level is low, 5%.

5. Conclusion

In this study, possible effects of exchange rate on financial depth in Russia, Brazil, China and South Africa between years 1994 and 2018. Because of absence of data belonging to the Indian economy, it is not possible to complete acronym BRICS and that is why acronym covers four of five.

The advanced panel data methods which take cross section dependency into account are employed. In the light of empirical findings obtained from these empirical methods, exchange rate volatility does not affect financial system in any economy. This may stem from public sector dominance in the banking sector, except South Africa. A possible volatility in exchange rate may not affect banking sector liquidity and size because of governments' persistency in the sector. Despite of all negative effects of exchange rate fluctuations, banks can provide liquidity and do not go to contractionary behaviors. This may be a kind of government policy.

In the South African case where, public banks are not dominant in the financial system, size of private banks are big enough to leaning against exchange rate fluctuations. So, it is possible to conclude that in financial systems, where dominance of public sector is high, it is possible to implement floating exchange without a fear of financial system's health. The policy makers can choose floating and/or fixed exchange rate.

The second finding of empirical analysis is uni-directional causality running from financial depth to exchange rate fluctuation. Financial depth affects exchange rate volatility in the short and long run. Despite of weak interaction, existence of causation linkage running from financial depth to exchange rate may be sight of relatively developed financial system in these economies. Especially, Emirmahmutoglu and Köse (2011) causality test results presents causation linkage in South Africa. This finding also supports a possible result of an advanced financial system.

When the results compared with existing literature, it is possible to emphasize that results of this study confirm the findings of Fujiware and Tenashi (2011). Also findings of Bahri and Sarmidi (2019). They have found that increasing level of development mitigates the effect of exchange rate volatility. In this regard, banking system that relatively developed and highly supported by public sector, mitigates the effects of exchange rate volatility.

In the light of explanations above, it is possible to conclude that level of financial development to reduce effects of exchange rate volatility on financial depth. To do this, it might be suitable to support of government on banking system till it is big enough to reduce external risks. This might be a government policy of developing and emerging market economies.

For the future studies, it is possible suggest that effect of exchange rate volatility on financial system can be measured not only via financial depth but also via financial access and financial efficiency measures. This would increase the robustness of findings of exchange rate volatility and financial system interaction.

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