SAVING-INVESTMENT DYNAMICS AND CAPITAL MOBILITY IN THE BRICS, 1970-2013

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Abstract

This study examines the saving-investment relationship and the extent of capital mobility in the BRICS over the period 1970-2013. However, saving and investment are cointegrated, but the error correction model exhibits structural instability with the onset of different country-specific crisis and over the period of global financial crisis in 2008. The inclusion of interactive dummy variables reveals that current period pass through of saving to investment is negative and statistically significant for the post-1980 period in Brazil, and over 1990s and 2000s in South Africa, indicative of capital mobility. Furthermore, the global financial crisis affects the exchange rate depreciation in Russia.

JEL Classification: F21; F32; F34; F41

Keywords: Capital Mobility; Savings; Investment; Error-Correction Model

1. Introduction

In a seminal study, Feldstein and Horioka (1980) tested the intuitively appealing proposition in a fully integrated world capital markets that there is no correlation between a nation's saving and its rate of investment. To the surprise of many, they found a high correlation between long-term saving and investment of OECD countries and the coefficient of a regression of investment on saving are close to unity (Moreno, 1997). Using cross-sectional analysis, they show that on an average 85 to 95 percent of domestic saving are transformed into investment in the domestic economies. Furthermore, the regression coefficient on saving is statistically different zero but not different from one, suggesting that international capital mobility is low, which is counter-intuitive and creating puzzle in the saving-investment dynamics (Ang, 2009).

Following this controversial finding, numbers of research are carried out to reconcile the Feldstein and Horioka (FH) puzzle of a high coefficient between saving and investment with a high degree of capital mobility. One critical reason to FH puzzle, because the sample was too short to capture an increase in the capital mobility that became particularly apparent after the second half of the 1970s. Some studies that extending the sample to the 1980s tends to reduce the observed saving-investment correlation (Feldstein and Bacchetta, 1991, Frankel, 1991). FH also stressed that a tight saving-investment link appears to be a long-run property and that co-movement appears to be smaller in time series data than in cross-section data.

Another strand of literature explains that the regressions of saving and investment are interpreted incorrectly. Obstfeld (1986) points out that a high coefficient in saving-investment regressions may reflect the influence of a common factor, such as economic growth on saving and investment. Baxter and Crucini (1993) constructed a two-country, one-good version of the neoclassical model where the productivity shocks relate saving to investment. In addition, they suggest that saving-investment correlation will depend on the country size, and the correlation will be higher for larger countries. McClure (1994)

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shows that high saving-investment correlations may also arise under perfect capital mobility if monetary authorities peg domestic rates to foreign returns and fiscal and monetary policies are coordinated. These arguments become contradictory to the FH findings, where high saving-investment correlations close to unity contain no information about capital mobility. AmirKhalkhali and Dar (2011) quantify the importance of domestic saving for investment in a group of 25 emerging economies over the period 1985-2006. They find that openness to trade exhibit greater capital mobility, and countries experiencing with best regulatory quality and highest degree of openness can achieve higher investment rate, which is independent of the domestic saving efforts of a country.

Is the FH (1980) contribution really a puzzle? This paper revisits the issue and FH original insight may be recovered by adopting a time series and panel framework that accounts for both the long-run and short-run behavior of saving and investment. A sizeable no of literature interprets the savings-investment correlations as a measure of capital mobility, intertemporal general equilibrium model suggests that the relationship reflects the inter-temporal budget constraint and current account solvency. This paper uses the Johansen system of cointegration method to estimate the cointegrating vectors and simultaneously uses the error correction modeling approach proposed by Jansen and Schulze (1996), Jansen (1996), Coakley, Hasan, and Smith (1999), and Coakley at al. (1996, 1998) to examine the saving-investment relationship in the case of five developing countries especially named as BRICS. Specifically the following questions are examined: (1) has better domestic saving shocks in the current period passed through to investment? (2) are saving and investment are cointegrated and what is the magnitude of adjustment? (3) what did the country-specific economic crisis of BRICS have on current period pass-through and the adjustment of the current account to long-run equilibrium? (4) and finally, to what extent the global financial crisis in 2008 has its effect on the current account deviation in the BRICS.

The results tell us something interesting about the long-run equilibrium relationship between saving and investment. We find that out of five developing countries, some countries experience the intensity of cointegration and some of them are not exhibiting the underlying mechanism of cointegration. The short-run coefficients of changes in the saving rate explain the extent of capital mobility and exchange rate depreciation of BRICS. The error correction model explains the structural instability and capital mobility of BRICS, especially in case of India, where huge capital flight was experienced during the period of balance of payment crisis in 1990s and over the period of 1990s and 2000s South Africa has undergone the phase of capital mobility and economic slowdown.

The article is structured as follows. Section 2 provides a brief overview of BRICS experience. Section 3 discusses the econometric procedures and data sets. Section 4 interprets the estimated results. Concluding remarks are presented in Section 5.

2. Brief overview of BRICS Experience

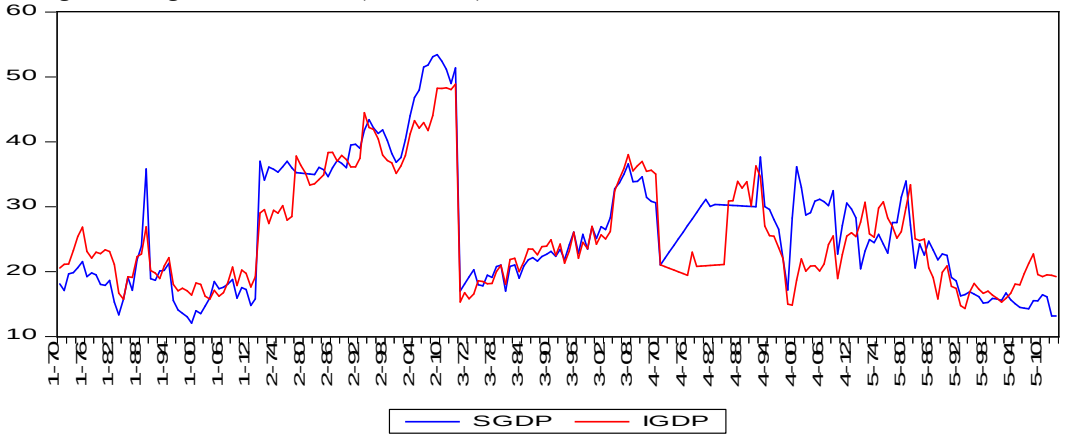
The saving-investment summary statistics of the BRICS are summarized in Table 1. Whereas the saving-investment trends of the BRICS countries are presented in Fig 1.

Table 1: Saving, Investment (% of GDP) Trends of the BRICS Countries over the period 1970-2013. [Summary Statistics]

Country		Max	Min	Mean	Std. Dev.
Brazil	S/GDP	35.806	12.056	17.787	4.029
	I/GDP	26.902	15.740	19.979	2.922
China	S/GDP	53.433	34.625	42.784	6.212
	I/GDP	48.886	27.402	37.773	5.935
India	S/GDP	36.607	16.981	25.312	5.428
	I/GDP	38.034	15.317	24.893	6.522
Russia	S/GDP	37.642	17.158	29.077	4.429
	I/GDP	36.267	14.830	24.000	5.437
South Africa	S/GDP	33.943	13.155	19.858	5.187
	I/GDP	33.381	14.313	21.308	5.129

Source: World Development Indicator Tables, World Bank. S/GDP and I/GDP represent the gross domestic saving divided by GDP and gross capital formation divided by GDP. Max, Min, Mean, and Std. Dev. represent the maximum, minimum, average, and standard deviation value of saving and investment as a percentage of GDP.

Fig 1: Saving and Investment (% of GDP) Trends of the BRICS Countries. Period 1970-2010



Source: Elaborated from World Development Indicator Tables, World Bank. Data for the period 1970-2010. *Note.* SGDP and IGDP represent the saving and investment as a percentage of GDP in the 5 countries of table 1: Brazil, China, India, Russia and South Africa

In case of Brazil, the saving-investment trends are clustered around 12 to 35 percentage and around 9 percent gap between saving and investment over the period 1970-2013. While India, Russia, and South Africa, saving-investment trends are clustered around 15 to 38 percentage, 14 to 37 percentages, and 14 to 33 percentages, respectively. China is one of the emerging economies in terms of investment among the BRICS countries with saving-investment trend cluster around 27 to 53 percentages. However, in case of China, the saving trend is bit higher in comparison to the investment trend. The other emerging economy like India, the rate of investment is little bit higher in comparison to the rate of saving. This could be the possibility that over a period of time, India receives a huge amount of foreign investment from abroad. Furthermore, the huge inflow of foreign capital could be spent on both development and non-development expenditures and it is depending upon the macroeconomic policies of the host countries.

In the past few decades, some large economies such as Brazil, Russia, India, China, and South Africa (BRICS) have acquired a vital role in the world economy as producers of goods and services, receivers of foreign capital, and as potential consumer markets. The BRICS economies have been identified as some of the faster growing countries and engine of the global recovery process, having undergone significant change in their roles. In the G-20 country forum, BRICS are playing a vital role in shaping macroeconomic policy after the recent financial crisis. BRICS encompasses over 40 percent of the world population and accounts for nearly 25 percentages of total global GDP in terms of PPP. The BRICS comprises a huge land share in the world.

The intensification of global financial crisis in September 2008 that engulfed almost all countries marked a painful adjustment at the macro level coupled with micro-level distortions and incentive created by past policy actions. The crisis spread to the BRICS countries through all channels via trade, finance, and confidence channels, etc. The slump in export demand and tighter trade credit caused a deceleration in aggregate demand. The reversal of capital flows led to equity markets and currency depreciation in BRICS countries, resulting in lower external credit flows. The crisis transmitted to the real economy, primarily through the equity price channel and, in a more differentiated fashion, through the credit channel. The shock to international confidence had an immediate and sharp effect on capital flows to emerging markets, as investors reassessed risks and global capital flows collapsed. In addition to poor confidence and wealth effects, the fall in equity prices led to a rise in the cost of capital and finally dampened investors confidence. The collapse in demand from advanced economies was transmitted through the integrated supply chain to developing economies, with dramatic effects on trade in these countries.

The increase in risk, both political and economic, experienced by the Brazilian economy for the majority of the period starting after 1980 would have inhibited investment and hampering economic growth. A fall in productivity implies a fall in the marginal product of capital and, consequently upon investment. Thus, the fall in the accumulation of capital could be seen also as a consequence of the fall in productivity. Mussolini and Teles (2010) find the explanation for the variations in productivity growth in Brazil in the behavior of public infrastructure investment. The very high inflation rates of the 1980s may also be a reason for the "down-break" trend growth observed after 1980. Between 2002 and 2008, Brazil benefited from global growth with its demand for commodities, the production of Brazil has an undeniable comparative advantage. Between August, 2002 and August, 2005, the price of Brazil's semi-manufactured exports rose by 43 percent and the price of its basic products by 59 percent. The exchange rate appreciation allowed for a reduction in the external debt and the increase in the prices of exports on investment for the production of raw materials was remarkable. Such prosperity came under threat in the second half of 2008 as a result of the global financial crisis. The local currency and stock market saw huge fluctuations as foreign direct investment dwindled, demand for commodity exports dried up, and external credit decreased. The external shock did interrupt the accelerated growth path by prompting a slight fall of 0.6 percent in GDP in 2009. The exports shrink was the direct impact of the financial crisis, which led to a reduction in the international prices of mineral and agricultural commodities and in the overall reduction in the external demand for goods and services.

Since the collapse of the Soviet Union in 1991, Russia has tried to develop a market economy and achieve consistent economic growth. In 1991, Russia would proceed with radical, market-oriented reform along the lines of "shock therapy", as recommended by the United States and IMF. However, this policy resulted in an economic collapse, with millions being plunged into poverty, corruption, and crime spreading rapidly. Hyperinflation resulted from the removal of Soviet price controls and again following the 1998 Russian financial crisis. Difficulties in implementing fiscal reforms aimed at raising government revenues and a dependence on short-term borrowing to finance budget deficits led to a serious financial crisis in 1998. Lower prices for Russia's major export earners and a loss of investor confidence due to the Asian financial crisis aggravated financial problems. The result was a rapid decline in the value of the currency, flight of foreign investment, delayed payments on sovereign and private debts, a breakdown of commercial transactions through the banking system, and the threat of runaway inflation.

Russia, however, appears to have weathered the crisis relatively well. As of 2009 real GDP increased by the highest percentage since the fall of the Soviet Union at 8.1 percentages, the currency remained stable, inflation had been moderate, and investment began to increase again. In 2007 the World Bank declared that the Russian economy had achieved unprecedented macroeconomic stability.[1] Russia is making progress in meeting its foreign debts obligations. During 2000–01, Russia not only met its external debt services but also made large advance repayments of principal IMF loans and built up Central Bank reserves with government budget, trade, and current account surpluses.

In India, by the end of 1990, it was a serious balance of payment crisis. The crisis was caused by currency overvaluation, the current account deficit, and investor confidence played significant role in the sharp exchange rate depreciation. The crisis was primarily due to the large and growing fiscal imbalances over the 1980s. Precipitated by the gulf war, India's oil import bill swelled, exports slumped, credit dried up, and foreign capital flight. Large fiscal deficit, over time, had a spillover effect on the trade deficit culminating in an external payment crisis. The foreign exchange reserves had dried up to the point that India could barely finance three weeks worth of imports. In 1991, Indian government ushered several reforms those are collectively called as liberalization, and most of these reforms came because IMF required those reforms as the condition for loaning money to India in order to overcome the crisis. India opened the door to foreign investment, reduced red tape that often crippled initiative and streamlined industrial policy. The foreign exchange reserves started picking up with the onset of liberalization policies. The recent global economic crisis in 2008 again slowdown GDP annual growth rate from around 7.5 percent in the first half to 6 percent in second half of 2008, amplified by sharp contraction in the performance of manufacturing sector. The export oriented manufacturing base export was dried up due to reduction in the external demand. It affects the growth rate of the economy as well as stability of the Indian currency.

Since 1978, China had initiated major reforms to its economy. The economy was driven from socialist Maoist set up to the capitalist market oriented economy. In 1978,

[1] http://en.wikipedia.org/wiki/Economy_of_Russia - cite_note-36

China allows foreign direct investment in several special economic zones along the coast. The reforms fuelled the increased production, the scale of change grew bolder by mid 1980s, but the state owned enterprises (SOEs) and banking system was inefficient and were running under losses. In 1997, China started the process of disinvestment and privatization of its SOEs. China economy grew at an average of 10 percent per year during the period 1990-2004, the highest growth rate in the world. Such high growth is necessary if China is to generate the 15 million jobs needed annually to employ new entrants into the national job market. In 2008, the impact of the financial crisis on China took the form of a sharp drop in external demand, which in turn led to an economic slowdown, difficulties for business, and rising unemployment. The outbreak and spread of the global financial crisis had a severe impact on China's financial and real estate markets, which mainly reflected in the falling stock index in the accelerated manner. Furthermore, the money supply and loan supply growth rate continued to fall in the mid 2008. The real effective exchange rate rose dramatically by 14.5 percent, resulting in an unfavorable effect on China's exports. The sharp drop in the exports lasted over a considerable period, and consequences to reduce the production or even shut down.

The economy of South Africa is the largest in Africa, which accounts for 24 percent of its gross domestic product in terms of purchasing power parity, and is ranked as an upper-middle income economy by the World Bank. In South Africa, a quarter of the population is unemployed, and according to 2013 Goldman Sachs report, that number increases to 35 percentage when including people who have given up and looking for work. The unemployment rate is very high, at more than 25 percent, and the poor have limited access to economic opportunities and basic services. High levels of unemployment, inequality, and poverty remains a chronic problem in South Africa. Crime is considered to be a severe constraint on investment by 30 percent of enterprises in South Africa, putting crime among the four most frequently mentioned constraints. But South Africa has a comparative advantage in the production of agriculture, mining and manufacturing products relating to these sectors. South Africa has shifted from a primary and secondary economy in the mid-twentieth century to an economy driven primarily by the tertiary sector in the present day which accounts for an estimated 65% of its GDP.

Like other emerging economy, South Africa has struggled through the late 2000s recession, and the recovery has been largely led by private and public consumption growth, while export volumes and private investment have yet to fully recover. The long-term potential growth rate of South Africa under the current policy environment has been estimated at 3.5 percent. Per capita GDP growth has proved mediocre, though improving, growing by 1.6 percentages a year from 1994 to 2009, and by 2.2 percentages over the 2000–09 decade, compared to world growth of 3.1 percentages over the same period. During the period of global financial crisis, South Africa entangled a large current account deficit, quickly turned to large net outflows, although overall net private flows remained positive as South Africans bank ran down foreign assets. Both exports and import volumes plummeted, South Africans main exports weakened, although this was outweighed by the effect of lower oil prices, resulting in an improvement in the terms of trade. The stock market weakened directly by net outflows of non-residents and indirectly by the large corrections in equity prices elsewhere.

3. The Econometric Procedures and Data Sets

The objective of our empirical estimation is to provide the estimates of cointegration and the long-and short-run dynamics of the saving-investment relationship in BRICS countries. The econometric methodology employs unit root tests and followed by cointegration tests. This is then followed by the vector error-correction modeling in order to capture the speed of adjustment between saving and investment. The cointegration technique has been widely applied in the empirical work to estimate the long-run relationship between saving and investment. According to this technique, if two variables are cointegrated, the finding of non-causality in either direction is ruled out. In other words, as long as the two variables have a common trend, causality in the Granger sense must exist at least in one direction. The cointegration indicates the presence or absence of Granger-causality; it does not indicate the direction of causality between variables. The direction can be detected though the vector error-correction models (VECM), which is derived from the long-run cointegrating vectors (Baharumshah, 2002).

In the intertemporal macroeconomic models in steady state, saving and investment are cointegrated and exhibit a one-to-one relationship. Within this theoretical framework, the long-run saving-investment correlation represents the intertemporal budget constraint. However, in the short-run, shocks may initiate movement in saving and investment away from their steady state values. Given that saving and investment are cointegrated in the steady state, the following error-correction model is estimated to find out the basis of our inquiry.

$$\Delta (I/Y)_t = \alpha + \beta \Delta (S/Y)_t + \hat{\gamma}[(I/Y)_{t-1} - \hat{\phi}_i - \hat{\delta}_i (S/Y)_{t-1}] + \varepsilon t \quad \forall t = 1,2,.....T. \ (1)$$

where $(I/Y)_t$ is the gross capital formation to GDP ratio, and $(S/Y)_t$ is the gross domestic saving-GDP ratio of BRICS countries over different time period *t*. The error-correction term (ECT) can be obtained by taking $[(I/Y)_{t-1} - \hat{\phi} - \hat{\delta}(S/Y)_{t-1}]$ to formulate an error-correction model. The estimate, β, reflects the average contemporaneous co-movement of saving and investment in response to shocks affecting the economy (i.e. current period pass through). The sign and significance of β estimate depends on the size and nature of shocks as well as structure of the economy. The high saving-investment correlation could represent either low capital mobility or the response of saving and investment to shocks stemming from the economy (Jansen and Schulze, 1996). However, small, positive, zero, or negative correlations are indicative of capital mobility in the countries. The estimate, γ, could represent the adjustment parameter associated with error-correction term, and if $\gamma \neq 0$, then saving and investment are cointegrated.

Eq. (1) is estimated using the annual data obtained for BRICS countries from the World Bank Indicators over the period 1970 to 2013. Gross savings are calculated as gross national income less total consumption, plus net transfers. Gross domestic investment consists of outlays on additions to the fixed assets of the economy plus net changes in the level of inventories. Domestic investment corresponds to the gross investment of the private and public sectors and saving corresponds to the sum of private and public sector savings. Both are divided by the gross domestic product (GDP) for conversion into rates.

4. Estimation Results

We begin the analysis by examining the unit root properties of the underlying variables. Following the standard practice, all variables are measured in natural logarithms. The integration properties of the variables are examined by using the standard unit root tests, the Augmented Dickey Fuller (ADF) tests. Table 2, in the Annex, shows the result of ADF unit root test, with a constant and time trend, to the series I/Y and S/Y for each country in our data set. The results suggest that in all individual countries, the I/Y and S/Y are non-stationary in levels and indicate the $I(1)$ process. This suggests to consider a cointegration approach between saving and investment in the BRICS.

The Johansen system of cointegration procedure has been utilized in each countries to determine the cointegrating vectors in the two-dimensional vector (saving and investment). The system is constructed with a maximum of three lags as determined by AIC criteria. Gonzalo (1994) demonstrates that the Johansen procedure performs well even when the disturbances are non-spherical, that is the estimates and inferences on βs are still valid. The Eigen values and trace statistics are used to find out the cointegrating vectors and compared with the Mackinnon-Haug-Michelis (1999) p-values. The cointegration tests between saving and investment across individual countries are reported in Tables 3 and 4 in the Annex. The result suggests that the cointegration could be found in case of Brazil, Russia, and South Africa. However, we do not find any clear evidence of cointegration between saving and investment in case of China and India.

The results of error correction model of individual countries are summarized in Table 5. As shown in the table, the estimated error-correction term in the cointegrating regressions appears to be negative and statistically significant, a feature necessary for model stability. A high adjustment (γ) coefficients means that the variables are adjust at faster pace to its steady state condition. Furthermore, if in the long-run saving and investment cointegrate because of the solvency constraint; γ equal to one implies that the adjustment to the long-run equilibrium would be immediate. Capital mobility, however, allows the saving and investment rates to drive from the steady state temporarily. Besides, higher the capital mobility, the longer could be the periods during which saving and investment rates deviate from their steady state levels, which is imposed by the solvency constraint. Capital mobility can then be defined as the capacity of a country to borrow and lend in order to run long lasting current account imbalances in the short-run, and this is measured by the error-correction coefficients (Moreno, 1997). Furthermore, the solvency constraint would be in fact already satisfied in the short-run (Rocha, 2009). The coefficients of γ range from 23% in case of Russia to 32 % in case of India. This suggests that in these discussed countries, the speed of adjustments are fairly slow to restore to its equilibrium value. For instance, more than 32% of the adjustment is completed in a year for India due to its short-run adjustment in the current account.

The short-run coefficients of the changes in the saving rate are found to be low and statistically significant. If β is not significantly different from zero, capital is mobile, if β is not significantly different from one, capital is immobile, and if β is significantly different from zero and one, there is an intermediate degree of capital mobility. Since β is significantly different from zero and one, we can infer that there is some degree of capital mobility, since such a low coefficient estimate is possible if capital is sufficiently mobile. Furthermore, since we obtain the low estimated values of short-run coefficients of the changes in the saving rate, which is different from zero and one, indicate that there is

some degree of capital mobility in the countries. For instance, the estimated short-run coefficient of changes in the saving rate is high in case of India, indicating the low capital mobility in India. Since the rate of changes in the saving is low, China and South Africa exhibit the sufficient degree of capital mobility. Furthermore, Brazil and Russia exhibit analogous experiencing of high and intermediate degree of capital mobility.

Table 5: Individual Results of the Estimation of the Error Correction Model

Country	α	β	γ	$\bar{R}^2$
Brazil	0.148(0.690)	0.534*(7.978)	-0.248*(-2.451)	0.654
China	0.086(0.338)	0.243**(2.174)	-0.269*(-2.550)	0.100
India	-0.154(-1.300)	0.840*(9.052)	-0.323*(-2.888)	0.683
Russia	-1.157*(-2.609)	0.569*(4.750)	-0.238*(-3.135)	0.399
South Africa	0.304(1.471)	0.179**(2.096)	-0.279*(-2.978)	0.143

Note: *t*-statistics are in parenthesis. ***, ** and * indicate 10%, 5% and 1% level of significance.

The structural stability of the error-correction model is examined by using the cumulative sum and cumulative sum of squares tests on the recursive residuals. The cumulative sum test is able to detect systematic changes in the regression coefficients whereas the cumulative sum of squares test detects abrupt and sudden changes from the constancy of the regression coefficients (Brown, Durbin & Evans, 1975). Fig 2 displays the Brazil cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) results, respectively. The CUSUM statistics are below the 5% critical bound from 1991 to 1997, which shows the structural shift of the parameters corresponding to the Brazil economic crisis over the period between 1980 and 1990. Besides, the Brazil economy has been affected by the global financial crisis in and around 2008-09, which is again reflected by the CUSUM and CUSUMSQ statistics, respectively. Similarly, in case of China, the structural shift has been explained in Fig 3 using the CUSUM and CUSUMSQ statistics, respectively. Upon closer inspection, the CUSUMSQ statistics are above the 2% critical bound from 1978 to 1992, which reflect the Chinese economic slowdown during this period of time. However, the Chinese economy revamps it growth rate after 1992.

The Indian economy experienced the balance of payment of crisis in 1990s due to huge fiscal imbalances over the period of 1980s. Fig 4 depicts the structural shift of Indian economy over 1990s, which has been reflected by the CUSUM and CUSUMSQ statistics, restively. The CUSUM statistics goes beyond the 5% upper critical bound in and around 1980s and continue till 1993-94. Furthermore, CUSUMSQ statistics are also below the 2% critical limit after 2005, which reflects the slowdown growth rate in macroeconomic aggregates on the onset of global financial crisis. The Russian economy was experienced the financial crisis over the period 1998. And this has been reflected by CUSUM statistics, which are above the 5% critical bound from 1990 to 1998 (Fig 5). Similarly, like other developing countries, South Africa experienced the economic slowdown and recession after 2000. Fig 6 depicts the structural shift of the saving-investment dynamics of South Africa during the period of 1992 to 2003. This reflects the economic crisis and structural shift of the economic condition due to huge fiscal imbalances on the onset economic recession in and around 2000 and continue to the late 2000.

To reflect the economic crisis of each individual countries over different time period, and the prolonged recessionary environment in each country due to global financial crisis in 2008, the entire sample period of each country has been divided into two sub-periods. In case of Brazil, the sub-periods are D1 (1.0 for 1980-1997 and 0.0 otherwise, reflect the economic crisis in 19980s and 1990s) and D2 (1.0 for 2008-2013 and 0.0 otherwise, reflect the impact of global financial crisis). Similarly, in case of China, the sub-periods are D1 (1.0 for 1978-1992 and 0.0 otherwise); India with D1 (1.0 for 1970-1993 and 0.0 otherwise, reflects the huge fiscal imbalances in 1970s and 1980s, and balance of payment crisis over the period of 1990s); Russia with D1 (1.0 for 1985-1998, reflect the financial crisis over the period of 1990s); South Africa with D1 (1.0 for 1992-2003, reflect the recessionary phase and economic slowdown in 1990s and late 2000s), and D2 is remained same as it is in the case of Brazil, which reveal the impact of global financial crisis in 2008. After including the interactive dummy variables with $\Delta(S/Y)$, the empirical model is written as follows:

$$\Delta(I/Y)_t = \alpha + \beta_1 \Delta(S/Y)_t + \beta_2[D_1 * \Delta(S/Y)_t] + \beta_3[D_2 * \Delta(S/Y)_t] + \hat{\gamma}[(I/Y)_{t-1} - \hat{\phi}_i - \hat{\delta}_i(S/Y)_{t-1}] + \varepsilon_t \quad (2)$$

Table 6 presents the estimated result of the error-correction model specified in Eq. (2). The coefficient estimate β_2 , representing the impact of economics crisis in 1980 and 1990 for Brazil, is found to be negative and statistically significant at 5% level, indicate of capital outflows and reduction of ability to borrow from abroad. [2]

Table 6: Individual Results of the Estimation of the Error Correction Model with Regime Shifts

Country	α	β_1	β_2	β_3	γ	$\bar{R}^2$
Brazil	0.084(0.379)	0.544*(8.00)	-0.004**(-2.604)	0.007(0.719)	-0.236**(-2.246)	0.649
China	-0.112(-0.282)	0.388*(2.459)	0.014**(1.969)	0.005(0.547)	-0.368*(-3.261)	0.155
India	-0.285(-1.050)	0.880*(8.787)	-0.009(-1.020)	-0.006(-0.745)	-0.401*(-3.177)	0.682
Russia	-0.219(-0.586)	0.730*(6.961)	0.118*(5.819)	0.023*(2.192)	-0.374*(-3.355)	0.674
South Africa	0.380(1.198)	0.264*(2.415)	-0.013***(-1.731)	-0.024(-1.152)	-0.387*(-3.508)	0.175

Note: *t*-statistics are in parenthesis. ***, ** and * indicate 10%, 5% and 1% level of significance respectively

The coefficient estimate β_3, for the impact of global financial crisis is found to be positive but statistically insignificant. So, we cannot inference the degree and direction of capital mobility in Brazil during the global financial crisis period. However, the speed of adjustment to its equilibrium is still low during the crisis period and estimated result further suggests that in a year 23% of adjustment in the current account could be possible due its short-run adjustment. The coefficient estimate β_2, representing the economic slowdown of the Chinese economy is found to be positive and statistically significant at 5% level, indicative of capital mobility during the period 1978-1992. China is an export driven economy, and its growth rate of GDP is depending upon the exports, and over the economic crisis period its export dried up due to the global economic recession, indicative of huge capital mobility. In fact, China started numerous step to overcome the

[2] Dooley *et al.* (1987); Jansen and Schulze (1996); and Payne (2005) provide evidence of a negative coefficient for the change in savings rate.

problem of economic slowdown in 1970 and adopt the financial liberalization after 1978. The coefficient estimate β_2 is found to be negative and statistically significant for South Africa, indicative of capital mobility over the period of 1990 and 2000 and it enhances the economic slowdown during the economic crisis period. Furthermore, the coefficient estimate β_3, representing the impact of global financial crisis is found to be positive and statistically significant in case of Russia. This suggests that Russia experience the capital mobility and its economy is affected by the global financial crisis. Furthermore, the result also reveals that India and South Africa struggled through the late 2008 financial crisis, investors took out their money from the market, indicative of huge capital mobility, its currency abruptly depreciates, and finally, reduction in the ability to adjust its current account deficit.

5. Concluding Remarks

In this paper**,** we examined the saving-investment dynamics of five countries. The purpose of this paper is to evaluate the cointegration between saving and investment and use an error-correction model to assess the degree of capital mobility in the BRICS countries. We use an error-correction model because it has a strong theoretical background since saving and investment rates are bounded by the intertemporal budget constraint. The results of this study find that savings and investment are indeed cointegrated in case of Brazil, Russia, and South Africa. However, in case of China and India, we do not find any clear evidence of cointegration between saving and investment. Furthermore, in all five economies the speed of adjustment to its steady state is fairly low. The short-run coefficients of the changes in the saving rate reflect the degree of capital mobility in the countries. Empirical result reveals that India reveals low capital mobility, whereas China and South Africa exhibit sufficient degree of capital mobility. Furthermore, Brazil and Russia exhibit intermediate degree of capital mobility.

Previous studies on the saving-investment relationship did not examine the structural stability of the parameters. The saving and investment are indeed cointegrated, but the error correction model exhibits structural instability during the different countries-specific economic crisis of BRICS and over the period of Global financial crisis in 2008. The coefficient of current period-pass through of saving to investment is negative and statistically significant for the post-1980 period in Brazil, indicative of capital mobility and reduction of ability to adjust its current account imbalances during the down-break trend growth period. Similarly, South Africa experience the capital outflows over the period of 1990s and 2000s and it facilitates to economic slowdown in the country. The global financial crisis has vehemently affected the Russian economy, indicative of huge capital mobility, and finally, it affects it's GDP growth rate and exchange rate market and currency devaluation.

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Annex

Table 2: Test Results for Unit Roots

country	Without trend I/Y	With trend I/Y	Without trend $\Delta(I/Y)$	With trend $\Delta(I/Y)$	Without trend S/Y	With trend S/Y	Without trend $\Delta(S/Y)$	With trend $\Delta(S/Y)$
Brazil	-2.500 (0.124)	-3.273 (0.114)	-6.963 (0.000)	-6.870 (0.000)	-2.890 (0.548)	-3.138 (0.110)	-7.913 (0.000)	-7.827 (0.000)
China	-1.291 (0.624)	-3.048 (0.131)	-6.646 (0.000)	-6.564 (0.000)	-0.154 (0.936)	-2.867 (0.183)	-5.663 (0.000)	-5.607 (0.000)
India	-0.827 (0.800)	-3.522 (0.49)	-9.837 (0.000)	-9.715 (0.000)	-1.28 (0.734)	-3.798 (0.260)	-9.885 (0.000)	-9.777 (0.000)
Russia	-2.102 (0.244)	-2.078 (0.543)	-6.402 (0.000)	-6.321 (0.000)	-3.807 (0.105)	-3.716 (0.131)	-6.375 (0.000)	-6.370 (0.000)
South Africa	-1.756 (0.396)	-1.906 (0.633)	-6.579 (0.000)	-6.605 (0.000)	-0.774 (0.816)	-3.383 (0.167)	-6.733 (0.000)	-4.584 (0.003)

Note. Augmented Dickey-Fuller *t*-statistics values are reported. Automatic selection of maximum lags is based on SIC: 0 to 2. Mackinnon (1996) one sided p-values are reported.

Table 3: Cointegration tests for the Current account (*CA/Y*), Saving(*S/Y*), and Investment (*I/Y*) Relationship.Unrestricted Cointegration Rank Test (Trace)

Series	Hypothesized No. of CE (s)	Trace statistic	5% critical value	Prob.**
Brazil	None	13.983	15.494	0.083
	At most 1 *	6.074	3.841	0.013
China	None	7.879	15.494	0.478
	At most 1	0.266	3.841	0.605
India	None	10.070	15.494	0.275
	At most 1	1.458	3.841	0.227
Russia	None *	21.942	15.494	0.004
	At most 1 *	4.071	3.841	0.043
South Africa	None	13.926	15.494	0.085
	At most 1*	3.943	3.841	0.103

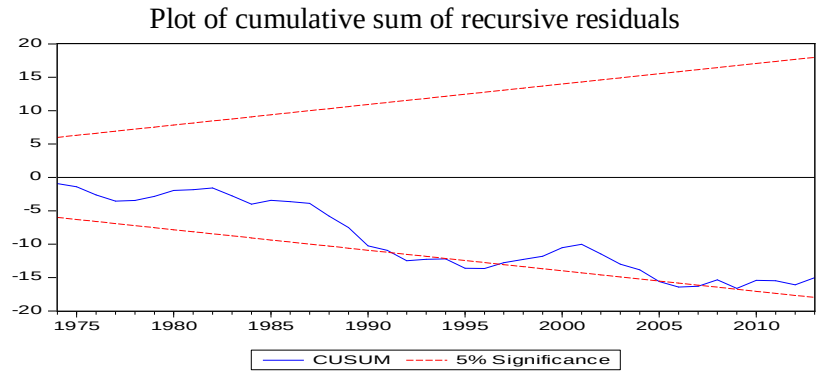
Note. Unrestricted Cointegration Rank Test (Trace) using the Johansen system cointegration Method. Trace test indicates no cointegration at 0.05 level. * denotes rejection of the hypothesis at the 0.05 level. **MacKinnon-Haug-Michelis (1999) p-values are reported. Linear deterministic trend are included.

Table 4: Cointegration tests for the Current account (*CA/Y*), Saving(*S/Y*), and Investment (*I/Y*) Relationship. Unrestricted Cointegration Rank Test (Maximum Eigen value)

Series	Hypothesized No. of CE (s)	Eigen value	Max-Eigen Statistic	5% critical value	Prob.**
Brazil	None	0.171	7.909	14.264	0.387
	At most 1 *	0.134	6.074	3.841	0.013
China	None	0.165	7.613	14.264	0.419
	At most 1	0.006	0.266	3.841	0.605
India	None	0.185	8.611	14.264	0.319
	At most 1	0.034	1.458	3.841	0.227
Russia	None *	0.346	17.871	14.264	0.012
	At most 1 *	0.092	4.071	3.841	0.043
South Africa	None	0.244	11.782	14.264	0.119
	At most 1*	0.049	3.943	3.841	0.103

Note. Unrestricted Cointegration Rank Test (Maximum Eigen value) using the Johansen system cointegration Method. Max-Eigen value test indicates no cointegration at 0.05 level. * denotes rejection of the hypothesis at the 0.05 level. **MacKinnon-Haug-Michelis (1999) p-values are reported. Linear deterministic trend are included.

. Fig 2 (A): [Brazil] Plot of cumulative sum of recursive residuals; (B) plot of cumulative sum of squares recursive residuals.



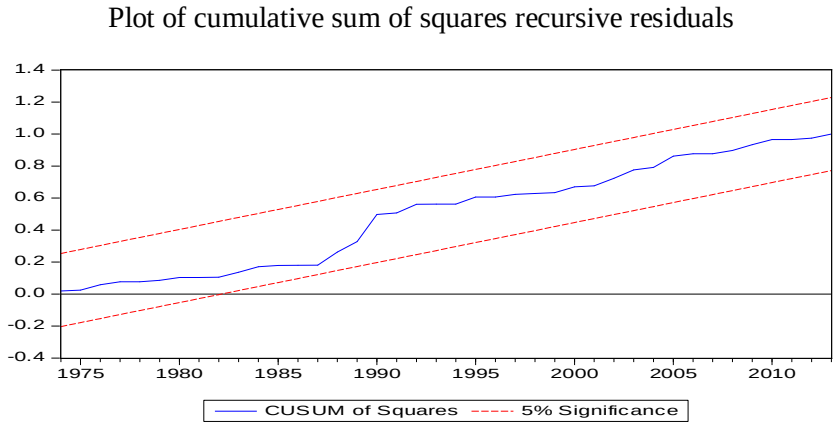
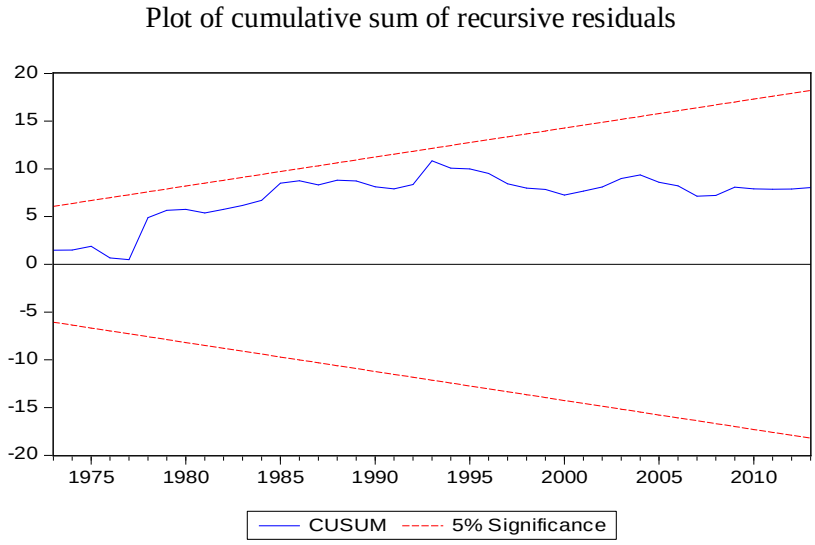


Fig 3 (A): [China] Plot of cumulative sum of recursive residuals; (B) plot of cumulative sum of squares recursive residuals.



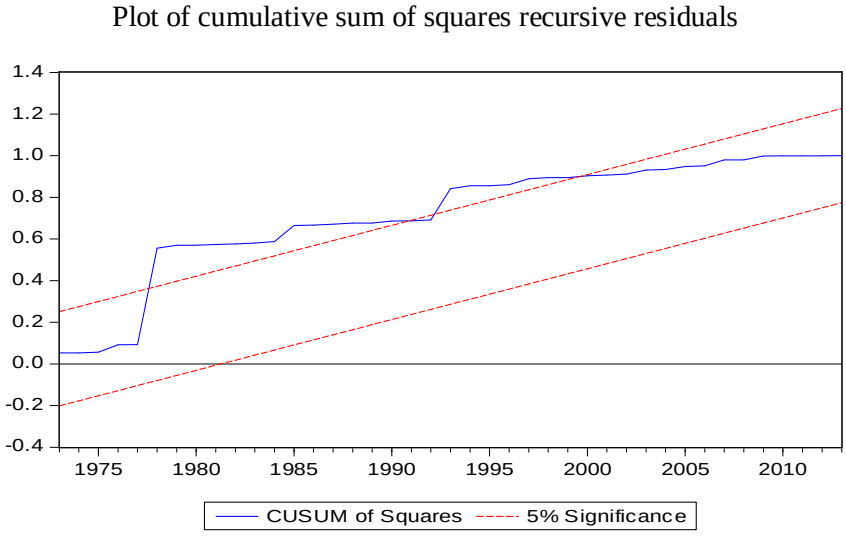
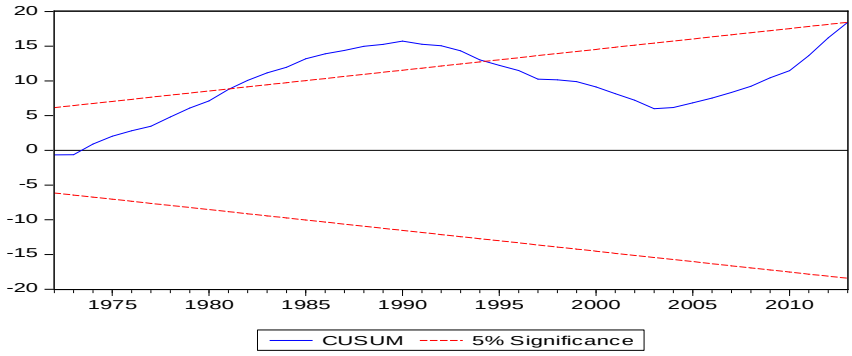


Fig 4 (A): [India] Plot of cumulative sum of recursive residuals; (B) plot of cumulative sum of squares recursive residuals.

Plot of cumulative sum of recursive residuals



Plot of cumulative sum of squares recursive residuals

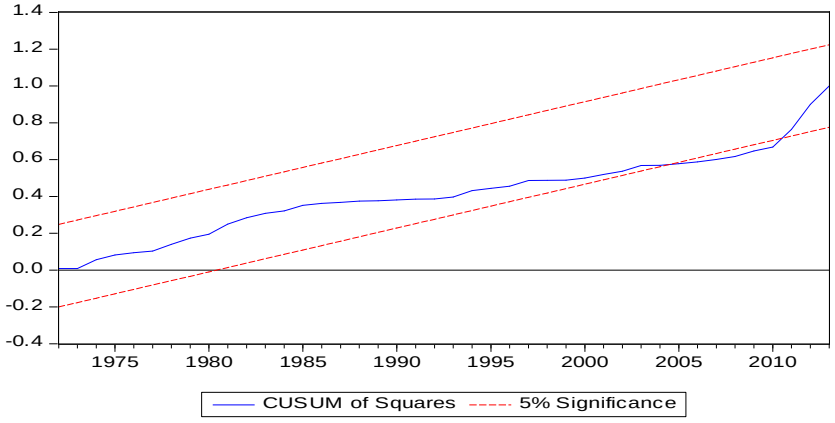
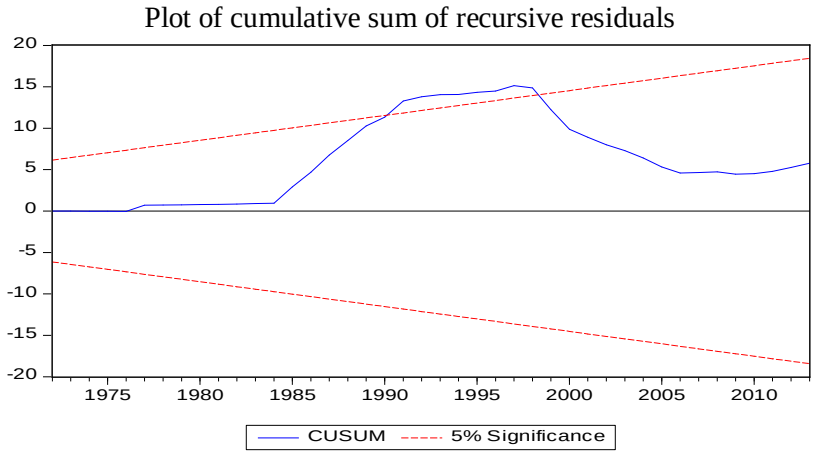


Fig 5 (A): [Russia] Plot of cumulative sum of recursive residuals; (B) plot of cumulative sum of squares recursive residuals.



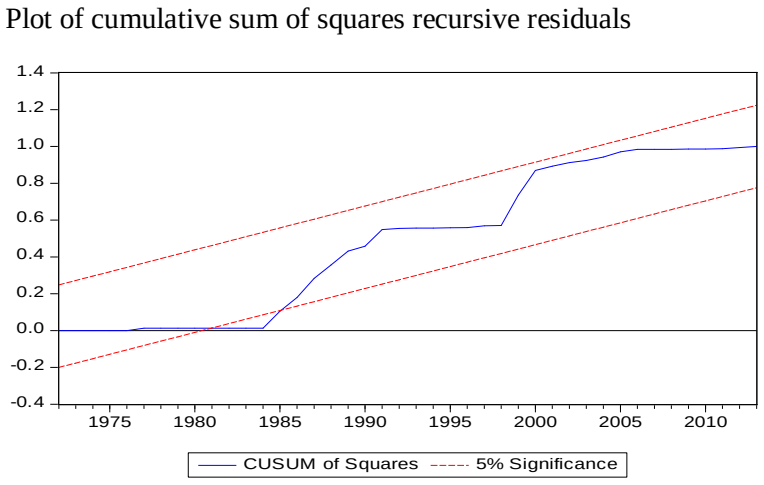


Fig 6 (A): [South Africa] Plot of cumulative sum of recursive residuals; (B) plot of cumulative sum of squares recursive residuals.